The 17th International Biochemistry of Exercise Conference

Conference Proceedings

Beijing · China

October 23rd – 25th, 2018
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PL-002 AGTR1 polymorphism is associated with elite endurance athletes: A functional study. Yang Xiaolin, Hu Yang, Li Yanchun, Mei Tao, Gong Lijing

PL-003 BMSCs transplantation aggravate inflammation, oxidative stress, fibrosis and impair skeletal muscle regeneration. Liu Xiaoguang, Xiao Weihua, Zhen Lifang, etc.

PL-004 Research on Monitoring power endurance training effect of Synchronized Swimmers. Fan Yuncai, Yan Qi

PL-005 Adaptation of skeletal muscle to aerobic exercise: specific transcriptome response to acute exercise and training. Popov Daniil, Makhnovskii Pavel, Lysenko Evgeny, etc.

PL-006 Not just a one HIIT wonder: two popular HIIT protocols elicit similar health benefits in a controlled but real world environment. Hesketh Katie, Cocks Matthew, Shepherd Sam, etc.

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PL-008 Astaxanthin Reduces High Intensity Training Induced Myocardial Cell Apoptosis Via Activating Nrf2 in Rats. Guo Xian, Cao Jianmin, Wang Yi, Zhou Haitao, etc.

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Plenary Lecture
**PL-001**

Home-Based High-Intensity Interval Training Improves Muscle Capillarisation and eNOS/NAD(P)Hoxidase Protein Ratio in Obese Individuals with Elevated Cardiovascular Disease Risk

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**Objective**  
Obesity and inactivity lead to structural and functional muscle microvascular impairments associated with development of chronic disease. This study is the first to investigate the effect of a novel home-based high-intensity interval training (HIT) (Home-HT) intervention in obese individuals with elevated cardiovascular disease (CVD) risk on capillarisation and muscle microvascular eNOS/NAD(P)Hoxidase ratio. Comparisons were made with home-based moderate-intensity continuous training (Home-MICT) and supervised laboratory-based low-volume HIT (Lab-HIT) as control group.

**Methods**  
Thirty-two sedentary obese adults (age 36±2 years; BMI 34.3±0.8 kg·m⁻²; O₂peak 24.6±1.0 ml·kg⁻¹·min⁻¹) were allocated to 12 weeks of Home-HT (n=9), Home-MICT (n=13) or Lab-HT (n=10). Muscle biopsies were taken pre- and post-training to assess specifically in the endothelial layer of muscle arterioles and capillaries the protein content of eNOS, serine¹¹⁷⁷ phosphorylated eNOS, NOX2 and p47phox, and various capillarisation measures using quantitative immunofluorescence microscopy.

**Results**  
All interventions induced comparable increases in total eNOS content in terminal arterioles and capillaries (P<0.001). There was no change in ser¹¹⁷⁷ phosphorylated eNOS (arterioles P=0.802; capillaries P=0.311), but eNOS ser¹¹⁷⁷/eNOS ratio significantly decreased following training in arterioles and capillaries (P<0.001). Training decreased NOX2 content (arterioles P<0.001; capillaries P<0.001), but there was no change in p47phox content (arterioles P=0.101; capillaries P=0.345). All measures of capillarisation increased (P<0.05). These adaptations occurred alongside increased O₂peak (P<0.001) and whole-body insulin sensitivity (P=0.033). There were no significant differences between training programmes.

**Conclusions**  
The training effects of Home-HT on skeletal muscle microvascular adaptations are comparable to those of traditional training methods, with the advantage that Home-HT reduces barriers to exercise in obese individuals with elevated CVD risk.

**PL-002**

AGTR1 polymorphism is associated with elite endurance athletes: A functional study

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Beijing Sport University

**Objective**  
To explore the association between the polymorphism of angiotensin II receptor type 1 gene (AGTR1) and elite endurance athlete performance and the mechanism of how the polymorphism works.

**Methods**  
(1) Polymorphism of AGTR1 rs5182 between 122 elite Chinese endurance athletes and 222 controls were analyzed by MALDI-TOF-MS. (2) Aerobic capacity of 79 elite Chinese endurance athletes such as VC/FEV1/MVV/VO2AT/HRAT/VAT/VO2max/HRmax/VVO2max were measured and association between rs5182 polymorphism and the performance was determined.
analyzed. (3) PcDNA3.1-AGTR1 -T and pcDNA3.1-AGTR1-C plasmid were build and the plasmids was transfected into mammalian 293T cells. mRNA levels were detected after 48 hours. Statistical analysis was performed using SPSS software version 15.0. Values of P < 0.05 were considered statistically significant. Continuous data were expressed as mean ± SD, while categorical data were expressed as frequencies. Genotype distribution and allele frequencies between athletes and control subjects were compared using χ² tests. Aerobic performance data was analyzed with One-Way ANOVA if it conformed to normal distribution and homogeneity of variance otherwise Non-parametric test of independent sample was used.

Results (1) Genotype frequencies of AGTR1 rs5182 are significant differences between the athletes and control subjects (p = 0.040), the Word-Class athletes and control subjects (p = 0.018), 5km athletes and control subjects (p =0.015), 10km athletes and control subjects (p = 0.026), male athletes and male controls(p=0.045). (2) Association is found between Genotype distribution and MV(L/min) though others not (Genotype: MV; CC: 122.514±6.767; CT:117.187±17.961; TT:119.688±20.226, p=0.047). (3) Transiently transfectedpcDNA3.1-AGTR1-T and pcDNA3.1-AGTR1-C plasmids into 293T cells successfully. The differences of mRNA levels between the groups were not significant (p = 0.991).

Conclusions AGTR1 gene rs5182 could be a candidate genetic mark of selection elite endurance athletes in Han Population from Northern China, but this polymorphism does not affect AT1R protein function through changing its mRNA level.

PL-003
BMSCs transplantation aggravate inflammation, oxidative stress, fibrosis and impair skeletal muscle regeneration

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Objective Skeletal muscle contusion is one of the most common muscle injury in sports medicine and traumatology. Bone marrow mesenchymal stem cells (BMSCs) transplantation is a promising strategy for muscle regeneration. However, the roles of BMSCs, especially the mechanisms involved, in the regeneration of contused skeletal muscle are still not fully recognized. The aim of the study is to evaluate the potential of BMSCs transplantation for muscle regeneration and mechanisms involved after contusion.

Methods Ninety-nine C57BL/6J mice were divided into three groups: control group (n=11), muscle contusion and BMSCs treated group (n=44), muscle contusion and sham treated group (n=44). BMSCs were immediately transplanted into gastrocnemius muscles (GMs) following direct contusion. At different time points (3, 6, 12 and 24 days) post-injury, the animals were killed and then GMs were harvested. Morphological and gene expression analyses were used to elevate the effect of BMSCs transplantation and mechanisms involved.

Results The results indicate that BMSCs transplantation impairs muscle regeneration, as well as more fibrotic scar formation after skeletal muscle contusion. Furthermore, macrophages, inflammatory cytokines, chemokines, matrix metalloproteinases and oxidative stress related enzymes were significantly increased after BMSCs transplantation. These results suggest that BMSCs transplantation impairs skeletal muscle regeneration and that macrophages, inflammatory cytokines, chemokines, matrix metalloproteinases and oxidative stress related enzymes may be involved in the process.

Conclusions BMSCs transplantation aggravates inflammation, oxidative stress and fibrosis, and impairs skeletal muscle regeneration, which shed new light on the role of BMSCs in regenerative medicine and cautions the application of BMSCs for muscle injury.
PL-004  
Research on Monitoring power endurance training effect of Synchronized Swimmers

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Objective  To explore the usage of heart rate and derivative index, such as quick recovery index (QRI) and training impulse (TRIMP), to monitor and evaluate load level at physical training course. With simplified load evaluation program, we can accurately feedback load stress and recovery conditions of the athletes, so as to timely adjust training load and avoid sports fatigue.

Methods  Maximum oxygen uptake is tested to determine maximum heart rate of the athletes, which can be used as the basis for monitoring assessment of physical training load. During training phase, monitoring the variation of the relative index of HR and sleeping conditions of 10 athletes by Firstbeat. The test means was High-intensity interval endurance of climbing machine in 7‘20s-20s before and after stage training. The main indexes include of QRI/TRIMP/POC/BLa\climbing height.

Results  It’s shown through monitoring that maximum heart rate of the athletes in the physical training course is up to 200BPM, which prompts high load level during training. Such athletic ability is promoted to satisfy the demands for complex choreography. Characteristics of energy supply for power endurance with high intensity closely agree with physical fitness demand during synchronized swimming competition, which is general performance of strength, speed and endurance. Through comparison of data on testing power endurance of climbing machine in 7‘20s-20s before and after training, average climbing height of the athletes is increased from 60.1m/20s to 62.4m/20s with increased range up to 3.8% and blood lactate level is decreased from 10.7mmol/L to 10.5mmol/L in 2 minutes after exercise, which can be regarded as slightly improvement of ability of the athletes for lactate decomposition and fatigue relief, and aerobic capacity of the athletes are improved to a certain degree. After training, heart rate QRI and TRIMP of the athletes are improved slightly. Among them, QRI is significantly improved from 19.6% to 21.6% after stage training, which shows slightly improvement of training quality and recovery capability of the athletes, i.e. adaptive capacity to training load; After physical training, research on monitoring QRI of the athletes during arrangement and relaxation shows that maximum heart rate level without voice guidance is 75.1bpm, which is higher than those with voice guidance 72.9bpm after 5-min quick recovery; QRI of the athletes is 31.9% when voice is used to guide relaxation, which is significantly higher than those without relaxation under voice guidance (QRI is 27.0%); night pressure monitoring unit (BodyGuard2) of Firstbeat is used to monitor sleeping conditions of the athletes. In the initial stage of heavy load training cycle, training load enables athletes to produce a strong stress response, which causes relatively poor sleeping and recovery conditions; with gradual adaptation of the athletes to the training load, in the middle and later stages of the cycle, stress response of the athletes during sleeping almost disappears, and their sleeping quality and recovery conditions are improved significantly.

Conclusions  Through Power endurance training, lactate elimination capacity of the athletes, i.e. anti-fatigue capacity and quick recovery capability are improved; during quick recovery of the athletes, voice guidance can be used to effectively promote quick recovery of the athletes. Exercise heart rate, TRIMP and QRI can be used to perceptually and rapidly monitor completion of physical training load in a real-time way, Objective to evaluate recovery and sleeping conditions of the athletes, and effectively evaluate high-intensity interval physical training load and training effect.
PL-005
Adaptation of skeletal muscle to aerobic exercise: specific transcriptome response to acute exercise and training

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Objective Variety of processes including circadian rhythm and systemic factors affect expression of many genes in skeletal muscle during a day. Therefore, post-exercise gene expression depends on many factors: contractile activity per se as well as circadian rhythm, nerve activity, concentration of different substances in blood, feeding and fasting. In our study, we investigated specific for contractile activity changes in the transcriptome in untrained and trained (after an aerobic training programme) human skeletal muscle. The second goal was to examine effect of aerobic training on gene expression in muscle in basal state.

Methods Seven untrained males performed the one-legged knee extension exercise (for 60 min) with the same relative intensity before and after a 2 month aerobic training programme (1 h/day, 5/week). Biopsy samples were taken at rest (basal state, 48 h after the previous exercise), 1 and 4 h after one-legged exercise from m. vastus lateralis of either leg. This approach allowed us to evaluate specific changes in the transcriptome associated with contractile activity.

RNA-sequencing (84 samples in total; ~42 million reads/sample) was performed by HiSeq 2500 (Illumina).

Results Two months aerobic training increased the aerobic capacity of the knee-extensor muscles (power at anaerobic threshold in incremental one-legged and cycling tests), the maximum rate of ADP-stimulated mitochondrial respiration in permeabilized muscle fibres and amounts of oxidative phosphorylation proteins. After one-legged exercise, expression of many genes was changed in exercised muscle (~1500) as well as in non-exercised muscle (~400). Pronounced changes in gene expression in non-exercised muscle may be associated with many factors, including circadian rhythm (result of GO analysis).

To examine transcriptome changes specific for contractile activity, the difference in gene expression between legs was examined. In untrained muscle, one-legged exercise changed expression of ~1200 genes specific for contractile activity at each time point. Despite the same relative intensity of one-legged exercise, transcriptomic response in trained muscle was markedly lower (~300 genes) compare to untrained.

We observed a strong overlap between transcriptomic responses (~250 genes) and particularly between enriched transcription factor binding sites in promoters of these genes in untrained and trained muscles. These sets of genes and transcription factors play the key role in adaptation of muscle to contractile activity independently on the level of muscular fitness.

Surprisingly, 2 months aerobic training changed the expression of more than 1500 genes in basal state. Noteworthy, these genes demonstrated a small overlap (~200 genes) with genes related to specific response to acute exercise. Moreover, these genes were associated with significantly different biological processes than genes related to specific response to acute exercise.

Conclusions Specific for contractile activity changes in the transcriptome in untrained and trained human skeletal muscle were revealed for the first time. After 2 month aerobic training, the specific transcriptome response to acute exercise become much less pronounced. A computational approach reveals common transcription factors important for adaptation of both untrained and trained muscle. We found out that adaptation of muscle to aerobic training associates not only with the transitory changes in gene expression after each exercise, but also with the marked changes in transcriptome in basal state.

*This work was supported by the Russian Science Foundation (14-15-00768).*
PL-006

Not just a one HIIT wonder: two popular HIIT protocols elicit similar health benefits in a controlled but real world environment.

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Objective
Currently 40% of the UK do not meet the physical activity guidelines with a ‘lack of time’ the most commonly cited barrier to sufficient physical activity. In laboratory based training interventions, high intensity interval training (HIT) offers a time-efficient alternative to moderate intensity continuous training (MICT) but its success requires expensive specialised cycle ergometers and vigorous encouragement from the researchers. Aim: To investigate whether two popular HIT protocols, performed using readily available cycle ergometers and without encouragement, can improve aerobic exercise capacity, arterial stiffness and body composition.

Methods
Eighty-two sedentary males (n=26) and females (n=56) aged 18-65 participated in the study (28±1 y, BMI 25±0.4 kg.m⁻²). In a randomised cross-over design, participants completed either 6 weeks of 30HIT (4-8x30s sprint with 120s active recovery) or 60HIT (6-10x60s sprint with 60s active recovery). Training sessions were completed on a Wattbike, 3 times per week. VO₂peak, body composition (DXA scan), blood glucose (oral glucose tolerance test (OGTT)) and arterial stiffness (pulse wave velocity (PWV)) were assessed pre and post each 6-week training phase, with 4-6 weeks washout period between interventions.

Results
VO₂peak increased post intervention in 30HIT (36±1 to 39±1 ml.min⁻¹.kg⁻¹) and 60HIT (36±1 to 39±1 ml.min⁻¹.kg⁻¹) (P<0.001), with no difference between intervention group (P=0.208). Body fat percentage decreased pre to post training in both conditions (P=0.001). PWV decreased in 30HIT (2%) and 60HIT (4%) (P<0.005). During the OGTT, there was a trend towards decreasing area under the curve pre to post (P=0.083). When normalized to Watt max the participants producing a higher mean power output improved their VO₂peak more than those producing a low MPO (P<0.05). Following further analysis this was only true in 60HIT (P<0.05).

Conclusions
Both 30HIT and 60HIT could be effective real world strategies to improve aerobic capacity, body composition, arterial stiffness and insulin sensitivity. Improvements were seen even though the time spent sprinting was less in 30HIT (4mins compared to 10mins in 60HIT). In addition, how the 30HIT protocol is executed does not seem to have an effect on physiological outcomes. This suggests 30HIT may be a more applicable training intervention in the real world.

PL-007

Chronic mild stress improves glucose homeostasis via myonectin-mediated suppression of sympathetic activity in high-fat diet-fed mice

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Objective
Recent studies suggest that chronic stress exposure can ameliorate the progression of diet-induced prediabetic disease, by inhibiting an increase in weight gain, caloric intake and efficiency and insulin resistance. To determine the underlying mechanism by which chronic stress
improves the progression of type 2 diabetes, we developed a model of chronic mild stress in high-fat diet (HFD)-fed mice which are resistant to obesity and exhibit a healthy-like metabolic phenotype.

**Methods**

High-fat diet (HFD): 45% kcal derived from fat (Research Diets, Inc.). Mice experienced one stressor during the day and a different stressor during the night. Stressors were randomly chosen from the following list: cage tilt on a 45° angle for 1 to 16 h; food deprivation for 12 to 16 h; white noise for 1 to 16 h; strobe light illumination for 1 to 16 h; crowded housing; light cycle (continuous illumination) for 24 to 36 h; dark cycle (continuous darkness) for 24 to 36 h; water deprivation for 12 to 16 h; damp bedding (200 ml water poured into sawdust bedding) for 12 to 16 h. Recombinant adeno-associated virus (AAV): AAV9 vectors encoding myonectin under the control of the ubiquitous CMV promoter (AAV9-CMV-Vip) or an equal dose of the AAV9-CMV-null vector were delivered to C57BL/6 mice by the tail vein. Mice were deprived of food for 16 h and then subjected to test 7 days after AAV injection.

**Results**

Chronic stress improved glucose intolerance and sympathetic overactivity in HFD-fed mice. Chronic stress attenuated epinephrine (EPI)-stimulated glycerol release into blood in vivo and accelerated glycerol release from white adipose tissue followed by in vitro incubation with EPI. Chronic stress reduced plasma triglyceride but increased the levels of plasma insulin and myonectin. We further found that adeno-associated virus 9 (AAV9)-mediated myonectin overexpression improved glucose homeostasis and reduced epinephrine sensitivity. Myonectin overexpression reduced plasma norepinephrine, EPI and leptin levels, and increased insulin sensitivity in brown and white adipose tissue. Intense sympathetic activity with high-intensity running inhibited myonectin expression in skeletal muscle, whereas medium and low-intensity exercise running increased myonectin expression.

**Conclusions**

These findings suggest that chronic mild stress can improve glucose homeostasis via myonectin-mediated suppression of sympathetic activity in high-fat diet-fed mice.

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**PL-008**

**Astaxanthin Reduces High Intensity Training Induced Myocardial Cell Apoptosis Via Activating Nrf2 in Rats**

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**Objective**

Long-term intensive training may lead to ischemia oxygen reaction and increase the ROS. Astaxanthin, as the super antioxidant, was investigated to antagonize anti-oxidative stress. By supplementing the astaxanthin, we wanted to observe if it can mediated Nrf2 reduces myocardial cell oxidative injury in rats after high intensity training of 6 weeks.

**Methods**

7-week SD male rats were divided into 3 groups randomly: control group (C group, n =10), high intensity training group (HT group, n = 15), astaxanthin and high intensity training group (HTA group, n = 15). The rats in HTA group were given with astaxanthin 20 mg/kg·d and in HT group were given with oil during the training day. The serum cTnI, myocardial apoptosis index, the expression of myocardial BAX, Bcl2, Nrf2, HO-1, myocardial MDA, SOD and T-AOC activity were measured 24 hours after the last training.

**Results**

After 6-week training of high intensity, compared with group C, the serum cTnI, myocardial apoptosis index, the expression of BAX and myocardial MDA were significantly higher in group HT (P<0.01). The Bcl2/Bax, the expression of HO-1, SOD and T-AOC activity were significantly declined (P<0.01). After the intervention of 6-week astaxanthin, compared with group HT, the serum cTnI, myocardial MDA, the myocardial apoptosis index, the expression of BAX were significantly lower in HTA group (cTnI(ng/ml): 1.16±0.27 VS 2.47±0.39, P<0.05; myocardial...
apoptosis index: 164.27±3.98 VS 196.20±9.65, P<0.01; BAX: 58.40±5.95 VS 78.03±3.80, 
P<0.01 ). Finally, Bcl2/Bax, SOD, T-AOC activity, the expression of Nrf2 and HO-1 were 
significantly higher (Bcl2/Bax : 1.92±0.10 VS 1.19±0.18, P<0.01; SOD(U/mg): 52.38±6.15 VS 
38.32±3.36, P<0.01; T-AOC(U/mg): 30.22±4.07 VS 23.76±3.20, P<0.01; Nrf2: 93.61±8.53 VS 
74.26±6.69, P<0.01; HO-1: 84.99±13.78 VS 64.22±11.39, P<0.05).

Conclusions The supplement of astaxanthin can mediate Nrf2 signaling pathway, and elevate 
the expression of Nrf2 and HO-1. Then it can increase the activity of SOD and T-AOC and reduce 
the myocardial oxidative level and myocardial apoptosis in rats caused by 6-week high intensity 
training. Finally, the structure and function of heart tissue are back to normal.

PL-009
Effect of hypoxic resistance training on the regulation of 
muscle mass an phenotype

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Objective Hypoxia is a state of lowered oxygen tension in tissue that can be created by 
environmental or pathological conditions. Whatever the origin of hypoxia, different tissues will 
adapt acutely and/or chronically to deal with this reduction in oxygen availability. Hypoxia has 
recently emerged as a particularly efficient stimulus to stimulate muscle cell proliferation and 
accretion of muscle mass and hypoxic resistance training has become popular amongst athletes 
as it is thought to favor muscle accretion. However, the molecular mechanisms are largely 
unknown.

Methods To determine those molecular mechanisms, 19 volunteers participated to 12 sessions 
of resistance training spread over 4 weeks whether in normoxia (n=9) or in hypoxia (n=10, 
FiO₂ 13.5% corresponding to 3500m altitude). Each session consisted in 6 sets of 10 repetitions 
of a one-leg extension exercise at 80% of one repetition maximum (1-RM). Blood and muscle 
samples in each leg were taken before and after the 4-week training period. Fiber types were 
determined by immunohistochemistry based on myosin heavy chain isotypes. Blood saturation 
(SpO₂, pulsoximetry) and tissue saturation index (TSI, near-infrared spectroscopy) were 
monitored during the exercise sessions.

Results Muscle thickness determined by ultrasound was increased by 7% in normoxia only 
(p=0.04). The 1-RM was increased in both groups but the increase was higher in hypoxia (+34%) 
than in normoxia (+24%) (p=0.02). In average, SpO₂ stayed around 98-99% in normoxia and 
around 93-94% in hypoxia during each set of contractions. No difference in TSI between 
normoxia and hypoxia was measured, which averaged 60% before starting muscle contractions 
and 40% during muscle contractions. A trend towards a shift in fiber type from type I to type IIa 
was observed in normoxia (p<0.09) but not in hypoxia. Fiber area was not modified by any 
condition.

Conclusions In summary, 4 weeks of hypoxic resistance training induced a larger increase in 1-
RM compared to normoxic resistance training, independently of muscle hypertrophy or any 
change in fiber type. Further investigation should determine whether metabolic or molecular 
changes may explain this potentiation of maximal muscle force by hypoxia.
Musclin: a myokine induced by aerobic exercise useful to contrast muscle wasting during cancer

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Objective Physical activity extends life span of patients affected by certain types of cancer, also by contrasting the associated muscle wasting (i.e. cachexia). The most effective type of physical activity against muscle wasting during cancer seems to be aerobic exercise. So, we asked whether it promotes secretion of proteins by muscles (i.e. myokines) that may contrast cancer cachexia.

Methods To mimic aerobic exercise, we infected C2C12 myotubes with PGC1α-expressing adenoviruses, because PGC1α is the main transcriptional coactivator involved in muscle adaptation during aerobic exercise. By microarray analysis, we identified a number of putatively secreted proteins inducible by PGC1α that were further confirmed by Q-PCR. We measured by Q-PCR and WB their expression in Tibialis Anterior (TA) muscle of C26 bearing-mice (i.e. cancer cachexia model) and their plasma levels by ELISA. To induce aerobic exercise adaptations, mice were run on treadmill for 5 consecutive days at a speed of 12 m/min and an uphill inclination of 15° for 45 min/day. Anaerobic exercise-like effects were obtained in plantaris muscle after 7 and 14 days from surgical removal of its synergist muscles (i.e. compensatory hypertrophy). We performed muscle in vivo electroporation of plasmids for musclin or its receptor (i.e Npr3) and in vitro we evaluated protein synthesis/degradation of atrophying myotubes treated with supernatants from GFP or PGC1α-overexpressing cells and Luciferase-based experiments.

Results Our microarray and Q-PCR analyses showed musclin as a PGC1α-induced myokine. Conversely, its expression was unchanged in myotubes hypertrophying because of activated AKT (to mimic anaerobic exercise). Dexamethazone-treated myotubes or constitutively active (ca)FoxO3-expressing myotubes undergo atrophy as measured by increased rates of proteolysis and MuRF1 induction. Unlike GFP, musclin was able to contrast the dexamethazone-induced MuRF1 expression in Luciferase assays. Consistently, musclin-containing supernatants of PGC1α expressing-myotubes restrained the caFoxO3-induced rates of long-lived protein degradation. Among other PGC1α-induced myokines, we found only musclin strongly downregulated in cachectic muscles and plasma of C26-bearing mice even at times when their body weights were not lost yet. Of note, also its receptor Npr3 was downregulated in cachectic muscles. Thus, we electroporated Tibialis Anterior (TA) of C26-bearing mice with musclin-encoding plasmids and found musclin to preserve fiber area. Interestingly, five days of treadmill exercise was able to protect C26-bearing mice from muscle loss with no effect on tumor growth and to rescue the C26-induced downregulation of musclin (but not its receptor) in cachectic muscles and plasma. By contrast, musclin expression did not change in overloaded plantaris of mice, subjected to compensatory hypertrophy.

Conclusions Musclin is a myokine induced specifically by PGC1α, typically increased upon aerobic exercise. Musclin overexpression is beneficial against muscle wasting during C26 growth or in atrophying myotubes. Overall, musclin could be a good drug option for cancer patients that cannot exercise and are at risk of developing cachexia.
Objective

Overweight was a global public health problem. In recent years, the number of overweight people in China had been increasing. Being overweight had a serious impact on health. 31.1% of overweight people had aggregation of risk factors for cardiovascular metabolic diseases. And overweight people were more likely to suffer from some diseases, such as hypertension, diabetes, dyslipidemia and arthritis. This study compared the gas metabolism index differences between overweight and normal weight women when they did exercise under different load, and summarized gas metabolism characteristics of overweight women, in order to lay the foundation for instructing overweight women to do exercise scientifically, reduce the risk factors of chronic diseases such as cardiovascular disease, and enhance and improve physical fitness and health.

Methods

Adult women between 20 and 30 years were taken as subjects. After measuring their height and weight, they were divided into normal weight group (BMI=18~23.9kg/m$^2$) and overweight group (BMI >24kg/m$^2$) according to body mass index (BMI). There were 15 participants in each group. After the baseline test, using modified Bruce treadmill protocol, the air metabolism indexes of two groups were determined by Cortex MetaMax 3B portable gas metabolic analyzer, including oxygen uptake($V_O_2$), minute ventilation($MV$), breathing frequency($BF$), expiratory end-tidal $CO_2$ concentration($ETCO_2$), expiratory end-tidal $O_2$ concentration ($ETO_2$), arterial blood carbon dioxide partial pressure ($PaCO_2$), carbon dioxide output($VCO_2$), oxygen pulse and maximal voluntary ventilation($MMV$), etc. The differences of gas metabolism indexes among resting, exercise, and recovery stages were compared and analyzed.

Results

(1) Most of indexes such as $V_O_2$, $VCO_2$, and $MV$ rose gradually with the load increase during exercise stress test except for $ETO_2$ and $PaCO_2$. $V_O_2$, $PaCO_2$, $VCO_2$ and $ETCO_2$ of overweight group were significantly lower than normal weight group during the same load. $PaCO_2$ of overweight group at grade 4 was significant lower than normal weight group by 5.6 mmHg ($P<0.05$). $VCO_2$ of overweight group at grade 5 was significant lower than normal weight group by 0.6L/min ($P<0.05$). $ETCO_2$ of overweight group at grade 3 and 4 were significant lower than normal weight group about 0.5% and 0.6% respectively ($P<0.05$). (2) During recovery stage, most of indexes decreased gradually, such as $MV$ and $BF$, while $ETO_2$ presented a rising trend. At a certain time during the recovery stage, $ETCO_2$ of overweight group was significantly lower than normal weight group (5.3% vs 5.8%), while $MMV$, $MV$ and oxygen pulse were significantly higher than normal weight group ($P<0.05$). $MMV$ of overweight group at 2, 3 and 4 minutes were significant lower than normal weight group by 1L/min, 1L/min and 0.9L/min, at the same time, $MV$ of overweight group were significant lower than normal weight group by 17.8L/min, 20.1L/min and 16.9L/min. The oxygen pulse of overweight group during whole 5 minutes recovery period were significantly higher than normal weight group by 2.7L/min, 3.9L/min, 3.9L/min, 2.9L/min and 2.0L/min. (3) The gaseous metabolism between two groups was significantly different when they did 7.1 and 10.2 METs exercise.

Conclusions

Although there was no difference in gas metabolism between overweight and normal weight adult women in resting state, the respiratory function of overweight women was weaker than normal weight women during exercise, especially at the intensities of 7.1 and 10.2 METs. During the recovery period after exercise stress test, the recovery rate of gas metabolism in overweight adult women was slower than that of normal weight women.
**PL-012**

**Aerobic exercise increases BKCa channel expression to enhance tracheal smooth muscle relaxation in a murine asthma model**

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**Objective** Increasing evidence has shown that moderate-intensity aerobic exercise training reduces airway hyperresponsiveness (AHR) in patients with asthma. However, the mechanisms underlying exercise-induced improvements in smooth muscle contractility have not been fully elucidated. Large-conductance Ca\(^{2+}\)-activated K\(^{+}\) channels (BK\(_{Ca}\)) are expressed broadly on smooth muscle cells and play an important role in the regulation of smooth muscle contraction. We tested the hypothesis that exercise training increases the contribution of BK\(_{Ca}\) channel to tracheal smooth muscle relaxation in an ovalbumin (OVA)-challenged asthmatic rats.

**Methods** Rats were sensitized/challenged with OVA or saline and exercised at a moderate intensity 5 times/week for 4 weeks. Tracheal smooth muscle contractility was tested. Membrane potential of primary cultured tracheal smooth muscle cells was measured. In addition, western immunoblotting was performed to study the expression levels of BK\(_{Ca}\) channel protein.

**Results** The contraction of rat airway smooth muscle induced by carbachol was significantly increased with asthma and exercise training reversed this alteration. Application of BK\(_{Ca}\) channel agonist, NS1619, induced tracheal smooth muscle relaxation. NS1619-induced relaxation was decreased in asthmatic rats, however exercise training significantly increased NS1619-induced relaxation. In primary cultured smooth muscle cells, NS1619-induced membrane potential was reduced with asthma and this alteration was diminished after exercise training. Additionally, western blotting revealed that the protein expression of BK\(_{Ca}\) was reduced in asthmatic group and aerobic exercise significantly improved BK\(_{Ca}\) expression.

**Conclusions** The present study reveals that aerobic exercise training increases BK\(_{Ca}\) expression on tracheal smooth muscle, which partly underlies the beneficial effect of exercise on improving airway smooth muscle relaxation in asthma.

**PL-013**

**Endurance training, muscle fibre type composition and the maximal capacity for fat oxidation**

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**Objective** A greater capacity for fat oxidation in endurance trained athletes is linked to greater utilisation of intramuscular lipid (IMCL). IMCL breakdown occurs only in type I muscle fibres yet little is known about the fibre type specific abundance of lipid regulatory proteins. We explored the impact of endurance training on the maximal rate fat oxidation, muscle fibre type and muscle fibre type specific abundance of proteins regulating IMCL metabolism.

**Methods** Endurance trained (n=7, 28 ± 3 years, VO\(_{2}\text{max}\) 62.6 ± 1.6 ml·min\(^{-1}\)·kg\(^{-1}\)) and untrained (n=8, 25 ± 1 years, VO\(_{2}\text{max}\) 44.9 ± 1.9 ml·min\(^{-1}\)·kg\(^{-1}\)) males performed an incremental exercise test to determine maximal fat oxidation rate. Muscle fibre type composition and fibre type-specific
IMCL content was assessed with immunofluorescence microscopy and protein abundance was analysed with immunoblotting on pooled single muscle fibres and whole muscle.

**Results** Endurance trained individuals displayed a higher peak fat oxidation rate (0.49 ± 0.05 vs. 0.20 ± 0.03 g·min⁻¹, \( P < 0.05 \)), which correlated with type I fibre percentage (\( R = 0.83, P < 0.01 \)) and VO\(_{2\text{max}}\) (\( R = 0.78, P < 0.01 \)). Type I muscle fibres from endurance trained individuals had a greater abundance of ATGL. In whole muscle, the endurance trained group had greater abundance of PLIN2, PLIN5 and ATGL compared to the untrained group (\( P < 0.05 \)). Furthermore, autophagy flux measured as LC3-II/I ratio was higher in type I muscle fibres and LC3-II/I, lysosomal markers (LAMP2) and chaperone-mediated autophagy markers (LAMP2A) were all higher in whole muscle of endurance trained individuals (\( P < 0.05 \)).

**Conclusions** These results demonstrate that the maximal rate of fat oxidation is related to the proportion of type I muscle fibres. Furthermore, IMCL storage and the abundance of key proteins regulating lipid metabolism is fibre type specific and greater in endurance trained individuals. Muscle fibre type composition should be considered when investigating the regulation of IMCL utilisation and markers of autophagy.

**PL-014**

High-fat overfeeding increases intramuscular triglyceride content and perilipin protein expression in human skeletal muscle.

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**Objective** High-fat high calorie diets can induce whole body insulin resistance (IR) whilst increasing stores of intramuscular triglyceride (IMTG) contained within lipid droplets (LD). Perilipin (PLIN) proteins assist in IMTG storage. Synaptosomal-associated protein (SNAP23) may support LD growth and also direct IMTG-derived fatty acids (FA) to mitochondria for \( \beta \)-oxidation. The objectives of this study were: 1) to test the hypothesis that 7 days of high-fat overfeeding increases IMTG content to prevent lipid induced muscle IR and 2) identify changes in PLINs, SNAP23 and mitochondria content and colocalisation of PLINs with LD, and SNAP23 with LD and mitochondria.

**Methods** Muscle biopsies were obtained from the vastus lateralis of thirteen healthy individuals (age: 23±1 years, BMI: 24.4±0.7kg.m\(^{-2}\)) before (0min) and during (30min) an oral glucose tolerance test (OGTT), pre and post 7-days consuming a high-fat (65% energy) high-calorie (+50% kcal) diet. IMTG, PLIN2, PLIN3, PLIN5, SNAP23 and mitochondria content were measured using (semi)quantitative confocal immunofluorescence microscopy. PLIN2, PLIN3 and PLIN5 colocalisation to LD was measured using object-based colocalisation analyses. Pearson’s correlation coefficient quantified colocalisation between SNAP23 and plasma membrane (PM), mitochondria and LD. Phosphorylation of intermediates of the muscle insulin-signalling cascade (Akt and AS160) were measured at 0 and 30 min of the OGTT before and after the dietary intervention.

**Results** Following overfeeding phosphorylation of Akt and AS160 in muscle was not impaired during the OGTT, however Matsuda index of whole-body insulin sensitivity decreased (−23%; \( P < 0.01 \)). IMTG content increased in type I fibres (+100%; \( P < 0.001 \)) due to both an increase in LD number (+43%; \( P < 0.001 \)) and size (+44%; \( P < 0.001 \)) of the PLINs investigated, only PLIN3 content increased (+50%; \( P < 0.01 \)) exclusively in type I fibres. PLIN2-associated LD increased (+80%; \( P < 0.01 \)) in type I fibres only, whereas PLIN3 and PLIN5-associated LD were unaltered. SNAP23 and mitochondria content did not change, nor did the colocalisation of SNAP23 with the PM, mitochondria or LD.
Conclusions Our data confirm the hypothesis that following high-fat overfeeding IMTG stores increased whilst activation of key muscle insulin signalling components were maintained. The increase in IMTG stores is likely supported by the concurrent increase in total PLIN3 content and a redistribution of existing stores of PLIN2 to the expanded LD pool in type I fibres. To confirm if increased IMTG storage protects muscle from IR future research should determine whether meal-derived FAs are directed to IMTG rather than ceramides and diacylglycerol.

PL-015
Effects and safety of exercise combined with medication and diet in treatment of diabetes and comorbidity

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Objective The role of exercise in the prevention and treatment of chronic diseases is widely accepted and regular physical exercise may play an irreplaceable role beyond traditional medicine and drug treatments. However, current guidelines do not provide details on the characteristics of exercise programs which are aimed to be carried out concomitantly to drug treatments. Moreover, the safety of combined exercise and drug treatments has rarely been considered.

The future of exercise is medicine research will likely need to focus on questions such as how to build customized exercise programs for different patients in the context of individual physiological responses to exercise? When combining drug and concomitant exercise treatment, what is the optimal exercise prescription in terms of timing, intensity and duration? Does exercise only have an additive effect or may exercise actually reverse or even cancel out some of the expected effects induced by the drug treatment? What is the role of diet in exercise interventions? Does a given exercise program affect the lipid and glucose metabolism to the same extent?

In this report, we will present different randomized clinical trials conducted in our research group to tackle some of the abovementioned questions. This particularly includes patients with comorbidity conditions (prediabetes and non-alcohol fatty liver disease, NAFLD), as well as patients with type 2 diabetes (T2D).

Methods Two different randomized trials are included, both of which were conducted in China (ChiCTR-IOR-16008469 and ISRCTN 42622771). The ChiCTR-IOR-16008469 study was a randomized crossover trial. The aim of this study was to assess whether the duration between metformin administration and high-intensity cycling (HIIT) affects the glucose metabolism. T2D patients performed a single session of HIIT (~25 minutes) at 30 (EX30), 60 (EX60), and 90 (EX90) minutes following breakfast and metformin administration in a randomized order. Subjects’ diurnal glucose metabolism was assessed between 8:00 a.m. and 4:00 p.m. (Metf) of each exercise day as well as on a control day. Furthermore, insulin was assessed both before and immediately after each exercise bout.

The ISRCTN42622771 trial was a four arm randomized trial. Six-hundred and three patients from seven clinics were recruited, out of which 115 individuals aged 50-65-year fulfilled the inclusion criteria (impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) and NAFLD) and were randomly assigned (1:1:1:1) to either of the four groups: aerobic exercise (AEx, n = 29), diet intervention (Diet, n = 28), aerobic exercise plus diet intervention (AED = 29), or no intervention (NI = 29). The study spanned over an average period of 8.6 months (7-11 months). Progressive
supervised aerobic exercise training (60-75% intensity) was carried out 2-3 times/week in 30-60 min/sessions, and the diet intervention consisted of a lunch with 38% carbohydrate and diet fibre of 12g per day, while the remaining meals were freely chosen but with supervised nutrition intakes. The hepatic fat content (HFC) assessed by 1H MRS, glycated haemoglobin (HbA1c) and insulin sensitivity were assessed by conventional methods.

**Results** In study 1, we found that in diabetes patient glucose levels significantly decreased in all exercise settings, irrespective of the timing. However, when HIIT was performed at 30 minutes post-metformin administration, the peak glucose was lowered, thereby further stabilizing the postprandial glucose fluctuation. The risk for hypoglycemia at different times to exercise after metformin administration was highest in EX90 (22.2%) compared to EX30 (3.7%) and EX60 (7.4%). While the lactate level was 19% higher in EX60 and 8% higher in EX90 compared to EX30. Compared with Metformin, the decrease in insulin was larger in EX30 and EX60 (both p < 0.001). These results indicate that timing of exercise is an important factor to consider when prescribing exercise as adjuvant to metformin therapy for T2DM patients.

In study 2, we showed that in patients with morbidity (prediabetes with NAFLD), HFC was significantly reduced in the AEx (–24.4%), diet (–23.2%), and AED (–47.9%) groups, as opposed to the 20.9% increase in the NI group (p=0.006, p=0.002, and P<0.0001, respectively). Importantly, HFC decreased to normal levels (<5.6%) in ten (44%) out of 23 participants in the exercise plus diet group and nine (41%) out of 22 participants in the diet group, while the in the exercise group it decreased only in three (14%) out of 29 participants. Further, all intervention groups showed improvements in insulin sensitivity (AEx 33%, p=0.023, Diet 37%, p=0.012, and AED 34%, p=0.029) but only the AED group significantly decreased HbA1c (–4.4%, p=0.01) compared with the NI group (1.9% and -0.6%). However, after controlling for the change of body weight as well as for the duration of the intervention and baseline values, the significant differences in HbA1c and insulin sensitivity between the groups disappeared. Furthermore, based on HbA1c IFG or IGT, no significant remission and progression from prediabetes to diabetes were observed between the intervention and NI.

**Conclusions** The results derived from these two trials imply that: 1) the combined effects of exercise and metformin therapy on T2D should take into account that both exercise and metformin are likely to affect the lactic metabolism because T2D is considered as a redox disease. For the acute effect of exercise combined with metformin therapy, exercising at 30 minutes post-metformin administration appeared to be optimal for reducing glucose fluctuation. To avoid the risk for hypoglycemia and lactases with the combined treatment, selecting optimal timing may be the first and easiest step towards personalized exercise medicine. Thus, when exercise is recommended to diabetic patients, the timing of exercise may be an important consideration so that the therapeutic effects of metformin are not compromised. However, further studies are warranted to elucidate the long-term effects of combining metformin and exercise on glycemic control and lactic metabolism as well as the underlying mechanisms. 2) Aerobic exercise training combined with a fibre-enriched diet can aid reduce HFC more effectively than either exercise or increased fibre intake alone in pre-diabetic patients with NAFLD. However, the effect on glycaemic control and insulin sensitivity is not substantial. Therefore, it remains to be addressed why the same intervention protocol did not show the similar effect on the HFC and glycaemic control/insulin sensitivity in the same subjects. When these questions being uncovered, the combined intervention could be considered as an integral part of lifestyle interventions for patients with a cordiality condition for an increased risk of developing T2D.
**PL-016**

**Effect of early exercise on autophagy of liver tumor in mice**

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**Objective**  
To investigate whether the liver autophagy level can be altered by pre exercise training in mice liver tumors.

**Methods**  
40 Male C57BL/6J mice aged 7 months were randomly divided into 2 groups: control group (YC) and exercise group (YE). YE were exercised on a treadmill for 12 weeks (12m/min). After 12 weeks each group was randomly divided into two groups. The tumor model was constructed by injection of HEPA-6 mouse hepatoma cell into liver tissue. Then the groups were control group (YC), exercise group (YE), tumor group (YCT), exercise tumor group (YET). The experimental samples were prepared on the 13 day after the tumor model was constructed. The hematoxylin and eosin stain of the liver was observed. The expression of autophagy related protein BECLIN1, LC3-II and ATG5 in liver tissues of mice was detected by Western blot.

**Results**  
Compared with YCT group, the boundary of inflammatory cells and tumor cells in YET group was clear with normal cells. Compared with YCT group, the expression levels of BECLIN1, LC3-II and ATG5 in liver tissue of YET group were significantly higher (p < 0.01, P < 0.01, P < 0.05).

**Conclusions**  
Early exercise can help the 7 month old mice to resist the occurrence and development of the liver tumor. It's probably associated with increased level of autophagy in the liver by early exercise training.

**PL-017**

**The research of High temperature exercise under different humidity environment effect on the body of water and salt metabolism**

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**Objective**  
Objective: This study was to investigate the body under high temperature (33 °C) with different relative humidity (80%, 50%, 20%) combination of environment, respectively for 20 min 60% VO2max individual strength of quiet before and after the exposure of movement and under the same conditions, by measuring the participants within the body weight, serum sex hormone of blood, blood Na⁺, K⁺, Na⁺, K⁺ concentration in the urine of change, to explore in the sports stress and thermal stress of two kinds of stimulating the body water and salt metabolism characteristics, and to explore the effects of environmental humidity on the body's homeostasis.

**Methods**  
Methods: This study selected 12 students of sports training major from Beijing sports university as subjects, with themselves as the control. The experiment is divided into six categories, respectively: high temperature 33°C and 20% RH exposure group, the high temperature 33°C and 20% RH campaign group, high temperature 33°C and 50% RH exposure group, the high temperature 33°C and 50% RH campaign group, high temperature 33°C and 80% RH exposure group and high temperature 33°C and 80% RH. In this study all the environmental temperature are set up to 33°C, exercise intensity level of 60% VO2max selection for individual participants. Before every experiment, all participants were asked to quiet sit for 20 min and then
measure the subjects' body weight, charge the subjects' vein blood and urine, take the same operation immediately after the experiment. Blood samples were stored at room temperature for 1 h, and 3000r/min was centrifuged for 20min. Serums were gathered through centrifugation, The urine and Serums were partial shipments in tube to be indicators of measurement. Serum Renin、ANGII、ALD、ADH、ANP、Na+、K+ concentration of serum and urine were tested

**Results**

Results: (1) The subjects' weight loss percentage of exercise group was obviously higher than that of quiet exposure group, the difference is statistically significant (P < 0.01); In 80% RH environment weight loss percentage is significantly higher than that of 50% RH and 20% RH values (P < 0.01). There is no difference between 20%RH and 50%RH. (2) The exercise group of Renin, ANGII, ALD, ADH, concentration is significantly higher than the value of exposed group (P < 0.01), but the ANP concentrations were significantly lower than pure quiet exposure levels (P < 0.01).

**Conclusions**

Conclusions: (1) The body sweat more after exercise than just quiet exposed in high temperature, weight loss phenomenon more obvious; And with the increase of relative humidity environment, dehydration will more serious. (2) Exercise factors can significantly promote the release of blood Renin, ANGII, ALD, ADH and inhibit the release of ANP in the blood. By the way of strengthening the absorption process of water and ions, it can maintain the body's balance of water and ions.

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**PL-018**

**The characteristics for the primary school students’ physical activity**

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**Objective**

This thesis provides a theoretical basis for improving children’s physical activity levels and promoting the healthy development of primary school children.

**Methods**

Measuring the height, shape index of children which are in 3-5 grades of primary school in Nanjing and taking the BMI cut-off point of the Cole as the object of this study BMI evaluation criteria. Applying the ActiGraph GT3X accelerometer to measure the physical activity of children in seven consecutive days which includes five school days and two weekend days. By counting the physical activity in a 60s interval, children's physical activity can be evaluated. Besides, using 100cm as the cut-off point, the number of students’ sedentary breaks can be calculated. And the relationship between the results and students' BMI characteristics can be discussed.

**Results**

(1) For the male students, the average sedentary breaks, LPA and MVPA time is 849.47min, 297.01min and 37.99 min respectively. And for the female students, the sedentary breaks, LPA and MVPA time is 874.12min, 272.33min, and 32.55min respectively. The male students’ MVPA time is significant higher than the female students (P<0.05), but for both of them, the MVPA time cannot achieve the international children’s physical activity daily recommended amount which is 60min. Besides, there is no difference between different grades(P>0.05). (2) Students’ daily MVPA time was significantly higher than the weekend MVPA time (P <0.05). Male students’ MVPA time in the school days is higher than the MVPA time in the weekend(P<0.01). For the children in different body shape, the MVPA time in the school days is higher than that in the weekend(P<0.05). In the school days, the male students’ MVPA time is significant higher than that of female. (P<0.05). In the weekend, the normal group’s MVPA time is much higher than that of overweight and obese groups(P<0.05). (3) The sedentary breaks of normal group is less than that of overweight and obese groups(P<0.05). There is no significant difference between different gender, grades and BMI(P>0.05).

**Conclusions**

(1) Male students’ MVPA time is higher than the female students. (2) The MVPA time in the school days is much higher than in the weekend. In terms of the sedentary breaks, there is no difference between different gender, grade and body shape. (3) Students
with more sedentary breaks get lower BMI, and the change of LPA will be the primary cause of MVPA changing.

**PL-019**

**Interruption of mitochondrial homeostasis inhibits Irisin biosynthesis in C2C12 Myoblast**

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**Objective** Irisin is a PGC-1α dependent myokines suggested to provide the basis for the crosstalk between skeletal muscle and other organs. PGC-1α induces the expression of a membrane protein fibronectin type III domain-containing protein 5 (FNDC5), and exercise triggers the cleavage of FNDC5 to secrete irisin into the bloodstream. It was found that low level of Irisin in circulation was accompanied with impaired skeletal muscle mitochondrial homeostasis during aging. However, the relationship between mitochondrial homeostasis and Irisin induction is merely correlative. This study established mitochondrial homeostasis interrupt model in order to explore whether mitochondrial homeostasis involved in regulation of Irisin synthesis.

**Methods** C2C12 myoblasts were treated with OPA1 siRNA for 48 hours. Mitochondrial energy metabolism was measured with seahorse XF24 Extracellular Flux Analyzer. Mitochondrial reticulum morphology was monitored with confocal laser scanning microscopy. Protein expression of Mfn1, Mfn2, OPA1, Drp1, FNDC5, PGC-1α, SirT1 and GCN5 were measured with Western blot. Content of Irisin in culture medium was determined with Elisa.

**Results** Compared with control, in OPA1 siRNA myoblast, the expression of Mfn2(-35%, P<0.01), Drp1(-45%, P<0.01), Irisin(-10%, P<0.05), FNDC5(-33%, P<0.01), PGC-1α(-48%, P<0.01), SirT1(-40%, P<0.01), GCN5(-22%, P<0.05) proteins and the levels of cell membrane potential(-92%, P<0.01) and the basic OCR(-20%, P<0.01), ATP potential(-20%, P<0.05), max respiration capacity of mitochondrial(-29%, P<0.05) were decreased significantly. The expression of Mfn1(+39%, P<0.01) was increased significantly.

**Conclusions** Interruption of mitochondrial homeostasis inhibits Irisin biosynthesis. This may be related to mitochondrial ATP loss and imbalance energy-sensitive signaling SirT1/GCN5, which in turn suppress PGC-1α and its downstream Irisin.

Supported by NSFC (No. 31771320, 81370454, 31110103919).

**PL-020**

**THE EFFECT OF SELECTED PARAMETERS ON HAND GRIP STRENGTH AMONG CRICKET PLAYERS IN PRISON DEPARTMENT**

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**Objective** Handgrip strength is a marker of upper body strength. The purpose of this study is to examine the relationship between the dominant handgrip strength and twelve selected parameters of cricket players in Sri Lanka Prison Department. The twelve selected variables are as follows; age, height, weight, arms subcutaneous fat percentage, skeletal muscle mass percentage, upper arm length, fore arm length, hand width, hand length, hand span, hand circumference and free testosterone hormone level.
**Methods** The study is conducted on a population of 35 cricket male players. Sample and population are the same. This population mainly consist of players who practice and play regular matches for the club and exclude players who are suffering from any acute or chronic upper limb injuries and players, who under performed in the recent matches. Dominant handgrip strength and other selected parameters are measured via standard techniques. Blood samples were collected to determine free testosterone level of players, for better result this study collected blood samples were at 7.30 a.m. to 8.00 a.m after a better sleep at previous night. Ordinary electric centrifuge use to centrifuge the sample tubes. Once centrifugation is completed the serum is separated from the centrifuged blood sample used by pipette. This study used High-performance liquid chromatography (HPLC) method to analyze free testosterone hormone level of the samples. Handgrip strength tests were performed the same morning of blood sample collected. The purpose of this test in this study is to measure the maximum isometric strength of the hand and forearm muscles of players. This study used “camry eh101” electronic hand dynamometer to measure hand grip strength and strength was measured in kilograms. This study used “Karada scan” bioelectrical impedance analysis to estimate percentage of body fat and fat free muscle mass of cricket players. Anthropometric data was measured as follows: stands erect, looking straight ahead, heels together, weight distributed equally on both feet, and with his arms hanging naturally at his sides. All measurements were made on the dominant hand of the body using steel tape and the circumferences of body parts were measured with the help of flexible steel tape. Statistical analysis is carried out utilizing SPSS and Minitab software.

**Results** Pearson correlation of dominant handgrip strength (kg) and age = -0.521 at p-value = 0.001. Pearson correlation of dominant handgrip strength (kg) and height (cm) = 0.394 at p-value = 0.019. Pearson correlation of dominant handgrip strength (kg) and weight (kg) = 0.100 at p-value = 0.568. Pearson correlation of free testosterone level (pg/mL) and dominant handgrip strength (kg) = 0.496 at p-value = 0.002. Pearson correlation of dominant handgrip strength (kg) and arms subcutaneous fat percentage (%) = -0.424 at p-value = 0.011. Pearson correlation of dominant handgrip strength (kg) and arms skeletal muscle mass percentage (%) = 0.436 at p-value = 0.009. Pearson correlation of dominant handgrip strength (kg) and fore arm length (cm) = 0.591 at p-value = 0.000. Pearson correlation of dominant handgrip strength (kg) and upper arm length (cm) = 0.240 at p-value = 0.165. Pearson correlation of dominant handgrip strength (kg) and Hand width (cm) = 0.319 at p-value = 0.062. Pearson correlation of dominant handgrip strength (kg) and hand length (cm) = 0.608 at p-value = 0.000. Pearson correlation of dominant handgrip strength (kg) and Hand span (cm) = 0.407 at p-value = 0.015. Pearson correlation of dominant handgrip strength (kg) and hand circumference (cm) = 0.232 at p-value = 0.180. Correlation of age and free testosterone hormone level (pg/mL) = -0.359 at p-value = 0.034. Correlation of age and arms subcutaneous fat percentage = 0.462 at p-value = 0.005. Correlation of age and arms skeletal muscle mass percentage = -0.619 at p-value = 0.000. Pearson correlation of weight (kg) and arms subcutaneous fat (%) = 0.596, P-value = 0.000. Correlation of weight (kg) and arms skeletal muscle mass (%) = -0.793 at p-value = 0.000. Pearson correlation of free testosterone hormone level (pg/mL) and arms skeletal muscle mass percentage (%) = 0.375 at p-value = 0.026. Standing height, correspondingly indicate significant a relationship with fore arm length, upper arm length, hand length, hand span and hand circumference. This indicates the when body height increase, it will subsequently lead to increment of the forearm length, upper arm length, hand length, hand span and hand circumference. Regression equation for dominant handgrip strength is (kg) = -0.578 age + 3.79 hand length (cm). Observed test statistic (4.309) > at critical value 5%(2.3205). It can be concluded with 95% confidence that at least one of the two variable significantly contribute for dependent variable of regression model. β_1 P value (0.019) < 0.05, β_2 P value (0.001) < 0.05. Therefore, predictor variables age and hand length are significant in this regression equation. Both age and hand length show a VIF value of 1.16 and which indicate that there is strong multicollinearity between the variables. Adjusted R-squared = 0.438 and it can be concluded that the fitted model is captured 43.8% of observed variability.

**Conclusions** Pearson correlation of dominant handgrip strength and height, free testosterone level, fore arm length, hand length, hand span, arms subcutaneous fat and arms skeletal muscle mass percentage have a statistically significant relationship. The direction of the relationship is
positive. Meaning that these variables tend to increase together. Pearson correlation of dominant handgrip strength and age, arms subcutaneous fat have a statistically significant relationship. The direction of the relationship is negative meaning that these variables move in inverse, or opposite, directions. Pearson correlation of dominant handgrip strength and hand circumference, weight, upper arm length and hand width have no statistically significant relationship. Age and Free testosterone hormone level, arms skeletal muscle mass percentage have a statistically significant linear relationship. The direction of the relationship is negative. In other words, as Age increases, the free testosterone hormone level and arms skeletal muscle mass percentage decreases. Pearson correlation of Age and Arms Subcutaneous fat percentage have a statistically significant linear relationship. The direction of the relationship is positive. Weight and Arms Skeletal muscle mass percentage have a statistically significant linear relationship. The direction of the relationship is positive. Pearson correlation of Free Testosterone hormone level and Arms Skeletal muscle mass percentage have a statistically significant linear relationship. The direction of the relationship is positive. 43.8% of handgrip strength depends on the variables age and hand length.

Coaches should periodically assess the free testosterone level and percentage of lean body mass of the players to maintain optimal level. Cricket coaches and team selectors can use age, height, fore arm length, hand length, hand span, free testosterone hormone level, arms subcutaneous fat and arms skeletal muscle mass percentage as talent predictors to select ideal players for cricket teams or to identify potential children/players. Cricket Brain Centers can use this research to analysis player performance and predict their future performance.

**PL-021**

**Mismatch between skeletal muscle glucose delivery, interstitial concentration and membrane permeability may limit insulin sensitivity after exercise**


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**Objective** The relationship between skeletal muscle perfusion, interstitial glucose concentration and sarcolemmal permeability to glucose in exercise-induced increases in muscle insulin sensitivity is not well established. A single bout of exercise increases skeletal muscle insulin sensitivity through coordinated increases in insulin-stimulated microvascular perfusion and insulin signalling. Reducing leg and muscle microvascular blood flow with local nitric oxide synthase (NOS) inhibition during a hyperinsulinaemic euglycaemic clamp reduces leg glucose uptake in a previously exercised, but not in a contralateral non-exercised leg, without affecting insulin signalling in either leg (Sjoberg et al. 2017). Therefore, it is possible that the reduction in muscle perfusion decreases muscle interstitial glucose concentration to a point that limits skeletal muscle insulin-stimulated glucose uptake following exercise. We examined this using microdialysis of vastus lateralis muscle.

**Methods** Ten healthy males (Age: 27±1 yr., Weight: 77.7±2.3 kg, BMI 23.9±0.5, VO2 peak: 50.7±1.5 ml·kg⁻¹·min⁻¹) performed 60 min of 1-legged knee extensor exercise at 80% of 1-legged peak work load with three 5 min intervals at 100% 1-legged work load. Participants then rested for 4 hours and catheters were inserted into the femoral artery and vein of both legs for subsequent measurement of leg glucose uptake and for femoral artery infusion of the NOS inhibitor NG-monomethyl L-arginine acetate (L-NMMA) and the vasodilator ATP. Catheters were also placed in antecubital veins for infusion of insulin and glucose. Three microdialysis catheters, with a semi-permeable membrane the length of 30 mm and a molecular cut-off at 20,000 dalton,
were inserted into the vastus lateral muscle of both legs. Glucose and D-[6-3H(N)]glucose were added to the perfusate. Four hours after discontinuing the exercise a 225 minute euglycaemic hyperinsulinaemic clamp was initiated (insulin infusion 1.4 mU·kg⁻¹·min⁻¹). Ninety min into the clamp L-NMMA was infused at a constant rate (0.4 mg·kg⁻¹·leg mass·min⁻¹) into both femoral arteries for 45 min. The insulin infusion was maintained for another 90 min and during the last 45 min ATP (0.3 μmol·ml⁻¹) was infused locally into both femoral arteries at a rate of 200-350 μl·min⁻¹ to obtain a leg blood flow that was double the blood flow during insulin only infusion. A second control protocol was undertaken that was identical in regards to exercise and recovery but no insulin, L-NMMA or ATP was infused.

**Results** During the clamp leg glucose uptake and leg blood flow were higher (P<0.05) in the previously exercised than the control leg whereas the interstitial glucose concentration decreased to lower (P<0.05) values in the exercised (~3.1mM) than the control (~4.8mM) leg. Estimated sarcolemmal glucose permeability was twice as high (P<0.05) in the exercised compared with the rested leg. The NOS inhibitor L-NMMA decreased LBF in both legs and interstitial glucose concentration dropped to ~2.3 mM in the exercised but only to ~3.7 mM in non-exercised muscle. This abrogated the augmented effect of insulin on LGU in the exercised leg while apparent sarcolemmal permeability to glucose remained unchanged with L-NMMA in both legs. Doubling leg blood flow by local infusion of ATP increased leg glucose uptake in both legs without any major change in interstitial glucose concentration or sarcolemmal permeability to glucose.

**Conclusions** These findings suggest that during flow restriction due to L-NMMA, the interstitial glucose concentration becomes limiting for leg glucose uptake in exercised but not in non-exercised muscle. Therefore, the vasodilatory effect of insulin is an important component of the increased insulin sensitivity to stimulate glucose uptake following exercise by limiting the drop in the interstitial glucose concentration that occurs due to the increased sarcolemmal permeability to glucose.

**PL-022**

Up-regulation of NRG1 improves cardiac repair in zebrafish and involved in the cardioprotective effects of exercise training in rats of myocardial infarction

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**Objective** Myocardial infarction (MI) remains a leading cause of morbidity and mortality worldwide. Exercise training could improve cardiac function following MI. However, the mechanisms are still not well-known. Neuregulin 1 (NRG1) plays an important role in heart development and regeneration. In this study, we investigated the effect of NRG1 on cardiac regeneration in a zebrafish model, detected whether exercise could improve cardiac function through regulating NRG1 expression in infarcted heart and explore the possible role of up-regulation of NRG1 in skeletal muscle play in the cardioprotective effects in rats with MI.

**Methods** Transgenic zebrafish line, cmlc2:CreER and β-act2:BSNrg1, were used to study the effect of NRG1 on heart growth and regeneration after injury. PCNA was detected by immunofluorescence staining and mRNA expression of gata4, nkx2.5, tbx5, smyd1b, hsp90a and murf were tested by RT-PCR. Sprague-Dawley rats were used to establish MI model and underwent four weeks of exercise training (ET) or pAAV-(dMCK promoter)rNRG1-eGFP intervention. AG1478 was used as an inhibitor of NRG1/ErbB signaling pathway. Cardiac function and structure, cardiomyocyte proliferation and NRG1 expression were detected in the heart or skeletal.
Results Cardiac-specific overexpression of NRG1 induced cardiac hypertrophy and cardiomyocyte proliferation, regulated the mRNA expression of gata4, nkh2.5, tbx5, smyd1b, hsp90a and murf in uninjured zebrafish, and promote cardiac repair and regeneration after injury in the zebrafish. Exercise activated NRG1/ErbBs signaling pathway, improved cardiac remodeling and heart function, enhanced cardiomyocyte proliferation, reduced cardiomyocyte apoptosis, ROS level and MuRF1 protein expression in rats with MI. Blocking ErbB signaling attenuated the ET-induced cardioprotection effects in rat with MI. Up-regulation of NRG1 expression in skeletal muscle could increase the protein level of NRG1 in serum and infarcted heart, improve cardiomyocyte proliferation and reduce the level of cardiac fibrosis, finally promote cardiac function.

Conclusions Up-regulation of NRG1 expression in the heart or skeletal muscle may be one of the underlying mechanisms of the beneficial effects of exercise training following MI.

PL-023
Aerobic exercise inhibits tau hyperphosphorylation through activation of the PI3K/Akt pathway in the hippocampus of APP/PS1 mice

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Objective Many studies suggest that regular physical exercise can reduce the risk of Alzheimer's disease and slow its onset and progression. However, the exact mechanism is still unclear. Clinically, Alzheimer's disease is characterized by the presence of extracellular amyloid plaques and intraneuronal neurofibrillary tangles, which are associated with amyloid-β and tau hyperphosphorylation respectively. The PI3K/Akt signaling pathway regulates tau phosphorylation and plays a pivotal role in the development of pathology in Alzheimer's disease. Here we investigated the effects of aerobic exercise on tau phosphorylation and examined whether these effects were mediated by the PI3K/Akt pathway in the hippocampus of APP/PS1 transgenic mice.

Methods 40 male APP/PS1 transgenic mice were randomly divided into four groups: sedentary group (T-SE; n=10), exercise group (T-EX; n=10), sedentary with GNE-317 treatment group (T-SEG; n=10) and exercise with GNE-317 treatment group (T-EXG; n=10). GNE-317 is a potent and selective PI3K/Akt pathway inhibitor that can cross the blood-brain barrier and show effective suppression of Akt phosphorylation in the mice brain. The mice in the T-EX and T-EXG groups were given exercise training on a treadmill for 5 days/week for 8 weeks with 0% grade, and progressively ran from 30 min/day at 12 m/min, up to 60 min/day at 15 m/min. The mice in the T-SE and T-SEG groups were placed individually on another treadmill at 0 m/min for the same duration. 48 hours after the last exercise bout, all mice were intraperitoneally injected an anesthetic for inducing anesthesia, and the hippocampus were rapidly extracted. The protein and phosphorylation levels of tau, PI3K, Akt and GSK3β were assayed by Western blot and immunohistochemistry. The cognitive function were tested by morris water maze.

Results We found out that 8 weeks of aerobic exercise reduced tau phosphorylation at multiple sites including Ser202, Thr231 and Ser396, and increased phosphorylation of Akt at Thr308 and Ser473 and of GSK3β at Ser9. Furthermore, in the morris water maze test, the exercise group showed a reduced escape time and distance compared with those of the sedentary group, suggesting that aerobic exercise improved learning and cognitive ability. While the above-mentioned results were attenuated in the PI3K/Akt inhibitor GNE-317 treatment groups.

Conclusions Our study demonstrated that aerobic exercise could inhibit tau hyperphosphorylation and improve cognitive function through activation of the PI3K/Akt pathway in the hippocampus of APP/PS1 mice.
PL-024

Responses of Urine and Blood Biochemical Markers to Exercise-induced Body Fluid Losses in Elite Chinese Road Cyclists

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Objective To examine biochemistry parameters regarding exercise induced fatigue, e.g. Sweat Loss (SL), Creatine Kinase (CK), Lactate Dehydrogenase (LDH), Blood Urinary Nitrogen (BUN), etc.

Methods This study examined Sweat Loss and blood biochemistry biomarkers regarding fatigue and muscle injury among elite cyclists under a training mode of 120 min moderate workload at 50 - 70% VO2max, then, 10 min relaxation, and then, followed up with a 20 min of spinning session over 85% VO2max. 12 healthy elite Chinese male cyclists (22.6 ± 2.9 years old, 78.3 ± 5.7 kg in weight, 184.6 ± 4.3 cm in height) were recruited. They performed four exercise performance tests throughout this study with 15 days washout period in between. Blood serum tests and urine tests were taken both pre- and post-exercise tests, and dynamic cardio-respiratory hardware (MetaMax 3B, Cortex Biophysik, Germany) was applied during each of their test. There were 2 different sport beverages available. The fluid replacement plan was a double blind crossover design. The volume of fluid intake was in accordance with ACSM recommendation for fluid replacement. Those who were assigned with sport beverage A (6% carbohydrate with 1% peptide) for the first and second performance tests, will be re-assigned to sport beverage B (6% carbohydrate without peptide) for the third and fourth performance tests, vice versa. Notes were taken for the volume of fluid intake to calculate the estimated Sweat Loss.

Results We found 91.7% trials have increased LDH, 88.9% trials have increased CK, and 100% trials have been observed increased BUN right after exercise performance test. Even with sufficient water supply, athletes hydration status were getting worse after exercise performance test, their urine USG results were 1.024 ± 0.006 and 1.027 ± 0.006 for pre- and post-exercise performance test respectively. Their dehydration status quantified by the percentage change in body mass (%BM) was 1.86% ± 1.03% with a 95% confidence interval ranging from 1.57% to 2.15%.

Conclusions Though, with sufficient water supply, athletes hydration status were getting worse after exercise performance test considering Sweat Loss and blood biochemistry indicators regarding fatigue and muscle injury.

PL-025

The effects of ACE gene polymorphisms on ACE content before and after High-Intensity Interval Exercise

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Objective Angiotensin Converting Enzyme (ACE) is expressed in human skeletal muscle. The ACE I/D polymorphism (rs4341) has been associated with athletic performance in some studies.
Studies suggested that the ACE I/D gene polymorphism is associated with ACE enzyme content in serum, however, the effect of ACE I/D on ACE protein content in human skeletal muscle is unclear. Angiotensin-converting enzyme 2 (ACE2) is a new component of the renin-angiotensin system (RAS), which is counter-regulatory to the ACE enzyme. The polymorphisms in the ACE2 gene (rs1978124 and rs2285666) have been reported to be associated with hypertension, however, their effects on ACE content in the blood and in skeletal muscle have yet to be explored. Utilising the Gene SMART cohort (n=81), we investigated whether the ACE I/D gene polymorphism (rs4341) and two ACE2 gene polymorphisms (rs1978124 and rs2285666) were associated with ACE enzyme content in the blood and skeletal muscle at baseline, and following a single session of High-Intensity Interval Exercise (HIIE).

Methods ACE and ACE2 gene polymorphisms were determined using the TaqMan SNP assay (Applied Biosystems, Foster City, California, United States) by Mastercycler® ep realplex2 (Eppendorf, Hamburg, Germany), and QuantStudio™ 7 Flex Real-Time PCR System (Applied Biosystems, Foster City, California, United States). For quantitation of ACE content in the plasma, Abcam Human ELISA Kit (ab119577 –ACE (CD143)) was used (Abcam, Cambridge, United Kingdom). Western blots were used to measure ACE content in skeletal muscle. We used robust linear models adjusted for age to test the effect of the ACE I/D polymorphism on outcomes at baseline, using the MASS package in the R statistical software. p-values were adjusted for multiple comparisons using the Benjamini and Hochberg method, and all reported p-values are adjusted p-values. An adjusted p value < 0.005 was considered significant.

Results We found that the ACE I/D gene polymorphism was associated with ACE content in the blood (p<0.005) at baseline, but not the ACE protein content in skeletal muscle at baseline. The ACE2 polymorphisms (rs1978124 and rs2285666) were not associated with ACE enzyme content in the blood or in skeletal muscle at baseline. A single session of HIIE tended (0.005 < p < 0.05) to increase blood ACE content immediately post-exercise, while skeletal muscle ACE protein content was lower 3 hours post a single session of HIIE (p<0.005). However, those changes were not related to ACE I/D or ACE2 polymorphisms.

Conclusions The ACE I/D gene polymorphism influences ACE enzyme content in the blood but not the ACE protein content of human skeletal muscle. ACE I/D gene polymorphism does not influence the changes of ACE content after a single session of HIIE. ACE2 gene polymorphisms seem to have no effect on ACE content in the blood and skeletal muscle, before or after a session of HIIE.

PL-026
Skeletal muscle blood flow determination using gold standard invasive arterial input function and non-invasive image-based input function by positron emission tomography (PET)

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Objective Skeletal muscle is unique among organs in that its blood flow, thus oxygen supply that is critical for muscular function, can change over a remarkably large range. Compared to the rest,
muscle blood flow can increase over 20-fold during intense exercise. Positron emission tomography (PET) and [15O]-H2O tracer provide a unique tool for the direct measurement of muscle blood flow in specific muscle regions. Quantification of PET blood flow requires knowledge of the arterial input function, which is usually provided by arterial blood sampling. However, arterial sampling is an invasive approach requiring arterial cannulation. In the current study, we aimed to explore the analysis and error estimation based on non-invasive, PET image-based input function for skeletal muscle blood flow in PET [15O]-labeled radiowater study.

Methods
Thirty healthy untrained men volunteered to participate in this study. [15O]-labeled radio water PET perfusion scans were performed at rest and right after cycling exercise. GE Discovery PET-CT scanner was used for image acquisition. The 15O isotope was produced with a Cyclone 3 cyclotron (IBA Molecular, Belgium). After 455 MBq of 15O-H2O was injected intravenously and after 20 seconds, dynamic scanning images were performed in following frames: 6x5 seconds, 12x10 seconds, 7x30 seconds and 12x10 seconds. Arterial blood was sampled continuously from radial artery during imaging for radioactivity with a detector during PET scanning. All the data analysis was performed using all in-house developed programs. Arterial input function was preprocessed with delay correction. Image-based input function was defined based on sum image of dynamic images. Blood flow was calculated using the 1-tissue compartment model, k1 is considered as blood flow without any further correction. All data analysis was performed by Carimas software (http://www.turkupetcentre.fi/carimas).

Data analysis was performed in five parts: 1) Modelling data using input function from artery. 2) By defining femoral artery Volume Of Interest (VOI) on PET images. 3) Modelling data using image-based input function. 4) Calculating the correlation for blood flow between artery (blood) input function and image-based input function. 5) Predicted true blood flow was calculated based on correlation based on the initial linear relationship between blood and image-based input functions. Results
Skeletal muscle blood flow had a good linear relationship calculated by femoral artery VOI and by arterial (blood) input function (y = 2.9587x - 0.096, R² = 0.8852, p<0.0001). Further, by using the prediction equation obtained by the linear relationship between VOI-determined (femoral) artery blood flow and direct gold standard (radial) artery input function determined blood flow, image-based input function determined blood flow was well predicted using this non-invasive approach (y = 1.1812x + 0.1219, R² = 0.9259, p<0.0001).

Conclusions
It is concluded that there is a strong linear correlation between gold standard invasive approach and non-invasive image-based approach to measure skeletal muscle blood flow by PET, but if no further corrections are made, image-based approach overestimates correct blood flow. However, this can be corrected by linear prediction equation, suggesting that invasive arterial input function may not always be needed in the future when measuring skeletal muscle blood flow by PET. This will be of benefit particularly for exercise studies.

PL-027
Physiological triggers involved in reduced slow myosin expression in disused postural muscle
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Objective
It is well known, that the reduced contractile activity of the postural soleus muscle under bedrest, immobilization or a space flight leads to decrease of slow myosin heavy chain (MyHC) expression rate and increase of the fast myosin isoforms expression [Pette, 2003; Stevens, 1999, 2000 et al]. The significant decline of the slow myosin mRNA content was found as early as after 24 hours of rat hindlimb unloading [Giger et al., 2009]. However, in the meantime, the mechanisms of this process had been substantially unexplored. At the same time,
the main pathways involved in the control of transcription of Myh7 gene (MyHC(β)) are well known. These mechanisms are based upon traffic of messenger molecules (NFATc1 and Class IIA histone deacetylases) transducing positive and negative signals for Myh7 gene expression in muscle fiber nuclei. This traffic is known to be triggered by myoplasmic calcium content. Almost nothing is known about the roles of other physiological regulators (nitric oxide and high-energy phosphates) in Myh7 transcription control [Martins et al., 2012; Putman et al., 2015]. Our study was aimed to disclose the physiological triggers involved in the decline of Myh7 expression in postural muscle at the early stages of disuse state. We supposed that at the early stage of unloading (24 hours) it was the shift of the ATP/ADP/AMP balance (ATP accumulation due to muscle inactivation) to drive the Myh7 gene expression decline via AMP-activated protein kinase (AMPK) dephosphorylation and HDAC4 myonuclear import. Then we supposed that the mechanisms involved in the reduction of Myh7 expression during the first week of disuse are implemented via the decrease of NO muscle content [Lomonosova et al., 2011] and subsequent NFATc1 nuclear export in the GSK3β-dependent manner [Lomonosova et al, 2017].

**Methods** Three experimental series were performed in order to testify the hypotheses. Unloading of the hindlimbs was induced by using a standard rodent hindlimb suspension/unloading (HU) model (Morey-Holton & Globus, 2002). During the first series, using the selective AMPK activator AICAR we evaluated the roles of the AMPK dephosphorylation during the first days of unloading which we found earlier [Vilchinskaya et al., 2015; Mirzoev et al, 2016]. Animals were daily treated with AICAR (400 mg kg⁻¹) or saline for 6 days before HU as well as during 24 h of HU.

The second series was designed to investigate the impact of high-energy phosphates ratio changes on AMPK activity and slow-type MyHC isoform expression in rat soleus muscle at the early stages of unloading. It is known that administration of β-guanidinopropionic acid (βGPA) allows shifting ATP/ADP/AMP balance to the enhanced ATP breakdown. We used administration of β-guanidinopropionic acid (βGPA), before (6 day) and during 24-h HU.

The third series was aimed to identify the functional relationship between the decrease of the nitric oxide (NO) content, the GSK-3β phosphorylation (leading to the GSK-3β activation), the NFATc1 amount in the muscle nuclei, and the MyHC I(β) isoform expression in the rat soleus muscle under gravitational unloading. Male Wistar rats were divided into five groups: the vivarium control group; the group of animals with a 7-day hind limb suspension receiving placebo; the group of HU animals receiving a NO donor (L-arginine); the group of HU animals receiving a NO donor and a NO-synthase inhibitor (L-NAME) and the group of HU animals receiving a GSK-3β inhibitor.

**Results** In the 1st experimental series we discovered that AICAR treatment prevented a decrease in content of phospho-AMPK and pre-mRNA and mRNA expression of MyHC I as well as MyHC IIA mRNA expression. Twenty-four hours of HU resulted in HDAC4 accumulation in the nuclei of rat soleus but AICAR pretreatment prevented this accumulation. The results of the study indicate that AMPK dephosphorylation after 24 h of HU had a significant impact on the MyHC I and MyHC IIA mRNA expression in rat soleus. AMPK dephosphorylation also contributed to HDAC4 translocation to the nuclei of soleus muscle fibers, suggesting an important role of HDAC4 as an epigenetic regulator in the process of myosin phenotype transformation.

In the 2nd experimental series after 24-h HS we observed a decrease (p<0.05) in phospho-AMPK content vs. control group, but in HS+ βGPA group didn’t differ from the control. After 24-h unloading we found a significant increase in the content of nuclear HDAC4 in the HS group, but in the HS+ βGPA group the content of nuclear HDAC4 didn’t differ from the control group. 24-h unloading resulted in a decrease in MyHC(β) pre-mRNA and mRNA expression vs. the control group. The expression level of MyHC(β) pre-mRNA and mRNA in HS+ βGPA group didn’t differ from the control. Thus, βGPA administration prevents a decline in AMPK phosphorylation. Therefore, we can conclude that at the early stage of gravitational unloading an accumulation of high-energy phosphates (ATP, ADP and creatine phosphate) may lead to reduced AMPK activity and a slow to fast myosin fiber type transition.

The third experimental series dealt with the fate of the nuclear NFATc1 transcription factor which triggers the myh7 expression but can be easily exported from myonuclei being phosphorylated. It is supposed that it is NO-dependent GSK3β that phosphorylates NFATc1 and promotes its nuclear export. We have shown that a 7-day unloading leads to a NO content decrease in the...
soleus muscle, and this effect is prevented by L-arginine administration. In addition, administration of L-arginine blocks the GSK-3β phosphorylation decrease, NFATc1 export from the muscle nuclei, and MyHC I(β) expression decrease caused by unloading. The NO-synthase inhibitor can block the L-arginine effect in each case. Administration of the GSK-3β inhibitor prevents the unloading-induced NFATc1 export from the muscle nuclei and a decrease of the MyHC I(β) expression.

**Conclusions** The data obtained in the described experimental series give evidence for the novel view on the well-known phenomenon of slow-to-fast fiber type transition during unloading/disuse. It is obvious that the signaling pathways involved in the slow myosin gene expression control during unloading are time-dependent and consecutive in the course of the exposure to unloading. The earliest triggering factor is supposedly the shift of the balance of high-energy mononucleotide phosphates leading to decrease of AMP and accumulation of ATP content. This signal is accepted by the AMPK as a universal energy sensor and transduced to the transcription level by the altered HDAC4 traffic. It seems possible that at the next stages of the exposure to unloading the alteration of the calcineurin/NFATc1 signaling pathway takes place due to the activated calcineurin inhibitors [Lomonosova et al, 2017] and enhanced NFATc1 phosphorylation and myonuclear export. We obtained the novel evidence that at these stages the decline of Myh7 expression might be provided by the GSK3β activation and NFATc1 phosphorylation due to the decrease of NO content in the soleus muscle.

The study was supported by Russian Science Foundation grant # 18-15-00107.

**PL-028**

**A translational model of muscle protein synthetic bioactivity in vitro, ex vivo and in vivo**

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**Objective** The aim of this research was the development and validation of a translational model for the evaluation of exercise and nutrient stimulated muscle protein synthesis (MPS). To achieve this overall aim, three primary objectives had to be realised: (i) Development of an in vitro skeletal muscle cell bioassay to measure muscle growth and MPS; (ii) Development of an ex vivo model to evaluate the humoral effect on MPS in response to nutrient feeding and exercise; (iii) Use of a stable isotope technique to evaluate MPS in response to nutrient feeding and exercise in vivo.

**Methods** To develop a novel in vitro skeletal muscle cell bioassay to measure muscle growth and MPS, C2C12 myoblasts were proliferated and subsequently differentiated to myotubes over 8 days in DMEM (2% HS). Changes in cell behavior and adhesion properties were monitored by measuring impedance via interdigitated microelectrodes using the xCELLigence system. MPS was measured by puromycin incorporation using the SUnSET technique, intracellular signalling measured by western blot, and myotube thickness by microscopy. To demonstrate the capability to monitor nutrient regulation of muscle growth, media was conditioned with a known potent regulator of MPS (leucine) in a dose response experiment (0.20 - 2.0 mM). To establish the ability of the bioassay to measure the humoral effect of MPS in response to feeding and exercise, media was conditioned by ex vivo human serum from fasted, rested, fed (protein and isonitrogenous non-essential amino acid (NEAA) control) and post-exercise conditions. To evaluate MPS in response to nutrient feeding and exercise in vivo, acute MPS (5 h) was assessed by measuring stable isotope deuterium oxide (D2O) incorporation into m. vastus lateralis skeletal muscle following consumption of either a Whey Protein (WP) or an isonitrogenous NEAA control combined with resistance exercise in resistance trained males.

**Results** In vitro experiments observed a dose-response effect with a 32 % increase in cell index and a 27 % increase in cell thickness after 2 h in the presence of 2.0 mM leucine when compared
with control myotubes. *Ex vivo* serum following ingestion of NEAA had no effect on protein signalling or MPS whereas WP fed serum significantly increased mTOR, P70S6K and 4E-BP1 phosphorylation (p<0.01, p<0.05) compared to fasted serum. Furthermore, the effect of WP fed serum on protein signalling and MPS was significantly increased (p<0.01, p<0.05) compared to NEAA fed serum. *Ex vivo* human serum following resistance exercise was also increased MPS (29%) and phosphorylation of mTOR (6%), p70S6K (12%) and 4EBP1 (7%), compared with resting serum. These *ex vivo/in vitro* findings translated to the *in vivo* model as myofibrillar fractional synthetic rates (myoFSR) (Basal 0.068±0.002%h⁻¹ vs. WP 0.084±0.006 %h⁻¹, p=0.033) and absolute synthetic rates (ASR) (Basal 10.34±1.01 vs. WP 13.18±0.71 g.day⁻¹, p=0.026) were increased from basal levels only when resistance exercise was combined with WP ingestion and not the NEAA control (NEAA MPS 0.072±0.004%h⁻¹, NEAA ASR 10.23±0.80 g.day⁻¹). Thus, ingestion of WP in combination with resistance training augments acute MPS responses in resistance trained young men.

**Conclusions** We have developed a translational model of muscle protein synthetic bioactivity using *in vitro, ex vivo* and *in vivo* methodologies. We have shown that we can impact MPS *in vitro* using *ex vivo* human serum to condition media, that MPS *in vitro* is differentially regulated by *ex vivo* serum containing bioactive WP compared to a non-bioactive NEAA control, and that this translates for resistance exercise combined with WP in humans when MyoFSR is measured using stable isotope technology. These experiments demonstrate that *ex vivo/in vitro* experiments translate to the *in vivo* model and these methods can be used to inform both exercise and nutrient human interventions.

**PL-029**

**Impact of PM2.5 Exposures and Pre-exercise on Pulmonary Function and Leukocyte Count in Aged Rats**

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**Objective** Exposure of PM2.5 has been associated with adverse respiratory and the risk of inflammation. While regular physical activity (PA) reduces the risk of many adverse health effects. This study aimed to examine the protection of pre-exercise on adverse health effects of Pulmonary Function and inflammatory induced by PM2.5 exposures in aged rats.

**Methods** 24 male wistar rats, aged 16 months, were randomly divided into 4 groups: Sedentary (S), Exercise (E), Sedentary+ PM2.5 exposures (S+PM), and Exercise+ PM2.5 exposures (E+PM). The rats in all E-related groups went through an aerobic treadmill exercise protocol (15m/min, 30 min) at every other day. The PM-related groups of aged rats were exposed to concentrated ambient particles of less than 2.5 μm (PM2.5) or filtered air (FA) in Beijing, for 4 hours per day, 7 days per week for a total of 2 weeks. After 2-week PM Exposure, blood was taken to measure the count of white blood cell (WC), neutrophil (NE), lymphocytes (LY), monocyte (MO), eosinophils (EO) and basophil (BA), and pulmonary function examined by whole body plethysmography.

**Results** After 2-week PM exposure, compared with E group, S+PM group’s percentage of NE decreased significantly (p<0.05), while the decline of NE% in E+PM group was small. Meanwhile, the obviously rise of BA% occurred in S+PM and E+PM group compared with sedentary group (p<0.05). 2) Compared with E group, the Index of constriction (Penh and PAU) were increased evidently in S+PM group after PM exposure (p<0.05), while the value of Penh were significantly improved in E+PM group (p<0.05). 3) Compared with E group, the rejection index (RinX) (p<0.01) and duration of pause before inspiration (TP) (p<0.05) were appeared a
clearly inclined in S+PM group, as well as several up-regulated of RinX and TP showed in E+PM group.

**Conclusions** 2-week PM2.5 exposures led to an increased susceptibility of infections, index of constriction and susceptibility of pulmonary function in aged rats. Moderate pre-exercise has beneficial effects on pulmonary function and immune function.

**PL-030**

Interactive effects of exercise and metformin on lactic metabolism in type 2 diabetes

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**Objective** Lactic acidosis is typically caused by an imbalance in lactic metabolism. This may be attributed to several reasons and is usually a result of complex interactions. There may be an increased risk for lactic acidosis in type 2 diabetes mellitus (T2D) patients when metformin treatment and physical exercise are combined since both metformin and exercise acutely affect lactic metabolism. As timing of exercise following metformin ingestion may determine the magnitude of long-term metabolic adaptations, this study aimed to test the acute effects of exercise performed at different times following metformin ingestion on lactic metabolism in T2D patients with a randomized crossover time series study design.

**Methods** Participants were recruited from two clinical health-care centers in China using a two-step screening procedure. First, approximately 2,523 patients with T2D were screened from the local diabetes database and clinical outpatient registration with inclusion criteria being men and women (30–65 years old) diagnosed with T2D no more than 5 years ago and treated with metformin (maximal daily dose of 2000 mg). Out of 100 potential participants who met the inclusion criteria, 56 were interested and invited to a laboratory visit. Finally, 34 patients participated in the study and of those, 26 patients (14 women and 12 men, mean age = 53.8 ± 8.6 years) completed all testing procedures.

All patients visited the laboratory on 4 occasions, each separated by at least 48 hours. Initially a control visit was performed and consisted of metformin administration only (Metf) and a maximal incremental cycle ergometer test in the afternoon. Thereafter, all participants performed a high-intensity interval training session (HIIT, 3 minutes at 40% followed by 1 minute of 85% of maximum power output) 30 minutes (EX30), 60 minutes (EX60), and 90 minutes (EX90) post breakfast and metformin administration, respectively, in a randomized order.

Serum lactate and glucose concentrations were assessed enzymatically, while insulin was assessed by an electrochemiluminescence immunoassay and superoxide dismutase (SOD) activity was determined by spectrophotometry. Measurements were performed before breakfast as well as both before and immediately after each exercise bout. In addition, capillary blood glucose concentrations were measured immediately after sampling using Omron AS1 glucose test strips (HGM-114) and lactate concentrations were assessed by ARKRAY Lactate Pro 2 test strips throughout each measurement day. Dietary intake was standardized on the evening prior to each laboratory day as well as between 8:00 a.m. and 4:00 p.m. during each testing day. This trial is registered with ChiCTR-IOR-16008469 on 13th of May 2016.

**Results** During all three-exercise sessions, the capillary lactate concentrations were significantly increased to a similar extent. However, sixty minutes following metformin administration, serum lactate levels began to accumulate to the highest level, where 30% of patients showed lactate concentrations above resting values (≥2 mmol·L⁻¹). The increased lactate concentrations were statistically associated with increased glucose when exercise was performed 60 minutes post metformin administration (r=0.384, p=0.048). Furthermore, in EX60 and EX90 lactate
concentrations were 19% and 8% higher, respectively, compared to EX30. In addition, we found that after exercise but not before exercise, the lactate level was positively correlated with SOD (EX30 $r=0.478$ and $p=0.012$, EX60 $r=0.562$ and $p=0.002$, EX90 $r=0.562$ and $p=0.003$, respectively).

**Conclusions** We found that the changes of lactate concentrations were related to the timing of exercise post meal and after metformin ingestion. Thus, timing of exercise appears to be an important factor to be considered when prescribing exercise for T2D patients treated with metformin. In the present study, the optimal timing of HIIT exercise was 30 minutes after metformin administration, which was indicated by a minimized fluctuation of both glucose and lactate levels in T2D patients. Our results also suggest that lactic metabolism and oxidative stress could be among the main underlying molecular mechanisms that elucidate the combinational therapy of exercise and metformin treatment on T2D. Since both acute exercise and metformin may induce opposite effects on ATP production and reactive oxygen species formation, it is important to conduct further studies in an attempt to define the “safe time” for exercise after metformin administration.

**PL-031**

Habitual swimming exercise induced partial resistance to rat Alzheimer’s disease

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**Objective** In MSSE, we have divided male 2.5-month-old Sprague-Dawley rats into the following 4 groups: control (C), habitual swimming (SW), Alzheimer's disease (AD) induction without swimming (AD), and habitual swimming and then AD induction (SA), and found the perfect resistance of habitual swimming to AD induction by using the P value statistics of the 5 behavior parameters of rats and the 23 physiological and biochemical parameters of their hippocampus. The topological difference of four groups were further calculated in this paper by using quantitative difference (QD) and self-similar approach.

**Methods** 1. The logarithm to base golden section $\tau$ (lt) is called golden logarithm. It was found that $\sigma=\text{lgt}=0.710439287156503$. 2. For a process from $x_1$ to $x_2$, $I(x_1,2)=\text{ltx}_2/x_1$ and its absolute vale are called the process logarithm and its QD, $QD(x_1,2)$. There are QD threshold values ($\alpha_x,\beta_x,\gamma_x$) of function $x$ which can be calculated in terms of $\sigma$. The function $x$ is kept to be constant if $QD(x_1,2) < \alpha_x$. A function in/far from its function-specific homeostasis is called a normal/dysfunctional function. A normal function can resist a disturbance under its threshold so that $QD(x_1,2) < \beta_x$. A dysfunctional function is defined as the QD is significant if $\beta_x \leq QD(x_1,2) < \gamma_x$ and extraordinarily significant if $QD(x_1,2) \geq \gamma_x$. 3. Self-similarity was studied in the fractal literature: a pattern is self-similar if it does not vary with spatial or temporal scale. First-order self-similarity condition leads to the power law between two data sets $A = \{x_i\}$ and $B = \{y_i\}$; $y_i = a_i x_i$ if the QD of $a_i$ and the average of $\{a_i\}$ is smaller than $\beta_{\text{min}}=\text{min}\{\beta_i\}$ and the average QD of $\{QD\}$ is smaller than $\alpha_{\text{min}}=\text{min}\{\alpha_i\}$. 4. The $\sigma$ algorithm for integrative biology was established based on high-order self-similarity. Those parameters that contribute to the topological difference were the biomarkers.

**Results** The 28 dimension data set consisted of all the 28 parameters. The first-order self-similarity held true for the 28 dimension data sets between groups C and SW. The topological algorithm of other groups suggested three AD biomarkers, protein carbonyl, granules density of presynaptic synaptophysin in the hippocampal CA1 and malondialdehyde intensity. The first two biomarkers were completely reversed by exercise pretreatment, but the third biomarker was partially reversed.
Conclusions  Exercise pretraining exerts partial benefits on AD that support its use as a promising new therapeutic option for prevention of neurodegeneration in the elderly and/or AD population.

PL-032  Heat Shock Proteins in human single skeletal muscle fibres resist age associated alterations and differentially respond to high-intensity exercise training

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Objective  Heat shock proteins (HSPs) are ubiquitously expressed proteins that help preserve cellular homeostasis. Within mammalian skeletal muscle three of the better characterised HSPs are HSP72, HSP27 and αB-crystallin. Among other roles, these three HSPs are involved in regulation of muscle mass and function and may be of importance in ageing. HSP’s are fibre-type dependent in rat skeletal muscle and thus examining these proteins in humans should be completed on the single fibre level, particularly in ageing where maladaptations primarily occur in Type II fibres. High-Intensity Training (HIT) is a commonly used method to improve muscle health and function in the elderly, but HSP adaptability to training has not yet been investigated.

Methods  This study examined isolated single muscle fibre segments collected from freeze-dried vastus lateralis muscle samples from young (25/-3 year old) and older (70/-4 year old) healthy individuals. A further sample was collected from the older individuals following 12 weeks of HIT, where they performed 4 x 4 min @ ~90-95% of peak heart rate (HR), with 4 min active recovery at 50-60% peak HR

Results  Basal expression of HSP’s in skeletal muscle: HSP70 tended to be higher in Type I fibres compared to Type II in young adults (p=0.08) and was higher in Type I compared to Type II fibres of older adults (p=0.03). HSP27 abundance was higher in Type I fibres compared to Type II in young adults (p=0.01) and tended to be higher in Type I compared to Type II fibres in older adults (p=0.07). The abundance of αβ-crystallin was more abundant in Type I fibres compared to Type II in both young and older adults (p<0.05). Preliminary data revealed that the abundance of pABCser59 and pHSP2782 displayed no fibre-type specific abundances in either young or older adults. Age effects on HSP’s: There was no difference in the abundance of HSP70, HSP27, ABC or pHSP2782 between young and older adults in either Type I or Type II fibres. There was an increase in the abundance of pABCser59 in Type I fibres in older adults compared to Type I fibres of young adults (p=0.03), with no difference in Type II fibres. Effects of HIT on HSP’s: HIT in the older individuals increased the abundance of HSP70 in Type I fibres (p<0.01) but not Type II. HIT tended to decrease the abundance of HSP27 in Type I fibres (0.92±0.66, p=0.06) and tended to increase the abundance of αβ-crystallin in Type I fibres (1.03±1.51 p=0.07).

Conclusions  These results revealed that in healthy, older individuals, the basal levels of HSP27, ABC or pHSP2782 are not different to those in young adults in either Type I or Type II fibres. This could indicate that the muscle from the older individuals was not compromised. Interestingly, in response to HIT there were varying changes between these HSP’s, and of note these occurred only in Type I fibres. Given that during HIT Type II fibres would be activated to a greater extent, it appears that the recovery phases of the HIT were most responsive to HSPs.
PL-033
A Metabonomic Study on the Urine of Rowing Athletes

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Objective To extract information that affect sport performance, the technique of urine metabolism and quantitative difference (QD) analysis were combined in search of the characteristic metabolites of the rowing athletes.

Methods Morning urine were collected in three consecutive weeks, main peaks of the ¹H NMR spectrum which have significant difference between the medalists and non-medalists were selected from thousands of one dimensional NMR hydrogen spectrum of urine. Pattern recognition method based on metabonomics combined with QD so that the metabolites which could reflect the competitive level of the elite athletes could be selected from the main components.

Results 1. The optimal principal component of rowing athletes were principal component 1 and 5 (PC1&PC5). 2. Results of 7-fold cross validation showed that the PLS-DA model were stable, reliable and has good prediction ability. Results of the repeatability experiment showed that sample test accuracy were above 85%. 3. N-methylnicotinamide was obtained by multi-criteria assessment methods as the characteristic metabolite. 4. Substance concentration related to aerobic and anaerobic metabolism were different in urine of the rowing athletes.

Conclusions The athletes' urine contains the information of sport performance. Metabonomics combined with QD analysis could be widely applied in the evaluation of rowing athletes' competitive ability. The role of nicotinic acid in regulating energy metabolism and protecting human body might be a necessary condition with which athletes could tolerate high strength training and competition.

PL-034
Effects of power resistance exercise and feeding on the expression of putative mechanosensing proteins in skeletal muscle of resistance-trained men

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Objective Power resistance exercise involves high intensity (load and velocity) dynamic muscular contractions and is frequently performed by athletes to enhance performance via improved muscle function. To investigate the remodelling processes that contribute to improved muscle function, we investigated the expression of putative mechanosensing genes implicated in this process (Kojic et al., 2011): titin-linked Muscle Ankyrin Repeat Protein (MARPs) family CARP, Ankrd 2 and DARP, and the Z-disc associated muscle-LIM protein (MLP) in healthy, resistance-trained men (n = 7) following 90 min of rest (Rest) or power resistance exercise, with (Ex + Meal) or without (Ex only) feeding during recovery.
Methods Percutaneous needle biopsy samples were obtained from the vastus lateralis of resistance-trained males using local anesthetic (2% Xylocaine), 3 h after performing each of the three experimental trials on separate days. Previously, we presented results from this study showing that the mRNA levels of CARP (~15-fold) and MLP (~2.5-fold) were upregulated in human skeletal muscle 3 h post power resistance exercise (Wette et al., 2012). Based on these results, we performed protein analyses on the same muscle samples to determine the protein levels of all MARPs and MLP in whole muscle homogenates after Rest, Ex only and Ex + Meal. To assess whether the exercise elicited a stress response in these resistance-trained individuals, the level of phosphorylated heat shock protein 27 at serine 15 (pHSP27-Ser15) was measured at Rest and 3 h after Ex only and Ex + Meal. The levels of pHSP27-Ser15 are typically upregulated 3 h after eccentric exercise in human skeletal muscle (Frankenberg et al., 2014).

Results The 90 min exercise session consisted of 180 intermittent muscular contractions at high intensity (70-96% maximal strength). Compared to Rest, there were ~5.8- and 12.6-fold increases in pHSP27-Ser15 levels at 3 h post Ex only and Ex + Meal (both P = 0.049, one-way ANOVA) respectively. CARP protein levels were elevated ~2.7-fold after Ex only (P = 0.049, one-way ANOVA) and ~7.6-fold after Ex + Meal (P = 0.326), due to markedly higher levels (6-40-fold) in three of the seven participants. Pearson correlation analysis revealed a significant positive correlation between the levels of pHSP27-Ser15 and CARP protein (r = 0.56, P = 0.008). Ankrd2, DARP and MLP protein levels were unchanged (all P > 0.05) following Ex only and Ex + Meal.

Conclusions These findings indicate that CARP is highly responsive to increased mechanical loading because the protein levels in skeletal muscle can be substantially increased as early as 3 h after stressful resistance exercise. This suggests a specialised role for CARP protein during the early phases of muscle remodelling that occur as a consequence of performing high intensity resistance exercise.
Oral Presentation
OR-001

Performance verification of Hitachi 7100 automatic biochemical analyzer detection system

Yongmei Wang
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Objective
To verify the analytical performance of the precision, accuracy, reference range, linearity and clinical portable range of Hitachi 7600 automatic biochemical analyzer. Ensure the accuracy of test results.

Methods
According to Clinical and Laboratory Standards Institute (CLSI) documents (EP5-A and EP6-A) to verify the analytical performance.

Results
The within precision was less than $1/4$TEa (Laboratory permissible total error), the day precision was less than $1/3$TEa, the accuracy was not more than $1/2$ TEa, the linearity and clinical portable range was within the manufacturer's standards.

Conclusions
The analytical performance of Hitachi 7600 automatic biochemical analyzer and supporting system is consistent with acceptable quality standards.

OR-002

Clinical observation of strengthened control training of knee joint on lower limb motor function in apoplexy patients

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Objective
On the basis of routine rehabilitation training for patients, increase the training of knee joint control, explore the effect of intensive knee joint training on the clinical efficacy of lower limb motor function in apoplexy patients, it can better improve the knee joint control ability of patients, improve the balance ability, stability and coordination of the patient's body, so that patients can recover quickly and reduce the burden on families and society.

Methods
Twenty-eight stroke patients who met the study criteria were randomly divided into treatment group and control group. Both groups of patients were treated with conventional rehabilitation. The treatment group was given strengthened control training of knee joint. The content of strengthened control training of knee joint includes bridge training, knee joint control training, and the ipsilateral lower limb weight bearing knee joint training. The training was done in 12 weeks. The lower limb function of the affected limb was assessed before and after treatment by the Berg balance scale (BBS), the daily life ability scale (MBI), the Fugl-Meyer scale (FMA). Among them, the BBS was used to assess the patient's balance ability, the MBI was assessed the ability of daily living activities, and the FMA was assessed the patient's athletic ability.

Results
(1) Compared with the BBS index score before treatment, there was no significant difference between the control group and the treatment group. After 12 weeks of rehabilitation treatment, the score of the balance function of the control group increased ($P<0.05$). The score of the function was also significantly improved ($P<0.05$). The scores of the balance function of the control group and the treatment group after treatment were significantly higher than those of the control group, with significant difference ($P<0.05$). (2) Compared with the FMA index score before treatment, there was no significant difference between the control group and the treatment group. After 12 weeks of rehabilitation treatment, the score of the control group was significantly improved after treatment ($P<0.05$). The scores after treatment were also significantly improved.
(P<0.05). Compared with the control group and the treatment group, the scores of the treatment group were significantly higher than those of the control group, with significant difference (P<0.05). (3) Compared with the MBI index score before treatment, there was no significant difference between the control group and the treatment group. After 12 weeks of rehabilitation treatment, the daily living ability score of the control group increased (P<0.05), and the daily life of the treatment group. The scores of life ability were also significantly improved (P<0.05). Compared with the control group and the treatment group, the MBI index scores in the treatment group were significantly higher than those in the control group (P<0.05).

**Conclusions** On the basis of routine rehabilitation training for patients, strengthened control training of knee joint can more effectively improve the balance of lower limb function in patients with cerebral apoplexy and enhance the stability and harmony of patients, improve the walking ability of patients.

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**OR-003**

**Time-sequential Changes of Myocardial AMPK and PGC-1α Expression during Detraining between High-intensity Interval Training and Moderate-intensity Continuous Training on Wistar Rats**

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Beijing Sport University

**Objective** Without appropriate training stimulus, the athlete experiences a loss of the physiological adaptations brought about by exercise. In most of highly trained athletes, short of training induces a rapid decline in VO$_{2\text{max}}$, but it remains above control values. However, there is no specific information for normal people about the effects of detraining during certain period aerobic training. Therefore, the purpose of this study was to examine the effects of detraining between high-intensity interval training (HIIT) and moderate-intensity continuous training (MICT) on myocardial AMPK and PGC-1α expression characterization time-sequential changes in Wistar rats, as well as the changing characteristics between AMPK and PGC-1α expression characterization and cardiopulmonary fitness (CRF). Moreover, the potential mechanism for exercise arrangement was also investigated.

**Methods** In this study, 27 four-month-old male Wistar rats were randomly divided into the sedentary control group (C), MICT group (M) and HIIT group (H). Animals in the training groups ran on a treadmill 5 days/week during 6 weeks. HIIT group (70%-90%-50%VO$_{2\text{max}}$) and MICT (50%VO$_{2\text{max}}$) group ran for 50 min exercise every training day. All the rats were free to gather the food and drinking water. All rats were measured the VO$_{2\text{max}}$ after a week adaptive training and then the M group and H group began to exercise intervention. After 6 weeks of training, rats were randomly selected from each group at the 24th, the 3rd day, the 7th day and the 10th day. The Maximal oxygen uptake test was carried out before the samples were taken, and the abdominal aortic blood, myocardium and other tissues were collected after anesthesia. The expression characterization of AMPK and PGC-1α was tested by Western blotting analysis. All statistical analyses were performed using SPSS 17.0 and GraphPad Prism 5.01 for Windows. Data was presented as mean and standard deviation (SD), unless otherwise stated. The two-way ANOVA (intervention × time) with repeated measures were used to analyze differences of HIIT and MICT with time-sequential. One-way ANOVA was used to compare the difference between time-sequential among the groups for each variable. The relationship between variables was assessed using the Pearson correlation coefficient. The expression characterization of the detraining effect was also assessed using Cohen’s d effect sizes (ES) and thresholds (<0.5=small; 0.5~0.79=moderate;≥0.8=large). The level of significance was set at P<0.05 and the confidence intervals at 95%.
**Results**

VO$_{2\text{max}}$ showed a gradual downward trend in both H and M groups throughout the 10 days detraining periods. Detraining in the 10$^{\text{th}}$ day, training cessation resulted in the VO$_{2\text{max}}$ of H and M group were significantly lower than detraining 24h. (P<0.05). Detraining in 3$^{\text{rd}}$ day, myocardial AMPK and PGC-1α increased in H group, it was significantly higher than the C group (P<0.05), but there is no differences in the other detraining days(P>0.05). Furthermore, detraining in the 7$^{\text{th}}$ day myocardial PGC-1α decreased in H group, this value was significantly lower than detraining 24h (P<0.05). Detraining in 7$^{\text{th}}$ day, myocardial AMPK and PGC-1α started decreasing, but it was not significant than C group or other detraining days (P>0.05).

**Conclusions**

(1) The present data suggest that 6 weeks HIIT and MICT can increase the expression of myocardial AMPK and PGC-1α, the VO$_{2\text{max}}$ training effects disappeared after 10 days detraining. (2) Detraining during the 3$^{\text{rd}}$ day and the 7$^{\text{th}}$ day was the critical time point for retraining, endurance training intervention should be arranging among these days. (3) The VO$_{2\text{max}}$ time-sequential changes was partially consistent with AMPK and PGC-1α expression characterization, but AMPK and PGC-1α expression characterization was more sensitive than VO$_{2\text{max}}$.

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**OR-004**

**Changes in serum indexes of obese adolescents induced by closed weight loss summer camp**

chunyan li, Caifeng Mao, Lei Xu, Feihu Feng  
Wuhan Sports University

**Objective**

A series of experiments were conducted to explore the changes of some serum indexes in obese adolescents induced by closed weight loss summer camp.

**Methods**

The 12 to 18 year old obese adolescents (BMI ≥ 28), who volunteered to participate in the Haoqian summer camp, were selected for 4 weeks of closed summer camp. The main activities of the summer camp included compound exercise (aerobic exercise + resistance exercise, 3 times / day, 6 days / week), Dietary intervention, fun activities and health knowledge lectures. In order to explore the changes of serum indexes of obese adolescents, glycolipid metabolism index, fatty acid components, inflammatory factors and oxidative stress markers were analyzed before and after 4 weeks.

**Results**

(1) The 4 week weight loss summer camp had no significant effect on blood sugar, but it can obviously reduce the level of serum total cholesterol, triglyceride and low density lipoprotein cholesterol, and significantly improve the abnormal lipid metabolism.

(2) The level of serum total saturated fatty acid (P < 0.05), total monounsaturated fatty acid (P < 0.01) and total polyunsaturated fatty acid (P < 0.05) in obese adolescents were decreased significantly in the 4 week weight loss summer camp.

(3) The 4 week weight loss summer camp significantly reduced serum inflammatory factors IL-6 and TN F- alpha in obese adolescents, increased the level of adiponectin per body fat mass (P < 0.05), and relieved the inflammatory state of the body.

(4) After 4 weeks weight loss summer camp, the serum total antioxidant capacity T-AOC, antioxidant enzyme catalase CAT, superoxide dismutase SOD and glutathione peroxidase GPx activity in obese adolescents were significantly enhanced (P < 0.05); oxidative damage markers 8-iso-PGF2α, 8-OHdG, and MDA levels were not significantly changed (P > 0.05), while protein oxidation product protein carbohydrate PC content decreased significantly (P < 0.05).

**Conclusions**

4 weeks weight loss summer camp can significantly alleviate the body's lipid metabolism abnormalities, change the serum fatty acid components, reduce the body's inflammatory state, enhance the body's antioxidant capacity, and reduce the body's oxidative damage.
OR-005
Effects of HIIT and MICT for 10 weeks on myocardial AMPK and PGC-1α in rats

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Objective: The improvement of cardiorespiratory fitness (CRF) is known as an effective strategy for prevention cardiovascular risk. Myocardial aerobic oxidation which control by the signal way of adenosine monophosphate -activated protein kinase (AMPK)- peroxisome proliferators γ activated receptor coactivator-1-α (PGC-1α) is the key for CRF. Previous studies only discuss the effect of the Moderate-Intensity Continuous Training (MICT) and High Intensive Interval Training (HIIT) on the signal way of AMPK-PGC-1α in skeletal muscle but not in the myocardium. The aim of this study was to compare the effects of 10 weeks HIIT and MICT on the expression of AMPK and PGC-1α in the myocardium of wistar male rats.

Methods: Wistar male rats (n=30) aged 6 weeks were randomly divided into HIIT or MICT or control (CON) group. The training groups ran on a treadmill 5 days/week for 10 weeks. HIIT group ran six times 3 minutes (0° slope) 90% of Vmax separated by 3 minutes 50% of Vmax and MICT group ran for 50min (0° slope) at 60–70% of maximal speed (Vmax). The expression of AMPK and PGC-1α were assessed by Western Blotting.

Results: After 10 weeks training, HIIT and MICT both increased the AMPK and PGC-1α expression compared with the CON group. Compared with the MICT group, the expression of AMPK and PGC-1α were significantly higher than the HIIT group (p<0.05). AMPK in MICT group were significant increased 1.16 times, and in HIIT group were significant increased 1.28 times to CON (P<0.05). PGC-1α level of HIIT was significant increased to 1.32 times to CON and also significant increased to 1.15 times to Group M (P<0.05); PGC-1α level of MICT was significant increased to 1.15 times to CON.

Conclusions: HIIT seems to improve myocardial AMPK and PGC-1α more efficiently than MICT in rats after 10 weeks training.

OR-006
Effect of Moderate-intensity Exercise on the Expression of Hypothalamic KiSS-1 and GPR54 mRNA in Diet Induced Obesity Rats

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Objective: To observe the effect of high fat diet on the hypothalamic expression of KiSS-1 and the G-protein coupled receptor (GPR) 54 mRNA and explore the modulatory role of moderate-intensity exercise in the diet induced obesity male rats.

Methods: After 8 weeks high fat feeding, 20 obesity 11-weeks SD rats were randomly assigned to high-fat diet sedentary (FS, n=8) and high-fat diet exercise (FE, n=8) groups, 20 normal diet 11-weeks SD rats also were randomly assigned to sedentary (SS, n=8) and exercise (SE, n=8) groups. During the following 8 weeks, obesity rats were continued expose to high-fat diet. SE and FE groups did the 60%-70% V(•)O₂max treadmill training (5 days/week, 1 hour/day). The V(•)O₂max of exercise groups were remeasured every two weeks. The hypothalamic expression of KiSS-1 and GPR54 mRNA were tested in each group.
Results After the first 8-weeks high fat feeding, the obesity rats were heavier than normal diet group (491.74±26.19g vs. 410.05±45.77g, p<0.01). After 8-weeks training, the FE group was lighter than FS group (590.23±35.74g vs. 681±52.56, p<0.01). The FS group had higher hypothalamic expression of KiSS-1 mRNA (1.51±0.66 vs 0.75±0.27, p<0.05) and GPR54 mRNA (2.45±0.38 vs 0.61±0.15, p<0.01) than SS group. The FE group had lower hypothalamic expression of KiSS-1 mRNA (0.69±0.13, p>0.05) and GPR54 mRNA (0.58±0.10, p<0.01) than FS group.

Conclusions There is stimulating effect of high-fat diet induced obesity on hypothalamic expression of KiSS-1 and GPR54 mRNA. 8-weeks 60%-70%V(•) O2max treadmill training could cure this effect.

OR-007
Identification of Early Predictive Biomarkers for Exercise-induced Immunodepression by Urinary iTRAQ-proteomic Analysis

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Objective Exercise-induced immunodepression is a common medical problem in competitive sports, leading to upper respiratory tract infection, affecting sports training and sports performance, and increasing athletes’ sports disease and injury risk. Finding non-invasive early predictive biomarkers of exercise-induced immunodepression and giving corresponding preventive measures is therefore an important issue in sports training. iTRAQ is an important method that currently looking for and discovering disease-specific protein biomarkers of disease prevention, diagnosis, prognosis, and efficacy monitoring. In this study, early predictive biomarkers of exercise-induced immunodepression will be identified through the iTRAQ proteomics technique, which helps to prevent the occurrence of exercise-induced immunodepression.

Methods Fifteen healthy males were recruited from the student cohort of Guangzhou Sport University. Subjects performed four-week incremental load running exercise. The weekly running load intensity was 60% VO2max, 70% VO2max, 80% VO2max, 90% VO2max respectively, 5d/w, and 1h/d. The fasting venous blood and urine of the subjects was collected in the morning before the start of the training intervention and at the end of each training week. The white blood cells of the whole blood and the levels of the lymphocyte subtypes CD4+ and CD8+ were tested to monitor the immune function status of the subjects. iTRAQ proteomics technology was used to test and identify differential proteins and their characteristics in urine.

Results During the four weeks of increasing running load, the subject’s immune function was progressively reduced. Whole blood white blood cells, and CD4+ and CD8+ lymphocyte fell by more than 10% at the end of the fourth week, showing exercise-induced Immunodepression. Using iTRAQ to test urine proteomes, there were as many as 1854 proteins in the urine during the incremental loading process. The relative molecular weights of most of the proteins were between 10-80 kDa, and the isoelectric point was between 4.5 and 7. During the four weeks of incremental loading running, there were 89, 52, 77, and 148 differential proteins up-regulated, and 66, 27, 68, and 114 differential proteins downregulated respectively in the urine of each week. The differential proteins were mostly found in extracellular and plasma membranes. It is mainly involved in the in vivo biological process, the immune system process, the material transport, and is related to the positive regulatory pathways and immune regulatory pathways for stress response. The up-regulation multiples of four up-regulated proteins such as Semenogelin-1, Prolactin-inducible protein, Platelet-derived growth factor receptor-like protein, and Nucleoside
diphosphate kinase increased with increasing exercise intensity. The up-regulated multiples of Glycerol-3-phosphate phosphatase, Secretogranin-1, Prosaposin, and Nephronectin (Fragment) increased with increasing exercise intensity from the second week of exercise. The down-regulation multiples of Ig kappa chain C region, Immunoglobulin lambda variable 3-21 of CUB and EGF-like domain-containing protein 2 and Uromodulin decreased further with the increase of exercise intensity from the second week of exercise, which was consistent with the change of immune function.

**Conclusions** Urine iTRAQ proteomics technique is an important method to identify early predictive biomarkers of exercise-induced immunodepression, which helps to prevent the occurrence of exercise-induced immunodepression. In this study, the differential proteins in urine, such as Semenogelin-1, Prolactin-inducible protein, Platelet-derived growth factor receptor-like protein, and Nucleoside diphosphate kinase can be considered as early predictive biomarkers of exercise-induced immunodepression.

**OR-008**

**ERK-BAX signaling is involved in GLP-1-mediated antidepressant effects of metformin and exercise in CUMS mice**

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**Objective** Both depression itself and antidepressant medication have been reported to be significantly related to the risk of type 2 diabetes mellitus (T2DM). Glucagon-like peptide-1 (GLP-1), a treatment target for T2DM, has a neuroprotective effect. As an enhancer and sensitiser of GLP-1, metformin has been reported to be safe for the neurodevelopment. The present study aimed to determine whether and how GLP-1 mediates antidepressant effects of metformin and exercise in mice.

**Methods** Male C57BL/6 mice were exposed to chronic unpredictable mild stress (CUMS) for 8 weeks. From the 4th week, CUMS mice were subjected to oral metformin treatment and/or treadmill running. A videocomputerized tracking system was used to record behaviors of mice for a 5-min session. ELISA, western blotting and immunohistochemistry were used to examine gene expression in mouse serum or hippocampus.

**Results** Our results supported the validity of metformin as a useful antidepressant; moreover, treadmill running favored metformin effects on exploratory behaviors and serum corticosterone levels. CUMS reduced GLP-1 protein levels and phosphorylation levels of extracellular signal-regulated kinase 1/2 (ERK1/2), but increased protein levels of B-cell lymphoma 2-associated X-protein (BAX) in mice hippocampus. All these changes were restored by both single and combined treatment with metformin and exercise.

**Conclusions** Our findings have demonstrated that ERK-BAX signaling is involved in GLP-1-mediated antidepressant effects of metformin and exercise, which may provide a novel topic for future clinical research.
OR-009
The expression and roles of IncRNAs in the regeneration of skeletal muscle contusion

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Objective In recent years, Accumulating evidence from myoblast differentiation in vitro, cardiotoxin (CTX)-mediated injury or mdx mice suggested that some IncRNAs such as Malat1, H19, linc-MD1, linc-YY1, Sirt1 AS and Inc-mg may modulate myogenesis and muscle regeneration. However, the change of IncRNAs in skeletal muscle contusion and their possible roles are still unclear. We hypothesize that the IncRNAs may be involved in the repair of skeletal muscle contusion.

Methods Forty C57BL/6 male mice were randomly divided into two groups, uninjured control group (group C) and muscle contusion group (group S). The mice of group S suffered from contusion injury. All the mice were killed to harvest gastrocnemius at 3, 6, 12 and 24 days post-injury. The gene expression were detected by PCR technique. Gastrocnemius were stained with H & E to evaluate the general morphology. Data were analyzed by One-way analysis of variance, with statistical significance being set at \( p \leq 0.05 \).

Results The expression levels of linc-MD1 and Sirt1 AS were significantly higher than that of the uninjured control group at 3, 6 and 12 days post-injury \( (p<0.01) \). And Malat1 was highly expressed in the skeletal muscle of the muscle contusion group at 3 days post-injury and continuously up-regulated at 6 days \( (p<0.01) \). Moreover, linc-YY1 and H19 were all elevated significantly at 6 days \( (all \ p<0.01) \), but their gene expression levels did not change significantly at 3, 12 and 24 days post-injury, as compared to the uninjured control group. Furthermore, Inc-mg mRNA level did not change significantly in the whole process of regeneration after muscle contusion except the time point of 12 days post-injury which decreased significantly \( (p<0.01) \). The expression of myogenic regulatory factors (MyoD, myogenin, myf5, myf6) were studied, they were all elevated significantly at 3 and 6 days \( (all \ p<0.01; except \ myogenin ) \), and returned to normal at 24 days post-injury, as compared to the uninjured control group. Meanwhile, Pearson correlations showed that there was an correlation between lincRNAs and myogenic regulatory factors mentioned above.

Conclusions The expression of myogenic regulatory factors increased significantly after muscle contusion. Meanwhile, varieties of IncRNAs (Malat1, H19, Inc-mg, linc-MD1, linc-YY1, Sirt1 AS) were also up-regulated. Moreover, there was correlation between IncRNAs and myogenic regulatory factors for skeletal muscle regeneration. These results suggest that IncRNAs may play important roles in the regeneration of skeletal muscle contusion.

OR-010
The potential role of MG53 in exercise-mediated modulation of diabetic cardiomyopathy in db/db mice

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Objective Diabetic cardiomyopathy is a major complication of Type 2 diabetes. Recent studies have shown that as an E3 ligase targeting insulin receptor (IR) and insulin receptor substrate 1 (IRS1), MG53 could result in insulin resistance and metabolic disorders. However, it is still to be investigated whether MG53 plays a role in the pathogenesis of diabetic cardiomyopathy, as well as whether the effect of exercise intervention on diabetic cardiomyopathy is mediated by MG53.
Methods 20 db/db mice and 20 m/m mice were randomly assigned to Groups DC (db/db control, N=10), DE (db/db exercise, N=10), MC (m/m control, N=10) and ME (m/m exercise, N=10). The mice of Groups ME and DE were trained to run on the treadmill for 12 weeks in total. For the first week, the mice ran for 20min at 7-13m/min, four times a week. Since the second week, the mice were trained to run at 13.3m/min, 6d/wk, and the running duration was increased from 30-45min/d for Week 2 to 1h/d since the third week. At the end of the intervention period, IPGTT and IPITT were performed to determine the exercise training. The mice were then euthanized and the heart was removed. Real-time PCR and Western blotting were performed to determine the expression levels of mRNA and proteins.

Results According to the result of IPGTT and IPITT, glucose concentration was significantly higher in DC compared to MC, and exercise intervention significantly decreased the glucose level of diabetic mice. Heart weight to tibia length ratio was not significantly different between MC and DC, but was higher in DE than in DC. As expected, the mRNA expression of MG53 was significantly higher in the diabetic mice, and was significantly decreased by exercise training. However, the protein level of MG53 was not significantly different between MC and DC, even though exercise intervention caused lower MG53 protein level in DC. The protein level of p-IR-β (Tyr1146) was significantly higher in DC than in MC. Exercise intervention significantly decreased the protein level of p-IRS1 (Ser1101) in both the lean and diabetic mice. Diabetes caused a significant decrease in p-AKT (Ser473), while exercise training increased the protein level of p-AKT (Ser473) in the diabetic mice. The mRNA expression of Ppargc1a, Cpt1b, Acadm, Acadvl, Acacb and Aca2 were significantly increased in DC compared to MC, suggesting that fat metabolism was enhanced in the hearts of diabetic mice. To the contrary, the enhanced fat metabolism was compromised by exercise intervention, as revealed by the mRNA expression level of Cpt1b, Acadm, Acacb and Aca2. Besides, the mRNA expression of Pdk1 and Pdk2 were significantly increased in db/db mice, suggesting that glucose metabolism was reduced by diabetes. PPAR-α is an important regulator of fat metabolism. The protein level of PPAR-α was significantly increased in DC compared to MC, and was decreased in DE compared to DC. Besides, the mRNA expression of key components of PPAR-α pathway, including Cd36, Ppargc1b and Fabp3 were all significantly increased in db/db mice, while exercise intervention significantly decreased the mRNA expression of Cd36 and Ppargc1b.

Conclusions MG53 is involved in the pathogenesis of diabetic cardiomyopathy of db/db mice by inhibiting insulin signaling, downregulating glucose metabolism and promoting fat metabolism. The state of insulin resistance and alteration of substrate utilization brought by diabetes could be improved by 12 week treadmill training, partly through the regulation of PPAR-α pathway.

OR-011
Effect of Aerobic and Resistance Exercise on TGF-β1/Smad3 Signal Pathway and Collagen in Skeletal Muscle of Aging Mice

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Objective The purpose of this study was to investigate the effects of TGF-β1/Smad3 signaling pathway and its downstream factor CTGF in collagen dPosition and its molecular mechanism. And then it explored further the effect of exercise on the TGF-β1/Smad3 signaling pathway and collagen dPosition in skeletal muscle. Therefore, it is expected to provide alternative exercise intervention approaches for skeletal muscle diseases, which are caused by age-related changes of collagen, and to provide new research perspectives for skeletal muscle satellite cell activation and skeletal muscle regeneration.
Methods 21 male BALB/c mice were normally raised from 4 weeks to 36 weeks under standard conditions. The mice was divided randomly into three groups, including: group C, the quiet control group; Group A, the aerobics training group, received nine weeks of treadmill training without loading; And the group R, the resistance training group, received nine weeks of climbing training with loading. The body weight and limb grip of the mice were measured on regularly during the experiment. After 24 hours of the last intervention experiment, the mice were weighed and then executed by dislocating the cervical spine. The quadriceps were taken. Real-time PCR technology was used to detect the mRNA levels of TGF-β1, TβR I, Smad 3, CTGF, Pax7, COL1 and COL3. Western blotting technique was used to detect the protein levels of TGF-β1, Smad3, P-Smad3, CTGF, COL1, COL3, Pax7 and MyoD. The dPOsition of collagen in the quadriceps muscle tissue of mice was detected by Sirius red staining. And the localization and expressions of COL1 and Pax7 in the quadriceps of mice were demonstrated by immunohistochemistry and immunofluorescence technology respectively.

Results
(1) Compared with group C, the weight of mice in group A was significantly increased (P<0.05), and the ratio of the wet weight of the quadriceps and the body weight of the mice increased significantly (P<0.05), while there was no significant change on the limbs relative grip strength. Compared with group C, the body weight of mice in group R showed a certain degree of increase but no significant difference, the ratio between the wet weight of the quadriceps and the body weight of the mice was significantly increased (P<0.01), and the limbs relative grip strength was significantly increased (P<0.05).

(2) Compared with group C, there was no significant difference in the mRNA and protein expression of COL1 and COL3 in the quadriceps of mice in group A, and there was no significant change in collagen volume fraction. Compared with group C, the mRNA and protein expression of COL1 and COL3 in the quadriceps of group R were significantly decreased (P<0.05), and collagen volume fraction significantly reduced (P<0.05), and collagen dPOsition decreased.

(3) Compared with group C, the mRNA level of CTGF and the protein level of TGF-β1 and CTGF in quadriceps tissues of mice in group A were significantly decreased (P<0.05). While the protein levels of Smad3 and p-Smad3 and the ratio of Smad3 and p-Smad3 had no significant change. Group R is compared with group C, the mRNA level of TGF-β1, TβR I and CTGF in quadriceps were significantly decreased (P<0.05); the mRNA levels of Smad3 and the protein levels of TGF-β1 and p-Smad3 were significantly decreased (P<0.01); and the protein levels of Smad3 and CTGF and the ratio of Smad3 and p-Smad3 were also significantly decreased (P<0.05).

(4) Compared with group C, the mRNA and protein expression of Pax7, and the protein expression of MyoD in the quadriceps of group A showed no significant difference. But group R is compared to group C, the expression of Pax7 mRNA in the quadriceps was significantly increased (P<0.01), and the expression of Pax7 protein was also significantly increased (P<0.05), while the protein expression of MyoD did not change significantly. Compared with group A, the mRNA levels of Pax7 in the quadriceps of the R group was significantly increased (P<0.05), but the protein expression of Pax7 and MyoD showed no significant change.

Conclusions
(1) Through 9 week resistance or aerobic exercise training, skeletal muscle mass index in mice increased significantly; and the resistance exercise training can improve the limbs relative grip strength to prevent sarcopenia.

(2) 9 week resistance exercise training can inhibit TGF-β1/Smad3 signaling pathway, affect the gene expression of COL1 and COL3, inhibit collagen synthesis, and improve collagen dPOsition.

(3) 9 weeks of resistance exercise training can effectively promote Pax7 gene expression, activate skeletal muscle satellite cells and promote its proliferation.

(4) The effect of 9 week of resistance exercise training on the improvement of skeletal muscle mass, strength, collagen dPOsition and the activation of satellite cells was significantly better than that of aerobic exercise.
OR-012

The Regulation of NF-κB-TNF-α/IDO/5-HT Axis by Aerobic Exercise against Hippocampal Neuroinflammation in CUMS Depressive Mice

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Objective To study the effect of aerobic exercise on the anti-chronic stress depression and the key metabolic enzymes indoleamine 2,3 peroxidase (IDO) of tryptophan and kynurenine pathway.

Methods Adopt the method of random numbers to make depression modelling for mice with 1 or 2 kinds of stimulating factors for 28 days in view of the 13 kinds of chronic stress stimulation. Collect and analyse motionless time for FST and TST of mice by using the Noldus EthoVision XT9 system. Test the serum factor level of laboratory mice with Cusabio imported IDO, NF-κB and TNF-α kit. Make real-time fluorescent quantitative PCR verification of the mRNA expression and protein expression level of IDO, 5-HT, NF-κB and TNF-α in hippocampus.

Results After 4 weeks of chronic stress stimulation, the motionless time for FST and TST of mice in the Model Group obviously prolonged (p<0.05). The bioactivity of IDO, NF-κB and TNF-α in hippocampus increased. The mRNA expression of IDO, NF-κB and TNF-α in hippocampus increased, while the mRNA expression of 5-HT decreased (p<0.01). Aerobic exercise can shorten the motionless time of mice, inhibit the activity of IDO, NF-κB and TNF-α, reduce the mRNA expression quantity of IDO, NF-κB and TNF-α and enhance the expression of 5-HT.

Conclusions Aerobic exercise has an antidepressant effect on mice for chronic stress depression, which is related to the IDO activation induced by inhibit inflammatory cytokines. Aerobic exercise may inhibit the NF-κB to reduce the pathway of tryptophan and kynurenine, affect the direct and indirect induced effect of IDO, and adjust its activity and expression.

OR-013

ONE YEAR OUTDOOR AND DAYTIME AEROBIC DANCE PRACTICE INCREASED SERUM 25(OH)D3 AND PTH, BUT DECREASED FSH LEVEL OF POSTMENOPAUSAL WOMEN

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Objective Vitamin D deficiency is widespread in postmenopausal women. It is verified that Vitamin D₃ supplementation intake can improve the Vitamin D₃ level of those Vitamin D deficiency patients. In addition to the exogenous intake, whether aerobic exercise plus sunshine could affect vitamin D level in postmenopausal women gained our attention.

Methods 16 postmenopausal women in Shanghai attended this test. They voluntarily participated in a one year aerobics plan, practicing Chinese traditional dance outdoor under sunshine for one hour from 9:30-10:30 am each day. Before and after one year practice, serum 25(OH)D, 25(OH)D₃ and estradiol E₂, follicle stimulating hormone(FSH), luteinizing hormone(LH), parathyroid hormone(PTH) of all participants were analyzed.
Results Before aerobics practice, serum 25(OH)D and 25(OH)D3 levels were 16.30±4.12(ng/ml) and 15.60±3.79(ng/ml). After one year practice, the data were significantly increased 19.50% (P=0.002) and 18.78% (P=0.002), separately. Before aerobics practice, the state of 25(OH)D level of 13 women was inadequacy (≤20.0ng/ml), 3 women was in lack status (20-30ng/ml). After one year practice, 9 women was inadequacy, 7 women in lack. The value of the chi square test was 4.747(P=0.029). After one year practice, serum PTH significantly increased, while FSH significantly decreased. E2 and LH had no significant variance before and after one year of aerobics practice.

Conclusions One year aerobics practice under sunshine could increase serum 25(OH)D level, and affected estrogen levels variably in postmenopausal women.

OR-014
Chronic exercise potentiates anorectic effects of leptin in hypothalamic Pomc neurons

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Objective Chronic imbalance of energy homeostasis leads to obesity and metabolic mellitus, which has developed as a major public health and economic burdens around the world. Disruption of “beige” fat mediated thermogenesis and hypothalamic neurons manipulated energy intake exaggerate this process. Multiple factors including hormonal regulation, fuel availability, and behavior contribute to energy utilization. The central nervous system (CNS) is critical for regulating energy balance and coordinating whole body metabolism. In the CNS, proopiomelanocortin (Pomc) neurons receive and integrate information about energy availability via responding to circulating hormones including insulin, leptin. Previous studies revealed that leptin receptors (LepRs) in arcuate Pomc neurons are required and sufficient for the proper regulation of energy balance and glucose homeostasis, including systemic insulin sensitivity and hepatic glucose production.

Exercise is an effective lifestyle intervention to combat obesity and metabolic diseases, which exerts many health benefits, including weight maintenance, appetite control, improved insulin sensitivity, improved mental health, and secondary prevention of chronic diseases such as obesity, type II diabetes mellitus, cancer, and hypertension. Moreover, the combined efficacy of exercise and dietary regimens on type two diabetes can surpass that of pharmacological interventions alone. Previous efforts aimed at identifying molecular mechanisms underlying the adaptive responses to exercise have mainly focused on the effects of exercise training in an organ or cell autonomous manner. However, the impact of exercise on performance, food intake after exercise, and more broadly, the healthy metabolic outcomes of exercise is not well-established. Despite the increased understanding of the importance of CNS underlying metabolic homeostasis, the specific neuronal groups and pathways that contribute to the metabolic responses during and following exercise remain largely unclear. In the current study, we aimed to investigate the role of exercise in mediating hypothalamic Pomc neuron activity, anorectic effects of leptin and glucose tolerance as well as insulin sensitivity.

Methods All mice were housed under standard laboratory conditions (12 h on/off; lights on at 7:00 a.m.) and temperature-controlled environment with food and water available ad libitum. All experiments were performed in accordance with the guidelines established by the National Institute of Health Guide for the Care and Use of Laboratory Animals.

Slice preparation and whole-cell recordings
Male mice were deeply anesthetized with i.p. injection of 7% chloral hydrate and transcardially perfused with a modified ice-cold artificial CSF (ACSF) (described below). The mice were then
and in vitro. Furthermore, gene assay demonstrated an upregulation of sirtin1 after exercise, leptin-induced dPOlarization of Pomc neurons and exerts leptin-induced anorectic effects in vivo. 

Leptin (100 nM) was added to the ACSF for specific experiments. Solutions containing drug were typically perfused for 5 min. A drug effect was required to be associated temporally with peptide application, and the response had to be stable within a few minutes. A neuron was considered dPOlarized or hyperpolarized if a change in membrane potential was at least 2 mV in amplitude. Neurons were voltage-clamped at −75 mV (for excitatory postsynaptic currents) and −15 mV (for inhibitory postsynaptic currents). Frequency and peak amplitude were measured by using the Mini Analysis program (Synaptosoft, Inc.)

Exercise protocols
Motorized treadmills (Exer-6; Columbus Instruments, Columbus, OH) were used for exercise experiments. All mice were familiarized to the treadmills for 7 days prior to the exercise bout [Day 1: 5 min rest on the treadmill followed by running for 5 min at the speed of 8 m/min and then for 5 min at the speed of 10 m/min; Day 2-3: 5 min rest on the treadmill followed by running for 5 min at the speed of 10 m/min and then for 5 min at the speed of 12 m/min; Day 4-7: 5 min rest on the treadmill followed by running for 60 min at the speed of 12 m/min]. On Day 8, mice were subjected to a high intensity interval exercise (HIIE) bout to assess exercise-induced changes in plasma leptin, blood glucose, and food intake. Briefly, food was removed from all the mice at the start of the light cycle (7 AM) for a duration of 6 h, so as to eliminate any differences in food intake on the measured parameters. Mice were rested on the treadmill for 5 min prior to performing the 1 h of exercise consisting of 3 × 20 min intervals (5 min at the speed of 12 m/min, followed by 10 min at the speed of 17 m/min, and then 5 min at the speed of 22 m/min), without rest between intervals.

Tolerance test and food intake
For GTT, mice fasted for 16 h received an intraperitoneal injection of glucose (1 g/kg). For ITT, mice fasted for 6 h received an intraperitoneal injection of human insulin (0.75 IU/kg). Blood glucose concentrations were measured from tail blood at the indicated times using a One-Touch Ultra® glucometer (LifeScan Inc., Milpitas, CA). Food intake was measured hourly for 6 hours and then a single measurement at 24 hours.

Results To assess the predominant role of exercise on the neuronal activation of hypothalamic Pomc neuron, electrophysiology studies was conducted on transgenic mice after treadmill habitation for 7 days. And we found that exercise significantly reduced food intake and enhanced glucose tolerance as well as insulin sensitivity. Notably, chronic exercise dramatically potentiates leptin-induced dPOlarization of Pomc neurons and exerts leptin induced anorectic effects in vivo and in vitro. Furthermore, gene assay demonstrated an upregulation of sirtin1 after exercise,
suggest--ing a link between the exercise and key proteins involved in epigenetics, providing potential targets for the treatment of metabolic disease.

**Conclusions** Our results demonstrated chronic exercise potentiates anorectic effects of leptin in hypothalamic Pomc neurons. Moreover, these data provide evidence for sirtin1 as a substrate of exercise to regulate food intake and glucose tolerance as well as leptin sensitivity via activating Pomc neurons.

**OR-015**

The changes of p-Akt/MuRF1 proteins expressions in rats’ soleus muscle following three preconditioning exercise under simulated acute microgravity

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**Objective** To observe the effect of three training ways, aerobic training, resistance training and aerobic combined with resistance training on cross-section and p-Akt/MuRF1 proteins expressions in rats’ soleus under simulated acute microgravity, the purpose of this study was to explore its roles in preconditioning exercise and the appropriate training methods to prevent the muscle atrophy in acute microgravity.

**Methods** 32 male SD rats (aged 6 wk) were randomly distributed into four groups: control group (CON, n=8), aerobic training group (AER, n=8), resistance training group (RES, n=8) and aerobic combined resistance training group (ACR, n=8). The training groups were trained once every other day, while CON was not trained. Rats in AER trained on an animal treadmill with the 0° at the speed of 35 m/min for 45 minutes. The rats in AER were trained by running resistance method, loaded with 50% of its weight in the tail of the rat, each training section included 4-repetition of 15-second 35° climbing on treadmill at the speed of 15 m/min, with the interval of 30 seconds between repetitions, and 3 minutes between sections, each circle comprised 3 sections, and 2 circles at a time. The rats of ACR were requested to carry out an aerobic training(25min) and a resistance training(1 circles) in training day. After 6 wk training, all rats were under the simulated acute microgravity (hindlimb suspension), the 6th-day soleus muscles were excised and muscle cells cross-section area(CSA) were observed, and p-Akt/MuRF1 proteins expressions were analyzed by Western blot.

**Results** 1) After 5 days of acute microgravity stimulation, the CSA of soleus muscles of rats in the three training groups were larger than those in CON, and RES and ACR have statistical significance ($P<0.05$, $P<0.01$). In three training models, ACR was significantly greater than the aerobic training group and resistance training group ($P<0.05$), and RES was significantly greater than AER ($P<0.05$).

2) Compared with CON, the p-Akt protein expression in the soleus muscle of rats in AER was significantly decreased ($P<0.01$), while it was increased in both RES and ACR, and in ACR increased significantly ($P<0.01$). Among the three training methods, the p-Akt proteins expressions in the soleus muscle of rats in ACR was significantly higher than AER ($P<0.01$) and RES ($P<0.05$).

3) Compared with CON, the MuRF1 proteins expressions in soleus muscle of rats in ACR are not significantly change ($P>0.05$), while AER and RES increased significantly ($P<0.01$, $P<0.05$). At the same time, the MuRF1 proteins expressions in soleus muscle of rats in AER and RES is significantly higher than ACR ($P<0.01$), and AER is significantly higher than that RES ($P<0.01$).

**Conclusions** Three training models have certain effects on preventing muscle atrophy in the acute microgravity environment, and the effect of aerobic combined resistance training is the best, which may relate to up-regulating the p-Akt proteins expressions in skeletal muscle and inhibiting the MuRF1 proteins expressions in the acute microgravity environment.
**OR-016**

**Inflammatory responses associated with cortisol and CK after intensive endurance exercise**

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**Objective** The aim of this study was to investigate the effect of acute intensive endurance exercise on circulating leucocyte and cytokine levels in trained kayakers, and to explore inflammatory responses associated with stress hormone and muscle damage.

**Methods** Nine male trained kayakers (average age 21.00±3.94 years, average training history 5.56±1.88 years, average height 187.70±4.69 cm, average weight 89.25±8.66 kg, average body fat% 10.96±4.15%, and average VO$_2$max 4.33±0.62 l/min) participated in this study. All participants were well informed with the procedures and gave written informed consent. All participants completed a 3000m running test 2 h after a normal breakfast. Participants were rested for 24 h prior to the exercise test, and kept fasting in 90 min after running test, but drank water ad arbitrum.

Mean heart rate was recorded by a Polar heart rate meter, the earlobe capillary blood lactate was tested with a portable lactate analyzer 3 min after running. Venous blood samples were taken from antecubital vein before (T0), 15 min (T1) and 90 min (T2) after exercise. Whole blood samples were used for leucocyte counting and its subpopulation counting immediately by Coulter Counter. CD3+, CD4+, CD8+, CD4+/CD8+, natural killer cells (NK) was evaluated by flow cytometry (Beckman Coulter), T cells were defined as CD3+ lymphocytes and NK was defined as CD3-CD16+CD56+ lymphocyte. Plasma and serum were isolated at 4°C. Plasma ACTH and serum testosterone, cortisol were assayed by CLIA (Immulite 2000), Serum IL-4, IL-6 were detected by ELISA (ST-360). Serum creatine kinase (CK) was assayed by autoanalyzer (Beckman CoulterAU680). Post-exercise concentration of parameters in plasma and serum was corrected according to the formula by Dill. The data was analysed by IBM SPSS Statistics for Windows, Version 21.0. Continuous variables with normal distribution were presented as mean±standard deviation. Differences between the 3 time points were tested using repeated measures analysis of variance. To classify immune-endocrine relationships and immune-muscle damage relationships, changes of inflammatory parameters were analysed in relation to testosterone, cortisol, ACTH and CK using Pearson's correlation coefficient respectively. Correlation between changes of testosterone, cortisol, ACTH and inflammatory parameters was tested to verify stress hormone related inflammation rPOnse, correlation between changes of CK and inflammatory parameters was tested to evaluate muscle damage related inflammation response. Only changes which from T1 or T2 differ significantly from T0, and from T1 differ significantly from T2 were included in the correlation analysis. The level of significance was set at p≤0.05.

**Results** Participants finished 3000m running with an average time of 715 ± 33.0 Sec, and the average heart rate was 167.00±12.88 b/min, Blood lactate concentration was 12.31±1.91 mmol/l.

The result showed significant increases for serum cortisol, serum CK, neutrophile granulocyte% (GR%), and significant decreases for testosterone, CD4+, CD4+/CD8+, lymphocyte% (LY%) immediately after intensive running. Change of leucocyte count was not significant as a result of increased NK, GR and decreased CD4+, LY. Compared with result of T1, significant increases of CD4+/CD8+, CD4+, leucocyte count, GR%, and significant decreases of ACTH, cortisol, CD8+, CD3+, LY% were observed at T2, leucocyte count increased with a trend for GR. Furthermore, compared the results of T2 with that of T0, participants presented increased CD4+/CD8+, CK, leucocyte, GR% and decreased testosterone, cortisol, ACTH, CD8+, CD3+, LY%, monocyte% (MO%) at T2. Compared all the levels of IL-4 and IL-6 at T0, T1 and T2 with each other, differences between any two were not significant. The time course of the changes revealed that significantly increased cortisol, NK and decreased CD4+ from T0 to T1, which recovered at T2 compared with T0 were fast response and fast recovery (FR-FR) parameters; Significantly increased CK, CD4+/CD8+, GR%, MO% and decreased testosterone, LY% from T0
to T1, which didn’t recovered at T2 compared with T0 were fast response and slow recovery (FR-SR) parameters; Significantly increased leucocyte from T0 to T2 and decreased ACTH, CD3+, CD8+ from T1 to T2 were slow response and slow recovery (SR-SR) parameters; IL-4 and IL-6 were nonsensitive response (NR) parameters. Significant correlation was observed between \( \Delta \text{cortisol}_{T1-T0} \) and \( \Delta \text{NK}_{T1-T0} \) \((r=0.78, p=0.04)\), \( \Delta \text{cortisol}_{T2-T1} \) and \( \Delta \text{leucocyte}_{T2-T1} \) \((r=-0.70, p=0.04)\), \( \Delta \text{ACTH}_{T2-T1} \) and \( \Delta \text{leucocyte}_{T2-T1} \) \((r=-0.76, p=0.02)\), \( \Delta \text{ACTH}_{T2-T0} \) and \( \Delta \text{CD8+}_{T2-T0} \) \((r=-0.79, p=0.03)\). No changes \((\Delta T1-T0, \Delta T2-T1, \Delta T2-T0)\) of inflammatory parameters correlated significantly to changes of testosterone and CK. But the correlation analysis revealed a significant correlation between \( \Delta \text{CK}_{\text{post-exercise}} \) and \( \Delta \text{cortisol}_{\text{post-exercise}} \) \((r=0.90, p=0.001; \Delta T2-T0, r=0.78, p=0.01)\).

**Conclusions** Findings demonstrate different time-course responses and recovery of inflammatory parameters to intensive endurance exercise, athletes and coaches should consider these different recovery time-courses in the subsequent training session after intensive endurance training. Correlation analysis between cortisol, CK and inflammatory parameters indicates that inflammatory response is a stress hormone other than a muscle damage tuned process, and on the contrary, the correlation between post-exercise changes of CK and cortisol suggests a hint that inflammatory response caused by cortisol may contribute to the post-exercise muscle damage but not that during exercising. Correlation analysis and time-course analysis reveal that cortisol exerting an acute effect on NK, but maybe a false time-lag effect on leucocyte. This research investigated the inflammatory rPOnses to intensive endurance exercise by correlation analysis, but inflammatory rPOnse is a multifactor process, and the conclusion is still challenging, further research is necessary to understand the underlying mechanism.

**OR-017**

**Supplementation of Ala-Gln inhibits protein breakdown of skeletal muscle in rats with altitude training through TNF-α/NF-κB/MuRF1 pathway**

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**Objective** To explore the effects of alanyl-glutamine (Ala-Gln) or glutamine (Gln) supplementation on protein metabolism in rat skeletal muscle during simulated altitude training, and compare the intervention of Gln or Ala-Gln to provide the necessary experimental basis for finding nutritional interventions to inhibit skeletal muscle protein degradation during altitude training.

**Methods** Forty SD rats aged 6 weeks were randomly divided into normoxic control group (NC group, \( n=10 \)), hypoxic exercise group (HE group, \( n=10 \)), hypoxic exercise + glutamine + alanine group (HEG group, \( n=10 \)), hypoxic exercise + alanyl glutamine group (HEAG group, \( n=10 \)). Rats were subjected to 6 weeks of 13.6% hypoxic exposure and 90% lactic acid threshold intensity weight-bearing swimming (load weight of 2.1% of body weight) exercise training, 30 minutes after the end of each training, the mixed solution of Ala and Gln was administered according to the dose of 0.75g/Kg body weight in HEG group, and the solution of Ala-Gln was administered in the HEAG group at a dose of 1.5 g/kg body weight. After 6 weeks, the contents of rat skeletal muscle total protein (Pro), myosin heavy chain (Myo), tumor necrosis factor-α (TNF-α), nuclear transcription factor-κB (NF-κB), NF-κB inhibitory protein α (IkBα), and mRNA expression of muscle atrophy box F gene (MAFbx), muscle ring finger gene 1 (MuRF1), and inhibitor of kappa B kinase complex-beta (IKKB) were measured.

**Results** (1) Compared with NC group, the content of Pro and Myo in skeletal muscle in HE group was significantly decreased \((P<0.05, P<0.01)\), and the mRNA expression of MAFbx
and MuRF1 in skeletal muscle was significantly increased \((P<0.05, P<0.01)\), the levels of TNF-\(\alpha\) and NF-\(\kappa\)B were significantly increased \((P<0.05)\), the content of IkB\(\alpha\) was significantly decreased \((P<0.05)\), and the expression of IKK\(\beta\) mRNA was significantly increased \((P<0.01)\). (2) Compared with HE group, the content of Pro and Myo in skeletal muscle in HEG group increased, but there was no significant difference \((P>0.05)\). The expression of MuRF1 mRNA and the content of TNF-\(\alpha\) and NF-\(\kappa\)B in skeletal muscle decreased. IkB\(\alpha\) content increased, there were no significant difference, but mRNA expression of MAFbx and IKK\(\beta\) was significantly decreased \((P<0.05, P<0.01)\). (3) Compared with HE group, the content of Pro and Myo in skeletal muscle in HEAG group increased significantly \((P<0.05)\), mRNA expression of IKK\(\beta\), MuRF1 and MAFb \((P<0.01)\) and TNF-\(\alpha\), NF-\(\kappa\)B content \((P<0.05)\) in skeletal muscle was significantly decreased, and the IkB\(\alpha\) content was significantly increased \((P<0.05)\).

Conclusions (1) Simulated altitude training can activate TNF-\(\alpha\)/NF-\(\kappa\)B/MuRF1 pathway and enhance the catabolism of skeletal muscle protein, which is one of the important mechanisms for the reduction of skeletal muscle protein content caused by altitude training. (2) Supplementation of Ala-Gln during altitude training can significantly reduce the activation of TNF-\(\alpha\)/NF-\(\kappa\)B/MuRF1 pathway in skeletal muscle, and reduce the catabolism of skeletal muscle protein during altitude training, which plays a very important role in preventing the loss of skeletal muscle protein caused by altitude training. supplementation of Gln monomer during altitude training has little inhibitory effect on the activation of TNF-\(\alpha\)/NF-\(\kappa\)B/MuRF1 pathway in skeletal muscle.

OR-018

The study of acupuncture intervention on the dynamic changes of Ca\(^{2+}\), Na\(^+\), H\(_2\)O\(_2\) flux at earlier time points of rat skeletal muscle regeneration following eccentric exercise

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Objective In this study, the Non-invasive Micro-test Technique was adopted to study the dynamic changes of Ca\(^{2+}\), Na\(^+\), H\(_2\)O\(_2\) flux during the early phase of skeletal muscle regeneration (0–24 h post-injury) after acupuncture intervention, and to explore the role of interaction between TRP channel and NADPH oxidase 2 (NOX2) in the acupuncture mechanism.

Methods 324 healthy male Wistar rats were randomly divided into 6 groups: blank control group (C), electrical stimulation group (E), electrical stimulation group with acupuncture intervention (EA), electrical stimulation group with acupuncture + TRP channel inhibitor (EAT), electrical stimulation group with acupuncture + NOX2 inhibitor (EAN), electrical stimulation group with acupuncture + placebo (EAP). Except for group C, the animal model of eccentric induced skeletal muscle injury was established by electrostimulation on gastrocnemius of anaesthetised rats in vivo. Immediately after electrical stimulation, GdCl\(_3\), apocynin and PBS buffer were injected by tail vein in EAT, EAN and EAP respectively. After 30 min, gastrocnemius muscle belly were stuck with acupuncture needles (diameter of 0.13 mm) in EA, EAT, EAN and EAP respectively. Shortly afterwards, a special polypropylene ring-shaped perforated vessel wall was sutured to the exposed gastrocnemius muscle, and to measure Ca\(^{2+}\), Na\(^+\), H\(_2\)O\(_2\) fluxes by non-invasive micro-test technique in the phase of retaining needle, needle drawing immediately, 3h, 6h and 24h, respectively. The phase and time of detection in the C and E groups were consisted.
Results 1 When the gastrocnemius muscle was in a resting state, Ca$^{2+}$ and Na$^+$ were influx in small amounts, and H$_2$O$_2$ had a small eflux.

2 Effect of eccentric Exercise and acupuncture on the dynamic changes of Ca$^{2+}$ influx at different phases: ① In the E, a small influx occurred at 0min, 10min and 3h, and the influx suddenly increased significantly at 6h ($p<0.05$), followed by a small eflux at 24h; ② In the EA, a small eflux occurred during retaining needle and needle drawing immediately, and surprisingly, a small influx was observed at 3h. After that, the eflux increased suddenly at 6h and 24h, and the eflux peaked at 24h, which was significantly different from the E group at 24h ($p<0.05$); ③ The EAT showed a significant influx trend. Specifically, except a small influx in the retention period and 3h phase, significant influx occurred immediately after the needle pulling. 6h and 24h. Compared with C and EA, there was no statistically significant difference in net influx (influx and eflux), but Ca$^{2+}$ oscillation amplitude (influx and eflux fluctuation amplitude) in EAT was significantly increased ($p<0.001$, $p<0.01$, respectively); ④ In EAN, the eflux was dominant. Specifically, there was significant influx in the retention period and immediately after needle pulling, and suddenly significant eflux was observed at 3h and 6h. The 6h phase was significant different than that of E ($p<0.05$), afterwards, the influx was significantly decreased at 24h, and was statistically different from 6h ($p<0.05$); ⑤ The EAP flowed outward at all phases, and the overall trend was similar to the E group. The influx peaked at needle drawing immediately, which was significantly different from that of the concurrent phase E and EA ($p<0.05$), and the influx was significantly decreased at 24h.

3 Effect of eccentric exercise and acupuncture on the dynamic changes of Na$^+$ influx at different phases: ① In the E, the influx occurred at during retaining needle and needle drawing immediately, and the influx occurred suddenly at 3h and 6h. There was a significant difference between 6h and the C ($p<0.001$), and the influx again occurred at 24h; ② In the EA, the influx occurred during retaining needle and needle drawing immediately, and after that, efflux occurred at the 3h, 6h, and 24h; ③ The EAT efflux at all phases was in line with the trend of changes in the E; ④ The EAN only influx at 6h ($p<0.05$), while the rest of the phases flowed inward, and the influx peaked at 3h, which was significantly different from that at needle drawing immediately ($p<0.05$). The influx amplitude decreased at 24h, showing a significant difference from 3h ($p<0.01$). ⑤ The EAP only flowed inward at 3h, and the rest of the phases flowed outward.

4 Effect of eccentric exercise and acupuncture on the dynamic changes of H$_2$O$_2$ influx at different phases: ① In the E, the influx occurred only at 10 min, and the rest of the phases flowed outward with an increasing trend. The peak value were reached at 24h, showing a significant difference with C group and 0 min($p<0.01$), and extremely significant with 3h ($p<0.001$) and 6h ($p<0.05$); ② EA only flowed inward during retaining needle, all other phases flowed outward and peaked at 24h, but the influx was less than that of E and there was a significant difference at 6h with E ($p<0.05$); ③ The EAT group flowed outward at all phases and reached the peak at 3h, showing a significant difference compared with the E and EA at the same phases ($p<0.001$); ④ The EAN flowed outward at each time phase and peaking needle drawing immediately, but the flow velocity was higher than that of the EAT. There was an extremely significant difference compared with EA at the peaking phase ($p<0.001$) and a significant difference with EAT at the same phase ($p<0.05$); ⑤ In the EAP, all phases flowed outward, but the flow rate was less than the EAT and EAN.

Conclusions 1 In the early subsequent phase of skeletal muscle regeneration, Ca$^{2+}$ efflux decreased, while Na$^+$ influx increased, accompanied by increased H$_2$O$_2$ efflux.

2 Acupuncture intervention increased Ca$^{2+}$ efflux in the early subsequent phase of skeletal muscle regeneration and advanced the Na$^+$ influx phase, with the decrease of H$_2$O$_2$ efflux, and the effect was related to the interaction of TRP channels synergize with NOX2 Activity.
OR-019
VEGF-B inhibits skeletal muscle apoptosis after exercise in Chronic heart failure rats

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Objective To investigate the effects of vascular endothelial growth factor B in aerobic exercise mediated chronic heart failure rats cardiac function improvement and skeletal muscle remodeling.

Methods We employed transverse abdominal aortic constriction (TAC) inducing CHF in Sprague Dawley rats. Controls were sham-operated animals. At 4 weeks after surgery, rats were randomized to 4 weeks of aerobic exercise (CHF+E) or to untrained groups (CHF). After 8 weeks, all rats went echocardiography test. After which, rats were sacrificed and samples were collected. Muscular cytokine VEGFB and its receptor NRP1 expression were analyzed. Expression of apoptosis and muscle atrophy markers were assessed in cardiac muscle, gastrocnemius.

Results TAC rats developed CHF (preserved LV ejection fraction, hypertrophy of myocardial cells, decreased FS, increased LVAW d and LVID s). Exercise ameliorate CHF rat cardiac function. TAC rat skeletal muscle developed irregular muscle fiber distribution. The two atrophy-related ubiquitin ligases atrogin-1 and MuRF1, as well as genes involved in apoptosis and autophagy were upregulated in muscles in CHF rats. Exercise inhibited muscle atrophy and skeletal muscle apoptosis. VEGFB and its receptor NRPI decreased significantly in CHF muscle. Exercise promoted VEGFB and NRP1 expression in cardiac tissue, gastrocnemius.

Conclusions Exercise ameliorates CHF rat cardiac function. VEGFB inhibits cardiac muscle and gastrocnemius apoptosis in CHF rats.

OR-020
High-intensive training leads to increasing apoptosis of podocyte in kidneys of rats

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Objective Athletes often choose high-intensive training load to improve athletic ability in their training cycle, its purpose is to pursue the super-compensation after training, but athletes and coaches frequently ignore the balance between load and reasonable recovery, which produce a sustained decline in athletic ability and physical function, and cause the visceras function disorder. High-intensive training damages the structure of renal filtration barrier in rats, especially the destruction and fracture of Silt diaphragm ultrastructure, as well as the partial fusion of foot processes, etc., so that the large amount of macromolecular proteins in the blood leak out far beyond the threshold of renal tubular reabsorption and form exercise-induced proteinuria. Podocyte is one of the most important. This research establishes a model of rats which simulates the progressive-load training in the cycle of athletes. Observe the apoptosis of renal cells in rats by bioimaging. Determine whether long-term intensive training causes apoptosis in kidney of rats or podocytes, and detect the expression and distribution of Bcl-2 and Bax, and the protein expression of Caspase-3, which is the final regulatory factor of apoptosis pathway. Study the mechanism of the abnormal podocyte due to intensive training from the characterization of kidney to the molecular level, providing experimental basis for explaining the relationship between intensive-training and exercise-induced proteinuria to guide of scientific training.
Methods This study selects 36 Sprague-Dawley rats, which are randomly divided into 3 groups: a control group (group C, 12), a group drawn immediately after exercise (group EI, 12), a group drawn 24 h after exercise (group EA, 12). Group C does not train. The rats in group EI and EA train on the treadmill with an increasing load for 6 weeks (10% grade, 6 d/w): in the first week, the rats run for 10 min at 10 m/min. Starting from the second week, the running speed increases by 5m/min/w, and the training time increases by 30min/w. In the last week the rats run to exhaustion if they could not maintain the target intensity. Record the exhausting time of rats, then group EI and group EA are respectively drawn immediately and 24 hours after exercise. Detect the apoptosis of renal cell apoptosis in rats by TUNEL, observe the ultrastructure of podocytes by TEM, detect urine total protein by BCA, serum and urine creatinine by Jaffe, serum and urine creatinine by two-point dynamic method, the expression and distribution of Bcl-2 and Bax by immunohistochemistry, and the expression of Caspase-3 by western-blot.

Results The rats in group EI and EA gradually lose weight at the first weekend of training, and their weight drop significantly from the third weekend to the end, it shows a significant difference compared with group C (p<0.01). There is no significant difference between group EI and EA. Total protein/creatinine in urine of rats 30 min and 24 h after exercise is significantly higher than that of group C (p<0.01), and group EA is slightly returned and lower than group EI (p<0.05). The H-SCORE of group EI and EA is significantly higher than group C (p<0.05), while that of group EA is higher than group EI (p<0.05). It shows by fluorescence microscopy that the positive cells in the group EI are close to the glomerulus and more than group EA. The results of TEM show that group C is normal, and the podocytes own normal chromatin and regular nucleus; Group EI: there are podocytes with apoptosis characteristics, cell chromatin aggregation in nucleus, cell volume reduction, concentration of cytoplasm, cell membrane integrity, but foot processes significantly disappear. Group EA: there are podocytes with apoptosis characteristics, the chromatin of the podocyte nucleus ruptures into several fragments, the cell volume decreases, the cytoplasm concentrates, the pseudopod decreases, the cell membrane is intact, and the vacuole in the cytoplasm increases obviously. Compared with group C, serum corticosterone is significantly decreased in group EI and EA, and there is a significant difference (p<0.01), while group EA is significantly decreased but still significantly lower than that in group EI (p<0.01). The Bcl-2 histological mean optical density in group EI and EA is lower than that of group C, and there is a very significant difference (p<0.05), while there is no significant difference between the two groups. But Bax in group EI and EA has no significant difference with group C. The distribution of Bax is significantly different: group C is distributed in the entire field of vision, and little in glomerulus, while the Bax distribution in glomerulus of group EI and EA became extremely rich, and the aggregation trend of group EI is the most obvious. Only the ratio of kidney Bax/ bcl-2 in group EA shows a significant difference compared with group C (p<0.01). The expression of Caspase-3 in group EI has no significant difference with group C (p>0.05), while group EA is higher than group C and EI (p<0.05).

Conclusions Persistent proteinuria is observed in rats after intensive training, their renal function is disordered and cannot be effectively recovered after 24 h rest, and renal cell apoptosis increases. High-intensive training reduces the expression of Bcl-2, and the Bax/Bcl-2 ratio increases with the prolongation of recovery time. Caspase-3 shows the same trend. It is suggested that the change in the expression and ratio of Bax and Bcl-2 in renal under excessive training stress is an important regulatory mechanism for the occurrence of apoptosis in renal cells. Meanwhile the apoptosis of renal cells increases in rats after training, and the apoptosis characteristics of podocyte in the glomerulus are obvious at 30 min and 24 h after exercise, and the structure and function of Slit diaphragm are damaged.
OR-021
GLUT4 rs5418 genotype and performance of Cross-country skiers in China

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Objective  The GLUT4 gene is one of the genes that have a potential influence on physical performance. Studies have shown that the rs5418 genotype of GLUT4 is more prevalent in endurance athletes. Therefore, the GLUT4 rs5418 polymorphism may become a genetic marker for Cross-country skiers. The study aimed to examine the association of the GLUT4 rs5418 genotype with the performance of Cross-country skiers.

Methods  The distributions of the GLUT4 rs5418 genotype and allele were examined in a general population (206) and a group of elite Cross-country skiers (163) in China by using PCR-RFLP and TOF.

Results  Compared with the general population, the elite Cross-country skiers ($\chi^2=9.267; \ df=2; P=0.01; P<0.05$), especially the females, had a higher frequency of the AA genotype (Total: 22.09% VS 13.59%, Female: 24.19% VS 13.59%). The Cross-country skiers had a higher frequency of the A allele than the general population (45.40% VS 33.98%), and the difference was statistically significant ($\chi^2=9.97; \ df=1; P=0.02; P<0.05$).

Conclusions  The GLUT4 rs5418 polymorphism was associated with the performance of elite Cross-country skiers in China. The SNP rs5418 could be used as a biomarker for selecting elite Cross-country skiers in China.

OR-022
Effects of aerobic exercise on the hemodynamics and structure of the common carotid artery in obese adolescents

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Objective  With the population of obese adolescents increases dramatically, a series of cardiovascular diseases, especially atherosclerotic, are triggered by obese which seriously threatens the life and health of teenagers. The aim of this study is to investigate the effects of aerobic exercise intervention on the hemodynamics and structure of the common carotid artery in obese adolescents.

Methods  Forty obese adolescents (18 ± 2 years) were randomly assigned into the experimental group (EG; n = 20) and control group (CG; n = 20). EG undertook 12 weeks of aerobic exercise training (AET), CG had no exercise intervention. The carotid artery of both CG and EG were examined and compared. Color doppler ultrasound was used to determine the tube diameter and axial flow of the common carotid before and after exercise intervention. The heart rate, systolic and diastolic blood pressure were simultaneously measured on the left brachial artery by a sphygmomanometer.

Results  Compared with CG, there were improvements of EG in peripheral resistance (22.90±6.70 VS 29.58±8.71, $p<0.01$) and Systolic blood pressure (123.57±7.36 VS 130.25±6.79, $p<0.05$) were verified after AET, except diastolic blood pressure. Following AET, blood flow velocity (0.28±0.05 VS 0.21±0.05, $p<0.01$) and wall shear stress (6.25±0.90 VS 4.97±1.54, $p<0.05$) increased prominently, which were also significant differences only in EG. In contrast, the
vascular diameter demonstrated consistently upper compared with CG, but no differences between EG and CG. **Conclusions** Regular aerobic exercise lasting 12 weeks could effectively change the dynamic parameters of the common carotid artery in obese adolescents, but no changes in arterial diameter. These findings indicated that 12 weeks of aerobic exercise can induce some changes of the common carotid artery blood flow within the circulation function in a short time. But the changing in common carotid arteries structure is needed after a long-term blood flow to the stimulation.

**OR-023**  
**Physical evaluation of 6-7 years old female preselected tennis players**

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**Objective** Through testing and analysis the characteristics of body shape, body composition, bone growth and physical fitness, hemoglobin, testosterone of 6-7 years old female preselected tennis players, the study aim was to provide reference bases for the early selection of female tennis players.

**Methods** A total of 75 female preselected tennis players (initial selection by the coaches) aged from 6 to 7 years were came from Hebei, Hubei, Qinghai and Inner Mongolia province, who came to Research Center for Heath related Physical Fitness Evaluation of Guangzhou Sport University for physical fitness test from July 2016 to July 2018. The height, weight, length of upper limbs, length of lower limbs, iliac width, shoulder width, body fat, muscle mass, bone age, bone mass density (BMD), anaerobic power and PWC170, reaction time, vertical jump, grip strength, hemoglobin, testosterone were measured using related instruments and methods, and calculated derived indicators BMI, iliac width/shoulder width. Data were compared with the national standard of physical health of students and/or evaluated by deviation method, and correlation had been analysed among physical parameters.

**Results** 1) The 75 female preselected tennis players' aged from 6 to 7 years height and weight were 128.10±5.32cm and 25.70±3.87kg, and there are 47 girls height upper medium grade level, 60% of which weight was at a moderate level, their BMI were 15.48±1.50kg/m², and all in the normal range, iliac width/shoulder width ×100 was 76.52±7.00, 70.7% of which was above medium grade level, the upper and lower limbs were 54.28±3.60cm and 71.68±5.26cm, girls' PBF were 21.03±6.44, muscle weight were 18.94±3.00kg, BMD were 2.04±2.20, and no low bone strength were fund; Anaerobic power of all female preselected tennis players were 135.93±31.65kg.cm, and the values of the PWC170 relative weight were 10.79±2.56kg.m/min.kg, reaction time were 0.628±0.128s, vertical jump were 21.13±4.95cm, the grip of right and left hand were 10.36±2.15kg and 10.06±2.40kg, the physical fitness parameters above in the upper middle class were more girls than the lower middle class; The hemoglobin content was 132.15±8.70g/L, which was above the normal level (110-160g/L), the serum testosterone concentration was 1.52±1.20umol/L, which was much higher than that of normal girls (0-0.7umol/L).

2. When age was controlled, there was negative correlation between T and PFB, vertical jump and body weight, PWC170 and reaction time (P<0.05), and there was positive correlation between hemoglobin and muscle weight (P<0.05), height, and vertical jump (P<0.01), muscle weight and anaerobic power (P<0.01), anaerobic power and height, weight. BMI, upper and lower limbs (P<0.01, P<0.01, P<0.01, P<0.05, P<0.01). PWC170 and vertical jump,
the grip of right and left hand ($P<0.01$, $P<0.05$, $P<0.05$), vertical jump and upper, lower limbs, iliac width/shoulder width ($P<0.01$, $P<0.01$, $P<0.01$).

**Conclusions** 75 female aged from 6 to 7 years old preselected tennis players' body shape, physical fitness, physiological and biochemical function were superior to peers, and in those parameters, there were more people in upper middle grade than lower middle grade. There is a certain correlation between body composition, shape and fitness of female preselected tennis players' aged from 6 to 7 years.

**OR-024**

**Changes of mitochondrial autophagy - related genes and autophagosome after skeletal muscle blunt trauma**

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**Objective** Objective: To study the changes of mitochondrial autophagy-related genes and autophagosome after skeletal muscle blunt trauma, to reveal the changes of mitochondrial adaptive repair process after skeletal muscle blunt trauma, and to elucidate the mechanism of blunt trauma repair process.

**Methods** Methods: Sixty - four male Wistar rats were randomly divided into control group and blunt trauma group (divided into 12h group, 2d group, 5d group, 7d group, 10d group, 15d group and 30d group) according to the time of extraction. The expression of HIF-1α, AMPKα2, BNIP3 and NIX protein in skeletal muscle hypoxia and autophagy-related factors were measured by Western-Blot. QRT-PCR was performed to analyze the expression levels of HIF-1α, AMPKα2, BNIP3 and NIX. The ultrastructure and autophagic formation at different time points were observed by transmission electron microscopy (TEM).

**Results** Results: The expression of HIF-1α and AMPKα2 protein reached the peak at 12h and 2d, and the expression of HIF-1α was significantly higher than that of the control group ($P<0.05$). The expression of AMPKα2 was significantly higher at 5 days after injury ($P<0.05$), and reached the normal level at 10 days. BNIP3 began to decline after 5 days, but still higher than normal at 10 days after treatment. NIX expression peak appeared at 12h and 2d after injury, with high-express to 7d. The expression of HIF-1α and AMPKα2 mRNA was significantly higher than that of the control group ($P<0.01$), but decreased until 5d ($P<0.05$), then decreased to normal level. The mRNA expression of BNIP3 and NIX was basically the same as their protein performance. A number of autophagosomes were observed at 12 h after injury, and the number of autophagosomes increased gradually at 2-7 d. After 10 days, the number of autophagosomes decreased compared with that of 12 h-7 d after blunt. And after 15 days, the number of autophagosomes decreased gradually.

**Conclusions** Conclusion: The changes of early stage metabolic regulator AMPKα2 and hypoxia-sensitive factor HIF-1α after skeletal muscle blunt trauma indicated that an energy crisis occurred in the skeletal muscle after injury, and the hypoxic environment was formed. The mitochondrial autophagy, the expression of BNIP3 and NIX showed that mitochondrial autophagy was activated and hypoxia induced mitochondrial autophagy at early skeletal muscle contusion peroid. Hypoxia-induced mitochondrial autophagy could remove the damaged mitochondria, maintain mitochondrial quality and provide raw materials for new mitochondria generation, facilitate the rapid recovery of damaged skeletal muscle, which may be a compensatory mechanism of the body response to injury.
OR-025  
Association study between Chinese excellent long-distance female athletes’ PGC-1β genetic polymorphism and aerobic capacity  

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Objective  Peroxisome proliferator-activated receptor-γ coactivator-1β (PGC-1β) is mainly expressed in mitochondria-rich tissues, which involved in skeletal muscle mitochondrial biosynthesis and energy metabolism processes such as fatty acid transport and oxidation, hepatic gluconeogenesis. PGC-1β is Previous studies have shown that this genetic polymorphism is associated with the athletic ability of elite endurance athletes. Therefore, based on the previous research, the relationship between PGC-1β gene polymorphism and aerobic exercise ability of elite female long-distance runners was discussed to provide new effective indicators for athletes' selection of materials, and improve the accuracy and advancement of athletes' selection of materials.  

Methods  56 Chinese elite female long-distance runners were selected, and venous blood was extracted to analyze the gene polymorphism of specific gene locus. The subjects were tested for aerobic endurance index and lung function index, wherein the aerobic endurance index included maximum oxygen uptake, relative maximal oxygen uptake relative value, anaerobic threshold and anaerobic threshold relative value, and lung function indicators including vital capacity, Time lung capacity, minute ventilation and maximum ventilation. Subsequently, the cross-sectional association study method was used to analyze the association between four genotypes locus of PGC-1β including rs32579, rs2161257, rs1544744 and rs10783180 in 56 subjects.  

Results  1) All four polymorphic locus were tested by H-W balance, indicating that the subjects were representative of the population. 2) rs32579 locus: There were no significant differences in lung function indicators and aerobic exercise capacity between different genotype athletes. 3) rs2161257 locus: There were no significant differences in lung function indicators and aerobic exercise capacity between different genotype athletes. 4) rs1544744 locus: There were no significant differences in lung function indicators and aerobic exercise capacity between different genotype athletes. 5) rs10783180 locus: There is a significant difference in the relative values of anaerobic threshold and anaerobic threshold between different genotype athletes. The anaerobic threshold of AG genotype athletes was 2156.35±227.69 ml/min and the anaerobic threshold of athletes with GG genotype was 2143.41±217.30 ml/min. So the anaerobic threshold of AG genotype athletes was significantly greater than the anaerobic threshold of GG genotype athletes. The Anaerobic threshold relative value of AG genotype athletes was 50.99±3.99 ml/kg/min, while the anaerobic threshold relative value for athletes with GG genotype was 48.12±4.25 ml/kg/min. The anaerobic threshold relative value of AG genotype athletes was significantly greater than that of GG genotype athletes. Other indicators showed no significant difference.  

Conclusions  The rs10783180 polymorphism is associated with the athletic ability of elite endurance athletes. The population carrying AG genotype may have higher anaerobic threshold value and relative value of anaerobic threshold, which may become more excellent endurance athletes. Rs10783180 polymorphic locus AG genotype can be used as a molecular genetic marker to predict the relative value of anaerobic threshold and anaerobic threshold of Chinese Han women's long-distance runners in northern China.
OR-026
Exercise induces HIF-1α redistribution in the small intestine

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Objective Intestinal epithelial cells are positioned between an anaerobic lumen and a highly metabolic lamina propria, affected by reduced blood flow and tissue hypoxia. Exercise induces blood flow redistribution, leading to hypoperfusion and gastrointestinal (GI) compromise. The hypoxia-inducible factor (HIF) 1α is pivotal in the transcriptional response to oxygen flux. In this study, we hypothesized that exercise induces GI system hypoxia and accumulates HIF-1α.

Methods (1) ROSA26 ODD-Luc/+ mouse model (ODD-Luc) was used to detect HIF-1α expression in the intestine (female, 8-week, n=6/group). ODD-Luc mice were randomized into 4 groups: stayed in 21% O₂ as the normoxic control (C), exercise (E), injected HIF-1α inhibitor PX-478 before swimming (PS), placed in the chamber containing 9% O₂ for 4 hours as the positive control (PC). (2) Exercise models were conducted by volume: Moderate Exercise (ME): mice voluntarily swim for 30 min; Heavy-intensity Exercise (HE): mice swim for 1.5 hours with 5% body weight loads attached to their tails; Long-time Exercise (LE): mice voluntarily swim for 3 hours or till fatigue.

Results (1) Exercise increased HIF-1α in the abdominal area. The luciferase activities boosted after exercise, compared to the controls (ME v.s. C, P<0.05; HE v.s. C, P<0.05; LE v.s. C, P<0.05) but no differences among three exercise groups (ME v.s. HE, P>0.99; ME v.s. LE, P>0.99; HE v.s. LE, P>0.99); (2) Exercise altered HIF-1α distribution in the small intestine in a time-dependent manner. The expression of HIF-1α was significantly increased after exercise and gradually reduced to the rest level. The photons increased at the 0th hour after exercise compared to that of the normoxic control (P<0.01). The level of photons then reduced over time, while the 2nd, 4th and 6th hour post-exercise were still greater than that of the normoxic control (2nd hour v.s. C, P<0.01; 4th hour v.s. C, P<0.01; 6th hour v.s. C, P<0.05), and returned to normal after 24 hours (24th hour v.s. C, P>0.99).

Conclusions Exercise induced the distribution of HIF-1α in the small intestine. The expression of HIF-1α is shown in a time-dependent manner after exercise.

OR-027
Research about Training Monitoring during Different training periods in Chinese Elite Swimmers

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Objective Training monitoring has become an integral component of total athlete training. Systematically monitoring the physiological and biochemical variables related to performance helps coaches and athletes to measure the effectiveness of their training programs and decide how to revise or update those programs, especially in swimming training. The key purpose of this study is to evaluate the physical function characteristics during preparation season and stress response during competition training sessions in 2017, and provides the helpful data for scientific training for the implementation of the preparation process.

Methods During the preparation period, the National Swimming Team athletes were planned to screen and test the physical function characteristics. There are 39 male athletes and 37 female
athletes to participate in the study. Body composition was assessed with dual energy X-ray (DXA). Anthropometric characteristics were assessed using Anthroscan 3D VITUS body scanner, and pulmonary function test using CHEST portable lung function meter (HI-101). During the competition period, the training load monitoring targets were 2 elite players who participated in XVII World Aquatics Championship in Budapest-2017 and the National Games 2017. The monitoring methods mainly included: blood tests (including Hb, CK, BU, testosterone, cortisol and ferritin etc.) were used to monitor the athlete's fitness functional status, and the Z-score method was used to express the index changes of two athletes; blood lactate was used to monitor the training load of athletes, and urine indexes were used to monitor body fluid balance and fatigue.

**Results**

1. During the preparation period, the weight of male athletes is 78.4±8.2kg, the percentage of body fat is 15.9±2.8%, the weight of female athletes is 64.8±6.6kg, and the percentage of body fat is 24.2±3.5%. The vital capacity (VC) was 6.65±0.87 L for males and 4.86±0.69 L for females, the value of forced vital capacity (FVC) was 4.29±1.33 L for males and 3.43±0.96 L for females, and the mean value of ventilation per minute was 148.1±23.12 L for males and 110.4±19.67 L for females.

2. During the competition preparation period, Z score was used to express the blood indicators of two athletes, before the XVII World Aquatics Championship in Budapest, the Z score of Hb, T, T/C ratio and ferritin were (-0.5, 0, -0.4, 1.1) and (-0.8, -0.1, -1.0, 0), respectively. Before the competition of the National Games, the Z scores were (1.0, 0.3, 0.7, 0.6) and (1.4, 1.0, 0.1, -0.6) respectively.

3. Training load monitoring was carried out using the blood lactate control test, as the training load increased, the athletes' performance improved and the lactate level increased slightly.

4. The urine indicator test is used to observe the athlete's dehydration and recovery. On the second morning after the intensive training day, both athletes were negative for urine protein and with normal urine specific gravity.

**Conclusions**

1. The screen and tests about the physical function characteristics of swimming athletes during preparation period is useful to develop a personalized training plan; 2. Z-score is easy and feasible for the elite swimmers to monitoring physical fitness capabilities, and higher Z-score is related with better athletic performance; 3. Blood lactate control test can be used for the training intensity monitoring of swimmers, athletes show higher levels of lactic acid metabolism and higher athletic performance before the competition.

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**OR-028**

**Ageing effect of muscular athletic capability in knee joints over healthy woman aged 45 - 64 years**

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**Objective** It is important to evaluate the effect of age on muscular athletic capability in knee joints over healthy woman aged 45 to 64. The research could provide female ageing effect on muscular athletic capability for elderly persons, aiming to promote the relative research on exercise improvement and Women's health.

**Methods** A total of 126 volunteers were selected. The knee muscle strength indexes were tested on side-to-side using self-developed digital isometric muscle function test system. Main indexes include muscle strength, muscle explosive force and muscle endurance on side-to-side. The age groups are classified with 5 years intervals recommended by WHO. The statistics of trend, correlation network, ANOVA and PCA were employed to distinguish the aging effects. All test were implemented in R platform (version 3.3.3).

**Results**

1. Muscle strength showed obvious differences between left and right; the relative higher explosive force occurred with extensor muscles on the left showing the significant changing point at 100 ms after 50; the muscle endurance and fatigue index showed side differences after 60.

2. Muscle strength trend showed “down then up” characteristics with the
slightly ahead of 55 on the right side as well as muscle endurance indexes. (3) indexes between explosive force variables showed strong significant difference (p<0.001) while muscle fatigue indexes showed side differences; muscle strength in flexor muscles displayed significant correlations with explosive force variables on the right but opposite in extensor muscles on the left. (4) the huge difference occurred in extensor groups especially the comparison between minimum and maximum groups. (5) the main influences on knee muscular athletic capability include explosive force variables as well as muscle fatigue index.

**Conclusions** Both ageing effect and side effect are observed in muscular athletic capability in knee joints over healthy woman aged 45 - 64 years. After 55, the related variables showed decrease trend indicating the potential decreased muscular athletic capability. In both flexor and extensor muscles, strength variables displayed significant side differences, showing high explosive force in flexor muscles on the right side. The crucial age 50 and 55 became the turning points for knee muscular athletic capability especially with explosive forces.

**OR-029**

**Effects of BCAA Plus Glucose Supplement Timing on Inflammatory Response Indicators after a Resistant Exercise**

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**Objective** A single bout of high-intensity exercise (such as resistant exercise) may result in oxidative stress and impaired immunity, for example, excessive-inflammation and compensatory immunosuppression during the recovery period. BCAA supplement has been reported that it can reduce immunosuppression and excessive inflammation after high-intensity resistant exercise. The purpose of this study was conducted to compare the effects of one-time BCAA plus glucose supplement at two different points of time, two hours before exercise and after it immediately, then figure out a better timing for improving human's impaired immune function after resistant exercise.

**Methods** The study was a randomized, controlled, one-blind crossover trial. The entire test lasted two weeks. It recruited 16 non-trained healthy male college students. They were divided into two groups (each group contained 8 people), pre-exercise supplement group (group A) and post-exercise supplement group (group B). All subjects have not had other high-intensity exercises at least 1 week before this study. Also, they did not have any exercise-induced injury or physical discomfort.

All subjects needed to ingest BCAA plus glucose and placebo supplement in 2 weeks respectively and they consumed them at 2 different timing (group A or B). Because of digestion time of the capsule, subjects of group A consumed supplements 0.5h before exercise, group B need to consume them after exercise immediately. At the test day, subjects were asked not to eat anything 3 hours before their resistant exercise. Besides, subjects’ diets were recorded for 2 weeks experience, to make sure if they consumed other excessive essential amino-acid which may influence this study. And the study compared each subject’s 2 different results and figured out whether one-time BCAA plus glucose supplement could improve human's impaired immune function after resistant exercise and which timing was better.

This exercise was designed to be a circular centrifugal movement which contained 3 different training subjects, including 5 sets of 95%10RM seated leg curl machine training, 3 sets of the maximum Drop-jumps and 2 sets of the maximum strength continuous 20m frog jump. The whole resistant exercise lasted about 1 hour. All subjects went through the same exercise and rest 7 days, then they repeated it in next week.
All subjects were taken 8 blood samples in vein in 2 weeks. In other words, there were 4 timing of taking subjects’ blood samples in each test. Samples would be placed on a shaker for 1h at-20℃, before being centrifuged for 10 mins at 3,000 g. 

The test indicators of this study included serum interleukin-6 (IL-6), serum C-reactive protein (CRP), serum immunoglobulin a (Iga) and DOMS soreness. Among them, the level serum IL-6 was tested using a human interleukin 6 ELISA kit in a double antibody one-step sandwich enzyme-linked immunosorbent assay. The serum C-reactive protein index was tested by a human C-reactive protein (CRP) ELISA kit, which is an experimental method for enzyme-linked immunosorbent assay. Serum Iga was analyzed by collecting peripheral anticoagulation and then using an automated biochemical analyzer. The degree of muscle soreness was evaluated using a visual simulation evaluation method. Participants will be asked to perform and hold a squat (90°knee angle) whilst they rated their perceived muscle soreness on a 200 mm visual analog scale. The scale consisted of a line from 0 mm (no pain) to 200mm.

Supplement protocol: The pure BCAA supplement contained a ratio of 2:1:1 (leucine, isoleucine, and valine, respectively), a dose of 40 mg per kilogram of body weight and glucose supplement was designed to a dose of 24 mg per kilogram of body weight. The form of BCAA was the capsule, and the glucose supplement was in the powder form; each serving was mixed with 300 ml of water. The placebo was the same dose of oligosaccharides in capsule, and artificial sweetener in 300ml of water to match the taste of glucose supplement.

Data analysis was performed using the PC version of SPSS 19.0 software. All indicators were statistically analyzed using repeated measures analysis. If the interaction of supplement x timing was significant, the independent sample t test was performed between the groups, and the paired sample t test or one-way ANOVA was performed in the group.

Results In this study, all the data from the two weeks were divided into four groups according to the timing of supplementation and the supplementary category. They were the pre-exercise, placebo group (called A-group), the post-exercise, placebo group (called B-group), the pre-exercise, BCAA plus glucose group (A+ group), the post-exercise, BCAA plus glucose group (B+ group). The data of A-group and A+ group were compared to determine the effectiveness of BCAA plus glucose supplement on anti-inflammatory response. Also, it’s the same goal to compare the data of B-group and B+ group. Then, through comparison between the the pre-exercise, BCAA plus glucose group and the post-exercise, BCAA plus glucose group, it is determined which supplemental timing IS better for lower resistant exercise-induced inflammatory response.

The results showed that serum IL-6 levels were 208.35±11.34 pg/ml in the pre-exercise, BCAA plus glucose group and 273.08±4.76 pg/ml in the pre-exercise, placebo group at 24 h after exercise. There was significantly lower in A+ group (p<0.05); the serum IL-6 level in the post-exercise, BCAA plus glucose group was 169.99±10.85 pg/ml, while the serum IL-6 value of 303.78±8.79 pg/ml in the post-exercise, placebo group. There was a significant decrease in B+ group comparing with the level of B-group (p < 0.05). Besides, the serum IL-6 level in the post-exercise, placebo group was lower than that in the pre-exercise, BCAA plus glucose group, and there was a significant difference at 24 h after exercise (p<0.05).

Serum CRP at 24 h after exercise, the serum CRP value of the pre-exercise, BCAA plus glucose group was 4.26 ± 0.29 mg /L, significantly lower than the data of CRP in pre-exercise, placebo group (4.64 ± 0.35 mg/L, p < 0.05). Similarly, the supplement The serum CRP level of post-exercise, BCAA plus glucose group was 3.75±0.44 mg/L, which was significantly different from it in post-exercise, placebo group (p<0.05). At timing of 48h after exercise, the serum CRP level of the B+ group was 3.92±0.24mg/L, which was significantly lower than the serum CRP value of the B- group after 48h (4.4±0.29 mg/L), and there was a significant difference (p<0.05). In addition, at the timing of 24 hour after exercise, the serum CRP level of the post-exercise, BCAA plus glucose group was significantly lower than it in pre-exercise, placebo group, and there was a significant difference (p<0.05). There was no significant difference in the data of exercise-induced immunoglobulin of each group after centrifugation. As a direct indicator of the systemic inflammatory response, serum IL-6 and CRP can significantly reflect the inflammatory response induced by BCAA combined with glucose supplementation at 24 and 48 hours after exercise. And
instead of Supplement before exercise, it is better for lowering resistant exercise-induced inflammatory response to supply it after exercise immediately. The degree of delayed onset muscle soreness is considered to be a clear indicator of the local inflammatory response. The Visual Analogue Scale (VAS) of delayed onset muscle soreness (DOMS) was 2.63±1.55 in A+ group at 24 h after exercise, was significantly lower than it (3.31±1.54) in the A- group (p<0.05). And the level of VAS in the B+ group was 1.27±0.72, which was significantly lower than it in the B- group at 24 h after exercise (2.86±1.77, p<0.05). At 48 h after exercise, the DOMS level in the post-exercise, BCAA plus glucose group(1.36±0.85) was significantly lower than the 48-hour DOMS level in the post-exercise, placebo group (4.4±0.29 mg/L). In addition, at the timing of 24 hour after exercise, the VAS of DOMS in the post-exercise, BCAA plus glucose group was significantly lower than it in pre-exercise, placebo group(p<0.05).

**Conclusions** Acute and one-time BCAA plus glucose supplement can reduce the exercise-induced systemic inflammatory response (serum IL-6 and serum CRP) and local inflammatory response (DOMS) 24 h and/or 48 h after a resistant exercise. Besides, compared with a supplementation before a resistant exercise, it's more effective to supply BCAA plus glucose after the exercise immediately for reducing body’s exercise-induced inflammatory response damage.

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**OR-030**

**Influences of Four Weeks Intermittent Hypoxic Training on Aerobic Ability of High-Level Race Walking Athletes**

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**Objective** Altitude training is an important training method for endurance athletes to improve aerobic capacity. Endurance athletes take advantage of the dual stimulation of hypoxia in the altitude environment and hypoxic during training to improve their exercise capacity and physiological function. However, due to the high stimulation of altitude training, the difficulty of recovery and other characteristics, and with the appearance of hypoxic installation, a series of new training methods have been developed. The advantage of IHT is that it can be combined with routine training, and the training altitude and training plan can be adjusted according to the actual situation. Studies in recent years have shown that IHT has some advantages in achieving better athletic performance: (1) IHT can prevent athletes from having sleep disorders and dehydration, which are typical symptoms of prolonged exposure to high altitude environments; (2) The recovery after IHT training is performed under normoxic conditions, which can prevent the athletes from the harmful effects of prolonged hypoxia, and shorten the recovery time after training; and (3) the time spent apart from training under hypoxic conditions may be used for normal training activity.

The study intended to develop a appropriate four-week IHT plan, which would be integrated into the training of five high-level race walking athletes in the winter training and with the plain training period, full attention to the combination of special training, hoping to achieve better training effect. At the same time, through the test of aerobic capacity-related indicators, explored the influences of four-weeks IHT on specific ability of high-level race walking athletes. This study will be of great significance to guide the race walking training in the future.

**Methods** Five high-level male race walking athletes(20.6±2.5 y, 175±7.7 cm, 57.4±9.1 kg) provided informed consent to participate in this study. They would be conducted to four weeks of routine training and four weeks of IHT training. IHT was performed for four weeks, three times a week, about three hours each, in a hypoxic laboratory at an altitude of 2500 m and an oxygen concentration of about 15.3%. Each week, athletes would do aerobic walk training (10 km~15 km, 85%AT), intermittent walking training (2 km*5~2 km*6, 90-100%AT) and special endurance walking training (16 km~20 km, 80%AT). The training programs
for routine training and hypoxic training were all consistent. Blood test and treadmill incremental load test were performed before and after the two trainings. In the blood test, the functional indexes such as RBC, Hb, Hct, CK and BU were recorded. In the incremental load test of treadmill, the initial speed was 9 km/h, added 1 km/h every 3 minutes, and HR, BLA, VO2 were recorded indicators of aerobic capacity. During the routine and hypoxic training, the athletes wore heart rate monitors and oxygen saturation meters throughout the course of training and recorded the heart rates and oxygen saturations before and after training.

Statistical analyses were undertaken using the SPSS software (Version 20). All test results were presented as mean ± SD, and the mean of relevant indicators before and after hypoxic training were analyzed using the paired sample T-test, as p<0.05, with significant difference, as p<0.01, with significant significance differences.

**Results** There was no significant difference in blood lactate and maximal oxygen uptake in post-routine training compared with pre-routine training, and heart rate was significantly different (p<0.01); post-IHT compared to pre-IHT, there was a significant difference in the heart rate and oxygen uptake (P<0.05), but the difference in blood lactate was not significant (P>0.05). Before and after the two trainings, there were no significant differences in blood parameters such as CK, BU, RBC, Hb, and Ferri (P>0.05). After routine training, the maximum speed increased from 13.2±0.64 km/h to 13.4±0.55 km/h, and the maximum heart rate of anaerobic threshold decreased from 194.7±10.17 beats/min to 188.6±12.18 beats/min. During the intermittent hypoxia training, the oxygen saturation in the quiet state and after training gradually increased. Among them, the maximum heart rate of anaerobic threshold decreased from 188.6±12.18 beats/min to 182.8±8.35 beats/min, and the maximum walking speed increased from 13.4±0.55 km/h to 13.8±1.1 km/h. After intermittent hypoxia training, HRAT and %HRmax increased, while HRmax decreased. The increase in HRAT and %HRmax indicated that the proportion of aerobic energy supply had increased in incremental loads. The decrease in HRmax indicated that the athletes' heart and lung function had improved after training.

VO2max is one of the major determinants of endurance exercise capacity. It reflects the ability of the body to ingest, transport and utilize oxygen. It is a good index for evaluating cardiopulmonary function and aerobic endurance of athletes. The anaerobic threshold (AT) refers to the body in the process of incremental loads, means the critical point from the aerobic energy supply to anaerobic energy supply. Evaluation of the body's aerobic capacity is not only dependent on VO2max, but also closely related to AT. VO2max mainly reflects the cardiopulmonary function and skeletal muscle metabolism, while AT can reflect the utilization of VO2max when lactic acid begins to accumulate, which can reflect the utilization of oxygen by skeletal muscle. Zhang compared the anaerobic threshold ventilation and heart rate anaerobic threshold, pointed out that the test condition of the ventilation anaerobic threshold is demanding, it is difficult to achieve in general, and use of heart rate monitoring training is simple and easy to operate. Ham's Study also pointed out that lactic acid anaerobic threshold requires blood, ventilation anaerobic threshold requires expensive equipment and manpower, and heart rate anaerobic threshold to estimate anaerobic threshold is more appropriate. The point at which heart rate begins to increase non-linearly is usually called the anaerobic threshold heart rate (HRAT). In this experiment, the results of HRAT, anaerobic thresholds / maximum heart rate (% HRmax) were analyzed. After hypoxic training, HRAT, % HRmax increased, while HRmax decreased. Increases in HRAT and % HRmax indicated that there is an increase in the proportion of aerobic energy supplied during incremental loads. The drop in HRmax indicated that athletes improved cardiorespiratory fitness after training.

After four weeks of routine and hypoxic training, RBC, Hb, Hct decreased. Wilber mentioned in his article, there was no relevant research that RBC production-related transferrin receptor, RBC volume, Hct quality had increased. Park conducted a meta-analysis of eight sports of elite athletes and found that hypoxic training for more than three weeks, three times per week, and one hour each can improve blood oxygen delivery and aerobic capacity, reflected in RBC, Hb and other related indicators. Levine related studies have shown that hypoxic training exercise performance improvement is not the role of hematological mechanisms, but the skeletal muscle mitochondria, capillary fiber ratio, the changes in fiber cross-sectional area. The reason for this may be related to the duration of hypoxic exposure in the experimental protocol and the training
intensity stimulating RBC production had not been reached or the body was still in an adaptive state. Increasing the duration of hypoxic exposure may result in an increase in RBC levels. In addition, because of individual differences, each athlete has his/her own range of the best parameters of blood cells, even if the relevant indicators are not high, but can complete the corresponding training plans. Besides of individual differences, it is also possible to reduce blood cell parameters during periods of intensive training due to excessive body exhaustion, as long as proper adjustment is made before the competition, a athlete can still be in the best condition. **Conclusions** After 4 weeks of IHT, the heart rate anaerobic threshold of high-level race walking athletes has been increased, indicating that aerobic energy ratio has been increased and aerobic capacity has been improved. After 4 weeks of IHT, the RBC, Hb and other hematological indicators of high-level walking athletes do not improve.

**OR-031**

**Mechanism of free-wheeling exercise attenuating muscle atrophy in SAMP8 mice**

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**Objective** Muscle atrophy is a decrease in the volume and number of skeletal muscle cells, decreased muscle strength, and increased connective tissue and fat as the patient ages, and clinical symptoms syndrome characterized by decreased physical function, falls, weakness, and varying degrees of disability. It is estimated that approximately 5-13% of the elderly over the age of 60 are affected by muscle atrophy. Studies have shown that increased myocyte apoptosis and decreased levels of autophagy are involved in the development of muscle atrophy. At present, appropriate exercise has been considered as an economical and convenient way to reduce muscle atrophy, delay aging, and activate autophagy. The molecular mechanism remains to be further studied. The aim of this study was to investigate the effect and mechanism of 8-week free-wheeling exercise on muscle atrophy in rapid aging model SAMP8 mice, in order to provide a theoretical basis for exercise training to improve muscle atrophy and inhibit apoptosis.

**Methods** Twenty-four SAMP8 male mice of 7-month-old SPF were randomly divided into control group (Con), exercise group (V), and exercise combined with autophagy inhibitor chloroquine group (VQ), with 8 rats in each group. The Con group was fed routinely without any intervention for a total of 8 weeks. After 8 weeks, the mice were sacrificed by cervical dislocation, and the gastrocnemius muscle tissue was taken immediately. The apoptosis of skeletal muscle and the expression of aging-related proteins were detected by Western-blot. Test indicators include BAX, Ac-p53, p21, and p16. All experimental data were analyzed by statistical software and showed significant differences at P < 0.05.

**Results** Western-blot results showed that compared with the Con group, the expression of apoptosis-related protein BAX and aging-related proteins AC-P53, p16, and p21 were significantly decreased in the skeletal muscle of the V group (P<0.01). In the VQ group, the protein expression of BAX was significantly increased (P<0.01), and the protein expression of AC-P53, p16 and p21 also increased (P<0.01).

**Conclusions** The above Western-blot results indicate that free-wheeling exercise significantly inhibits skeletal muscle cell apoptosis in aged mice and reduces muscle atrophy. At the same time, under the action of free-wheeling exercise combined with autophagy inhibitor chloroquine, the apoptosis-related protein and aging-related protein increased abnormally, suggesting that free-running movement may inhibit apoptosis and delay muscle atrophy by activating autophagy. Further research is needed.
OR-032

Effects of Protein Supplement Timing during 4-Week Resistance Training on Muscle Hypertrophy in Males

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Objective Nutrient timing is a new system of exercise nutrition that can help improve strength and lean body mass in a short time and does not require a change in exercise plan and energy intake. The concept of nutrient timing began to be used to solve problems such as the stagnation of muscle strength growth in high-protein diets, high quality proteins to gain weight and strength, but to obtain and utilize nutrient supplements at the right time to maximize muscle growth. Therefore, it is necessary to supplement the appropriate nutrients at different times.

At present, some studies have found that the type and protein supplementation timing have some influence on the resistance training of high-level athletes. Protein supplementation before or after exercise plays a positive role in improving sports performance, recovery after exercise, muscle hypertrophy and muscle strength improvement. Due to the different types, dosage and time of protein supplementation, there are still some differences.

It is still necessary to study the effect of nutrient timing of whey protein and the CEUS on the morphological indices of the rectus femoris. Therefore, by observing the thickness, circumference and area of the rectus femoris, we observed the effect of different nutrient timing and lower limb strength training on the shape of rectus femoris in healthy male youth. It is suggested that the different timing and dosage produce different effects and provide scientific suggestions for the later strength training and whey protein supplementation.

Methods A total of 32 healthy male students participated in a randomized, double-blind, placebo-controlled study. Subjects were randomly divided into four groups, the control group (Group A), the pre-exercise supplementary group (Group B), the after-exercise supplementary group (Group C) and both pre-exercise and after-exercise supplementary group (Group D), which were supplemented by: two bottles of placebo before and after the training in Group A, two bottles of whey protein water before training and two bottles of placebo after training in Group B, two bottles of placebo before training and two bottles of whey protein water after training in Group C, two bottles of whey protein water before and after training in Group D. The bottles of supplements before training should be supplemented half an hour before the start of training, and the bottles of supplements after training should be supplemented within half an hour after training. Each bottle of whey protein water was 350ml which contained 15g whey protein. The training method was 70% 1RM for barbell squat, 4 sets of 10 times, each set rest for 60s. Three training sessions were conducted each week, and the training lasted for four weeks. During this period, in order to deal with the training effect, at the end of the second week, we performed a maximum squat strength test to adjust the training intensity for the following two weeks. The body composition test used GE lunar IDXA, a dual-energy X-ray scanning method and the indexes were body weight, muscle mass and FFM. The CEUS used GE Vivid 7 holographic Color Doppler Ultrasound Diagnostic system. The test sites of CEUS were in the anterior superior iliac crest and the upper margin of the patella 1/4, and the indexes were the thickness of the femoral rectus femoris, the circumference of the rectus femoris, and the cross-sectional area of the femoral rectus femoris. Tests were performed before and after 4-week resistance training. After the intervention, the variance of paired sample t test and One Way ANOVA were used to test the significance of each group.

Results According to the change of the body composition, compared with the control group (Group A), the FFM of Group B, Group C and Group D were decreased, but there were no significant differences (p>0.05). The muscle mass of Group C increased from 54.53±4.64 kg to 58.54±5.82 kg, and muscle mass of Group D increased from 55.74±4.09 kg to 58.75±4.74 kg, compared to group A, Group C and Group D had significant increase in muscle mass (p<0.05). Body composition is mainly composed of adipose tissue and lean tissue, the body composition is
influenced by the acquired factors, resistance training will also decrease the FFM and the increase the lean weight. Combined with 4-week resistance training with protein supplementation, we can see that the FFM in Group B, Group C and Group D declined a lot, which may be related to protein supplementation. The muscle mass of Group C and Group D were significantly improved, it was indicated that after resistance training, protein supplementation can improve muscle mass, but there was no differences between Group C and Group D, which indicates that the increase of protein supplementation has little effect on the increase of muscle mass, which may be due to the increase of protein supplement, the amount of muscle synthesis will increase, but the amount of decomposition will increase, too. In addition, the changes in the synthesis and decomposition, resulting in little change in muscle mass.

About the morphological changes of rectus femoris in dominant leg, compared with the control group (Group A), the thickness of the rectus femoris (changed from 12.55±3.94 mm to 16.71±3.04 mm), the circumference of the rectus femoris (changed from 8.38±1.98 cm to 10.08±1.79 cm), the cross-sectional area of the rectus femoris (changed from 3.64±1.91 cm² to 5.43±1.61 cm²) in Group C and the thickness of the rectus femoris (changed from 14.12±2.33 mm to 15.91±2.10 mm) in Group D were significantly increased (P<0.05). The thickness of the rectus femoris, the circumference of the rectus femoris, the cross-sectional area of the rectus femoris in Group B and the circumference of the rectus femoris and the cross-sectional area of the rectus femoris in Group D were also increased, but there were no significant changes (p>0.05).

About the morphological changes of rectus femoris in non-dominant leg, compared with the control group (Group A), the thickness of the rectus femoris (changed from 13.54±3.82 mm to 16.77±3.37 mm), the cross-sectional area of the rectus femoris (changed from 4.07±2.11 cm² to 5.42±1.86 cm²) in Group C and the thickness of the rectus femoris (changed from 13.46±2.91 mm to 16.39±1.24 mm) in Group D were significantly increased (P<0.05). The thickness of the rectus femoris, the circumference of the rectus femoris, the cross-sectional area of the rectus femoris in Group B, the circumference of the rectus femoris in Group C and the circumference of the rectus femoris and the cross-sectional area of the rectus femoris in Group D were also increased, but there were no significant changes (p>0.05).

It could be seen from the results that the thickness, circumference and cross-sectional area of rectus femoris in Group C and Group D had a significant increase, and the change in Group B was not significant, indicating that after resistance training, protein supplementation will have better effects, more conducive to promoting the synthesis of muscle protein, so that the morphology of muscle was more obvious. From the comparison between Group C and Group D, we can see that the morphology of the rectus femoris in Group C has a significant change, although there were significant changes in the thickness of the rectus femoris in Group D, there was no significant increase in the circumference and cross-sectional area of the rectus femoris, which showed that the increase of protein supplementation had little effect on the morphology of the rectus femoris. This may be related to the synthesis and decomposition rate of the muscle, the increase in protein intake, to some extent, accelerated the rate of muscle synthesis, but the rate of decomposition of the muscle will also be accelerated, the synthesis rate and the rate of decomposition to achieve a positive balance. The rectus femoris of Group D will have a significant increase, but compared to group C, the effects were not obvious.

**Conclusions** For the nutrient timing of the whey protein, taking whey protein after exercise is the better timing to improve the thickness, circumference, cross-sectional area of rectus femoris and the muscle mass by the lower limb resistance training for males. There is a certain effect on the reduction of body FFM, but no significant improvement is found. The increase of whey protein supplementation may have little effect on body composition and muscle hypertrophy.
OR-033
Alterations in Inflammatory Markers and Hepatic Lipid Accumulation following Dietary and Exercise Intervention of Obese Rats

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Objective This study aimed to investigate the effects of diet and different exercise training: High Intensity Interval Training (HIIT) and Continuous Training (CT) on body mass gain, serum inflammatory markers and hepatic lipid accumulation of obese rats.

Methods Male Sprague-Dawley rats were fed with a normal standard diet (N) or a high fat diet (H; 45% kcal as fat) for eight weeks without exercise stimuli. Obese rats were defined as increased at least 20% body weight than normal diet rats. After this period, N rats were continue fed with a normal diet (N), and half of obese rats were fed with a normal diet (ON), while the other half were continue fed with a high-fat diet (OH). Each diet type group was then divided into three subgroups, control (NC, ONC, OHC groups), High Intensity Interval training (NHI, ONHI, OHHI groups) and Continuous Training (NCT, ONCT, OHCT groups) (n=10). The interval and continuous straining consisted of a swimming exercise performed over eight weeks. Body weight, serum inflammatory markers, plasma and liver lipid concentrations were measured.

Results Obese high fat diet rats showed greater body mass gain, visceral adipose tissue (VAT) mass, serum low density lipoprotein (LDL), triglycerides (TG), total cholesterol (TC), and serum inflammatory markers (MCP-1, IL-1β, TNF-α) in values than normal diet rats (OHC versus NC). In contrast, for the obese normal diet rats, no significantly difference was observed compared with normal diet rats on VAT weight, serum lipids, inflammatory markers except MCP-1 (ONC versus NC). On the other hand, the trained groups of obese high fat diet rats showed lower values of body and VAT weight, serum lipids, inflammatory markers levels compared with the OHC group and CT showed more remarkable effect than HIIT except on VAT weight, serum IL-1β levels (OHHI versus OHC and OHCT versus OHC). However, the significantly positive effect of CT on obese normal diet rats was only observed on serum TG, LDL and MCP-1 levels (ONCT versus ONC). In addition, compared to normal rats, hepatic wet weight (HWW), liver triglycerides (TG) in the OHC group presented obvious high level (OHC versus NC), no differences were exhibited between ONC and NC groups. Interestingly, HIIT but not CT significantly deceased liver TG content compared with OHC group (OHHI versus OHC and OHCT versus OHC), which consistent with liver oil red O stain images as well as higher hepatic CPT-1 level.

Conclusions Both training methodologies were shown to be effective in controlling body mass gain and adiposity levels in high-fat diet fed obese rats, HIIT displayed more positive effect on hepatic lipid accumulation. Additionally, diet and exercise was more effective than exercise alone in reducing body weight, VAT mass, serum inflammatory and liver TG content.

OR-034
The parvalbumin positive neuron involved the regulation of motor cortex excitability in the exercise-induced fatigue

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Objective Cortical parvalbumin-expressing inhibitory neurons (PV) control the activity of excitatory neurons and regulate their spike output. The present experiment is to determine the
role of PV neuron in the regulation of excitability of primary motor cortex (M1) during the exercise-induced fatigue and possible molecular mechanism.

**Methods** Male Wistar rats randomly divided into control group (C), exhaustive exercise group (E) and repeated exhaustive exercise group (RE). The gradually increasing load treadmill exercise-induced fatigue model was employed in the Group E and RE. The in vivo multi-channel recording methods was used for recording the neuronal electrophysiological activities of primary motor cortex. To observe the neuron firing rate changes during the rest state, immediately after exhausted exercise and after repeated exhaustive exercise. We also detected the expression of PV positive neurons in the primary motor cortex by the immunofluorescence method. The western blot method was used to determine the expression of calmodulin-dependent protein kinase II (CaMKII), phosphorylated calmodulin-dependent protein kinase II (pCaMKII) and extracellular signal regulated kinase (ERK) in the primary motor cortex.

**Results** The electrophysiological results indicated that the neuron firing rate after repeated exhausted exercise significantly decreased compared with the rest state (P<0.05), but have no significantly changes as compared with exhausted exercise; The expression of PV positive neurons in the group of E and RE significantly increased compared with the group C (P<0.01); The western blot results indicated that the protein expression of ERK in group RE significantly decreased compared with group C, the pCaMKII expression of group RE decreased, but have no statistical difference.

**Conclusions** After exercise-induced fatigue, the increase of PV positive neuron maybe one reason for the excitability changes in primary motor cortex. The alterations in the electrical signal may be participate in the regulation of exercise-induced fatigue. pCaMKII and ERK signal pathway may involvement in the molecular mechanism of exercise-induced fatigue.

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**OR-035**

**Effect of Aerobic Training on the Exercise Capacity of Apelin Knock-out Mice**

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**Objective** Aerobic training is considered to be an effective way to enhance the body’s exercise capacity which is closely related to the improvement of skeletal muscle energy metabolism. And as a new myokine, apelin has been found to play a key role in regulating the energy metabolism of skeletal muscle. However, whether the loss of apelin gene affects exercise capacity and what role aerobic training play in it remains unknown. This study was designed to investigate the effect of apelin on exercise capacity during aerobic training and to provide a theoretical basis for the mechanism of aerobic exercise affecting exercise capacity.

**Methods** Male C57BL/6J wild type mouse (n=20) and apelin knock-out mouse (n=20) were assigned by random allocation to four groups (n=10): wild type control (WC), wild type exercised (WE), apelin knock-out control (KC) and apelin knock-out exercised (KE). Exercise training consisted of treadmill running 60 minutes/day × 6 days/week for 4 weeks. The training intensity corresponded to the 70-75% maximum oxygen uptake of mice. The running speed was 15m/min with an incline of +5° in the first 2 weeks and subsequently adjusted to 20m/min according to the maximum oxygen uptake in the last 2 weeks. On the day after training, all groups were forced to perform an incremental exercise test to exhaustion. This test was started with an incline of +5° and a speed of 10 m/min for 5 min. After this initial phase, the speed was progressively increased by 3m/min every 3 min until animal exhausted. The maximum running speed, movement time and distance were recorded during the test.

**Results** Compared with group WC, the maximum running speed, movement time and distance of group KC were significantly decreased (P<0.01). And the maximum running speed, movement
time and distance of group KE were clearly higher than those of group KC (P<0.01). There is no significant difference between group WE and group WC, and between group KE and group WE.

**Conclusions** The exercise capacity of mice was significantly decreased because of knocking out the apelin gene, and the exercise ability of apelin knock-out mice can be clearly enhanced by aerobic training.

**OR-036**

Aerobic exercise activates CHI3L1/PAR2 to promote cardiomyocyte proliferation and protect cardiac function in rats with MI

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**Objective** The aim of this study is to investigate the changes of protein expression of chitinase-3-like protein 1 (CHI3L1) and its receptor PAR2 (protease-activated receptor 2) after exercise, and the possible mechanism to promote the proliferation of cardiomyocytes and protect MI rats heart.

**Methods** Using rhCHI3L1 (150 ng/ml), AMPK agonists (AICAR, 50 mM) separately or together administer stimulation for 24 hours. H9C2 cells were divided into control group (H9C2 group), CHI3L1 recombinant protein intervention group (H9C2+rhCHI3L1), AMPK agonist intervention group (H9C2+AICAR), and CHI3L1 recombinant protein and AMPK agonist combined intervention group (H9C2+rhCHI3L1+AICAR). SD rats were subjected to left anterior descending (LAD) coronary artery ligation to prepare MI models and randomly divided into sham operation group (S), myocardial infarction group (MI), myocardial infarction aerobic exercise group (ME), and injection of PAR-2 blocker agent (FSLLRY-amide) was divided into 7-day PAR2 blocker injection group (7d+FS), MI 7-day saline injection group (7d+SA), MI 14 days PAR2 blocker injection group (14d+FS), MI 14-day saline injection group (14d+SA). One week after surgery, the ME group were subjected to one-week adaptively exercise followed by four weeks aerobic exercise. At the end of the training, the rats were intraperitoneally anesthetized the next day. Hemodynamic measurements of LVEDP, ±dp/dt max, and LVSP were used to evaluate cardiac function. The protein levels of CHI3L1/PAR2, pPI3K/PI3K, pAKT/AKT, pERK/ERK and Cyclin D1 in H9C2 and rat hearts were determined by Western blotting. The proliferation of H9C2 was detected by CCK-8. The proliferation of H9C2 and cardiac tissue was observed by immunofluorescence. Masson staining was used to observe myocardial collagen volume percent (CFV%).

**Results** Compared with H9C2 control group, the expression of CHI3L1, pPI3K/PI3K, pAKT/AKT, pERK/ERK, and Cyclin D1 protein increased significantly after rhCHI3L1 and AICAR intervention for 24 h, respectively. CCK-8 test and immunofluorescence indicated that H9C2 had significant proliferation effect. In MI rat heart, compared with MI group, the expression of CHI3L1, pPI3K/PI3K, pAKT/AKT, pERK/ERK and Cyclin D1 protein in ME group increased significantly, the number of cell proliferation increased, and LVEDP significantly decreased, ±dp/dt max, LVSP significantly increased, and the CFV% decreased significantly.

**Conclusions** Exercise may promote cardiomyocyte proliferation and improve cardiac function in MI rats by activating the CHI3L1/PAR2-PI3K-AKT-ERK signaling pathway.
OR-037
The Effect of Exercise on Inflammatory Factors in Breast Cancer Patients: A Meta-analysis

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Objective Breast cancer is one of the most common malignant tumors that threaten the physical and mental health and even life-threatening of women worldwide. Chronic inflammation plays a key role in the occurrence, progression and recurrence of cancer. Several sources of evidence indicate that exercise during and after breast cancer could positively modulate the tumor microenvironment. The purpose of this meta-analysis is to determine the impact of exercise training on inflammatory factors in breast cancer patients.


Results Pooled analyses revealed compared with the control group, the exercise group significantly improved the serum concentration of IL-8 (Z=0.07, SMD=-0.02, 95%CI:[-0.47, -0.44], p=0.946) and TNF-α (Z=2.10, SMD=-0.60, 95%CI:[-1.16, -0.04], p=0.036). No significant differences were found in the serum concentrations of IL-2 (Z=1.96, SMD=-0.69, 95%CI:[-1.37, 0.00], p=0.05), IL-6 (Z=0.40, SMD=-0.12, 95%CI:[-0.69, 0.45], p=0.686), IL-10 (Z=1.73, SMD=-0.45, 95%CI:[-0.95, 0.06], p=0.084) or C-reactive protein (Z=0.18, SMD=-0.03, 95%CI:[-0.35, 0.41], p=0.861).

Conclusions Exercise training can effectively improve some inflammatory factors in breast cancer patients and may affect tumor microenvironment. These findings provide a theoretical basis for the promotion of sports in this population.

OR-038
CHANGE of SERUM TESTOSTERONE and ENDOCRINE INDEXES after CRYOTHERAPY in DIFFERENT AGE GROUPS

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Objective Ultra-low Temperature Whole-Body Cryotherapy can relieve pain, inhibit inflammation, improve sleep quality, promote immune regulation, reduce excessive muscle tone, and improve damaged joints and muscle function. Currently, it is widely used in competitive sports. There have been few studies on the effects of Ultra-low Temperature Whole-Body Cryotherapy on some endocrine indexes such as testosterone. In the previous study, it was found that the 25-year-old soldier had a good effect on the changes of hormones and other indicators after the cold treatment the next morning and after a week of cold treatment. However, the impact of Ultra-low Temperature Whole-Body Cryotherapy on large age groups with a marked decline in testosterone
secretion has not yet begun. Therefore, this study intends to pass a rigorous controlled experiment, taking ordinary healthy men aged 20 and 40 as research subjects, to observe the changes of testosterone and other endocrine indicators before and two hours after cryotherapy for 2 different age groups. Investigate deeply of the changes in testosterone and other endocrine indicators after ultra-low cryotherapy in the general population of different ages, to provide more reference for the application of ultra-low temperature cold therapy in a wider population.

Methods Eight male students with age of 22.0±0.8 yrs in the physical fitness class of Beijing sport university as group A. Eight healthy men with age of 42.2±4.5yrs as group B. The cold therapy parameters used in the experiment were -130 °C ,for 150 s. The blood samples collected in group A were from 8:00 to 9:00 in the morning immediately after cold therapy, 30 minutes after cold therapy, and 2 hours after cold therapy. In group B were collected before cold treatment and 2 hours after cold treatment. In order to avoid the influence of the time rhythm of testosterone secretion, the time points of blood sample collection during cold therapy and non-cold therapy were strictly consistent. Group A and group B were compared before and after cold treatment at the same time at room temperature. No statistical comparison was made between groups A and B. The test indicators were testosterone (T), follicular stimulating hormone (FSH), luteinizing hormone (LH) and estradiol (E2). The data obtained from the experiment were expressed by mean and standard deviation, and the relevant indicators collected were statistically analyzed.

Results (1) Compared with the test value of before cryotherapy, Testosterone(T) in group A had a decrease of -7.8%, -13.4%, and -3.6% at the point of the cryotherapy finished immediately, 30 minutes after cryotherapy, and 2 hours after cryotherapy, respectively. There has been a continuous decline in the Control group with a decrease of -5.7%, -11.3%, and -12.0%, respectively. Compared with the test value of before cryotherapy, there was a significant difference at each time between the cryotherapy group and the control group; there was also a significant difference between the two groups at 2 hours after the cryotherapy. (2) Compared with the test value of before cryotherapy, FSH in group A increased 8.6% after cryotherapy immediately, increased 2.3% at the time of 2 hours after cryotherapy. However, the control group showed different degrees of decline, with a decrease of -4.09%, -6.9%, and -6.4%, respectively. And there were significant differences in FSH between the time point of after cryotherapy immediately and 30 minutes after cryotherapy compared with before cryotherapy. (3) Compared with the test value of before cryotheraphy, group A had an increase of 7.9% in LH immediately after Cryotherapy and 1.0% in 2 hours after cryotherapy, while the control group showed different degrees of decline, with a decrease of -13.4%, -13.5% and -8.0%. (4) Compared with the test value of before Cryotherapy, group A showed different degrees of decline in E2 as immediately after cryotherapy, 30 minutes after cryotherapy and 2 hours after cryotherapy with the decrease ranges of -8.6%, -21.9% and -35.2% respectively. The changes of the control group were 8.7%, -18.7% and -22.6%, respectively. There were significant differences between the cryotherapy group and the control group at 30 minutes and 2 hours after the cryotherapy compared with before the intervention.(5) Before cryotherapy and 2 hours after cryotherapy, FSH and LH in group B decreased in cryotherapy and control, but the decrease in cryotherapy group was higher than control group; The change of T was different from FSH and LH. After the cryotherapy, the cryotherapy group showed a significant increase, which was 27% higher than before the cryotherapy, while the control group decreased by -7.5%, and there was a significant difference in T between the cryotherapy group and the control group before and after cryotherapy.

Conclusions (1)Ultra-low Temperature Whole-Body Cryotherapy has a certain degree of influence on the hypothalamic-pituitary-gonadal (H-P-G) axis. Testosterone will increase 2 hours after cryotherapy, and Ultra-low Temperature Whole-Body Cryotherapy can promote testosterone secretion.(2) Ultra-low Temperature Whole-Body Cryotherapy can reduce the decomposition of testosterone and improve serum testosterone to some extent. (3) Ultra-low Temperature Whole-Body Cryotherapy is more effective in promoting testosterone secretion in people with relatively high age and testosterone secretion relative to the downhill stage (35-40 years old and older).
OR-039
Normal-weight obesity and physical fitness in Chinese university students: an overlooked association

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Objective The primary aim of this study was to examine the associations of normal weight obesity with physical fitness in Chinese university students. As a secondary aim, we assessed whether possible differences in physical fitness between students classified as NWO and normal weight non-obese (NWNO) were mediated by skeletal muscles mass.

Methods A total of 383 students (205 males and 178 females, aged 18–24 years) from two universities volunteered to participate in this study. Body height and weight were measured by standard procedures and body composition was assessed by a bio-impedance device (InBody 720). NWO was defined by a BMI of 18.5 - 23.9 kg/m² and a body fat percentage of > 20% and > 30% in male and female students, respectively. Physical fitness was measured using a 10-min intermittent endurance running test (Andersen test), counter movement jumps (CMJ) and a 5 × 5-m shuttle run test (5mSR). The level of leisure time physical activity (PA) was assessed by a questionnaire.

Results 13.7% of male and 27.5% of female students were classified as NWO. Compared to NWNO, students classified as NWO showed a significantly poorer performance on the Andersen test (males: 1146 ± 70 m vs. 1046 ± 95 m, females: 968 ± 61 m vs. 907 ± 67 m, p < 0.001), CMJ (males: 55.0 ± 7.6 cm vs. 44.9 ± 7.5 cm, females: 39.8 ± 8.0 cm vs. 33.7 ± 5.9 cm, p < 0.001), 5mSR (males: 18.7 ± 1.0 s vs. 20.0 ± 0.9 s, females: 21.1 ± 1.1 s vs. 22.4 ± 1.3 s, p < 0.001), respectively. The lower levels of physical fitness in NWO were partially explained by lower skeletal muscle mass (p < 0.001) both in male and female students.

Conclusions NWO was associated with poorer physical fitness and the relationship was partially mediated by lower skeletal muscle mass. The study indicated that attention should be paid for the potential hidden health risk in university students with normal body mass index but excessive fat mass.

OR-040
Effect of leptin on mRNA expression of the leptin-JAK-STAT3 signaling pathway in testicular interstitial cell culture of obese male mice after exercise

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Objective Leptin is a protein product of obesity gene expression, and in early stage of foodborne obesity induced leptin resistance, it is possible to inhibit testosterone synthesis by reducing the leptin-jak-stat3 signaling pathway. Exercise can affect this pathway, reducing the inhibition of
testosterone synthesis, thereby improving male reproductive function due to obesity. In this study, we investigated the effect of exogenous leptin on the mRNA expression level of the leptin-JAK-stat3 signaling pathway in the testicular mesenchymal cells of obese mice.

**Methods** Four weeks old male C57BL/6J mice who had just been weaned were divided into NC (normal control) group and NE (normal exercise) group. There was no significant difference in body weight between the two groups (p>0.05). The NC and NE groups continued to feed on the normal diet, while the OHC and OHE groups continued to feed on the high-fat diet. The NE and OHE group performed platform exercise (v=20m/min, t=60min), with 6 days of exercise per week (Monday to Saturday, Sunday rest) for 8 weeks. After cervical dislocation, male mice were subjected to testicular mesenchymal cell culture with leptin intervention concentration of 10-9mol/L. Culture was divided into groups: the groups without intervention were NC-0, NE-0, OHC-0 and OHE-0. The leptin intervention groups were NC-L, NE-L, OHC-L and OHE-L. The relative expression of leptin-JAK-STAT3 mRNA in tissue was detected by RT-PCR after successful culture.

**Results** In the testicular interstitial cell culture tissues of male mice, compared with the NC-0 group, the relative mRNA expression of leptin in the OHC-0 group was significantly increased (p<0.01), while the relative expression of JAK2 and STAT3 mRNA was decreased (p<0.01, p<0.05). Compared with the NC-0 group, the relative mRNA expression of leptin in the NE-0 group showed an increasing trend but have no statistical significance(p>0.05), and the relative mRNA expression of JAK2 and STAT3 increased (p<0.05, p<0.05). Compared with OHC-0 group, the relative mRNA expression of leptin in OHE-0 group decreased (p<0.05), and the relative mRNA expression of JAK2 and STAT3 increased significantly (p<0.01, p<0.01). After leptin intervention, the relative mRNA expression of leptin, JAK2 and STAT3 in the NC-L group showed an increased trend compared with the NC-0 group, but there was no statistical significance (p>0.05) compared with NE-0 group, the relative mRNA expression of leptin in NE-1 group increased (p<0.05), while the relative mRNA expression of JAK2 and STAT3 increased (p<0.05, p<0.01). compared with OHC-0 group, the relative mRNA expression of leptin in OHC-1 group decreased (p<0.05), while the relative mRNA expression of JAK2 and STAT3 increased (p<0.05, p<0.05). compared with OHE-0 group, the relative mRNA expression of leptin in OHC-L group decreased (p<0.05), and the relative mRNA expression of JAK2 and STAT3 increased significantly (p<0.01, p<0.05).

**Conclusions** Obese may cause leptin resistance in the leydig cells of male mice, which may further affect the relative expression of JAK and STAT3 mRNA, and exercise can improve this situation. After leptin intervention, the sensitivity of normal mice was not high. The relative mRNA expression level of leptin-jak-stat3 signaling pathway in the normal exercise group, the obese group and the obese exercise group may reach an appropriate level, thereby increasing the expression level of testosterone synthase and improving the reproductive function of mice.

**OR-041**

**Infection of Different Altitudes on College Students’ Body Shape**

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**Objective** Considering that guizhou is located in a plateau region with various gradient altitude, and we have never seen any relevant report on the study of different altitudes influence the students' physical fitness at home or abroad. the aim of this research is the author runs a normal physical fitness test on native 774 non-PE major students who all comes from different altitudes 774, so as to provide reference standard for promoting the health of the students group.

**Methods** Literature data, fitness testing, statistic, and logic analysis.
Results 1. There was no obvious consistency between the height change of students in different attitudes indicating that the influence of different altitude environments on the height of students was not obvious. 2. Most of the students on the plateau show the thickness of the skinfold is the thickest, while the thickness of the skinfold of students on the plain and the subplateau is different and irregular. 3. There was no significant difference in the chest circumference of the four groups of students at three altitudes, indicating that the environment at different altitudes had no significant influence on the development of the respiratory organs and chest muscles of the students. 4. The waist circumference of the three groups showed no obvious pattern, indicating that the environment at different altitude had no significant influence on the waist circumference. 5. The waist-hip range of female students on the plateau is relatively high, while other students are in the ideal range. 6. The BMI of all the students in the three places is within the range of 18.5 ~ 22.9, that is, all the students in the three places are in the normal range.

Conclusions altitude has no significant effect on students' height, chest circumference, waist circumference and BMI. The thickness of skinfold of students on plateau is thicker than that of plain and subplateau students. The waist-hip range of female students on the plateau is relatively high, while other students are in the ideal range.

OR-042

Effect of exercise and dietary intervention on serum and adipose tissue metabolomics in patients with insomnia: a 6-month randomized-controlled trial

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Objective Objectives: Insomnia is common in modern society, with a prevalence between 10-20% among adults. Insomnia is associated with numerous adverse health outcomes and carries a heavy burden for health-care system. Accumulating evidences have shown that lifestyle interventions such as exercise and dietary modification could benefit sleep by mitigating symptoms of insomnia. However, the metabolic profile change in people with insomnia following exercise or diet intervention is not clear.

Methods Methods: Seventy-two Finnish men (age: 51.5 ± 10.2 years; body mass index, BMI: 29.3 ± 3.9 kg/m²) with chronic insomnia symptoms participated in this study. They were then randomly assigned into three groups: exercise (n = 24), diet group (n = 24) or control group (n = 21). Nordic walking or other aerobic exercise was performed 30 to 60 minutes per session, one to five sessions per week, at the intensity level of 60%–75% of estimated maximum heart rate. Specific individualized diet programs are developed after baseline assessments of each participant's current dietary intakes (based on three-day food diary) and body weight. Blood samples were collected in the morning between 7:00 and 9:00 a.m. after overnight fasting. In addition, subcutaneous adipose tissue biopsies were obtained from a subgroup of 20 subjects. Gas Chromatography Time-Of-Flight Mass Spectrometry (GC-TOF-MS) method was used to investigate the serum and adipose tissue metabolites. Sleep was assessed by using a non-contact sleep monitoring system. Multivariate analysis and univariate analysis were used for metabolomics data analysis.
Results Results: Sleep onset latency (SOL), wakefulness after sleep onset (WASO), and sleep efficiency (SE) were all significantly changed ($p < 0.05$) after 6-month exercise intervention, and total sleep time (TST), SOL and SE were significantly changed ($p < 0.05$) after 6-month diet intervention. A total of 223 known metabolites in serum and total of 154 known metabolites in adipose tissue were detected. Eleven metabolites were affected by exercise and eight metabolites were affected (Variable importance in the projection, VIP > 1 from (orthogonal) partial least-squares-discriminant analysis (OPLS-DA) and $p < 0.05$ from $t$ test) by diet in adipose tissue. Among the metabolites detected in serum, there were 17 metabolites affected by exercise, 21 metabolites by diet and 13 changed in the control group (VIP > 1 and $p < 0.05$). We found that in the exercise group, in serum, change of shikimic acid correlated with change of WASO ($r = -0.479, p = 0.038$) and SE ($r = 0.462, p = 0.047$), change of Cystathionine correlated with change of TST ($r = -0.545, p = 0.016$) and SE ($r = -0.6, p = 0.007$), while in adipose tissue, change of cholesterol ($r = -0.822, p = 0.023$) and Behenic acid ($r = -0.833, p = 0.02$) correlated with change of SE. In diet group, change of leucine correlated with change of WASO ($r = -0.655, p = 0.001$) and change of SE ($r = 0.499, p = 0.013$), change of Linoleic acid correlated with change of WASO ($r = -0.519, p = 0.009$) and change of SE ($r = 0.506, p = 0.012$), change of L-Allothreonine ($r = -0.460, p = 0.024$) and Erythrose ($r = -0.441, p = 0.031$) correlated with change of BMI, change of L-Rhamnose correlated with change of TST ($r = -0.480, p = 0.018$) in serum, while change of glycylproline correlated with change of SOL ($r = -0.845, p = 0.034$) in adipose. In addition, change of acetanilide correlated with change of TST ($r = -0.772, p < 0.01$), change of palmitoleic acid correlated with change of BMI ($r = -0.491, p = 0.038$) in serum but not association in adipose tissue was observed in control group.

Conclusions Conclusion: Several metabolites related to energy metabolism are altered after exercise and dietary intervention in people with insomnia. The change of these metabolites may explain partly the underline mechanisms of improvement of sleep quality through lifestyle interventions.

OR-043

UPRmt and mitophagy are selectively activated depending on muscle fiber types in insulin resistant rats

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Objective To investigate how different skeletal muscle fiber types affect development of insulin resistance, and to explore the role of mitochondrial quality control system, especially mitochondrial unfolded protein response (UPRmt) and mitophagy, in response to metabolic stresses.

Methods Male Wistar rats were randomly divided into 2 groups: fed with the normal diet for 8 weeks (Con), and fed with 45% high-fat diet for 8 weeks (IR). Fasting blood glucose (FBG), fasting insulin (FIN) and oral glucose tolerance test (OGTT) were used to identify insulin resistance model. Gastrocnemius (GC), soleus (SOL) and tibialis anterior (TA) muscle were isolated, and RT-qPCR was used to determine the expression of Myhc7, Myhc4. Oxygraph-2k was used to determine the mitochondrial State 3 (ST3), State 4 (ST4) respiration and respiration control rate (RCR). JC-1 probe was used to measure mitochondrial membrane potential. Western Blot was used to determine the expressions of marker proteins of muscle fiber types (Myhc4, Myhc7), UPRmt related proteins (Hsp60, Hsp70) and mitophagy related proteins (Pink1, LC3).

Results Compared with Con group, in IR group, FBG (7.1±1.27 vs. 5.4±0.43, $p < 0.05$), FIN (19.4±5.2 vs. 31.6±6.7, $p < 0.05$) and OGTT (area under the curve, about 31.7% increases, $p < 0.05$) were significantly higher. Myhc4 mRNA (relative fold about 55.6% increases) and protein expression (about 33.9% increases, $p < 0.05$) were significantly higher in GC. Myhc4 protein
expression was significantly higher in GC (about 60.5% increases, \( p < 0.05 \)). While Myhc7 mRNA expression (about 51.1% decreases, \( p < 0.05 \)) was significantly lower in SOL. Compared with Con group, in IR group, mitochondrial RCR in SOL muscle was significantly lower (about 22.5% decreases, \( p < 0.05 \)). Furthermore, the expression of HSP60 (about 36.7% increases, \( p < 0.05 \)) and HSP70 (about 44.3% increases, \( p < 0.05 \)) was significantly higher in TA muscle, while the expression of Parkin (about 18.8% decreases, \( p < 0.05 \)) and the ratio between LC3 II/I (about 26.0% decreases, \( p < 0.05 \)) expression in SOL muscle were significantly lower.

**Conclusions** In this study, we found that the percentage of fast muscle fibers was elevated in IR skeletal muscle, which were supported by increased Myhc4 and decreased Myhc7 level. Impaired mitochondrial function was only observed in slow muscle as inhibition of mitochondrial respiration. As marker of UPRmt, HSP60/70 were specifically activated in fast muscle in IR, while mitophagy-related proteins were specifically increased in slow muscle. These results indicate that mitochondrial quality control systems are selectively activated to recover mitochondrial functions depending on muscle fiber types in insulin resistant rat.

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**OR-044**

**Effect of Elastic Band Exercise, Brisk Walking and the Diabolo Exercise on the Serum Lipid Level of Women with dyslipidemia between 60 to 69 Years Old**

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**Objective** This study investigated the effect of elastic band exercise, brisk walking and the diabolo exercise on the serum lipid level of abnormal blood lipids women between 60 to 69 years old.

**Methods** 252 subjects were randomly divided into the elastic band exercise group (EBG), the brisk walking group (BWG), the diabolo exercise group (DEG) and the control group (CG), each group of 63 people. In the end, 186 people \( (\text{N}_{\text{EBG}}=63, \text{N}_{\text{BWG}}=45, \text{N}_{\text{DEG}}=32, \text{N}_{\text{CG}}=46) \) completed all the tests in 12 weeks due to various reasons, such as withdrawal, travel abroad, and hospitalization. The EBG and the DEG respectively carry on the self-braiding and the Diabolo exercise (DE) training for 1 h, 3 times per week for 12 weeks. Participants in the BWG wore pedometers for brisk walking, 5 times per week, and 8,000 to 10,000 steps per time. The CG did not intervene. Measurement on height, body weight, TG, TC, HDL-C, LDL-C were made at two time points—baseline, 12 weeks.

**Results** After 12 weeks of exercise, TG, TC and LDL-C levels of the EBG, BWG and DEG were significantly lower than those in the pre-test group, and the difference was statistically significant, there was no significant change in the control group. The average level of HDL-C in the BWG and DEG was higher than that before the experiment, and the difference was statistically significant. The average level of TG change rate \( (P_{50}=0.16) \) of DEG was greater than EBG \( (P_{50}=0.09) \) and BWG \( (P_{50}=0.05) \), all of the experimental group were greater than the CG, and the difference was statistically significant. The average level of TC change rate of the EBG, BWG and DEG was greater than the CG, and the difference was statistically significant. The average level of LDL-C change rate of the CG \( (P_{50}=0.04) \) and the DEG \( (P_{50}=-0.08) \), and the difference was statistically significant. The EBG is compared with the BWG, and the comparison between DEG and CG, the difference was not statistically significant.

**Conclusions** The TG level in the blood was significantly reduced in the EBG, BWG and DEG, and the effect of the diabolo exercise (DE) was better than that of the elastic band exercise.
(EBE) and the brisk walking (BW). The EBE, BW and DE can significantly reduce the TC level in blood. Both BW and EBE can raise the level of HDL-C in the blood. Both the EBE and BW can reduce the level of LDL-C in the blood. Therefore, all three types of exercise can effectively regulate the Serum Lipid Level of elderly women with dyslipidemia and reduce the risk of ASCVD.

OR-045
Comparative Study on Physical Fitness in Female College Students between Different BFP Grades

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Objective Through testing the body fat percentage (BFP) and physical fitness by laboratory methods in female college students, the relationship between physical fitness and body morphology of female college students was revealed.

Methods BFP and fat free mass were measured among 633 healthy female college students randomly selected. All subjects were divided into five groups by their BFP: low, normal, high body fat, grade I obesity and grade II/III obesity. Grip Strength, Leg Strength, Back Strength, Vital Capacity, Maximal Oxygen Uptake, Reaction Time, Sit And Reach, Back Scratch and Standing On One Foot With Closed Eyes were tested.

Results There were significant differences between all groups in Grip Strength, Back Strength, Vital Capacity, the absolute and relative value of VO\textsubscript{2}\text{max}, Back Scratch on both sides and Standing on One Foot with Closed Eyes. The difference in Grip Strength and Back Strength showed significantly (P < 0.05), and the others showed very significant difference (P < 0.01). There was no significant difference in Resting Heart Rate, Reaction Time, Sit And Reach and Leg Strength. The results of multiple comparison showed that compared with 4 group, there were significant differences in Vital Capacity, relative value of Maximum Oxygen Uptake, Back Scratch in both sides in 2 group and 3 group. Moreover, compared with 5 group, there were significant differences in all the indicators in 2 group and 3 group. And there were significant differences in all the indicators except Back Strength and the relative value of Maximum Oxygen Uptake between 5 group and 4 group.

Conclusions The results showed that the physical fitness of female college students with normal BFP was significantly better than that of obese ones. The major influence of exceeding 30 percent in BFP was the cardiopulmonary endurance fitness and upper limb flexibility fitness. In the group of BFP higher than 35%, these influences were more significant, meanwhile, balance fitness declined.

OR-046
Comparative Study on the Influence of Different Resistance Ratio Settings on Speed Skaters' Anaerobic Power Test Results

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Objective Wingate 30 seconds anaerobic power test is one of the test methods to evaluate anaerobic capacity. Different resistance coefficient settings have different test results for Wingate
30 seconds anaerobic power test. The results were compared and analyzed to provide reference for setting resistance coefficient of anaerobic work test of speed skaters. Methods Ten Chinese male speed skaters were selected as subjects (18.2 ± 2.78 years old, 173.7 ± 2.63 cm and 65.5 ± 5.38 kg). The test instrument is Monark894E cycle ergomeite which is made in Sweden. Resistance coefficients were 10% and 8% of body weight. Anaerobic power test was performed on two days. Resistance load was 10% of body weight on the first day (body weight*0.1) and 8% of body weight on the second day (body weight*0.08). The preparations for the two tests were consistent, which is a warm-up of 60-80 W for 5 minutes consisting of 6 second sprint for three times and a 5 minute break until the formal trial begin. The subjects pedaled with all their strength as harder as possible, and loaded the resistance load when the pedal frequency reached the maximum. The test time was 30 seconds. The peak power, the average power and the descent rate were selected for comparative analysis. Results The peak power was 825.99 ± 148.08 W and 754.23 ± 110.85 W respectively when the resistance coefficient load was set at 10% and 8% of the body weight, the average work was 647.19 ± 108.42 W and 585.47 ± 91.13 W, and the decrease rate was 47.09 ± 3.70% and 51.34 ± 13.64% respectively. There was no significant difference between 10% and 8% resistance coefficient load. Conclusions 1. In anaerobic power test, the peak power and average power are higher when the resistance coefficient is set to 10% of body weight than 8%. 2. The descending rate was lower for the resistance coefficient was set at 10% of body weight than that of body weight at 8% when the anaerobic power tested. 3. For the anaerobic power test, the resistance coefficient setting should be based on the project's characteristics in order to more accurately reflect the anaerobic ability of athletes.

OR-047 Mechanical stretch activates glycometabolism-related enzyme through estrogen in C2C12 myoblasts

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Objective Exercise is involved with some Metabolic diseases, moderate exercise may improve glycometabolism and type 2 diabetes mellitus in menopausal female. Previous study showed that exercise increased the level of muscular estrogen in Ovariectomized rats, improved muscle mass and glycometabolism, it provided a reference to relief type 2 diabetes mellitus symptom. Until now, the effect of estrogen induced by exercise on muscular glycometabolism is not clear, the present study was designed to explore the effect of estrogen induced by mechanical stretch on glycometabolism in mouse C2C12 myoblasts. Methods The mouse C2C12 myoblasts in vitro were plated at BioFlex Culture Plate, and assigned randomly to the control group (C), stretch group (S), SA group. SA group was cultured in growth medium with 400μg/ml anastrozole (aromatase inhibitor), other groups were cultured in GM with DMSO for 36h, and then S, SA groups were stretched by Flexcell FX-5000™ system (magnitude 15%, frequency 1Hz, duration 6hours), Cellular proteins were extracted after 24h of stretch, ELISA assay was used to detect estradiol levels, we detected the expression of HK, PI3K, the ratio of p-AKT and AKT, GLUT4 protein level by Western blotting. Results Compared with the control group, a higher estradiol level was detected in stretch group (P<0.05), and the protein expression of HK, PI3K, the ratio of p-AKT and AKT, GLUT4 is higher (P<0.05) after stretching. The estradiol level and protein expression is lower in SAF group as compare to the stretch group (P<0.05), while there was no significant difference in estradiol level and protein expression between SF group and SAF group (P>0.05).
Conclusions Estrogen induced by mechanical stretch can improve glycometabolism-related enzyme and protein expression of mouse C2C12 myoblasts.

OR-048

Effects and Mechanism of myokines in exercise mediated improving obesity rats skeletal muscle remodeling

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Objective From the year 2000, many experimental research data have indicated that skeletal muscle could express, synthesis and secrete multiple cytokines and polypeptides. The cytokines and polypeptides, not only regulate skeletal muscle growth, metabolism and motor function by paracrine/autocrine pathway, but also regulate functions of peripheral tissue and organs by endocrine pathway. Further researches proposed muscle as a secretory organ played a key role in mediating the health-promoting effects of physical activity and proteins expressed and released by skeletal muscle have been termed as myokines. Disorders of skeletal muscle endocrine function have related to the occurrence and development of multiple metabolic diseases, and myokines participate in obesity skeletal muscle remodeling. This study aims to investigate the expression changes of myokines and its effects in exercise mediated improving skeletal muscle remodeling on obesity mice, and explore the underlying mechanism of its functions.

Methods Five-week-old male Sprague-Dawley(SD) rats were randomly divided into a control group of 8 and a high-fat diet (HFD) group of 16. The control group was given normal food, while the HFD group were provided with high-fat diet for eight weeks and further divided into a sedentary HFD group and a treadmill running HFD group, each of 8. The exercise mice underwent 60 min treadmill running at 26 m/min each day, 5 days/week for 8 weeks. Biochemical analyses, immune-histochemical, ELISA, RT-PCR and Western Blot methods were used to investigate multiple myokines expression changes and its mechanism.

Results 1) Exercise significantly upregulated the expression of IL-15 in soleus and gastrocnemius muscle of obesity rats, indicating IL-15 could inhibit skeletal muscle endoplasmic reticulum stress and improve insulin sensitivity. 2) Exercise significantly inhibited the expression of myostatin (MSTN) in gastrocnemius muscle and mediated the changes of muscle fiber types. 3) Exercise markedly promoted the expression of apelin/APJ and angiogenesis function in obesity skeletal muscle. 4) Exercise upregulated skeletal muscle vascular endothelial growth factor B receptor expression and improved skeletal muscle ectopic lipid accumulation.

Conclusions Exercise regulates skeletal muscle myokines expression and secretion and have the effects on skeletal muscle fiber type changes, myofiber capillary density, glucose and lipid metabolism, thus improves the skeletal muscle remodeling and maintain body homeostasis.
Objective (1) Through the blood physiological and biochemical tests during the altitude training, to analyze the body function of swimmers in this stage. (2) Through the individual lactate threshold tests before and after the altitude training, to analyze the effects of altitude training.

Methods Eight swimmers took a 26-day altitude training session. The individual lactate threshold test was carried out by the Swedish Monak839E power cycle progressive loading method before and after the training; During the altitude training period, 5ml of the subjects’ elbow vein was extracted and tested on an empty stomach and in a quiet state every Monday morning.

Results (1) When swimmers reached the plateau, the hemoglobin value was indistinguishable from the plain (male 156.2±7.01, female 135.7±8.75g/L). From the hemoglobin value (male 154.03±5.67, female 134.23±9.66g/L), there was a decrease in both male and female in the second week. But hypoxia stimulated red blood cell production, and the body itself was gradually adapting to the training load. Thus, the hemoglobin value of the third week (male 157.17±3.7, female 141.93±10.06g/L) was significantly improved, and higher than the level of the first week. During the altitude training period, the mean value of male’s blood testosterone was 474.33±97.06ng/dl, and the female’s blood testosterone was 33.67±17.25ng/dl. Male’s blood testosterone was lower than the mean of the national team, because the study participants were younger who were not fully developed and had shorter training years. There were different trends in blood testosterone value between male and female. Male’s blood testosterone values during the Monday morning of these three weeks were 479.67±76.25, 492.33±83.61, 451±153.41ng/dl respectively. Female’s blood testosterone values during the Monday morning of these three weeks were 29.33±21.83, 32±23.26, 39.67±9.29ng/dl respectively. These further indicated that this altitude training plan was more suitable for male with shorter training years, and the body had certain fatigue accumulation, but the decrease range was within a reasonable range. However, the increase of blood testosterone per week in female indicated that the training stimulation depth was not enough, and the potential of athletes should be further explored. According to the changes of creatine kinase, the sensitivity of male to the change of altitude training intensity was also shown, and the highest value of creatine kinase was 731U/L in the first week. (2) From the value of the individual lactate threshold before and after altitude training, no matter male or female, the change was not obvious, but was generally improved, this may be the altitude training adopted the pattern of three and a half weeks, training time was short. Secondly, as a professional athlete, the “plastic space” gradually decreased with the extension of the training years. Most of the peak blood lactate occurred in 1-3 minutes of recovery period, and the average value increased from 8.96±1.86mmol/L before altitude training to 9.99±1.47mmol/L. Among them, the peak value of male’s blood lactate was increased from 8±2.22mmol/L before the altitude training to 10.91±1.43mmol/L, and there was a significant difference in the peak of blood lactate before and after the altitude training. However, the peak value of female’s blood lactate was decreased from 9.92±0.79mmol/L before the altitude training to 9.07±0.88mmol/L. This was mainly due to the fact that a member of the swimmers had caused the result, and this swimmer’s enduring lactate level was lower than the one before the plateau.

Conclusions The altitude training generally improved athletes’ training ability, but based on factors such as training age, gender, should be targeted according to the individual situation of each athlete training plan, so as to achieve more from less.
OR-050
The Development of a Protein Powder Product with an integrated solution for Active Population

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Objective Sports nutrition is expanding from professional athletes to a broader spectrum of consumers focused on fitness and improving overall wellness. The recommendation of combining exercise and healthy diet has been highlighted by Health China 2030 and National Nutrition Planning, leading to increased embrace of active lifestyle among Chinese people. Along with the increasing involvement in sports comes with concerns on decreasing resting metabolic rate due to weight loss, impaired joint health and post-exercise immunological response. To confront the above-mentioned challenges, we aimed to develop a product with an integrated solution to support fitness goals while diminishing exercise-related concerns.

Methods Literature review was conducted for core ingredient screen, followed by in vitro studies to substantiate and compare efficacy of ingredients from various resources. Muscle protein synthesis was measured in myotubes during the differentiation and fusion of C2C12 myocytes. Myotube fusion density was quantified by ImageJ, an image processing program, subsequent to myotube staining.

Results Muscle mass gain enhances resting metabolic rate. It has been shown that whey protein supplementation at 20 g/d significantly increased lean muscle synthesis rate in post-exercise subjects. The efficacy of whey protein powder sourced from different resources were compared by conducting in vitro studies. A large body of evidence has shown that collagen peptide supplementation can mitigate joint pain and maintain joint health in athletic population. Yeast β-glucan was spotlighted as an immunity enhancer with antimicrobial protection and benefit in minimizing post-exercise immunosuppression.

Conclusions A protein powder containing over 20 g/serving whey protein, combining with collagen peptide and yeast β-glucan may convey beneficial effects in muscle synthesis, as well as protective effects against joint pain and post-exercise immunosuppression among active population. The combination of the above-mentioned ingredients could provide a well-round solution to confront the challenges that met by most active population.

OR-051
Exploration of Potential Integrated Biomarkers for Sports Monitoring Based on Metabolic Profiling

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Objective Metabolomic analysis is extensively applied to identify sensitive and specific biomarkers capable of reflecting pathological processes and physical responses or adaptations. Exercise training leads to profound metabolic changes, manifested as detectable alterations of metabolite levels and significant perturbations of metabolic pathways in sera, urine, and rarely, in saliva. Several metabolites have been exploited as biomarkers for generally evaluating physical states in almost all sports. However, alterations of metabolic profile caused by specific sports
would be heterogeneous. Thus, developments of new techniques are eagerly required to identify characteristic metabolites as unique biomarkers for specifically accessing training stimulus and sports performances. In the present work, we conducted both metabolic profiling and a binary logistic regression model (BRM) of biological fluids derived from rowing ergometer test with the following aims: 1) to examine changes of metabolite profiles and identify characteristic metabolites in the samples of sera, urine, and saliva; 2) to screen out potential integrated biomarkers for sports-specific monitoring.

**Methods** A total of 11 rowers (6 male, 5 female; aged 15±1 years; 4±2 years rowing training) underwent an indoor 6000m rowing ergometer test. Samples of sera, urine and saliva were collected before and immediately after the test. 1D $^1$H NMR spectra were recorded with a Bruker Avance III 650 MHz NMR spectrometer. NMR spectra were processed and aligned, resonances of metabolites were assigned and confirmed, and metabolite levels were calculated based on NMR integrals. Multivariate statistical analysis was carried out using partial least-squares discrimination analysis (PLS-DA) to distinguish metabolic profiles between the groups. The validated PLS-DA model gave the variable importance in the projection (VIP) for a given metabolite. Moreover, inter-group comparisons of metabolite levels were quantitatively conducted using the paired-sample t-test. Then, we identified characteristic metabolites with VIP>1 in PLS-DA and p<0.05 in t-test. Furthermore, we screened out potential biomarkers based on the characteristic metabolites identified from the three types of biological fluids using the BRM (stepwise).

**Results** The rowing training induced profound changes of metabolic profiles in serum and saliva samples rather than in urine samples. Totally, 44 metabolites were assigned in which 19, 20, and 19 metabolites were identified from serum, urine and saliva samples, respectively. Seven metabolites were shared by the three types of samples. Moreover, five characteristic metabolites (pyruvate, lactate, succinate, N-acetyl-L-cysteine, and acetone) were identified from the serum samples. The elevated levels of pyruvate, lactate and succinate suggested that, the rowing training evidently promoted both oxidative phosphorylation and glycolysis pathways. Furthermore, three characteristic metabolites (tyrosine, formate, and methanol) were identified from the saliva samples. Given that tyrosine is the precursor of dopamine, the increased level of salivary tyrosine in all rowers experiencing the test, suggesting that salivary tyrosine could be explored as a potential indicator closely related to nervous fatigue in the test. On the other hand, PLS-DA did not show observable distinction of metabolic profiles between the urine samples before and immediately after the test. Moreover, 20 urinary metabolites did not display detectable altered levels. We then established the BRM with the identified characteristic metabolites, from which we selected one optimal regression model based on serum pyruvate and salivary tyrosine (adjusted R square was 0.935, P<0.001), indicating that the two selected metabolites would efficiently reflect the metabolic alterations in the test.

**Conclusions** As far as the 6000m rowing ergometer test is concerned, serum samples could be a preferred resource for assessing the changes of energy metabolism in the test, while urine samples might have a relatively lower sensitivity to exercise-induced metabolic responses. Even though metabolite levels in saliva samples are generally lower than those in serum and urine samples, some salivary metabolites potentially have higher sensitivities to exercise-induced metabolic responses. Thus, the integration of multiple biomarkers identified from different type of species could potentially provide more sensitive and specific manners to monitor physical states in sports and exercise. This work may be of benefit to the exploration of integrated biomarkers for sports-specific monitoring.
OR-052
Effects of Exercise Intervention on Cancer-Related Fatigue in Breast Cancer Survivors
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Objective: Cancer-related fatigue (CRF) is the most commonly reported and most distressing symptom in cancer patients. The purpose of this study was to review the effect of exercise intervention on cancer-related fatigue in breast cancer survivors.

Methods: From 1998 to 2018 in Chinese and English literature of Wanfang Database, Pubmed, SportDiscus and Springer databases, picked out the randomized controlled trials which up to standard. Keywords: cancer, exercise, fatigue, etc. were used for systematic search and tracking. 12 experiments were reviewed to analyze the effect differences between exercise intervention and exercise-related fatigue.

Results: Most interventions use aerobic exercise as the primary form of exercise. Generally, exercise interventions are effective for cancer-related fatigue, but some findings are not. Many studies have shown that moderate intensity aerobic exercise has a significant effect on cancer-related fatigue, with 50-70% heart rate reserve and 3-5 times of exercise per week for at least 30 minutes each time. Exercise methods mainly include walking, yoga, cycling, and tai chi. Firstly, Supervised aerobic exercise was statistically more effective than conventional care in improving CRF among breast cancer survivors. It has been shown that group-based, supervised exercise produces positive psychosocial ‘side-effects’ due to social interactions, improved self-efficacy, and attention from a trainer. Secondly, Cancer fatigue is divided into acute and chronic fatigue, 18 weeks of exercise intervention can reduce the short-term fatigue, at 36 weeks, baseline levels of fatigue index responses and contrast on the issue of the multivariate statistics. Thirdly, usual-care group were reported that they had been actively engaged in regular exercise before study enrollment. During the exercise intervention, most studies on the control ways are according to the daily life or to take care of, but studies have reported, before intervention, to a high level of 40% in the control group often exercise, exercise also as usual during the intervention, which causes the control to the baseline level is higher, but the intervention group and control group will be difference, no significant difference, lead to the result is invalid.

Conclusions: First, the exercise intervention of cancer-related fatigue needs to be supervised; second, the exercise intervention is effective for short-term cancer-related fatigue; third, the daily exercise level of the control group will affect the intervention effect.

OR-053
A Comparative Study of Different Intervention Methods on Protein Expression of ERα in Uterus of Ovariectomized Osteoporosis Rats
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Capital University of Physical Education and Sports

Objective: The aim of this study was to compare the effects of different intervention methods on the protein expression of estrogen receptor alpha (ERα) in the uterus of ovariectomized osteoporosis rats.

Methods: Eighty healthy female SD rats, aged 3 months, were randomly divided into the following two groups by body weight: sham-operation (Sham) and ovariectomized (OVX). After ten weeks,
the OVX groups were randomly divided into the following six groups by body weight: OVX; 17β-
estriadiol (E₂); Genisteine (G); treadmill exercise (TE); Lithium chloride (Licl); Whole-body vertical
vibration (WBVV). Then the rats was began to be treated with different intervention methods. The
WBVV group rats were vibrated on a vibration platform twice per day for 7 weeks according to the
following schedule: 90 hertz a minute and 15 minutes a time. The TE group rats were running on
5-uphill treadmills 45 minutes per day, 4 times a week, at a speed of 18 meters per minute. The
G group rats were lavaged by genistein once per day according to body weight (dose
1mg/kg).The E₂ group rats were treated with neck subcutaneous injection with 17β-E₂ three times
a week according to their body weight (dose 25ug/kg). At the end of 8 weeks intervention, during
36-48 hours, took blood from the abdominal aorta, and extracted the protein. The
proteinexpression of ERα in uterus was detected by western blot.

**Results**

After OVX, the uterus weight index and serum E₂ was significantly decreased. Both the
uterus weight index and the serum E₂ level were significantly increased after treatment with E₂.
However, no significant differences were seen after treatment with the other four methods. As
revealed by the western blot results, the protein expression of ERα in the OVX groups was
significantly higher than that of in the Sham group. After treatment with E₂, treadmill exercise,
whole-body vertical vibration, and lithium chloride, the protein expression of ERα was
significantly lower than that of in OVX group. However, the genistein treatment had no significant difference.

**Conclusions**

Apart from genistein treatment, the other four interventions had inhibitive effects on
the protein expression of ERα in uterus of OVX osteoporosis rats.

**OR-054**

**Effect of whey protein on rehydration after exercise**

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Beijing Sport University

**Objective**

The purpose of this study is to determine the effects of a rehydration solution
containing whey protein on fluid balance after exercise-induced dehydration. The ACSM Sports
Guide recommends that healthy adults exercise moderate-intensity aerobic exercise for 30
minutes a day. This type of exercise can dehydrate the body by about 1%. Dehydration 1% affects
exercise capacity and performance. The purpose of this study was to exercise-induced
dehydration of sports drinks containing whey protein.

**Methods**

Twelve college students (20 ± 2 years, 169.9 ± 8.1 cm, 63.3 ± 13 kg) participated.
Participants reduced body mass by (0.67±0.33) after intermittent exercise and re-hydrated with a
volume of drink in liter equivalent to 1.5 times their body mass loss in kilograms of a solution of 4
kinds of drinks: Distilled water (trial C), carbohydrate-electrolyte (trial D), carbohydrate-electrolyte-
low whey protein (trial LWP) and carbohydrate-electrolyte-high whey protein (trial HWP). Solutions
were matched for carbohydrate and electrolyte content in trail D, LWP and HWP. Trials were
administered in a random, counterbalanced, crossover design, with subjects blinded as to which
drink they consumed during each trial. Each participant completed 4 experimental trials, which
were separated by at least one week. Urine samples were collected before and after exercise
(immediately, 40, 80, 120, 160 minutes later). Urine volume, drink retention, urine osmolality
and urine specific gravity were tested. Drink retention was calculated as difference between the
volume of drink ingested and urine produced.

**Results**

1. Total cumulative urine output after exercise was not different between each of the four
groups (C: 1002 ±102ml, D: LWP: HWP:, p>0.5).
2. During the study, drink retention of trail LWP is the highest (80.3±11.2%), but there was not different between each of the four groups (C: 70.5±20.6%; D: 70.7±17.9%; HWP: 75.0±12.4%,
p>0.5).
3. At the 40th minute after exercise, the urine specific gravity of the D was significantly lower than that of the LWP (1.020±0.006 vs
1.028±0.003, p=0.020), and the urine specific gravity of the LWP at 120 minutes after exercise
significantly higher than the D (1.018 ±0.003 vs 1.021 ±0.007, p = 0.006).
Conclusions When the amount of dehydration after exercise is 1%-2%, each kind of the drinks in the study is useful for rehydration, and the addition of whey protein does not increase rehydration.

OR-055
No cardiovascular responses to energy drink consumption in young healthy adult

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Objective Svatikova et al. (2015) in JAMA have conducted a randomized trial of cardiovascular responses to energy drink consumption in healthy adults, and found it significantly increased levels of blood pressure and catecholamines in young healthy adults. Their data were re-analyzed in terms of fractal self-similarity and quantitative difference (QD) in this paper.

Methods 1. The logarithm to base golden section $\tau$ (lt) is called golden logarithm. It was found that $\sigma=\text{lts}=0.710439287156503$. 2. For a process from $x_1$ to $x_2$, $l_{x}(1,2)=\text{lt}(x_2/x_1)$ and its absolute vale are called the process logarithm and its QD, $QD_{x}(1,2)$. There are QD threshold values $(\alpha_{x}, \beta_{x}, \gamma_{x})$ of function $x$ which can be calculated in terms of $\sigma$. The function $x$ is kept to be constant if $QD_{x}(1,2) < \alpha_{x}$. A function in/far from its function-specific homeostasis is called a normal/dysfunctional function. A normal function can resist a disturbance under its threshold so that $QD_{x}(1,2) < \beta_{x}$. A dysfunctional function is defined as the QD is significant if $\beta_{x} \leq QD_{x}(1,2) < \gamma_{x}$ and extraordinarily significant if $QD_{x}(1,2) \geq \gamma_{x}$. 3. Self-similarity was studied in the fractal literature: a pattern is self-similar if it does not vary with spatial or temporal scale. First-order self-similarity condition leads to the power law between two data sets $A = \{x_i\}$ and $B = \{y_i\}$; $y_i = a_i x_i$ if the QD of $a_i$ and the average of $\{a_i\}$ is smaller than $\beta_{min}=\text{min}\{\beta_i\}$ and the average QD of $\{QD_{x}\}$ is smaller than $\alpha_{min}=\text{min}\{\alpha\}$. 4. The $\sigma$ algorithm for integrative biology was established based on high-order self-similarity.

Results The 18 dimension data set consisted of all the 18 parameters. The first-order self-similarity held for the 18 dimension data sets between after and before for placebo or energy drink, and between placebo and energy drink for the 18 dimension ratio data set of after to before.

Conclusions There may be no cardiovascular responses to energy drink consumption in young healthy adult.
E – Poster
**PO-001**

**Effect of C2C12 Myotubes Function after Electrical Stimulation at Different Time**

Jun Zhao, Heiling Dong  
Jinan university

**Objective** To study the effect of different time of electrical stimulation on C2C12 myotubes function, and further explore its molecular mechanism.

**Methods** An electrical stimulation was given 7 days after C2C12 myotubes differentiation, of which intensity was 30ms, 3Hz, and the stimulation time was 60mins, 120mins, and 180mins, respectively. A total of four experimental groups, including Con (control group), E60 (60 mins group), E120 and E180. Microscope was used to observe the muscular myotubes form; Kits were to detect MDA and ROS; Western blot was used to detect the expression of autophagy proteins and mechanism proteins, including PGC1, p-ULK, SIRT1 and SIRT3.

**Results** Compared with the control group, MDA, ROS, SIRT3 increased significantly in E60 (p<0.05), p-ULK and PGC1 increased significantly (p<0.01), SIRT1 decreased significantly (p<0.05). In E120, MDA, ROS, SIRT3 and PGC1 increased significantly (p<0.01), SOD decreased significantly (p<0.05). In E180, MDA and ROS increased significantly (p<0.01), SOD decreased significantly (p<0.01).

**Conclusions** Moderate electrical stimulation can significantly activate oxidative stress, and further promote SIRT3, PGC1 and p-ULK expression, while excessive stimulation has the opposite effects.

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**PO-002**

**The influence of lifestyle on the quality of life of breast cancer patients**

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¹. Jinan University  
². Zaozhuang College

**Objective** To explore the effects of healthy lifestyle such as exercise and diet on health-related quality of life in patients with breast cancer.

**Methods** 427 breast cancer patients who met the inclusion criteria were investigated and analyzed. All the patients were collected in the department of oncology of a third-class first-class hospital from January 1, 2015 to June 30, 2016. The cancer treatment quality of life core scale (EORTC QLQ-C30) and cancer treatment function evaluation system scale (FACT-B) were used to investigate and collect the questionnaire for statistical analysis of all data.

**Results** The scores of health-related quality of life were higher in regular exercise than those in non-regular exercise. Patients who ate more than 300g of vegetables per day had higher health-related quality of life scores. The scores of health-related quality of life were higher in patients who ate more than 200g fruit per day (p<0.05). Patients with two healthy lifestyles had higher health-related quality of life scores than patients with one healthy lifestyle (p<0.05).

**Conclusions** Multi-frequency exercise and adequate intake of vegetables and fruits play a positive role in the health-related quality of life of breast cancer patients. Breast cancer patients with two healthy lifestyles had significantly better health-related quality of life than patients with one healthy lifestyle. Healthy lifestyle with adequate exercise and adequate intake of fruits and
vegetables should be paid more attention to in improving the health-related quality of life of breast cancer patients.

PO-003

The Dietary Nutrition Adjustment Continuous 16 Weeks and the Nutrition Supplement Plan after Weighing of Women's Wrestlers

Jingjing Liao
Hubei Institute of Sports Science

Objective This study develops the nutrition supplement plan after weighing, and research how to supply nutrition in this important time on the basis of the dietary nutrition adjustment in pre-competition. Formulate the nutrition supplement plan for women's wrestlers by quantized, and evaluate this plan.

Methods To prepare for the key players of the 13th National Games, a 16-week daily dietary adjustment was conducted according to the results of a nutrition survey on the slow-fall-weight control phase before the competition. Routine dietary adjustment was proved by changes in body composition and improvement of anaerobic capacity. The plan was developed, that includes weighing meals, liquid nutritional supplements and inorganic salts solutions after weighing, on the basis of the regulation on nutrition.

Results The balance between the total daily dietary intake and its ratio can make the athlete achieve the ideal effect of weight control in the normal training. Comparing the indicators before and after 16 weeks, it was found that after the athlete's diet was basically balanced and reasonable the body weight decreased significantly, the fat-free body weight remained unchanged, the body fat percentage decreased significantly, and the anaerobic capacity increased significantly. After weighing during the competition nutritional supplement plan can be executed, and the total body water, urine protein, urine specific gravity can be restored to normal levels.

Conclusions This study through the understanding of the basic nutritional status of athletes before the game, according to the conditions of each athlete to give the corresponding dietary guidance, and use 16 weeks to supervise the implementation. Athletes' dietary structure and nutrient intake change significantly, and then the nutrition achieves balanced and reasonable. To investigate the nutritional situation this time, that combined with the characteristics of energy supply and nutritional, which for wrestling athletes, worked out the nutritional supplement plan after weighing by quantitative data. This plan can be performed well; the effect of supplement is improved obviously; and on discomfort appeared during the game by the athletes who performed it. This study is a preliminary exploration of the nutritional supplement plan for athletes during the important recovery phase of the game. Follow-up research will involve more projects in order to promote this special period to other weight-level projects eventually.
PO-004

**Blackcurrant extract alleviate exercise-induced acute kidney injury through down-regulation of NF-κB signaling pathways**

Xia Liu, Yue Ding, Jiaye Jiang, Haiying Lu, Fei Yao
Shanghai University of Chinese Traditional Medicine

**Objective** Exhaustive exercise is a pathological state of multiple organ dysfunctions due to the strong and durable exercise load which is beyond the bearing ability of the body. Our study aimed to evaluate whether blackcurrant extract (BE) could alleviate oxidative stress and inflammation status in the kidney during exhaustive exercise.

**Methods** We used exhaustive swimming animal model to investigate the effect of BE on oxidative stress and inflammation in rats. We determined the levels of superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), malondialdehyde (MDA), NF-kappa B (NF-κB), and tumor necrosis factor-α (TNF-α) with and without BE treatment during exhaustive exercise. We also analysed the morphology of renal tissue and its function before and after BE administration while performing exhaustive exercise.

**Results** BE administration significantly reduced MDA content (P<0.05), increased SOD activity (P<0.05), and downregulated the expression of NF-κB and TNF-α in the kidneys of exhaustive swimming animals. BE also alleviated morphological and functional damages in the kidney induced by exhaustive exercise.

**Conclusions** BE treatment improves exhaustive exercise-induced structural and functional damage in the kidney by reducing oxidative stress and improving inflammation status. Thus, we suggest that BE has therapeutic potential to treat exhaustive exercise-related kidney injury.

PO-005

**Association of six gene polymorphism with tendon injuries in Chinese athletes**

Qi Wei
Hubei Institute of Sports Science

**Objective** In recent years, more and more studies have shown that gene polymorphism is associated with susceptibility and recovery of sports injury. We select Collagen type I alpha 1 gene (COL1A1), Collagen type V alpha 1 gene (COL5A1), Collagen type XII alpha 1 gene (COL12A1), collagen type XIV alpha 1 gene (COL14A1), Tenascin C gene (TNC), Growth/differentiation factor-5 gene (GDF-5) polymorphic loci to study their relationship with tendon injuries in Chinese athletes.

**Methods** A case-control experiment was designed to analyze the distribution characteristics of six gene polymorphism loci in 65 Chinese athlete injured group and 115 control group. These six polymorphic loci were detected by PCR-RFLP.

**Results** The distributions of COL1A1 TT genotype, COL5A1 CC genotype and GDF-5 CC genotype were decreased in injured group compared with the control group. The COL12A1, COL14A1, TNC gene polymorphic loci showed no significant difference between two groups. The COL1A1, COL5A1 and GDF-5 genes were involved in encoding for collagen, matrix metallopeptidase, tenascin and growth factors which protect the athletic from the musculoskeletal injuries, particularly in tendon and ligament tissues.

**Conclusions** The genetic loci will help to identify individuals with advantageous physical performance and a lower chance of suffering from injuries.
PO-006
Influences of ACE I/D and ACTN3 R577X polymorphisms in elite female soccer athletes

Qi Wei
Hubei Institute of Sports Science

Objective The performance phenotype is regulated by polygenes. There were few rPOrts about the cumulative effect of the I/D polymorphism in the angiotensin I-converting enzyme (ACE) gene and ACTN3 in athletes. This study was to investigate the association of ACE I/D and ACTN3 R577X polymorphisms with the performance of Chinese elite female soccer athletes for the first time.

Methods The genotype distributions of ACE I/D and ACTN3 R577X in the athlete group (N=92) and the control group of Chinese females (N=200) were evaluated via PCR and compared.

Results Regarding the distribution of ACE polymorphisms, the genotype frequency was indifferent between the athletes (II 40.2%, ID 46.7%, DD 13.1%) and the controls (II 42%, ID 48%, DD 10%) based on the chi-square test. No difference in the I/D allele frequency was observed between the athlete group (I allele: 59.25%; D allele: 40.75%) and the control group (I allele: 60.8%; D allele: 39.2%). Regarding the distribution of ACTN3 polymorphisms, the genotype frequency was significantly different between the athletes (XX 0%, XR 53.3%, RR 46.7%) and the controls (XX 16%, XR 44%, RR 40%). The allele frequency was observed no different between the athlete and the control group (X allele: 34.8%/41.7%; R allele: 65.2%/58.3%, respectively). The ACE and ACTN3 genotype combinations (II/ID/DD+RR/XR) significantly differed between the athletes and the controls by χ2 test (p<0.05).

Conclusions These results suggested that the Chinese elite female soccer athletes were more likely to harbor the I allele and the R allele and that the combination of ACE II/ID and ACTN3 RR/XR was a synergetic determinant of the athletic performance of females in soccer.

PO-007
Exercise Adaptation of Skeletal Muscle Fibers: The Role of MicroRNAs

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Shanghai University of Sport

Objective Explore the relationship between exercise adaptation of skeletal muscle fibers and microRNAs.

Methods Research related papers.

Results Endurance training can switch muscle fiber type by promoting microRNAs (miR-208b, miR-499). For example, the conversion from fast Type IIb muscle fibers to slower Type IIx/d muscle fibers, or from Type IIx muscle fibers to Type IIa muscle fibers. Endurance training can also promote the expression of Peroxisome Proliferator Receptor Gamma Coactivator-1α (PGC-1α) and enhance the oxidative potential for slow muscle fibers by inhibiting some microRNAs such as miR-23a. Resistance training can activate insulin-like growth factor-1/phosphatidylinositol-3-kinase/protein kinase B/mammalian target of rapamycin/P70 ribosomal protein S6 kinase (IGF-1/P3K/Akt/mTOR/P7056K) pathways and promote fast muscle fibers hypertrophy by inhibiting negative microRNAs (miR-1, miR-133, miR-128a) and promoting positive microRNAs (miR-27, miR-29, miR-486).

Conclusions MicroRNAs play an important role in the exercise adaptation of skeletal muscle fibers.
PO-008
Effects of kickboxing on body composition of adolescents with obesity

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Objective In order to find a scientific and effective way to lose weight, the effect of kickboxing exercise was studied by the method of experiment. Through research, it is found that kickboxing can effectively change the body shape and body composition of the human body and achieve a better weight loss effect. This study further enriches and improves the theory of exercise and fitness, which can provide scientific guidance for obese children and adolescents to lose weight and provide a good reference for obesity of other age groups and special populations.

Methods In this paper, 20 students of 12~14 years old in the summer class of Wuhan diet training camp were selected as the subjects. Through the test of height and weight, the 20 subjects of drug induced obesity or non secondary obesity were selected by BMI as the main basis, including 8 girls and 12 boys. kickboxing training time is 8 weeks, 3 times a week, each class 60 minutes, from warming up, basically, relax three parts. In order to study the effects of kickboxing on body composition of obese people, skin fold thickness, girth and body fat were monitored and tested.

Results After 8 weeks of kickboxing exercise, there was a significant difference in the thickness of the upper arm skin fold of the boys P < 0.05, and the thickness of the skin fold of the lower scapula was P < 0.01, but the changes in the abdomen were not obvious. While the skin thickness of the upper arm and the abdominal skin fold were P < 0.05, and there was no significant difference in the skin fold thickness of the scapula. Male hip circumference P < 0.05 had a very significant change, chest circumference, waist circumference and waist hip ratio P > 0.05 did not change significantly. The waist circumference and waist hip ratio were significantly changed, but there was no significant change in chest circumference and hip circumference. After exercise, the changes in fat content, muscle weight and BMI were the most significant. Girls' weight, fat content, body fat percentage and BMI were the most significant changes, followed by a slight change in muscle weight.

Conclusions From the qualitative point of view, it can be concluded that the practice of kickboxing exercises can effectively develop flexibility, balance, coordination and so on. It has a significant effect on improving human posture and sports ability. From a quantitative point of view, aerobics can also reduce fat content, increase muscle weight, make the percentage of BMI, body fat change significantly, and have a significant impact on maintaining muscle content and muscle / weight ratio and laying a solid foundation for future exercise. It can be concluded that kickboxing is a suitable exercise for obese people to lose weight.
The effects of HIIT on ROS-AMPK- PGC-1α pathway in skeletal muscle and VO2max of ageing Wistar rats.

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Objective To observe the 16 weeks of HIIT intervention on SOD, ROS and its related factors AMPK and oxidation capacity PGC-1α expression and the influence of the VO2max and its change rule in the process of the natural aging rats. To explore the correlation between the expression of ROS, AMPK and PGC-1α and the change of VO2max; Furthermore, it provides a theoretical basis for HIIT to delay the reduction of aerobic capacity in skeletal muscle ageing.

Methods 58 male wistar rats (age: 32 weeks) were selected and randomly divided into quiet group (C) and HIIT intervention group (H). All rats were fed in the barrier environment. Each group of rats entered the animal laboratory for a week of adaptive feeding and exercise. VO2max was tested and observed every two weeks in each group. Rats of group C don’t exercise, group H at a rate of 50%, 70% and 90% VO2max corresponding alternation of 50 min/day, 5 days/week, for 16 weeks of exercise intervention, and according to the VO2max test results the exercise intensity. Both groups of rats in the intervention of 8 weeks, 16 weeks after the end of the 24 hours of materials, stripping rats soleus, SOD and content of ROS was tested by multifunctional enzyme mark, using western blot test the expression of AMPK and PGC-1α. VO2max, SOD, ROS test results and AMPK, PGC-1α, and relative expression data were analyzed using SPSS for one way ANOVA.

Results The cardiopulmonary endurance of rats in group C and group H showed a decreasing trend in group C and group H during HIIT intervention, but the decrease trend in group H was slower than that in group C. 2. During 16 weeks aging, SOD expression of group C in the process of rendering first rise after falling, and expressed in 8 weeks SOD content was significantly lower than base value (P < 0.05), 16 weeks group C SOD levels higher than the base state. After 16 weeks of intervention, the expression of SOD in group H was relatively flat in the first 8 weeks, and the trend was in 8-16 weeks, and was significantly lower than 8 weeks in 16 weeks (P < 0.05). 3. The ROS content was significantly higher than basic state in 8 weeks and 16 weeks in the intervention process (P<0.05), and the ROS content was significantly higher than 8 weeks (P<0.05) at 16 weeks. The ROS content of group C and group H was significantly higher than that in the group at 8 weeks (P < 0.05). 4. The AMPK content in group C was significantly lower than that of the basic value (P<0.05), and the AMPK content in group H was significantly higher than that in group C (P<0.05). 5. After the intervention of 16 weeks, the content of PGC-1α in group C and group H showed a decrease trend and significantly lower than the basic value (P<0.05), but the content of group H was significantly higher than that of group C (P<0.05). 6. The changes of AMPK, PGC-1α and cardiopulmonary endurance were the same in all groups during the intervention.

Conclusions 1. 16 weeks of HIIT can effectively delay the decrease of SOD content in the aging rats, thus inhibiting the accumulation of ROS in the body. 2. 16 weeks of HIIT intervention can effectively delay the expression of VO2max and AMPK and PGC-1α in aging rats. 3. 16 weeks HIIT may delay the decrease of AMPK-PGC1 protein expression by inhibiting the accumulation of skeletal muscle ROS in the aging rats, thus inhibiting the decrease of VO2max.
PO-012
Meta-analysis on the relationship between PGC-1α -482 genetic polymorphism and exercise intervention in insulin resistance

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Objective To study the relationship between the genetic polymorphism of PGC-1α -482 and insulin resistance to exercise intervention.

Methods Databases including PubMed (includes MEDLINE), SCOPUS (a large, multidisciplinary database) and the Cochrane Library were searched to collecting the literatures that were with information on relationship between the genetic polymorphism of PGC-1α -482 and insulin resistance to exercise intervention. The odds ratio (OR) of PGC-1α genotype distributions in cases-control groups was calculated. The Meta-analysis software RevMan5.3 was applied to heterogeneity test and pooled OR calculation.

Results A total of 11 case-control studies met the criteria and were selected for the Meta-analysis. Among the studies, there were totally 718 cases of insulin resistance and 732 cases of control were included. The pooled OR of the PGC-1α genotype G/G vs. G/S+S/S was 0.97 (95% CI = 0.78 ~ 1.20), which showed statistically no significant difference (Z = 0.32, P = 0.75). This indicates that the frequency distribution of PGC-1α genotype may be related to the increased risk of insulin resistance, and this association is statistically significant; however, the frequency distribution of this genotype is not necessarily related to exercise intervention in insulin resistance.

Conclusions The genetic polymorphism of PGC-1α may be a susceptible factor for insulin resistance but not an independent influence factor of exercise intervention in insulin resistance.

PO-013
Applied Research of training session RPE and blood lactic acid of Elite Woman Wrestlers before Competitions

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Objective By testing and analyzing the training session RPE, blood lactic acid, urine protein, urine specific gravity and urine pH value of elite woman wrestlers, investigated variation and score differences of the elite woman wrestlers’ five indicators during the four weeks before the elite woman wrestlers championship, to provide a reference for scientific training.

Methods 12 elite woman wrestlers completed 24 special training session, 16 strength training session and 12 cardio workout session before four weeks in the elite woman wrestlers championship. The degree of fatigue of athletes in this section were scored within 5 minutes after the end of each training session using Borg 15 subscales, scores were dictated and record. Training session RPE was calculated by the training session time multiplied RPE, daily and weekly training session RPE (sRPE) was counted respectively. The blood lactic acid after intensive training and the daily urine protein, urine specific gravity , urine pH value of elite woman wrestlers were tested using EKF lactateScout appearance of portable blood lactate and blood lactic acid test strip and using Roche Miditron Junior II semi-automatic urine analyzer and supporting Comber 10 test M urinary ten test strip, in accordance with standard test procedures.In this study, the measured indicators were analyzed statistically by SPSS19.0 and
the measured indicators were expressed as mean±standard deviation(X±S). The total amount of training sRPE that reflected the six weeks was tested by repeated measures analyzing of variance of repeated measures. Differences of the first week and the other five weeks was compared respectively, the level of significance was set up as α=0.05. The correlation of training sRPE, the blood lactic acid after intensive training, urine protein, urine specific gravity and urine pH values was tested by Pearson correlation analysis, P < 0.05 was set up a significant difference, P <0.01 was set up a very significant difference, |r|<0.3 was believed with no correlation.

Results  The total sRPE of elite woman wrestlers decreased gradually before four weeks in the national championship. Special training sesión sRPE and strength training sesión sRPE reach a higher level respectively in the second week and the third week. The aerobic workout sRPE maintained at a lower level during four weeks. The correlation coefficient of elite woman wrestlers' sRPE, urine specific gravity and urine pH value was negative. The correlation coefficient of elite woman wrestlers' sRPE, the blood lactic acid after intensive training and urinary protein was positive, showed a different relationship. The correlation coefficient of elite woman wrestlers' sRPE, the blood lactic acid after intensive training and urine protein is |r|>0.3, there is a low degree of correlation. Other indicators showed no significant correlation.

Conclusions  Training session RPE is an effective and operational noninvasive method of evaluating women's soccer training. The blood lactic acid after intensive training, urine protein, urine specific gravity and urine pH value is relatively sensitive indicator of reflecting the volume and the intensity of training. Five test indicators will be affected by the athletes' different athletic level.

PO-014  Effects of Food Composition and Exercise Training on Body Weight Regulation and Physiological and Biochemical Mechanisms in Male Mice

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Objective  To explore the effects and the physiological and biochemical mechanisms of food composition and aerobic exercise on the body weight regulation among sub-adult and adult mice, with a view to the reference of exercise and diet in adolescents and adults.

Methods  There are 72 sub-adult mice and 39 adult mice which were selected by the treadmill exercise pre-screening. They were engaged for a period of time to domesticate in accordance with the different exercise intensity, time and food compositions. During the domestication, the body weight and food intake were measured several times, and the digestibility was calculated. The mice were dissected after domestication, and the fresh weight of adipose tissue and internal organs were measured, which including the weight and length of digestive organs. Serum glucose, triglyceride, urea nitrogen and creatinine were measured by colorimetric method. The contents of creatine kinase(CK) and muscle glycogen(MG) and glucose transporter 4(GLUT-4) in serum were determined by ELISA, and the digestive enzyme activity was detected by colorimetric method.

Results  1. Sub-adult mice: food composition has no significant effect on many indicators, including body weight, major fat weight, the length, fresh weight and content weight of stomach, the fresh weight of heart, spleen and lung, the level of blood glucose, triglyceride and CK (P>0.05). But the food composition has a significant effect on the following indicators: the food intake, digestibility, the length, fresh weight and content weight of small intestine, cecum and colon, fresh weight of liver and kidney, the level of blood urea nitrogen and creatinine, the level of MG and GLUT-4 in muscle, the enzyme activity of intestinal brush border membrane sucrose,
maltase and aminopeptidase-N ($P<0.05$). Aerobic exercise has no significant effect on the following indicators: the length and content weight of stomach, small intestine and colon, the weight and content weight of cecum, fresh weight of heart, spleen, lung and kidney, the level of serum triglyceride, urea nitrogen and CK, the level of GLUT-4 in muscle, the enzyme activity of intestiinal brush border membrane sucrose and aminopeptidase-N ($P>0.05$). But aerobic exercise has a significant effect on the following indicators: body weight, major fat weight, the food intake, digestibility, the fresh weight of stomach, small intestine and colon, the length of cecum, the fresh weight of liver, the level of blood glucose and creatinine, the level of MG in muscle, and the enzyme activity of intestinal brush border membrane maltase ($P<0.05$).

2. Adult exercise mice: food composition has no significant effect on the following indicators: the body weight, major fat weight, the length, fresh weight and content weight of stomach, small intestine and colon, fresh weight of heart, liver, spleen, lung and kidney, the level of blood glucose and triglyceride, and the enzyme activity of anterior intestinal brush border membrane sucrose, maltase and aminopeptidase-N ($P>0.05$). But the food composition has a significant effect on the following indicators: the food intake, digestibility, the fresh weight and content weight of cecum, the level of blood urea nitrogen and creatinine, and the enzyme activity of middle intestinal brush border membrane sucrose, maltase and aminopeptidase-N ($P<0.05$). The body weight changes with time significantly, but the magnitude of the change before and after exercise is less than 5%.

3. Sub-adult exercise mice vs adult exercise mice: with the increase of exercise time, the weight gain of sub-adult exercise mice was decreased significantly ($P<0.001$), and the weight of adult exercise mice was also decreased significantly ($P<0.001$). Compared with adult exercise mice, the perirenal fat ratio, mesenteric fat ratio and the gonadal fat ratio in sub-adult exercise mice were lower than that of adult exercise mice ($P<0.001$), but the lean body weight ratio in sub-adult exercise mice was higher than that of adult exercise mice ($P<0.001$). The food intakes of sub-adult and adult exercise mice were significantly increased with time ($P<0.001$), the effects of food composition on the digestibility of sub-adult and adult exercise mice were associated with decreased movement with the increase of protein content in food. The length, fresh weight and content weight of stomach and colon were significantly lower in adult adult mice than in sub-adult mice ($P<0.05$). The fresh weight of heart, liver and kidney of sub-adult mice was significantly lower than that of adult mice ($P<0.05$). But fresh weight of the spleen was significantly higher in sub-adult mice than in adult mice ($P<0.05$). The levels of glucose, triglyceride and creatinine in sub-adult mice were significantly higher than those in adult mice ($P<0.05$). It was significantly lower in sub-adult mice than in adult mice that the enzyme activity of anterior intestinal brush border membrane sucrose and maltase and posterior intestinal brush border membrane aminopeptidase-N ($P<0.05$). However, the enzyme activity of middle intestinal brush border membrane sucrose of sub-adult mice was significantly higher than that in adult mice ($P<0.05$).

**Conclusions**
1. It was not affected for body weight and fresh weight of major fat in change of food composition in a certain range, aerobic exercise could control the excessive growth of body weight and weight of major fat of sub-adult exercise mice, but the body weight of adult exercise mice had no significant effects on regulation by food composition.
2. The food intake of sub-adult and adult exercise mice and the digestibility of sub-adult exercise mice were significantly changed with time. Influence of food composition on digestibility of sub-adult and adult exercise mice with exercise time showed that it decreased with the increase of protein content in food. Food intake of sub-adult and adult exercise mice increased with aerobic exercise in a certain range.
3. The changes of food intake and digestibility mainly rely on the regulation of the morphology and function of digestive organs. the changes of blood indicators showed that food composition and aerobic exercise had contribution on sub-adult and adult exercise mice to maintain good health, part of which has offset the metabolic changes caused by the high protein foods that was aerobic exercise, and high protein foods produced certain metabolic burden on the liver and kidney, but aerobic exercise can improve the metabolism of liver and kidney.
4. Aerobic exercise can increase the reserve of MG in muscle of sub-adult mice, the storage and transport of MG in muscle can be improved with the increase of starch content in food. In this study, aerobic exercise intensity did not cause muscle fatigue or injury.
5. The activity of the enzyme increased with the increase of the content of starch in food, which was not affected by aerobic exercise. Aminopeptidase-N activity was effected by aerobic exercise, which decreased in non-exercise state with dropping down protein content in food, but which did not show the same trend in the exercise state. It might be more regulated by the increase in protein demand under the exercise state.

PO-015
A Follow-up Study of 8-10 age pupil's physical activity status and related factor

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Objective Purpose: Regular physical activity in children has many benefits, including reducing the occurrence of obesity and lower levels of cardiovascular disease risk factors, promote bone mass deposition, improve health. Our research in order to using accelerometer survey children daily PA status in our country, and analyzes its characteristic.

Methods Methods: Our research assessed the PA of the same group of children in Beijing Yuxin Primary school for three consecutive years using ActiGraph accelerometers. The total available valid data are 183 children (male 94, female 89).

Results Results: (1) The average total PA is 627.2±134.5 counts/min (boy accrued 665.6 ± 139.1 counts/min and girl 579.8 ± 112.2 counts/min), among them boy accrued 59.0min/d and girl 48.1min/d of MVPA. 35% of participants could meet the WHO PA guideline (boys =49%, girls = 18%).
(2) MVPA increased significantly from 8 to 9 years of age (MVPA of 8-year-old children:53.2min/d, 9-year-old children:56.1min/d) and MVPA decline slightly from 9 to 10 (10 year-old children:55.8min/d). And both boys and girls meet this regular.
(3) Both in weekdays and weekend, the MVPA time of boys (60.2min/d, 57.8min/d) are outstandingly higher than girls (49.7min/d, 46.5min/d).
(4) TWO-way (gender *BMI category) ANOVA revealed that girls were less active than boys.
(5) The moderate and vigorous physical activity time of obese children in weekends are 42.3 min/d while those of normal children are 49.7 min/d, (p<0.05).
(6) The total PA level, VPA, MVPA are negatively correlated with body fat percentage while LPA is positively correlated with BMI.

Conclusions Conclusions: Objective data indicated that Chinese youth are generally not physically active enough, and lower levels of PA were observed in girls, and during weekend days. The findings of this study will better inform the development of PA-related policies in schools, the design of PA intervention programs.
**PO-016**

Effects of Yin Yoga for Three Months on Insomnia in Menopausal Women

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**Objective** To assess changes in sleep quality before and after 3 months Yin yoga on insomnia in menopausal women, which provides a scientific and reliable theoretical basis for improving insomnia of menopausal women by doing Yin yoga exercise.

**Methods** Twenty menopausal women (year \(48.16 \pm 3.66\)) with non-organic insomnia who volunteered for Yin yoga were selected. They all performed the same six poses of Yin yoga at 22:00 PM. Each pose lasted for 5 min, 30 min each time, 5 times per week, and for 3 consecutive months. Before and after 3 month Yin yoga exercise, polysomnogram (PSG) and Pittsburgh sleep quality index (PSQI) were used to evaluate the improvement of insomnia.

**Results** After 3 months Yin yoga exercise, the sleep latency (SL), rem sleep latency (RL) and sleep efficiency (SE) of the insomniacs all improved, with statistically significant differences \((P<0.05)\). Three months of Yin yoga exercise later, the Pittsburgh sleep quality index showed a significant difference in sleep scores compared with the start of exercise \((P<0.01)\).

**Conclusions** Yin yoga exercise can improve insomnia in menopausal women and the effect is significant, worthy of promotion.

**PO-017**

Aerobic Exercise Attenuates Myocardial Injury Through Activation of SIRT1 Signaling in T2DM Rats

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**Objective** Myocardial injury caused by elevated blood glucose is a major risk factor for type 2 diabetes mellitus (T2DM) cardiomyopathy. Aerobic exercise can significantly improve the energy metabolism and is widely used in clinic to prevent and cure T2DM and other metabolic diseases. Myocardial injury can be attenuated after aerobic exercise. Some researches showed SIRT1 is a histone deacetylation enzyme activated by NAD\(^+\)/NADH, and mainly distributes in the heart, liver, etc. SIRT1 plays an important role in controlling the insulin secretion, which can regulate glucose and lipid metabolism and some other important biological functions. It is not known whether the myocardial injury was reduced by regulating the level of SIRT1 after aerobic exercise. The purpose of the research was to illustrate the regulatory mechanism of decreased myocardial injury after aerobic exercise, and provided theoretical basis for early prevention and treatment of T2DM myocardial injury.

**Methods** There were two stages in the experiment. At the first stage, 30 male SD rats, 12-month old, were randomly divided into two groups, the control group (CC, fed with standard diet and kept sedentary, 8 rats), the high-sugar-lipid fodder for T2DM model Group (DC, kept sedentary, 22 rats). High sugar and high fat diet formula for 10% lard, 20% sucrose, egg yolk powder 8%, 0.1% sodium deoxycholate, 61.9% basic feed, AIN-93g, provided by animal experimental center of Hebei Province. After 5-week high-sugar-lipid fodder, the DC rats were injected streptozocin (STZ, 35mg/kg), the FBG of the tail vein were measured after 12h, and FBG≥7.0mmol/L was defined as T2DM model. Six rats were excluded because of low FBG \(<7.0mmol/L\). At the second stage, all of the rats were fed with standard diet. The T2DM rats were randomly assigned to the T2DM group (DC, kept sedentary, 8 rats) and T2DM combined with aerobic exercise, (DE,
run on treadmill at 15m/min~19m/min, 45min/d, slope 5%, 6d/w, 5W, 8 rats). The myocardial tissue sections were stained with hematoxylin and eosin (HE) to observe the histological changes. The level of serum insulin was examined by ELISA kits. The content of serum glucose, the activity of SOD and the content of MDA in heart were examined by reagent kits after 5 weeks. The expression of SIRT1 protein in heart were measured using Western blot. ELISA kits were used for the determination of the NAD+/NADH ratio.

**Results**

1. The myocardial sections of CC can be observed clear cell contour, bright color, arranged closely and neatly, and nuclear distribution in cells border and nuclei of uniform size. In DC myocardial sections, myocardial cell contour was fuzzy, nuclei were relatively large, reduced the number of nuclei and inward migration. The broken cells and part of the cells and nuclei overflow can also be seen. The shape of nucleus was irregular and shifted to the internal. In myocardial cell sections of DE rats, the cell profile was relatively clear, and arranged more orderly, a larger number of nuclei, generated less shift.

2. The plasma insulin of DE were obviously lower than that of DC ($P<0.01$). The content of serum glucose of DE was significantly decreased compared with that of DC ($P<0.01$). (3) The ratio of NAD+/NADH in DE heart was higher than that of DC ($P<0.05$). (4) The expression of SIRT1 in DE heart was higher than that of DC ($P<0.05$). (5) The activity of SOD in DE heart was increased while the content of MDA in DE was significantly decreased compared with those in DC ($P<0.01$).

**Conclusions** Aerobic exercise can effectively reduced the blood glucose level of T2DM rats. The NAD+/NADH ratio in the myocardium of T2DM rats were increased after the aerobic exercise. As a result, the content of SIRT1 protein in myocardial cells of T2DM rats were increased after the aerobic exercise, which resulted in the increased SOD activity and antioxidant capacity in the cardiac muscle cells, which lead to the attenuated myocardial injury in T2DM rats.

**PO-018**

The Effect of Aerobic Exercise on Alternative Splicing of Lipin1 pre-mRNA and its isoforms

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**Objective** Obesity is one of a world-wide chronic diseases, which is the leading cause of cancer, T2D, cardiovascular disease other metabolic complications. Aerobic exercise as a moderate intervention, has potential mechanisms for the loss weight. Lipin1 as a key regulator of lipid metabolism is a member of the Lipin family. Through alternative splicing, Lipin1 exists two isoforms, Lipin1α is mostly expressed in preadipocytes during the initial stages of differentiation, whereas the Lipin1β mainly expressed in mature adipocytes, and is responsible for lipogenesis and adipocyte hypertrophy. The aim of our present study was to investigate the effect of aerobic exercise on the levels of Lipin1α, Lipin1β and splicing factor SFRS10.

**Methods** C57BL/6 mice were randomly assigned to control group (C, n=20) and obesity control group (O, n=20). After 4 weeks, mice were further assigned to normal control group (NC, n=10), and control exercise group (CE, n=10). O group (O, n = 10) and obesity exercise group (OE, n = 10). CE and OE were on aerobic exercised for 8 weeks. RT-PCR was generated to detect Lipin1α, Lipin1β and SFRS10 mRNA expression.

**Results** The results suggest that the level of lipin1α mRNA was decreased in obesity group. With exercise, levels in CE and OE increased. Furthermore, Lipin1β was increased in obesity group and decrease after aerobic exercise in both CE and OE. We also demonstrated the SFRS10, which can bind to lipin1 exon8 and regulate Lipin1 alternative splicing, had a lower ex pression in obesity group and higher expression in CE and OE.

**Conclusions** Our data suggest that aerobic exercise can reduce body weight by influencing lipin1 pre-mRAN alternative splicing, and change the expression of two isoforms. Besides aerobic exercise can also affect SFRS10 mRNA Levels and change the expression of Lipin1 isoform.
PO-019
Exploratory Study on Predicting Acute Altitude Sickness by Using Oxygen Saturation
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Objective The aim of the present study was to investigate the probability of altitude sickness based on the correlation coefficient between oxygen saturation and LLS score by analyzing the correlation of physiological parameters, like oxygen saturation, between the simulated altitude 5000m and altitude conditions. The results of our study may provide suggestions for public and mountaineering team.

Methods Fourteen male subjects from Chinese Agricultural University participated in acute hypoxic exposure a simulated altitude of 5000m. The study was carried out in hypoxic laboratory (Low Oxygen Systems GmbH, Germany) at Sports Science Research Centre. Oxygen Saturation (SpO2), maximum expiratory flow, Peak Expiratory Flow (PEF), heart rate, blood pressure, the Lake Louis consensus scoring of AMS (LLS) and other indicators were measured every 1h in hypoxic environment. After hypoxic exposure, all subjects climbed the Mountain in Sichuan Province (the main peak was 6300m above sea level). During climbing, the SpO2, maximum expiratory flow, heart rate, blood pressure and LLS assessment were measured in the early morning of the team’s arrival at 4020m, 4950m and 5000m. All results were expressed as mean ± standard deviation. The data were analyzed by paired sample T test by SPSS 19.0. The difference between two tests was considered significantly when P < 0.05.

Results The significant difference was observed between simulated altitude of 5000 meters and three levels real high altitude conditions in SpO2, heart rate, maximum expiratory flow, blood pressure. There was a significant negative correlation between blood oxygen saturation and AMS score at the simulated altitude of 5000m at 4th-5th hour (4th hour P=0.030, 5th hour P=0.011), and the correlation function relationship AMS score=(76.842-SpO2)/1.313 was obtained. When the oxygen saturation decreased 1.313mmol/L, AMS score increased 1.0. PEF and LLS scores has a high negative correlation (P<0.05). As the height increased, the score increased and PEF decreased significantly.

Conclusions In simulated altitude of 5000 meters, the change of human SpO2 has a corresponding relationship with oxygen concentration, and the SpO2 value is significantly correlated with the AMS score. It has a functional relationship of AMS=(76.842-SpO2)/1.313 during the period of 4th-5th hour exposure to hypoxia. Therefore, oxygen saturation in simulated 5000m altitude can predict the altitude response intensity during the actual mountaineering process.

PO-020
Associations between the Sedentary Behavior and Cardiovascular Risk Factors in Adults of 40-49year
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Objective Large amounts of pieces of evidence suggest sedentary behavior (SB) might have a negative impact on all-cause mortality, cardiovascular disease, and metabolic system. Our aim is to explore the associations between sedentary behavior and cardiovascular risk factors in adults of 40-49year.
Methods Participants (N=372) were adults 40-49 years old who had a survey by using adult sit-Q-7d. The indexes of body mass index (BMI) and Waist circumference (WC) were measured as per standard protocols and blood pressure measured using an automated sphygmomanometer (Carescape V100; GE Healthcare, UK) following five minutes seated rest. HDL cholesterol (HDL-C), LDL cholesterol (LDL-C), triglycerides (TG) and fasting plasma glucose (FPG) were assessed for blood sampling of venous blood following an overnight fast (Cholestech LDX; Alere Inc, USA). We analyzed data in 2 h/day and 1 h/day as segmentation criteria of sitting time were classified as 8 groups (0<2, 2-4, 4-6, 6-8, 8-10, >10 h/day) and 10 groups (<1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8, 8-9, >9 h/day). Statistical analyses were performed using STATA software 15.0 (STATA Corp, College Station, TX). We performed multiple linear regression models adjusting for health-related confounders to assess the associations between SB of difference range and risk factors of cardiovascular disease.

Results (1)When the sitting time as category criteria in 2 h/day, the relationship of LDL-C (β=0.651, 95%CI=0.069 to 1.232, P=0.028) and HDL-C (β=0.129, 95%CI=0.013 to 0.245, P=0.028) to sitting time in segment of 6-8h/day were statistically significant after adjustment for relative factor of risk; and the same in TC (β=0.932, 95%CI=0.244 to 1.620, P=0.008) to sitting time in segment of 8-10h/day; (2) When the sitting time as category criteria in 1 h/day, in 3-4h/day segment, the index of BMI (β=1.550, 95%CI=0.025 to 3.074, P=0.046) had a significant rise; in 7-8h/day segment, the index of LDL-C (β=0.919, 95%CI=0.155 to 1.683, P=0.019) also had a significant rise; as well as, in 8-9h/day segment, the index of TC (β=1.531, 95%CI=0.497 to 2.565, P=0.004) had a highly significant. (3) As has mentioned above, the threshold for each segment of sitting time for the index of LDL-C in 7-8h/day segment and the index of TC in 8-9h/day.

Conclusions This study suggests that (1) the different category criteria of sitting time, for categories criteria in 1h/d or 2h/d, will help reduce the risk of Cardiovascular risk in some degree and determining to their dose-response relationships. (2) For the 40-49year adult of health, the sitting time threshold is less than 7 h/d, in order to decrease the detrimental effects on metabolic markers associated with cardiovascular disease and metabolic system. (3) As well as the sitting time threshold is less than 3 h/d for adding to the negative aging effect on risk of cardiovascular markers.

PO-021
The application of serum creatinine in training monitoring

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Objective Study the role of serum creatinine in physiological function assessment of weightlifters combined with other indexes, in order to evaluate the effect of phased training and arrange training plan scientifically.

Methods Taking weightlifters as the main research object, the sports features of Cr, the correlation between Cr and body composition, Cr and physical ability of the athletes were studied, and the exercise load of the athletes were monitored with other physiological and biochemical indexes.

Results There was a significant difference in Cr value between anaerobic metabolism (ATP-CP and glycolysis) and aerobic metabolism (p < 0.01); Cr was highly correlated with lean body weight, skeletal muscle content and BMI (R^2 was 0.562, 0.574, 0.871 respectively); Cr was basically consistent with the change trend of hemoglobin, testosterone, creatinine kinase and other physiological and biochemical indicators in terms of training monitoring; Cr was highly correlated with maximum anaerobic work, average anaerobic work and maximum anaerobic work/body weight (R^2 was 0.625, 0.707, 0.660 respectively).
Conclusions In the sports dominated by phosphoric acid, Cr can be used to assess athletes muscle mass and non-invasive measuring level of creatine phosphate in the body. The change of Cr concentration in human body is closely related to athletic train. It can be used to control the quantity and intensity of exercise more scientifically combined with other indexes. At the same time, it can monitor the function of the kidneys in the training process. When the Cr is abnormally higher than the personal threshold, it is necessary to pay attention to the physical function of the athletes, such as diet, nutrient, weight loss control etc. Moreover, excessive fatigue should be adjusted in time to avoid overincrease of Cr which may cause kidney damage.

PO-022
Effects of Different Exercise on the Expression of White Fat Browning Proteins in Growing Rats

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Objective The prevention of obesity in children and adolescents can reduce the risk of obesity and various chronic diseases in adulthood. In recent years, it has been found that inducing browning of white fat can regulate energy balance and inhibit fat accumulation. Exercise as a healthy intervention can regulate energy balance by affecting the browning of white fat. However, the effect of exercise on the browning of white fat during the critical period of growth and development is not yet known, and the effect of different exercise methods on the browning of different location of white fat is inconsistent. Therefore, this study intends to explore the effects of different exercise methods on the expression of browning-related proteins of peripheral white adipose tissue and browning-related genes of hypothalamus in growing rats through animal experiments, and to explore the relationship between them.

Methods 30 Male, 3-week-old SD rats were randomly divided into three groups, C group: Control group (sedentary, n=10); MD group: moderate-intensity training group (MD group, n=10), and high-intensity intermittent training group (HIIT group, n=10). MD group exercise program: 60% VO2max exercise for 60 minutes, 5 times a week for a total of 4 weeks. HIIT group exercise program: 85% ~ 90% VO2max exercise 6min, 50% VO2max exercise interval 4min, repeated 6 times. 5 times a week for a total of 4 weeks. The exercise intensity was adjusted based on the maximal oxygen uptake measurement every 2 weeks. Three groups of rats were weighed once a week. After the experiment, anesthesia was performed with 10% chloral hydrate 50 mg/Kg (body weight) in the abdominal cavity to rapidly separate the hypothalamus, perirenal and epididymal fat and put into liquid nitrogen and transfer these to -80°C refrigerator for testing. The expression of POMC, NPY, LEPR and GRP78 mRNA in hypothalamus was determined by RT-PCR. The expression of PRDM16 and UCP1 protein in perirenal white fat was measured by Western Blot.

Results 1. The weight of the three groups of rats increased continuously within 4 weeks of exercise intervention. Compared with group C, the weight of group E and group H increased slowly from the second week (p<.05). 2. The increase in absolute weight and relative weight of visceral fat in MD group and HIIT group was significantly lower than that in C group (p<.01); the increase in absolute weight and relative weight of visceral fat in MD group was significantly lower than HIIT group (p<.05). 3. Compared with group C, the expression of PRDM16 protein in WAT of the kidneys in group MD was significantly increased (p<.01), and the UCP1 protein expression was significantly increased (p<.01). Compared with group C, there was no significant difference in PRDM16 and UCP1 protein expression in WAT of HIIT group (p>.05). 4. Compared with group C, the expression of NPY mRNA in hypothalamus in group MD was significantly decreased (p<.01), POMC, LEPR, GRP78 mRNA expression had no significant difference (p>.05); Compared with group C, there was no significant difference in the expression of hypothalamus POMC, NPY, LEPR and GRP78 mRNA in HIIT group (p>.05). 5. There was a negative correlation between the
expression of NPYmRNA in hypothalamus and the expression of PRDM16 protein in white fat (p<.01).

**Conclusions** Moderate-intensity exercise for 4 weeks in the growth and development period of rats can decrease NPY expression in hypothalamus of rats and induce white-to-brown phenomena in perirenal adipose tissue, but not in HIIT.

**PO-023**

*Effects of exercise-induced miRNAs on mitochondrial autophagy signaling pathway in PI3K/Akt/mTOR*

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**Objective** To explain the regulation of mitochondrial autophagy by exercise-induced miRNAs, it provides a new reference for the prevention and treatment of diseases such as inflammation and tumor.

**Methods** Through the literature data method, this paper refers to more than 100 articles and writes this review, which provides relevant research directions for relevant researchers.

**Results** Exercise promotes the up-regulation of miR-30, miR-223 and miR-210 expression through the PI3K/Akt/mTOR signaling pathway to inhibit its related target proteins, and promote mitochondrial autophagy to affect inflammation, tumor and other diseases.

**Conclusions** In recent years, people's concept of exercise has undergone a slow and fundamental change. In addition to medical factors, the role of exercise factors in the prevention or treatment of various diseases such as inflammation and cancer has gradually strengthened. Mitochondrial autophagy has a significant effect on tumor cells. The successful discovery of PI3K/Akt/mTOR signaling pathway provides more support for the involvement of tumor-like diseases. miRNAs may regulate PI3K/Akt/mTOR signaling in mitochondrial autophagy. Pathways significantly affect tumor-like diseases. Exercise is widely recommended as a means of preventing and treating various diseases such as inflammation and tumor. The induction of normoxic exercise and hypoxic exercise has a significant effect on the regulation of PI3K/Akt/mTOR signaling pathway in mitochondrial autophagy by miRNAs. In the future, studies on the regulation of mitochondrial autophagy by miRNAs can focus on the relationship with exercise. At present, the research on mitochondrial autophagy regulated by exercise-induced miRNAs is still insufficient. As a new discovery, it will receive more and more attention. miRNAs regulate the regulation of PI3K/Akt/mTOR signaling pathway in mitochondrial autophagy, which provides a new idea for solving the treatment problems of inflammation, tumor and other diseases.

**PO-024**

*Advances in Research on Exercise-Mediated miRNAs Regulating White Fat Browning*

Runzi Yuan
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**Objective** In this paper, we reviewed the positive and negative regulation of miRNAs on white fat browning and the effects of exercise on miRNAs and white fat browning, and explored the mechanism and physiological significance of miRNAs on white fat browning, and prospecting white fat browning. Prospects provide experimental researchers with new research ideas and
provide potential methods for the prevention and treatment of obesity and metabolic related diseases.

**Methods** Through the literature data method, 110 articles were reviewed. Finally, 75 papers (including 69 English papers) were used to analyze the research progress of exercise-mediated miRNAs regulating white fat browning, and provide new models for experimenters. Research ideas.

**Results** The analysis found that only a small number of miRNAs have a mechanism of action on white fat browning. In the future, the mechanism of action of other miRNAs on white fat browning should be further studied. The research on the effects of exercise on miRNAs is still in its infancy. There are few studies on the effects of exercise on white fat browning, and there is controversy. In the future, it is necessary to clarify the effects of different exercise modes on the regulation of white fat browning by miRNAs. Mechanism and physiological significance. In summary, miRNAs are closely related to the process of white fat browning, miRNAs can regulate the transcription of brown genes, and miRNAs have positive and negative regulation of white fat browning. However, the mechanism of action of only a small number of miRNAs on white fat browning has been elucidated (as shown in Figure 1), and the mechanism of action of other miRNAs on white fat browning should be further studied in the future. It is worth noting that the current studies on the browning of white fat by miRNAs have only been verified in animal experiments and human cell culture, and the exact mechanism of action in humans remains to be further verified. In terms of disease, RNA-based therapy has entered clinical trials, and further exploration of the function of miRNAs in white and brown adipose tissue will be a new treatment to help humans treat obesity and its subsequent complications. In addition, research on the effects of exercise on miRNAs is still in its infancy. There are few studies on the effects of exercise on browning of white fat, and there is controversy. In the future, it is necessary to clarify more different ways to induce miRNAs to regulate white fat browning. The mechanism of action and physiological significance make the research system in this field more perfect, and find as many miRNAs as possible to effectively intervene in obesity, promote brown fat production and white fat browning, and prevent and treat human obesity and metabolic abnormal diseases.

**Conclusions** In summary, miRNAs are closely related to the process of white fat browning, miRNAs can regulate the transcription of brown genes, and miRNAs have positive and negative regulation of white fat browning. However, the mechanism of action of only a small number of miRNAs on white fat browning has been elucidated (as shown in Figure 1), and the mechanism of action of other miRNAs on white fat browning should be further studied in the future. It is worth noting that the current studies on the browning of white fat by miRNAs have only been verified in animal experiments and human cell culture, and the exact mechanism of action in humans remains to be further verified. In terms of disease, RNA-based therapy has entered clinical trials, and further exploration of the function of miRNAs in white and brown adipose tissue will be a new treatment to help humans treat obesity and its subsequent complications. In addition, research on the effects of exercise on miRNAs is still in its infancy. There are few studies on the effects of exercise on browning of white fat, and there is controversy. In the future, it is necessary to clarify more different ways to induce miRNAs to regulate white fat browning. The mechanism of action and physiological significance make the research system in this field more perfect, and find as many miRNAs as possible to effectively intervene in obesity, promote brown fat production and white fat browning, and prevent and treat human obesity and metabolic abnormal diseases.
PO-025

Advances in research on hypoxia-mediated miRNAs affecting glucose metabolism

Han Jiang
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Objective This article reviews the role of miRNAs in promoting insulin sensitivity, controlling insulin synthesis, and regulating insulin resistance in hypoxia exercise, and discusses the relationship between miRNAs and glucose metabolism, and the mechanism of hypoxia-induced regulation of miRNAs in glucose metabolism. It provides a theoretical basis for better research on the prevention and treatment of disorders of glucose metabolism.

Methods This paper uses the literature data method, collects a large number of documents and cites more than 90 articles for comprehensive statistical analysis to write this article, which provides researchers with relevant research directions.

Results Studies have shown that miRNAs such as miR-138, miR-26b, miR-27a, miR-122, miR-802 and miR-143 have regulatory effects on obesity; some miRNAs such as miR-128, miR-7, miR-25, miR-92a, miR-375 and miR-15 family (miR-15a and miR-15b) and other miRNAs play an important role in regulating glycolipid metabolism, thereby maintaining a stable state of glycolipid metabolism. Expressions such as miR-802 and miR-143 are up-regulated in the liver of obese patients, resulting in impaired glucose tolerance.

Conclusions By regulating the expression of target genes and maintaining the homeostasis of glucose metabolism, miRNAs can effectively improve or prevent obesity and disorders of glucose metabolism such as type 2 diabetes. Current studies have shown that miRNAs affect glucose metabolism from insulin sensitivity, insulin synthesis and insulin resistance. At the same time, studies have shown that exercise intervention can effectively improve glucose metabolism. However, the research on the metabolism of miRNAs in glucose metabolism during hypoxia is still insufficient. It is for further study. Studying the mechanism of the effects of miRNAs on glucose metabolism in hypoxic exercise can not only provide a theoretical basis for scientific hypoglycemic and weight control, but also can be used as an intervention for the prevention and control of diseases related to glucose metabolism disorders. In the future, drugs can regulate the expression of miRNAs, thereby providing a new therapeutic approach for the treatment of diseases caused by abnormal glucose and lipid metabolism.

PO-026

Oxidative phosphorylation in response to high intensity interval training

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Objective The aim of our study was to investigate the adaptive effect of six sessions of high intensity interval training (HIIT) on changes in the amount and activity of mitochondrial enzymes.

Methods Twenty seven students (age 21.2±0.9) were assigned to HIIT (n=10) and control (CON, n=17) group and performed six training sessions for 14 days: 6 × 90 s intervals at 80% maximal aerobic power (MAP) output separated by 180 s rest. Pre and post interventions anthropometric measurements, maximal activity of citrate synthase (CS) and 3-HydroxyacylCoA (HADH) was determined in muscle samples. The effect of HIIT on proteins involved in oxidative phosphorylation (OXPHOS) in the skeletal muscle was used via proteomic analysis’s. We took
into consideration 89 identified subunits from the mitochondrial respiratory chain complexes and the ATP synthase complex. For these proteomic tests a muscle biopsy samples from the three representative participants HIIT and three CON before and after training were collected.

**Results** Training induced the moderate and large effects in maximal enzymes activities CS and HADH. The HIIT caused the increase of level proteins involved in oxidative phosphorylation.

**Conclusions** HIIT can be an optimal strategy for the prevention of certain civilization diseases or for the rehabilitation of diseases, especially cardiovascular disease.

**PO-027**

**Research on Tapering to Elite Female Race Walking Players with Altitude Training Characteristics**

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**Objective** The ultimate goal of athletic training is to perform the optimum competitive states in the competitions. The research has shown that one of the key factors to achieve the goal is effective and appropriate Tapering in preparing period. By systematically and completely tracing and summarizing the Tapering in endurance events with altitude training at the entire training period which could provide a better guidance for the training and bring into an furthest effects, providing a real reference cases for achieving competitive targets and scientific training.

**Methods** Have Selected 20 players and 10 games from annual competitions (National Championships, the National Games, World Games, Olympic qualifiers etc.) from 2011 to 2017, which involved 9 players who are the international master athletes and 11 players who are the National master athletes with 4-10 years of training. According to entire preparing period schedule and training targets to analyze the intensity, volume and rhythm of training, recording the athletes whose Hb(hemoglobin) number in different circulatory sports and concluding the athlete's Tapering mode and effects.

**Results** 1. The systematical time of preparing for competition was 65±5 days; 2. The entire training arrangements comprised of four stages: the plain training preparation phase, the altitude training phase, the plain training, pre-competition training phase; 3. Applied single peak and single cycle training model, the training structure was cycling 12 to 15 to 10 to 15 to 26kms, and the maximum training interval was 5-7 days after highest intensity training. 4. The tapering was engaged in the first week before the altitude training phase and 10-12days before competition; 5. The training load decreased 10-15%, the training intensity decreased by 25%-30% and the training volume was maintained to 90-105% during the first Tapering which mainly decrease training intensity; 6. During the second Tapering, the training load decreased by 40-60%, the training intensity was 90%-95% and at the key class, training intensity was more than 100% which mainly decrease training volume; 7. The training frequency was kept at 95-105% at two Tapering training phases; 8. Athletes' Hb number was maintained at 132.04 ±6.53IU. The whole adjustments varied with the Tapering training arrangements.

**Conclusions** 1. There were two Tapering training models with altitude training characteristics before the preparing competition period; 2. The one Tapering was decreasing training volume passively at the beginning of the altitude training, and the another Tapering was decreasing volume initiative before the competition. 3. The first Tapering was to reduce the intensity of training, and the second Tapering was to reduce the volume of training; 4. The first Tapering is last 5 to 7 days, and the second Tapering last 10 to 12 days; 5. The entire preparing preformed as hyperbolic mode. The first tapering was the exponential tapering (slow decay), and the second tapering was the exponential tapering (fast decay); 6. The athletics’ function capacity changes vary with the changes of Tapering. When the ability of adaption was quicker, the competitive states improved.
PO-028
The protective effects of curcumin on exercise-induced renal ischemia reperfusion injury in rats

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Objective This study was designed to investigate the effects of curcumin on inflammatory factors and ECM expression in exercise-induced renal ischemia reperfusion injury in rats.

Methods Sixty 7-week-old male SD rats were divided randomly into three groups: group A (normal control group, n=12), group B (overtraining group, n=24) and group C (curcumin + overtraining group, n=24). Group B and C performed 6 weeks of incremental load training on the treadmill. 24 hours after the last training, the rats were anesthetized intraperitoneally, the morphology of renal tissue and the dPOsition of glomerular ECM were observed using light microscope, the related biochemical indexes were tested.

Results (1) the renal structure of rats in group A were normal, histopathological changes were observed in group B and C, Paller score of group B were significantly higher than group A (P<0.01), and that of group C were significantly lower than group B (P<0.05). (2) Blood urea nitrogen (BUN) and serum creatinine (Scr), serum and renal inflammatory factors, TGF-β protein expression level and glomerular ECM dPOsition of group B were significantly higher than group A (P<0.01) and those of group C were lower than group B (P<0.05).

Conclusions Supplementation of curcumin can effectively protect rats from exercise-induced renal ischemia reperfusion injury, by inhibiting the up-regulation of inflammatory cytokines and TGF-β expression and maintaining the dynamic balance of ECM.

PO-029
Mitochondria-associated Ampk mediates mitochondrial quality control in skeletal muscle

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Objective Mitochondria exist as a complex, interconnected reticulum with the degree of complexity at homeostasis varying by cell type. Declines in mitochondrial quality is a hallmark of numerous diseases and is partly maintained through the targeted removal and degradation of damaged/dysfunctional regions of the reticulum known as mitophagy. We have demonstrated that acute exercise causes targeted degradation of a subset (<1%) of the mitochondrial reticulum through mitophagy in an AMPK-dependent manner. However, how such spatial regulation is achieved is unclear. Given that AMPK is a well-known bioenergetics sensor critical for maintenance of energetic homoeostasis, and numerous studies have linked AMPK-signaling to mitochondrial remodeling and functional adaptations under physiological and pathological conditions, we hypothesized that AMPK regulates mitophagy by being physically associated with the mitochondria.
Methods C57BL/6 mice (3 or 20 months of age) were kept in standard conditions (12:12 light, dark cycle) on normal chow. Enriched mitochondrial fractions from skeletal muscle were obtained via differential centrifugation and percoll gradient isolation. Skeletal muscle energetic stress was induced via acute treadmill running, direct electrical stimulation, or hindlimb ischemia-reperfusion. Somatic gene transfer into skeletal muscle was done via electroporation. Confocal microscopy of whole mount skeletal muscle was performed at least 10 days post-electroporation to assess MitoTimer fluorescence Red:Green Ratio and Mitophagy (i.e. presence of pure red puncta).

Results We have discovered that AMPK is enriched in isolated mitochondria from both mouse and human skeletal muscle (mitoAMPK) and that, in mice, mitoAMPK consists exclusively of α1/β2/γ1 isoforms. Furthermore, skeletal muscle mitoAMPK Thr172 phosphorylation, indicative of activation, is increased following electrical stimulation, ischemia-reperfusion, and acute treadmill running. By co-transfecting mouse FDB muscle with pMitoTimer and a mitochondrially-targeted AMPK inhibitor peptide (mitoAIP), we show that mitoAMPK activity is required to maintain mitochondrial quality (as evidenced by increased MitoTimer Red:Green ratio) and exercise-induced mitophagy (MitoTimer pure red puncta). Interestingly, association of mitoAMPK with mitochondria declines by ~50% in skeletal muscle in old mice and coincides with poor mitochondrial quality (increased MitoTimer Red:Green ratio), which may explain the loss of mitochondrial quality and metabolic flexibility with aging.

Conclusions Our current working hypothesis is that activation of mitoAMPK by exercise plays an instrumental role in promoting mitochondrial remodeling, hence contractile and metabolic adaptations, by spatially recognizing damaged regions of the mitochondrial reticulum. Future research on mitoAMPK will significantly improve the mechanistic understanding of exercise training-induced adaptation in skeletal muscle and AMPK biology.

PO-030 
Effect of Voluntary Exercise on Cartilage Morphology of Knee Osteoarthritis in Obese Mice Induced by High-fat Diet 

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Objective To examine the effect of voluntary wheel-running exercise on cartilage morphology of knee osteoarthritis (KOA) in obese mice induced by high-fat diet, and explore the protective role of 4 weeks voluntary wheel-running exercise on KOA, finally providing effective experimental evidence for clinical treatment of knee osteoarthritis.

Methods C57BL/6J mice were randomly assigned to the C-Sed group, C-Ex group, HF-Sed group and HF-Ex group. The control groups were fed a control diet (13.5% kcal from fat), and the high-fat groups were fed a high-fat diet (60% kcal from fat). After feeding 8 weeks different diets, the exercise groups were starting running. In order to examine the effect of voluntary wheel-running exercise on cartilage morphology of KOA, the joint of knee were harvested to be fixed, decalcified and embedded in paraffin, and the four-micrometer-thick sections were stained with both HE and toluidine blue.

Results After feeding twelve weeks different diets, the body mass of the high-fat diet group mice has a significant increase, which demonstrates that high-fat diet could successfully induce the mice obese. From the results of HE and toluidine blue, in comparison to the C-Sed group, the surface of the knee articular cartilage in the HF-Sed group was not intact and smooth, and the thickness of articular cartilage has a significant decrease (p<0.001); contrary to the HF-Sed group, the surface of the knee articular cartilage in HF-Ex group was slightly smooth, and there was significant increase in cartilage thickness.
Conclusions Four weeks voluntary wheel-running exercise can increase cartilage thickness, decrease the Mankin’s score and delay the degeneration of knee cartilage in obese mice. To conclude, the short-term wheel-running exercise protects against obesity-induced KOA.

PO-031
Exercise-induced BMI declined were association with increased sperm motility in college students: A short paper

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Objective Male reproduction cell level were effect by intensity and amount of exercise, therefore, we investigate the effect on semen parameters from six weeks aerobic exercise on normal weight and obesity male.

Methods

Exercise intervention
Participants completed 6 weeks of exercise intervention, 6 times per week and rest on Sunday. The exercise is composed of 20 push-ups and moderate intensity running 400 meters. The most suitable exercise heart rate (heart rate) = maximum heart rate of 75-80%, 8-10 minutes of warm-up exercise each time, the duration of each exercise duration is 60 minutes.

Laboratory methods:
BMI, body weight and Waist circumference were evaluated. Sperm count, percentage of sperm motility was evaluated. All subjects were requested to observe a 3 to 4day abstinence period before provide a semen sample, and the subjects were no performance heavy exercise. Semen samples were obtained at the second peoples hospital of Dazhou city, China. Sperm motility and count were analyzed using the World Health Organization (WHO) 2000 definition.

Results

Characterization of the subjects:
The baseline and Post-Pre Characteristics of the subjects were provided in Table 1. There were significant difference on body weight (p < 0.05), Waist circumference (p < 0.01) and BMI (p < 0.05) between normal weight group and obesity group. However, there was no significant difference on after of exercise intervention.

There was not significantly increased on total sperm count, sperm motility (%) and sperm motility a (%). However, sperm motility b (%) was significantly increased trend after exercise intervention (p = 0.06), although there was only seven subjects.

Conclusions Our study demonstrated that exercise-induced BMI declined-amplitude were significantly associated with increased sperm motility, this finding may be explained, at least in part, by an improvement of male reproductive health. A significant correlation-trend was found between induced BMI# and sperm motility (%) (R²=0.77, p =0.12) in normal weight group, but not in obesity or all subjects.
PO-032
Validation Of Capillary Blood Gas Analysis For The Assessment Of Training Load In Track Cycling

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Objective The energy supply of daily training of track cycling should be mainly by anaerobic metabolism, which can make the blood buffer capacity facing huge Challenge and being improved. The arterialized capillary blood gas analysis can be a reliable method to evaluate the blood status of base-acid balance, which may reflect the effect of exercise intensity on blood buffer system. The paper validate the blood gas analysis as a reliable method for evaluating the total periodical training load of track cyclists.

Methods Five male and five female elite track cyclists performed two phases (four weeks per phase) of training respectively. The content included the track specific, strength and aerobic training. The Borg’s Rating of Perceived Exertion (RPE) Scale (0-11) was recorded in the ten minutes after each session and calculated the session RPE (sRPE). The total inertial load (TIL) was calculated by sRPE sum from Monday to Thursday. The arterialized capillary blood gas analysis was performed at 7:00 AM on Monday and Friday. The delta value (ΔPH, ΔPCO2, ΔTCO2, ΔHCO3-, ΔBE, ΔPO2, ΔSO2) were calculated by Friday minus Monday. Pearson’s linear correlation was applied to calculate the correlation between TIL and delta value. Independent t test was used to test the differences between two genders.

Results There was the moderate correlation between TIL with ΔPH and ΔHCO3- (Correlation Coefficient= 0.712 and 0.642 respectively, \( P<0.01 \)). But other blood gas indexes didn’t show the obvious relationship with TIL (Correlation Coefficient < 0.5). There was no differences for TIL between male and female (3870.1±788.4 vs. 4130.2±716.7, \( P>.05 \)). Moreover, ΔHCO3- of male was significant more than female by 95.1% (\( P<0.01 \)). There were significant correlation between TIL and ΔPH for both male and female (Correlation Coefficient= 0.785 and 0.662 respectively, \( P<0.01 \)), and between TIL and ΔPH for both male and female (Correlation Coefficient= 0.662 and 0.658 respectively, \( P<0.01 \)).

Conclusions The PH value and bicarbonate radical of blood should be sensitive to the high intensity track cycling training, which can be the valid to evaluate the inertial load. However, gender has no influence on evaluating. The oxygen partial pressure and oxygen saturation of blood can not reflect the training load accurately.

PO-033
Effect of diet and exercise intervention on the treatment of diabetic patients

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Objective To investigate the effect of nutrition and exercise intervention on lowering blood glucose level in type 2 diabetes patients.

Methods In Wuhou district of Chengdu and Tianfu New Area, select TongZi Community health service centers and Er Jiang community health service center in patients with type 2 diabetes health management team, the latest Glycosylated Hemoglobin (HbAlc) \( \geq 7.4\% \) of the patients as the research object, 592, randomized methods for nutrition intervention group + exercise intervention group, exercise intervention group and control group, each group of about 200
people. Adopt the self-designed questionnaire to collect the general information of patients, including gender, age, culture level, course of the disease and the complications, etc., using the standard method of measurement, the measurement of the patient's body, including blood pressure, heart rate, biochemical tests Glycosylated Hemoglobin (HbAlc) and so on. Patients were followed for one year. At 3, 6 and 12 months, patients were followed up with questionnaires, physical measurements and HbAlc tests.

**Results** The patients with 3, 6 and 12 months the total response rate was 98.2%, 99.2% and 98.6%, compared with the baseline, the two intervention groups Glycosylated Hemoglobin (HbAlc) in different periods of follow-up is falling, 6 months is more noticeable, nutrition intervention group + exercise intervention group decreased by 0.44%, movement intervention group decreased by 0.23%, while the control group increased by 0.08%. It can be seen that proper exercise can increase the sensitivity of body tissues to insulin, thus increasing the use of glucose angiosperms and other tissues in blood and lowering blood glucose. Even for individual patients, exercise combined with diet therapy can even stabilize blood glucose at normal levels. Effective exercise and nutrition intervention is an important measure to treat diabetes.

**Conclusions** The long-term diet and exercise intervention for diabetic patients is not only beneficial to the health of diabetes, but also can significantly improve the quality of life of patients. Effective exercise and nutrition intervention are important measures to treat diabetes.

**PO-034**

**Influence of Physical Activity on Aerobic Endurance Capacity on Primary School Students**

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**Objective** The physical fitness of primary school students is not optimistic in recent years. The obesity rate and myopia rate have continuously increased, and the aerobic endurance capacity has insistently declined. The aerobic endurance capacity is an important indicator to evaluate the physical fitness of students. This article explores the effects of physical activity(PA) designed by NSPEL on the improvement of aerobic endurance by intervening in the fourth grade students of Shifoying Primary School in Chaoyang District in Beijing, and provides a reference for students' physical fitness promotion.

**Methods** 155 fourth-grade students from Shifoying primary School in Beijing were selected as subjects. They were subjected to PA intervention for 16 weeks and their physical fitness related indicators were evaluated. PA intervention includes in-class and extracurricular sports activities. Physical education was guided by the syllabus. Extracurricular sports activities were mainly activities in break and after-school sports interest classes. The final analysis of the physical fitness assessment scores, BMI, 50m run, 50-meter shuttle run, skipping and sit-up were performed before and after the intervention.

**Results** The average score of physical fitness assessment of students was 79.79 before PA intervention, and the score was significantly increased and increased to 88.12 (10.43%) after the intervention. Physical shape of the students changed significantly after PA intervention. The mean of BMI was within the normal range before and after intervention, and the obesity rate was reduced by 1.29%. The student's speed capacity improved significantly after the intervention, the average score of the 50-meter race increased from 10.22 seconds to 7.90 seconds, the difference was very significant, with an increase of 2.32 seconds after the intervention. The student's aerobic endurance capacity was significantly improved before and after PA intervention. The average score of the 50 meter shuttle run was increased from 2.01 min to 1.74 min, and the result was significantly improved by 13.43%. The average score of sit-up was 21.64, and it increased to 42.30 after the intervention, with an average increase of 20.66.
Conclusions  Students' physical fitness assessment scores improved significantly after PA in and out of class, suggesting that PA effectively improved the physical fitness status of 11-year-old pupils. Students' 50-meter run, 50 meter shuttle run, skipping, and sit-ups were all significantly improved after PA interventions, suggesting that PA is of great significance for improving aerobic endurance. The combination of activities inside and outside class can be used as a reference mode to improve students' physical fitness (NSFC31401018, SKXJX2014014, Corresponding_houlj@bnu.edu.cn).

PO-035
IDEEA Estimation of Daily Behavior Energy Consumption: Verified by Metabolic Chamber
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Objective  To investigate the accuracy of Intelligent Device for Ener gety Expenditure and Activity (IDEEA) in the measurement of energy consumption in the evening of adults in Nanjing.

Methods  120 subjects were selected, and worn IDEEA into the metabolic chamber for 11 hours of energy consumption test.Body composition by Dual-Energy X-ray Absorptiometry. Sleep metabolic rate (SMR), Rest metabolic rate (RMR) and Basal metabolic rate (BMR) by metabolic chamber.

Results  The energy consumption results were paired with sample T test. The results showed significant difference between MC and IDEEA, but the effect size was between 0.004 and 0.042. The correlation between MC and IDEEA was 0.85 to 0.96. The absolute error rate of energy consumption measurement was from 6.16 % to 7.92 %, of which the measurement error of sleep energy consumption was 6.16 %±4.16 %, and that of Internet energy consumption was 7.92 %±5.99 %.

Conclusions  Energy measurement of IDEEA absolute error rate is within acceptable range, and it provides a high-precision alternative method for estimating energy consumption. The immediate and cumulative energy consumption data can be used to estimate the energy consumption for human physical activities over a period of time.

PO-036
The Mechanism of Exercise and Torkinib(PP242)-mediated Skeletal Muscle TFEB Transcriptional Function in the Regulation of Insulin Resistance
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Objective  Establish a C57BL/6 mice model of insulin resistance fed with high-fat(45% as energy) diet:1) Explore whether or not endurance exercise, PP242 and joint intervention could regulate muscle glucose uptake & utilization and insulin resistance, reveal its relevant possible molecular mechanism; 2) Understand the moderating effect and molecular mechanism (autophagy-lysosome mechanism and mitochondrial quality control) of TFEB-mediated transcriptional mechanism regulated by exercise, PP242 and joint intervention on glycolipid metabolism and insulin resistance; 3) Analyse whether or not joint intervention could exert an synergistic or inhibitory effect on glycolipid metabolism and insulin resistance.
Methods Group-division of mice: common diet group(Con), high-fat diet group (HFD), high-fat diet+exercise group (HFD+E), high-fat diet group+PP242 (HFD+P) and high-fat diet+PP242+exercise group(HFD+PE). Then drug intervention experiment and treadmill exercise were put on the agenda after insulin resistance models established successfully. HFD+P group mice and HFD+PE group mice were injected with PP242 (200 nM/kg/d, 3 times/week, 6 weeks) at bilateral hind limbs, while other groups were injected with isodose PBS. HFD+P group mice and HFD+PE group mice undergo treadmill exercise. Specific exercise program was as follows: Exercise adaptation(15min/day, 13m/min, slope was 0°), and then 6-week treadmill and endurance exercise(13 m/min, 60 min/day, 6 day/week, slope was 0°), all the intervention(including exercise and PP242) last for another 6 weeks.

Results 1) exercise could reduce body weight and body fat content in high-fat-diet-fed mice, improve hyperglycemia, hyperlipidemia, hyperinsulinemia and glucose tolerance level, promote muscle glucose uptake and transport capacity, and eventually improve glycolipid metabolism disorder and insulin resistance. Exercise could promote the nucleus localization of muscle TFEB and its transcriptional operation mechanism in high-fat-diet-fed mice, up-regulate muscle autophagy flux, increase mitochondrial biogenesis, mitochondrial fusion ability and mitophagy flux, inhibit mitochondrial fission ability, and eventually improve mitochondrial quality control.2) Local injection of PP242 could reduce body weight and body fat content in high-fat-diet-fed mice, improve hyperglycemia, hyperlipidemia, hyperinsulinemia and glucose tolerance level, promote muscle glucose uptake and transport capacity, and eventually improve glycolipid metabolism disorder and insulin resistance, but its overall curative effect was not as good as exercise. PP242 could also promote the nucleus localization of muscle TFEB and its transcriptional operation mechanism in high-fat-diet-fed mice, up-regulate muscle autophagy flux, but have no effect on mitochondrial biogenesis and mitochondrial fission ability. however, it could improve mitochondrial fusion ability and mitophagy flux, and eventually improve mitochondrial quality control and its functional integrity.3) Combined exercise and PP242 intervention could reduce body weight and body fat content in high-fat-diet-fed mice, improve hyperglycemia, hyperlipidemia, hyperinsulinemia and glucose tolerance level, promote muscle glucose uptake and transport capacity, and eventually improve glycolipid metabolism disorder and insulin resistance. It could also promote the nucleus localization of muscle TFEB and its transcriptional operation mechanism in high-fat-diet-fed mice, up-regulate muscle autophagy flux, depress mitochondrial fission ability, and eventually improve mitochondrial quality control and its functional integrity.

Conclusions 1) Exercise could activate TFEB-mediated transcriptional function in muscle, up-regulate autophagy flux level, enhance mitochondrial biogenesis, mitochondrial fusion and mitophagy, inhibit mitochondrial fission capacity, ameliorate mitochondrial quality control, promote glucose uptake and transport capacity, and eventually improve glycolipid metabolism disorder and insulin resistance. 2) PP242 could activate TFEB-mediated transcriptional function in muscle, up-regulate autophagy flux level, enhance mitochondrial fusion and mitophagy, ameliorate mitochondrial quality control, promote glucose uptake and transport capacity, and eventually improve glycolipid metabolism disorder and insulin resistance.3) Joint intervention could activate TFEB-mediated transcriptional function in muscle, up-regulate autophagy flux level, enhance mitochondrial fusion and mitophagy, repress mitochondrial fission capacity, ameliorate mitochondrial quality control, promote glucose uptake and transport capacity, which eventually improve glycolipid metabolism disorder and insulin resistance, and its key effect was mainly attributed to PP242.
PO-037
Effect of 8 weeks aerobic combined with resistance exercise on hepatic glycolipid metabolism induced by high fat diet in mice

Jing Xiao
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Objective C57 mice were fed with high-fat diet. After the pathological features were detected, a group of C57 high-fat diet mice were randomly selected for eight weeks aerobic and anti-resistance exercise. To observe the effect of exercise on liver glucose and lipid metabolism in mice fed with high fat. To explore the effect of exercise on liver glucose and lipid metabolism disorder caused by high fat feeding, to provide the direction and evidence for the treatment and rehabilitation of fatty liver and other diseases caused by high fat diet.

C57 mice were fed with high-fat diet. After the pathological features were detected, a group of C57 high-fat diet mice were randomly selected for eight weeks aerobic and anti-resistance exercise. To observe the effect of exercise on liver glucose and lipid metabolism in mice fed with high fat. To explore the effect of exercise on liver glucose and lipid metabolism disorder caused by high fat feeding, to provide the direction and evidence for the treatment and rehabilitation of fatty liver and other diseases caused by high fat diet.

Methods 30 male C57 mice were 8 weeks old, with an average weight of 20.02 ±0.06 g. The purchased mice were randomly divided into C57 diet group (n = 10) and high-fat diet group (n = 20). A pathological model of hepatic glycolipid metabolism disorder was established by high-fat feed feeding. The success of the model was measured by calculating the area under the blood glucose curve. After modeling, the C57 mice were randomly divided into high fat group and high fat exercise group, with 10 mice in each group. The mice in high fat exercise group were trained 6 days a week for 8 weeks. At the end of the exercise, the three groups were uniformly selected.

Results 1. Compared with the normal diet quiet group, there was a significant difference in the area under the blood glucose curve in the high-fat diet quiet group (p < 0.01). Compared with the quiet high-fat diet group, there was a significant difference in the area under the blood glucose curve after intraperitoneal injection of glucose in the high-fat diet exercise group (p < 0.05).

2. After two weeks of high fat diet feeding, the body weight of the quiet group was significantly higher than that of the quiet group fed with normal diet (p < 0.05). After two weeks exercise training of high-fat mice, the body weight of high-fat exercise group was significantly lower than that of quiet high-fat mice (p < 0.05). Compared with the normal diet group, the liver weight and liver weight of the high-fat quiet group increased (p < 0.01), while the liver weight and liver weight of the high-fat exercise group were lower than those of the high-fat quiet group (p < 0.05).

3. The liver AST (aspartate amino transferase) and ALT (Alanine transferase) in the High-fat diet quiet group were significantly higher than those in the normal diet quiet group (p < 0.01). The ALT (alanine transferase) in high-fat diet exercise group was lower than that in quiet high-fat diet group (p < 0.05).

Conclusions 16-week high-fat diet can establish a pathological model of hepatic glycolipid metabolism disorder. Hyper-insulinemia, hyper-lipidemia and other pathological phenomena will occur in mice. 8 weeks aerobic combined with anti-exercise intervention can improve hepatic glycolipid metabolism disorder and liver function.
PO-038
The Effects of One-Time High Intensity Intermittent Training on Expression of LC3 Gene in Rats’ White Adipose Tissue

Qishu Zhou, Chunyu Liang, Yafei Li, Yi Yan
Beijing Sport University

Objective  To investigate the effect of one-time high-intensity intermittent exercise in white fat autophagy in obese rats and provide a theoretical basis of the molecular mechanism of exercise fat loss.

Methods  Eighteen male 3-weeks-old rats were selected and divided into control group fed with normal diet (C), high-fat diet group fed with high fat diet (H). After 16 weeks, there were twelve obesity rats that divided into diet group (HS) and exercise group (HE). The other six control group rats of 19 weeks age were used as the standard (CS group). OE group did the high intensity intermittent exercise once. The CS group and the CS group were kept quietly. Three groups were taken subcutaneous white adipose tissue (S) and epididymal white adipose tissue (E) immediately after exercise. Mensurate the expression of LC3 gene in the tissue using the fluorescent quantitative PCR.

Results  1. The expression of LC3 mRNA from white fat tissue was different to the tissues, which the expression of epididymal white adipose tissue of each group was higher than that in subcutaneous white adipose tissue (P <0.01). 2. Compared with CS group, the expression of epididymal white fat adipose tissue LC3 mRNA decreased (P<0.01) and the expression of the subcutaneous white adipose tissue increased from HS group (P <0.05). 3. Compared with OS group, the expression of epididymal white fat adipose tissue LC3 mRNA decreased (P<0.05) and the expression of subcutaneous white adipose tissue decreased from OS group.

Conclusions  The expression of LC3mRNA in epididymal white fat adipose tissue of rats was significantly higher than that of subcutaneous white fat. The changes of LC3mRNA expression of adipose tissue caused by high-fat diet have tissue differences. One-time high-intensity intermittent exercise can reduce the expression of LC3mRNA in fat tissue of obese rats. Its regulatory mechanism needs to be further studied.

PO-039
Effects of one-time high intensity intermittent training on the expression of UCP1 mRNA in adipose tissue of obese rats

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Beijing Sport University

Objective  To observe the effect of one-time high-intensity intermittent training (HIIT) on the white fat browning in obese rats.

Methods  12 obese male rats at the age of 19-week were randomly divided into control group (OC group, n=6) and HIIT group (n=6). OC group doesn’t do exercise, and HIIT group finish the once high-intensity intermittent training (①Warm up: 70%VO₂max, 7min; ②High intensity exercise: 90%VO₂max, 3min+ 50%VO₂max, 3min, 6 times; ③Convalescence: 70%VO₂max, 7min.). The maximal oxygen uptake (VO₂max) of HIIT group was tested before training, and the exercise intensity was determined according to the average VO₂max. The subcutaneous and testicle white
adipose tissue (WAT) and brown adipose tissue (BAT) of the scapula were taken immediately after exercise. The expression of UCP1 mRNA in the WAT and BAT using the fluorescent quantitative PCR.

**Results** Compared with the OC group, the expression of BAT UCP1 mRNA, in the HIIT group was increased, but there was no significant difference (1.40±0.50 vs 1.03±0.27, P>0.05). In both OC and HIIT group, the expression of UCP1 mRNA of the subcutaneous and testicle WAT were too low to test. The results showed that one-time HIIT exercise had no effect on the expression of UCP1 mRNA in WAT.

**Conclusions** The effects of One-time HIIT on the expression of UCP1 mRNA in adipose tissue of obese rats are still not definite.

**PO-040**

**Effect of Hypoxic Pre-conditioning and Altitude Training on CD55 and CD59 Expressions of Swimmers**

Xi Wang, Huan Gao

Shanghai Research Institute of Sports Science

**Objective** By studying the swimmer after preconditioning during altitude training again after the change of erythrocyte immune and immune function, summarizes the change law of erythrocyte immune to try on erythrocyte immune to the connection between the immune index, further perfect the study on hypoxic training for athletes erythrocyte immune level, provide help and reference for scientific plateau training, comprehensive monitoring the immune function, so that more clear understanding of the athlete’s body function condition, effective judgment level of fatigue, for the early diagnosis of overtraining and training plan of reasonable adjustment has important significance.

**Methods**

1. Subjects: 8 first-line swimmers in Shanghai, aged 16.9 ± 3.5 years.
2. Hypoxic training program: the 3-week hypoxic training was conducted in the east green boat hypoxic training laboratory with a starting height of 1500m and a height of 2200m after 3 days. Sleep from 19:00 PM to 6:00 am in the hypoxic laboratory six days a week. Day training in an aerobic environment. 3 days after the end of hypoxic training, I went to kunming (2,200m) for 3 weeks of altitude training. After the highland training, go to the field to prepare for the competition.
3. Test indicators: RBC immune indicators CD55, CD59; Functional status indicators RBC, HGB, HCT;
4. Test time: 1 week before hypoxic start, 1 week before hypoxic start, 1 week after hypoxic end (i.e. before plateau training start), and 4 times of day elbow-venous blood taken at the end of altitude training was used for testing. P<0.05 indicates a significant difference, while P<0.01 indicates a very significant difference.

**Results** It was founded that: 1) The CD55 levels of the swimmers increased 0.56% at the 10th day, decreased 2.74% at the 3rd week and increased 9.89% 1 week after hypoxic pre-conditioning training. 2) The CD59 levels of the rowers revealed the similar changes as the CD55 during hypoxic pre-conditioning training. 3) The CD3 decreased by 4.13% and CD4/CD8 by 2.4% at the 1st week after hypoxic pre-conditioning training. 4) Compared with normal altitude training, CD55 and CD59 were kept in a high level in the third week of altitude training. CD59 of this week was lower than last two weeks. 5) WBC of the first hypoxic training week increased a little, and then, it come down in the next two weeks. In the third week of altitude training, WBC has gone up again. Three white cell subsets have different reaction. This result is similar with other researches.

**Conclusions** These results suggest that the effect of our altitude training method takes a different stimulation compared with normal altitude training. Mainly presented: 1). The expressions of CD55 and CD59 increased after hypoxic pre-conditioning and altitude training. 2). The erythrocyte immunity was more sensitive to the hypoxic training. CD55 and CD59 kept in a high level in the third week of altitude training. CD3 increased also. These showed that three weeks
hypoxic training accelerated the adaption to altitude training. It suggested that our method took good effects on improving physical functions in altitude training period.

**PO-041**

**Gene expression profiling of peripheral blood mononuclear cells in young male trampoline athletes**

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Shandong Sport University

**Objective**  
Evidence indicates that physical activity influence bone health. However, the molecular mechanisms mediating the beneficial adaptations to exercise are not well understood. The purpose of this study was to examine the differentially expressed genes in PBMC between athletes and healthy controls, and to analyze the important functional genes and signal pathways that cause increased bone mineral density in athletes, in order to further reveal the molecular mechanisms of exercise promoting bone health.

**Methods**  
Five professional trampoline athletes and five age-matched untrained college students participated in this study. Used the human expression Microarray V4.0 expression profiling chip to detect differentially expressed genes in the two groups, and performed KEGG Pathway analysis and application of STRING database to construct protein interaction Network; Real-Time PCR technology was used to verify the expression of some differential genes.

**Results**  
Compared with healthy controls, there were significant improvement in lumbar spine bone mineral density, and 236 up-regulated as well as 265 down-regulated in serum samples of athletes. The differentially expressed genes involved 28 signal pathways, such as cell adhesion molecules. Protein interaction network showed that MYC was at the core node position. Real-time PCR results showed that the expression levels of CD40 and ITGα6 genes in the athletes were up-regulated compared with the healthy controls, the detection results were consistent with that of the gene chip.

**Conclusions**  
The findings highlight that long-term high-intensity trampoline training could induce transcriptional changes in PBMC of the athletes. These data suggest that gene expression fingerprints can serve as a powerful research tool to design novel strategies for monitoring exercise. The findings of the study also provide support for the notion that PBMC could be used as a substitute to study exercise training that affects bone health.

**PO-042**

**Expression of Aromatase and Synthesis of Sex Steroid Hormones in Skeletal Muscle Following Exercise Training in Ovariectomized Rats**

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**Objective**  
Age-related muscle wasting (sarcopenia) is accompanied by a decrease in estrogen levels which can compromise the health of aging women. Recent studies have shown that the key enzyme of estrogen synthesis (aromatase) is detected in the skeletal muscle. The purpose of this study was to investigate the effects of exercise on the expression of aromatase and the synthesis of sex steroid hormones in skeletal muscle following exercise training.
Methods Fourteen female ovariectomized rats were divided into two groups, treadmill running (n=7) and sedentary (n=7) group. Exercise training on a treadmill (25 m/min, 60 min/day, 6 days/week) for 5 weeks. Immunofluorescence assay was used to detect estradiol and aromatase levels in soleus muscle and plantar muscle. Detected the expression of AKT, Aromatase, FoxO1, MyoD protein level by Western blotting.

Results We found that in ovariectomized rats, exercise training significantly increased the soleus and plantar muscles mass. The level of aromatase expression and 17-b-estradiol (E2) were increased significantly in skeletal muscle following exercise training(\(P<0.05\)). In addition, the down-stream Akt-FoxO1-MyoD signaling pathway was significantly regulated in both soleus and plantaris muscles following exercise(\(P<0.05\)).

Conclusions These results demonstrate that exercise training increased the expression of aromatase and local estrogen production in skeletal muscle, which potentially influences skeletal muscle in ovariectomized rats through activation of Akt-FoxO1-MyoD signaling pathway.

PO-043
Effects of royal jelly administration on endurance training-induced mitochondrial adaptations in skeletal muscle

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Objective In this study, we investigated effect of royal jelly (RJ), which is produced by honey bees to feed to developing larvae and contains various ingredients including protein, carbohydrate, lipids and minerals, on endurance training-induced adaptations in skeletal muscle in ICR mice.

Methods Male mice received either RJ (1.0 mg/g body weight) or distilled water for 3 weeks. Mice in the training group performed treadmill running at 20 m/min for 60 min from 30 min after the administration five times a week.

Results We found a significant positive main effects of RJ treatment on the weight of tibialis anterior (TA) muscle and gastrocnemius muscle. There was a significant positive main effect of endurance training on the maximum activities of citrate synthase and β-hydroxyacyl CoA dehydrogenase, which are mitochondrial enzymes, in TA and plantaris muscle (type I/IX dominant), while no significant effect of RJ treatment was found. In soleus muscle (about 40% fiber consistent with type I), the maximum activities of citrate synthase and β-hydroxyacyl CoA dehydrogenase were significantly increased by endurance training in the RJ treated group, while no significant effect of endurance training was found in the control group.

Conclusions Our results suggest that RJ treatment had positive effects on the induction of mitochondrial adaptation by endurance training in soleus muscle.

PO-044
The Effects of Altitude Training on Erythropoietic Response and Hematological Variables in elite endurance athletes

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Objective To increase the capacity of blood oxygen-carrying of the endurance performance in athletes is the goal of altitude training. The key factor in the achievement of enhanced
hematological variables is the stimulation in the hypoxia condition. Reticulocyte cells is the earliest red blood cells released to the bloods, it to be matured about 4days in the marrow. There are lots of research in the clinic tested reticulocyte can be monitor the change of the bone marrow hematopoietic system. The purpose of this study was to find out the effect of altitude training on reticulocyte indices of elite endurance athletes, further to analyzes the kinetics of erythropoiesis and hematological variables during and after altitude training;

**Methods** The main content of high altitude training are as following: 1~2weeks before the plateau, the main content of training was special aerobic endurance training and special strength endurance training; 1~5days after plateau, the main content of training was Low intensity, relaxation of the adaptive training; 5~15day after plateau, the main content of training was Intensive training phase, the main content of training was aerobic endurance and greater intensity of the special training; 16~20 days after the plateau, adjustment training 21~25days after the plateau, the main content of training was same to the training plan of 5~15day after plateau; 2~3days after return to the sea level, adjustment training; 1~2days after return to the sea level, the mainly training content was rhythm and strength training; 2 weeks after return to the sea level, the mainly content of training was normal training, the intensity of training was greater than the intensity in the sea level.

At this stage, we tested the changes of the reticulocyte indices before \after half past three weeks altitude (2366m,DuoBa,QingHai) training, to provided the basis for the develop research the influence of the bone marrow hematopoietic system. Blood parameters were collected two days before altitude training; two days after off altitude; two weeks after altitude. All the data measured from venous blood samples (1.5~2ml) collected via venipuncture from athletes in a supine position. All the samples were tested using ADVIA120. Data were analyzed by spss17.0 software.

**Results** MCVr/RDWr were significantly increased after altitude training, P<0.05; CHCMr and RDWr significantly decreased after altitude training, P<0.05; CHCMr were changed more significantly between before and after , P<0.01; the reason why retic# was decreased were analyzed that when the athletes training in the hypoxia condition, lack of oxygen and the mechanical injury of friction resulting in a new generation of reticulocyte number was less than the number of destruction. Hb#RETIC\RDW were changed significantly, P<0.05; but there was no significant changed find in RBC/HCT. After two weeks off altitude, MCVr、CHCMr、#RETIC、%RETIC all had significantly changed. P<0.05;and #RETIC、P<0.01: Hb is significantly increased controlled to the indices which tested before the athletes went to the altitude. It indicated altitude training can stimulated the bone marrow hematopoietic system to released more reticulocyte cells.RBC and HCT were decreased in our study ,but they were not showed any significantly changed, to analyzed that we found it was relatively large individual differences, which mean the athletes had the different reaction when they training in the plateau and after they back to the sea level; RDW was increased ,but it was not showed the significantly changes too. IRF was increased, but #RETIC\%RETIC\RBCwere decreased after back to the sea level, it showed that the #reticulocyte was not increased, it means that the consumption of the RBC was faster than the number of the erythropoiesis. The indices(Chr、MCVr、CHCMr) which correlated with the Hb contents was increased significantly, it indicated the stimulate of the hypoxia condition can enhance the synthetic of hemoglobin content, but the effect was not occur immediately, it will occurred after 2~3weeks after the athletes back to the sea level.

**Conclusions** Because the test groups were top-level middle-long distance race athletes, they were adapt the training stimulate, so it can not make the reticulocyte indices changed solely, but in the plateau where lack of the oxygen, it will be result the bone marrow hematopoietic system to released more reticulocyte cells to satisfied the needs of the oxygen; the indices which be mutually related with Hb and #reticulocyte both showed the good effecce, it indicated that there had certain effect of altitude training on erythropoiesis, but these changes did not showed immediately, it needs 2~3 weeks to occur after returning to sea level.
PO-045
Effects of Exercise on Gene Expression Correlative to Bone Metabolism in Peripheral Blood Mononuclear Cells

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Objective To examine the gene expression pattern of Peripheral Blood Mononuclear Cells (PBMCs) and to explore exercise-sensitive genes correlative to bone metabolism in PBMCs. Thus to provide a theoretical basis for exercise intervention to prevent and treat osteoporosis.

Methods Uphill (+8°) and downhill (-8°) training were used for the exercise loading in two-month-old male Sprague-Dawley rats. The exercise method performed at 25 m/min, training 50 min/d, 5 d/wk, for 12 wk, respectively. Bone mineral density of distal femurs was measured using dual X-ray absorptiometry, and the expressed gene profile of PBMCs was examined using Gene Chip IVT Labeling Kit (Affymetrix).

Results Compared with control (CON) group, the BMD of the femur in the downhill (DOWN) group was significantly increased. Compared with the uphill (UP) group, the BMD and BMC of the femur in the DOWN group were significantly increased. There were 38 genes detected differentially expressed between two exercise groups together with CON group. The expression of genes modified by running involved in immunity, cell proliferation, Rheumatoid arthritis, Cell adhesion molecules and Tnf signaling pathway. There were 105 differently expressed genes between the DOWN group and the UP group which were mainly enriched in biological processes and pathways such as response to hydrogen peroxide, lipopolysaccharide, cell factor and mechanical stimulus, Cell adhesion molecules, cell migration, collagen biosynthetic process and Tnf signaling pathway. Tnf, Cxcl2, Ccl2, Jun and Mmp9 as the key nodes of protein interaction network were identified as candidate genes related to bone metabolism and sensitive to exercise.

Conclusions With weight gaining, age increasing and training time prolonging, long-term and high-intensity exercise will be harm for bone. At the same time and same running speed, downhill running conduces to increase bone density more than uphill running. It may be associated with differential expression of exercise-sensitive genes involved in bone metabolism in PBMCs.

PO-046
Status of Relationship of Risk of Gestational Diabetes Mellitus and Physical Activity intervention

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Objective Gestational diabetes mellitus is the first time or any degree of glucose tolerance abnormalities discovered during the pregnancy. In the global the incidence of GDM can reach 15%. In China also reached 6.6%. Numerous studies have demonstrated that lifestyle intervention for the pregnant woman, especially to increase physical activity can significantly reduce the risk of GDM. Our research aims to search and analyze researches about the relationship of risk of gestational diabetes mellitus and physical activity intervention. Then we clear the effect of physical activity intervention and provide some advices for the future in this field.

Methods The literature data were used though Pubmed, Web of Science, EBSCO, CNKI et al. database and we searched with the keywords of "physical activity", "exercise", "exercise
intervention”, “gestational diabetes mellitus”, “glucose tolerance”, “postpartum diabetes prevention” in all these database. Finally we reviewed researches on physical activity interventions in GDM patients, discussed the relationship of before pregnancy, during pregnancy and postpartum physical activity intervention between the GDM risk. And we used the comparative analysis to get the corresponding conclusions.

**Results**
1. Women of European and American countries during pregnancy who participated in physical activity and achieve the recommended amount was common, but only about 1/5 of Chinese women can achieve the physical activity amount which was recommended. 2. Join in regular physical activity before, during and after pregnancy, women could reduce the risk of GDM. 3. Aerobic training and/or resistance training could effectively improve glucose metabolism and insulin in patients with GDM and the recommended exercise prescription was moderate intensity, 3 to 5 days a week, last longer than 6 weeks.

**Conclusions**
The incidence of GDM is closely connected with pregnancy lifestyle changes. Women take part in regular physical activity before, during and after pregnancy could reduce the risk of GDM. But this kind of research is rare and behindhand in China. In the future, we should put forward the corresponding suggestions for our country to make pregnancy physical activity guidelines. In the other hand, researchers should verify the effect of health of pregnant women after the exercise intervention.

**PO-047**

**Study on the Expression of Inflammatory Factor, chemotactic factor in the Repair of Skeletal Muscle Contusion in Mice**

Linlin Zhao, Weihua Xiao, Xin Xu
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**Objective**
To investigate the regulation of muscle inflammatory factors and chemotactic factors during the repair of skeletal muscle contusion in mice.

**Methods**
Forty C57 male mice were needed. Eight for control group (C, n=8) and thirty for muscle contusion group (S, n=32). Subsequently, their gastrocnemius muscles were harvested at 0d, 1d, 3d, 7d, 14d after injury. Hematoxylin and eosin (HE) stain were used to assess the changes of muscle morphology. In addition, the gene expression of inflammatory factors and chemotactic factors was analyzed by real-time polymerase chain reaction.

**Results**
1. Morphology of skeletal muscles showed signs of regeneration at 3d post injury. The maximum amount of regeneration muscle fibers appeared during one week post contusion. Two weeks post-injury morphology of myofibers nearly recovered to normal. 2. After skeletal muscle injury, macrophage markers (CD68, CD163, CD206), a variety of inflammatory factors (IL-1, IL-6, IL-10) were up-regulated. 3. chemotactic factors (CCL2, CCL3, CCL5, CCL8, CXCL9, CXCL10, CXCL12, mRNA) were up-regulated.

**Conclusions**
After skeletal muscle contusion, the expression of a variety of chemotactic factors is up-regulated, which promotes macrophage infiltration and produces a variety of inflammatory factors. They may be involved in the inflammatory response and regeneration process after skeletal muscle contusion.
PO-048
Research on Animal models of Alzheimer's Disease

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Objective This paper analysis amount of literature about domestic and abroad with establishing the animal model of AD as the basics point of the research, and explore the construction of animal models of AD and the theoretical basis of the study. The purpose of the paper was to better probe AD Pathogenesis and etiology, and how to take appropriate intervention methods to lay the foundation.

Methods

Results Following the analysis, we found that the animal models of AD were mainly modeled by transgenic animal model, modeled by AD histopathological features, cholinergic nerve injury, aging, multifactorial complex, and ischemia and hypoxia. Each modeling method was based on the corresponding theoretical research carried out on the basis of the current research, however, the exact pathogenesis of AD was not clear, so the scholars in a variety of hypotheses on the premise Under the experimental animal model, naturally with a certain degree of one-sidedness. Transgenic animal model is expensive, disease resistance was poor, it was difficult to carry out a large amount of experimental study; cholinergic neuron damage in AD experimental animals for cholinergic function impairment and cognitive function of the ideal study.

Conclusions The modeling method of AD had many advantages and disadvantages, and the compound animal model of AD was more complex than single factor modeling. Thus, no matter which way AD animal model, it was difficult to replicate all the typical pathological changes in AD, suggesting that the pathogenesis of AD and its pathological changes in the complexity and multi-factor.

PO-049
Changes of trace elements in skeletal muscle and serum of rats after exercise-induced injury

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Objective This study is to investigate the changes of trace elements (Cu, Fe, Zn, Se, Mg) in serum and skeletal muscle of rats after skeletal muscle injury induced by downhill running, and to find out the change regularity of trace elements in the body after exercise injury. To provide experimental basis for how to use trace elements supplements reasonably.

Methods Fifty-four healthy male Sprague-Dawley rats aged 8 weeks were randomly divided into two groups: control group (C, N=6) and exercise group (E, N=48, include: 0 h group, 6 h group, 12 h group, 24 h group, 48 h group, 72 h group, 1- week group and 2- week group). The rats in exercise groups run down a 16°incline at 16m/min for 90 minutes. At the end of the exercise, the rats were killed at 0 h, 6 h, 12 h, 24 h, 48 h, 72 h, 1 week and 2 weeks, respectively. The serum was got from the inferior vena cava blood and diluted by 1% nitric acid. The muscle was got from the right side of the rat's sural which were digested by concentrated nitric acid and 30% hydrogen peroxide in 75°C water bath for 20mins. The content of trace elements in muscle and serum were measured by inductively coupled plasma atomic emission spectrometry (ICP-MS). All the data are analyzed and processed by SPSS22.0 statistical software.

Results
(1) The contents of trace elements in serum showed: Cu, Zn, Mg, Se decreased immediately after exercise, but the Cu still increased to reach a peak at 24h after decreasing, and after 2
weeks the content of Cu was slightly lower than pre-exercise level. However, the content of Zn did not elevate again, it continued declined to the lowest at 24h which was significantly lower than control group (P < 0.05). And after 2 weeks, Zn did not return to the pre-exercise level. The changes of Mg, Se in serum was not statistically significant. There is no difference between 0h and control groups in content of Fe, after that Fe decreased continually and appeared the least value at 24h, the differences between immediate group and control group were statistically significant (P < 0.05). Fe returned to the pre-exercise level after 2 weeks. (2) The contents of trace elements in muscle showed: Most of trace elements increased to the maximum level at 6 h, after that Mg, Fe, Cu decreased to the lowest value at 72 h which were significant lower than 0h group or 6h group (P < 0. 05). ALL the trace elements were lower than pre-exercise level. There was no statistical difference in the content of Se in muscle.

Conclusions
(1) The different changes of trace elements in skeletal muscle and serum after exercise injury may be due to the redistribution of trace elements caused by the body adaptability. (2) The most obviously changes of trace element in serum and muscle are Cu and Zn. Both of them did not return to the pre-exercise level after 2 weeks, it suggests that the supplement include Cu and Zn may play an important role in recovering after exercise-induced injury.

PO-050
Endocannabinoid CB1 receptor-mediated abnormal enhancement of rat corticostriatal glutamatergic pathway participates in exercise fatigue Regulation
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Objective By monitoring the expression of CB1 receptor protein and key regulatory protein RGS4 in the endocannabinoid system (eCBs), and the changes in the transmission efficiency of Corticostriatal glutamatergic pathway and movement ability after microinjection of CB1 receptor agonist WIN 55212-2 into the lateral ventricles in rats, this study investigates the possible mechanism of striatal eCBs regulation of exercise fatigue. The results may provide experimental basis for further improving the theory of exercise fatigue and indicate new targets for the regulation of exercise fatigue.

Methods 74 adult male Wistar rats were randomly divided into control group (Control) and 1-day fatigue group (1 FG), 3-day fatigue group (3 FG) and 7-day fatigue group (7 FG) after 3 days rearing. The Control group was in a quiet state and the exercise fatigue group performed exhaustive exercise for 1 day, 3 days and 7 days, respectively. After the induction of exercise fatigue, the expression of CB1 receptor and RGS4 in the striatum was determined by Western blotting technique. WIN 55212-2 (2mM, 5μL) microinjection into the lateral ventricle plus the stimulation-induced electrophysiological technique was used to determine the effect of CB1 receptor activation on the evoked spike discharges in striatal MSNs.

Results (1) The results of Western blotting showed that there was no significant change in the expression of CB1 receptor and RGS4 protein in the striatum of rats in 1 FG compared with Control group (P > 0.05). But the expression of CB1 receptor and RGS4 in the striatum was significantly increased in both FG and 7 FG compared with Control group (P < 0.01).
(2) The results of stimulation-induced electrophysiological experiment plus microinjection of lateral ventricle showed that the evoked spike frequency of MSNs in striatum of Control group (2.35±0.66Hz) at 1h after injection of WIN55N212-2 was not significantly different from that before injection (2.43±0.49Hz) (P > 0.05), that the evoked discharge frequency of MSNs in striatum of rats in 1 FG (2.63±0.54Hz) was decreased at 10~20min after injection of
WIN55N212-2 (2.16±0.43Hz), but no significant difference was found (P>0.05), that the evoked discharge frequency of MSNs in the striatum of rats in 3FG was decreased at 10－20min after injection of WIN55N212-2 (2.16±0.43Hz), that the evoked discharge frequency of MSNs in the striatum of 3FG (10.57±2.12Hz) was significantly decreased at 10－20min after injection (10.47±2.83Hz), and that the evoked discharge frequency of MSNs in the striatum of 7FG (21.7±3.28Hz) was significantly decreased at 10－20min after injection (15.14±1.94Hz) (P<0.01), and it was basically recovered at 50－60min after injection (19.12±2.89Hz) (P>0.05).

Objective The nervous system is the control center that performs the function of the human body, including each nucleus of the cerebral cortex and basal ganglia, which can control the motion of the body through three pathways-direct pathway, indirect pathway and hyperdirect pathway. Long-term physical exercise can effectively improve the human respiratory and circulatory system function indicators and promote the development of nervous system. In order to discuss the mechanisms of the high level athletes' control of the brain function network and provide the experimental basis for the study of the motor control of the central nervous system, this research collects the activation images of the cortex and basal ganglia nuclei of the ordinary college students and the high level athletes and analyzes the function connection coefficient between the groups.

Methods The subjects were 15 high level athletes and 15 ordinary college students. the changes of the brain structure and DTI fiber in the state of quiet and fatigue were collected by the functional magnetic resonance imaging (fMRI). Matlab software was used to compare images and data and to calculate the correlation coefficient between the related nuclear groups.

Results (1) Compared with ordinary college students, the functional connectivity coefficient between the left thalamus and the left hippocampus is different in high level athletes (P<0.05). (2) The high level athletes' functional connectivity in the left premotor area-right premotor area, left
premotor area-right striatum, right premotor area-left central buckle in supplementary motor area, right premotor area-right central buckle in supplementary motor area, right premotor area-right striatum and right premotor area-left cerebellum were changed significantly after exercise fatigue ($P<0.05$).

**Conclusions** The plasticity of brain function can be affected by long-term exercise training, which depends on sport training level. After exercise fatigue, the network connection system and nerve projection density change between cortical and subcortical nuclei, suggesting that exercise fatigue will change the functional connection between parts of the brain. (NSFC: 31401018 SKXJX2014014)

**PO-052**

**The influence of different intensity exercise on DEN-induced hepatocellular carcinoma and liver metabonomic study**

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**Objective** To study the influence of high internal intensity exercise and long-term moderate intensity endurance exercise on DEN-induced hepatocellular carcinoma (HCC) by metabonomics approach, and compare the anti-tumor effect between the different intensity exercise.

**Methods** From 8 to 26 weeks of age, mice with DEN treatment run on the treadmill at different intensity. NC: injection saline only. DEN: injection DEN only. HIT: treatment DEN, running on the treadmill at 1.5km/h, alternating run 2 minutes and rest 2 minutes for 40 minutes once a day, 5 days a week. ET: treatment DEN, running on the treadmill at 0.8 km/h for 40 minutes once a day, 5 days a week. Gas chromatograph time-of-flight mass spectrometry (GC−TOFMS) test liver samples of mice and multi-dimensional statistical methods fond differential metabolites in all group.

**Results** We observed that tumor incidence was similar between DEN and HIT; however, it was significantly smaller in ET compared to DEN and HIT. Orthogonal partial least squares analysis (OPLS) model was generated based on identified metabolites and showed clear discrimination from only DEN injection group and endurance exercise group, endurance exercise group and high intensity interval exercise group. Compared to DEN group, the level of galactinol, timonacic, glycine, cholesterol, carbamate and palmitic acid significantly decreased in endurance exercise group. Nevertheless, the level of malonic acid, ornithine and glutamic acid obviously increased in endurance group.

**Conclusions** Long-term endurance exercise inclines the hepatic tumor incidence by regulating the level of liver palmitic acid and glutamic acid metabolism. In addition, high intensity interval exercise does not have the effect to prevent tumor development.
PO-053
Changes of Cardiovascular Function during Exercise Tolerance Testing in Sedentary Postmenopausal Women after Exercise Intervention

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Objective Previous studies suggested that being postmenopausal could increase the risk of cardiovascular disease (CVD). If we can master the change characteristics of postmenopausal women’ cardiovascular function when they doing exercise, we may prevent or reduce the risk of CVD which induced by exercise. To get a more accurate tolerant judgment of the intensity of exercise, we discussed the change of cardiovascular function in sedentary postmenopausal women during exercise tolerance testing after exercise intervention, wish to provide more reliable theory basis in preventing exercise emergence and make an appropriate exercise prescription.

Methods Thirty postmenopausal women participated the study. PAR-Q questionnaires and International Physical Activity Questionnaire-Short Forms were used to screen participants. They were randomly divided into control group (n=15) and experimental group (n=15). The experimental group had an exercise intervention with 3 months walking while the control group lived as usual. Using an exercise tolerance testing by cycle ergometer, let participants do one-time maximal graded exercise test to exhaustion, get the indicators of heart rate, blood pressure, VO₂max, then analyzed the changes of cardiovascular function indexes before and after exercise intervention in experimental group, compared with control group in the same age categories, explored the similarities and differences between index variation.

Results (1) After 3 months of exercise intervention, the rest systolic blood pressure in the experimental group was significantly lower than that in the control group (P<0.05). (2) With the increase of exercise intensity, heart rate tend to rise in both two groups (P<0.05). After 3 months of exercise intervention, the amplitude of heart rate variation between two intensities got smaller in the experimental group. (3) With the enlargement of exercise intensity, systolic blood pressure tend to increase in both two groups (P<0.05). After 3 months of exercise intervention, the amplitude of systolic blood pressure variation between two grades got smaller in the experimental group. (4) The exercise intervention can effectively improve the cardiac functional capacity of postmenopausal women (P<0.05).

Conclusions Exercise for 3 month can efficiently increase the ability of postmenopausal women’s cardiovascular system in the quiet state, increase the reaction and adaptability of intensity stimulation of heart.

PO-054
Acute exercise intervention combined with metformin’s influences on glucose homeostasis in T2D mice

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Objective Type 2 diabetes mellitus is a common chronic diseases prevailing in the world and the amount of diabetic and pre-diabetic patients is increasing gradually. Exercise combined with hypoglycemic drug is the first recommended therapy to treat type 2 diabetes. Metformin was found from galegine in 1957 and has been used now as the first cheap and effective hypoglycemic guanidines. Our study aims to explore the effects of different ways of acute
exercise intervention combined with high dose of metformin on glucose homeostasis and its relative molecular mechanisms in type 2 diabetic mice.

**Methods** Adopt 4-week high fat diet (HFD, 45% fat content) and one-time STZ (Streptozocin, 100mg/kg) intraperitoneal injection to build type 2 diabetic mice. There are 84 mice in total, 24 mice were divided into three groups: normal control (NC) group, normal acute resistance training (NCR) group and normal acute endurance training (NCE) group, N=8 each group, they were fed normal chow. The rest 60 mice were fed HFD as T2D modeling group. 48 mice were developing type 2 diabetes and they were divided into 6 groups: diabetic control (DC) group, diabetic acute resistance training (DCR) group, diabetic acute endurance training (DCE) group, high dose of metformin control (HMC) group, high dose of metformin combined with acute resistance training (HMR) group and high dose of metformin combined with acute endurance training (HME) group, N=8 each group. Acute resistance training is climbing 1 meter ladder from down to up, 5 times a group, 3 groups in total, monitoring the glucose change with extracting mouse tail vein blood during each group, using ACCU-CHEK monitor. Acute endurance training is running at the speed of 18 m/min on the platform for 50 minutes and blood glucose change was monitored every 10 minutes by extracting mouse tail vein blood. HMC, HMR and HME group mice were intraperitoneally injected high dose of metformin (200mg/kg) one hour before the acute exercise intervention. Comparatively, NC, NCR, NCE, DC, DCR, DCE group mice were intraperitoneally injected 0.9% saline one hour before the acute exercise intervention. ELISA, RT-PCR and Western Blot were used to evaluate relative serum indicators, mRNA and protein expression of regulating blood glucose homeostasis.

**Results** 1) 4-week high fat diet and one time 100mg/kg Streptozocin intraperitoneal injection induces mice to develop type 2 diabetes. The fasting blood glucose, IPGTT, ITT, glucose AUC and insulin AUC of T2D group mice are significantly higher than NC group. 2) Compared with DCR group, the blood glucose value and fluctuation of HMR group mice are both significantly decreased, but the blood glucose value of DCR and HMR group mice are significantly higher than NCR group. In the same way, the blood glucose value and fluctuation of HME group mice is lower than DCE group and the whole blood glucose level of both group are higher than NCE group. Acute resistance training and acute endurance training combined with high dose of metformin have not affected the weight of type 2 diabetic mice. Hence compared with HMC group, the eWAT (epididymal white adipose tissue) of HMR and HME group mice is significantly declined. 3) Compared with NC group, the indicators of serum glucose, GSP (glycosylated serum protein), serum TG and serum T-CHO of DC group are notably increased, further reflect that the success model of type 2 diabetic mice. Compared with HMC group, the indicators of serum glucose, GSP, serum TG and serum T-CHO of HMR group mice are notably decreased, in the mean time, the indicators of serum glucose and serum TG of HME group mice are significantly declined. Interestingly, the serum insulin of HME group mice is notably lower than HMR group. 4) Compared with DC group, the indicators of mRNA expression about hepatic gluconeogenesis key rate-limiting enzymes PEPCK and G6pase of HMC group are significantly declined, but mRNA expression of regulating hepatic glucose homeostasis GLUT2 of HMC group is notably raised. Compared with HMC group, G6Pase mRNA expression of HMR and HME group mice is significantly escalated and Fbp mRNA expression of both groups are significantly declined. Compared with HMC, the indicators of mRNA expression about regulating hepatic glucose homeostasis GLUT2 and Gck of HMR and HME group mice show opposite trend, the former is down and the latter is up. Compared with HMC group, PEPCK mRNA expression of HMR group mice is notably escalated. Compared with HMR group, PEPCK and G6Pase mRNA expression of HME group mice are notably raised. 5) In the liver, there is a signaling pathway of AMPKα-PGC-1α-CREB to regulate glucose homeostasis and hepatic gluconeogenesis. Our study find that compared with HMC group, AMPKα2, PGC-1α and CREB mRNA expression of HMR and HME group mice are notably increased and only AMPKα1 mRNA expression of HMR group mice is significantly increased.

**Conclusions** 1) Acute resistance training and acute endurance training combined with high dose of metformin can effectively reduce glucose fluctuation during exercise in type 2 diabetic mice, therefore these two way can both improve glucose homeostasis during acute exercise intervention in type 2 diabetic mice. 2) Acute resistance training and acute endurance training...
combined with high dose of metformin can improve serum glucose and lipid metabolism in type 2 diabetic mice, but acute resistance training combined with high dose of metformin are better to improve serum lipid metabolism. 3) Acute exercise intervention combined with high dose of metformin can comparatively increase hepatic gluconeogenesis key rate-limiting enzymes PEPCK and G6Pase and regulating hepatic glucose transport Gck mRNA expression. In the opposite, these two ways inhibit the other hepatic gluconeogenesis key rate-limiting enzyme Fbp and regulating hepatic glucose transport GLUT2 mRNA expression. 4) Compared with acute endurance training combined with high dose of metformin, acute resistance training combined with high dose of metformin can better improve glucose homeostasis and hepatic gluconeogenesis in type 2 diabetic mice via the signaling pathway of AMPKα-PGC-1α-CREB.

PO-055
Exercise alleviates insulin resistance by regulating MG53 and IR/IRS/AKT/mTOR signaling in db/db mice skeletal muscle

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Objective In the current study, we aim to investigate whether 12-week treadmill exercise alleviates insulin resistance and muscle atrophy, and to explore whether MG53 along with IR/IRS/AKT/mTOR cascade play a role in the physiopathological changes of db/db mice.

Methods 20 db/db mice and 20 age-matched non-diabetic m/m mice were assigned to 4 groups as MC (m/m control) group, ME (m/m exercise) group, DC (db/db control) group and DE (db/db exercise) group. After an intervention of treadmill exercise of moderate intensity for 12 weeks, glucose and insulin tolerance tests, insulin resistance index (HOMA-IR, homeostasis model assessment of insulin resistance) and lipid metabolic profile were determined using blood samples. Skeletal muscles were utilized for determination of cross-sectional area (CSA), protein level detection of MG53 and insulin signaling pathway.

Results Compared with MC mice, the AUC (areas under curve) of IPGTT (intraperitoneal glucose tolerance test) and IPITT (intraperitoneal insulin tolerance test) as well as HOMA-IR were significantly increased, and lipid parameters (serum triglyceride and total cholesterol) increased significantly in DC group. The upregulation of MG53 protein in different skeletal muscles (quadriceps, gastrocnemius and soleus muscle) could be observed in DC mice. Phosphorylated proteins of IR-β (β subunit of insulin receptor), IRS1, AKT (protein kinase B), mTOR (mammalian target of rapamycin), p70S6k and S6 ribosomal protein after acute insulin stimulation were downregulated with significance, whereas no significant difference was found in total protein levels of IR-β and AKT except IRS1 in DC group. The results of AUC of IPGTT and IPITT, HOMA-IR and serum lipid parameters in DE group were significantly decreased compared with DC group. 12-week moderate exercise was sufficient to downregulate the expression of MG53 in skeletal muscles of diabetic db/db mice. In addition, treadmill exercise-induced improvement of insulin signal transduction and insulin-dependent protein synthesis may partially account for the heavier muscle mass and larger muscle size.

Conclusions In summary, insulin resistance and muscle atrophy of diabetic db/db mice could be effectively attenuated by 12-week moderate treadmill exercise by regulating MG53, MG53-mediated ubiquitin-dependent degradation of IRS1 and insulin signaling transduction.
PO-056
A potential role of stretch-activated channels in anabolic mechanotransduction in the atrophied rat soleus muscle
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Objective Prolonged immobilization or unloading of skeletal muscle causes muscle disuse atrophy, which is characterized by a reduction in muscle cross-sectional area and compromised contractile function. To date, the mechanisms of anabolic mechanotransduction in the atrophied mammalian skeletal muscle remain poorly understood. The aim of the present study was to assess a possible role of stretch-activated ion channels (SAC) in the propagation of a mechanical signal to anabolic signaling and protein synthesis (PS) in an isolated rat soleus muscle following mechanical unloading.

Methods The mechanical unloading was performed via hindlimb suspension (HS). Twenty-eight male Wistar rats weighing were randomly assigned to the following 4 groups (n=7/group): 1) vivarium control (C), 2) control + SAC inhibitor (gadolinium) (C+Gd3+), 3) 7-day HS (HS), 4) 7-day HS + SAC inhibitor (HS+Gd3+). Following unloading, an isolated rat soleus was placed in an organ culture medium and subjected to a bout of eccentric contractions (EC). Upon completion of the EC, muscles were collected for Western blot analyses to determine the content of the key anabolic markers. The rate of PS was measured by SUnSET technique.

Results EC-induced increase in PS was significantly less in the HS and HS+Gd3+ groups vs. the C group. There was no statistically significant difference between the HS and HS+Gd3+ groups in terms of EC-induced increase in muscle PS. A decrease in EC-induced phosphorylation of p70S6K, 4E-BP1, RPS6 and GSK-3beta in the 7-day unloaded soleus treated with SAC inhibitor did not differ from that of the 7-day unloaded soleus without SAC blockade. Thus, the inhibition of SAC with gadolinium did not lead to further decline in EC-induced phosphorylation of the key anabolic markers and muscle PS.

Conclusions The results of the study suggest that attenuation of mTORC1-signaling and PS in response to EC in unloaded soleus muscle may be associated with inactivation of SAC. The study was supported by the RFBR grant # 16-34-60055.

PO-057
The Role and Mechanism of Endocannabinoid System in Exercise-induced Antinociception
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Objective As we all know, exercise can enhance the will, improve the mood, and counteract the bad feelings of the body, but the cause and mechanism of action have not been clear. The endocannabinoid system is an important regulatory system in the central nervous system that regulates cognition, mood and behavior. Endocannabinoids can exert physiological regulation through cannabinoid receptor 1 (CB1) and cannabinoid receptor 2 (CB2). Cannabinoid receptors are widely distributed in the body and participate in the regulation of anti-nociceptive signals at multiple levels. This study will explore the role and mechanism of the endocannabinoid system in exercise-induced antinociception by literature research methods.

Methods Using endocannabinoid, exercise/sports and antinociception or emotion as keywords, using Pubmed, Medline, and Embase databases to search for nearly 15 years of research
literature and the literatures from cross-references of journals, after excluding the literature that is not relevant to the research content, the 12 articles included were analyzed.

**Results** Exercise can activate the endocannabinoid system, the degree of activation is related to exercise intensity, and high-intensity exercise significantly increases endocannabinoid levels in the human body. Cannabinoid receptor 1 (CB1) and cannabinoid receptor 2 (CB2) are widely distributed in the nervous system including the central nervous system and the peripheral nervous system. When exercise activates the endocannabinoid system, the increased endocannabinoid in the circulatory system activates CB1 and CB2 receptors, promotes hyperpolarization of the nervous system cells, reduces the rate of excitable cell release, and inhibits neurotransmitters, and reduce nociceptive impulses, thereby the body produces antinociception. Pretreatment with endocannabinoid metabolic enzyme inhibitors (MAFP, JZL184) and endocannabinoid reuptake inhibitors (VDM11) can be extended and enhanced the antinociceptive effect of exercise. Pretreatment with endocannabinoid receptor antagonists (AM251 and AM630) will inhibit the antinociception induced by aerobic exercise in mechanical and thermal nociceptive tests.

**Conclusions** Exercise can enhance the level of circulating endocannabinoids, activate the endocannabinoid system through endocannabinoid receptors, and then induce the body to produce anti-nociceptive effects. The degree of activation is related to exercise intensity. Studying the role and mechanism of the endocannabinoid system in exercise-induced antinociception can provide a theoretical basis for exercise to improve depression, anxiety and other emotions, improve the sense of life and prevent mental disorders.

**PO-058**

**The Function of Lycium Barbarum Juice Supplement in Exercise Stress Regulation during Increasing Resistance Training**

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**Objective** The purpose of this study was to explore the function of Lycium Barbarum juice on exercise stress regulation when male university students drank Lycium Barbarum juice during increasing resistance exercise, by observing the effects of oral Lycium Barbarum juice on the blood glucose, serum Adrenocorticotropic Hormone (ACTH), insulin and glucagon concentration.

**Methods** 21 to 22, healthy, 28 male university students participated in the study. They were randomly divided into a control group (n=16) and an experimental group (n=12). All participants completed four-stage incremental load movement for a total of 32 days. The exercise intensity of four stages was 60% VO₂ max, 70% VO₂ max, 80% VO₂ max and 90% VO₂ max, respectively. Each stage was exercised every-other-day, 4 times per stage and 1 hour each time. During the exercise, each subject in the experimental group drank 100 ml of 100% Lycium Barbarum juice before going to bed every day. Before the experiment and the morning after the end of each phase, a participant’s elbow-venous blood was collected to separate the serum. In all serum substances, the concentrations of ACTH, insulin, glucagon were detected by ELISA system. Fasting blood glucose concentration was detected by a blood glucose meter (Kyoto GT-1640 glucose meter, Japan). SPSS 17.0 software was used for statistical analysis.

**Results** 1) The serum ACTH concentration of the subjects continually increased with the progress of the incremental load exercise and reached the highest at the end of the fourth stage. Compared with the increase in the control group (P<0.05), the experimental group was more
significant \((P<0.01)\). 2) Compared with before the experiment, both control group and experimental group were no obvious changes of blood glucose concentration in the first and second stages, and the control group was significantly decreased in the third and fourth stages \((P<0.05)\), while the experimental group was not \((P>0.05)\). 3) During the increasing load exercise, the changes of insulin in serum of the participants were basically the same. The insulin level increased significantly at the end of the first stage and decreased successively at the end of the last three stages. At the end of the fourth stage, the serum insulin level of the control group decreased more significantly \((P<0.05)\) than the experimental group \((P>0.05)\). 4) The glucagon concentration in the control group continued to increase with the increase of the load. By contrast, the glucagon concentration in the experimental group gradually decreased at the end of the first stage and then increased at the end of the fourth stage. However, all of the increase and decrease are not statistically significant.

Conclusions During increasing resistance exercise, drinking Lycium Barbarum juice can increase the ability of the body to regulate Adrenocorticotropic Hormone (ACTH), insulin and glucagon through the exercise stress regulation systems, the Hypothalamic-Pituitary-Adrenal Cortical Hormone system (HPA) and the Sympathetic-Adrenal Medullary system. It plays an important role in maintaining blood sugar levels during increasing resistance exercise and accelerating post-exercise function recovery after exercise.

PO-059
Effects of oral Lycium barbarum juice in red blood cell antioxidant biomarkers and physical function during 8 days of aerobic exercise
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Objective Lycium barbarum polysaccharide (LBP) is the main active components of Lycium barbarum, its benefits to anti-aging, vision, kidney, and liver functions. Nevertheless, there is still a scarcity of experimental evidence to support the effect of Lycium barbarum on aerobic exercise. This a randomized controlled trial was observed the effects of oral Lycium barbarum juice in red blood cell antioxidant biomarkers and physical function during 8 days of aerobic exercise.

Methods 28 healthy male college students were divided into control group (16) and experimental group (12), and underwent interval running once every other day. total of 8 days. Exercise program: An exercise session includes two 30-minute aerobic exercises at 60%VO2max and a five-minute break. For the duration of the 8 days period, participants exercised one time every other day and the experimental group drank 100ml Lycium barbarum juice (each LBP content 360-440mg%) at bedtime every night. In ninth days, all the experimenters did exhaustive exercise with 80%VO2max on a treadmill with 8°. simultaneous recording of motion duration. The levels of red blood cell SOD, MDA, GSH-PX, serum CAT, serum TAC and other oxygenation stress markers and BLA, Glu, Urea, CK, Urine eight items and other physical function indexes of the subjects were determined before the experiment and after the completion of each intensity exercise. Differences between before and after intervention values were tested using a paired t test. And to compare the mean of outcomes in quantitative variables between the 2 groups, a independent t-test was used. The SPSS software (version 17, SPSS Inc, Chicago, IL, USA) was applied for data analysis and statistical significance was accepted at \(P < 0.05\).
Results (1) After 8 days of oral Lycium barbarum juice, the exhaustion time of exercise force in the experimental group was 30.76 ±12.19min, while the control group was 23.64±8.56min. Compared with the control group, the average exercise exhaustion time of the experimental group was prolonged 7.12min. (2) The red blood cell SOD in the two groups after 8 days of aerobic exercise had significant and significant improvement (P < 0.05, P < 0.01), and moreover, the increase of the experimental group was significantly higher than that of the control group (P < 0.05). As well as, the blood erythrocyte GSH-PX and serum TAC were significantly enhanced after the experiment (P < 0.01). It is suggested that increasing the levels of SOD and GSH-PX in vivo is beneficial in scavenging the free radicals produced by body movement. (3) After the 8 days oral Lycium barbarum juice, the decrease of MDA in blood red blood cells in the experimental group was greater than that of the control group (P < 0.01), indicating that the juice of Lycium barbarum could reduce the production of lipid peroxide products. (4) Exhaustion exercise after 8 days of oral Lycium barbarum juice, the physical function indexes of the experimental group were reduced. The positive rate of eight urine items was less than that in the control group, 8 in the control group, 2 for bilirubin positive, 3 in the urinary occult blood and 5 in the urine protein, while only 1 in the experimental group were positive for urine protein.

Conclusions Oral Lycium barbarum juice can improve the activity of antioxidant enzymes during aerobic exercise, reduce the formation of lipid peroxides in the body, protect the biological function of red blood cells, improve the physical function and postpone the production of sports fatigue.

PO-060  
Influence of different intensity exercise on immune factor in the hot and humid environment

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Objective to study the influence of exercise on immune factor IL-2, IL-3, IL-6 in the hot and humid environment by comparing the changes of leukocytes after different intensity exercise with the normal environment, exploring the training program which is beneficial for the immune system in the hot and humid environment, and supply the theoretical basis for the sports training and National Physical Fitness in the hot and humid area.

Methods The experimental subjects were 32 healthy male college students of Guangzhou Sports with an average age of 20.9 years. All the subjects tested the maximum oxygen uptake before the experiment, and then were divided into the control group, the 55%VO₂max sports group, the 70%VO₂max sports group and the 85%VO₂max sports group. The experimental subjects took a treadmill running in the normal environment (20-25℃; RH: 55-60%) and finished the same exercise training program in the hot and humid environment (30-32℃; RH: 90-95%) after a week, collected the elbow venous blood before and after exercise in the normal environment, The main test indicator contained IL-2, IL-3 and IL-6. Training program: control group sit quietly for 30 min; The 55%VO₂max group: Movement × 2, 15min one time, Interval 5 min; The 70% VO₂max group: Movement × 3, 10min one time, Interval 5 min; The 85%VO₂max group: Movement × 4, 7.5 min one time, Interval 5 min. All data were calculated using SPSS 25.0, Mean ± SD, standard deviation (Mean ± SD), paired T test, single factor variance and multifactor variance analysis. P<0.05 was the significant level, and P<0.01 was the very significant level.

Results 1. IL-2 is mainly produced in activated T lymphocytes, which can promote T cell proliferation, improve the secretion and function level of NK cells, play an important role in immune regulation and is an important regulatory factor. Under normal circumstances, IL-2 of the body of each exercise group increased slightly after acute exercise, but there was no statistical
significance ($p>0.05$). In the humid and hot environment, IL-2 decreased in all groups after exercise, and the decrease in the quiet group was large, but there was no statistical significance ($p>0.05$). IL-3 is a multipotent hematopoietic regulatory factor that ACTS on the proliferation and differentiation of hematopoietic cells, mainly produced by activated T lymphocytes. Under normal circumstances, the IL-3 increase of 55% VO$_{2}$max and 85% VO$_{2}$max group was not obvious after exercise, while that of 70% VO$_{2}$max group was not obvious before and after exercise. After acute exercise in hot and humid environment, IL-3 increased in all groups, but there was no statistical significance ($p>0.05$). Compared with the normal environment, IL-3 increased after exercise in each group. IL-6 plays an important role in the regulation of motor mediated function, known as kinematic factor, mainly from stimulated mononuclear macrophages, fibroblasts and vascular endothelial cells. Skeletal muscle can also express IL-6 under exercise stress, which is involved in the repair of muscle cell injury and plays an important regulatory role in skeletal muscle metabolism. Under normal circumstances, after exercise, there was a significant increase in all the exercise groups, among which 55% of the VO$_{2}$max group and 70% of the VO$_{2}$max group had a significant difference in IL-6 before and after exercise ($p<0.05$), and 85% of the VO$_{2}$max group had a very significant difference ($p<0.01$). In the humid and hot environment, IL-6 increased after thermal stress in the quiet group, and IL-6 increased significantly after acute exercise in all the exercise groups ($p<0.01$). Compared with the normal environment, IL-6 increased more significantly and significantly in each group after exercise.

**Conclusions** The combined effect of heat stress and exercise stress on human immune function in the thermal environment is more significant than that of heat stress or exercise stress alone. The greater the intensity of exercise, the decrease of IL-2 and the significant change of IL-6, the more attention should be paid to the temporary immunosuppression caused by excessive intensity of exercise in the humid and hot environment.

**PO-061**

**Treadmill exercise reduces Aβ dPOsition in the hippocampus of APP/PS1 mice by activating AMPK**

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**Objective** To investigate the molecular mechanism of AMPK-mediated motion reduction of Aβ dPOsition in the hippocampus of APP/PS1 mice.

**Methods** The 3 months of C57BL/6 48 APP/PS1 mice and 48 wildtype mice were randomly divided into APP/PS1 quiet control group (ADC, n=24) and exercise group (ADE, n=24), wildtype quiet control group (the WTC, n=24) and exercise group (WTE, n=24). ADE and WTE groups performed 12 weeks of treadmill exercise, while ADC and WTC groups were placed in a quiet running platform environment. The contents of ATP, AMP in hippocampus were tested by ELISA, AMPK and BACE1 mRNA in hippocampus were tested by RT-qPCR, Protein expression of AMPK, Sirt1, PPARγ, PGC1α, BACE1, Aβ in hippocampus were tested by Western Blot, the hippocampus SPs were tested by immunohistochemical experiments.

**Results** 12 weeks treadmill exercise can improve the AMP, ATP content, and the AMP/ATP ratio ($p<0.05$) in APP/PS1 mice hippocampus, up-regulation the mRNA and protein phosphorylation of AMPK ($p<0.05$), the protein expression of Sirt1, PPARγ and PGC1α ($p<0.05$) in APP/PS1 mice hippocampus, down-regulation the BACE1 mRNA and protein expression levels ($p<0.05$), Aβ protein and SPs level ($p<0.01$) in APP/PS1 mice hippocampus.

**Conclusions** The molecular mechanism of decrement Aβ dPOsition in APP/PS1 mice hippocampus mediated by 12 weeks of treadmill exercise may be related to activation of AMPK and the improvement of hippocampus energy metabolism by exercise, and then regulating the AMPK-BACE1 pathway.
PO-062
Effects of hypoxic exercise training on aerobic capacity-related proteins in overweight/obese adult males

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Objective
Since the Mexican Olympic Games, altitude training has attracted the attention of international sports science circle with its remarkable training effect, which is regarded as one of the effective methods to improve aerobic capacity. With the improvement of altitude training by scholars at home and abroad, hypoxic training has gradually entered the public view. Hypoxic training aims to achieve hypoxic stimulation by artificially simulating the natural hypoxic environment in the plateau or simulating the biological effects of hypoxic on human body. However, whether the aerobic capacity can be improved through hypoxic training requires us to further study and explore the mechanism of hypoxic training. This study explored the mechanism of hypoxic exercise training by stimulating long-term hypoxic exercise training for overweight or obese adult males.

Methods
In this study, 40 male (aged 18—47 years) overweight/obese subjects were recruited. No physical condition was abnormal after physical examination, and BMI ≥ 24 was overweight, while BMI ≥ 28 was obese. All subjects were paired according to their weight and divided into the hypoxic group and the normoxic group, the exercise intervention lasted for 6 weeks. The exercise intervention program consists of 30min strength training and 30min endurance training, with 5 minutes of warm-up and finishing activities before and after training. Strength training uses dumbbells, chooses 12RM weight, exercise with 8 actions, which are dead lift, upright row, squat, shoulder press, calf Jump, advance junge, biceps curl and triceps extension, each action 2 Group, rest between groups for 30s. Endurance training grade 0° treadmill, speed range according to the target heart rate adjustment, the target heart rate interval computation method for 60% HR_{max}—70% HR_{max}. Among them, subjects in the hypoxic group wore inhaled low-oxygen devices, which enabled them to exercise in a hypoxic environment. The oxygen content of the inhaled mixed gas was 16%. The subjects in the aerobic group exercised in an aerobic environment. Nutritional education was administered to all subjects prior to the start of the exercise intervention, but diet was not restricted during the intervention. Fasting venous blood before and after intervention, the detection of hemoglobin (Hb) and erythropoietin (PO), hypoxia-inducible factor 1 alpha (HIF1α), vascular endothelial growth factor (VEGF) and testosterone (T). All test results are the mean ± standard deviation, data comparison between groups using nonparametric the Mann-Whitney U test, data comparison in the group using nonparametric Wilcoxon match the symbol rank test, the significance level of P<0.05, very significance level of P<0.01.

Results
(1) After 6 weeks of intervention, Hb levels were elevated in the hypoxic group, but there was no statistically difference compared with the pre-intervention (P>0.05). And the change rate of Hb in the hypoxic group was higher than that in the normoxic group, but there was no statistically significant difference between the subjects (P>0.05).
PO levels were significantly higher in hypoxia group than before intervention (P<0.01). There was no significant change in PO levels in the normoxic group (P>0.05). The change rate of PO in the hypoxic group was statistically higher compared with the normoxic group (P<0.05).
The level of HIF1α was significantly increased in the hypoxic group (P<0.01), and the change rate of HIF1α in the hypoxic group was statistically higher compared with the normoxic group (P<0.01).
The VEGF level in the hypoxic group was significantly higher than that before the intervention (P<0.05). The change rate of VEGF in the hypoxic group was statistically higher compared with the normoxic group (P<0.01).
The T level of the hypoxic group was significantly higher than that before the intervention (P<0.01), and the T level was decreased in the normoxic group, but it was not statistically
difference compared with the pre-intervention (P >0.05), the rate of T change in the hypoxic group was statistically significant compared with the normox group (P<0.01).

**Conclusions**

Conclusion: 6-week hypoxic exercise training can increase the levels of PO, HIF1α, VEGF and T in the blood of overweight/obese people.

**PO-063**

**Effects of Resistance Training of Different Loads on Gastrocnemius Protein, IGF-I and TNF-α in Aging Rats**

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**Objective**

To observe the effects of different load resistance training on skeletal muscle dystrophy in aging rats by observing the expression of protein and protein of IGF-I and TNF-α in aging rats after 8 weeks of different load resistance training. The resistance training delays the theoretical basis for anti-skeletal muscle aging.

**Methods**

40 aging SD rats (18 months old) were randomly divided into a quiet control group, a non-weight-bearing exercise group, 30% of the largest negative recombination, 50% of the largest negative recombination, and 70% of the largest negative recombination. The sports group carried the treadmill movement with the tail load, the slope was 35°, the running speed was 15m/min, the rest was 30s every 15s, the rest was 3min after four cycles, and the three groups were one cycle. The cycle was intermittent for 10 minutes, and the exercise frequency was the next day for 8 weeks. After 8 weeks, the rat gastrocnemius muscle was taken. The protein content of the gastrocnemius muscle was determined by Coomassie brilliant blue method. The contents of IGF-I and TNF-α in the gastrocnemius muscle were determined by enzyme-linked immunosorbent assay.

**Results**

1. After 1.8 weeks of different load resistance exercise, compared with the quiet control group, the skeletal muscle protein content of each exercise group increased, among which 50% of the largest negative recombination and 70% of the largest negative recombination was the most significant (P<0.01). Compared with 70% of the largest negative recombination, the 50% maximum negative recombination content was relatively high (P<0.05);
2. After 8 weeks of different load resistance exercise, compared with the quiet control group, the content of IGF-I in the gastrocnemius of each exercise group was higher than that of the quiet control group, and there was a very significant difference (P<0.01), and 50%. The highest negative recombination and 70% of the largest negative recombination content is the highest;
3. After 8 weeks of different load resistance exercise, compared with the quiet control group, the TNF-α content in the gastrocnemius muscle of the rats in each resistance exercise group increased slightly, and the increase of only 50% of the largest negative recombination was statistically significant (P<0.05), although there were differences between the exercise groups, there was no statistical significance (P>0.05).

**Conclusions**

50% of the maximum weight-bearing resistance training can effectively increase the skeletal muscle muscle protein content of aging SD rats, and it is related to up-regulation of IGF-I factor and down-regulation of TNF-α factor expression by resistance training.
PO-064

Study on immune function monitoring during altitude training for adolescent athletes

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**Objective** Monitoring the changes of the body’s immune function during altitude training is of great significance for understanding the athlete’s physical function and judging the degree of fatigue. In this paper, the immune function of adolescent athletes in sports training in different altitudes was monitored, and the effects of different altitude training on immunoglobulins and T lymphocytes and their subgroups in adolescent athletes were discussed.

**Methods** Male adolescent middle and long distance runners were divided into two groups according to training performance, 2500m group (10 people, age: 14.8±1.4 years old, height: 163.6±7.3cm, weight: 49.5±6.0kg, training period: 1.2±0.6 years) and 1800m group (10 people, age: 15.7±1.7 years old, height: 164.7±8.8cm, weight: 49.2±6.1kg, training period: 1.3±0.8 years) volunteered to participate in the 2-stage training (3 weeks plateau and 3 weeks plain). The change of CD3+CD4+、CD3+CD8+、CD4+/CD8+、IgA、IgG、IgM were tested every week.

**Results** The result showed that: (1) The 2500m group had shown statistical differences of CD3+CD4+、CD3+CD8+ at different times, and CD4+/CD8+ had no changes. The 1800m group had not shown statistical differences of CD3+CD4+、CD4+/CD8+ at different times. Compared with the base value, the CD3+CD8+ was significantly increased (P<0.01). There was no statistical differences of CD3+CD4+、CD3+CD8+、CD4+/CD8+ at different times between two groups. (2) The 2500m group had not shown significant changes of IgA. Three weeks altitude training following with three week plain training the IgM and IgG showed a downward trend; and compared with altitude period, the IgM and IgG was lower in plain(P<0.05). The 1800m group had not shown statistical differences of IgA、IgM、IgG at different times. There was no statistical differences of IgA、IgM、IgG at different times between two groups.

**Conclusions** The immunity function of adolescent athletes is more affected during high altitude training, suggesting that the adolescent athletes in the pursuit of high altitude training should pay attention to the monitoring and regulation of immunity function. CD3+CD8+ is more sensitive to hypoxia which can be used as a sensitive indicator and has significant meaning in monitoring altitude training.

PO-065

The influence of cold acclimatization training on plasma NO and NOS contents in recruits

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**Objective** To observe the influence of cold acclimatization training on plasma NO and NOS contents in recruits, so as to provide basis for further study of cold acclimatization mechanism and training methods.
Methods 50 new recruits in cold regions were chosen as study objects, were divided randomly into two groups. Control group did normal exercise. The experimental group was trained according to the cold acclimatization training plan. The content of NO and NOS in the blood plasma were detected respectively before training and 30 days after training.

Results Comparison between after training and before training, the content of plasma NO in experimental group increased very significantly (P<0.01), and the content of plasma NOS decreased very significantly (P<0.01) after training. The content of plasma NO in the control group was significantly higher than that before training (P<0.05), and the content of plasma NOS was significantly lower than that before training (P<0.05). Comparison of two groups after training, the plasma NO content of the experimental group was higher than that of the control group, and the plasma NOS content was significantly lower than that of the control group (P<0.05).

Conclusions The local cold stimulation combined with the extension of outdoor exercise time can promote the changes in the content of NO and NOS, so as to adjust the vasoconstriction and make the body adaptable to the cold.

PO-066
Acute effects of lactate administration prior to endurance exercise on intramuscular signaling

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Objective High-intensity exercise, which increases blood lactate concentration, is known as an effective method to induce mitochondrial biogenesis compared to traditional endurance exercise. In addition, it has been reported that lactate acts as a signaling molecule inducing mitochondrial biogenesis. Therefore, we hypothesized that efficacy of high-intensity exercise is partly induced by lactate. The purpose of this study was to investigate the effects of lactate administration on signaling related to mitochondrial biogenesis.

Methods 8-week-old male ICR mice were used in this study. Mice were intraperitoneally administrated phosphate buffered saline (PBS) or 1 g/kg of body weight of sodium lactate. Immediately after the administration, mice were kept sedentary or performed treadmill exercise (20 m/min) for 60 min. Hence, there are the following four groups in this study: the PBS-sedentary, the Lactate-sedentary, the PBS-exercised and the Lactate-exercised. The blood, and the soleus and the plantaris muscles were harvested immediately after the rest or exercise. Nucleus and mitochondria were isolated to assess the localization of p53. Two-way ANOVA (Lactate x Exercise) was performed for statistical analysis.

Results We first measured blood substrates and muscle glycogen concentrations. Lactate administration significantly increased blood lactate and plasma free fatty acid concentrations. Exercise significantly decreased glycogen concentration both in the soleus and the plantaris muscles. Furthermore, lactate administration significantly decreased muscle glycogen concentration only in the soleus muscle. To clarify the effects of lactate administration on intramuscular signaling, we assessed kinases related to mitochondrial biogenesis. Main effect of exercise was observed in phosphorylation state of AMPK, ACC, p38 MAPK, and CaMKII in the soleus and the plantaris muscles. There was a trend of negative effect of lactate in CaMKII phosphorylation in the soleus muscle. However, there was no effect of lactate administration on the other kinases. We also investigated phosphorylation and localization of p53. As a result, lactate administration tended to increase p53 phosphorylation in the plantaris muscle. However, p53 was not translocated to nucleus or mitochondria.
Conclusions Lactate administration affected plasma FFA concentration and muscle glycogen concentration. However, acute lactate administration did not dramatically change intracellular signaling assessed in this study.

PO-067
Effects of hypoxic exercise on weight loss and lipid metabolism in overweight/obese adult women

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Objective To investigate the effectiveness of hypoxic exercise intervention on weight loss and weight control in overweight and obese people from the perspective of lipid metabolism through the exercise intervention in this experiment under normal pressure and low oxygen environment. Exercise is indispensable in the prevention and treatment of obesity. Scientific weight loss is firstly to change the original unhealthy daily life habits and to develop a good lifestyle and to control diet and to exercise regularly. Exercise in a hypoxic environment, the body should accept the dual stimulation of environmental what hypoxia and exercise hypoxia. Exercise in a hypoxic environment can deepen the impact on lipid metabolism. In a hypoxic environment, the oxygen saturation of the human arteries (the concentration of blood oxygen in the blood) is reduced; in altitude training or intermittent hypoxia training conditions, blood oxygen saturation can be reduced to 80-85%, and it is not in the normoxic environment. The result of hypoxia is that the muscles are forced to do anaerobic metabolism. In order to provide energy during exercise, and the body will store the stored fat to supply energy.

Methods The subjects in this study were adult overweight or obese women between the ages from 18 to 47 for a total of 40. Subjects with a BMI ≥ 24 were overweight and subjects with a BMI ≥ 28 were obese. Subjects who passed the physical examination screening were healthy and had normal motor function. All subjects used the weight index to pair the average into subgroups what hypoxic and normoxic groups. Exercise intervention, the training period is 6 weeks, the training the next day and 7 times in two weeks. The training content is divided into strength training and endurance training. The strength training is divided into each group of eight. To complete two cycles and the interval is 30s. The interval between each subgroup is 10s. Warm up and stretch before training. The time is 30 minutes. 12RM weight for strength training dumbbells, each group do 10-15 times. Eight actions include dead lift, upright row, squat, shoulder press, calf Jump, advance junge, biceps curl and triceps extension. Endurance training uses a running platform with a slope of 0°. The running speed is adjusted according to the target heart rate interval. The formula for calculating the target heart rate interval is (220-age) × 60%~(220-age) × 70%, running time is 30 minutes. In the hypoxic group, a suction-type atmospheric hypoxic device was used during exercise, and a mixed gas having an oxygen content of 16% was inhaled. The normoxic group is in a normal atmospheric environment during exercise. The ideological education of a reasonable nutritional diet for the subjects before and during the intervention is not mandatory to control the subject's daily diet. Height and weight and BMI were measured before and after exercise intervention. Fasting venous blood was taken to detect total cholesterol (TC), total triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C), leptin (LEP) and adiponectin (ADPN). All test results were expressed as mean ± standard deviation, non-parametric Mann-Whitney U test was used for comparison between groups, and non-parametric Wilcoxon was used for comparison within the group. The n-match was tested on the symbol level, with a significance level of P < 0.05 and a very significant level of P < 0.01.

Results After the intervention, the body weight of both groups decreased. The Δ body weight (P<0.01), body weight change rate (P<0.01) and BMI change rate (P<0.01) in the hypoxic group were significantly higher than the normal rate. Oxygen group. TG, TC and LDL-C decreased in
hypoxia group, and TG (P<0.05), TC (P<0.05) and LDL-C (P<0.01) were significantly different from those before intervention (P<0.01). The levels of TG and LDL-C increased after the intervention of normoxia group, and LDL-C was significantly different from that before intervention (P<0.05). The TC change rate (P<0.01) and LDL-C change rate (P<0.01) in the hypoxic group were significantly higher than those in the normoxic group, and the TG change rate was not different from the normoxic group (P>0.05). The HDL-C in hypoxia group and normoxia group increased after intervention. The hypoxia group had a statistically significant difference compared with the pre-intervention group (P<0.01), and the HDL-C rate in the hypoxic group was significantly higher than that in the hypoxic group. Oxygen group (P<0.05). LEP and ADPN in the hypoxic group increased after intervention, but there was no significant difference compared with before intervention (P>0.05). There was no significant difference between LEP and ADPN in the hypoxic group before and after intervention (P>0.05). The change rate of LEP (P<0.05) and ADPN (P<0.01) were significantly higher in the group than in the normoxic group.

Conclusions

1. Under the same exercise intensity, After 6 weeks of hypoxic exercise intervention the hypoxic environment is more conducive to weight loss in overweight/obese women. (2) Compared with normotensive exercise, The six weeks of hypoxic exercise can effectively improve the lipid metabolism of overweight/obese women. (3) Hypoxic exercise failed to significantly increase serum LEP and ADPN levels in subjects, but the index change rate was better than that of oxygen group.

PO-068
High and moderate intensity strength exercises to exhaustion activate different signaling cascades regulating protein metabolism in trained skeletal muscle

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Objective

The aim of the study was to evaluate the activation of signaling cascades regulating protein synthesis and degradation after strength exercise sessions of high and moderate intensity in the muscles of athletes adapted to strength training.

Methods

Eight strength-trained men were recruited for the experiment. The volunteers performed 4 sets of leg press to volitional fatigue with moderate intensity (65% 1RM) for one leg and 4 sets of leg press to volitional fatigue with high intensity (85% of 1RM) for contralateral leg. The sets for both legs were performed in turn with rest intervals of 2 min. Biopsy from m. vastus lateralis was performed before, 1, 5 and 10 hours after cessation of exercise. Content of signaling proteins was evaluated using Western blot.

Results

Total work performed by the leg during moderate intensity strength exercise was 32% (P<0.001) higher in comparison with contralateral leg performing high intensity exercise. The phosphorylation levels of p70S6kThr389 and 4E-BP1Thr37/46 increased only after the exercise of moderate intensity (P<0.05). On the contrary, the phosphorylation level of ERK1 / 2Thr202 / Tyr204 increased only after the exercise of high intensity (P<0.05). The level of phosphorylation of eEF2Thr56 significantly decreased after 1 (P<0.001), 5 (P<0.01) and 10 (P<0.01) hours after the exercise of high intensity. The phosphorylation level of ACCSer79, an AMPK activation marker, was significantly increased 1 hour after the exercise of moderate intensity (P<0.01). The phosphorylation level of FOXO1Ser256 significantly decreased after the exercises of both intensities (5 hours after the exercise of moderate intensity, P<0.001; 1 hour after the exercise of high intensity, P<0.05).

Conclusions

Strength exercises of high and moderate intensity, performed to volitional fatigue, may cause activation of different signaling cascades. Herewith, activation of mTORC1 after
strength exercise is more dependent on the total work, whereas the ERK1 / 2 and eEF2 activation on the exercise intensity.
The work was supported by RFBR grant №17-04-00878.

**PO-069**

**Hypoxia exercise improves glucose metabolism in the overweight and obese women**

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**Objective** With the increase of social pressure and the unreasonable diet structure, the proportion of the overweight and obese people is increasing. Obesity is an important factor causing many chronic diseases, such as type II diabetes, atherosclerosis, hypertension, hyperlipidemia and so on. Epidemiological studies show that the proportion of obese people in China is still high. It has seriously hindered the further development of the Chinese health. The combination of diet and exercise is effective for reducing the weight. However, this method isn’t effective for overweight and obese people. Therefore, the way to reduce weight has become a central issue for many researchers. Studies have shown that the exposure of hypoxia condition can decrease weight and exercise can promote energy consumption. Exercises in a hypoxic environment provide a new way of thinking for the prevention and treatment of obesity and national fitness, and which are also a research hotspot for weight loss.

**Methods** The study enrolled 40 young women with overweight/obese subjects, aged 18-47 years, with no abnormal physical examination. The criterion for overweight is BMI ≥ 24 and the criterion for obesity is BMI ≥ 28. All subjects were paired according to their body weight, divided into hypoxia group and normoxia group and they exercised for 6 weeks, 3 times a week, every other day. The content of the exercise intervention includes 30 minutes strength training and 30 minutes endurance training. Strength training is in front and endurance training is in the back. There are 5 minutes of warm-up and finishing activities before and after training. Strength training uses dumbbells, chooses 12RM weight, exercise with 8 actions, which are dead lift, upright row, squat, shoulder press, calf Jump, advance junge, biceps curl and triceps extension, each action 2 Group, rest between groups for 30s. Endurance training uses a treadmill with a slope of 0°, and the speed is adjusted according to the target heart rate interval. The calculation method of the target heart rate interval is (220-age)×60%~(220-age)×70%. Meanwhile, the hypoxia group wears inhaled atmospheric hypoxia equipment and they exercised in a low-oxygen condition. The oxygen content of the inhaled mixed gas is 16%; the normoxia group exercises under the normal oxygen condition. Nutritional education was given to all subjects prior to the start of exercise intervention and the personal diet was controlled as much as possible, but diet was not restricted during the intervention. Body weight was measured before and after intervention. Fasting venous blood was taken. Blood glucose (GLU), insulin (INS) and glycated hemoglobin (GHb) were measured. Insulin resistance index (HOMA-IR) was calculated. All test results were expressed as mean ± standard deviation, non-parametric Mann-Whitney U test was used for comparison between groups, and non-parametric Wilcoxon matching was used for symbol level test. The significance level was P<0.05, the level of very significant was P<0.01.

**Results** After intervention, the fasting blood glucose level of the hypoxia group and normoxia group decreased and the hypoxia group decreased more, but there was no significant difference compared with before intervention (P>0.05). There was no significant difference between the rate and the normoxia group (P>0.05). After intervention, the GHb levels in the hypoxia group and the normoxia group decreased, but there was a significant difference between the hypoxia group and the hypoxia group (P<0.05). The difference between the normoxia group was not significant (P>0.05). There was no significant difference in the rate of GHb change between the oxygen exercise group and the normoxia group (P>0.05). After intervention, the fasting INS levels in the
hypothesis group and the normoxia group decreased, but there was a significant difference between the hypoxia group and the hypoxia group (P<0.05), and the difference between the normoxia group was not significant (P>0.05). There was no significant difference in the rate of fasting INS between the hypoxia group and the normoxia group (P>0.05). The HOMA-IR of the hypoxia group and the normoxia group decreased after intervention, but there was significant difference between the hypoxia group and the hypoxia group (P<0.05) and the difference between the normoxia group was not significant (P>0.05). The HOMA-IR rate of hypoxia exercise was not significantly different from that of normoxia group (P>0.05).

Conclusions Compared with the normoxia group, the hypoxia group has a more improved glycosylated hemoglobin and insulin resistance index. It suggests that the exercise intervention of the hypoxia condition may be more effective in treating obesity and preventing chronic diseases.

PO-070
Effects of aerobic and resistance training on cardiac diastolic dysfunction in type 2 diabetic rats

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Objective To compare the effects of two types of physical training on cardiac diastolic dysfunction in type 2 diabetes mellitus and investigate the role of passive tension regulators—titin and collagen.

Methods Sprague-Dawley (SD) male rats were divided into two groups: control and diabetes. Each group was subdivided into three subgroups: sedentary rats, rats submitted to aerobic trained and rats submitted to resistance training. Diabetic rats were induced by high-fat diet combined with low-dose injections of streptozocin (STZ). Aerobic trained rats ran on a treadmill at 21m/min for 60 min per day, while resistance trained rats climbed a ladder with incremental loads. The train period lasted for 8 weeks.

Results All diabetic rats had increased fasting blood glucose (FBG) and left ventricular end diastolic pressure (LVEDP), a lower down stroke of the pressure curve (dp/dt min), longer exponential time constants of relaxation (Tau) in relation to control rats, while the protein expression of titin was decreased significantly, and the expression of collagen I, TGFβ1 were increased slightly, the ratio of type I and III collagen was raised in diabetic rats. Both types of training promoted a decrease in FBG and HOMA-IR in diabetic rats. Aerobic exercise trained diabetic rats had significant higher –dp/dtmin, and shorter Tau, but -dp/dtmin and Tau in resistance exercise trained diabetic rats had no significant been improved, even more aggravation. Moreover, aerobic training increased the protein expression of titin and HSP27, and the amount of co-localization of titin and HSP27 elevated, the protein expression of collagen I, TGFβ1 were decreased, and the ratio of type I and type III got close to normal. Resistance training further decreased the expression of titin, collagen I, and TGFβ1, collagen volume fraction (CVF) was increased significantly, and the ratio of type I and III collagen was disturbed, but the co-localization of titin and HSP27 elevated slightly.

Conclusions Aerobic training ameliorates cardiac diastolic dysfunction in diabetes and this improvement may be related to increase titin repaired by HSP27, while resistance training aggravates the cardiac diastolic dysfunction in early diabetes mellitus and it could be caused by worsening myocardial interstitial fibrosis.
PO-071
Overtraining results in abnormality of renal silt diaphragm in rats with persistent proteinuria

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Objective Silt diaphragm is the most important and bioactive membrane structure in the filtration barrier of kidney, and the root cause of proteinuria is the structural and functional abnormalities of Silt diaphragm. So far, there is little literature on the changes of silt diaphragm caused by overtraining. This research establishes a model of rats with exercise-induced proteinuria with long-term intensive treadmill exercise, and it simulates the progressive-load training in the cycle of athletes. Histological and ultrastructural changes of kidney immediately and 24 h after exercise are observed, and it aims to analyze the change law of silt diaphragm during the occurrence of persistent proteinuria.

Methods this study selects 36 Sprague-Dawley rats, which are randomly divided into 3 groups: a control group (group C, 12), a group drawn immediately after exercise(group EI, 12), a group drawn 24 h after exercise(group EA, 12). Group C does not train. The rats in group EI and EA train on the treadmill with an increasing load for 6 weeks(10% grade, 6 d/w): in the first week, the rats run for 10 min at 10 m/min. Starting from the second week, the running speed increases by 5m/min/w, and the training time increases by 30min/w. In the last week the rats run to exhaustion if they could not maintain the target intensity. Record the exhausting time of rats, then group EI and group EA are respectively drawn immediately and 24 hours after exercise. Observe the histological changes of renal glomerulus by optical microscope, and the ultrastructure of silt diaphragm by TEM. Detect urine total protein by BCA, serum and urine creatinine by Jaffe, serum testosterone and corticosterone by radioimmunoassay, serum urea by two-point dynamic method, and the expression of Nephrin by western-blots.

Results The rats in group EI and EA gradually lose weight at the first weekend of training, and their weight drop significantly from the third weekend to the end, it shows a significant difference compared with group C(p<0.01). There is no significant difference between the exercise group. Glomerular morphology, group C: The structure of glomerulus is compact, the boundary between vascular sphere and the wall of capsule is obvious, and the distribution of erythrocytes in vessels is regular; Group EI: The thickness of glomerulus membrane is uneven, the structure of the podocyte is incomplete, part of the foot process is fused, and SD is discontinuous; Group EA: Part of the glomerular endodermis is abnormal, part of the foot process is fused, detached, and unevenly distributed, and SD is discontinuous. Total protein/ creatinine in urine of rats 30 min and 24 h after exercise is significantly higher than that of group C(p<0.01), and group EA is slightly returned and lower than group EI(p<0.05). Compared with group C, Serum Testosterone/Corticosterone of rats in group EI and EA is significantly decreased, and there is a significant difference (p<0.01). However, there is a significant decrease in EA group but it is still significantly lower than group EI(p<0.01). Serum corticosterone is significantly decreased in group EI and EA, and there is a significant difference (p<0.01), while group EA is significantly decreased but still significantly lower than that in group EI(p<0.01). Serum urea and espression of Nephrin are significantly decreased in group EI and EA(p<0.01), but there are no significant difference between group EI and EA(p>0.05).

Conclusions The rats suffer from overtraining syndrome caused by intensive training, and with persistent proteinuria, their renal function is disordered and cannot be effectively recovered after 24 h rest. Meanwhile, the renal morphology and ultrastructure of silt diaphragm in rats undergo "pathogenetical-like" changes, which do not significantly decrease with the extension of recovery time. It is revealed that the injury of renal structure and ultrastructure of silt diaphragm caused by overtraining are the structural basis of continuous exercise-induced proteinuria.
PO-072
16-Week high intensity interval training does not alter LKB1 and AMPKα protein in Rats Liver

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Objective Liver, as one of the most important organs involved in lipids and glucose metabolism, yet no study has examined the response of liver kinase B1 (LKB1) and AMP-activated protein kinase α (AMPKα) signaling after high intensity interval training. This study aims to evaluate the effect of 16-week high intensity interval training intervention on the expression of LKB1、AMPKα in liver of aging rats.

Methods 8-month-old male Wistar rats (n=40) were randomly divided into control group (C) and HIIT group (H). Group H with 70%-90%-50%VO₂max intensity training for 50min/day, 5 days/week, lasted for 16 weeks. Rats were killed on 0, 8 and 16 weeks. We examined the protein expression of LKB1 and AMPKα in liver. Proteins were analyzed by western blot analysis. Data are mean±SD; for ANOVA, p<0.05 was significant.

Results The AMPKα levels in group C and group H increased with time and there was no significant difference between the groups. The content of LKB1 in group C and group H both increased first and then decreased, but there was no significant difference between the groups.

Conclusions 16-week high intensity interval training intervention had no effect on LKB1, AMPKα protein expression in aging rats.

PO-073
Tracking Research of Body Function Monitoring on Mountain Cyclists during Plain-Plateau-Lower Plateau Training

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Objective To explore the functional changes of mountain bike athletes in the course of continuous training of six weeks plain, plateau and lower plateau, and to provide reference basis for coaches to choose plateau training, arrange plateau training and downhill time in a targeted way.

Methods The continuous tracking and monitoring of the 6 weeks plain, 6 weeks plateau and 6 weeks lower plateau training of the 8 Anhui mountain cycling team athletes were carried out, and some functional indicators (WBC, RBC, HCT, HB, BUN, CK, T, C, etc.) were analyzed.

Results (1) Six weeks of plain training, serum BUN, CK showed a significant increase in the 5th and 6th weeks (P<0.01), serum T reached the lowest level in the 3rd week (P<0.05), and reached a higher value in the 5th and 6th weeks. (2) Six weeks of plateau training, HB and HCT have been maintained at a high value, BUN has an upward trend, CK and C have a downward trend, and T has a gradual upward trend, with no significant differences (P>0.05). (3) Six weeks of training in the lower plateau, HB and HCT began to show a gradual downward trend from the first week, starting from the fourth week, BUN has a downward trend, CK has increased significantly, serum T has decreased, and the fourth week reaches The lowest value, the fifth week began to rebound.
**Conclusions** (1) Plain training can gradually improve the athlete’s ability to adapt to the training load and the level of function; (2) Plain training is easier to increase load strength than plateau training, and plateau training is easier to increase load than plain training. (3) Plain training and plateau training can all improve the athletes’ HB, HCT, and T levels, but plateau training is more advanced than plain training; (4) HB, HCT, and T can be maintained at a higher level within 1 week of the Lower Plateau. From the second week, HB, HCT, and T show a gradual downward trend. In the third week, HB drops to the lowest value, and in the fourth week, T reaches the lowest value.

Proposal: (1) mountain bike athletes can consider arranging 5-6 weeks of plain training before going to the plateau; (2) During plateau training, it is easy to cause BUN to rise. Coaches must plan the active recovery time of athletes; (3) Plateau training can improve the athletes’ functional level, but the time to participate in the competition in the lower plateau must be controlled within one week.

**PO-074**

Research of HIIT Detraining on Mitochondria of Soleus Muscle Beclin1 and Bnip3 Contents in Aging Rats

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**Objective** To observe the temporal variation of Beclin1 and Bnip3 protein in skeletal muscle aging degeneration by constructing the aged rat model, and to observe the effect of HIIT intervention on the changes of Beclin1 and Bnip3 protein and the relationship between the two. It provides a theoretical basis for the effect of exercise on the aging degeneration of skeletal muscle by affecting the level of mitochondrial autophagy.

**Methods** 40 male Wistar rats aged 8 months were randomly divided into quiet control group (C) and HIIT intervention group (H). After the rats entered the animal room for one week of adaptive feeding and exercise, the rats in the C group did not exercise, and the H group exercise alternately based on the maximum oxygen uptake test results of the rats with the 70%-90%-50%-VO2max intensity. Once every two weeks, the maximal oxygen uptake of the rats in group H and group C was tested. Group H underwent 50min/ days, 5 days / weeks, and lasted for 16 weeks. The rats in the two groups were randomly selected after the first VO2 test and eighth and sixteenth weeks after intervention. After anesthesia, blood was collected from the abdominal aorta and soleus tissue was obtained. The ROS activity in soleus muscle was tested by fluorescence enzyme labeling method. Isolation of mitochondria from soleus muscle using tissue mitochondria Isolation Kit, and the expression of Beclin1 and Bnip3 in the mitochondria of the soleus muscle was tested by Western blot. The Image Lab 4 software was used to collect the data of the protein test strip, and the SPSS 17 software was used to analyze the data. The results of the data analysis were presented in the form of mean standard deviation. In the process of protein strip analysis, the relative value of the protein content of each sample was obtained by the gray scale analysis method. The results of the first sampling were taken as the baseline value, and the ratio of the H group in the C group of 8 weeks and 16 weeks was obtained with the baseline value, that is, the relative value of the protein content. Then, repeated measurement of variance analysis was used to analyze the differences of different indicators at baseline level, 8 weeks and 12 weeks between group C and group H. The independent sample T test was used without interaction effect, and multivariate analysis of variance was used. A significant level of alpha =0.05 is set.

**Results** (1) the content of ROS in skeletal muscle of rats was related to the process of natural aging (F=119.314, P < 0.001), and the level of ROS would rise with the process of natural collars (F=28.884, P=0.001; F=127.607, P < 0.001) through the comparison of the time points in the group C and the H group. At the same time, the level of ROS in group H was lower than that in
group C, but there was no significant difference (P=0.310). And the interaction effect of time and exercise mode (HIIT) will not affect the result (F=0.814, P=0.477). But the growth rate of ROS in group H was lower than that in C group. (2) Exercise, time change and their interaction did not affect the content of Beclin1 in rat skeletal muscle mitochondria (P > 0.05). (3) The mitochondrial Bnip3 content in H group and C group was significantly different at 8 weeks (F=14.500, P=0.001), H group was significantly higher than that in C group, but there was no significant difference in mitochondrial Bnip3 content at the 16 week (F=0.090, P=0.767), and the Bnip3 content of skeletal muscle mitochondria changed with age (F=20.852, 0.001). The trend of H increased, but then decreased. There was a linear trend (F=6.950, P=0.005) between the level of mitochondrial Bnip3 content and the intergroup factors (time point changes) and the interaction between time and HIIT movement in rats.

Conclusions With the process of aging, (1) The content of ROS in skeletal muscle of rats increased significantly, while long-term HIIT training could delay the increase, but the best exercise time was unknown. (2) There was no obvious change in Beclin1 content in skeletal muscle mitochondria of rats, and HIIT training had no obvious effect on it. However, the changes in mitochondrial Beclin1 content relative to the total Beclin1 content of skeletal muscle need to be further studied; (3) The content of Bnip3 in skeletal muscle mitochondria in rats is increased, and long-term HIIT training has a delayed effect.

PO-075
Investigation and assessment of nutritional status among Chinese elite artistic swimming athletes
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Objective The sport of artistic swimming is unique which requires a mixture of endurance, power, acrobatics, flexibility, and eurhythmics to produce an artistic performance. Optimal nutrition plays an important role in attaining high level of achievements for artistic swimming athletes, a poor nutritional status will significantly affect their health, athletic performance and post-exercise recovery. However, the assessment of nutritional status among artistic swimming athletes is very lack. The purpose of present study was to assess the nutritional status of Chinese elite artistic swimming athletes and provide suggestions for them to modify their dietary structures.

Methods During the summer training season before the 17th FINA World Championships, 17 Chinese elite artistic swimming female athletes participated in this study. After an overnight fast, the anthropometric data including height, weight, BMI, body fat percentage (BF%), and waist/hip ratio were collected in the early morning around 7 a.m. before breakfast. The 24 hours dietary recall was used to collect dietary intake data of individuals, the athletes were required to record their daily dietary intake in the structured questionnaire for 2 work days and 1 weekend day. During data processing, the cooked foods were converted into raw amounts of each food material by standardized recipe method, and the nutritive value was calculated by using a dietary nutrients analysis software.

Results The athletes were 19.6±1.7 years old and their training age was 10-12 years. The athletes’ BMI was 18.3±1.4 kg/m², their BF% and waist/hip ratio was 16.6±2.6% and 0.85±0.02 respectively. Even the athletes’ body composition level was in the normal range, the BMI and BF% were lower than Russia and Spain artistic swimming athletes. The daily energy intake was 1528±276 kcal which was composed of 435±50 kcal breakfast, 477±62 kcal lunch, 402±49 kcal supper, and 214±22 kcal snacks. However, the energy intake was much lower than the recommendation of 3500 kcal/day. Carbohydrates provided approximately 51% of total energy which was lower than the practical demands, but both fats and proteins provided more energy
(31.3% and 17% respectively) than the recommendations. In addition, the supplementation of many important vitamins and minerals, except vitamin E and sodium, were not reached the recommended level, for example, the consumption of vitamin C and calcium was only 46±12 mg and 430±72 mg per day.

**Conclusions** The data showed that the nutritional status was unsatisfactory among Chinese elite artistic swimming female athletes, the dietary energy intake and many important vitamins and minerals were much lower than the recommendations. In order to keep healthy and increase the exercise performance, it was suggested that the artistic swimming athletes should modify their dietary structures to supply more energies, vitamins and minerals according to their physical conditions and training arrangements.

**PO-076**

*Application of Data Mining Technology in Analysis of Biochemical Indicators of Competitive Sports*

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**Objective** Training monitoring is an important part of scientific training, and also accumulated a large amount of data, but the analysis and evaluation of biochemical indicators are mostly concentrated on the level of experience and the general, phased and individualized research application of statistical methods. The data mining technology is applied to the analysis and evaluation of the biochemical indexes of competitive sports, the analysis of the data is carried out in the deep level, the potential, new and useful information and knowledge are extracted, and the new exploration ideas are carried out for the analysis of the biochemical indexes of competitive sports, and a more reliable and more powerful data branch is provided for the scientific and efficient training support.

**Methods** Using the literature data method, logic analysis method and expert interview method, the application of the current data mining technology in the analysis of biochemical indicators is summarized.

**Results** The scientific analysis and evaluation of athletes' physical function status has been the focus of domestic and foreign coaches and sports researchers. The application of data mining technology in sports biochemical indicators is also becoming more and more extensive. For example, Mao Jie and others applied the gray ART clustering model analysis method to the monitoring of competitive sports biochemical indicators. Through this data mining model, the coach can easily judge the athlete's competitive physical condition, and can provide a scientific basis for correct training according to the different competitive conditions of each athlete, using different training guidance programs and training methods. Ma Jing et al. explored the feasibility of applying decision tree algorithm and association rules in volleyball biochemical analysis. It was found that C5.0 decision tree and Apriori association rule algorithm can be used to predict and analyze the technical level of women's volleyball players. Li Guangjun and others successfully applied the association rule data mining to the biochemical data analysis of canoeists, and provided a basis for scientific decision-making and analysis of sports training and athlete selection. Zhang Hui designed a data mining system for sports biochemical index based on association rules. The results show that the system has fast data mining rate, short time consuming and high reliability. It provides a more scientific evaluation standard for the data mining of sports biochemical index, and also provides a basis for the future training program.

**Conclusions** With the development of competitive sports, in order to achieve new heights, the application of data mining technology to vast biochemical data is of great significance for the establishment of scientific training evaluation methods and standards, and is also the inevitable development of future sports scientific research.
PO-077
Effects of 6-days nitrate supplementation on [Ca2+] and CRT in skeletal muscle of exhausted rats

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Objective There are many active ingredients in sports nutrition, and nitrate is gradually being valued by sports nutrition and product developers. Supplementation of nitrate is a practical method to increase circulating plasma nitrite, thereby increasing NO bioavailability. However, the existing research has rarely reported the dose effect between nitrate supplementation and changes in exercise efficiency and capacity. The mechanism of action of nitrate is not fully understood yet. The aim of this study was to analyze the effects of different doses of nitrate on the exercise capacity of rats, as well as the detection of [Ca2+] and calreticulin (CRT) expression in the gastrocnemius, soleus and extensor digitorum longus, trying to figure out the effects of different doses of nitrate supplementation on calcium homeostasis in different types of muscle fibers.

Methods 40 SD rats (8-week-old) weighing 270-290 grams were randomly divided into control group (C group, 8), exercise control group (EC group, 8), exercise with low-dose supplementation group (ELN group, 8), exercise with medium-dose supplementation group (EMN group, 8) and exercise with high-dose supplementation group (EHN group, 8). Sodium nitrate was used as exogenous nitrate for oral gavage. The intragastric concentration was 0.3 mmol/day/kg body weight in the ELN group, 0.7 mmol/day/kg body weight in the EMN group, and 1.0 mmol/day/kg body weight in the EHN group. The others were orally administered with normal saline. All exercise groups (EC, ELN, EMN and EHN) underwent 3 days adaptive low-intensity treadmill training with slope 0°, speed 16 meter/min, and the time is 5 min, 10 min and 15 min incrementally. 24 hours after the end of the last gavage, a one-time exhaustion treadmill experiment was started. The running platform slope was -16°, the speed was 16 meter/min. Exhaustive experiment participants were not aware of the grouping of rats. Immediately after the end of exhaustive exercise, the rats were weighed and anesthetized with sodium pentobarbital solution. Blood is collected for testing [NO2-]. The gastrocnemius, soleus and extensor digitorum longus were collected for testing NOS activity, tissue [Ca2+] and CRT expression.

Results (1) Compared with the EC group, the exhaustion time of the other exercise groups was prolonged. The exhaustion time of the EMN group was very significantly prolonged from that of the EC group (P<0.01). At the same time, the difference between the EMN group and the ELN group was statistically significant (P<0.05). (2) Serum [NO2-] in the supplemented nitrate groups (ELN, EMN and EHN) was higher than that in the EC group, and the difference was statistically significant (P<0.01). The serum [NO2-] in different groups (ELN, EMN and EHN) raised with the increase of nitrate concentration, and the difference between each adjacent concentration group was statistically significant (P<0.05). (3) In the gastrocnemius, soleus and extensor digitorum longus respectively, there were no significant differences in TNOS, iNOS and cNOS activities between the groups (P>0.05). (4) In the gastrocnemius, compared with the EC group, the [Ca2+] (P<0.05) and CRT expression (P<0.05) in the EMN group were significantly decreased. There was no difference between the ELN vs EC group (P>0.05) and the EHN vs EC group (P>0.05). (5) In the soleus, the [Ca2+] (P<0.05) and CRT expression (P<0.05) in the EMN group were significantly decreased. There was no difference between the ELN vs EC group (P>0.05) and the EHN vs EC group (P>0.05). (6) In the extensor digitorum longus, compared with the EC group, the [Ca2+] (P<0.05) and CRT expression (P<0.05) in the EHN group were significantly decreased. There was no difference between ELN and EC group (P>0.05). The expression of CRT in EMN group was significantly decreased (P<0.05), but there is no difference of [Ca2+] between EMN and EC group (P>0.05).
Conclusions (1) 6-day sodium nitrate supplementation is a reliable method to increase serum [NO₂⁻] concentration. (2) 6-day sodium nitrate supplementation can prolong the duration of one-time exhaustive exercise in rats, and the dose of 0.7mmol/kg/d is the best. (3) Sodium nitrate supplementation can affect the [Ca²⁺] and the expression of CRT in skeletal muscle after one-time exhaustive exercise. Different concentrations of sodium nitrate have different effects on different types of muscle fibers.

PO-078
Effects of 6-week Hypoxic Exercise on Glucose Metabolism in overweight/obese Males

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Objective Early studies have shown that exercise can have positive impacts on the body’s glucose metabolism, but there has been no experiment revealing the different effects between normal and hypoxia, two different exercise conditions, on the glucose metabolism of adult males. The aim of this study is to expose the effects of hypoxic exercise intervention on glucose metabolism in 18-45 years old overweight/obese males. In this study, 40 males were given exercise intervention with different exercise condition. The research aims to discriminate the exercise environment that has a better influence on glucose metabolism by detecting and calculating the changes in glucose metabolism-related indicators during the different oxygen content environments exercise.

Methods A parallel group design was used to study 40 healthy 18-47 years old overweight/obese males. The overweight standard is BMI≥24 and the obesity standard is BMI≥28. All 40 males were randomly divided into the hypoxia group (HG) and normal group (NG) matched on BMI and age at the pretest. The HG was provided a hypoxic exercise environment by wearing a suction-type atmospheric hypoxic device, and the oxygen content of the inhaled mixed gas is 16%; the NG was provided a normal environment. Nutritional education was given to 40 males prior to the start of exercise intervention, but diet was not restricted during exercise intervention. Both groups involved a 6-week exercise intervention which three times per week and there will be a one-day recovery time after each exercise. The intervention consists of a strength training session and an endurance training session, each intervention was generally composed of a 5minutes warm-up, 30minutes strength training, 30minute endurance training, and 5minute cooldown. The strength training contains deadlift, upright row, squat, shoulder press, calf jump, bow step, biceps curl, triceps extension, all these training loading 12RM, repeating twice and there being 0.5mins rest between sets. The treadmill was used for the endurance training, adjusting running speed according to the target heart rate interval. The calculation method of the target heart rate interval is (220-ages) ×60%~(220-ages) ×70%, and the slope is 0°. Both groups were measured body weight and taken of fasting venous blood samples, measured fasting blood glucose (GLU), glycosylated hemoglobin (GHb) and insulin (INS), calculated insulin resistance index (HOMA-IR) before and after the exercise intervention.

Results After the intervention, the fasting blood GLU, INS and HOMA-IR level in the HG were significantly lower (P≤0.05). The fasting blood GLU, INS and HOMA-IR level in the NG were increased, but there was no statistically significant difference before and after the intervention (P>0.05). There was a significant difference when compared the HG with NG in the fasting blood GLU, INS and HOMA-IR level (P≤0.05). After the intervention, the GHb levels in the HG and NG both increased, but there was no significant difference compared with the pre-intervention group (P>0.05). There was no significant difference in the GHb change rate between the HG and the NG (P >0.05), either.

Conclusions Through 6-week intervention, the exercise in the hypoxic environment can more effectively improve the indicators of glucose metabolism in adult obese men compared with the
normal environment. The condition of hypoxic mode has more significant benign effects especially for fasting blood GLU, INS, and HOMA-IR. For the GHb results of this experiment, because this index reflects the overall glycemic control in the past 1-2 months, and this study only carried out six weeks of uncontrolled diet exercise intervention, there may be insufficient time for exercise intervention, or the long, excessive glucose intake during the intervention, resulting in no significant differences in the comparison before and after the intervention.

PO-079
5-year changes and effects of bone mineral density in 6-year-old children

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Objective: To explore the development and developmental characteristics of forearm bone mineral density in childhood, to understand the effects of body composition and developmental type on bone mineral density, and to provide a basis for studying the changes of human forearm bone mineral density.

Methods: Bone development follow-up study of Huilongguan primary school affiliated to Capital Normal University in 2013 enrolled in primary school for five years (2013, 2014, 2015, 2016 and 2017), tracking test indicators: height, weight, body fat composition, forearm bone density. Bone age testing was conducted in 2013 and 2017. Data were analyzed for students who were 6 years old at the end of the first year of the test date. The effective data was 297 (age 6.6 ± 0.2 years), including 147 boys and 150 girls.

Results: 1. Forearm bone mineral density (g/cm²) for the boys and girls were 0.237±0.061 and 0.221±0.059 for children aged 6, 0.220±0.042 and 0.201±0.032 for 7 years old children, 0.219±0.040 and 0.198±0.038 for 8 years old children, 0.236±0.051 and 0.208±0.043 for 9 years old children, while 0.237±0.044 and 0.213±0.047 when children were 10 years old. An independent sample t-test was performed on bone mineral density in boys and girls. At 7 years, 8 years, 9 years, and 10 years, the bone mineral density of boys was greater than that of girls, and the difference was statistically significant (p<0.05). 2. The same batch of child follow-up studies found that girls and boys aged 6 to 8 had a decreasing trend, and the decline of girls was greater than that of boys; girls and boys aged 8 to 10 have risen again, and the increase in girls is less than that of boys; body weight and BMI are factors influencing the forearm bone density of children aged 6-10 years. Height changes and weight changes have a certain effect on changes in forearm bone density. 3. There was no statistically significant difference between bone mineral density and height. The partial correlation with body weight was statistically significant between 6 and 10 years old, r=0.200 (p<0.01), r=0.124 (p<0.05), r=0.176 (p<0.01), r=0.110 (p<0.05), r=0.162 (p<0.05); the partial correlation with BMI was statistically significant, r=0.223 (p<0.01), r=0.134 (p<0.01), r=0.183 (p<0.01), r=0.150 (p<0.05)r=0.208 (p<0.01); As for the relationships between body fat ratio, FFM ratio and bone mineral density, there are no partial correlations(p > 0.05). 4. The partial correlation between bone mineral density change and height change (6-8 years old) and body weight change (8-10 years old) was statistically significant, r=-0.138 (p<0.05), r=0.178(p <0.01), the change in bone mineral density of the children with highest 25% and the lowest 25% with different indicators, only the height of the independent sample t-test results was statistically significant. 5. After multiple stepwise linear regression model. At the age of 7, the adjustment of R² is the highest. The gender and body mass index entered the model. 6. The overweight and obesity rate of 6-10 years old is more than 40% for boys and over 30% for girls. The obesity rate for boys aged 6 to 10 is reduced from 21.9% to 23.8%; the obesity rate for girls is from 20.3% to 17.3%.
Conclusions Conclusion: The same batch of child follow-up studies found that girls and boys aged 6 to 8 had a decreasing trend, with the decline of girls greater than that of boys; girls and boys between the ages of 8 and 10 were rising again, and the increase in girls was less than that of boys; Weight and BMI are factors influencing the forearm bone mineral density of children aged 6-10 years. Height changes and weight changes have a certain effect on changes in forearm bone density.

PO-080
Effects of hypoxic exercise on weight loss and lipid metabolism in overweight/obese men

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Objective In recent years, people's diet has undergone tremendous changes. Excessive energy intake combined with insufficient exercise has made obesity a serious social problem. This study aims to achieve different training conditions under hypoxia and normoxia, conducting a six-week exercise training for obese overweight people. Comparing the difference in exercise weight loss between obese and overweight people in the normoxia training environment compared with hypoxia intervention, and the effect of hypoxic intervention on lipid metabolism indicators in overweight and obese people.

Methods A total of 40 male overweight/obese subjects were enrolled in the study, aged 18-47 years, with no abnormal physical examination and no motor contraindications. The overweight standard is BMI≥24, and the obesity standard is BMI≥28. All subjects were randomly matched according to body weight, divided into hypoxia group and normoxia group, and exercised for 6 weeks, training 3 times a week, one time every two days. Sports training includes 30 minutes of strength training and 30 minutes of aerobic endurance training. There are 5 minutes of warm-up and finishing activities before and after training. The strength training tool is dumbbell, and the weight of the corresponding 12RM is selected according to the exercise ability of the subject, and 8 exercises are performed. They are dead lift, upright row, squat, shoulder press, calf jump, advance lunge, biceps curl and triceps extension. Those 8 movements are divided into two small loop trainings, which complete two large groups (each small loop is completed twice). Aerobic endurance training is done using a treadmill with a slope of 0° and the speed is adjusted according to the range of the target heart rate. The target heart rate is 60%-70% at the maximum heart rate. The maximum heart rate calculation method is (220-age). The hypoxic group is equipped with a suction-type atmospheric hypoxic device and is operated under a low-oxygen environment. The oxygen content of the inhaled mixed gas is 16%, the normoxic group was exercised under normoxic conditions. Nutritional education was given to all subjects prior to the start of exercise intervention, but diet was not restricted during the intervention. Before and after intervention, height and weight were measured, and BMI was calculated. Fasting venous blood was used to detect total cholesterol (TC), total triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C), leptin (LEP) and adiponectin (ADPN). All test results are expressed as mean ± standard deviation. Comparison of data between groups, using nonparametric Mann-Whitney U test. Comparison of intra-group data, using non-parametric Wilcoxon matching for symbol level checking, the significance level was P<0.05, and the very significant level was P<0.01.

Results (1) After the intervention, the body weight of both groups decreased, and the Δbody weight (P<0.01), body weight change rate (P<0.01) and BMI change rate (P<0.01) in the hypoxic group were significantly higher than normal oxygen group. (2) TG, TC and LDL-C decreased in the hypoxic group, and there was a significant difference between TG and TC before intervention (P<0.01). There was no significant difference in TG, TC and LDL-C between the normoxic group and the intervention group (P>0.05). (3) The TG change rate (P<0.05), TC change rate (P<0.05)
and LDL-C change rate (P<0.01) in the hypoxic group were significantly higher than those in the normoxic group. (4) HDL-C in hypoxia group and normoxia group decreased after intervention, and there was no significant difference between the two groups (P>0.05), and there was no difference between HDL-C(P>0.05). (5) LEP and ADPN in the hypoxic group increased after intervention, but there was no significant difference compared with before intervention (P>0.05). LEP and ADPN in the normoxic group decreased after intervention, and there was no difference between the LEP change rate and the ADPN change rate (P>0.05).

Conclusions Under hypoxic intervention, the weight change, rate of change, and BMI change rate of overweight people were larger than those of the normoxic group. Body weight, BMI is a direct indicator of the degree of obesity in individuals. The hypoxic weight loss intervention shows greater advantages than the normoxic group from the intuitive data, which can help overweight and obese people to lose more weight under the same training load and intensity. After six weeks of training, in the hypoxic group, TC, TG and LDL-C decreased, and HDL-C increased. However, in the normoxic control group, these indicators did not show similar significant changes. It shows that through hypoxia intervention combined with exercise training, it can prevent and alleviate various chronic diseases caused by obesity more effectively, such as atherosclerosis. The other two indicators, LEP and ADPN, did not change significantly in both hypoxic and normoxic training. Conjecture there may be other mechanisms affecting the expression levels of these two hormones in the body. In summary, the researchers think the hypoxic exercise to lose weight is better than normal oxygen exercise, and it has a greater impact on most lipid metabolism indicators, which can stimulate most lipid metabolism to produce benign changes.

PO-081

Effects of 6-week hypoxic exercise on aerobic capacity-related proteins in overweight/obese women

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Objective To explore the effects of hypoxic and normoxic exercise on hemoglobin (Hb), erythropoietin (PO), hypoxia-inducible factor 1α (HIF1α) and vascular endothelial growth factor (VEGF) in overweight women.

Methods This study enrolled 40 female overweight/obese subjects, age is among 18-47 years old, with no abnormal physical examination. The overweight standard is BMI ≥ 24, and the obesity standard is BMI ≥ 28. All subjects were paired according to body weight, divided into hypoxia group and normoxia group, doing 6 weeks of exercise intervention, 3 times a week, every next day one time. The exercise intervention includes 30 minutes of strength training and 30 minutes of endurance training. There are 5 minutes of warm up before training and 5 minutes cool down after the training. Strength training uses the device as a dumbbell. The training content consists of 8 movements, there are dead lift, upright row, squat, shoulder press, calf Jump, advance junge, biceps curl and triceps extension, and the weight is 12RM. 2 sets for each action, rest between sets is 30s. Endurance training uses a treadmill with a slope of 0°, and the speed is adjusted according to the target heart rate interval. The calculation method of the target heart rate interval is (220-age)×60%~(220-age)×70%. Among them, the hypoxic group is equipped with a suction-type atmospheric hypoxic device, which moves with low-oxygen environment, and the oxygen content of the inhaled mixed gas is 16%; the normoxic group moves with normal oxygen environment. Nutritional education was given to all subjects prior before the start of exercise intervention, but diet was not restricted during the intervention. Fasting venous blood was taken before and after Fasting venous blood before and after exercise intervention intervention, and Hb, PO, HIF1α, and VEGF were detected. All the test results were expressed by mean±standard deviation (x±SD). The data between two groups were compared by non-parametric Mann-Whitney U test. The intra-group data were compared using a
nonparametric Wilcoxon match for the symbol level test, with a significance level of \( P < 0.05 \) and a very significant level of \( P < 0.01 \).

**Results** After the intervention, the Hb level in the hypoxic group was increased, but there was no significant difference compared with the pre-intervention group (\( P > 0.05 \)). There was no significant difference in the Hb change rate between the hypoxic group and the normoxic group (\( P > 0.05 \)).

The PO level in the hypoxic group was significantly increased, and there was a statistically significant difference compared with the pre-intervention group (\( P < 0.01 \)). There was no significant change in the PO level in the normoxic group (\( P > 0.05 \)). The PO change rate in the hypoxic group was compared with the normoxic group. There was no statistical difference (\( P > 0.05 \)). The level of HIF1\( \alpha \) in the hypoxic group was significantly higher than that before the intervention (\( P < 0.01 \)).

The level of HIF1\( \alpha \) in the normoxic group was significantly lower than that before the intervention (\( P < 0.01 \)). The rate of change of HIF1\( \alpha \) in the oxygen group was statistically different from that in the normox group (\( P < 0.01 \)). The level of VEGF in the hypoxic group was increased, but the level of VEGF in the normoxic group was decreased, but there was no significant difference compared with the pre-intervention group (\( P > 0.05 \)). There was no significant difference in the rate of VEGF in the hypoxic group compared with the normoxic group (\( P > 0.05 \)).

**Conclusions** Compared with normotensive exercise, 6-week exercise increased the levels of Hb and PO in overweight women, but the difference between hypoxia and normoxia was not significant. The level of HIF1\( \alpha \) in the hypoxic group was increased, and the level of HIF1\( \alpha \) in the normoxic group was decreased. This index was significantly affected by hypoxia. The level of VEGF in the hypoxic group was increased, and the level of VEGF in the normoxic group was decreased, but the effects of hypoxia and exercise were not obvious.

**PO-082**

**p38 MAPK controls of E3-ligases expression and soleus atrophy attenuation in rat upon hindlimb unloading.**

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**Objective** Unloading causes rapid skeletal muscle atrophy mainly due to the increased protein degradation. Muscle proteolysis results from the activation of ubiquitin-proteasome systems. The ubiquitination proteins are carried out by muscle-specific E3 ubiquitin ligases – MuRF-1 and MAFbx. It is known that MuRF-1 and MAFbx expression significantly increases on the third day of muscle unloading. We tested the hypothesis that p38 MAPK participates in the regulation of E3 ligases expression and the development of skeletal muscle atrophy during unloading. To check this idea we inhibited p38 MAPK by VX-745.

**Methods** 21 male Wistar rats were divided into 3 groups (7 rats in each group): intact control (C), rats suspended for 3 days (HS) and rats suspended and injected i.p. with VX-745 (10 mg/kg/day) (VX). The hindlimb suspension was carried out according to Morey-Holton technique. The animals were anaesthetised with an i.p. injection of tribromoethanol (240 mg/kg). Under anesthesia, the m.soleus were excised, frozen in liquid nitrogen, and stored at \(-80^\circ\)C until further analysis. All procedures with the animals were approved by the Biomedicine Ethics Committee of the Institute of Biomedical Problems of the Russian Academy of Sciences/Physiology section of the Russian Bioethics Committee. The statistical analysis was performed using the REST 2009 v.2.0.12 and Origin Pro programs at the significance level set at 0.05. The results are given as median in percent and interquartile range (0.25-0.75).

**Results** The muscle weight in HS group was significantly reduced (72.3±2.5 mg) compared to C (83.0±3 mg), \( p < 0.05 \), while the soleus weight of VX group didn’t differ from the control (84.2±5 mg). The MuRF1 mRNA expression was elevated dramatically in HS group (165 (138-210) %) when compared with the control (100 (64.6-112.5) %), \( p < 0.05 \). In the VX group the level of MuRF1 mRNA expression (127 (105-138) %) didn’t differ from the control group. The MAFbx
mRNA expression was observed to increase equally in both suspended groups (294 (265-342) % and (271 (239-309) %) vs C (100 (91-106) %), so, VX-745 administration did not have any significant effect on its expression. We also found that the level of ubiquitin mRNA expression in the soleus of HS rats was higher (423 (325-485) %) in comparison with the C group (100 (78-166) %, p<0.05) while VX-745 injection prevented increasing the mRNA ubiquitin expression (200 (190-237) %). We discovered that the elevation of calpain-1 mRNA expression upon HS was prevented by VX-745 administration and its level didn’t differ from the control group (C - 100 (97-105) %, HS – 120 (116-133) %, VX - 107 (100-115) %, p<0.05).

Conclusions Thus, the results indicate that the p38 MAPK signaling pathway takes part in the regulation of E3-ligase MuRF1 but not MAFbx expression. The p38 MAPK inhibition prevents muscle atrophy and the elevation of ubiquitin and calpain mRNA expression at the early stage of hindlimb unloading. This work was supported by RFBR grant No.17-04-01838.

PO-083
Effects of dynamic foot stimulation on GSK-3 beta signaling pathway in rat soleus muscle under hindlimb unloading

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Objective It is known that under simulated microgravity GSK-3 beta phosphorylation (Ser 9) is decreased [Mirzoev et al., 2016] which is associated with the activation of its kinase activity. GSK-3 beta activation may lead to NFATc1 export from myonuclei resulting in a slow-to-fast myosin shift in soleus muscle and may cause a decrease in muscle oxidative capacity and protein synthesis [Glass, 2003, Theeuwes et al, 2017].

It was demonstrated that GSK-3 beta Ser 9 phosphorylation is decreased in response to nitric oxide synthase inhibition [Martins et al., 2011]. Under unloading conditions, the content of NO as well as nitric oxide synthase is attenuated in rat soleus muscle [Tidball et al., 1998; Lomonosova et al, 2011]. Dynamic foot stimulation (DFS) of the soles of the feet results in an increase of neuromuscular activation [Muller et al., 2005] of the lower limb muscles and prevents nitric synthase content decrease during 7-day exposure to dry immersion [Moukhina et al, 2004; Shenkman et al., 2004]. The aim of our study was to analyze the effect of rat dynamic foot stimulation during early unloading on GSK-3 beta phosphorylation and some of its downstream targets.

Methods Male Wistar rats were randomly assigned to vivarium control, 1-day unloading and 1-day unloading with DFS. The pressure stimulation protocol mimicked the normal animal walking (104 mm Hg pressure, 4 Hz frequency and 250 ms signal duration) for a total of 20 min followed by a 10-min rest interval for 4 hours.

Results We found that 1-day unloading caused a significant decrease (p< 0.025) in NFATc1 nuclear content as well as slow myosin (MHC I (beta) isoform) mRNA expression. In the 1-day unloading group, the level of glycogen synthase 1 phosphorylation (Ser 641), which is a direct GSK-3 beta target, was significantly higher than that in the control group, although a decrease in GSK-3 beta Ser 9 phosphorylation in the 1-day unloaded group was not statistically significant compared to the control group. However, in the DFS-treated unloaded rats the level of GSK-3 beta phosphorylation was significantly higher than in the untreated unloaded rats. NFATc1 nuclear content, slow myosin mRNA expression and glycogen synthase 1 phosphorylation (Ser 641) did not differ from the control group. The glycogen content in soleus muscles of both unloaded groups was higher than in the control group, which is in accordance with previous
studies [Henriksen and Tischler, 1988], but in DFS subjected unloaded group the glycogen content was higher compared to the untreated unloaded group.

Conclusions  Thus, we found that dynamic foot stimulation during 1-day hindlimb unloading leads to GSK-3 beta inactivation and prevention of both NFATc1 myonuclei export and the decrease in MyHC I beta expression. The study was supported by the Russian Foundation for Basic Research grant #17-29-1029 and Basic Research Program of the IBMP, RAS. The authors express their deep gratitude to Prof. Inessa B. Kozlovskaya for useful recommendations concerning the design of the study.

PO-084
Correlation between Muscle oxygen and Cardiopulmonary of young cyclists at Ventilation threshold

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Objective To investigate the relationship between Near-infrared spectroscopy (NIRS)-derived muscle oxygen saturation (SmO₂) and Cardiopulmonary indexes at the Ventilatory threshold (VT1 and VT2) during Cardiopulmonary exercise test (CPET) of young cyclists.

Methods 12 young cyclists performed a maximal incremental exercise test to exhaustion on a friction-braked cycle ergometer (Monark 839E, Sweden). Heart rate (Polar RS400, Finland) and respiratory gas exchange were measured during the Resting and exercise phases using a breath-by-breath system. SmO₂ of active muscles during cycling was measured by NIRS monitors (Fortiori Design LLC, USA), and three of the monitors were placed on both vastus lateralis (VLL & VLR) and left gastrocnemius lateralis (GLL) of left leg. The resting value of the SmO₂ of the GLL (SmO₂-GLL), the left vastus lateralis (SmO₂-VLL), and the right vastus lateralis (SmO₂-VLR) was recorded as a baseline. Then after VT1 and VT2 of each subject were measured by the V-slope method during a CPET, values of muscle oxygen corresponding to the three lower limb sites at two ventilation thresholds was recorded to reflect the muscle oxygenation level at the anaerobic threshold; And the change of muscle oxygen relative to the baseline was calculated to reflect the degree of muscle deoxygenation, which is termed as deoxygenation indexes (ΔSmO₂-GLL, ΔSmO₂-VLL, ΔSmO₂-VLR); As well, Cardiopulmonary indexes including Heart rate (HR), Minute ventilation (VE), Relative oxygen uptake (VO₂R), Carbon dioxide production (VCO₂) and Respiratory exchange rate (RER) at the Ventilatory threshold were measured. All Results were expressed as mean ± standard deviation. Finally, Pearson correlation analysis was used to determine the relationship between multi-site muscle oxygen saturation of lower extremities and Cardiopulmonary indexes (HR, VE, VO₂R, VCO₂, RER). The significance level was defined as p<0.05.

Results Each subject performed their best to complete the aerobic capacity test. The average VO₂peak of the 12 subjects was 42.77 ± 9.69 ml/kg/min (Male: 47.38 ± 9.41 ml/kg/min; Female: 36.31 ± 3.33 ml/kg/min). At rest, the calf and thigh SmO₂ were 67.92%± 6.84% (SmO₂-GLL), 61.42% ± 13.77% (SmO₂-VLL), 64.83% ± 10.62% (SmO₂-VLR) respectively; HR, VE, VO₂, VO₂R, VCO₂ and RER were 112.08 ± 14.38, 25.96 ± 8.74 L / min 0.94 ± 0.32 L/min, 15.82 ± 4.30 ml/kg/min, 0.81 ± 0.24 L/min, 0.88 ± 0.12 L/min, and 0.38 ± 0.07, respectively. Correlation analysis shows that when adolescent athletes reached the anaerobic threshold level, there was a significant correlation between muscle oxygen and cardiopulmonary: At the time of VT1, for Oxygenation index, SmO₂ of GLL was highly negatively correlated with HR (r=-0.69, p<0.05), VE (r=-0.71, p<0.01), VO₂R (r=-0.65, p<0.05), VCO₂ (r=-0.66, p<0.05) and RER (r=-0.58, p<0.05); SmO₂-VLL was also highly negatively correlated with VE (r=-0.70, p<0.05), VO₂R (r=-0.70, p<0.05), VCO₂ (r=-0.66, p<0.05); Additionally, there is also high inverse correlation between SmO₂-VLR and HR (r=-0.66, p<0.05), VE (r=-0.70, p<0.05), VO₂R (r=-0.66, p<0.05), VCO₂ (r=-
In terms of deoxygenation indexes, ΔSmO₂-GLL was highly negatively correlated with VE (r=-0.61, p<0.05), VO₂R (r=-0.64, p<0.05) and VCO₂ (r=-0.59, p<0.05); While, ΔSmO₂-VLL was highly negatively correlated with HR (r=-0.62, p<0.05), VE (r=-0.72, p<0.01), VO₂R (r=-0.80, p<0.01) and VCO₂ (r=-0.84, p<0.01); ΔSmO₂-VLR was correlated with HR (r=-0.75, p<0.01), VE (r=-0.62, p<0.05), VO₂R (r=-0.58, p<0.05) and RER (r=-0.74, p<0.01), and it also shows highly negative correlation. When VT2 occurred, only SmO₂ of the GLL in the oxygenation indexes was highly positively correlated with HR (r=0.65, p<0.05), there was no correlation between GLL-SmO₂ and any other gas exchange indexes. In terms of muscle deoxygenation indexes, only ΔSmO₂ in the thigh VLR was significantly negatively correlated with RER (r=-0.75, p<0.05).

Conclusions Based on these results, there is a high correlation between NIRS-derived regional muscle oxygen saturation (Oxygenation and Deoxygenation indexes) of lower extremities and cardiopulmonary index (HR, VE, VO₂R, VCO₂, RER) during CPET of young cyclists at first Ventilatory threshold, however, it is still unclear whether there is a significant correlation between muscle oxygen saturation of lower extremities and other cardiopulmonary indexes when second Ventilatory threshold occurs except Heart rate or Minute ventilation.

PO-085  
The effect of 4 weeks intermittent negative pressure treatment on the functional state of excellent rowers  

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Objective To study the effect of intermittent negative pressure treatment on the functional state of elite rowers, and providing theoretical basis for the application of this method in sports science.

Methods The 15 elite male athletes selected from the national rowing training team were divided into experimental group and control group. The daily training plans of the two groups were the same. The members of experimental group were treated for 20 minutes by the Vacusport Regeneration System from German, five times one week, for a total of 4 weeks. The control group did not use any intervention. Before and after 4 weeks, venous blood from 15 male athletes was used to test athletes' red blood cells (RBC), hemoglobin (HGB), hematocrit (HCT), creatine kinase (CK), blood urea nitrogen (BU), testosterone (T), cortisol (C) et, Observing the changes about data from two tests.

Results There was no statistically significant difference between the experimental group and the control group before and after the intervention. The results of the intra-group comparison were as follows: (1) The RBC, HGB, and HCT of the experimental group decreased by 2.90%, 3.80%, and 1.08% respectively. The RBC, HGB, and HCT of the control group decreased by 6.55%, 7.02%, and 1.08% respectively, and the decline of RBC and HGB showed statistically significant changes (p<0.05). (2) The CK and BU values of the experimental group increased by 1.26% and 27.08% respectively, and the increase of BU had statistically significant changes (p<0.05). The CK and BU values of the control group increased by 33.10% and 9.54% respectively. (3) The values of T, C and T / C in experimental group decreased by 11.85%, 7.6% and 4.31% respectively. The values of T, C and T / C in the control group decreased by 16.38%, 4.03% and 19.39% respectively, and the decrease of T values was statistically significant (p<0.05).

Conclusions Conclusion: The intermittent negative pressure therapy can promote the athletes' metabolism, relieve the degree of the decline of functional state, and prevent the occurrence of fatigue.

PO-086
Effect of HIIT on mitochondrial telomerase of skeletal muscle in aged rats

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Objective The HIIT and moderate-intensity exercise are two different exercise models among the public fitness. In recent years, HIIT become more and more popular, unfortunately, there is a tremendous lack of research being done effects of mitochondrial reverse transcriptase (TERT) on age-related degeneration of skeletal muscle by HIIT. The purpose of this study was to compare the HIIT group and moderate-intensity group, and research difference of telomerase expression and cardiopulmonary endurance between the exercise group and the quiet control group was discussed.

Methods Fifty-nine male Wistar rats were divided into three groups at random: control group (Q=19), moderate-intensity intervention group (M=20), and HIIT intervention group (H=20). The rats in Q group did not any exercise, and the rats in M group developed the exercise with 60% VO2max intensity for 8 weeks. H group did a training program for an 8-week exercise with alternating 40%, 60%, and 80% VO2max intensities. The rats in the experimental group were exercised for 50 minutes every day and trained for 5 days per week. After the baseline value group was sampled, each group of rats was selected after the training reached the specified number of weeks (4 and 8 weeks), and the maximum oxygen uptake test was performed before the material was taken. Single factor analysis of variance were used to assess differences in VO2max, and expression of protein between conditions.

Results It was found that H group VO2max was significantly higher than M group and Q group (P<0.05). At same time, the mTERT expression of the M group at the 4th week was significantly higher than that of the Q group (P<0.05). The mTERT expression in group H was significantly higher than that in group Q at week 8 (P<0.05). There was no significant difference between the H group and the Q group at 8th week (P<0.05).

Conclusions 1. HIIT exercise lasting for 8 weeks can effectively inhibit the decrease of maximal oxygen uptake in aging rats compared with moderate exercise. 2. HIIT training for 8 weeks promotes the expression of mTERT; 3. The maintenance of VO2max in aging rats may be related to the enhancement of mitochondrial antioxidant function by HIIT-promoted TERT to mitochondrial translocation.

PO-087
Effects of long-term high-intensity exercise training on renal local renin-angiotensin system in rats

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Objective Exercise stimulation to the body of the first stress: blood changes, regulated by the renin-angiotensin system. Long-term high-intensity exercise training will lead to changes in kidney structure and function, resulting in renal injury. This will not only affect training and competition, but also affect the health of athletes, thus it is becoming an influential factor in the occurrence and development of excessive fatigue. At present, the mechanism of renal injury and proteinuria caused by exercise is not very clear. Therefore, this study conducted an in-depth study on the upstream mechanism of renal blood flow changes from the molecular level and explored the effects of 6-week high-intensity exercise training on the renal local renin-angiotensin system in rats.
Methods 30 SD male rats (8 weeks old) were randomly divided into control group (10) and exercise group (20). Then according to different time, the exercise group (20) was divided into two groups on average, which are 0h group and 24h group. The rats in the control group did not do any exercise, and the rats in the exercise group were trained to run on the platform with high intensity for 6 weeks. At the beginning of the sixth week, the urine of rats from different group were selected randomly, and the urine NGAL, urinary microalbumin (mAlb), urinary creatinine (UCr) and total urine protein (TP) were tested, to determine the rat model of exercise-induced renal injury with proteinuria. After training on the 6th weekend, the renal tissue renin activity and angiotensin II (Ang II) content in right kidney were tested. At the same time, the left kidney of the rat was taken to make HE staining sections.

Results (1) The mAlb, Alb/Cr and TP of the exercise group were higher than those of the control group, while the UCr content was lower than that of the control group. There was a significant difference between mAlb and TP in the exercise group and the control group(p<0.05). UCr, mAlb/Cr were significantly different from the control group(p<0.01). The urine NGAL concentration in the exercise group was higher than that in the control group, and the difference was significant(p<0.05). (2) The glomerulus of the rats in the 0h group showed obvious congestion, swelling and erythrocyte exudation. The tissue morphology of rats in the 24h group recovered slightly, but it was still different from the control group. (3) The renin activity and Ang II were the lowest in the 0h group, and the renin activity and Ang II were highest in the 24h group. There is a very significant difference between the groups(p<0.01).

Conclusions (1) The 6-week high-intensity training used in this study increased the levels of NGAL, TP, and mAlb in the urine of rats, and successfully established a rat model of exercise-induced renal injury with proteinuria. (2) Long-term high-intensity exercise training can cause obvious congestion, swelling, and erythrocyte exudation in rat glomeruli, which can’t return to the quiet level 24 hours after exercise. (3) Renal injury caused by exercise decreased the expression of local renin activity and angiotensin II in the kidney, and the recovery of renal renin activity and angiotensin II was increased 24h after exercise.

PO-088

Analysis of Body Composition and Body Function of Athletes in Freestyle ski Half-pipe National Team

Lin Li, Hao Wu

Objective The objectives were to analyze the body composition and body functions of the freestyle ski half-pipe national team athletes, to understand the body composition characteristics of the athletes, and to explore the relationship between body composition and body function in the sports program, in preparation for 2022 The Winter Olympics provides a theoretical reference.

Methods 9 members of the freestyle ski half-pipe national team were used as subjects (average age 15.78±0.97, exercise age 6.38±2.75), and they were tested and analyzed using an ultrasonic body composition tester and Wingate anaerobic power bike. Body composition test indicators: body fat rate, lean body mass. Body function test indicators: maximum anaerobic power. This paper uses literature, experimental and mathematical statistics. And the mathematical statistics method: using SPSS 2.0 to analyze the data by Pearson correlation.

Results Results: 1. The body fat rate of male and female athletes in freestyle half-pipe national team was: 7.60±1.16; 19.75±1.25. The lean body mass of male and female athletes was: 53.8±1.85KG; 44.75±0.62KG. 2. The maximum anaerobic power of male and female athletes in freestyle half-pipe national team was: 453.80±17.87; 345.50±3.01.
3. The lean body mass of male athletes was significantly positively correlated with the maximum anaerobic power \((r=0.995, P<0.01)\). Female athletes' lean body mass was positively correlated with maximum anaerobic power, but not significant.

4. There is no correlation between the body fat rate and the maximum anaerobic power of male and female athletes in the freestyle ski half-pipe national team.

**Conclusions**

1. Freestyle ski half-pipe players have a positive correlation between lean body mass and anaerobic capacity. According to the characteristics of the sports program, the higher lean body weight has a positive impact on improving the athletic ability and thus ensuring the completion of difficult movements.

2. Due to the relationship between athletes' age and sample size, the data in this paper is only a recommended reference for this sports program. It is not applicable to all programs. It is necessary to continue to supplement the data to establish a body composition evaluation system for the freestyle ski half-pipe team.

**PO-089**

**Inhibition of Aerobic Exercise on PKC/CaV1.2 pathway enhanced the function of vascular smooth muscle in hypertension**

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**Objective** The purpose of this study was to investigate the effects of aerobic exercise on PKC/CaV1.2 pathway in mesenteric arterial smooth muscle from spontaneously hypertensive rats (SHRs).

**Methods** Twelve-week-old male normotensive Wistar-Kyoto (WKY) rats and SHRs were randomly assigned to sedentary groups (SHR-SED, WKY-SED) and exercise training groups (SHR-EX, WKY-EX). Exercise groups were performed an 8-week moderate-intensity treadmill running. After 8 weeks, vascular contractility of mesenteric arteries was measured. Vascular smooth muscle cells (VSMCs) were obtained with an enzymatic isolation method. CaV1.2 channel currents were examined by using whole-cell patch clamp recording technique.

**Results**

1. Body weight and systolic blood pressure (SBP) in both WKY-EX and SHR-EX were significantly lower than those of their sedentary counterparts (both \(P<0.05\)). Body weight in SHR-SED was remarkably lower than WKY-SED (\(P<0.05\)), while SBP was much higher than WKY-SED (\(P<0.05\)).

2. PDBu (PKC activator) elicited a tension increase, and Gö6976 (PKC inhibitor) induced vasodilation. Both the responses of PDBu and Gö6976 in SHR-SED were notably increased compared with WKY-SED (both \(P<0.05\)), however, exercise training significantly suppressed these increases (both \(P<0.05\)).

3. Nifedipine (CaV1.2 inhibitor) induced vasodilation. Response to nifedipine in SHR-SED was more sensitive than both SHR-EX and WKY-SED (both \(P<0.05\)).

4. The current density of SHR-SED and WKY-EX exhibited an increase compared to the WKY-SED (both \(P<0.05\)), and the current density of the SHR-EX decreased obviously in contrast with SHR-SED (\(P<0.05\)). Besides, PDBu enlarged current density of all the groups, while Gö6976 decreased current density. The increase or decrease amplitude in SHR-SED was significantly higher than WKY-SED (both \(P<0.05\)), whereas exercise training markedly inhibited those responses (both \(P<0.05\)).

**Conclusions** Aerobic exercise efficiently prevents the upregulation of PKC/CaV1.2 pathway in hypertension, and enhances the function of vascular smooth muscle.
**PO-090**  
Meta-analysis of the effects of exercise on patients with chronic kidney disease

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**Objective** To systematically evaluate the impact of exercise on patients with chronic kidney disease

**Methods** Computers were searched for PubMed, The cochrane Library, EMbase, CNKI, VIP, Medline, and WangFang Date for a decade between 2008 and 2018 to find out about the effects of exercise on patients with chronic kidney disease (VO2peak, HDL, Cholesterol). Aspects of the clinical randomized controlled trial (RCT). The included studies were evaluated for quality one by one, and the effects of the training group and the control group were meta-analyzed, and Meta analysis was performed using RevMan 5.3 software

**Results** A total of 5 RCTs were included, including 386 patients. The results of the meta-analysis showed that the VO2peak experimental group was significantly better than the control group (P<0.05, 0.01) and the changes in HDL and cholesterol were not significant

**Conclusions** Exercise intervention can effectively improve the cardiopulmonary function of patients with chronic kidney disease without causing excessive burden on the kidney. Exercise can promote the treatment of patients with chronic kidney disease. However, due to the limitations of the quality of the literature, the meta-analysis of the effects of exercise on the treatment of patients with chronic kidney disease needs further improvement.

**PO-091**  
The mechanism of long-term regular exercise intervention on liver injury in patients with NAFLD based on miR-146a regulation of TLR4/NF-KB signaling pathway

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**Objective** To investigate the effects of long-term regular exercise on hepatic function in patients with non-alcoholic fatty liver (NAFLD) using blood biochemistry and liver fibrosis markers, and to compare the differential expression of cytokines related to TLR4/NF-KB signaling pathway. A preliminary discussion was made on its regulation mechanism.

**Methods** Forty patients with NAFLD diagnosed in the Hunan Normal University School of Medicine, according to the degree of steatosis and exercise intervention, the patients were divided into control group (NAFLD group) 20 cases and long-term regular exercise group 20 cases, and the same time in our hospital Twenty patients with physical examination were normal controls; general data of all subjects, ALT, AST, GGT, serum type III procollagen (PCIII), hyaluronan (HA), and type IV collagen (CIV) were examined; Fluorescent quantitative PCR was used to detect the differential expression of TLR4/NF-KB signaling pathway-related cytokines and miR-146a in the blood of each group of subjects, revealing the effects and possible mechanisms of long-term regular exercise on liver fibrosis.

**Results** Compared with the normal group, the levels of serum ALT, AST, GGT, PCIII, HA, and CIV in the non-alcoholic fatty liver patients were significantly lower in the long-term regular exercise group than in the control group; blood TLR4, NF-KB, MY-D88 Compared with the control group, the gene expression level was significantly downregulated in the long-term regular exercise group.
Conclusions Long-term regular exercise can effectively reduce nonalcoholic inflammatory liver injury and has a clear anti-fibrotic effect. Its mechanism may be related to long-term regular exercise through regulating the TLR4/NF-KB signaling pathway related factors and the regulation of molecular miR-146a, reducing inflammation and preventing the formation of fibrosis.

PO-092
The shifted balance of high-energy phosphates drives the AMPK dephosphorylation and reduced slow myosin expression during unloading
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Objective Mechanical unloading of postural muscles results in both muscle atrophy and a slow to fast fibre type transition. The cause of such changes is a reduction in slow-type MyHC isoform expression and an increase in fast-type MyHC isoform expression. It is believed that calcineurin/NFAT signalling pathway and AMP-activated protein kinase (AMPK) are involved in the regulation of slow-type MyHC isoform. Previously we showed that AMPK phosphorylation is significantly decreased in rat soleus at the early stage of mechanical unloading. We found, that stimulation of AMPK activity at the early stage of gravitational unloading prevents a decline of slow MyHC expression. We assumed that a decrease in AMPK activity at rat soleus at the early stage of gravitational unloading could be associated with changes in the ratio of intracellular high-energy phosphates (ATP/ADP). The aim of the study was to investigate the impact of high-energy phosphates ratio changes on AMPK activity and slow-type MyHC isoform expression in rat soleus muscle at the early stages of gravitational unloading.

Methods To verify the hypothesis, we used administration of β-guanidinopropionic acid (βGPA), before (6 day) and during 24-h hindlimb suspension. The content of phospho-AMPK, phospho-ACC, phospho-PKD, HDAC4/5 in rat soleus was determined by Western-blotting. The amount of MyHCI(β) pre-mRNA and mRNA was evaluated by RT-PCR.

Results After 24-h HS we observed a decrease (p<0.05) in phospho-AMPK content vs. control group, but in HS+ βGPA group didn’t differ from the control. After 24-h unloading we found a significant increase in the content of nuclear HDAC4 in the HS group, but in the HS+ βGPA group the content of nuclear HDAC4 didn’t differ from the control group. 24-h unloading resulted in a decrease in MyHCI(β) pre-mRNA and mRNA expression vs. the control group. The expression level of MyHCI(β) pre-mRNA and mRNA in HS+ βGPA group didn’t differ from the control.

Conclusions Thus βGPA administration prevents a decline in AMPK phosphorylation. Therefore, we can conclude that at the early stage of gravitational unloading an accumulation of high-energy phosphates (ATP, ADP and creatine phosphate) takes place and leads to reduced AMPK activity and a slow to fast myosin fibre type transition. The study was supported by Russian Science Foundation grant # 18-15-00107.
PO-093
Exercise regulates HMGB1 / TLR4 / NF-κB pathway by H2S to improve OJ intestinal injury

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Objective To study the effect of aerobic exercise on the damage of intestinal mucosal barrier function caused by obstructive jaundice (OJ) and to explore its mechanism of action.

Methods 50 male KM mice were randomly divided into 5 groups: sham operation group (S), model group (M), exercise group (TM), DL-Propargylglycine + exercise (PT) group and sodium hydrosulfide + exercise (NT) group. In addition to the S group which are in the common bile duct to the abdominal wall hanging 48 hours to build mouse obstructive jaundice model. In the PT group, PAG (40 mg/kg) was intraperitoneally injected 7 days after surgery; NaHS (50 μmol/kg) was intraperitoneally injected in the NT group 7 days after surgery; TM group, NT group and PT group were graded at 0%, and the speed was 10m/min no weight training (30min/day). After 6 weeks, HE staining was used to observe the morphological changes of the intestinal mucosa. Biochemical analysis was used to detect the concentration of hydrogen sulfide (H2S) in blood and ileum, and total bilirubin (TBIL), alanine aminotransferase (ALT), and aspartate aminotransferase (AST) Liver function, diamine oxidase (DAO), D-lactic acid intestinal barrier function biochemical index; qRT-PCR and immunohistochemical staining were used to observe the expression changes of H2S-mediated related channel mRNA and protein (HMGB1, TLR4 and NF-κBp6) in intestinal tissues.

Results HE staining showed that the intestinal mucosa of group M was atrophied and the villus was broken. Compared with M group, the intestinal mucosa arrangement in TM group was relatively regular. Compared with TM group, intestinal mucosa atrophy in PT group, fluff hair loss, sparseness and disorder, partial mucosa The layer was separated from the lamina propria and the gland was severely damaged. The intestinal mucosa of the NT group was relatively regular, and the changes of intestinal mucosa atrophy were restored. Serum test results showed that H2S levels were higher in the TM group than in the M group; compared with the TM group, the PT group decreased and the NT group increased. DAO level: The TM group was lower than the M group; compared with the TM group, the PT group was elevated and the NT group was decreased. Changes in serum D-lactic acid levels were similar to DAO. The results of qRT-PCR and immunohistochemical staining showed that the expressions of HMGB1, TLR4 and NF-Kbp6 mRNA and protein in the intestinal tissues of mice in TM group were significantly lower than those in M group and PT group, and the mRNA and protein expression levels in NT group were the lowest.

Conclusions Aerobic exercise inhibits the HMGB1 / TLR4 / NF-κB signaling pathway through the H2S / CSE system, thereby exerting a protective effect on the intestinal mucosal barrier.
**PO-094**

Anisochronous aerobic exercise improves glucose and lipid metabolism of obstructive jaundice by activating Akt signaling pathway

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**Objective** To observe the effect of moderate intensity and different interval aerobic exercise on hepatic injury and AKT signaling pathway induced by severe obstructive jaundice in mice.

**Methods** 40 male KM mice were randomly divided into 4 groups: sham operation (OJ) group, model (OM) group, 3-week exercise (ST) group and 6-week exercise (SU) group. Mice in OM group, ST group and SU group all adopted the orthotopic hanging choledochotomy method modified by this study group to construct the animal model of obstructive jaundice. The slope of group ST and group SU were 0% and the speed was 10m/min. After the above 6 weeks of intervention, HE staining was used to observe the morphological changes of hepatocytes. Methods of automatic biochemical analyzer test serum total bilirubin (TBIL), alanine aminotransferase (ALT), aspertate aminotransferase (AST), liver function and fasting plasma glucose (GLU), glycosylated hemoglobin (HbA1c), glycosylated serum protein (GSP), total cholesterol (TC), triglyceride (TG) and high-density lipoprotein cholesterol (HDL - C) of sugar, lipid metabolism and biochemical indexes such as detection; Immunohistochemical staining and qrt-pcr technology were used to observe the expression changes of AKT related molecules such as SREBP-1c, LDL-C, gsk-3β, GCK and G6Pase in liver tissues.

**Results** HE staining showed that the liver cell cords of the normal group were orderly. In the model group, the hepatocytes of the rats were fibrosed in large amounts, which showed degeneration, necrosis and even disordered structure of hepatocytes. In the 3-week exercise group, a small number of hepatic cells were found with patchy necrosis, hepatic lobule structure was changed, and hepatic cords were not well arranged. There was no obvious tissue necrosis in the 6-week exercise group, the hepatic lobule structure was basically normal, and the liver cord was arranged in order. Serological results showed that the levels of TG, TC, LDL-C, HDL - C and GLU in the 6-week exercise group were significantly lower than those in the model group (P < 0.01), and the levels of TG and TC in the 3-week group were also significantly decreased (P < 0.05). In liver tissues, the mRNA and protein expression of related molecules of AKT pathway such as SREBP-1c, LDL-C, gsk-3β, GCK and G6Pase were significantly decreased.

**Conclusions** Moderate intensity aerobic exercise can regulate glucose and lipid metabolism in mice with severe liver injury caused by obstructive jaundice. The underlying mechanism may be related to regulating the AKT pathway.

**PO-095**

Applied Research on Heart Rate Variability in Monitoring Sports Fatigue of Boxing Athletes

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**Objective** Based on the diagnosis of sports fatigue using physiological and biochemical indicators, to detect the changes of heart rate variability (HRV) index before and after heavy load training in boxing athletes, and observe the effect of heavy load training on cardiac autonomic nerves. The purpose of this study was to investigate the application of HRV to monitor boxing athletes’ sports fatigue.
Methods 16 athletes from Shanghai men’s boxing team were recruited. The coach organized a 4-week heavy load training, on Monday morning before and after heavy load training, to evaluate whether athletes have exercise fatigue by testing white blood cell (WBC), red blood cell (RBC), hemoglobin (Hb), blood testosterone (T), cortisol (C), testosterone/cortisol ratio (T/C), creatine kinase (CK), blood urea (BU) and morning pulse. Heart rate variability (HRV) indicators were detected simultaneously. The data were analyzed by SPSS 19.0 statistical software. Pearson correlation analysis was used to compare the correlation between HRV and physiological and biochemical indexes. The paired sample T test was used to compare the differences between the indicators, P<0.05, P<0.01 was statistically significant.

Results After heavy load training, when compared with indexes before heavy load training, T and T/C ratios decreased significantly (-38%, -52.7%, p<0.01), C and morning pulse increased significantly (+32.4%, +20.4%, p<0.05), BU and CK had an increasing trend but no statistical significance (+16.5%, +52.7%, p>0.05), while WBC, RBC and Hb showed no statistical significance (p>0.05), these changes in physiological and biochemical indexes can diagnose sports fatigue of boxing athletes after heavy load training. SDNN of HRV index was significantly correlated with morning pulse (p<0.05), RMSSD was significantly correlated with CK (p<0.05), LF was significantly correlated with Hb (p<0.05), and LF/HF was significantly correlated with T, C, T/C, morning pulse, CK (p<0.05). After heavy load training, LF and LF/HF of HRV index in boxing athletes were significantly increased than that before heavy load training (1744.7±1526.3 ms² vs. 1134.5±1003.3 ms², 2.5±1.3 vs. 1.6±1.0, p<0.05), the other HRV indexes showed no statistical significance (p>0.05).

Conclusions The LF and LF/HF changed significantly when boxing athletes appeared sports fatigue, suggesting that the sympathetic nervous system had enhanced activity and increased tension, the imbalance between Sympathetic and parasympathetic tend to predominate in sympathetic activity. LF and LF/HF are sensitive HRV indicators for monitoring sports fatigue in boxing athletes.

PO-096
The relationship between Obesity and Sleep behavior in adolescents
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Objective With the increasing detection rate of overweight and obesity in adolescents, many kinds of fat-related hazards affect the quality of life. This paper aims to study the relationship between overweight and obesity and sleep behavior in adolescents. To provide theoretical basis for adolescent obesity intervention policy according to the relevant links.

Methods A questionnaire survey was conducted on 156 (84 males, 72 females) aged 12 to 18 years old to collect information on their basic physical condition and sleep related behaviors, and the questionnaire was collected on the spot. Subjects were divided into three groups according to BMI: normal, overweight and obese. The gender and BMI groups were analyzed and compared.

Results (1) Obesity The rate of obesity in boys was higher than that in girls (P < 0.05). (2) The rate of staying up late during workday (71.7%) and early rising (83.0%) in obese group was higher than that in girls (83.0%). In obese group, the sleeping time was longer (25.16 ±6.3min) and had no siesta behavior (30.8%). In normal group, 15-30min (38.6%), (P < 0.05). (3) BMI (29.86 ±7.53) in boys was significantly higher than that in girls (26.85 ±5.50), (1), while in normal group (38.6%), (P < 0.05). (3), BMI in boys (29.86 ±7.53) was significantly higher than that in girls (26.85 ±5.50), (P < 0.05). Male students with no siesta behavior and nap time in 15-30 minutes accounted for more (25. 5%), while female students had more lunch break time between 30 and 60 minutes (36.9%). (4) Male students' nap time and sleep duration were negatively correlated.
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with BMI, (P < 0.05). BMI was proportional to nap time and sleep time, but was inversely proportional to sleep time, (P < 0.05).

Conclusions Sleep behavior of adolescent boys and girls may have an effect on body weight status. Staying up late, lack of sleep and lack of lunch time will aggravate obesity and reduce sleep barrier. In addition, shortening sleep time can improve overweight and obesity status.

PO-097

Resistance Training prevents Skeletal Muscle Atrophy Induced by hypoxia through regulating Akt-FoxO1 pathway

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Objective Skeletal muscle atrophy induced by hypoxia on the plateau will lead to the decrease of muscle strength and the degeneration of athletic ability. Resistance training is an efficient method to stimulate the growth of muscle and improve protein synthesis. Akt-FoxO1 (Fork head box protein 1) pathway plays a significant role in the regulation of skeletal muscle protein degradation. However, it is not clear whether resistance training could prevent skeletal muscle atrophy induced by hypoxia and what is the regulation role of Akt-FoxO1 pathway. This study built a rat model that resistance training inhibited the skeletal muscle atrophy induced by hypoxia and explore the variation of Akt, FoxO1, Murf and Atrogin-1.

Methods 40 male 8-week-old Sprague-Dawley (SD) rats were divided into 4 groups randomly: control group (C), resistance training group (R), hypoxia group (H) and hypoxia resistance training group (HR). H and HR group were placed into simulated 4000m altitude (12.4%, O2%) and R and HR group received ladder resistance training. Their incremental load is calculated by using average body weight. After 4 weeks intervention of hypoxia and resistance training, body composition, wet weight of skeletal muscle (soleus, musculus gastrocnemius, extensor digitorum longus and muscelus biceps brachii) and skeletal muscle cross-sectional area (CSA) were measured. The expression of Akt, FoxO1, Murf and Atrogin-1 were detected by Western blot and RT-PCR. Moreover, immunofluorescence technique was used to locate the phosphorylation of FoxO1.

Results The lean body mass of HR group was significantly higher than H group (P<0.05). The wet weight and CSA of musculus biceps brachii in HR group were also higher than H group obviously (P<0.05). The results of real-time fluorescence quantitative PCR and western blot showed that the expression of FoxO1 and MuRF of hypoxia group (H group) were significantly higher than control group. However after the intervention of resistance training, the expression of Akt was significantly up-regulate and FoxO1, MuRF were significantly down-regulate. Immunofluorescence technique was used to observe the location of FoxO1 phosphorylation and the expression out of nucleus.

Conclusions Resistance training contribute to prevent the occurrence of skeletal muscle atrophy induced by hypoxia and the form of climbing ladder training can stimulate the hypertrophy of biceps in rats. The results revealed that FoxO1 phosphorylation out of nucleus became higher after resistance training. All above revealed that resistance training could inhibit skeletal muscle atrophy induced by hypoxia. Akt promoted FoxO1 phosphorylation may become the molecular mechanisms that resistance training can inhibit the atrophy of skeletal muscle induced by hypoxia.
PO-098
The relationship between beverage consumption and overweight of university students

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Objective
Previous studies have shown a clear correlation between university students' eating habits and the rate of obesity. According to the WHO's information, obesity was not only a chronic disease that did harm to health, but also a risk factor for a variety of chronic disease such as type 2 diabetes, coronary heart disease and respiratory disease, etc. With the booming of economy and the continuous improvement of university students' living standard, the growth of university students' drinking consumption and the diversification of consumption patterns, beverage had gradually become a part of university students' daily diet. The relationship between intake of drinks and health in university students is not clear. Knowing the relationship between the consumption habits and the prevalence rate of overweight in university students can help university students to establish a healthy lifestyle, control weight and lead a reasonable beverage consumption. Thus a questionnaire survey was conducted and students were divided into beverage group and non-beverage group for horizontal comparison, so to investigate the relationship between the beverage consumption habit of university students and the prevalence of overweight.

Methods
We conducted a questionnaire survey on university students (130 males and 115 females) from a university through a self-designed questionnaire. The method of investigation was a self-filling questionnaire which includes the consumption of beverages, the frequency and the variety of beverage per week. All the subjects' height, weight, waist circumference and hip circumference were measured, the BMI and waist-hip ratio were calculated. Alpha reliability coefficient, non-parametric test, chi-square test, kruskal-wallis H test, non-conditional Logistic regression analysis of dichotomies and Logistic multivariate analysis were used for statistical analysis of the data.

Results
The intake of all kinds of beverage in university students was as follows: the sugary beverage (carbonic acid and juice) was up to 55.5%, the dairy products was 19.5%, the tea beverage (no sugar or low sugar) was 12.5%, and the functional beverages was 25%. Male students drunk carbonic acid beverage more than female (P<0.01), and female students drunk fruit juice was significantly higher than that of male students (P<0.01). The overweight and central obesity rate of male and female students were roughly equivalent (P > 0.05). Overweight and obese (BMI ≥24) students consumed more sugary drinks than normal weight students (P<0.05). Multifactor's logistic regression analysis showed that the risk factors associated with overweight and obesity were sugary drinks and purchase times; the risk factors associated with central obesity included sex and the frequency of beverage purchased.

Conclusions
The consumption all kinds of sugary drinks in overweight and obese university students were higher than that of normal weight students. Male university students liked "carbonated" and "tea" drinks more than female university students, while female students liked "juice" and "milk" drinks more than male students. Sugary drinks could be a risk factor to obesity. And female students are more likely to be central obese than male students. There is a certain correlation between the intake of sugary beverages in university students' overweight and central obesity. This research shows that the intake of sugar beverages was closely correlated to overweight and central obesity. It's important for university students to reduce the intake of sugary beverages appropriately and establish a correct and healthy consumption concept of beverage.
PO-099
Effects of aerobic exercise on fatty acid metabolism in liver of NAFLD Rats

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Objective Aerobic exercise can improve liver metabolic diseases such as non-alcoholic fatty liver disease (NAFLD), but the molecular mechanism is not completely clear, which limits the application of aerobic exercise in the treatment and improvement of NAFLD. In this paper, the effects of aerobic exercise on the expression levels of important genes regulating fatty acid metabolism in the liver of NAFLD rats were studied in order to explore the possible molecular mechanism of aerobic exercise regulating hepatic fatty acid metabolism.

Methods 1. Animal grouping. 36 male Sprague Dawley (SD) rats aged 21 days old were randomly divided into three groups after 1 week of adaptive feeding: 10 in the normal diet quiet group (NC group), 10 in the high-fat diet quiet group (HC group) and 16 in the high-fat diet exercise group (HT group). 2. Training arrangements. After 12 weeks, the rats in the HT group underwent 8 weeks of aerobic exercise with a training intensity of 25 m/min, and continued exercise for 1h/d, 6d/w for a total of 8 weeks. 3. Sample collection. After an overnight fast, rats in the three groups were weighed and anesthetized with an intraperitoneal injection of 10% chloral hydrate (0.3 ml/100 g body weight). Blood samples were collected from the aortaventralis, centrifuged, and kept frozen at -80 °C for chemical assays. The rat liver was removed, frozen in liquid nitrogen, and stored in a -80 °C freezer. 4. Serum lipid concentration and liver function detection. Serum levels of total cholesterol (TC), triglyceride (TG), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), free fatty acid (FFA), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were detected in three groups of rats. 5. Detection of expression levels of fatty acid metabolism related genes in liver. The expression levels of AMP-activated protein kinase (AMPK), silence information regulator 1 (SIRT1), peroxisome proliferator-activated receptor γ coactivator 1α (PGC-1α) in rat liver were detected by SYBR Green real-time PCR. 6. Data statistics. Results were expressed in the form of mean±standard deviation. Spss17.0 statistical software was used to conduct one-way ANOVA to compare the differences between the groups, p<0.05 indicates significant difference between groups.

Results 1. Effects of aerobic exercise on Blood lipids and liver function. The serum levels of TC, TG, LDL-C, FFA, AST and ALT in HC group were significantly higher than those in NC group (p < 0.05), while HDL-C level was significantly lower (p < 0.05). The serum concentrations of TC, TG, LDL-C, FFA, AST and ALT in HT group were significantly lower than those in HC group (p < 0.05), while HDL-C level was significantly higher (p < 0.05). 2. Effects of aerobic exercise on the expression of fatty acid metabolism related genes in liver of rats. The mRNA expression levels of AMPK, SIRT1 and PGC-1α in liver of HC group were significantly lower than those of NC group (p < 0.05). While the mRNA expression levels of AMPK, SIRT1 and PGC-1α in liver of HT group were significantly higher than those of HC group (p < 0.05).

Conclusions Conclusions: Aerobic exercise can improve serum lipid concentration and liver function in NAFLD rats. It increased the consumption of ATP, led to an increase in AMP/ATP ratio, enhanced the mRNA expression of AMPK, SIRT1 and PGC-1α, activated AMPK - SIRT1 - PGC-1α signaling pathway, reduced hepatic fat synthesis and accelerated fatty acid oxidation in NAFLD rats liver.
PO-100
The exploration of constitutively expressed myokines utilizing tissue-engineered skeletal muscle

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Objective Recent evidence has identified skeletal muscle as a secretory organ. Many myokines, which are bioactive substances secreted from skeletal muscle, have been identified in plane muscle culture cells. Compared to the plane muscle culture cells, the tissue-engineered muscle is an excellent model as culture system mimicked native skeletal muscle. However, constitutively expressed genes and secreted compounds from tissue-engineered muscle have not been analyzed sufficiently. The purposes of this study were 1) to clarify kinetics of constitutively secreted compounds, and 2) to explore constitutively expressed genes in the tissue-engineered muscle.

Methods C2C12 cells embedded within collagen gel solution were placed between two tendons made up of elastase-treated acellular porcine blood vessel. The constructs were cultured in growth media for 2 days and cultured in differentiation media for 6 days. To compare with plane culture cells, C2C12 cells were cultured in plane under the same condition as the construct. The culture media were obtained, and analyzed by MALDI-TOF Mass Spectrometry. Furthermore, constitutively up-regulated genes in tissue-engineered skeletal muscle were explored based on microarray analysis and confirmed by RT-PCR.

Results MALDI-TOF Mass Spectrometry revealed that the number of detected peaks in tissue-engineered muscle was abundant compared to that of plane muscle culture cells, especially at range of low molecular weight. Furthermore, the detected peaks were substantially different among these culture media and specific peaks were identified in tissue-engineered muscle. Based on microarray analysis, the transcription of cholecystokinin identified, and confirmed the up-regulation in tissue-engineered skeletal muscle by RT-PCR.

Conclusions These results suggested that the tissue-engineered muscle constitutively secreted many compounds compared to plane culture cells, especially at range of low molecular weight. Furthermore, the transcription of cholecystokinin was up-regulated in tissue-engineered skeletal muscle. Besides of the plane muscle culture cells, it is possible to expect to obtain novel myokines utilizing tissue-engineered muscle.

PO-101
Long-term Various Load Training Effects on Free Radical Metabolism in the Brain of Aging Mice

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Objective To investigate the effects of long-term various load aerobic exercise on the free radical metabolism of the brain in aging mice through the establishment of different swimming exercise models.
**Methods** sixty 3-month-old male Kunming mice were randomly and equally divided into five groups, which were the control group (group C), 10 minute exercise group (group E₁), 30 minute exercise group (group E₂), 60 minute exercise group (group E₃), and 90 minute exercise group (group E₄). Group C had regular feeding during the natural aging time in 8 months without any exercise intervention. All other exercise groups performed different load swimming exercise (from 10 to 90 minutes as mentioned above) during the same 8 month period. All subjects were decapitated after exercise on the last day of the 8th month; and the brain tissues were harvested as samples. The malondialdehyde (MDA) amount was measured by the Thiobarbituric Acid method, and the superoxide dismutase (SOD) activity level was measured with Xanthine Oxidase method.

**Results** group E₃ demonstrated significantly higher SOD activity level and lower MDA amount than the other groups.

**Conclusions** Conclusions: Long-term, medium-load aerobic exercise had greatly impacted the metabolism of free radicals in the brain of the mouse, evidenced by increased SOD activity level and decreased MDA production. These effects may indicate that this exercise model may be beneficial in slowing down brain aging by eliminating free radicals and improving brain anti-oxidation ability.

**PO-102**

**Effects of one-time exhaustive exercise on peripheral drive in rats**

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**Objective** In this study, we observed the effects of one-time exhaustive exercise on the grip strength, the time of grabbing, and the changes of the electromyography (EMG) of the hind limb flexor muscles and the flexor elbow muscles of the forelimbs, and revealed the effects of exercise fatigue on the peripheral motor drive level.

**Methods** Male SD rats finished exhaustive fatigue exercise. A one-time exhaustive treadmill exercise fatigue model was established after one-week adaptive training in rats. The model was established by the modified Bedford incremental load motion program of the laboratory. The load is divided into 3 levels: the first stage movement speed 8.2 m/min, exercise time 15 min; second stage speed 15 m/min, exercise time 15 min; third stage speed at 20 m/min, exercise to exhaustion. At the same time, a miniature wireless acceleration sensor (18g) was worn in the tail of the rat to monitor the acceleration change of the running direction of the rat while running on the running platform. Three consecutive parallel experiments were performed using a rat grip tester (BioSEB GS3) to measure and compare the maximal muscle strength changes of the limbs before and after exercise fatigue in rats. Compared the static contraction of the rat muscle before and after exercise fatigue to overcome the length of time and gravity of the rod, and evaluated the muscle endurance after training the rats to learn to grab the rod. The EMG, square root amplitude (maxRMS), frequency domain analysis of EMG median frequency (MDF) and mean frequency (MF) of the hind limb flexor and the forelimb flexor muscles (EMG) was measured by the Italian BTS FREEEMG ultra-miniature wireless surface electromyography tester to predict peripheral muscle tone and drive level.

**Results** 1) The maximum holding force of the rat in resting state was 68.53 N/Kg, and the gripping force was significantly decreased (p<0.05) and reduced to 25.47 N/Kg after exercise fatigue .2) Exercise fatigue has a significant effect on the static grab time of rats. The rat has a grab time of 287.65s in a quiet state, and can only last for 27.78s after fatigue, and even can hardly maintain static contraction. The maxRMS of hindlimb flexor muscles in rats was significantly lower than that before fatigue (P<0.05) at rest, and there was no difference in forelimb flexor elbow muscle groups. MDF and MDF of forelimb flexor elbow muscle group and
hind limb flexor muscle group were significant increased (P<0.05). 4) MaxRMS MDF and MDF of hind limb flexor muscle group and forelimb flexor elbow muscle group were significantly lower than those before fatigue (P<0.05) under the state of grabbing rod.

Conclusions The sprinting ability in the running direction, maximum gripping force and grabbing time of the rats decreased significantly after exercise fatigue, revealing that the fatigue of the muscles may cause the decrease of the muscle static contraction ability. The inability of the hind limbs to maintain standing with exercise fatigue may be related to a significant decrease in hindlimb tension, and it was found that there was an explosive discharge and the phenomenon of tonic contraction in the muscles at rest. The muscle endurance and tension of the muscles were significantly reduced, and the contraction frequency of the muscle movement unit decreased significantly after exercise fatigue, causing insufficient peripheral driving level. (NSFC31401018, SKXJX2014014, Corresponding_houj@bnu.edu.cn).

PO-103
Effects of Phosphatidylserine on Mental States in Elite Shooters
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Objective The purpose of this study was to examine effects of a short-term oral supplementation of PS on biochemical stress indicators, whole brain neurotransmitters, mood states, and sleep quality in elite shooters.

Methods Eighteen shooters including 9 males and 9 females participated in the study. They were randomly assigned into either of the three groups: 1) those who ingested PS at 400 mg·day⁻¹ (n=6) (PS-400); 2) those who ingested PS at 800 mg·day⁻¹ (n=6) (PS-800); 3) those who with no supplement (n=6) (CON). PS supplementation lasted for 14 days and was administered in a double-blinded fashion. Within a week prior to the supplementation, serial venous blood samples were taken for measuring serum levels testosterone (T), cortisol (C), blood urea nitrogen (BUN), and creatine kinase (CK). Subjects also completed the Profile of Mood States (POMS) scale and the Pittsburgh Sleep Quality Index (PSQI) questionnaire and undertook electroencephalogram that determined activation values of six neurotransmitters in whole brain, including inhibition of medium (INH), five hydroxy-tryptamine (5-HT), acetylcholine (ACH), dopamine (DA), norepinephrine (NE), and excited medium (EXC). Subjects repeated the same testing protocols and all variables were measured again after 14 days of supplementation.

Results No between-group differences in all variables were observed at the baseline prior to the start of supplementation. After supplementation, both C and C increase were lower (P=0.025, P=0.016, respectively) in PS 800 than CON, while no significant differences in C and C increase were seen between PS-400 and CON and between PS-800 and PS-400. 5-HT and DA were higher (P=0.049, P=0.019, respectively) in PS-800 than CON, while no differences in 5-HT and DA were observed between PS-400 and CON and between PS-800 and PS-400. All neurotransmitters were increased by supplementation in PS-800, with ACH and DA reaching statistical significance (P=0.050, P=0.029, respectively). A synchronized trend of INH, 5-HT, ACH, DA, NE, and EXC were observed in a few brain regions (P<0.05). PS Supplementation decreased panic score of POMS following both PS-400 and PS-800, with a greater decrease seen in PS-800. The panic score post-supplementation was lower in PS-800 than PS-400 (P=0.016) or CON (P=0.027). Although results of PSQI indicated an improved sleep quality following supplementation in both PS-400 and PS-800, these improvements did not reach statistical significance and no differences in PSQI were seen across the three groups.
Conclusions It appears that supplementation with phosphatidylserine at 800 mg·day⁻¹ for 14 days can reduce stress hormones, modulate central neurotransmitters, and mitigate negative emotions, thereby alleviating stress levels among elite shooters.

PO-104
Hematological, hormonal and fitness indices in youth swimmers: gender-related comparisons

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Objective This study was to evaluate gender differences in hematological, hormonal and fitness parameters among youth swimmers and to explore relationships between erythrocyte indices and aerobic and anaerobic capacity.

Methods 308 youth swimmers including 137 girls and 171 boys aged 8 to 16 volunteered to participate in this study, and they were divided into three (Beginner, intermediate and advanced) groups based on their training experiences. Blood samples were obtained to determine red blood cell counts, hemoglobin concentration, hematocrit, and serum erythropoietin and testosterone levels. VO₂max was assessed using a submaximal cycle protocol. 76 girls and 102 boys also undertook a Wingate test to determine their peak anaerobic power. One-way analysis of variance (ANOVA) was used to compare gender differences in hematological indices hormonal indices and aerobic and anaerobic capacities. Two-way (gender × training) ANOVA was used to analyze the interactive effect of gender and training on hematological variables.

Results Boys had higher (p<0.05) means than girls for all hematological variables except for erythropoietin and values demonstrated an increase with training in boys. The average VO₂max in l·min⁻¹ and peak anaerobic power in watts were also higher in boys (2.91±0.08 and 547±28, respectively) than girls (2.25±0.07 and 450±26, respectively). Modest but significant (p<0.05) correlations were found between VO₂max and red blood cell counts (r=0.252), hemoglobin concentration (r=0.345), or hematocrit (r=0.345) and between peak anaerobic power and red blood cell counts (r=0.304), hemoglobin concentration (r=0.319) or hematocrit (r=0.351).

Conclusions This study revealed relatively lower yet age- and gender-appropriate hematological, hormonal and fitness indices in youth swimmers. The gender-related differences in erythrocyte indices seems unrelated to erythropoietin and may be explained by the higher testosterone levels seen in boys. Erythrocyte indices may be used as part of talent identification for sports.

PO-105
to compare the impact of running and walking on physical health

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Objective Under the natural and comfortable condition of the private human body, explore which of the running and walking is more conducive to the physical health of the human body

Methods Among the sports crowd of the NanMingRiver Rubber Exercise Road in Guiyang City, select 20 people who have walking exercise habits and who can take the running test under the age of 60 as group A and select 20 people who have running exercise habits and who can take
the walking test under the age of 60 as group B. Inclusion criteria for the exercise habits is “Exercise at least 3 times a week for more than 30 minutes and for more than one year.”

(1) Experimental method:
Two groups of subjects with different exercise modes adopted the exercise mode of the corresponding group. Under the condition that other environmental conditions were unchanged, the health benefits of different exercise methods in the same group were compared before and after the experiment. The time of experiment lasts three months. The intensity of walking exercise is the intensity that the athlete feels natural and comfortable. The intensity of running exercise is the intensity that the athlete feels natural and comfortable. Before and after the experiment, the test contents of the two group subjects included height, weight, BMI, grip strength, reaction time, closed-eyes standing on a leg, sitting body flexion, step test, lung capacity, lung capacity index of body mass.

(2) Literature and Information method:
Through the retrieval and review of relevant literatures on sports and physical health at home and abroad, this paper provides theoretical references and methodological basis for this research.

(3) Data analysis method:
Paired sample t-test was used to analyze the changes of constitution of the two groups experimental people before and after the exercise modes.

Results After a 3-month walking in group A, the step test, lung capacity, and lung capacity index of body mass were higher than before, and the difference was statistically significant (P<0.01). The grip strength, reaction time, closed-eyes standing on a leg decreased compared with prior exercise. The difference was statistically significant (P<0.05); body mass, body mass index (BMI), and sitting body flexion were higher than before, but the difference was not statistically significant. After three months of walking exercise in group B, the step test, lung capacity, lung capacity index of body mass, and grip strength decreased compared with the previous exercise, and the difference was statistically significant (P<0.01); body mass, body mass index (BMI), reaction time, the closed-eye standing on one foot was lower than before, and the difference was statistically significant (P<0.05). The anterior flexion of the sitting body decreased, but the difference was not statistically significant.

Conclusions In comfortable, natural conditions, running is more conducive to physical fitness than walking, and running is a more effective way to exercise.

PO-106
Effects of field-battle hypoxia supporter on free radical metabolism after exercise at high altitude

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Objective To explore the effects of field-battle hypoxia supporter on free radical metabolism after exercise at high altitude.

Methods A total of 40 healthy fighters stationed in the 3800m plateau for 10 days were randomly divided into two groups. Each group of 20 men, armed with heavy weapons and hypoxia supporter, hiked 5 km and then climbed a 4,300 m peak, a total distance of 10 km. The control group closed the valve of hypoxia supporter without oxygen inhalation, the experimental group opened the valve and inhaled oxygen. The serum levels of superoxide dismutase(SOD), total antioxidant capacity(T-AOC), reactive oxygen species (ROS) and malondialdehyde (MDA) were measured at rest and after exercise. In addition, The average marching speed of the two groups were compared.

Results The T-AOC, ROS and MDA were increased both in the control group and experimental group after exercise, and the SOD increased significantly in experimental group.
Compared with control group, the SOD and T-AOC were increase but the ROS and MDA were decreased significantly after exercise (P<0.01). The average speed of 10km cross-country march in the control group and the experimental group was (3.0±0.3)km/h and (2.3±0.5)km/h respectively, and there were significant differences (P<0.01).

**Conclusions**
The field-battle hypoxia supporter can restrain free radical damage after exercise at high altitude and increase the efficiency of work at high altitude.

**Acknowledgements:** This work was supported by the Guangdong Science and Technology Equipment Mobilization project (Research and application of field-battle hypoxia supporter).

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**PO-107**

**Adrenergic Receptor β3 Up-regulates Uncoupling Protein 1 and Cyclooxygenase 2 Expressions in The Brown Adipocyte**

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**Objective**
Brown adipose tissues (BAT) activation is important for losing weight as its high energy expenditure in Mammalian. Recent studies showed that exercise may also be essential for BAT activation. Uncoupling protein 1 (UCP1), specifically expressed in BAT's mitochondria, uncouples oxidative phosphorylation and dissipates energy from Free Fatty Acids into heat. Activating the Adrenergic Receptor β3 (Adrβ3) provides fuel for mitochondrial heat production and up-regulates Cyclooxygenase 2 (COX2), which is a key factor of UCP1 synthesis. Sympathetic nerve excitement stimulated by exercise can release norepinephrine as a neurotransmitter, which can affect Adrβ3. Brown adipocyte (BAC) is a kind of adipocyte in vitro as a model to study heat production. Isoprenaline Hydrochloride (ISO) is a widely used as an Adrβ agonist. In this research, we tried to figure out the response of BAC to Adrβ3 activations with different time points and whether ISO can be used as a BAC activator.

**Methods**
C₃H₁₀T₁/₂ cells were maintained in a humidified, 37°C, 5% CO₂ incubator in DMEM/F12 medium with 10% fetal bovine serum (FBS). For brown adipogenesis, cells were first split into differentiation medium (DMEM/F12 containing 10% FBS, 20nM insulin, 1nM 3,3'5-Triiodo-L-thyronine(T₃)) for 4 days, the medium was changed every other day. Confluent cells were treated for 2 days with brown adipose adipogenesis cocktails (differentiation medium containing 2µg/mL dexamethasone, 0.5mM isobutylmethylxanthine (IBMX), 0.125mM indomethacin and 1µM rosiglitazone) on day 4. Then the medium was replaced by differentiation medium and changed every other day. At day 10, the full differentiation adipocytes were treated with 10µM ISO for 0 (as control), 1, 3, 6, 12 and 24 hours. For the lipid droplets staining, the cells were fixed by 4% paraformaldehyde solution then stained with Oil Red O. The cells were harvested and the total cell lysates were extracted for protein analysis after each time point. The UCP1, COX2, and Adrβ3 expression levels were detected by western blot, using Actin as the internal protein. The results were expressed as the mean ± standard error of the mean (SEM). Group comparisons were performed using two-way ANOVA and LSD's post-hoc tests.

**Results**
After differentiation, the cell shapes converted from fibroblastic to a spherical shape. Dispersed small lipid droplets were observed in the cells. After ISO treatment, the red color after Oil Red Staining became lighter and the size of the lipid droplets turned to smaller. The Adrβ3 protein expressions were 1.00±0.00, 1.34±0.32, 1.07±0.50, 4.65±1.84*, 2.44±0.73, and 3.43±1.09 at 0h, 1h, 3h, 6h, 12h, and 24h after ISO treatment, respectively. After introduced to ISO, the UCP1 expression levels were 1.00±0.00, 1.95±0.39, 2.72±0.57, 5.68±1.82*, 3.49±0.92, and 2.79±1.05 at 0h, 1h, 3h, 6h, 12h, and 24h, respectively. And for COX2, the protein expressions were 1.00±0.00, 2.13±0.67, 1.82±0.33, 4.67±1.82*, 2.88±0.44, and 2.65±0.54, respectively. The *
means p < 0.05, compared with oh controls. The proteins expressions were reached to peak after 6 hours ISO treatment from the above results.

**Conclusions** UCP1 and COX2 protein expressions were increased in BAC according to Adrβ3’s expression in different time points, indicating that Adrβ3 may induce adipolysis in BAC and help to burn fat and produce heat.

**PO-108**

**Research on the fluctuation of Reticulocyte during different altitude training patterns in swimming athletes**

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**Objective** To explore the fluctuation of reticulocyte during different altitude training in swimming athletes and their difference between altitude training focused on special aerobic capacity and altitude training focused on high load and sprint, to provide the theory basis for further analyze the altitude training improve the physiological function and athletic performance.

**Methods** Twenty female swimming athletes participated in altitude training for four weeks, which could be divided into two patterns, special aerobic capacity group(G1, n=9) and intensity and sprint group(G2, n=11). Fasting venous blood samples were drawn for each week were determined using Beckman Coulter LH780 automated hematology analyzer, including Reticulocyte related parameters such as Reticulocyte percentage (Ret%), Reticulocyte count (Ret#) and immature Reticulocyte fraction (IRF) and also erythrocyte related parameters.

**Results** (1) In G1, Ret%, Ret# and MRV showed continuous decline and represented minimum level in 4th week. While IRF increased during 2nd and 3rd, and then decreased in 4th week. (2) In G2, Ret%, Ret# and MRV were relatively steady during 1st and 2nd week. Ret% and Ret# gave an increased in 3rd week, and then decreased in 4th week, while MRV decreased in 3rd week and increased in 4th week. IRF significantly decreased in latter period compared to earlier period. (3) There were no significant changes for RBC, HCT and HGB in both G1 and G2. MCV, MCH, MCHC and RDW showed improved in later stages compared to their in earlier stages for all in G1, while MCV increased and then decreased, MCH and MCHC continued decline, and RDW kept at sustaining higher levels in G2.

**Conclusions** (1) Reticulocytes were not in accordance with the trend of erythrocyte during different altitude training. Compared to erythrocyte, the behavior of Reticulocyte could reflect erythropoiesis, and IRF could more sensitively detect the change of bone marrow stimulation in particular.

(2) The variability of Reticulocytes during altitude training was influenced by hypoxia, training and especially their interactive effects. In aspect of training type, it was crucial for considering the fluctuation of training load and athletes’ adaptation during different patterns.

**PO-109**

**Influence of HDAC1 inhibitor on the E3-ligases expression in rat soleus during hindlimb unloading**

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**Objective** Muscle unloading leads to its atrophy development. The MuRF-1 and MAFbx E3-ligases expression is increasing under this condition. FOXO3 was considered to be the only
transcription factor that triggers E3-ligases expression. Beharry A.W. et al pinpoints HDAC1 as a primary regulator of FoxO in skeletal muscle that is both sufficient and required for skeletal muscle atrophy. We aimed to determine the role of histone deacetylase 1 (HDAC1) proteins in activation of MuRF-1 and MAFbx E3-ligases expression at the early stage of muscle unloading.

**Methods** We investigate it by CI-994 (inhibitor of HDAC1) administration in male Wistar rats (180-200 g) upon 3-day hindlimb suspension. The method of hindlimb suspension was described in Morey-Holton E & Globus R (2002). 24 animals were divided into 3 groups (n=8 in each): C-control, CI - hindlimb suspension with CI-994 (i.p. 1 mg/kg/day), or placebo (HS group) administration. The animals were anaesthetized with an i.p. injection of tribromoethanol (240 mg/kg), soleus muscles were surgically excised, frozen in liquid nitrogen. The Western blot and RT-PCR analyzes were done. The statistical analysis was performed using REST 2009 v.2.0.12 and Bio-Rad CFX Manager programs at the significance level set at 0.05. The significant differences between groups were statistically analyzed using Mann-Whitney test.

**Results** The evaluation of the levels of mRNA expression of MuRF-1 and MAFbx showed that CI-994 treatment inhibited unloading induced up-regulation of MAFbx in CI group but had no effect on mRNA expression of MuRF-1. After unloading, mRNA expression of MAFbx increased 2.12-fold (p < 0.05) in HS group. There were statistically significant differences in MAFbx mRNA expression between HS and CI groups. When compared with the control, unloading increased MuRF-1 mRNA expression 1.67- and 1.56-fold in HS and CI groups, respectively. CI-994 treatment also inhibited unloading-induced upregulation of mRNA expression of ubiquitin. The levels of ubiquitin mRNA expression when compared with the control were 4.21- and 2.32-fold in HS and CI groups, respectively. We did not find any differences in the content of phosphorylated anabolic signaling system components (Akt/mTOR/S6k) between both suspended groups (CI and HS).

**Conclusions** Therefore, HDAC1 inhibiting prevented hindlimb suspension-induced up-regulation of MAFbx and ubiquitin, but did not any effect MuRF-1 expression. This work was supported by Russian Science Foundation (grant № 18-15-00062).

**PO-110**  
Voluntary wheel training attenuate brain aging in SAMP8 mice

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**Objective** Alzheimer’s disease (AD), is a progressive neurodegenerative disease. The pathological hallmarks including the deposition of senile plaque and neurofibrillary tangles (NFTs) in AD. The underlying molecular mechanisms for AD are not fully understood. Studies have shown that exercise as an economical and popular fitness method, long-term exercise can reduce the risk of AD, delay the occurrence of AD or delay the progression of AD. This study was to investigate the protective effect of the Voluntary wheel on cerebral cortex senescence in SAMP8 mice.

**Methods** Fifteen SPF-class 7-month-old SAMP8 mice were randomly divided into control group (CON), voluntary wheel group (V) and voluntary wheel with chloroquine group (VQ), with 5 mice in each group. Each group was under adaptive feeding for one week. After 3 days of adaptive voluntary wheel training for V and VQ groups, the experiment officially started. The V and VQ groups performed an 8-week voluntary wheel training and the VQ group received a daily intraperitoneal injection of chloroquine (40 mg/kg). After 8 weeks intervention, the Morris water maze test was used to determine the changes in spatial learning and memory ability of each group. After 24 hours of the end of this experiment, the mice were killed by breaking neck. The degree of hippocampal cell injury was detected by Nissl staining; the expression of apoptosis and senescence-associated protein in the cerebral cortex was detected by Western blot.
Results Compared with the CON group, the escape latency of the V group mice in the Morris water maze test was significantly shorter (P<0.01), the number of crossing target quadrants was significantly increased (P<0.05), however, the VQ group exacerbate the response compared with CON group. Nissl staining showed that the cells of cerebral cortex in the CON group had obvious damage, while the V group showed significant improvement. The VQ group had a significant damage compared with the V group; Western blot results showed that the expression of AD-like pathological changes such as BACE1 protein in the cortex of group V was significantly decreased, and the expression of P-GSK-3β protein was increased (P<0.01) compared with CON group. On the contrary, compared with V group, VQ alleviated the improvement effect of voluntary running. (P<0.05); the expression of apoptosis-related protein increased, and the decreased in CON group, while voluntary running intervention down-regulated BAX, Cleaved-caspase3, increased the Bcl-2 protein level compared with the CON group (P<0.05). Furthermore, compared with the CON group, the expression level of aging-related protein AC-P53 was decreased in the V group, and the expression level of Sirt1 was increased.

Conclusions The 8-week voluntary wheel training can significantly improve the learning and memory ability of SAMP8. Mechanismly, voluntary wheel training can improve the senescence of cerebral cortex by inhibiting cell apoptosis, the expression of AD-like pathological protein and increasing Sirt1 protein level.

PO-111
Fis1 governs normal mitophagy in slow muscle during the low-intensity and long-period exercise

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Objective Mitochondrial dynamics include mitochondrial fusion and mitochondrial fission. It has long been widely recognized that Fis1 plays a role in mitochondrial fission in mammals. However, the finding of Dr. Youle’s team suggests that Fis1 may play an important role in mediating normal mitophagy. Both of mitochondrial dynamics and mitophagy are closely related to skeletal muscle homeostasis. Therefore, in this study, Fis1 was specifically knocked out in skeletal muscle in vivo, looking forward to: 1) investigating the relationship between Fis1 and mitochondrial morphology, mitophagy in mouse skeletal muscle. 2) The mechanism of Fis1 in mitochondrial quality in skeletal muscle under exercise stress. So as to we can clarify the molecular mechanism of Fis1 in mediating mitochondrial quality in skeletal muscle, but also expect to provide more theoretical basis for skeletal muscle health and exercise adaptation.

Methods We constructed conditional skeletal muscle Fis1 knockout mice (C57BL/6) and littermate control mice through Cre/Loxpt technique. The mice were free feeding, drinking and activity during the test, we only selected male mice for all of the tests. And the genotypes were Fis1FL/FL MCK-Cre + (Fis1KO) and Fis1FL/FL MCK-Cre – (WT). First, we performed endurance test on 10 WT and 10 Fis1KO mice (32-40 weeks, n = 10), then dissected quadriceps, gastrocnemius and soleus (n=4-5) quickly and rapidly frozen in liquid nitrogen, then stored at -80 °C freezer for testing Fis1 and OXPHOS expression (Western-blot). On the other hand, we selected WT and Fis1KO mice (n=3) to prepare EM samples, so as to observe mitochondrial morphology and muscle ultrastructure. Skeletal muscle (n=3-4) was snap-frozen in isopentane cooled with liquid nitrogen for HE, NADH staining, and observing GFP-LC3 (mitophagy).

Base on the exploration of loss of Fis1 without stress, we adopted endurance exhaustive exercise on WT (WT EEE) and Fis1KO mice (Fis1KO EEE) (n=3-4). Mice were acclimated to and trained on a 10° uphill treadmill. Mice were acclimated to and trained on a 10° uphill treadmill.
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(Columbus Instruments) for 2 days. On day 3, mice were subjected to a single bout of running starting at the speed of 10m/min. Forty minutes later, the treadmill speed was increased at a rate of 1m/min every 10 min for a total of 30 min, and then increased at the rate of 1m/min every 5 min until mice were exhausted. Exhaustion was defined as the point at which mice spent more than 5 s on the electric shoker without attempting to resume running even if we used short air puffs and tail tickles with bristle brush. We dissected soleus and gastrocnemius to observe muscle ultrastructure and mitophagy through EM and confocal microscope respectively (same methods as before). At the same time, we used immune-EM to observe autophagosome morphology and LC3 distribution.

**Results** Behavior test on specific knock out skeletal muscle Fis1 mice model

We found that loss of Fis1 induced significantly lower performance in treadmill endurance tests than controls (P <0.001). The effect of loss of Fis1 on mitochondrial morphology and function

In soleus, knocking out Fis1 caused mitochondrial hyperfusion (mitochondrial size was significantly increased, P = 0.01). In addition, we found more swollen mitochondria in Fis1 knock-out gastrocnemius.

On the other hand, compared with the control mice, lack of Fis1 significantly reduced the protein expression of Complex I, Complex II and Complex IV in soleus (P <0.01). As same as before, we also found a significant increase GFP-LC3 (P <0.01) in Fis1KO soleus.

3) Changes of muscle ultrastructure and mitophagy after endurance exhaustive exercise (EEE)

First, comparing with the control group, swollen sarcoplasmic reticulum (skeletal muscle endoplasmic reticulum (ER)) and extremely swollen terminal cisternae (TC) were found in Fis1KO soleus and gastrocnemius respectively after endurance exhaustive exercise.

We found a significant accumulation of GFP-LC3 (P <0.0001) in Fis1KO soleus compared to the control. However, GFP-LC3 signal still increased (P <0.001) in Fis1KO soleus after exercise compared with that in soleus before exercise. Moreover, we observed a lot of large and irregular autophagosomes appeared in Fis1KO soleus after EEE through immune electron microscope.

**Conclusions** 1) Loss of Fis1 causes a certain degree of mitochondrial hyperfusion, increases mitophagy and significantly decreases mitochondrial function in slow muscle. However, losing Fis1 does not cause obvious alteration on quick muscle and synthetic muscle. Therefore, the absence of Fis1 has a significant effect on mitochondria-rich muscle. 2) Mitochondrial-ER interactions may be involved in the connection of endoplasmic reticulum swelling after endurance exhaustive exercise. 3) Endurance exercise with oxidative phosphorylation aggravate the increase and abnormality of mitophagy caused by the loss of Fis1 in slow muscle, suggesting that Fis1 governs normal mitophagy in slow muscle during the low-intensity and long-period exercise. This phenomenon may be related to the worse performance in treadmill endurance test of Fis1 KO mice.

**PO-112**

Inhibition of HIF-1α Alleviates Exaggerated Pressor Response Induced by Static Muscle Contraction in Rats with Peripheral Arterial Disease

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**Objective** Hypoxia-inducible factor 1α (HIF-1α) is a transcription factor mediating adaptive responses to hypoxia and ischemia. A prior work showed that HIF-1α is increased in sensory nerves of rats with femoral artery occlusion. The present study was to examine if the reflex response of blood pressure induced by muscle contraction was altered after injection of HIF-1α inhibitor BAY 87-2243 (BAY87) into the arterial blood supply of the ischemic hindlimb muscles.
Methods A rat model of femoral artery ligation was used to study peripheral artery disease. Western blot analysis was employed to examine the protein levels of HIF-1α in the dorsal root ganglion (DRG) tissues. The exercise pressor reflex was evoked by static muscle contraction.

Results HIF-1α was increased in the DRG of occluded limbs (optical density: 0.89±0.13 in control vs. 1.5±0.05 in occlusion; \( P < 0.05 \), \( n=6 \) in each group). Arterial injection of BAY87 (0.2 mg/kg) inhibited expression of HIF-1α in the DRG of occluded limbs three hours following its injection (optical density: 1.02±0.09 in occluded limbs with BAY87 vs. 1.06±0.1 in control limbs; \( P > 0.05 \), \( n=5 \) in each group). In addition, muscle contraction evoked a greater increase in blood pressure in occluded rats. BAY87 attenuated the enhanced pressor response in occluded rats to a greater degree than in control rats.

Conclusions Inhibition of HIF-1α alleviates exaggeration of the exercise pressor reflex in rats under ischemic circumstances of the hindlimbs induced by femoral artery occlusion.

PO-113
Research progresses of exercise intervention methods in non-alcoholic fatty liver disease

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Objective This review summarizes the effects of aerobic exercise (AE), resistance exercise (RE), and high-intensity interval training (HIIT) on nonalcoholic fatty liver disease (NAFLD). Discuss The main differences of intervention methods, intervention time, and intervention effects among the NAFLD people, To explore the targeting and dose-response relationship of different exercise models intervention in NAFLD.

Methods This paper uses the keywords such as Non-alcoholic fatty liver disease, non-alcoholic steatohepatitis, NAFLD, NASH, NAFLD and aerobic training, aerobic exercise, resistance training, resistance exercise, high-intensity interval training, high-intensity interval exercise, high-intensity aerobic exercise, HIAT, HIIT, HIT, etc to search in the web of science. Pubmed database, the deadline is March 1, 2018. Inclusion criteria: (1) study design: randomized controlled trials; (2) study questions: effects of exercise on hepatic steatosis in patients with NAFLD; (3) type of exercise: AE, RE, and HIIT; (4) subjects: biochemical examination liver biopsy or ultrasound examination includes a combination of abdominal imaging and magnetic resonance imaging (MRI) imaging of the NAFLD population. Exclusion criteria: (1) non-original studies (2) meeting abstracts (3) did not provide sufficient experimental data (4) animal experiments (5) non-English literature. The search results showed that a total of 16 studies rPOrted the effects of exercise on NAFLD populations.

Results (1) AE, RE and HIIT can reduce hepatic steatosis and improve liver histology in NAFLD people, but their intervention effects are different. AE stands out in reduce body weight, decreases insulin resistance (IR); RE stands out in reduce hepatic fat and increases muscle strength; HIIT has a significant effect in reducing hepatic fat and enhancing cardiovascular fitness. (2) the frequency, duration, and intervention period of AE and RE are similar; achieve the same or better intervention effect, HIIT only requires the 1/3 exercise time of the previous two.

Conclusions RE may be more effective than AE in patients with poor cardiovascular fitness, sarcopenia, and NAFLD who are unable to tolerate or participate in AE; HIIT has certain advantages in the time-effect and dose-effect due to less exercise time and smaller amount of exercise, This is easy for the NAFLD people to accept, and it will facilitate long-term adherence in the future.
**PO-114**

**Effects of 30%, 50%, 70%VO2 max treadmill exercises on gut microbiome of atherosclerotic mice**

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**Objective** To observe the dynamic changes of gut microbiome in mice before and after different intensities of treadmill exercises, and to explore the effects of different intensities of treadmill exercises on gut microbiome of atherosclerotic (AS) mice.

**Methods** The 50 male ApoE−/− mice aged 8 weeks were randomly divided into 2 groups, 10 mice in the general feeding group and the other 40 mice in the AS group, which were fed with normal and high-fat diet for 4 weeks respectively. Weight and blood test were taken before and after 4 weeks feeding. The serum Triglyceride (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein (HDL) levels were examined by blood test in ApoE−/− mice model, and atherosclerotic disease degeneration score of adult mice was used to determine the success of modeling after 4 weeks feeding. Then two mice selected from the normal and high-fat group respectively selected to test the maximum oxygen uptake (VO2 max) by the reformative Bedford method, and the running platform speed and slope corresponding to 30%, 50% and 70%VO2 max were determined. The 40 AS mice were randomly divided into the model blank group, the low-intensity exercise group, the medium-intensity exercise group and the high-intensity exercise group according to their weight for 4 weeks of exercises, respectively. The low-intensity exercise group was 30% VO2 max, with a slope of 10 degrees and a speed of 10 m/min. The medium intensity exercise group was 50% VO2 max with a slope of 10 degrees and a speed of 15 m/min. The high-intensity exercise group was 70% VO2 max with a slope of 10 degrees and a speed of 20 m/min. The exercises were performed for 4 weeks, 5 days a week, 20 minutes a day. The fresh feces were collected from 5 groups of mice before and after 4 weeks treadmill exercises. The number of gut Lactobacillus, Bacteroides, Firmicutes, Bifidobacterium, Verrucomicrobiacea, Akkermansia, Escherichia coli, Collinsella and Clostridium in AS mice were analyzed by 16s sequencing.

**Results** Results: 1. The TG, TC and LDL-C were significantly increased in the blood serum of the mice after the modeling, and the HDL-C was decreased, and the atherosclerotic disease degeneration score was significantly increased in the adult mice, and the modeling was successful. 2. The different intensity treadmill exercises can increase the number of gut probiotics in mice and decrease the number of harmful bacteria. The beneficial bacteria in gut tract of AS mice with moderate intensity of 50% VO2max was observed in the experiment: Bacteroides, Bifidobacterium and Verrucomicrobiacea, Akkermansia were significantly increased, P<0.05. The harmful bacteria:Lactobacillus, Escherichia coli, Collinsella and Clostridium were significantly decreased, P<0.05. The ratio of Firmicutes / Bacteroidetes was increased.

**Conclusions** Conclusions: 1. High-fat diet can lead to AS in ApoE−/− mice. 2. The different intensity treadmill exercises can reduce the weight of AS mice. 3. The number and abundance of probiotics of gut microbiome of AS mice could be promoted by different intensity treadmill exercises, among which the medium intensity aerobic exercise can significantly increase the number of beneficial bacteria such Bacteroidetes, Bifidobacteria, Verrucomicrobiacea and Akkermansia, meanwhile, the structure of gut microbiome in AS mice was improved as well.
PO-115

Effect of endurance training on liver NK cells in mice

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Objective

NK cell (natural killer cell) is a large granular lymphocyte distinct from a group of T and B lymphocytes. At present, the research shows that NK cells can specifically identify target cells and release killing media and then play a killing effect. It is confirmed that the expression of IL-15 is closely related to the differentiation and maturation of NK cells. Furthermore, skeletal muscle is an endocrine tissue and plays a key role in regulating the whole-body metabolic health by synthesizing and releasing humoral factors called myokines, such as IL-15. Whether the IL-15 induced by exercise training can promote the maturation of NK cells remain unsolved. This study aimed to explore the effects of moderate endurance training on NK cells and relative mechanism.

Methods

Twenty male C57BL/6J mice were randomly divided into 2 groups: control group (YC) and exercise group (YE). YC animals were fed normally for 12 weeks, YE animals were trained for 12 weeks on moderate intensity treadmill (12 m/min). Then the samples were isolated and RT-PCR was used to detect IL-15 and Nkg2d genes in the liver, Western blotting was used to detect the killer factor IFN-γ released by NK cells. Flow cytometry was used to detect NK1.1 cell markers in primary liver cells.

Results

1) Compared with the YC group, the expression level of IL-15 and Nkg2d gene in the liver tissue of YE mice increased significantly (P < 0.05, P < 0.01); 2) Compared with the YC group, the expression of IFN-γ protein in the liver tissue of the YE mice increased significantly (P < 0.05); 3) Compared with two group. The proportion of NK cells in liver cells of group YE increased significantly (P < 0.05).

Conclusions

Moderate intensity endurance training can enhance the content and killing ability of NK cells through induced IL-15 in the liver.

PO-116

Biological Mechanism of Exercise in Improving Dyslipidemia

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Objective

The purpose was to further improve the understanding of exercise to improve dyslipidemia and to formulate exercise prescription more scientifically. It provides a reference for the further study of exercise mimics in the treatment of dyslipidemia and helps to reduce the high incidence of dyslipidemia.

Methods

Methods of documentation and comparative analysis are applied.

Results

It was found that the effects of exercise on dyslipidemia were beneficial or had no obvious effect on some indexes so far, and had no adverse effect. The biological mechanism of exercise regulating dyslipidemia and the effects of different exercise forms (acute exercise, long-term exercise training, different intensity exercise) on improving dyslipidemia were summarized. It is pointed out that exercise plays an important role in regulating the enzymes and proteins associated with dyslipidemia. Research from several aspects: exercise to block cholesterol biosynthesis, exercise inhibits cholesterol absorption, exercise affects cholesterol conversion, exercise promotes cholesterol conversion to bile acid, and exercise promotes cholesterol metabolism, exercise regulating triglycerides, etc.
Conclusions The regulation of dyslipidemia is a complex process, involving multiple pathways, multiple gene regulation, and different hypolipidemic pathways. A large number of experimental studies have demonstrated the effect of exercise on the improvement of dyslipidemia, but there are few studies on the biological mechanism of exercise, which need to be further studied. In addition, when chemically synthesized anti-hyperlipidemia drugs have many safety problems, we should increase the in-depth study of sports drugs, especially some natural products, that can simulate exercise effectiveness. In order to better control the high incidence of dyslipidemia, it is necessary to improve the development of exercise mimic drugs in improving dyslipidemia.

PO-117 Impact of short-term inhibition of PKA in Nucleus Accumbens on voluntary wheel running
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Objective Based upon a Booth lab goal of establishing molecular regulators of physical activity motivation, my current study focuses on the effects of short-term inhibition of protein kinase A (PKA) activity in the nucleus accumbens (NAc). The NAc is a brain region integral to motivated behaviors. Downstream immediate-early gene (IEG) expression from PKA has been shown to exhibit rapid responses to acute stimuli, such as voluntary wheel-running behavior. According to previous work in our lab, long-term NAc overexpression of the endogenous PKA inhibitor, Protein Kinase Inhibitor Alpha (PKIα), increased nightly running distance in rats selectively bred for low voluntary running (LVR) behavior (Mol Neurobiol 2018 Jun 21). However, paradoxically, the same PKIα overexpression failed to increase running distance in wild-type (WT) rats. It is known that chronic manipulation of the NAc PKA pathway produces different molecular (gene expression profiles) and behavioral outcomes from that of acute manipulations. Given the above, the goal of the current work is to determine how short-term inhibition of PKA in the NAc influences its downstream gene networks and the nightly voluntary running behavior in WT rats.

Methods An ex vivo preparation of the NAc was utilized to determine the effects of Rp-cAMPS, a selective protein kinase A inhibitor, upon its stimulation of dopamine D1-like receptor agonist SKF 38393 on downstream gene expression level in sedentary WT female rats. Further, real-time PCR was implemented to analyze the transcriptional expression of IEGs (Homer-1, Arc, Zif268) following Rp-cAMPS administration.

Results Data showed that there were no significant difference of mRNA level for Homer-1, Arc or Zif268 among the vehicle, 50uM, 100uM and 200uM Rp-cAMPS treatment groups upon the stimulation of 10uM SKF 38393.

Conclusions In addition to the PKA, other protein kinases such as Ca++ activated and growth factor activated kinases have both been shown to phosphorylate CREB at Ser\textsuperscript{133}, and thus, lead to activation of gene transcription. Given the above results of the ex vivo experiment, in which NAc slices were treated with multiple dosages of Rp-cAMPS concurrent with the stimulation of SKF 38393, it is possible that other protein kinase pathways could be compensating the effects of short-term inhibition of PKA and, in turn, lead to no difference of IEG expression. Further experiments will need to be performed in order to testify this hypothesis.
PO-118
Effects of different concentrations of hydrogen on oxidative stress in rats with high intensity exercise

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Objective Exercise-induced oxidative stress is due to the massive increase in free radicals caused by strenuous exercise, which exceeds the ability of self-clearing. It is one of the main causes of sports injury and sports fatigue. Eliminating excessive production of free radicals is the key to alleviating exercise-induced oxidative damage. Therefore, the purpose of this study is to study the effect of hydrogen on exercise-induced oxidative damage, to explore its possible mechanism and to explore the best dose of hydrogen with different concentrations.

Methods 40 male SD rats (200±20g) were randomly divided into five groups (n=8): sedentary, exercise control, low concentration hydrogen with exercise (H1), medium concentration hydrogen with exercise (H2), high concentration hydrogen with exercise (H3). The rats performed high-intensity exercise for 4 weeks, except the sedentary. Rats that with low, medium and high concentration hydrogen were placed in a hydrogen atmosphere with a concentration of 0.5%, 1% and 1.5% for 1 h immediately after each exercise (keeping the concentration of oxygen and nitrogen in the environment the same as those in the air). The rats were weighed weekly during the experiment. The next day after 4 weeks of training, the samples were collected, and the contents of total superoxide dismutase (T-SOD), catalase (CAT), total antioxidant capacity (T-AOC) and malondialdehyde (MDA) were determined respectively.

Results The weight of exercise control was significantly lower than sedentary in the third and fourth weeks of exercise (P<0.05). Compared to sedentary rats, there was no significant difference in the weight of rats between H1, H2 and H3 group. The contents of T-AOC, CAT and T-SOD in exercise control were significantly higher than those in sedentary (P<0.05). The content of CAT in H2 group was significantly decreased compared with exercise control (P<0.01). Compared with exercise control, the T-AOC and T-SOD in the H2 group showed a downward trend but no statistical difference (P>0.05), there was no significant difference between the above indexes, compared with sedentary. In addition, there was no difference in T-SOD and CAT content between H1 group and exercise control; Compared with exercise control, there was no significant difference in T-SOD, T-AOC and CAT in H3 group. At the MDA level, each exercise group increased significantly compared with the sedentary (P<0.05), and the MDA levels in the H1, H2, and H3 groups were decreased compared with the exercise control, but there was no statistical difference.

Conclusions It can be seen from the above results that different concentrations of hydrogen intervention can improve the weight loss of rats after intensive exercise. More importantly, the dosage and effect of 1% concentration of hydrogen is easier to remove the excessive radicals produced by intense exercise in the body, avoid the aggravation of oxidative stress, and have very good therapeutic effect. It provides a theoretical basis for the further study of the application of hydrogen in exercise oxidative damage.
PO-119

Establishment of skeletal muscle-specific PGC-1α overexpression model via in vivo local transfection

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Objective To establish a skeletal muscle-specific PGC-1α overexpression mouse model via in vivo local transfection.

Methods For the PGC-1α in vivo transfection study, the Male FVB/N mice were randomly divided into 2 groups: subject to green fluorescent protein (GFP) transfection (Con-GFP), and subject to PGC-1α in vivo transfection (Con-PGC-1α). Plasmid DNA solution (2.5 mg/ml GFP or 2.7 mg/ml Flag-PGC-1α) were injected into the proximal (6 ml) and distal (6 ml) ends of the muscle belly. Following the injections, electric pulses were applied through 2 stainless steel pin electrodes laid on top of the proximal and distal myotendinous junctions. Then skeletal muscle and myocardium were isolated, and PGC-1α, mtTFA, NF-κB, MnSOD, FNDC5 protein expression were measured with Western blot.

Results In skeletal muscle, compared with con-GFP group, the expression of PGC-1α (+125%, p<0.01), mtTFA (+210%, p<0.01), and FNDC5 (+47%, p<0.05) were significantly increased in con-PGC-1α group. However, NF-κB and MnSOD protein level had no change in con-PGC-1α group. In myocardium, compared with con-GFP group, the expression of mtTFA (+130%, p<0.01) and FNDC5 (+55%, p<0.05) were significantly increased in con-PGC-1α group.

Conclusions Skeletal muscle-specific PGC-1α overexpression model via in vivo local transfection was established, which was supported by elevated expression of PGC-1α and its downstream FNDC5 and mtTFA. Furthermore, skeletal muscle-specific PGC-1α overexpression induced increase in myocardial mitochondrial biogenesis, while relative mechanism remains to be determined.

PO-120

Application of Wireless Heart rate system in Men's Freestyle

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Objective Using heart rate wireless system to continuously track the morning pulse of male freestyle wrestlers after different training loads. The basic value of individual morning pulse and the interval of variation of individual morning pulse after class were established for the elite players.

Methods The paper is based on 6 elite male freestyle wrestlers, we continuously test morning pulse after different training load and recovery period, then fill in fatigue questionnaire. We use Spss statistical software to carry out statistical treatment of the experimental data, and analysis the descriptive, difference, correlation and reliability of data.

Results Men freestyle athletes base morning pulse at 43-47 / min. After high intensity, the morning pulse increased by about 6%-11%, and the range of change was basically consistent
with the change of subjective feeling and heart rate in training class. The average (X) and standard deviation (SD) of the morning pulse in high intensity training class were different from each other. Combined with the results of training diary and fatigue questionnaire, the players appeared body and psychological fatigue and complained that they felt very tired. The X-SD~X SD interval can be used as the early morning pulse range for evaluating athletes' fatigue after high intensity class. The morning pulse and SpO\textsubscript{2} was associated with exhaustion of emotional energy, negative evaluation of exercise, decreased sense of achievement, and no significant correlation with heart rate fatigue. However, these three dimensions were significantly related to mental fatigue, r>0.934.

**Conclusions** After high intensity, the morning pulse increased significantly compared with the basic value of morning pulse. Combined with questionnaire survey and training diary feedback, the subjective feeling of body appeared fatigue after high intensity class, which was also consistent with the change of morning pulse. Can be based on individual morning pulse changes to learn about the high intensity class fatigue situation. The morning pulse after high intensity can reach the fatigue interval, which indicates that the training intensity can stimulate the body greatly, and the gradual recovery of the morning pulse can be regarded as the state of whether or not there is overfatigue. If maintain oneself high level all the time, need to adjust training intensity in time. If you can gradually recover close to the basic value, the large-intensity training class can be well adapted to the body.

**PO-121**

**Cycling Incremental test using Breath-by-breath Metabolic Cart to Predict VO\textsubscript{2} max**

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**Objective** Maximal oxygen uptake (VO\textsubscript{2} max) is a key indicator to assess health as well as sports performance. In heterogeneous, athletic populations, VO\textsubscript{2} max is one of the most frequently measured variables in exercise physiology laboratories. The purpose of this study was to investigate the relationship between Maximal oxygen uptake with other metabolism parameters during one high-intensity activity, and provide simple solution for VO\textsubscript{2} max prediction.

**Methods** A total of 27 young athletes were selected. The incremental test was performed on a cycle ergometer (Monark 874 E, Sweden). Participants warmed up for 5 min at 50 watts (W); thereafter, the power output was increased 125 W every 3 min until exhaustion, which was defined as the incapacity to maintain a pedal cadence above 60 revolution per minute (rpm). Oxygen uptake (VO\textsubscript{2}), carbon dioxide production (VCO\textsubscript{2}) and other metabolism indexes were obtained breath-by-breath throughout the test using a metabolic cart (Quark b\textsuperscript{2}, COSMED, Italy). Heart rate (HR) was measured throughout the test using a HR monitor (Polar Vantage NV, Finland). The main method in the VO\textsubscript{2} prediction is the use of a mixed effects regression model. The potential explanatory variables include VO\textsubscript{2}kg (functional data with information on oxygen consumption per kg weight during the test), HR (functional data with heart rate information during the test), MHR (maximum heart rate of the athlete), VO\textsubscript{2}kgmean (average oxygen consumption during the test), VO\textsubscript{2}kgmax (maximum oxygen consumption value during the test), VCO\textsubscript{2} (carbon dioxide emissions per minute during the test), HRmean (heart rate average), HRmax (maximum heart rate value during the test), age, height, weight. The model statistical analyses were implemented in R platform (version 3.3.3).

**Results** (1) Regression model results revealed MHR did not have stronger effects on VO\textsubscript{2} max prediction. (2) Parameters of VO\textsubscript{2}kg, HR, HRmean, height, weight showed relative higher \( r^2 \) values and lower RMSE values indicating the possible indexes for VO\textsubscript{2} max prediction. (3) the interaction effects occurred between indicators which increase the complexity of the model.
Conclusions In this study, a simple methodology for the prediction of maximum oxygen consumption has been presented. It combines a relatively simple level of base metabolism parameters. Despite the easy test and low level of exercise required the test provides an rational prediction of VO\textsubscript{2} max, which could provide necessary information when it applied as a simple way.

PO-122
Epigenetic regulation of exercise-improved LTCC and BKCa channels function in hypertension mesenteric arteries

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Objective To investigate the epigenetic mechanism of the voltage-gated L-type Ca\textsuperscript{2+} channel (LTCC) and the large-conductance Ca\textsuperscript{2+}-activated K\textsuperscript{+} channel (BK\textsubscript{Ca}) function in mesenteric arterial myocytes improved by regular aerobic exercise in hypertension.

Methods 12-week-old male SHR and WKY rats were randomly assigned to sedentary and exercise training groups, respectively. Exercise groups were performed a moderate-intensity treadmill running. After 8 weeks, patch clamp study, Ca\textsuperscript{2+} image, Western blot, qPCR, bisulfite sequencing PCR were used to detect the LTCC and BK\textsubscript{Ca} channel currents, BK\textsubscript{Ca} single channel gating properties, Ca\textsuperscript{2+} spark, mRNA and protein expression of LTCC \textalpha\textsubscript{1c} together with BK\textsubscript{Ca} \textalpha and \textbeta1 subunits, DNA methylation level of \textalpha\textsubscript{1c} and \textbeta1 gene promoter region, miR-328 expression. In vitro experiment, miR-328 mimic and miR-328 inhibitor were transfected into cultured arterial myocytes to make miR-328 overexpressing or silencing, the mRNA and protein expression of \textalpha\textsubscript{1c} subunits were determined after 48 h transfection.

Results 1) After 8 weeks of exercise, SBP in both exercise groups of WKY and SHR were significantly lower than that of their sedentary counterparts. 2) Exercise normalized the increased LTCC and BK\textsubscript{Ca} current density of mesenteric arterial myocytes in SHR. 3) Exercise attenuated the increased single BK\textsubscript{Ca} channel open Probability (Po) and the amplitude of Ca\textsuperscript{2+} spark in hypertension. 4) Exercise inhibited the upregulated mRNA and protein expression of BK\textsubscript{Ca} \textbeta1 subunit in mesenteric arteries from SHR; \textbeta1 gene promoter was demethylation in hypertension, exercise increased the methylation level at \textbeta1 gene promoter of SHR. 5) The protein expression of LTCC \textalpha\textsubscript{1c} subunit was significantly increased in SHR, while decreased by exercise; the expression of miR-328 in mesenteric arteries was highly negative correlation with \textalpha\textsubscript{1c} subunit. 6) The miR-328 overexpression by transfecting miR-328 mimic decreased \textalpha\textsubscript{1c} subunit protein level significantly, while miR-328 inhibitor made \textalpha\textsubscript{1c} subunit a slight increase.

Conclusions Regular aerobic exercise efficiently reduces blood pressure of SHR, enhances \textbeta1 gene promoter methylation, mediates miR-328 inhibiting the \textalpha\textsubscript{1c} expression at post-transcriptional level, which might be the epigenetic mechanism underlying exercise-improved LTCC and BK\textsubscript{Ca} channels function in mesenteric arteries of hypertension.

PO-123
Effects of Exercise During Pregnancy on CaV1.2 Channel in Mesenteric Artery from SHR Offspring

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Objective To investigate the effect of exercise during pregnancy on L-type Ca\textsuperscript{2+} (CaV1.2) channel in mesenteric artery from spontaneously hypertensive rats (SHR) offspring.
Methods Female (11 weeks old) and male (12 weeks old) SHR, female (11 weeks old) and male (12 weeks old) WKY rats were selected to use for breeding. The day when the vaginal bolt was found was considered day 1 of gestation. The pregnant rats were randomly divided into four groups: WKY sedentary group (WKY-SED), WKY exercise group (WKY-EX), SHR sedentary group (SHR-SED) and SHR exercise group (SHR-EX). The exercise groups were subjected to swimming at the first day of pregnancy, 1h/d, 6 days/week for 3 weeks. The 6-month-old male offspring were operated with femoral arterial and venous cannulation, and the blood pressure after intravenous (i.v.) injection of Ca\(_{\text{v1.2}}\) channel opener BayK8644 and blocker nifedipine were monitored in vivo. In vitro study, the mesenteric arteries were removed and used for isometric contraction studies. The non-selective NOS inhibitor N\(^\text{N\text{-}}\)nitro-L-arginine methyl ester (L-NNAME, 100 \(\mu\text{M}\)) was added after 60mM KCl measurement. To investigate the contribution of Ca\(_{\text{v1.2}}\) channels in vascular tone regulation, the vascular responses to nifedipine (10\(^{-9}\)–10\(^{-8}\)M) were examined. Western blot was applied to examine the protein expression levels of Ca\(_{\text{v1.2}}\) channel.

Results (1) The mean arterial pressure(MAP) were higher in the 6M offspring of SHR-SED group than that of WKY-SED group \((P<0.01)\), but there was no significant difference between the 6M offspring of SED and Ex groups. (2) The pressor responses induced by i.v. injection of BayK8644 (0.1mg/Kg) were increased in the 6M offspring of SHR-SED group \((P<0.05)\) compared with the WKY-SED group. Exercise during pregnancy markedly decreased the pressor responses in 6M offspring of SHR-EX group \((P<0.05)\). (3) Compared with the 6M offspring of WKY-SED group, the depressor responses induced by i.v. injection of nifedipine (1mg/Kg) were increased in the 6M offspring of SHR-SED group \((P<0.01)\). Exercise during pregnancy markedly attenuated the depressor responses in 6M offspring of SHR-EX group \((P<0.05)\). (4) The isometric contraction study revealed that nifedipine induced concentration-dependent vasorelaxation in mesenteric artery precontracted with noradrenaline. The sensitivity of tissues to nifedipine in 6M offspring of SHR-SED group was significantly higher than that of WKY-SED group \((P<0.01)\). Exercise during pregnancy normalized the increased sensitivity of tissues to nifedipine in 6M offspring of SHR \((P<0.05)\). (5) Compared with the 6M offspring of WKY-SED group, the protein expression of Ca\(_{\text{v1.2}\alpha1\text{C}}\) was significantly increased in SHR-SED group \((P<0.01)\). Exercise during pregnancy markedly inhibited the expression of Ca\(_{\text{v1.2}\alpha1\text{C}}\) in 6M offspring of SHR-EX group \((P<0.05)\).

Conclusions Pregnancy exercise has no significant effect on basic blood pressure in 6M offspring of SHR; but the increased function and protein expression of Ca\(_{\text{v1.2}}\) channel in 6M offspring of SHR may be normalized by exercise during pregnancy.

PO-124

Physiological and Molecular Adaptations to Concurrent Training in Combination with High Protein Availability

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Objective Attenuated muscle strength, hypertrophy and power adaptations with combined resistance and endurance (‘concurrent’) training may result from blunted cell signalling. Protein intake potentiates anabolic signalling pathways to facilitate adaptation. We hypothesized that 12 wk concurrent training with a high protein diet would elicit similar adaptations to a) strength, hypertrophy and power compared to resistance training alone, and b) aerobic capacity compared to endurance training.

Methods Thirty-two recreationally active males (age 25±5y; BMI 24±3kg•m\(^{-2}\); mean±SD) performed 12 wk of either resistance (RES; \(n=10\)) or endurance (END; \(n=10\)) training (3x•w\(^{-1}\)), or
concurrent training (CET; n=12; 6x•w⁻¹) with a high-protein (2g•kg⁻¹•d⁻¹) diet. Strength (1RM), aerobic capacity (VO₂peak) and anaerobic power (Wingate) were assessed PRE and POST. Vastus lateralis biopsies (immunoblotting) and thickness (ultrasound) were assessed PRE, after week 4 (WK4) and 8 (WK8), and POST. Changes were analyzed by two-way ANOVA with repeated measures.

**Results** Muscle thickness increased PRE to POST by 18% in CET, 14% in RES and 10% in END (P<0.001) and was greater in CET and RES compared to END (P<0.05). Leg press 1RM increased PRE to POST by 24% in CET and 33% in RES (P<0.01) but was not different between CET and RES. VO₂peak (L•min⁻¹) increased PRE to POST by 7% in CET and 12% in END (P<0.05) but was not different between CET and END. Wingate peak power (N•kg⁻¹) increased PRE to POST by 10% in RES (P<0.01) and was greater compared to CET and END (P<0.05). Total mTORC1 increased PRE to POST in CET (P<0.001) and was greater in CET compared to RES and END (P<0.01) and RES compared to END (P<0.05).

**Conclusions** Despite a high protein intake, concurrent training selectively attenuates developments to anaerobic power compared to resistance training. High protein availability may be effective for curtailing interferences to strength and hypertrophy with concurrent training.

**PO-125**

**The cardiovascular protection of irisin and its research progress in sport field**

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**Objective** The irisin, recently identified novel molecule, exercise induced myokine, has been shown to be secreted from fibronectin type III domain containing 5 (FNDC5) of skeletal muscle by an unknown protease. It can drive brown-fat-like development of white fat, increase thermogenesis and lose weight. Apart from this, its expression and role in various other conditions such as inflammation, hippocampal neurogenesis, aging and other metabolic conditions have been reported. Moreover, it has been reported that irisin play an important role in the regulation of various cardiovascular disease, such as endothelial disfunction, hypertension and atherosclerosis. The present review discussed the research progress of irisin in the field of sports, and the protective effects for cardiovascular disease. However, due to conflicting results, several issues have been raised regarding its expression, cleavage, circulating levels, detection, the form of exercise, etc. And it also discussed the current challenges and future perspectives.

**Methods** Complete literature survey was performed using PubMed and WOS database search to gather available information regarding FNDC5/irisin.

**Results** The present review discussed on the discovery of irisin, its possible role in the cardiovascular protection and its research progress in sport field. It provide a research direction and new perspective of the possible target for the prevention and treatment of related disease.

**Conclusions** Irisin has a promising effect in predicting and diagnosing cardiovascular diseases, and the exercise level could be a influence factor. More research will be needed in the future.
PO-126  
Effects of hypoxia preconditioning on acute hypoxic exercise-induced phosphorylation of AMPKα in mice skeletal muscle

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Objective  AMP-activated protein kinase (AMPK) is a metabolic energy sensor and its activation plays an important role in the regulation of energy homeostasis. Increasing evidence indicates that AMPK activation depend on the phosphorylation sites in AMPKα. Thr^{172} is involved in AMPK activation, whereas Ser^{485/491} are not. Under suitable stress stimulations, the phosphorylation of AMPKα at the Thr^{172} site can increase AMPK activation. However, serious hypoxic exercise or taking antioxidants before exercise can reduce the activation of AMPK by phosphorylating AMPKα1Ser^{485}/α2Ser^{491} sites. The aim of this study was to investigate the effects of hypoxia preconditioning on exhaustive exercise under hypoxic condition induced AMPKα Thr^{172} and Ser^{485/491} phosphorylation in mice skeletal muscle.

Methods  The 40 eight-week-old male C57BL/6J wild type mice were randomly divided into four groups (10 mice/group): non-hypoxia preconditioning control group (NC), hypoxia preconditioning control group (HC), non-hypoxia preconditioning acute hypoxic exercise group (NE), and hypoxia preconditioning acute hypoxic exercise group (HE). Hypoxia preconditioning groups were exposure in hypoxia for 48h, with the oxygen concentration was 11.2%. Meanwhile, non-hypoxia preconditioning was in the normoxic condition for 48h. After hypoxia preconditioning, acute hypoxic exercise groups finished an exhaustive exercise. Tibialis anterior muscles of mice were collected immediately after the exhaustive exercise. The protein expression of the total AMPKα, Thr^{172}-AMPKα phosphorylation, and Ser^{485}-AMPKα1/Ser^{491}-AMPKα2 phosphorylation were measured by Western Blot. Thr^{172}-AMPKα phosphorylation to total AMPKα ratio and Ser^{485}-AMPKα1/Ser^{491}-AMPKα2 phosphorylation to total AMPKα ratio was calculated.

Results  Compared with NE group, The Thr^{172}-AMPKα phosphorylation to total AMPKα ratio was increased significantly, whereas the relative expression of Ser^{485}-AMPKα1/Ser^{491}-AMPKα2 phosphorylation to total AMPKα ratio seemed to decreased in skeletal muscle of HE group.

Conclusions  The 48h hypoxia preconditioning could improve the AMPK activation by Thr^{172} AMPKα phosphorylation in mice skeletal muscle following an exhaustive exercise under the hypoxic condition.

PO-127  
Effects of treadmill exercise on the expression of corticostriatal mGluRs in hemiparkinsonian rats

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Objective  Exercise therapy has been widely used for the clinical treatment of Parkinson’s Disease (PD). However, the rehabilitation mechanisms involved remain unclear. mGluRs play an important role in the progression of PD. In this study, immunohistochemistry and western blot analyses were used to detect the expression of presynaptic corticostriatal mGluR2/3 and postsynaptic mGluR5, and we attempted to investigate the molecular basis of the reconstruction of functional connectivity in the corticostriatal pathways from a mGluR perspective.
Methods Male SD rats (230–250 g) were used as subjects in this experiment. After 1 week of habituation, the rats were randomly assigned to three groups: control group (Control, n = 24), PD group (PD, n = 24) and PD with exercise group (PD + Ex, n = 24). The experimental models were prepared by unilateral injection of 6-hydroxydopamine (6-OHDA) (2 μg/L, 8 μg) into the medial forebrain bundle, and the control group was administered an equivalent dose of saline solution. The models were evaluated with the apomorphine (APO)-induced rotation test. Two weeks postoperatively, exercise intervention was applied to the PD + Ex group for 4 weeks. Immunohistochemistry and western blot analysis were used to evaluate the expression of presynaptic corticostriatal mGluR2/3 and postsynaptic mGluR1/5.

Results Results showed that the PD + Ex group had a significantly higher level of mGluR2/3 expression ($P < 0.01$) and significantly lower level of mGluR1/5 expression ($P < 0.05$) compared with the PD group.

Conclusions Exercise intervention significantly increased the expression of mGluR2/3 and simultaneously reduced the expression of mGluR5, indicating that mGluRs can improve the behavioral function of PD rat models through exercise, and that the reconstruction of the functional connectivity of corticostriatal pathways plays an important role in nervous system regulation.

PO-128

Effects of HIF-1α on Nrf2-ARE antioxidant signal in mice skeletal muscle after acute exhaustive exercise

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Objective Hypoxia or exercise could lead to oxidative stress. Hypoxia inducible factor-1 (HIF-1) is an oxygen sensor and the expression of its α subunit can be regulated by hypoxia. NF-E2-related factor 2 (Nrf2) is an important modifier of cellular responses to oxidative stress. A major mechanism in defense oxidative stress is the activation of the Nrf2-ARE antioxidant pathway. But whether the increase of HIF-1α could affect the Nrf2-ARE antioxidant signal, and further influence the oxidative stress status in vivo remains unknown. In this study, we wished to examine the effect of HIF-1α on Nrf2-ARE antioxidant pathway in mice skeletal muscle after acute exhaustion exercise.

Methods HIF-1α high expression (H) and C57BL/6J mice(W) were used at 20 respectively and each kind of mice were randomly divided into two groups: control (C) and exercise (E). The treadmill exercise was preformed at the acute exhaustion exercise. On the day of acute exercise, mice allocated to perform treadmill running were subject to 5% incline and 5min at 10m/min, and then increased 3m/min every 3 minutes. Mice were sacrificed at the indicated time points following treadmill running. Nrf2, phosphor-Nrf2 (Ser40), nuclear Nrf2 protein were measured by Western Blot and Nrf2-ARE binding activity, the mRNA and protein levels of Nrf2 target genes, key antioxidant enzymes (SOD1, SOD2, CAT, NQO-1) and ROS level, were also measured in skeletal muscles after the interventions.

Results (1) The results showed that compared with WC, RNA and protein expression level of Nrf2 were increased in HC skeletal muscles. Nrf2-ARE binding activity, Nrf2 target gene SOD1, SOD2, NQO-1 mRNA expression and NQO-1 protein expression were also increased in HC skeletal muscles. Meanwhile, ROS level in HC skeletal muscles decreased significantly.

(2) After the acute exhaustion exercise, high HIF-1α expression mice (HE) had higher expression of p-Nrf2(Ser 40) and nuclear Nrf2 protein than the wide type mice (WE). The mRNA expression of SOD1 and mRNA /protein of NQO-1 in HE increased as well. In contrast, ROS level decreased significantly in HE muscles.
**Conclusions** The result indicated the proper high expression of HIF-1α could promote the antioxidant capacity of skeletal muscle in mice through Nrf2-ARE pathway.

**PO-129**  
**Effects of aerobic exercise training on GTT and ITT in apelin Knockout mice**

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**Objective** Aerobic exercise training is important to prevent and cure chronic diseases such as diabetes, cardiovascular diseases and so on. Apelin has been identified as a novel myokine in recent years, and the exogenous supplementation of apelin can promote the glucose absorption, the biosynthesis of mitochondria and the oxidation of fatty acids in skeletal muscle. Intraperitoneal glucose (GTT) and insulin tolerance tests (ITT) are useful in vivo assays that provide approximations of glucose metabolism and homeostasis. The bigger area under the curve (AUC) confirmed the decreased glucose clearance, which is evaluated by GTT. However, the mechanism of apelin mediating glucose metabolism during aerobic exercise training is not clear. Our study was to investigate the differences of GTT and ITT after four weeks training between wild-type (WT) mice (C57BL/6J) and apelin Knockout (KO) mice.

**Methods** Two-month-old WT and KO were divided into trained and control groups (n=8-10/group) respectively. There are four groups: WT control (WC), apelin KO control (KC), WT trained (WT), and apelin KO trained (KT). The trained groups were trained on treadmills for four weeks (six days per week and one hour per day). In order to maintain the exercise intensity, the speed is at 70%-75% VO$_2$max with an incline of 5 degrees. The control groups were kept at a sedentary condition. after four weeks of interventions, glucose was measured at 0, 15, 30, 45, 60, 90, 120min following GTT. Glucose was also measured at 0, 30, 60, 90, 120min following ITT.

**Results** (1) blood glucose levels and AUC of the KC were significantly bigger than those of WC. ITT showed that KC also had slower insulin-stimulated glucose clearance compared with the WC. (2) Following 4-week training, KT had lower blood glucose levels and AUC of the KT was significantly smaller than those of KC. KT had faster insulin-stimulated glucose clearance compared with KC.

**Conclusions** Without apelin, glucose tolerance and insulin tolerance in mice will decrease. And aerobic exercise training improves them in apelin deficiency mice.

**PO-130**  
**Effect of Exercise-induced Fatigue on the Electrical Activity of the External Globus Pallidus Neurons in rats**

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**Objective** The motor cortex (MC) stimulation-induced unitary responses of globus pallidus external segment (GPe) neurons in control and exercise induced-fatigue rats were recorded in vivo to examine the role of cortical-striatum-external globus pallidal pathway in the mechanism of central fatigue.

**Methods** 32 Clean healthy male Wistar rats (260~300g), were randomly divided into 4 groups: control group (Control), 1-day fatigue group (1FG), 3-day fatigue group (3FG) and 7-day fatigue group (7FG). Rats were subjected to a 5-day adaptive treadmill training. Modified Bedford
treadmill exercise with progressively increasing load was used to create the exercise fatigue model. (3 levels: 8.2 m/min, 15 min; 15 m/min, 15 min; 20 m/min, lasting till exhaustion) The spontaneous unit activity and responses to MC stimulation of GPe neurons were recorded by the electrophysiological technique of extracellular recording of glass microelectrodes.

**Results** The results showed that the firing frequency of high-frequency firing with pause (HFP) and low frequency firing with burst (LFB) in the GPe of 1FG was comparable with that of control group (P>0.05). However in 3FG and 7FG, the percentage of HFP neuron was significantly decreased (P<0.05), while the proportion of LFB was significantly increased (P<0.05), and the average firing rate of LFB was higher and inter spike intervals (ISI) was significantly lower than that of the control group.

With 200μA electrical stimulation, the explosive discharge of GPe neurons was attenuated after fatigue in rats. The response of GPe neurons to variable frequency stimulation in exhausted model groups was stronger than that of the control group. MC-stimulation typically induced a triphasic response composed of early excitation, inhibition, and late excitation in GPe neurons. The population of neurons showing a short inhibition slightly increased in 3FG and 7FG.

**Conclusions** 1. The results confirmed that GPe is an important nucleus of basal ganglia involved in the regulation of exercise-induced fatigue by the change of spontaneous activity. 2. Electrical stimulation on the cortex can alter response patterns of GPe neurons in exercise-induced fatigue rats, the results confirmed that the Ctx-Str-GPe neural pathway is involved in the regulation of exercise fatigue, and the indirect pathway is over-activated.

**PO-131**

**Effect of Aerobic Exercise on the Expression of CaMKIIδ/MEF2 in Hypertensive and Physiological Cardiac Hypertrophy**

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**Objective** The type II calcium/calmodulin-dependent protein kinase IIδ (CaMKIIδ) signal plays a key role in the development of cardiac hypertrophy. This study used CaMKIIδ as an entry point to investigate the mechanism of moderate-intensity aerobic exercise affecting myocardial function.

**Methods** Male spontaneously hypertensive rats (SHRs) and Wistar-Kyoto rats (WKYs), 12 weeks age, were randomly divided into aerobic exercise group (SHR-EX/WKY-EX) and sedentary control group (SHR-SED/WKY-SED), with 12 rats in each group. The aerobic exercise group conducted an 8-week treadmill exercise training with a slope of 0°, 20 m/min (about 55-65% of maximal aerobic velocity), 60 min/day, and 5 d/wk. The control group did not exercise. The body weight of each group of rats was measured weekly and the blood pressure of the rats was measured non-invasively. After 8 weeks, the hearts of SHR-EX group, WKY-EX group, SHR-SED group and WKY-SED group were weighed, and then myocardial tissue sections were taken for HE staining to observe the thickness of the ventricular wall and the morphology of myocardial cells. The expression of CaMKIIδ and MEF2 in each group was determined by Western blotting.

**Results**

1. The body weight of SHR-SED group was significantly higher than that of SHR-EX group (p<0.01), and the heart weight of rats in exercise group changed significantly. The WKY-EX group had greater heart weight than the WKY-SED group, and the SHR-SED group was heavier than the SHR-EX group (p<0.05). The heart weight/body weight ratio of the WKY-EX group was significantly higher than that of the WKY-SED group (p<0.01). The heart weight/body weight ratio of SHR-EX group and SHR-SED group was higher than that of WKY-EX group and WKY-SED group (p<0.01). 2. Compared with the WKY-SED group, the SHR-SED group had loose interstitial cells and increased single cell area. The SHR-EX group is more compact than the
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SHR-SED group, and the cell cross-sectional area is reduced. (3) The expression of CaMKIIδ protein in SHR-EX group was significantly lower than that in SHR-SED group (p<0.01), but the expression level of CaMKIIδ in WKY-EX group was significantly higher than that in WKY-SED group (p<0.01). The expression level of CaMKIIδ was significantly higher in the SHR-SED group than in the WKY-SED group. In addition, the expression of MEF2 protein in SHR-EX group and WKY-SED group was significantly lower than that in SHR-SED group (p<0.01), while the MEF2 expression level in WKY-EX group was higher than WKY-SED group and SHR-EX group (p<0.05).

Conclusions There is an interaction between aerobic exercise and hypertension. Aerobic exercise can effectively delay the development of hypertensive cardiac hypertrophy by regulating the expression of CaMKIIδ and MEF2 protein in the myocardium, but it can also cause cardiac hypertrophy in normal heart. It is one of the important mechanisms affecting the myocardial morphology and function.

PO-132
Taekwondo Exercise Improving Cardiopulmonary Function of Female College Students after 16 Weeks Intervention

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Objective Taekwondo is one of the popular exercise styles to promote aerobic endurance for college students because of its combination of hands and feet and simple technology and interesting. This study observed the effect of Taekwondo on the cardiopulmonary function of female college students, trying to find the best heart rate in the teaching class of Taekwondo and evaluate the effect of maximal oxygen uptake and improve the basic theory of Taekwondo exercise to enhance students' aerobic endurance and provide theoretical reference for scientific methods to improve classroom practice intensity.

Methods 1) This study used heart rate telemetry to perform a time domain analysis of heart rate variability in 10 university students in the Taekwondo class. The indicators used in the time domain analysis are: average RR interval value, standard deviation of RR interval (SDNN), standard deviation of the average of every 5 minutes R-R interval (SDANN), and standard deviation of R-R interval every 5 minutes. The mean value (SDNNindex), the difference between adjacent NNs> the percentage of the number of total sinus beats per 50 ms (PNN50). By analyzing the information of these indicators, the sympathetic and vagal nerves are balanced. 2) The maximum oxygen uptake and respiratory exchange rate of 10 female college students were measured by the treadmill exercise load per breath method. The cardiopulmonary function of female college students was assessed by cardiopulmonary function indicators and heart rate variability indicators.

Results 1) The R-R interval value, the mean value of the R-R interval standard deviation (SDNNindex), and the standard deviation (SDANN) of the R-R interval mean value per 5 min were increased after exercise intervention. The three indicators increased by 438.22ms, 0.87ms, and 64.67 ms, respectively; The standard deviation of the R-R interval (SDNN), the difference between adjacent NNs> the percentage of total sinus beats (PNN50) decreased. They dropped by 44.23ms and 0.06% respectively. With the increase of the sports load of Taekwondo students, the heart rate variability gradually decreases, showing a decline in the vagus nerve tension of female college students. 2) The average relative oxygen uptake of female college students before the start of the course was 30.7ml (kg*min), 35 ml (kg*min) after the intervention, and the maximum oxygen uptake increased by 14.01%. The average respiratory exchange rate of female college students before the start of the course was 1.26, 1.28 after the course intervention, and the respiratory exchange rate increased by 1.59%.
Conclusions 1) Taekwondo exercise reduces the heart rate variability of female college students, and long-term exercise can enhance the ability of the vagus nerve to control the heart. 2) Increased maximal oxygen uptake and respiratory exchange rate of female college students through Taekwondo course intervention. After a long period of Taekwondo exercise, it can effectively improve the aerobic endurance of college students and improve their cardiopulmonary function. （NSFC: 31401018 SKXJX2014014）

PO-133
Different gradient altitude training on the impact of RET、PO and RBC

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Objective This study is based on the regional characteristics of Guizhou Province, athletes living in the subplateau and training in the plateau-plain and the high plateau-plain. The effects of altitude training on hematological indexes of PO、RBC and RET. To evaluate the two training modes is more beneficial to endurance runners and explore which one is better. To provide scientific reference for sports training practice.

Methods Twenty male endurance runners and divided into two groups (all living on subplateau): plateau-plain group and high plateau-plain. One group reached to the 1900 m plateau and the other one reached to the 2900 m plateau, training 3 weeks; The two groups then reached to the plain for 3 weeks of training. Finally arrived at the sub-plateau for performance testing. Using multivariate analysis of variance to test significant differences between groups. The data are represented by the standard deviation of the average （）. P<0.05 is a significant difference, P<0.01 is a very significant difference.

Results 1 PO
There is no significant difference in PO between 1900m plateau and 2900m plateau athletes. at the end of plain the amplitude of elevation and basic value of high altitude group is more than that of high altitude group.

2 RBC
Comparison of RBC between plateau group and high altitude group during the period of plateau, there is significant difference at the end of plateau (P=0.049 < 0.05), and there is a significant difference between the two groups at the end of plateau training (P=0.043 < 0.05). The change trend of the two groups is the same, but the increasing is more than the high altitude group, and the decreasing is relatively less during the plain period, and it showed an upward trend at the end of the plain period.

3 Ret
There is significant difference in RET between the two groups (P=0.018 < 0.05) when the endurance runners arrived at the plateau at the first week. RET at 2900m altitude is significantly higher than that at 1900m altitude, and at the end of the plateau, the increase of RET in the high altitude group is still higher than that in the plateau group. There is no significant difference between the two groups during the plain period.

Conclusions The influence of altitude training on the PO of the SUBPlateau athletes is more profound than that of the plateau group. During the first week of plateau, PO decreased significantly, but it fluctuated up and down later, and the two groups are on upward trend during the period of plain. However, the percentage of elevation in the plateau is higher in the high altitude group than in the high altitude group. After plateau training, chose 2900m plateau for training, and the hematopoietic function of bone marrow is improve greatly, nutrition supplement should be paid attention to after plateau training.

To prevent the effect of RBC reduction;
The change characteristics of precompetition biochemical indexes of excellent male gymnasts

Objective  In order to ensure that Chinese gymnasts in Hubei province can adapt to the pattern of large intensity and large training volume before the national games in good condition, the training monitoring and regulation of athletes' physical function and fatigue recovery are carried out by monitoring blood, urine and other biochemical indicators. On this basis, the characteristics of the physical and biochemical functions of the gymnasts in Hubei province are summarized, hoping to provide the accumulated data of the physical function evaluation of the gymnasts in the future, and to strengthen the scientific degree of the gymnastics training in Hubei province.

Methods  To prepare for the national games in 2017, 12 men gymnastics athletes of Hubei province as the research object, and in the precompetition training period, every Monday morning test hemoglobin(Hb), white blood cells(WBC), blood urea(BUN), creatine kinase(CK), every two weeks on Monday morning test testosterone, cortisol, and body composition, test every two weeks training on the second day of urine 10 items such as indexes. Blood samples and urine samples were sent to the laboratory of the laboratory of Tongji Hospital in Wuhan city and Hubei institute of sports science, respectively.

Results  1. The WBC of male gymnasts in Hubei province was between 3.6~11.7×10^9/L, with an average value of 5.7 ±1.4 ×10^9/L, and the WBC level was within the normal range with a small range of variation, with no significant difference in each test. In the experiment, we found that there were large individual differences in the low WBC. Individual athletes' WBC was high for a long time, indicating weak resistance and easy to have inflammatory infection. In addition, the WBC of some athletes is low for a long time, and it is difficult to recover. Although the targeted treatment is improved, it is easy to relapse. Therefore, in sports practice, attention should be paid to WBC detection and long-term monitoring of susceptible athletes.

2. The Hb level of male gymnasts in Hubei province is between 131~175 g/L, with an average of 156.3±8.1 g/L, and that of Chinese excellent male gymnasts is 156.9 ± 8.83 g/L, indicating that the Hb level of male gymnasts in Hubei province is relatively high compared with the project itself. In the early stage of large amount of exercise, Hb concentration will decrease. With the adaptation to the training amount, Hb concentration gradually rises, which is reflected in the improvement of functional state and the improvement of sports ability.

3. The change range of serum CK was between 118~594 U/L, with an average of 282.4 ±105.2 U/L, which was relatively high. CK changes obviously with the training intensity, and the period of high-intensity training is significantly higher than the adjustment period, and there is a trend of accumulation with the extension of training time.

4. The change range of BUN was between 3.19~7.23 mmol/L, with an average value of 5.15± 1.04 mmol/L, and the average value of each stage of precompetition training was between 4.5-5.5 mmol/L, with no significant change and no statistical difference.

5. The change range of serum testosterone was between 3.03~9.69ng/mL, with an average of 5.45 ±1.29ng/mL, and the overall level of testosterone was low. Serum cortisol changes ranged from 7.5 to 24.9 ug/dL, with an average of 14.5 ±3.3ug/dL, and the overall level was stable. After a long period of intensive training, testosterone levels declined and cortisol did not change significantly.

6. In the test of ten urine items, there were 10 cases of urinogen positive, 2 cases of bilirubin, and 1 case of urinary protein.

Conclusions  1. The WBC level of gymnasts in Hubei province is within the normal range and the variation range is small. Studies have shown that adaptive exercise can improve disease resistance, but in fact the athletes are less resistant at late periods of heavy duty training, before
or during competition, and the risk of various diseases increases. In sports practice, WBC testing should be emphasized, and athletes with low immunity should be monitored for a long time. 

2. Athlete's Hb level is at a higher level relative to the project itself and combined with training. Starting from the end of winter training in February, athlete's Hb level is significantly decreased, reflecting the decrease of Hb when the intensity is on the upper level. At the same time, the individual difference of athletes' Hb level is large. Hb level will produce a great impact on the aerobic capacity of athletes, although aerobic capacity is not gymnastics technology projects focus on the development of special technical ability, but high aerobic capacity of athletes than aerobic athletes are more able to withstand the great physiological load of exercise, poor ability of aerobic capacity of athletes in training is usually poor second half for a longer time, prone to pay enough concentration, movement quality decreased obviously, can't do difficult moves.

3. The CK level of gymnasts in Hubei province is at a relatively high level, which is related to the characteristics of gymnastics. The precompetition training of gymnastics mainly highlights the intensity load, the intensity of strength training is relatively high, and the muscle cell membrane is damaged more. The differences of serum CK in the period of high-intensity training and adjustment are significant, which can reflect the intensity of precompetition training, as well as the fatigue and recovery of athletes. The changes of blood urea were not obvious at each training stage before the competition, and there was no significant reaction of blood urea accumulation. There was no significant difference between the intensity training stage and the adjustment period, indicating that blood urea was not a sensitive fatigue index in the strength training. In addition, when athletes lose weight before the competition, it is easy to see increased blood urea.

4. The overall level of serum testosterone of gymnasts in Hubei province is relatively low, indicating that the muscle strength and explosive power of gymnasts in Hubei province are relative weak. Cortisol is relatively stable, suggesting that the body's resilience is modest.

5. After the intensive training, the positive rate of urobiogen is much higher than that of urinary protein and bilirubin, indicating that urobiogen is more sensitive to the evaluation of the intensity of training in gymnastics.

PO-135

The effects of 4 weeks training mediates apelin on the p-AMPK(Thr172)/AMPK ratio in skeletal muscle of mice

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Objective To investigate the effects of 4 weeks aerobic exercise mediates apelin on the p-AMPK(Thr172)/AMPK ratio in skeletal muscle of mice.

Methods The C57BL/6J wild type mice(n=40) were randomly divided into four groups: control group (WC), exercise group (WE), apelin injection control group (AC) and apelin injection exercise group (AE), with 10 mice in each group. Apelin injection group mice were intraperitoneally injected with apelin (0.1 μmol/kg/day) for 4 weeks. At the same time, the exercise groups mice underwent 60min/day treadmill running with a slope of 5°at the speed of 15m/min for 2 weeks, and the speed was adjusted to 20m/min in the later 2 weeks. 48 h after the final exercise session quadriceps muscles were harvest. The protein expression of apelin, APJ, AMPKα and p-AMPKα (Thr172) in skeletal muscle was determined by Western Blot.

Results (1) Compared with WC group, the protein expression of apelin, APJ and p-AMPKα (Thr172)/AMPKα ratio in AC group skeletal muscle of mice were increased; (2) Compared with WE group, the p-AMPKα (Thr172) / AMPKα ratio in AE group skeletal muscle of mice were increased.

Conclusions Apelin supplementation for 4 weeks can up-regulate AMPK protein activity in skeletal muscle both in sedentary group and exercise group.
PO-136
Exercise induced redistribution of oxygen in internal organs
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Objective Exercise induces tissue blood flow redistribution, which decreases splanchnic circulation and leads to physiologic hypoxia in the gastrointestinal (GI) system and liver. We hypothesized that the oxygen redistribution in the internal organs is affected by exercise.

Methods Twenty-four female 8-10wk ROSA26 ODD-Luc/+ mice (n= 6 per group) were used in this study. Three exercise models were conducted: (1) Moderate Exercise (ME): mice voluntarily swam for 30 min. (2) Heavy-intensity Exercise (HE): mice swam for 1.5 hours with 5% body weight loads attached to their tails. (3) Long-time Exercise (LE): mice voluntarily swam for 3 hours or till fatigue. Sedentary mice (SED) were used as controls. A hypoxic marker pimonidazole HCl was applied to detect tissue hypoxia. Pimonidazole HCl forms protein adducts when PO2 is under 10 mmHg. An hour after intraperitoneal injection of pimonidazole HCl (60 mg/kg body weight), the mice were anesthetized with isoflurane then sacrificed. The small intestine, colon, skeletal muscle, heart, liver, spleen and kidney specimens were fixed in 4% paraformaldehyde and stained with a specific monoclonal antibody against the pimonidazole HCl protein adducts to observe the hypoxic level of internal organs.

Results (1) The distributions of immunostaining intensity of pimonidazole HCl were different among the internal organs. In the kidney, the renal tubules demonstrated staining for hypoxia. In the liver, the positive staining was radiating outwards from central veins. In the small intestine and colon, there was the retention of pimonidazole HCl from the crypt to villus. (2) In the ME group, the extent of hypoxia in the kidney, liver and colon was increased compared with the SED. We found the small intestine is susceptible to exercise-induced tissue hypoxia distribution. Exercise resulted in a markedly increased staining in the crypts, whereas decreased staining in the villus. Intensified positive stains were observed in the nuclei of hypoxic cells, mostly in ME and HE groups. (3) The heart, skeletal muscle and spleen were not shown positive staining pre- and post-exercise.

Conclusions This study presented evidences that exercise induces the oxygen redistribution in the small intestine, colon, liver and kidney. The small intestine is susceptible to exercise induced physiological hypoxia.

PO-137
Comparison of effects of different exercise modes on rat gastrocnemius muscle
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Objective To explore the effects of different exercise patterns on gastrocnemius weight.

Methods Forty-eight SD rats were randomly divided into 4 groups, which were quiet control group (Con), continuous exercise group (CE), high-intensity intermittent exercise group (HIIT) and ladder exercise group (LE). After 8 weeks of exercise training, each group was anesthetized and samples were collected for testing. The body weight and gastrocnemius weight of each group were recorded. The cross-sectional area (CSA) of gastrocnemius muscle was observed by
HE staining. The levels of MSTN and insulin in serum were detected by ELISA. The expressions of MSTN, IGF1 and p70S6K in rat gastrocnemius muscle were detected by Western blot.

**Results** Compared with group Con, the body weights of the three exercise groups were significantly lower, and the weight of the gastrocnemius muscles in group CE was significantly lower. Morphological observation of gastrocnemius showed that the cross-sectional area of the gastrocnemius muscle in group CE was significantly decreased, compared with group Con, and the cross-sectional area of the gastrocnemius muscle in group LE was significantly increased. There was no significant change in the cross-sectional area of the gastrocnemius muscle in group HIIT. The ELISA results showed that serum GDF8 levels were significantly decreased in the three exercise groups compared with group Con, while the insulin levels were not significantly changed. Compared with group Con, the expression of GDF8 protein in the gastrocnemius muscle of the group LE was significantly decreased, while the protein expression of IGF1 and P70S6K was significantly increased. The protein expression of the gastrocnemius P70S6K in group CE was also significantly increased.

**Conclusions** Although the three exercise modes can significantly reduce the body weight of rats, only HIIT and LE improve the gastrocnemius muscle mass index. CE significantly reduced the body weight and cross-sectional area of the gastrocnemius muscle. Although the protein expression of P70S6K was increased, there was no significant effect on the protein expression of GDF8 and IGF1. Ladder movement may increase the gastrocnemius cross-sectional area by reducing MSTN and increasing protein expression of IGF1 and P70S6K.

**PO-138**

Effects of acute hypoxic exercise on TRPV4 channels in prefrontal cortex of rats

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**Objective** At the early stage of high altitude training, the decrease of motor ability caused by hypoxia makes it impossible for the training to be carried out normally. Since 90s, researchers have focused more on the decrease of the cardiopulmonary function and muscle oxygen utilization capacity, but there are few studies on cerebral hemodynamic factors, and no related mechanism studies. This study will take this as a starting point, to study the acute hypoxic exercise and its biological mechanism for brain hemodynamic effects of prefrontal cortex, providing a new target in order to improve the athletes at the beginning of the plateau duration and decreased exercise capacity problems.

**Methods** In order to explore the changes of the TRPV4 channels protein in rat prefrontal cortex induced by exercise under hypoxic exposure, this study used HE staining and immunohistochemical method to analyze the pathological changes and TRPV4 channel protein expression of prefrontal cortex in rats during incremental exercise in different oxygen concentration environment.

**Results** The results showed that cortex lesions characterized by venous congestion and neuronophagia, when exercise to level 5 under the condition of the simulated 4500 meters altitude, which was similar to normoxia exercise to level 8. With the increasing of exercise load, the expressions of TRPV4 in rat prefrontal cortex were significantly increased. And the TRPV4 expressions of every groups in the simulated 4500 meters altitude were significantly higher than those in normoxia groups.

**Conclusions** The results indicate that increased load exercise in acute hypoxia can lead to pathological changes of brain tissue much earlier that in normoxia condition, and increase the expression of TRPV4 channel protein in brain tissue. This study will provide valuable data for the
The study of the role of Ca\(^{2+}\) channels in the membrane of central nervous system in the phenomenon of the centers fatigue appearing earlier in hypoxic exercise.

**PO-139**

**Effect of exercise training on mitochondrial content after ischemia in the cerebral cortex of rat**

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**Objective** To investigate the effect exercise training on mitochondrial content after ischemia in the cerebral cortex, and the balance between mitochondrial biogenesis and mitophagy in this process.

**Methods** Male Sprague-Dawley rats were randomly divided into 4 groups (n = 8): Sham operation group (SH), Sham operation and training group (ST), ischemia control group (IC), ischemia and training group (IT). The ischemia model rats were subjected to right middle cerebral artery occlusion which was produced by the intraluminal suture technique. The rats in the sham group underwent the same procedure except for the occlusion of the middle cerebral artery. Fourteen days after operation, the exercise training animals were exercised on a motor-driven rodent treadmill at a speed of 10 m/min, 5% grade for 30 min/day, 5 days/week for 4 weeks. Mitochondrial membrane potential was determined using JC-1. ATP synthesis capacity was determined using a bioluminescence technique. The protein expression of VDAC-1, COXIV, PGC-1α, Tfam, PINK1 and Parkin in cerebral cortex were detected by Western-blotting.

**Results** Compared with SH group, ischemia attenuated mitochondrial membrane potential, ATP synthesis capacity, and the expression of VDAC-1, COXIV, PGC-1α, Tfam in cerebral cortex (P<0.05~0.01). Furthermore, ischemia increased the expression of PINK1 and Parkin (P<0.05~0.01). Compared with IC group, exercise training elevated mitochondrial membrane potential, ATP synthesis capacity, and the expression of VDAC-1, COXIV, PGC-1α, Tfam, PINK1, Parkin in IT group (P<0.05~0.01).

**Conclusions** A combination of reduced mitochondrial biogenesis and increased mitophagy seems to be responsible for the decrease in mitochondrial content after ischemia. Exercise training after ischemia elevated mitochondrial content and function in cerebral cortex, which may be mediated by appropriately increase and co-regulation of mitochondrial biogenesis and mitophagy.

**PO-140**

**Association Of Glucose Metabolism and Physical Activity By Chronotype in Elderly Japanese Adults**

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**Objective** Chronotype is a trait determining individual circadian preference in behavioral and biological rhythm relative to external light-dark cycle. Although evening chronotype has been reported to be associated with bad glucose control and low physical activity in middle-aged adults, it is not known whether it is true in elderly people. Therefore, the aim of this study was to investigate the relationship between glucose metabolism and physical activity by chronotype (circadian rhythm) in elderly Japanese adults.
Methods A cross-sectional study was conducted in 178 adults (72 men and 106 women), aged 60-79 years, who were classified into three chronotype groups, "definitely morning type (DMT)", "moderately morning type (MMT)" and "neither type (NET)", based on the Morningness/Eveningness Questionnaire scores (MEQ-Score). All participants were required to report their daily rhythms of behavior, such as meal time and sleep-wake cycle. Additionally, their physical activity were measured by an uniaxial accelerometer (Kenz Lifecorder EX, SUZUKEN, Nagoya, Japan). Energy intake was assessed by a brief self-administered diet-history questionnaire. Blood was drawn for biochemical analysis after an overnight fast.

Results BMI and serum insulin in the DMT group was significantly higher than MMT and NET groups in male. The DMT group had a significantly shorter time interval between dinner and sleep than the other two groups, both in male and female. After adjustment for covariates (age, smoking and alcohol status, energy intakes, moderate-vigorous physical activity (MVPA) and sleep duration), the BMI, serum insulin, fasting blood glucose (FBG) and HOMA-IR in the DMT group was significantly higher than other groups. However, after adjustment for the time interval between dinner and sleep, the significant difference had disappeared. There was significant difference in terms of low-intensity physical activity between male and female. And MVPA in the DMT group, the subjects with low MVPA (<23Mets·hour/week) had higher FBG, serum insulin and HOMA-IR than the subjects with high MVPA (>23Mets·hour/week) in men, but not in women.

Conclusions This study demonstrated that the DMT group with early sleep-wake lifestyle had higher BMI, FBG, serum insulin and HOMA-IR, specially in elderly Japanese men with low MVPA, but not in women.

PO-141
Swimming improves metabolic syndrome by regulation insulin sensitivity and monosaccharide transporter proteins activity via NF-κB signaling pathway

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Objective Diabetes is one kind of metabolic diseases characterized by hyperglycemia and metabolic syndrome due to insulin secretion defects or/and biological function damage. Evidences have suggested that sports plays essential role in the progression of diabetes and affects insulin resistance and monosaccharide transporter proteins activity. The purpose of this study was to investigate relationship between sports and diabetes by evaluation the insulin sensitivity and monosaccharide transporter proteins activity.

Methods A db/db mice model of type-II diabetes mellitus was used to analyze the efficacy of swimming in the processes of glucose and insulin. Body weight, glucose metabolism and insulin serum levels were studied in experimental mice. Expression levels of inflammatory factors of IL-1, IL-17, TGF-β and VEGF in the serum was analyzed in the experimental mice. Expression levels of sirtuin-1 and NF-κB signaling pathway was investigate in the lives. Histological analysis was studied the therapeutic effects of swimming on mice with type-II diabetes.

Results Our results indicated that swimming up-regulated metabolism of glucose and insulin. Sport of swimming enhanced the consumption of fat and fatty acid in the mice with diabetes. In addition, expression levels of inflammatory factors of IL-1, IL-17, TGF-β and VEGF in the serum were down-regulated by swimming in the mice with diabetes. Toll-like receptor 4 (TLR4) and sirtuin-1 expression levels were up-regulated in the liver in the experimental mice after receive swimming. Furthermore, we observed that swimming improved insulin sensitivity and monosaccharide transporter proteins (MTP) activity in liver in the experimental mice after receive swimming. Histological analysis showed that TTLR4 and sirtuin-1 accumulation were significantly
decreased in the live in mice treated by swimming. NF-κB activity and expression levels of p65, IKK-β and IκBα were up-regulated in the mice receiving swimming.

**Conclusions** In conclusion, these results indicate that swimming is beneficial for glucose and insulin metabolism for type-II diabetes mice, which further improves metabolic syndrome by regulation insulin sensitivity and monosaccharide transporter proteins activity via NF-κB signaling pathway.

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**PO-142**

**Effect of different type of exercise on mitochondrial homeostasis in rats with myocardial infarction**

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**Objective** To investigate the different effect of moderate-intensity continuous training (MCT) and high-intensity interval exercise training (HIT) on ventricular remodeling and mitochondrial homeostasis after acute myocardial infarction (AMI).

**Methods** The AMI rat model was achieved by ligating coronary artery. The AMI and sham operation rats were randomly divided into four groups: sham operation group (Sham), AMI control group (AMI), AMI MCT group (AMI+M), and AMI HIT group (AMI+H). Animals in the AMI+M and AMI+H groups underwent 4 weeks MCT and HIT respectively. Five weeks after AMI, hemodynamic changes, mitochondrial bioenergetics, and PINK1, Beclin1, Mfn2, Drp1, Tfam, COX IV, PGC-1α were detected.

**Results** Comparing with AMI group, in AMI+M and AMI+H groups, Beclin1 (146.33±18.47, 143.28±16.96 vs. 123.27±13.27, P<0.05), PINK1 (150.33±20.54, 152.28±18.34 vs. 125.27±17.67, P<0.05), Mfn2 (122.28±18.81, 117.19±17.04 vs. 46.27±6.72, P<0.01), and PGC-1α (82.15±16.58, 102.25±13.27 vs. 60.27±9.36, P<0.05~0.01) expression elevated significantly, whereas ROS generation (122.28±18.81, 117.19±17.04 vs. 46.27±6.72, P<0.01) and Drp1 expression (9.58±1.40, 10.18±1.37 vs. 15.85±1.61, P<0.05) showed dramatic decrease. In addition, in AMI+H group, +dp/dt max (6326±325 vs. 5368±271, P<0.05), -dp/dt max (-5312±246 vs. -4457±250, P<0.05), mitochondrial membrane potential (85.24±11.94 vs. 71.28±8.34, P<0.05), ATP synthesis activity (38.77±5.16 vs. 32.33±4.14, P<0.05), Tfam (95.25±12.05 vs. 78.27±12.22, P<0.05) and COX IV (89.25±14.06 vs. 67.27±13.71, P<0.05) expression improved significantly. Comparing with AMI+M group, in AMI+H group, +dp/dt max (6326±325 vs. 5775±310, P<0.05), -dp/dt max (-5312±246 vs. -4778±305, P<0.05), PGC-1α (102.25±13.27 vs. 82.15±16.58 1, P<0.05), Tfam (95.25±12.05 vs. 80.15±11.99, P<0.05) and COX IV (89.25±14.06 vs. 72.15±10.89, P<0.05) expression improved significantly.

**Conclusions** High-intensity interval exercise training is superior to moderate-intensity continuous training for ameliorating ventricular remodeling and mitochondrial homeostasis after acute myocardial infarction.
PO-143
ELABELA Facilitates Exercise-Induced Cardioprotection in Post-Infarction Cardiac Remodeling

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Objective Exercise has been reported to have positive function after myocardial infarction (MI), but the mechanisms of exercise-induced cardioprotection are poorly understood. ELABELA (ELA) is a hormone and plays a vital role in cardiovascular system. The aim of this research is to investigate the effect and the mechanisms of exercise and exogenous ELA administration on cardioprotection in MI rat.

Methods MI was established by left coronary artery ligation. MI rats underwent 4 weeks of sustained aerobic exercise and Fc-ELA-21 or Fc-ELA-32 injection. H9C2 cells were treated by ELA-14 peptide. Akt signal was inhibited by LY294002. Heart function was evaluated by hemodynamics; Myocardium fibrosis, cell proliferation, angiogenesis and apoptosis were visualized by Masson’s staining, immunohistochemistry and TUNEL, respectively; Protein expression was quantified by Western blotting.

Results Exercise induced angiogenesis and cardiomyocyte proliferation, reduced fibrosis and improved the function of MI heart. Fc-ELA-21 injection further facilitated the exercise-induced cardioprotection effects. APJ expression was up-regulated and Akt-mTOR-P70S6K signal was activated by both exercise and Fc-ELA-21. In H9C2 cells, ELA-14 activated Akt signal by dose dependent manner. Akt signal inhibition invalidated ELA-14 function. Fc-ELA-32 directly improved structural and functional recovery of post-MI hearts.

Conclusions ELA is a heart protector and facilitates exercise-induced cardioprotection through Akt-mTOR-P70S6K signal in post-infarction cardiac remodeling.

PO-144
Effect of exercise intervention on appetite regulating hormones in obese children

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Objective Obesity in children usually develops from early age and is due to chronic energy imbalance, and long-term exercise has been shown to have the capacity to alter the sensitivity of the appetite regulatory system. Therefore, the current study was designed to examine the circulating levels of appetite regulating hormones after exercise intervention in obese children.

Methods 24 obese children were subjected to exercise training program lasted for 6 weeks, and eating behavior of the children were evaluated using the Children Eating Behavior Questionnaire (CEBQ) before and after intervention. Plasma leptin and ghrelin were also determined using ELISA kits.

Results Circulating levels of cholesterol, triglycerides, and low-density lipoprotein cholesterol were also decreased with significant difference (P<0.05), while high-density lipoprotein cholesterol was significantly increased (P<0.05). Fasting plasma glucose was also decrease but with no significant difference. The level of leptin was decreased after 6 weeks intervention with no
statistical significance, while the circulating level of ghrelin was significantly enhanced (P<0.05). The scores of FR and EF were significantly decreased (P<0.05) after intervention. No significant change was found on SR and SE of CEBQ, even though they were observed increased compared with that of baseline. **Conclusions** The current study found that there were obvious effects of 6 weeks exercise intervention on appetite regulating hormones and subjective appetite changes in obese children.

**PO-145**

**Effects of Living-High Training-Low on HIF-1α Transcriptional Regulatory Factors MAPKs mRNA in Gastrocnemius of Rats**

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**Objective** To evaluate the effects of Living-High Training-Low on HIF-1α transcriptional regulatory factors MAPKs mRNA in gastrocnemius of Rats.

**Methods** After adaptive training, 40 8-weeks-old male SD rats were divided into living-low quiet control group (LC), living-low training-low group (LoLo), living-high quiet control group (HC), living-high training-low group (HiLo). All living-high groups stayed in the environment with 13.6% oxygen concentration, about altitude of 3500 m, for 12h/day. All training groups underwent treadmill training with 35m/min for 1 hour/day, 5 days/week. 4 weeks later, the gastrocnemius was sampled 24 hours after the last training. The ERK, p38MAPK, JNK and HIF-1α mRNA genes expressions in gastrocnemius were measured by real-time quantitative PCR.

**Results** The gastrocnemius ERK mRNA of HiLo group was significantly higher than LC (P<0.01), LoLo and HC groups (P<0.05). The p38MAPK mRNA of HiLo group was significantly higher than LC and LoLo groups (P<0.01 and P<0.05), and there was no significant difference between HiLo and HC group (P>0.05). The JNK and HIF-1α mRNA of HiLo group were significantly higher than other groups (P<0.01).

**Conclusions** Living-High Training-Low significantly raise ERK, p38MAPK, JNK and HIF-1α gene expression in gastrocnemius of Rats. ERK, p38MAPK and JNK may be one of the transcription factors regulating HIF-1α mRNA expression in Living-High Training-Low in gastrocnemius of Rats.

**PO-146**

**Neuromuscular Fatigue after maximal Concentric and Eccentric Contractions of Knee Extensor**

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**Objective** The aim of this study was to investigate after different maximal contractions concentric and eccentric would cause different neuromuscular fatigue of knee extensor.

**Methods** Ten healthy young men (ages 21-24) who were not adapted by electrical stimulation were the subjects. The subjects were asked to arrive at the laboratory in three weeks at the same time of every week to avoid the effects of biological rhythms. Each subject performed three group maximal contractions on the ISOMED2000 isokinetic muscle tester according to the
requirements. The subjects performed the same neuromuscular function test before and after exercise. The centripetal motion scheme: 3*30, M1 (knee flexion) - CON, M2 (knee extension) - CON. Angular velocity is 60 °, interval 30s in each group. Centrifugal motion scheme: 3*30, M1 (knee flexion) - ECC, M2 (knee extension) - ECC. Angular velocity is 60 °, interval 30s in each group.

**Results** The decrease rate of peak torque after concentric exercise was 55.93±13.20%, which was significantly higher than that after centrifugal exercise (20.06 ±11.06%, P < 0.01). The total work of the concentric movement was 8737.20±1543.43J, which was significantly smaller than that of the centrifugal exercise group (14312.20±2978.31J, P < 0.01). The decline rate of MVC in concentric exercise was 24.89 ±10.54 and that in centrifugal exercise was 19.32±9.90, there was no significant difference between the two groups. Double Twitch induced a very significant decrease in PT-SSR RFD-SSN RHD-SS (P<0.01). There was no significant difference in VA decline rate. PAP decreased from 142.82±14.55% to 125.23±11.36 after concentric exercise, and after eccentric exercise PAP decreased from 141.12±15.72% to 126.02 ±10.45.

**Conclusions** The neuromuscular fatigue caused by two kinds of exercise. Peripheral fatigue accounted for 39.19% after concentric exercise and 23.59% after centrifugal exercise, but there was little difference in the degree of central fatigue. All of them showed low frequency fatigue, and the low frequency fatigue after centrifugal exercise was more obvious.

**PO-147**

**Epidemiology of children's febrile seizures and prospects for health education**

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**Objective** In this paper, through the epidemiological characteristics of febrile seizures (FS) and the status quo of health education, the non-drug prevention system based on scientific physical activity intervention is gradually formed in the future, so as to establish "knowledge, prevention, medical, nursing, sports nutrition" The protection and maintenance of the five-in-one sports promotion health network lays the theoretical foundation.

**Methods** Through domestic and foreign literatures, CNKI, Pubmed, Web of science and other databases are reviewed.

**Results** (1) The exclusion criteria of FS are similar at home and abroad, only the definitions of onset age are different, the disease has age dependence. (2) The index of FS prognosis health assessment is single. There are few reports on the post-exercise ability and physical changes of FS children. And there is a lack of preventive health care related to exercise and brain health. (3) The descriptive study of FS in China lacks the incidence rate based on large-scale population samples, and the interventional research is limited to the clinic. The prevention and prognosis interventions for this disease lack relevant health education guidelines and intervention programs for kindergartens, schools and communities. (4) In the process of continuous seizures, hypoxia can cause transient or long-term organ damage in the body, affecting the development of the nervous system. The effects of FS on physical fitness are mainly concentrated on balance ability, systemic coordination ability and motor discrimination ability. Balance, sensitivity and coordination quality are related to nervous system, skeletal muscle and sensory organs.

**Conclusions** The research on the epidemiological characteristics of FS in China needs to be further improved. Prognosis and health assessment should be complementary to physical health and medical health. For children with history of febrile seizures, exercise as a simple, convenient, non-burden, drug-free effective way to promote central nervous system and brain health, has a positive effect on improving the immune level of children with FS and improving the prognosis of brain damage. Provide new ideas for prognosis and prevention, and promote health education and health communication of febrile seizures.
New insights into exercise intervention for chronic diseases: by promoting α-Klotho expression

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Objective A new view is proposed for the mechanism of exercise prevention and improvement of chronic disease, that exercise may play a role by promoting the expression of anti-aging protein α-Klotho.

Methods By means of literature review and prospective analysis, this paper summarizes the research status of the application of exercise in the prevention and improvement of chronic diseases and the effects of anti-aging protein α-Klotho on chronic cardiovascular disease, diabetes, chronic kidney disease and cancer and other chronic diseases and the effect of exercise on the expression of plasma α-Klotho and its possible mechanism. The research prospects of exercise to interfere with chronic diseases by promoting the expression of α-Klotho are envisioned.

Results (1) At present, the incidence and mortality of chronic diseases are high on a global scale. With the development of aging, chronic diseases will cause a serious economic burden and great waste of resources. Therefore, research on how to prevent and treat chronic diseases related to aging and lifestyle has become a top priority. Strong evidence suggests that exercise is an economical and efficient way to slow down the progress of some chronic diseases and to control symptoms such as diabetes, chronic kidney disease, heart failure, cardiovascular disease, and so on. However, we have not fully understood the cellular and molecular mechanisms underlying the effects of exercise. (2) α-Klotho is an anti-aging protein that regulates calcium and phosphorus metabolism, inhibits Wnt signaling, inhibits oxidative stress, and inhibits tumor and fibrosis. It has been proved to play an important role in the occurrence and development of chronic diseases such as chronic cardiovascular disease, diabetes, chronic kidney disease, tumor and other chronic diseases. (3) Exercise has been proved to be effective in promoting the expression of plasma α-Klotho protein, and the degree of response may be related to physical fitness and age. However, the mechanism of exercise to promote the expression of α-Klotho protein has not been reported. Combined with the existing research results, it is presumed that it may be related to DNA methylation, Peroxisome proliferator-activated receptor gamma (PPARγ) signal transduction and vitamin D receptor.

Conclusions Exercise has gradually become an important way to intervene in chronic diseases, but the lack of understanding of its mechanism hinders the development of exercise in the field of prevention and treatment of chronic diseases. It is found that exercise can promote the expression of plasma α-Klotho protein, and the expression of α-Klotho protein will be beneficial to the prevention and improvement of chronic diseases such as chronic cardiovascular disease, diabetes, chronic kidney disease and tumor. Therefore, it is speculated that promoting the expression of α-Klotho may be one of the mechanisms of exercise prevention and improvement of chronic diseases, but there is still a research gap on the mechanism of exercise promoting α-Klotho expression. In addition, the current research on the expression of plasma α-Klotho is aimed at healthy people, and the effect of exercise on the expression of α-Klotho in chronic diseases, such as chronic cardiovascular disease, diabetes, chronic kidney disease, is also needed to be studied more. The study of the mechanism of exercise prevention and improvement of chronic diseases provides a theoretical basis for the selection and formulation of related exercise programs, and may provide new ideas for the development of new drugs for chronic diseases. Therefore, studies on exercise to interfere with chronic diseases by promoting the expression of α-Klotho have good research prospects.
PO-149

The Effects of Interval Exercise on oxidative stress and Smyd1-related myocardial hypertrophy in Rats with Myocardial Infarction

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Objective This study was carried out to investigate interval exercise on Smyd1 expression and F-actin sarcomere assembly in non-infarcted myocardium of normal and myocardial infarction (MI) rats and its possible mechanism.

Methods Male SD rats were randomly divided into normal control group (C), normal interval exercise group (CE), sham-operated group (S), MI group (MI), MI with interval exercise group (ME) and MI with ROS Tempol group (MT), n=10. MI model was established by left anterior descending coronary artery ligation. Interval exercise was carried out on a small animal treadmill. MT group was given an oral solution of Tempol (2mmol/L). Hemodynamics was performed to evaluate cardiac function. HE and Masson staining were used to analyze the cross-sectional area (CSA) of cardiomyocytes and collagen volume fraction, respectively. T-SOD and MDA kits were used to detect oxidative stress. H9C2 cells were treated with H2O2. Immunofluorescence staining was used to determine Smyd1 expression and F-actin sarcomere assembly. RT-qPCR and Western blotting were used to detect the gene or protein expression of Smyd1, Trx1, Hsp90, MuRF1, cTnl, α-actinin and BNP.

Results Smyd1, Trx1, Hsp90, MuRF1 and BNP expression in the peri-infarcted area were up-regulated, but cTnl and α-actinin expression and F-actin assembly were decreased. The cardiac function was reduced. Both interval exercise and Tempol intervention significantly increase the CSA and expression of Smyd1, Trx1, cTnl and α-actinin, improve the antioxidation capacity and F-actin sarcomere assembly and cardiac function, reduce the expression of Hsp90, MuRF1, BNP and ROS level, and inhibit the fibrosis of myocardium. The oxidative stress level was closely related to the Smyd1 expression. Improvement of cardiac function were correlated with Smyd1 expression. H2O2 can induce oxidative stress injuries of H9C2, and its closely related to cardiomyocytes oxidative stress level and Smyd1 expression.

Conclusions Interval exercise could promote antioxidant capability and physiological cardiomyocyte hypertrophy, regulate the expression of Smyd1, Hsp90 and MuRF1 in infarcted heart; so as to improve the cardiac function. Smyd1 may participate in pathologic hypertrophy of cardiomyocytes caused by oxidative stress.

PO-150

Nutritional supplement characteristics of different sports

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Objective This review mainly summarize the nutritional supplement characteristics of speed, endurance and strength sports, which can provide theoretical reference for coaches and athletes.

Methods Literature

Results Carbohydrates, VB1 and VC should be added to the speed program diet. Endurance items can be added to meet energy needs. The power type project should be sufficient protein, and appropriate complement of sodium, potassium and other electrolytes.
Conclusions Due to different energy supply methods, sports items have their own characteristics of nutritional supplement. According to the difference of sports, it is beneficial to improve athletes' performance to supplement nutrition.

PO-151
The Effects of Different Intensity Treadmill Exercise to Kidney Functions

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Objective To provide more scientific and authoritative theoretical basis for body-building exercises after analyzing the changes of exercises of different intensities for the kidney functions.

Methods The objects of the research are eight male students from Guangzhou Sport College, being exerted the treadmill exercises according to their own maximum oxygen intake. The intensities of exercises are respectively 55% VO₂max, 75% VO₂max, 85% VO₂max, 95% VO₂max. The urine 40ml and venous blood 3ml will be collected and tested before sport and 15minutes after the exercises.

Results After four different intensities of exercise, the renin of each exercise group increased compared with the quiet value, and the greater the intensity, the more obvious the trend of change. Compared with the quiet value, the expression of angiotensin II increased in all groups after exercise, but there was no significant difference between the 55% VO₂max intensity group and the 75% VO₂max intensity group (P > 0.05), and there was significant difference between the 85% VO₂max intensity group and the 95% VO₂max intensity group (P < 0.05). Compared with the quiet value, the expression of aldosterone increased after each exercise. The mean value of 55% VO₂max intensity group, 75% VO₂max intensity group and 85% VO₂max intensity group increased, but the difference was not significant (P > 0.05), and the 95% VO₂max intensity group had a very significant difference (P < 0.01). The expression of urine beta 2 microglobulin was compared with the quiet value. There was significant difference in 85% VO₂max intensity group and 95% VO₂max intensity group (P<0.05).

Conclusions High-intensity exercise causes renal function and body function decline. It is more appropriate to select 75% intensity exercise for body-building.

PO-152
Heat Treatment and Exercise Prevents Skeletal Muscle Insulin Resistance in Wistar Rats Fed High-Fat Diet

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Objective Insulin resistance (IR) is associated with many related health complications. Previous studies demonstrate that heat and exercise independently reduce IR. The purpose of this study was to test the hypothesis that combined exercise and heating is even more favorable in reducing IR.

Methods Male Wistar rats were randomly divided into five groups: exercise (NE; n=10), heated (HC; n=10), exercise and heated (HE; n=10), sedentary (NC; n=10), and normal diet plus sedentary (CC; n=10). All but the latter group was fed a high-fat diet (60% calories from fat) for 10
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weeks while receiving heat and/or exercise exposure for latter 8 weeks. Following this regimen, protein expression from the soleus and extensor digitorum longus muscles, serum, and brown fat were analyzed using Western blotting.

Results Exercise combined with heating shifted the metabolic characteristics of rats on a high-fat diet toward that observed in the rats on a standard diet. Specifically, eight weeks of combined heat and endurance exercise increased PGC-1α, CaMKIV and p38 MAPK protein expression in the soleus (P < 0.05), insulin protein expression in the serum (P < 0.05), and UCP1 protein expression in the brown fat (P < 0.05), when compared to the high fat fed sedentary group. There were some significant differences in responses (i.e., body weight and Leptin & Adiponectin concentrations) between the combined exercise and heat group relative to the exercise alone group.

Conclusions Exercise combined with heat exposure mitigates the development of IR, presumably from the Irisin pathway. The study provides potential non-pharmaceutical methods for therapeutic treatment of IR.

PO-153
Prevention of sarcopenia and regulation of the ERK1/2 and p38MAPK phosphorylation by resistance training

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Objective Study of the effect of treadmill resistance training on the cross section and phosphorylation of ERK1/2 and p38MAPK of gastrocnemius of aging rats, and explore the role of resistance training in prevention and regulation of sarcopenia.

Methods 11-month-old male Sprague-Dawley (SD) rats (n = 40, SPF grade, initial body weight 776.9 ± 50) were raised in various cages in a room with a room temperature of 23 ± 2°C, a humidity of 40–60%, and a natural light/dark cycle. After eight months, the treated rats were then divided into one sedentary group (control, n = 8/group) and four groups for resistance training (GRT 1–GRT 4, GRT for Group for Resistance Training, n = 8/group) lasting for 8 weeks. For resistance training, GRT1 to GRT4 carried no loading, 30% maximum loading, 50% maximum loading and 70% maximum loading, respectively. The protocol for treadmill running was as follows: 15m/min (speed), 35°C (slope), 15s each time, an interval for 30s between two runnings, four runnings as one training, an interval for 3mins between two training, three training as one cycle, two cycles one training day, and one-day break between two training days. The morphology and cross section of gastrocnemius and the phosphorylation of the ERK1/2, p38MAPK proteins in the rats were examined after 8 weeks’ training.

Results Compared with the control, GRT1-GRT4 displayed relatively better aligned muscles fibers and noticeably larger cross-sectional area (P<0.05). The content of p-ERK1/2 (phosphorylated ERK1/2) displayed a descending trend as the loading increased compared with the control (GRT1 VS control, P>0.05; GRT2 VS control, P<0.05; GRT3 VS control, P>0.05; GRT4 VS control, P>0.05). However, the pairwise comparison revealed that only the difference between GRT1 and GRT2 was significant. Similarly, the content of p-p38MAPK (phosphorylated p38MAPK) displayed a descending trend as the loading increased compared with the control (GRT1 VS control, P>0.05; GRT2 VS control, P>0.05; GRT3 VS control, P<0.01; GRT4 VS control, P<0.01). Besides, the pairwise comparison revealed that the difference between GRT1 and GRT3 was significant (P<0.05) and that between GRT1 and GRT4 was even highly significant (P<0.01).
Conclusions Resistance training with middle-class intensity or above can prevent sarcopenia. ERK1/2 and p38MAPK were subject to high-level phosphorylation in aging skeletal muscles, which resulted from the stress-like status of the aging body. Treadmill training of with middle-class intensity or above can reduce ERK1/2 and p38MAPK phosphorylation in aging skeletal muscles of rats, which indicates that resistance training can effectively prevent sarcopenia by inhibiting ERK1/2 and p38MAPK phosphorylation.

PO-154
Effect of Accumulated Exercise and Continuous Exercise on Energy Metabolism

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Objective Sedentary behavior is the main feature of modern lifestyle, which relate to most chronic diseases. Therefore, it has great significance in both theory and practice of weight control and health promotion to find some exercise modes which can effectively break sedentary lifestyle and increase daily physical activity. The multiple short-time exercise scattered throughout the whole day was called Accumulated Exercise. Accumulated exercise can break the sedentary lifestyle, but our understanding about the energy metabolism and its influence on appetite is limited. This study measured the energy expenditure of two kind of exercise with equal workload (moderate intensity continuous exercise and accumulated exercise) as well as their impact on appetite, in order to enhance the effect and adherence of exercise intervention in weight control and health promotion.

Methods 16 healthy college students (8 male and 8 female) were recruited. Three experiments were randomly carried out with one week’s interval, which were recorded as rest control, accumulated exercise and continuous exercise. Accumulated exercise and continuous exercise were performed on treadmill with 65%VO2max intensity. Continuous exercise was lasted 1 hour without interval, while accumulated exercise was divided 4 times, 15min each, with 1 hour’s interval. The total exercise load (running distance) of the two exercise is equal. The volume of consumed O2 and generated CO2 in pre-exercise, during exercise, and post-exercise (0-4h) were dynamically monitored. The gastric electricity and appetite scale after exercise, as well as the basal metabolic rate of the next morning was also measured. Using the Peronnet and Massioctte equations to calculate the carbohydrate oxidation, fat oxidation, and the total energy expenditure during exercise and post-exercise (0-4h), then compare the differences between the two kind of exercise in energy expenditure, appetite, and gastric electrical activity.

Results Compared with continuous exercise with equal workload, accumulated exercise can increase fat oxidation (and %) during exercise and exercise interval, as well as the total energy expenditure in exercise interval, especially in male students. However, accumulated exercise has the potential to promote stomach emptying, and then increase the appetite (before bedtime). While the continuous exercise can significantly suppress the appetite of the next meal.

Conclusions Accumulated exercise and continuous exercise has different advantage in promoting energy (fat) expenditure and suppressing appetite respectively, so they should be jointly applied to enhanced effects of exercise intervention on weight control.
PO-155
The Comparative Study on the Maximum Oxygen Uptake Test of 10-Month Old Wistar Rats

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Objective The maximum oxygen uptake (VO₂max) is an ideal index to objectively evaluate the cardiopulmonary function, as well as the basic to define exercise intensity. In the field of sports science, laboratory animals are often used to explore the effect and mechanism of exercise intervention. Therefore, it is very important to design optimal VO₂max test protocol and to ensure the accuracy of VO₂max according to the characteristics of the experimental animal itself. In this study, Wistar rats were selected, and various VO₂max test protocols were designed and analyzed to screen out the optimal VO₂max test protocol for the 10-month old wistar rats.

Methods 20 SPF Wistar rats (male, 10 month old) were tested for maximal oxygen uptake by a four channel metabolic monitoring system and running treadmill. Five different test protocols were executed. Each rat completed five test protocols in random order with 3 days’ interval. The exercise performance (coordination degree, exhaustion state), oxygen uptake platform, finish time, VO₂max and RER value were recorded during the test of each program, and the performance and test data were compared.

Results 1) 12 rats completed all 5 test protocols of VO₂max. The induction ratio of VO₂max of P1 was only 58%, and P2 and P4 were 75%. While, the induction rate of P3 and P5 were both 83%. 2) For the Bedford improvement protocol (P1), due to the intense increased exercise load, the rats showed more intense stress, the less coordination degree, injured even death, and lower induction rate of VO₂max. 3) The VO₂max and RER values induced by the P5 are significantly higher than that of P1 (p<0.05). The finish time of P3 is significantly higher than that of P1 (p<0.01) and P5 (p<0.05).

Conclusions For the VO₂max test for middle aged rats, with the suitable speed of the running treadmill, the change of gradient should be as the main way of increasing load, or increasing the gradient of the slope firstly, which can obtained optimal VO₂max, meanwhile reduce the stress response and the risk of injury and serious damage.

PO-156
Effect of Treadmill Running on Brown Adipose Tissue of Heart Failure Rats Induced by Abdominal Aortic Constriction

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Objective To observe the effect of treadmill exercise on brown adipose tissue of heart failure rats induced by abdominal aortic constriction (AAC).

Methods 210g healthy male SD rats were randomly divided into control group and AAC group, after 4 weeks abdominal aortic constriction rats were selected and randomly divided into AAC group and treadmill running group. The exercise rats underwent treadmill running at 12m/s (40 min each, for 4 weeks). Real-time PCR and immunohistochemistry were used to detect the mRNA content and protein expression of cardiac ANP, BNP, and pgc1-a, ucp-1, leptin and adiponectin of the brown adipose tissue respectively.
**Results** The rats with abdominal aortic constriction developed significant heart failure with preserved LV ejection fraction, increased LVAW d and LVID s. Compared with the control group, the myocardium levels of ANP and BNP in AAC group were significantly up-regulated. In the operation group, the function of brown adipose was enhanced. The volume of brown adipose cells decreased, the number of lipid droplet increased. The mRNA levels of UPC-1 and PGC1-a were significantly up-regulated, and the mRNA levels of leptin and adiponectin were down-regulated. In the exercise group, the browning of brown adipose was reduced, and the mRNA levels of UPC-1 and PGC1-a were decreased.

**Conclusions** Exercise can affect the function of brown adipose tissue in heart failure rats induced by abdominal aortic constriction.

**PO-157**

**Effects of resistance training and aerobic training on Fibronectin of Skeletal Muscle Extracellular Matrix and Satellite Cell in Aging Mice**

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**Objective** To investigate the effects of resistance and aerobic training on the content of fibronectin in skeletal muscle extracellular matrix and satellite cell in 9-month-old BALB/c mice, and then explore the effect of fibronectin content change on satellite cell and its intrinsic mechanism, which will provide a new research perspective and theoretical evidence for delaying sarcopenia.

**Methods** 27 one-month-old BALB/c mice of SPF grade were purchased and fed for natural aging. At 9 months of age, the mice were divided into three groups randomly. Group R was resistance exercise training group (n=9), group A was aerobic exercise training group (n=9), and group C was control group (n=9). The load ladder model for resistance training in group R, the pyramid training program for 9 week training, 5 sets of load ladder training every time. 2 min for rest between sets, 1 min for rest between repetitions, 3 times a week. The treadmill training for aerobic training in group A for 9 weeks, the speed of 0.8km/h, 40min every time, 3 times a week. There is no training in group C. During the training, mouse grip strength was tested by the BIOSEB grip instrument once a week. After exercise intervention, the blood of mice was taken from the eyeball, and the gastrocnemius muscles were removed and placed in -80℃ temperature refrigerator to be freezed for tested. Immunofluorescence was used to detect FN and Pax7; The Real-time PCR was used to detect mRNA of FN, Sdc4, Fzd7, Wnt7a, c-Jun, Pax7; Western Blotting was used to detect the FN, sdc4, Fzd7, Wnt7a, c-Jun, p-c-Jun, Pax7 protein content.

**Results** (1) Body weight, grip strength and skeletal muscle mass of mice: The body weight of group C and group R were significantly decreased after 9 weeks to compared with group A (P<0.05; P<0.05). The grip strength of group R and A was significantly increased in the ninth week to compared with group C, (P<0.01; P<0.05); The grip strength of group R and A in the ninth week were significantly higher than that in the first week (P<0.01; P<0.01);

(2) FN in skeletal muscle extracellular matrix and it’s receptor Sdc4: The integrated optical density (IOD) of FN in group R was higher than that in group C and group A, but there was no significant difference among the three groups. The FN mRNA in group R was significantly increased to compared with group A (P<0.05). The FN protein content in group R was significantly increased to compared with group C and group A (P<0.01; P<0.01). There was no significant difference in the expression of Sdc4 mRNA in gastrocnemius muscle among the three groups. Compared with group C, the Sdc4 protein content was significantly down-regulated in both group R and group A (P<0.01; P<0.05).
The Wnt7a/PCP signaling pathway: The Wnt7a mRNA and Wnt7a protein content in the gastrocnemius muscle of group R were significantly increased compared with group C (P<0.05; P<0.01). Compared with group A, Wnt7a protein content in group R was also significantly increased (P<0.05). There was no significant difference in Fzd7 mRNA in gastrocnemius muscle among the three groups; but the Fzd7 protein content in group R was significantly increased compared with group A (P<0.05). The c-Jun mRNA in group R was significantly increased compared with group C and A (P<0.05; P<0.05). The c-Jun protein content in group R was significantly increased compared with group C and group A (P<0.01; P<0.01). The content of p-c-Jun protein in group R was significantly increased compared with group C (P<0.05).

Pax7: The number of Pax7 positive cells in group R was higher than that in group C and group A, but there was no significant difference among the three groups. Pax7 mRNA in group R and group A were significantly lower than that in group C (P<0.05; P<0.01), but Pax7 protein content in group R was significantly higher than group C and group A (P<0.05; P<0.05).

Conclusions (1) Exercise can improve muscle strength of aging mice. (2) Resistance training can promote FN in skeletal muscle extracellular matrix and improve skeletal muscle extracellular matrix components of aging mice. (3) Resistance exercise training can promote Pax7 expression through the increase of FN and up-regulation of Wnt7a/PCP signaling pathway, thus make it possible for satellite cell proliferation.

PO-158
Lifestyle intervention modify DNA methylation of adipose tissue in overweight and obese men with insomnia symptoms
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Objective To study whether diet and exercise intervention affect sleep and obesity-related genes’ DNA methylation in overweight and obese men with insomnia symptoms
Methods The study participants were a subgroup of a large intervention and consisted of 10 overweight or obesity men aged 34-65 years with insomnia symptoms. They participated in a 6-month progressive aerobic exercise training and individualized dietary counseling program and were randomly selected from diet (n=4), exercise (n=3) and control (n=3) groups. Body composition included fat mass and lean mass in the whole body and abdominal android region were assessed by dual-energy X-ray densitometry. The fitness level (VO2max) was determined by 2-km walk test using a standard protocol. Blood samples from venous were taken at fasted state in the morning. Total cholesterol, high density lipid cholesterol, low density lipid cholesterol, triglycerides, glucose, insulin, non-esterified fatty acid, alanine aminotransferase, aspartate aminotransferase and γ-glutamyltransferase were assessed by conventional methods. Subcutaneous adipose tissue was taken from abdominal region before and after the intervention. DNA was extracted from subcutaneous adipose tissue using a QIAamp DNeasy Tissue Kit. Whole genome-wide DNA methylation was obtained using MethylRAD-Seq. MethylRAD library
preparation started from DNA digestion by FspEI, then digested products were run on agarose gel to verify digestion and DNA ligase was added to the digestion solution. After ligation products amplification, PCR was conducted by MyCycler thermal cycler (Bio-Rad). The target fragment was excised from polyacrylamide gel and DNA was diffused from the gel in nuclease-free water. For relative quantification of MethylRAD data, DNA methylation levels were determined using the normalized read depth (reads per million, RPM) for each site. For each restriction site, its methylation level was estimated by dividing the log-transformed depth of each site by the log-transformed maximum depth (representing 100% methylation; i.e. M-index \( \frac{1}{4} \log(\text{depth site})/\log(\text{depth max}) \)), where depth max was summarized from the top 2% of sites (approx. 500 for the standard library) with the highest sequencing coverage. Heat map images are generated with Matlab 7.0 software and pathways are analysed by WEB-based Gene SeT AnaLysis Toolket. A statistical significance for methylated CpGs and pathways were set to \( p=0.001 \) and \( p=0.05 \), respectively.

**Results** No significant group differences by time were found in sleep-related variables, body composition, lifestyle factors nor with measured lipid and glucose biomarkers. However, whole genome-wide DNA methylation was decreased after dietary intervention, but was increased after exercise intervention, respectively. Correspondingly, 1253 and 708 differentially methylated loci were found in diet and exercise groups by contrast to the control group. Among them, the overlap genes between diet and exercise had multiple differentially methylated CpGs, including e.g. MYT1L (4 CpGs), CAMTA1 (3 CpGs), NRXN1 (3 CpGs), RPS6KA2 (3 CpGs), SEMA4D (3 CpGs). DNA methylation in PCDH8 was negatively correlated with wake after sleep onset after exercise intervention and MYRIP associated with sleep duration showed lower methylation after the dietary intervention. Further, 13 (DIO1, GCK, GYS1, LMNA, LY86, PNMT, PPARA, PPARD, SERPINE1, TH, TMEM18, TNFRSF1B and UBL5) and 2 (SDCCAG8 and TNF) obesity-related genes' DNA methylation profile changed in response to diet and exercise, respectively. Percentage changes of CpGs within KLHDC8A, ANKS1A, FGFRL1 and KDM3B were correlated with energy yield fat and carbohydrate, HOMA-IR and VO2max, respectively.

**Conclusions** We found that both exercise and dietary interventions have impacts on these genes related to sleep indicating by DNA methylation in PCDH8 and MYRIP, respectively. Further diet may be more effective than aerobic exercise intervention since greater number of modified obesity-related genes observed after dietary intervention. Our results indicate that reduce insomnia symptoms may need to more focus on control obesity.

**PO-159 Effects of Shaolin Ba Duan Jin on Hypertensive Patients**

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**Objective** To investigate the effects of Shaolin Ba Duan Jin on patients with hypertension. Methods In the hypertensive patients detected in the national physical fitness test of public officials in Guiyang City, 40 patients with hypertension were selected. The experiment was started after Shaolin Ba Duan Jin has been practiced for seven days and the subjects had learned it.

**Method** Frequency of subjects practicing Ba Duan Jin is 7 days a week, subjects practice once a day, practicing time is 6:00-7:30 am or 18:00 -19:30 pm, practicing lasts 1.5 hours each time (practicing has 3 groups, 14 minutes in each group: subjects rest 2 minutes between groups; preparing part is 8 minutes; ending part is 5 minutes), record the blood pressure of the subjects before and after each experiment, and fill in the quality of life scale (WHOQOL-BREF scale) regularly for a period of 12 weeks.

**Questionnaire method:**
Fill in the quality of life scale every three weeks and measure heart rate and blood pressure before and after each exercise.

Mathematical statistics:
The paired sample t test was used to analyze the changes in blood pressure before and after the 12-week experiment.

**Results**
1) The systolic and diastolic blood pressures of the subjects were significantly lower than before the experiment (P < 0.01).
2) The WHOQOL-BREF scale after 12 weeks has improved significantly in all areas than before the experiment.

**Conclusions**
1) Martial arts Ba Duan Jin has a good influence on the circulatory system of hypertensive patients. The performance is that the heart rate is slow and the systolic and diastolic blood pressures have a downward trend.
2) Martial arts Ba Duan Jin has significant improvement in the physiology, psychology, social relations, environment and other fields.

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**PO-160**

**Effects of Tai-Chi exercise on blood lipids, inflammatory factors and baPWV of middle-aged and elderly people**

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**Objective** To investigate the interventional effects of 12 months Tai-Chi exercise on blood lipids, inflammatory factors and the interventional mechanism of exercise in arteriosclerosis of middle-aged and elderly people

**Methods** 30 in middle-aged and elderly people with average age of 63.50±2.91 joined 12 months taijiqian exercise that conducted 60 minutes each time, six times per week. Left brachial-ankle pulse wave velocity (L-baPWV), right brachial-ankle pulse wave velocity(R-baPWV), left ankle brachial index (L-ABI), right ankle brachial index(R-ABI), serum triglyceride(TG), total cholesterol(TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), interleukin 6 (IL-6) and hypersensitive c-reactive protein (hs-CRP) were detected at 3 time points including before exercise programme, by the end of exercise for 6th and 12th month.

**Results**
① Compared with pre-exercise, the R-baPWV and R-ABI of the elderly people were decreased at the end of the 6th month, and the L-baPWV, R-baPWV, R-ABI and L-ABI were decreased significantly at the end of 12th month. ② Compared with pre-exercise, TC and LDL-c were declined markedly (P<0.01) at the end of the 6th and the 12th month, and there was no difference of the level of TG and LDL-c between pre-exercise and post-exercise. ③ Compared with before exercise, the subjects had significantly decreased IL-6 at the end of 6th months of exercise (P < 0.01), and the decrease of hs-CRP was not obvious. At the end of 12th months, IL-6 and hs-CRP decreased significantly (P < 0.01). ④ According to the correlation analysis, baPWV were positively correlated with TC, IL-6 and hs-CRP.

**Conclusions** 12 months of exercise intervention can effectively reduce the elderly baPWV and ABI level, improve the blood pressure, blood lipid and body inflammation levels, thus to prevent the happening of the atherosclerosis development plays an important role.
**PO-161**

**Cardiac autonomic recovery from an acute bout of cardio pulmonary exercise test**

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**Objective**

Objective: Heart rate variability (HRV) is a non-invasive clinical indicator of cardiovascular health, to date there has been little agreement on what HRV recovery following exercise. The present study aimed to evaluate the acute effects of cardio pulmonary exercise test (CPET) on cardiac autonomic activity in adolescent individuals.

**Methods**

Methods: Fifty-two healthy participants (Male=26, age: 20.31±1.49 years, height: 176±5.67 cm, body mass: 69.08±10.27 kg. Female=26, age: 20.62±0.98 years, height: 162.46±5.39 cm, body mass: 53.42±7.31 kg) underwent CEPT measurements of HR max and VO2peak. Tests were performed on the Master Screen CPX model according to the Bruce protocol (JAEGER, Germany). Predicted peak heart rate was calculated as 220-age. HRV measurements were collected using the SphygmoCor device (AtCor Medical, Australia) at baseline, 5, 30 and 60 min after the CPET. Differences between groups were assessed using an independent t-test. The HRV variables were analyzed using a 2-factor [sex (male, female); time (Baseline, Post-5min, Post-30min, Post-60min)] repeated-measures ANOVA.

**Results**

Results: There were significant differences in VO2peak (51.09±4.41 vs. 37.59±3.62 ml min⁻¹ kg⁻¹) (P<0.05), RPE (ratings of perceived exertion), RER (respiratory exchange ratio) were similar between groups (P>0.05). There were significant increases (P<0.01) in heart rate, markers of sympathetic activity (nLF) and sympathovagal balance (nLF/nHF) for 60 min after the CEPT trial, there were also significant decreases (P<0.01) in markers of vagal tone (RMMSD, nHF) for 60 min. There were no significant interactions between groups from rest to recovery from maximal exercise for any HRV variables. The overall change in ln LF/HF was of greater proportion in male participants (P<0.05) within 5 min.

**Conclusions**

Conclusion: Our findings indicate that the change of autonomic recovery was difference between male and female within 5 min, and it takes longer than 60 min to recover following an acute bout of CPET trial.

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**PO-162**

**The effect of hypoxic training at different simulated altitude on the antioxidant activity mediated by Nrf2 in mice skeletal muscle**

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**Objective**

It is generally believed that the long-term hypoxic training could impact oxidation resistance. Nrf2-Keap1 signaling pathway is a key pathway of cell oxidative stress reaction. This research attempts to investigate the role and mechanism of Nrf2 in oxidation resistance to hypoxic training of different oxygen concentration.

**Methods**

Part one, 8-week-old Nrf2 knockout mice and wild type mice were divided into normoxic control group (NC), simulated altitude of 3500m hypoxic training group (3500HT) and simulated altitude of 5000m hypoxic training group (5000HT) randomly and respectively. The mice run on treadmill in speed of 12 m/min, 1h/day, 6day/week, for 4 weeks. Oxygen concentration in hypoxia...
was 13.3% and 10%. Mice were treated for 4 weeks, 8h/day. 48 h after the last training, the mice were sacrificed and skeletal muscles of legs were collected. Western Blot tested Nrf2 and antioxidant enzyme protein. Antioxidant enzymes mRNA were tested by RT-PCR. High quality fluorescence measurement was used to test ROS levels in skeletal muscle. Part two, The 30 C57BL/6J mice were divided into three groups: control group (WC), hypoxia group (WH), hypoxic training group (WHT). The hypoxic training arrangement was same as before. After both the interventions, the mice were sacrificed and collected skeletal muscle of legs. The expression of Nrf2, Keap1 and p-Nrf2 were analyzed by western blot. High quality fluorescence assay was done to detect ROS level in skeletal muscle of mice.

Results (1) Compared with the same type mice NC group, Nrf2 protein, the mRNA and protein of CAT, GPX-1, GCLm, the mRNA of SOD1, SOD2, HO-1 were increased in wild type mice 3500HT group. And the Nrf2 protein, the mRNA and protein of SOD1, SOD2, the mRNA of CAT, NQO-1, GCLc, GCLm mRNA, the protein of HO-1 were decreased, and the ROS levels was higher in wil type mice 5000HT group. The mRNA of CAT, HO-1 in Nrf2-KO mice 3500HT group were increased, the mRNA and protein of SOD1, the mRNA of SOD2, the protein of GCLc were decreased, but the GCLc mRNA was increased in Nrf2-KO mice 5000HT group. When compared with the same intervention wild type mice, the mRNA and protein of SOD1, GPX-1, SOD2, HO-1, the mRNA of CAT, NQO-1, GCLc, GCLm were decreased in Nrf2-KO mice 3500HT group. The mRNA of GCLm, NQO-1, the protein of GCLc, HO-1 were decreased, but the GCLc mRNA was increased. (2) Nrf2/Keap1 complex contents in mice skeletal muscle of WH and WHT groups were significantly increased compared with WC group respectively. The free Nrf2 in mice skeletal muscle of WH, WHT groups were significantly reduced compared with WC group respectively. After both types of intervention, free Keap1 had no change nearly in skeletal muscle of mice. Compared with WC group, p-Nrf2 in mice skeletal muscle of WH and WHT groups were significantly reduced. The ROS level in mice skeletal muscle of WHT group significantly increased compared with WC group mice. Conclusions: Hypoxia and hypoxia training three interventions could increase Nrf2/Keap1 combination in skeletal muscle of mice, reduce the volume of free Nrf2; Phosphorylation of Nrf2 in skeletal muscle of mice in hypoxia training group was significantly lower, which may be result in marked increase in ROS level.

Conclusions (1) Hypoxic training could affect antioxidant activity via Nrf2 in mice skeletal muscle, which is connected with the oxygen concentration. (2) Moderate hypoxia training (at the altitude of 3500m) can promote the antioxidant activity via Nrf2. However, extremely hypoxic training (at the altitude of 5000m) can restrain the antioxidant activity via Nrf2 through the inhibition of Nrf2/Keap1 dissociation.

PO-163
Comparative Study on Screening Results of Functional Movements of Middle-aged and Old Women before and after Square Dance Exercise

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Objective This study will conduct a functional action screening (FMS) test for middle-aged and older women who participate in square dances, and explore the influence of square dance exercise on the screening results of middle-aged and older women, and provide reference for women's square dance exercise.

Methods Experimental method: A 12-week weekly square dance exercise was conducted on middle-aged and elderly women who participated in the square dance exercise. The functional action screening results of the experimental subjects before and after the experiment were tested and compared.
Results 3.1 Functional screening results of middle-aged and older women before exercise
The average functional screening results of middle-aged and older women before exercise were 13.70±2.518. The shoulder flexibility score of middle-aged and old women was 2.55±0.711, the average score of leg flexibility was 2.55±0.718, the average score of trunk stability of middle-aged and old women was 1.79±0.485, and the rotational stability was 1.70±0.529. The scores of the front and rear leg squatting modes were 1.58±0.663, the scores of the hurdles were 1.97±0.305, and the scores of the squatting mode were 1.76±0.792.

3.2 Changes in functional action screening results of middle-aged and elderly women after the experiment
After exercise, the squat action mode score was 1.39±1.088, the hurdle step action mode score was 2.30±0.529, the front and rear leg squat action mode was 1.82±0.769, and the shoulder flexibility was 2.36±0.895. The knee lift leg score was 2.36±0.549, the trunk stability score was 1.52±0.870, the rotational stability score was 1.88±0.415, and the total score was 13.67±2.847.

3.3 Comparison of screening results before and after exercise
After the experiment, the total scores of FMS test indicators, shoulder flexibility, trunk stability, rotational stability, squat movement mode and front and rear leg squat mode were not significantly changed (P = 0.951, 0.311, 0.119, 0.056, 0.070 and 0.118 respectively). The hurdle step movement mode was significantly improved, and the mean increased from 1.97 to 2.30 points (p<0.01).

Conclusions 4.1 The functional quality of middle-aged and older women who participate in square dance exercises is generally not high.
4.2 Once a week, 2 hours of 12-week square dance exercise can effectively improve the walking movement mode of middle-aged and older women.
4.3 Once a week, 2 hours of 12-week square dance exercise can not effectively improve the upper and lower limb flexibility, core stability and squat and front and rear leg movement modes of middle-aged and older women.
4.4 Middle-aged and older women who participate in square dance exercise need to add functional training in a targeted manner, instead of relying solely on square dance.

PO-164
Exercise training decreased lipid accumulation in murine skeletal muscle through Sestrin2-mediated SHP2-JNK signaling pathway

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Objective Obesity is becoming increasingly prevalent and is an important contributor to the worldwide burden of diseases. It is widely accepted that exercise training is beneficial for the prevention and treatment of obesity. However, the underlying mechanism by which exercise training improving skeletal muscle lipid metabolism is still not fully described.

Sestrins (Sestrin1-3) are highly conserved stress-inducible protein. Concomitant ablation of Sestrin2 and Sestrin3 has been reported to provoke hepatic mTORC1/S6K1 activation and insulin resistance even without nutritional overload and obesity, implicating that Sestrin2 and Sestrin3 have an important homeostatic function in the control of mammalian glucose and lipid metabolism. Our previous results demonstrated that physical exercise increased Sestrin2 expression in murine skeletal muscle, while the role of Sestrin2 in regulating lipid metabolism remains unknown.

SH2 domain containing inositol 5-phosphatase (SHIP2) acts as a negative regulator of the insulin signaling both in vitro and in vivo. An increased expression of SHIP2 inhibits the insulin-induced Akt activation, glucose uptake, and glycogen synthesis in 3T3-L1 adipocytes, L6 myotubes and
tissues of animal models. Alterations of SHIP2 expression and/or enzymatic function appear to have a profound impact on the development of insulin resistance. However, the regulatory function of SHIP2 in lipid metabolism after exercise remains unclear. It has been reported that SHIP2 modulated lipid metabolism through regulating the activity of c-Jun N-terminal kinase (JNK) and Sterol regulatory element-binding protein-1 (SREBP-1). JNK is a subclass of mitogen-activated protein kinase (MAPK) signaling pathway in mammalian cells and plays a crucial role in metabolic changes and inflammation associated with a high-fat diet. Inhibition of JNK reduces lipid deposition and proteins level of fatty acid de novo synthesis in liver cells. It has been reported that Sestrin2 regulated the phosphorylation of JNK, however the underlying mechanism remains unclear. SREBP-1 is important in regulating cholesterol biosynthesis and uptake and fatty acid biosynthesis, and SREBP-1 expression produces two different isoforms, SREBP-1a and SREBP-1c. SREBP-1c is responsible for regulating the genes required for de novo lipogenesis and its expression is regulated by insulin. SREBP-1a regulates genes related to lipid and cholesterol production and its activity is regulated by sterol levels in the cell.

Altogether, the purpose of this study was to explore the effect and underlying mechanism of Sestrin2 on lipid metabolism after exercise training.

Methods Male wild type and SESN2-/- mice were divided into normal chow (NC) and high-fat diet (HFD) groups to create insulin resistance mice model. After 8 weeks the IR model group was then divided into HFD sedentary control and HFD exercise groups (HE). Mice in HE group underwent 6-week treadmill exercise to reveal the effect of exercise training on lipid metabolism in insulin resistance model induced by HFD. We explored the mechanism through which Sestrin2 regulated lipid metabolism in vitro by supplying palmitate, overexpressing or inhibiting SESNs, SHIP2 and JNK in myotubes.

Results We found that 6-week exercise training decreased body weight, BMI and fat mass in wild type and SESN2-/- mice after high-fat diet (HFD) feeding. And exercise training decreased the level of plasma glucose, serum insulin, triglycerides and free fatty acids in wild type but not in Sestrin2-/- mice. Lipid droplet in skeletal muscle was also decreased in wild type but did not in Sestrin2-/- mice. Moreover, exercise training increased the proteins expression involved in fatty acid oxidation and decreased the proteins related to fatty acid de novo synthesis. The results of oil red staining and the change of proteins related to fatty acid de novo synthesis and beta oxidation in myotubes treated with palmitate, Ad-SESN2 and siRNA-Sestrin2 were consisted with the results in vivo, which suggested that Sestrin2 was a key regulator in lipid metabolism. Exercise training increased Sestrin2 expression and reversed up-regulation of SHIP2 and pJNK induced by HFD in wild type mice but not in Sestrin2-/- mice. In parallel, overexpression of Sestrin2 decreased the level of SHIP2 and pJNK induced by palmitate while Sestrin2 knock down by siRNA-Sestrin2 treatment did not change the expression of SHIP2 and pJNK, which suggested that Sestrin2 modulated SHIP2 and JNK in the state of abnormal lipid metabolism. Inhibition of SHIP2 reduced the activity of JNK, increased lipid accumulation and the proteins of fatty acid synthesis after palmitate treatment and over expression of Sestrin2, which suggest that Sestrin2 modulated lipid metabolism through SHIP2/JNK pathway.

Conclusions Sestrin2 plays an important role in improving lipid metabolism after exercise training, and Sestrin2 regulates lipid metabolism by SHIP2-JNK pathway in skeletal muscle.

PO-165

Urinary metabolomics study on effects of Rhodiola on Marathon Amateurs after Quantitative Exercise Load

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Objective To study the effect of Chinese medicine Rhodiola on oxidative stress injury in amateur marathon runners after quantitative exercise load (20 km) and explore its mechanism.
Methods Eight marathon amateurs were divided into four groups according to different test time, including before and after quantitative exercise load (group C and group CE), before and after quantitative exercise load after taking a month of the Rhodiola (group MC and group ME). The participants had serum superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), total antioxidant capacity (T-AOC) and malondialdehyde (MDA), as well as myocardial enzyme index - creatine kinase (CK), lactate dehydrogenase (LDH), creatine kinase isoenzyme (CK-MB) and glutamic oxaline aminotransferase (AST/GOT) activity evaluated. In order to further explore the mechanism of action of Rhodiola, the urine was analyzed by 1H-HMR metabolomics technique.

Results 1) Compared with group C, the activity of serum CK, LDH and AST/GOT of group CE increased significantly (P<0.01 or P<0.05), MDA content and SOD activity also increased significantly (P<0.05). A total of fifteen potential biomarkers were found in group CE, such as valine, lactic acid, 2- hydroxy isobutyric acid and so on (P<0.05 and VIP>1). 2) Compared with group CE, the activity of serum CK and AST/GOT and the content of MDA of group ME decreased significantly (P<0.05), eleven metabolites among the fifteen potential biomarkers reverted significantly (P<0.01 or P<0.05), which mainly involved in 4 metabolic pathways including alanine, aspartic acid and glutamic acid metabolism and so on.

Conclusions Rhodiola can enhance the antioxidant capacity and improve myocardial damage of marathon amateurs after quantitative exercise load, which may be due to increased synthesis and utilization of aminoacyl-tRNA and other amino acids.

PO-166
Effects of different exercises on cyocardial cell cycles

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Objective With the advent of the era of great health, people's health awareness is increasing. As an economical and environment-friendly way, exercise should be viewed as a “first line” strategy for prevention and treatment of arterial aging and a vital component of a contemporary public health approach for reducing the projected increase in population Cardiovascular diseases burden. The objective of this work was to study the effect of 8-week spin training and swim training on normal cyocardial cell cycle.

Methods A total of 30 C57BL/6 mice were randomly allocated to 8-week spin training and swim training program (intervention group) or no supervised exercise (control group). Normal cyocardial cell cycle proteins were measured by Western Blotting. All the outcomes were measured after 8 weeks. Repeated measures were analyzed using mean ±SD and T tests were used to analyze the data.

Results Compared with the control group, Western Blotting shows that CDK4 of spin training significantly increase (0.7698± 0.01130 to 1.111 ±0.02027, p<0.001) and CDK4 of swim training significantly increase (0.7698 ±0.01130 to 1.258± 0.01427, p<0.001), following 8 weeks of exercise, CyclinD1 of spin training increase (0.8558 ± 0.007912 to 1.499 ± 0.06303, p<0.001) and CyclinD1 of swim training significantly increase (0.8558 ± 0.007912 to 2.097 ± 0.3622, p<0.05).

Conclusions The 8-week spin training and swim training was found to be effective in increasing cyocardial cell cycles proteins in normal mice. There was significant improvement inCDK4 and CyclinD1 in intervention group compared to control group.
PO-167
Effects of aerobic exercise training on F13A-mediated energy metabolism in mice

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Objective Apelin, an adipokine and also a myokine, is involved in energy metabolism. F13A is an analog of apelin-13. In this study, we aim to investigate the effect of aerobic exercise on F13A-mediated energy metabolism in mice.

Methods 20 C57BL/6J wild mice were randomly divided into 4 groups (n:5), namely saline control group (SC), saline exercise group (SE), F13A control group (FC), and F13A exercise group (FE). Mice were intraperitoneally injected with F13A (0.2 μmol/kg/day) or saline (15 μl/kg/day). Mice in the exercise group underwent 60 min/day treadmill running at a speed of 15 m/min with a slope of 5°. After 2 weeks, the maximal oxygen uptake was measured and the running speed was adjusted to 20 m/min. The treadmill running continued 4 weeks. The mice were individually housed in a Comprehensive Lab Animal Monitoring System (Columbus Instruments, Columbus, OH, USA) between the 3rd and 4th week of training with free access to food and water. O₂ consumption (V\(\text{O}_2\)), CO₂ production (V\(\text{CO}_2\)) and respiratory exchange ratio (RER) during a 24-h period were measured after 24h of acclimatization. Glucose oxidation (in g/min/kg\(^{0.75}\)) = \((4.545\times V\text{CO}_2)−(3.205\times V\text{O}_2)\)/1000, and lipid oxidation (in g/min/kg\(^{0.75}\)) = \((1.672\times(\text{V}_2−\text{V}_2)\)/1000) were calculated.

Results F13A alone increased glucose oxidation (P<0.01, vs SC group). Exercise plus F13A caused a significant decline in RER (P<0.01 vs FC and P<0.05 vs SE group), glucose oxidation (P<0.001 vs FC and P<0.05 vs SE group), whereas it increased lipid oxidation (P<0.05 in comparison with FC group). Exercise alone has no influence on 4 groups.

Conclusions These findings suggest that 4 weeks aerobic exercise can regulate F13A reduce RER in mice, with a decrease of glucose oxidation and an increase of lipid oxidation in vivo.

PO-168
Effect of aerobic exercise on antioxidation ability of mice kidneys

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Objective To study the total antioxidant capacity of the kidney in the Aged mice Total Antioxidant Capacity (T-AOC), Malondialdehyde (MDA) and superoxide dismutase (SOD) expression level by aerobic exercise. Objective to explore the effect of aerobic exercise on antioxidation ability of mice.

Methods 30 Male C57BL/6 strain mice were randomly divided into adult group (group CC) in the 13 months old, in the control group (Group C), 5 months of quiet feeding, the aerobic exercise group (Group E) ran for 5 months, 10 per group, and the adult group (group CC) compared with the control group (Group C), The Analysis control Group (Group C) was compared with the aerobic exercise group (Group E). After 5 months of Treadmill running in Group E. Determination of antioxidant index of each group. The statistical method is processed by SPSS20.0 statistic software, the experimental data is expressed by the mean ± standard deviation, the two mean numbers are analyzed by independent sample t test, and the difference of (p<0.05) is statistically significant.
Results T-AOC of adult Group was (0.99±0.13) U/mg Prot, control group was (0.27±0.07) u/mg prot, aerobic exercise group (0.39±0.10) U/mg prot, adult group SOD as (46.32± 1.84) U/mg, control Group (29.71±7.64) U/mg, aerobic exercise group (39.85±5.83) U/mg, adult group MDA (8.15±0.16) nmol/mg, control Group (8.83±0.26) nmol/mg, The aerobic exercise group was (6.31±1.23) nmol/mg, the adult group was SOD/MDA (5.69±0.32), the control group was (3.88±0.89) and the aerobic exercise group was (6.55±1.08). Compared with the adult group, the control group T-AOC and SOD decreased significantly, MDA significantly increased, the difference was very significant (p<0.01), sod/MDA significantly decreased, SOD/MDA difference was significant (p<0.01). Compared with the control group, the aerobic exercise group T-AOC and SOD obviously increased, MDA significantly decreased, the difference was significant (p<0.01), SOD/MDA increased significantly, the difference was very significant (p<0.01).

Conclusions To sum up, with the increase of the age of mice MDA expression is increased, the 18 months old SOD expression is lower than 13 months old, indicating that the antioxidant capacity with the increase in age. The results of this study are consistent with the results of previous scholars. The results show that aerobic exercise has some antioxidant effect, and aerobic exercise can decrease expression of kidney tissue SOD, raise the expression of kidney tissue T-AOC, increase the expression of kidney tissue, increase the expression of SOD/MDA, and reduce the oxidative stress of kidney to some extent. So as to protect the role of the kidney, aerobic exercise and kidney-related mechanisms also need our further study.

PO-169
Meta analysis of Exercise Intervention on Dyslipidemia in recent 6 years

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Objective Abstract: Objective: To investigate and evaluate the evidence of exercise intervention in dyslipidemia, this study aims to make a systematic evaluation of exercise intervention in recent 6 years and a summary evaluation of meta analysis.

Methods Methods: The electronic database was searched including CNKI, Wanfang. The Chinese key words, dyslipidemia, exercise, physical activity, acute exercise, aerobic exercise, exercise training, etc., were collected from various databases from January 2013 to July 2018. After extracting the data,RevMan5.3 software was used to analyze the merging effect.

Results Results: 2066 subjects were included in 17 articles, 1026 in the experimental group and 1040 in the control group. The results showed that: (1) Total cholesterol (TC) SMD=-0.74 (95% CI: -1.07- 0.41,P < 0.00001); (2) Triglyceride (TG) SMD=-0.98 (95%CI: -1.39 -0.56,P < 0.00001); (3) Low density lipoprotein cholesterol (LDL-C )SMD=-1.06 (95%CI: -1.63-0.50, P < 0.00001); (4) High density lipoprotein cholesterol (HDL-C)SMD = 0. 66 (95% CI: 0. 39~0.93, P < 0.00001).

Conclusions Conclusion: Exercise intervention can effectively reduce the plasma TCG LDL-C concentration and increase the plasma HDL-C concentration.
PO-170
Aging attenuates the effect of aerobic capacity in muscle and serum metabolic profile but not in white adipose tissue

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Objective Aerobic capacity is a quantitative predictor of the morbidity and mortality in many diverse patient populations. While aging is the main factor affecting aerobic capacity. The present study aimed to assess the effect of aerobic capacity and aging on metabolic profile in rats and to investigate the metabolic interactions between white adipose tissue (WAT), muscle and serum.

Methods In this study, we used rat models that were selectively bred to differ in maximal running capacity (High capacity runners (HCR) and Low capacity runners (LCR)). Part of the rats were sacrificed after 9 months and the rest at 21 months. The effect of aerobic capacity on metabolic profile was assessed from 9 months old young rats (HCR-Y and LCR-Y), while the effect of aging on the metabolic profile in different capacity rats was determined comparing 9 months to 21 months old rats (HCR-O and LCR-O). Nuclear magnetic resonance (NMR) spectroscopy was performed to detect the metabolomics of WAT, muscle and serum. Partial least-squares-discriminant analysis (PLS-DA) was used for pattern recognition between HCR-Y and LCR-Y and between HCR-O and LCR-O. Metabolites with variable influence on projection (VIP) >1.0 and p<0.05 were classified as significantly different metabolites between groups. Spearman correlation was used to assess the metabolic interactions between white adipose tissue (WAT), muscle and serum.

Results HCR-Y rats had significantly higher skeletal muscle mass-to-body mass ratio (p<0.001), while lower body mass (p<0.001), fat mass (p<0.001), skeletal muscle mass (p=0.035) and fat mass to body mass ratio (p=0.004) than LCR-Y rats. The running capacity of HCR-Y rats was 132.7% (best running speed) better than LCR-Y rats (p<0.001). However, with age, the difference between body compositions between the two capacity groups became insignificant. HCR-O only had significantly lower body mass than the LCR-O (p=0.02). Running capacity (p=0.06) was 86.4% (best running speed) higher in the HCR-O rats than that of the LCR-O rats. PLS-DA revealed marked effects of aerobic capacity on metabolic profile in all three tissue types between HCR-Y and LCR-Y. The metabolic profile classification and prediction was best (i.e. sharper) in muscle than in WAT and serum. In addition, muscle and serum contained more significantly different metabolites than WAT in HCR-Y than in LCR-Y. Pathway analysis of the significantly different metabolites between HCR-Y and LCR-Y revealed that all the pathways belong to the lipid metabolism and amino acid metabolism in muscle while in serum it is only amino acid metabolism. However, in the case of the old groups, the PLS-DA gave reversed results. It revealed that WAT performed best in terms of classification and prediction of metabolites between HCR-O and LCR-O and had the most significantly different metabolites out of the three tissue types. The significantly different metabolites’ pathways belong to lipid metabolism in WAT. When assessing the metabolic interaction between different tissue types, all significantly different metabolites between HCR and LCR rats in young and old groups were moderately or strongly correlated (Spearman correlation between 0.45-0.9) with one or more metabolites in any of the three tissues.

Conclusions In this study, we assessed the metabolic profile and body composition of WAT, muscle and serum in young and old rats with different aerobic capacities. We found that aerobic capacity greatly impacts body composition and the metabolic profile in muscle and serum in young rats, however the impact is attenuated with age. In addition, it is aging and not aerobic capacity that had the most influence on WAT metabolites. This suggest that WAT has more important role in aging process than previously assumed.
Across generations maternal exercise in hypoxic environment on mitochondrial biosynthetic factors in rat skeletal muscle

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Objective Environmental and maternal exercise experienced even during the very earliest stages of life has the potential to cause developmental changes. The growing evidence demonstrated that diverse environmental stressors affect offspring in various aspects in early stage of life and can be transmitted directly or indirectly by both parental lines. The purpose of the present study was to investigate the effect of across generations maternal exercise training under the hypoxic environment on mitochondrial biogenesis and angiogenesis related protein expressions of skeletal muscle in offspring of multiple generations.

Methods The experimental groups were divided into four groups as NCON (control in normoxia), NEXE (exercise in normoxia), HCON (control under hypoxia), HEXE (exercise under hypoxia), and studied for three generations. Exercise groups were run on animal treadmill at 60%-75% VO₂max for one hour per day, five times per week for 10 weeks (seven weeks before conception and during conception for three weeks). Animals were sacrificed at a given time table and assayed mitochondrial biogenesis and angiogenesis related protein expressions using western blotting.

Results The major findings from the present study were firstly, maternal exercise training before and during conception under hypoxic environment increase in mitochondrial biogenesis and angiogenesis related proteins expressions in both maternal and offspring skeletal muscles, secondly, long term of exposure to hypoxic environment without exercise training increase in mitochondrial biogenesis and angiogenesis related proteins expressions in offspring skeletal muscles, and further increased when exercise training performed at hypoxic environment, lastly, there was no cumulative benefit by consecutively exposure for three generations under hypoxic environment, which is indicating world winning runners from high altitude dwellers may not rely on the duration of sojourn under hypoxic environment, but rather selection and training related factors.

Conclusions In summary, maternal exercise training before and during conception under hypoxic environment increase in mitochondrial biogenesis (PGC-1α, COX-IV, NRF-1, mtTFA) and angiogenesis (HIF-1α, VEGF_total) related proteins expressions in both maternal and offspring skeletal muscles, especially exercise training stimulated the protein expressions under hypoxic environment than normoxic condition. Therefore, exercise capacity may be endowed by both hypoxic environment and exercise training at hypoxic environment.
PO-172

Effects of hypoxia and/or endurance exercise on autophagy of skeletal muscle in rats with nutritional obesity

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Objective
The globalization of obesity has become an important factor threatening human health, and the rational health of the solution has driven the exploration of experts and scholars. For this reason, this experiment uses hypoxia and exercise as interventions for 8 weeks. Changes of autophagy-related factors LC3 mRNA, p62 mRNA and energy regulation factor AMPKα2 mRNA, and cell stress-inducing factor Sestrin2 mRNA after hypoxia and/or combined endurance exercise, and explored the effect of hypoxia endurance exercise on autophagy of skeletal muscle cells To provide a reasonable experimental basis for exploring hypoxic exercise to lose weight and to prevent or reduce autophagy-related diseases.

Methods
First, a nutritional obese rat model fed with high-fat diet for 8 weeks was constructed and randomly divided into 8 groups: the normoxia group (A), the normoxic group (AE), and 16.3%. Oxygen quiet group (B) and 16.3% hypoxic exercise group (BE), 13.3% hypoxic quiet group (C), 13.3% hypoxic exercise group (CE), 11.3% hypoxic quiet group (D), 11.3% low Oxygen exercise group (DE), 10 in each group, and continued to feed with high fat diet. Secondly, establish a hypoxic and/or endurance exercise model, and the experimental experiment is expected. The rat training program is as follows: the normoxia quiet group does not perform any endurance exercise and other interventions under normoxia; the normoxic exercise group underwent a medium-intensity endurance exercise with a running speed of 20 m/min in a normal oxygen environment for 40 min. Similarly, rats in the hypoxic quiet group underwent continuous hypoxia intervention for 12h in the corresponding hypoxic environment; the hypoxic-binding endurance exercise group was based on the intervention of the hypoxic-quiet group, with a time of 40 min and a running speed of 20 m/Min's medium-intensity endurance exercise. The frequency of exercise is 5 times a week (every Monday to Friday) for 8 weeks. After the last training, fasting for 24 hours, the rats were sacrificed and sampled. Biochemical indicators were used to measure blood lipids and blood glucose concentration; real-time quantitative PCR was used to detect the expression of autophagy regulators Sestrin2, AMPKα2 and autophagy Beclin1 and LC3II mRNA.

Results
1. Nutritional obesity rat model: After 8 weeks of high-fat feeding, the body weight, Lee's index, BG, TC, TG and LDL-c concentrations in the high-fat group were significantly increased (P<0.05).
2. Changes in morphology and blood lipids of rats: Compared with group A, the body weight, BG, TC, TG, LDL-c concentrations in the AE group were significantly decreased (P<0.05), and the HDL-c concentration was significantly increased (P<0.05). LDL-c in group D, TG and HDL-c concentrations in group B, group C and group D were significantly decreased (P<0.05), and HDL-c concentrations in groups C and D were significantly increased (P<0.05); Compared with the group, the LDL-c and TG concentrations in the DE group were significantly lower (P<0.05), the BG concentrations in the CE group and the DE group were significantly lower (P<0.05), and the HDL-c concentration in the DE group was significantly increased (P<0.05).
3. Real-time quantitative PCR showed that compared with group A, the expression of Sestrin2, Beclin1 and LC3II mRNA in skeletal muscle cells of AE group, C group and D group was significantly increased (P<0.05), and the expression of AMPKα2 mRNA in group D was significantly increased. Compared with AE group, the expressions of Beclin1, LC3II and AMPKα2 mRNA in CE group and DE group were significantly increased (P<0.05), and the expression of Sestrin2 mRNA in DE group was significantly increased (P<0.05).
Conclusions
1. Three different concentrations of hypoxia and/or combined endurance exercise can reduce the body weight of obese rats, improve the blood sugar, blood lipids, hypoxia and exercise in obese rats, the effect of weight loss, blood sugar and blood lipids is more obvious.
2. Endurance exercise, hypoxic exposure, hypoxia combined with endurance exercise can induce autophagy in skeletal muscle cells; and the cumulative stimulation effect of exercise and hypoxia is more prominent than simple endurance exercise and hypoxia exposure.
3. Three different concentrations of hypoxia and/or combined endurance exercise can up-regulate the expression of Sestrin2, AMPKα2, Beclin1, and LC3II mRNA, thereby effectively activating and enhancing the autophagy level of skeletal muscle cells in obese rats, especially 11.3% hypoxia. The endurance exercise group has a more pronounced effect.

PO-173
Effect of AMPK agonist / inhibitor on Nrf2 expression in C2C12 cells

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Objective
In the past few decades, the study of skeletal muscle oxidative stress has been concerned about the increase of free radicals induced by muscle contraction. In recent years, the activation of antioxidant stress signaling pathway has gradually become one of the hot topics in the field of sports medicine. Although current research has confirmed that long-term aerobic training can bring health benefits to the body, the molecular mechanism of its role is still not very clear. Traditionally, AMPK has been regarded as the energy receptor of cells. During exercise, the energy consumption of skeletal muscle doubled, ATP decreased, AMP increased, and the ratio of AMP/ATP increased, thus inducing the activation of AMPK and regulating cell energy metabolism. Recent studies have found that AMPK not only plays an important role in the regulation of energy metabolism, but also plays a role in the body's antioxidant stress response. However, the relationship between AMPK and oxidative stress has been studied only in a small number of cells in non skeletal muscle cells. The results of this few studies show that oxidative stress in AMPK can not depend on the increase of intracellular AMP/ATP ratio, and the independent activation of AMPK, thus reducing the level of intracellular ROS, but the molecular mechanism of its action is not clear. Nrf2 is an important nuclear transcription factor in the body and plays an important role in the body's antioxidant stress response. Whether AMPK can participate in the regulation of Nrf2 mediated antioxidant activity in skeletal muscle has not been reported. In this study, the mouse skeletal muscle C2C12 cells were used in vitro cell experiments. The AMPK pharmacologic activator AICAR and the pharmacological inhibitor Compound C were used to treat the cells respectively. The role of AMPK in the regulation of Nrf2 expression in C2C12 cells and its mechanism were observed.

Methods
Cell experiments were performed on C2C12 cells of skeletal muscle of mice, and AMPK activator AICAR and AMPK inhibitor Compound C were used to intervene. The fluorescence intensity of C2C12 cells in each group was qualitatively detected by fluorescence inverted microscope, and the ROS level of C2C12 cells in each group was detected by fluorescence colorimetry. Results the ROS level of each group was significantly higher than that of the control group. RT-PCR assay was used to detect the antioxidant enzyme mRNA level of C2C12 cells in each group. Western Blot assay was used to detect the expression of AMPK alpha, pAMPK alpha, Nrf2, pNrf2 and antioxidant enzyme protein in C2C12 cells of each group.

Results
(1) compared with the control group, the pAMPK alpha /AMPK alpha ratio of C2C12 cells in the agonist group increased significantly, the expression of pNrf2 protein in the cells increased significantly, and the expression of NQO1mRNA, HO-1mRNA and GSR mRNA increased significantly, and the cells SOD1, GCLM, NQO1, HO-1, pNrf2, and protein were significantly
increased. Low. (2) compared with the control group, the levels of NQO1mRNA, HO-1mRNA, CATmRNA, SOD1mRNA, Gpx-1mRNA and GCLc mRNA in the C2C12 cells of the inhibitor group decreased significantly, and the expression of NQO1 and GCLM proteins in the cells decreased significantly, and the ROS level of the cells increased significantly.

**Conclusions** (1) the activation of AMPK by AICAR activates the increase of Nrf2 activation in skeletal muscle C2C12 cells, and then increases the expression of mRNA and protein (SOD1, GCLM, NQO1, NQO1, GSR) in the downstream of Nrf2 (NQO1, HO-1, GSR), and significantly reduces the intracellular level. (2) the inhibition of AMPK by Compound C significantly decreased the mRNA expression of C2C12 cells (NQO1, HO-1, CAT, SOD1, Gpx-1, GCLc) in skeletal muscle, and significantly decreased the expression of protein (NQO1 and GCLc).

**PO-174**

**Effects of chemerin/CMKLR1 on aerobic exercise-induced improvement of glycolipid metabolism in atherosclerosis rats**

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**Objective** As an adipokine and inflammatory cytokines, chemerin plays an vital role in the occurrence and severity of obesity and its related disease such as atherosclerosis (AS), type 2 diabetes and coronary artery disease, among which the regulation of chemerin on glycolipid metabolism is of great important. Chemerin exerts its main biological functions through binding to its receptor: G protein-coupled receptor chemokine-like receptor (CMKLR1). Chemerin/CMKLR1 has become potential targets for diabetes treatment. For AS, the serum level of chemerin is also related to the disorders of glycolipid metabolism as well as the size and fibrous cap maturity of AS plaques. Exercise decreased the serum level of chemerin in AS, accompanied with the improvement of glucose and lipid metabolism, which indicated the possible relation between decrease of chemerin and improvement of glycolipid metabolism. However, it is still unclear whether exercise-induced improvements of glycolipid metabolism is associated with the changes of chemerin and CMKLR1 in tissue such as livers and gastrocnemius (play key roles in the modulation of glycolipid metabolism) and the mechanism by which chemerin/CMKLR1 modulated glycolipid metabolism. Recent studies reported that chemerin is a target gene of nuclear transcription factor- peroxisome proliferator activated receptor γ (PPARγ). PPARγ links glycolipid metabolism and inflammation through its target gene-adipose triglyceride lipase (ATGL) and lipoprotein lipase (LPL), gate-keeping enzymes hydrolyzing lipids in intracellular triglyceride and plasma lipoproteins respectively. Our previous work has found that aerobic exercise decreased the level of chemerin/CMKLR1 in serum and tissues of type 2 diabetes rats by the mediation of PPARγ-ATGL and LPL. So the purposes of this study were to clarify if exercise-modulated improvement of glycolipid metabolism of atherosclerosis rats was also associated with the changes of chemerin and CMKLR1 in serum and tissues (liver and gastrocnemius), similar as in diabetes, and further its mechanisms.

**Methods** Twenty-seven male Sprague-Dawley (SD) rats aged 6 weeks were randomly divided into control group (Con, n=9) and atherosclerosis (AS, n=18) model rats. AS model rats were established by intraperitoneal injection of Vitamin D3 (600,000 IU/kg body weight in the first week, 100,000 IU/kg body weight in the third week and six week) in combination with 8-week high fat diet feeding. For verifying the successful establishment of AS rats, one rat from Con group and two rats from AS model group were taken randomly to determine the levels of blood glucose and lipid as well as the morphological and pathological alterations of the aorta. Then, 16 successfully established AS rats were randomly divided into AS group (n=8) and exercised AS group (EAS, n=8). EAS group rats experience 4-week moderate intensity aerobic exercise on
treadmill with gradually increasing intensity, while the Con and AS rats were kept sedentary life, with all of the rats were fed with common diet during the experiments. Before and after 4-week exercise, the blood sample of the three group rats were drawn to measure the circulating levels of fasting blood glucose (FBG), triglyceride (TG), total cholesterol (TG), LDL and HDL. The serum fasting insulin (FINS) and serum chemerin were measured by ELISA. The protein levels of chemerin, CMKLR1, PPARγ, ATGL and LPL in livers and gastrocnemius were detected by Western blot. And the full-length aorta of the rats were separated to determine AS arteriosclerosis plaques with oil red O staining and histopathological examination with HE staining.

**Results**  1) Compared with AS rats, the disorder of glycolipid metabolism (reflected by increases in TC, TG, LDL and FINS as well as decrease in HDL in blood although no difference in serum level of FBG) were all improved in EAS rats. 2) Compared with AS rats, the atherosclerotic plaque in aoras and the enhanced proliferation and arrangement disorder of smooth muscle cells in aorta membrane were all alleviated in EAS rats. 3) Compared with AS rats, the increased chemerin in serum and the enhancements of chemerin and CMKLR1 in liver and gastrocnemius at protein levels were all significantly decreased in EAS rats. 4) Compared with AS rats, the protein levels of PPARγ, ATGL and LPL in the livers and gastrocnemius were all increased in EAS rats.

**Conclusions**  This study verified that: 1) the exercise-induced improvement of glycolipid metabolism in AS rats was likely to be associated with the decreases of chemerin in serum as well as of chemerin and CMKLR1 in tissues (liver and gastrocnemius). To our knowledge, it is the first report that exercise down-regulated chemerin/CMKLR1 in tissues in AS rats, and the decreases of chemerin/CMKLR1 might be related to the improvement of glycolipid metabolism in AS rats. 2) the exercise-induced decreases of chemerin/CMKLR1 in AS rats might be mediated by PPARγ and its target genes- ATGL and LPL, which need further investigations.

**PO-175**

**Effect of exercise intensity and diet on Glucose Metabolic factors in T2DM rat skeletal muscle**

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**Objective**  This study was to examine the effect of different exercise intensity and diet on the expression of the metabolism related factors in T2DM rat skeletal muscles.

**Methods**  Diet induced T2DM rat by a combination of low dose streptozotocin (STZ: 40mg/kg) and feeding of a high fat diet used as experimental animals. The rats trained on the treadmill for 8 weeks with low (40% max) and high (80% max) intensities of exercise on the treadmill for 8 weeks. The soleus (SOL) and extensor digitorum longus (EDL) muscles were excised. The western blotting was performed for the expression of AMPK, p-AMPK, PGC-1α, and GLUT-4 proteins.

**Results**  The expression of AMPK, p-AMPK, PGC-1α, and GLUT-4 proteins in SOL and EDL muscles were higher in both training groups compared to the non-training groups. The AMPK was differently expressed to the recruitment pattern of muscle group during exercise; expressed higher in SOL during low intensity of exercise and also highly expressed in EDL during high intensity of exercise, whereas the PGC-1a was expressed a contrast phenomenon to AMPK expression in both muscle groups. The expression of p-AMPK in both muscle groups was higher in low intensity of exercise and normal diet groups than in high intensity of exercise and high fat groups. The AMPK, p-AMPK, PGC-1α, and GLUT-4 protein expression demonstrated
significantly higher in normal diet with endurance training group than in high fat diet with endurance training group.

**Conclusions** In summary, the expression of AMPK, p-AMPK, PGC-1α, and GLUT-4 proteins was differed with exercise intensities, diet and the type of muscles. These results indicated that the endurance training improved the insulin sensitivity according to the exercise intensity and diet in T2DM rats.

PO-176

**Effect of resistance training on functional fitness and bone mineral density in elderly women**

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**Objective** Try to carry out the intervention experiment of the strength exercise of the elderly in the community, aiming to provide theoretical and data basis for the daily strength exercises of the elderly in China.

**Methods** Recruiting 18 elderly female volunteers in Xicheng District, Beijing, required independent living ability and were willing to participate in the experiment. They were randomly divided into intervention group (N=9, 62.0±6.0 years) and control group (N=9, 63.0 ± 4.8 years). On Tuesday afternoon and Thursday morning, under the leadership of a professional coach, follow the planned "Resistance Exercise Plan" to carry out resistance training. Each practice time is about 90min for 9 weeks. The exercise intensity control is divided into two phases: the first phase lasts for one week, mainly the learning and adaptation phase of the action, and the heart rate control in the 30%~40%HRR or RPE 10 subscale is 4 (a little easy); The stage lasts for 8 weeks of the medium-intensity practice phase, the heart rate control in the 40%~60%HRR or RPE 10 subscale is 5~6 (moderate, slightly strenuous).

**Results** Intervention group before and after experiment, the grip strength (25.0±5.0 VS 26.8±3.9 kg, P<0.05) and the 30s arm curl test (23.1±5.2 VS 25.4±4.0 reptitions, P<0.05) increased. Five sit-up tests (6.99±2.01 VS 6.51±2.00 s, P<0.05) and the 8-foot standing walk (5.13±1.03 VS 5.07±1.01 s, P<0.05) were all shortened. The bone density T value (-1.3±0.4 VS -1.0±0.4, P<0.05) increased. After intervention, the intervention group compared with the control group, grip strength (26.8 ± 3.9 VS 22.1 ± 4.5 kg, P < 0.05), 30s arm curl test(25.4 ± 4.0 VS 22.1 ± 3.0 reptitions, P < 0.05) increased. Five sit-up tests (6.51 ± 2.00 VS 6.94 ± 1.05 s, P < 0.05) and 8 feet of standing walk (5.07 ± 1.01 VS 5.27 ± 0.97 s, P < 0.05) were all shortened. Bone density T value (-1.0 ± 0.4 VS -1.4 ± 0.4, P < 0.05) increased. There was no significant change in the 30-second chair stand test.

**Conclusions** Through 9 weeks of progressive resistance exercise, the experiment made the upper limb explosive force, upper limb muscle endurance, lower limb explosive power, flexibility and dynamic balance enhanced, and bone density increased. The enhancement of lower limb endurance is not obvious, which may be the reason for short experimental time and small exercise intensity of lower limbs.
PO-177
Reliability and Validity of Measuring Energy Expenditure in Inline and Shuttle Running with Honor and Lifesense Fitness Wristbands

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Objective
Energy expenditure is an indicator that comprehensively reflects the amount of physical activity. Fitness wristbands are used to monitor the energy expenditure of human activities in the fitness field. Among the fitness wristbands popular in China, Honor and Lifesense rank in the top list. However, there was no research on the reliability and validity of these two wristbands in measuring the energy expenditure. This study aims to evaluate the reliability and validity of the two fitness wristbands (Honor and Lifesense) in measuring the energy expenditure in inline and shuttle running.

Methods
18 male collegiate students (age: 22.4±2.5yrs, height: 177±7cm, mass: 69.3±8.4kg) volunteered to participate in two four-stage incremental inline running tests (8km/h, 10km/h, 12km/h, 14km/h) and two 20m four-stage incremental shuttle running test (6km/h, 8km/h, 10km/h, 12km/h). The duration of each stage was 5 min, and intermittent per stage was 1 min. Honor B3 (GMN-BX9, Honor, China) and Lifesense Mombo2 (LS417-B, Lifesense, China) fitness wristbands was utilized to measure the energy expenditure of each stage in incremental inline and shuttle running. A portable spirometric system (K4b², Cosmed, Italy) was utilized to measure the ventilator information during the test. The energy expenditure was converted into equivalent units (kcal) according to the measured respiratory quotient coefficient. The repeat measuremented reliability test was carried out on the energy expenditure indicators measured by the fitness wristbands in the twice incremental inline running and the shuttle running. The energy expenditure calculated by the portable gas metabolic instrument was compared with those measured by Honor and Lifesense fitness wristbands.

Results
The result test-retest reliability found that the Honor and Lifesense fitness wristbands had well correlations between the two tests at a speed of 8km/h, 10km/h, 12km/h in inline running, and 8km/h, and 10km/h in shuttle running (r=0.44~0.93, P<0.05), but the correlation was not well at 6km/h in shuttle running (r<0.43, P>0.05). The Honor wristband correlation (r=0.83~0.93, P<0.05) was higher than the Lifesense fitness wristbands (r=0.44~0.60, P<0.05) at 8km/h, 10km/h, and 12km/h in inline running and at 8km/h, and 10km/h in shuttle running. The correlation coefficients of the two fitness wristbands at 8km/h and 10km/h in inline running (r=0.52~0.93, P<0.05) were both higher than those in shuttle running (r=0.44~0.83, P<0.05). The energy expenditure measured by K4b² and the two kinds fitness wristband was significantly different (P<0.05), except at 12km/h in inline running and 10km/h in shuttle running (P > 0.05).

Conclusions
Honor and Lifesense wristbands have acceptable reliability in measuring energy expenditure at 8, 10, 12km/h in inline and shuttle running, with the fore slightly higher than the after. The two wristbands have higher reliability in measuring the energy expenditure in inline running than in shuttle running. The validity of measuring the energy expenditure with the two fitness wristbands is acceptable at 12km/h in inline running and at 10km/h in shuttle running, but not at other speed.
Objective Exercise can induce the release of various myokine such as Irisin, which promote browning of white fat, improve body metabolism, and loss weight. Appropriate hypoxic training plays a better role in weight loss than single exercise, but the effect of hypoxic training on muscle factors that promote browning of fat is rarely reported. Therefore, this study aims to observe different concentrations of hypoxia training on the PGC1α-Irisin-UCP1 signaling pathway in nutritional obese rats, and the role of weight loss.

Methods Male Sprague-Dawley rats (n=140) of 6 weeks old were divided into normal diet feeding group (group N, n=20) and high-fat diet feeding group (group HFD, n=120). The HFD rats became obese after 8 weeks' feeding, and they were further divided randomly into 8 groups. Including sedentary group(group A), training group (group AE), 16.3% hypoxia exposure group (group B), 16.3% hypoxia training group (group BE), and 13.3% hypoxia exposure group (group C), 13.3% hypoxia training group (group CE), 11.3% hypoxia exposure group (group D), 11.3% hypoxia training group (group DE), group B, group C and group D Rats were exposed to oxygen in concentrations of 16.3%, 13.3%, and 11.3% for 12 h/d, respectively. Rats in group BE, CE, and DE were subjected to animal treadmill training during hypoxic exposure with a slope of 0°, 20 m/min, 40min/d, 5d/w. After 8 weeks of intervention, blood, adipose tissue and skeletal muscle were collected and tested.

Results (1) In group AE, the body weight of obese rats decreased in a short time, but bounced back later. The body weight of rats in group CE and group DE decreased continuously. Hypoxia exposure and hypoxia training can inhibit the food intake of obese rats in varying degrees, and group CE has the most obvious effect. Hypoxia, endurance training and hypoxia training all reduced the percentage of visceral fat to body weight, group C is significantly lower than group B and D group (p < 0.05), the effect of hypoxia training is more obvious than single hypoxia or exercise, and the lower oxygen concentration the more significant effect. Group C, group CE, group D and group DE significantly decreased the concentration of LDL-C, increased the content of HDL-C in serum than other groups (p < 0.05).(2) The concentration of serum Irisin in group AE, group BE, group CE and group DE rats was significantly higher than that in group A (p < 0.05), and the highest level was found in group CE and DE. The insulin resistance of obese rats in group CE and group DE was significantly better than that in group AE (p < 0.05). (3) Three different concentrations of hypoxia exposure and hypoxia training can significantly increase the skeletal muscle PGC-1α and FNDC5 gene expression, showing that the lower the concentration of oxygen, the higher the expression. 13.3% and 16.3% hypoxia training can significantly promote the gene transcription of UCP1. The contents of PGC-1α and FNDC5 protein in skeletal muscle of obese rats in group C, AE and DE were significantly higher than those in group A (p < 0.05). The expression of UCP1 protein in skeletal muscle of rats in group C, CE and DE was significantly higher than that in group A (p < 0.05).

Conclusions 13.3% and 11.3% oxygen concentration combined with endurance training can effectively reduce the body weight and visceral fat of nutritional obese rats, enhance serum HDL-C and decrease LDL-C levels and insulin resistance. 13.3% and 11.3% oxygen concentration training can significantly improve the level of serum Irisin, 11.3% oxygen concentration training can significantly promote the expression of PGC1α-Irisin-UCP1 gene and protein in skeletal muscle.
PO-179
The Association of Gait Speed and Quality of Life in Older Adults

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Objective With aging, the health and self-care ability of the elderly generally decrease, falling into frailty ultimately. In this process, the loss of muscle mass is very obvious, which will result in sluggishness, especially in walking speed. This study aimed to assess whether gait speed could be used as a predictor for health-related quality of life in older adults.

Methods 368 subjects were recruited from community-dwelling older adults. Gait speed measurements included usual gait speed (UGS) and fast gait speed (FGS), at a distance of 50 meters. Health-related quality of life (HRQoL) was assessed through SF-36 questionnaire. The correlation of gait speed and quality of life was analyzed.

Results Gait speed (both UGS and FGS) possessed a closed correlation with the total score of SF-36 questionnaire (r >0.6, P <0.05). Most subcomponent of HRQoL (Physical functioning, role limitations because of physical health problems, social functioning, vitality, and general health perceptions) are related to UGS and FGS, where the correlation coefficient is higher on FGS in Physical functioning, vitality, and general health perception than UGS.

Conclusions Gait speed is correlate to health-related quality of life in elderly people. Therefore, in health services for the elderly, we should strengthen the monitoring of gait speed, and take brisk walking as an effective way of exercise.

PO-180
The Effects of Aerobic Exercise on Spatial Learning and Memory and Expression of PDE-4 in Hippocampus of the Aging Rats

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Chengdu Sport Institute

Objective To discuss the effect of aerobic exercise intervention before aging rats and on aging rats, the spatial learning and memory abilities and the expression of PDE-4 in hippocampus.

Methods 64 male SD rats were divided into 4 groups at random (n=16): control group (group C), D-galactose aging model group (group A), Pre-aging aerobic exercise intervention group (group S1), Aerobic exercise intervention on aging group (group S2). After 6 weeks, each group was randomly divided into Morris water maze behavior training group (M group) and natural feeding group (N group), record as CM, AM, S1M, S2M, CN, AN, S1N, S2N. At the end of 7th week, all rats were killed and the cerebral cortex SOD, GSH-PX and MDA content were tested; The expression of PDE-4 gene in hippocampus was detected by Real-time PCR and Western blotting.

Results 1) The general state: When compared to the rats in C group, which in A group show obvious symptoms of aging, such as lethargy, loss of appetite, slow, yellow curly hair color, even off signs and so on; but S2 group were similar to C group; S1 group were a little worse than S2 group. 2) HE staining: When compared to the rats in C group, the hippocampus neurons in A group were disordered, the cells staining were deepened, the cytoplasm were edema, most of the interstitial cells were loose, and other morphological structure in aging state; S2 group were similar to C group; S1 group were a little worse than S2 group. 3) The free radical detection: Almost no difference in each corresponding M group and N group. The activities of the cerebral cortex SOD and GSH-PX in were consistent: C group and S2 group were significantly or
very significantly higher than others ($P<0.05/0.01$); The cerebral cortex MDA content: C group was the lowest, S2 group followed, and all significantly lower than those in A group and S1 group ($P<0.05$).

4)The Morris water maze test: the Positioning navigation experiment results showed that the spatial memory was preliminarily formed on the day 2, CM group, S1M group and S2M group formed stable spatial learning and memory on day 3, but that of AM group formed on day 4; The space exploration test results showed that the maximum number of times of through the site was CM group, the percentage of the original site quadrant of CM group was the highest, and there was a very significant difference with the other groups ($P<0.01$); S2 group followed, but AM group and S1M were relatively low.

5)The results of Real-time PCR and Western blotting: When compared to the rats in C group, which in A group and S1 group were very significantly higher ($P<0.01$), but which in S2 group was very significantly lower ($P<0.01$); When compared to the rats in A group, which in S2 group was very significantly lower ($P<0.01$), but S1 group were significantly higher ($P<0.01/0.05$); When compared to the rats in S1 group, which in S2 group was very significantly lower ($P<0.01$).

Conclusions

1) Aerobic exercise can improve the antioxidant capacity of the brain, protect and repair the hippocampal neurons, change the morphological structure of hippocampal neurons, improve and maintain the brain's spatial learning and memory, and thus delay brain aging.

2) Aerobic exercise intervention can down-regulate the expression of PDE-4 gene, may directly activate the cAMP/PKA/CREB signal transduction pathway to promote the synthesis of some learning memory proteins, thereby improving the learning and memory ability of aging rats and delay brain aging.

3) The different periods of aerobic exercise on brain aging intervention were different. Aerobic exercise intervention in the aging process performed relatively well. Tip: sustained aerobic exercise need to better play its role.

PO-181

Plasma metabolomics study on the anti-depression effect of different exercise modes on CUMS model rats

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Objective

Objective: To study the anti-depression effect of different modes of exercise on CUMS rats and explore the mechanism by ¹H-NMR metabolomics methods.

Methods

Methods: Healthy male SD rats were got on sugar consumption training within one week of adaptive feeding, rats with similar scores were then randomly divided into control group (group C), model group (group M), aerobic exercise group (group A), and resistance exercise group (group R) by open field test. Chronic unpredictable mild stress (CUMS) procedure was conducted for four weeks, assess the success or failure of the model through behavioral indicators (rat increased amount of body weight, sucrose preference, crossings and rearings in open field test). The rats that were successfully modeled continued to undergo CUMS procedure for four weeks, and the rats in group A and group R were given different exercise training at the same time. After the end of training, the rats were executed and the blood sample was taken from the abdominal aorta to determine plasma superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GSH-PX) activity and malondialdehyde (MDA) content. In order to further explore the mechanism of action of different exercise modes, the plasma was analyzed by ¹H-HMR metabolomics technique and the metabolic pathways were analyzed by metaboAnalyst.

Results

Results: 1) After 4 weeks of CUMS, the behavioral indicators of group M, group A and group R were significantly lower than those of group C ($p<0.05$, $p<0.01$, $p<0.001$), indicating that the rat model of CUMS was prepared successfully. 2) After 4 weeks of exercise intervention, the behavioral indicators, SOD, CAT and GSH-PX activities of rats in group C, group A and group R were significantly higher than those in group M ($p<0.05$, $p<0.01$), MDA content is significantly
lower than that in group M (p<0.01), there was no significant difference in behavioral and biochemical indicators between the group A and the group R. 3) A total of fifteen pathological markers were found in group M, such as isoleucine, valine, N-acetyl glycoprotein and so on (P<0.05 and VIP>1). Six metabolites among the fifteen pathological markers reverted significantly after aerobic exercise training (P<0.05 or P<0.001), such as N-acetyl glycoprotein, leucine, lactic acid, LDL, glucose and acetoacetate, which mainly involved in 3 metabolic pathways including ketone bodies, butanoate metabolism, and biosynthesis of branched-chain amino acids. Another six metabolites reverted significantly after resistance exercise training (P<0.01 or P<0.001), such as lactic acid, glucose, creatine phosphate, acetoacetic acid, inositol and choline, which mainly involved in 3 metabolic pathways including ketone bodies, butanoate metabolism, and inositol phosphate metabolism. The above results suggest that both modes of exercise can improve the characteristics of plasma metabolites of depressed rats.

**Conclusions**

**Conclusion:** Different modes of exercise can effectively improve depressive symptoms, reduce the oxidative stress and adjust the plasma biomarkers of depressed rats to varying degrees, which may be related to different metabolic pathways involved in exercise modes.

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**PO-182**

**Comparative study of dual energy X-ray absorptiometry and bioelectrical impedance test for body fat percentage**

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**China Institute of Sport Science**

**Objective**

To analyze and compare the correlation between dual-energy X-ray absorption method and bioelectrical impedance method in measuring body fat rate.

**Methods**

Twenty-one Chinese cyclists were selected as subjects, including 10 male cyclists, aged 21.11 (+ 2.52), height 179.7 (+ 5.01 cm), weight 80.93 (+ 10.94 kg) and BMI 25.0 (+ 28.3). Eleven female athletes, age 21.5 (+ 1.50), height 169.46 (+ 2.51 cm), weight 61.19 (+ 4.16), BMI 21.3 (+ 1.32). The body fat rate of the subjects was measured by dual-energy X-ray absorption GE tester made in America and bioelectrical impedance SECA515 tester made in Germany. The results of the two methods were analyzed and the correlation analysis was made.

**Results**

For the male athletes, the results of measuring body fat rate in by dual-energy X-ray absorption GE tester and bioelectrical impedance SECA515 tester were 12.81±5.14 and 16.15±4.44 respectively. The correlation coefficient r=0.927. For the female athletes, the results of fat rate were 18.28 ± 4.21 and 23.33 ± 3.65 respectively. The correlation coefficient r=0.929.

**Conclusions**

Dual-energy X-ray absorption GE tester and bioelectrical impedance SECA515 tester have high correlation in measuring the body fat rate of Chinese cyclists, but the data results have some differences, which need to be corrected.
PO-183

Experimental study on exercise intervention to improve cardiac risk during exercise in men aged 40~49 years

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Objective Through 12 weeks exercise interventions of different exercise volume (1200kal/w or 2000kcal/w) on 40-49 years old male subjects, trying to explore the effect of exercise intervention on the d risk indicators of ECG (ST, QTcd) during the exercise, to provide a scientific basis for the public health in the future.

Methods The subjects were randomly divided into 3 groups. (1) control group (n=9); (2) low volume group (n=7); (3) high volume group (n=8). The exercise group exercise intervention lasted 12 weeks. The indices of HRV at rest and risk indices of ECG (ST, QTcd) during exercise.

Results (1) Compared the underdraught of ST segment during exercise before and after the intervention, we found that exercise intervention did not produce significant change, and QTcd during the exercise in both high and low volume group after the intervention was significantly lower than before (P <0.05). (2) Compared the difference of ECG indices during exercise before and after, we found that descender of QTcd in low volume was significantly higher than the control group (P<0.05), while the descender of QTcd in high group was very significantly higher than the control group (P<0.01). The difference of ST segment in different group did not have significantly change.

Conclusions (1) 12 weeks exercise intervention (intensity of 65-80% VO2max, exercise volume of 2000kcal/w) has no effect under the pressure amplitude of the ST segment during the exercise. (2) 12 weeks exercise intervention (intensity of 65-80% VO2max, exercise volume of 2000kcal/w) produce QTcd during exercise significantly reduced, reducing the risk of exercise-induced myocardial ischemia.

PO-184

HIIT prescription and diabetes

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Objective To clarify the effect of HIIT prescription on diabetic mellitus (DM) and provide reliable exercise advise for DM patients. Method: Through literature

Methods Through literature method to collect studies by key words: HIIT, diabetic mellitus, T1DM, T2DM. And through data analyze method to organize the related studies to make a conclusion.

Results As a non-infectious metabolic disease, the incidence of DM is increasingly continuing in recent years. The epidemiological studies show that the global incidence of DM in the population aged 20-79 was 8.8% in 2015, and the total number reached 415 million. It is predicted that by 2040, the number of DM patients in this age group will reach 642 million with the prevalence rate rose to 10.4%. Insulin secretion and insulin signal transduction disorders are the main mechanisms of the onset of type 1 diabetes (T1DM) and type 2 diabetes (T2DM) respectively. The inducers of DM are complex, such as obesity, inactivity, insomnia and heredity. The current interventions for DM are mainly drugs, diet, exercise, self-monitoring and education. Among
them, exercise is accepted by the majority of diabetic patients because of its economic, fewer side effects and obvious effects. The occurrence of T1DM is closely related to heredity with the majority of adolescence patients. Due to insufficient insulin secretion, the clinical treatment of T2DM is mainly exogenous insulin injections. However, long-term insulin injections on the one hand leads to a continuous decline in the effect of insulin action, and are also a painful process for T1DM patients. Regular exercise can increase insulin sensitivity, decrease insulin resistance, promote the glucose uptake of skeletal muscle and regulate the blood glucose. However, the occurrence of exercise hypoglycemia makes it difficult for T1DM patients to insist exercise. The mechanism for the occurrence of exercise hypoglycemia is not clear, but studies show that it may related to insulin regulation change, counter-regulatory response decline and energy substrate metabolism disorder. Studies have shown that high intensity interval training (HIIT) prescription can avoid the occurrence of exercise-induced hypoglycemia caused by long-term moderate-intensity exercise to a certain extent. Therefore, the relationship between HIIT exercise and T1DM patients requires more research to prove. The occurrence of T2DM is accompanied by obesity. Obesity leads to the development of insulin resistance. A large number of studies have confirmed that exercise has a good intervention effect on obesity and T2DM. Compared with the traditional moderate intensity continuous training (MICT), HIIT has a better effect on reducing abdominal fat in the obesity. T2DM is often accompanied by many complications, such as diabetes cognitive dysfunction, diabetic Cardiomyopathy, diabetic liver disease and so on. The intervention effect of the HIIT prescription on these complications has also been confirmed by numerous studies. **Conclusions** As a non-pharmaceutical treatment of diabetes, exercise has obvious effects on diabetes intervention. The HIIT has gradually become one of the exercise intervention prescription because of its short time-consuming and obvious effects. However, the HIIT exercise prescription for DM patients of different ages, types, and complications remains to be further clarified.

**PO-185**

**Effects of different motor functional therapies on cognitive impairment in type 2 diabetes mellitus**

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**Objective** The clinical manifestations of diabetic cognitive dysfunction are decreased visual spatial ability, executive dysfunction, mental activity speed and attention, and decreased abstract logical reasoning. Cognitive dysfunction is irreversible. Timely and accurate assessment and diagnosis, early detection and intervention to delay disease progression are particularly critical. The Cognitive Assessment Scale plays an important role in screening for cognitive dysfunction in diabetes. To observe the effects of motor functional therapy on cognitive impairment and blood glucose, blood lipids, body weight, body composition, and maximal oxygen uptake in patients with type 2 diabetes.

**Methods** A total of 63 elderly patients with type 2 diabetes mellitus in Chengdu community aged ≥65 years and educated for ≥12 years were enrolled in the motor function therapy group according to the simple mental state examination (MMSE) score (diabetes cognitive impairment, MMSE total score ≥ 20 points, aerobic exercise group, n = 21) and functional function therapy group (diabetes cognitive impairment, MMSE total score ≥ 20 points, resistance exercise group, n = 21). The adult community of diabetes in Chengdu (normal cognitive function) with age ≥ 65 years, education time ≥ 12 years, and MMSE total score ≥ 24 points was used as the control group (n=21). Montreal Cognitive Assessment Scale (MOCA): MOCA is an assessment tool developed by Nasreddine and clinically proven to be used for rapid screening of MCI. There were no statistical differences in baseline data (age, gender, and hypertension incidence) among the 3
groups of patients. The LOTCA scale was used to evaluate the cognitive function of the subjects and to compare between groups. Sixty-three patients with type 2 diabetes were randomly divided into aerobic exercise intensity group (50% VO2max) (n=21), resistance exercise intensity group and control group (n=21). Both the aerobic exercise group and the resistance exercise group underwent a 12-week moderate-intensity exercise three times a week. The resistance middle strength group was trained 2 groups each time, each group was 25 minutes, the group rested for 5 minutes, 55 minutes in total, and the aerobic medium intensity group continued to exercise for 55 minutes. All patients underwent fasting blood glucose (FPG), glycated hemoglobin (HbA1c), total cholesterol (TC), triglyceride (TG), low density lipoprotein (LDL), body weight, and fat weight (FW) before and after training. 

**Results**

There were no significant differences among the three groups before the test (P>0.05). All the indexes of the medium-intensity resistance exercise group and the medium-intensity aerobic exercise group were significantly different from the control group (P<0.05). After the MOCA score test There was an improvement in the score before the trial, and the total score of LOTCA was significantly different among the three groups. In addition to perceptual sub-items (item identification), the aerobic exercise group and the resistance exercise group LOTCA scale in perceptual sub-projects (incomplete object recognition), visual motion organization and its sub-projects (copying two-dimensional graphics, building blocks) The design and puzzle) project scores were higher than before the test, close to the control group score. The scores of the two groups of exercise therapy in the thinking operation and its sub-projects (Riska organized shape classification, picture arrangement B and geometric reasoning) and attention-focused items were lower than the control group. Compared with the resistance exercise, there was a significant difference in the maximum oxygen uptake between aerobic exercise and resistance exercise (P<0.05). Compared with the total exercise energy consumption in the first 6 weeks, the aerobic exercise group was superior to the resistance exercise group. The total exercise energy expenditure was compared in the last 6 weeks, and the resistance exercise group was superior to the aerobic exercise group.

**Conclusions**

Elderly patients with type 2 diabetes may have cognitive impairment earlier. In the absence of differences in exercise, the aerobic exercise group and the resistance exercise group improve cognitive impairment, blood sugar, blood fat, body weight, and body composition in patients with type 2 diabetes. There is no significant difference. Compared with MMSE, LOTCA has the advantage of identifying early cognitive impairment in elderly patients with type 2 diabetes and distinguishing the severity of the damage.

**PO-186**

**The Influence of Different Route Randomness on Energy Contributions of College Students' Badminton Running Practice with Change of Direction at Two Frequencies**

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**Objective**

Badminton four-corner running practice with change of direction commonly includes fix route and random route. However, the study of the energy contributions characteristics of these two training methods was very limited. The aim of this study was to investigate the influence of different route randomness on energy contributions of college students' badminton running practice with change of direction at two frequencies.
Methods 15 college badminton player whom from Shanghai University of Sport (Male, N=15, 22.9±1.4 yrs, 175.7±6.0 cm, 68.0±6.4kg, badminton training experience 2.2±0.5 yrs) volunteered to perform one test for maximal oxygen uptake \((VO_{2max})\) on treadmill and four field tests with two route randomness (fix route and random route, F and R ) and two frequencies (24 times per 1min and 24 times per 1min, H and L ) of change of direction. A portable spirometric system (K4b², Cosmed, Italy) was utilized to measure the ventilator information during the test, and capillary blood was taken from earlobe and analyzed prior and post the tests. The energy contributions was calculated with the method based on the fast component of oxygen debt \((W_{Ala})\), accumulated blood lactate \((W_{La})\) and \(VO_{2}\)\((W_{Aer})\) during the tests.

Results Higher frequency significantly increased the energy contributions from the three pathways both with F and R \((W_{Ala}:26.2±6.3 kJ vs. 39.5±12.6 kJ, W_{La}: 5.7±2.4kJ vs. 23.1±9.3 kJ, W_{Aer}: 27.1±6.5kJ vs. 33.3±5.7kJ, P<0.01), and significantly increased the \(W_{La}\) \((F: 23.9±8.1% vs. 9.6±3.4%, P<0.01; R: 30.5±6.6% vs. 11.7±5.2%, P<0.01), whereas significantly reduced the \(W_{Aer}\% \) \((F: 35.2±6.5% vs. 46.0±8.5%, P<0.01; R: 35.7±5.4 % vs. 50.4±10.2%, P<0.01). The R significantly reduced the \(W_{La}\% \) both in L \((44.4±8.5% vs. 38.0±8.6%, P<0.05) and H \((40.9±10.5% vs. 33.8±8.6%, P<0.05), significantly increased the \(W_{La}\) \((23.1±9.3kJ vs. 28.9±7.3kJ, P<0.05) and \(W_{La}\% \) \((23.9±8.1% vs. 30.5±1.7%) in H.

Conclusions The route randomness of badminton running practice with change of direction at two frequencies has different effects on the energy contributions. The R will reduce the stimulation to the \(W_{Ala}\) and increase the stimulation to the \(W_{La}\); the H will increase the intensity of the running with change of direction as a whole, and will reducing the stimulation to the \(W_{Aer}\) and increasing the stimulation to the \(W_{La}.\) It is recommended that the coaches can change the stimulation of the \(W_{La}\) by changing the frequency of the change of direction and the randomness of the route when design the badminton four-corner running practice with change of direction.

PO-187
Survey and Exercise Prescription Formulation on the Physical Fitness of 36-45 years Old Female Teachers

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Objective Chinese scholars believe that physical fitness means that individuals have sufficient energy to do daily work (study) without fatigue, spare no effort to enjoy the fun of leisure life, and have the ability to adapt to emergencies. According to the American academy of sports medicine, physical fitness includes "fitness for health" and "fitness for skill". Healthy fitness includes: cardiovascular fitness, muscle fitness, flexibility fitness and body fat percentage. In this study, female teachers aged 36 to 45 from Taiyuan institute of technology were tested for fitness test based on body composition, bone density and cardiovascular fitness to understand the fitness status of its health body and analyze its possible causes in combination with the questionnaire. The health risk analysis and the exercise prescription of improving health fitness were given to different teachers.

Methods The Research uses the questionnaire survey method and the interview method to investigate the teacher’s life rule, the experimental method to test the female teacher's body composition, the bone density, and the cardiovascular fitness. The main indicators are as follows: (1) Body composition index (Acmeway BH-380 Body composition analyzer, China): height, weight, body mass index, body fat rate, fat volume, visceral fat content. (2) Bone mineral density index (GE Achilles EXPII, America): T value, Z value, bone strength index. (3) Cardiovascular Fitness Index (A&D TM-2656VP, Japan): systolic and diastolic pressure.

Results The body mass index of female teachers in this age range is 25.8±2.6 kg/m². Body mass index is in the normal value of high close to the overweight threshold relative standard value.
The BMI of female teachers aged 36 to 45 at Taiyuan Institute of Technology is within the normal range but close to the threshold of overweight and has health risks, which should be paid attention to. This people has high fat rate; The T value of bone mineral density indicates that it belongs to normal and healthy bones, but it is close to the threshold of bone oligopolies, and there is a certain risk. Blood pressure of cardiovascular fitness is in the high range of this age standard, indicating a certain risk of cardiovascular fitness.

Conclusions: The BMI of female teachers aged 36 to 45 at Taiyuan Institute of Technology is within the normal range but close to the threshold of overweight and has health risks, which should be paid attention to. This people has high fat rate; The T value of bone mineral density indicates that it belongs to normal and healthy bones, but it is close to the threshold of bone oligopolies, and there is a certain risk. Blood pressure of cardiovascular fitness is in the high range of this age standard, indicating a certain risk of cardiovascular fitness.

Suggestions and exercise prescriptions: The main reasons for the questionnaire analysis are: (1) The high pressure mainly from work, life, psychology and society. (2) Bad living habits: some teachers have irregular diet, poor sleep quality and unpunctuality. (3) Lack of physical exercise: they often engaged in copywriting work, with few times of exercise and short time of each exercise, and their health consciousness is shallow. (4) Lack of scientific planning and guidance for physical exercise, and be in a state of blind exercise.

It is suggested that college teachers should carry out assessment and analysis of body composition, bone density and cardiovascular fitness at least once every 3 months, so as to timely find out potential or existing problems, and then take targeted measures to improve the health awareness of college teachers and reduce the risk of disease. Schools should pay more attention to the health of college teachers. The corresponding exercise prescription is formulated for each teacher, and the core exercise goal is to improve the fitness level of healthy body. The exercise method is a combination of aerobic exercise, total body strength, flexibility exercise and other exercise items. Please do warm up before exercise and relax after exercise.

(1) Aerobic exercise: rhythmic gymnastics, skating, jogging, badminton and other sports can be carried out, and the target rate is kept at 100-135 times/min. Subjective feeling is best if you feel a little bit hard, as you can feel the body heat, breathing faster.

(2) Body strength training: Vibration can be prone leg, reverse abdominal muscle contraction, the frog sat, sit-ups; Hand strength exercises for lower abdomen, arm and back, leg and shoulder dumbbells. Use your weight load to hold in a relatively fixed position for 3-10 seconds. The five movements are one group, 15-20 times each.

(3) Flexibility exercises: hurdling posture to stretch, Hurdle stretch, Bow forward, Hip stretch, Stretch your waist and legs and other equitant stretching. The intensity of the exercise is to feel the muscles being stretched until they feel they are being stretched. Each movement is held at a fixed position for another 10-30 seconds. If you feel uncomfortable, you need to ease the tension. Be careful not to use too much or too much force in practice to prevent muscle strain.

PO-188
Effect of high-fat diet on body weight and spontaneous physical activity of SD rats
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Objective Background: Excessive intake of high-energy foods and insufficient levels of physical activity are important causes of obesity. In addition, inadequate physical activity is also a major cause of cardiovascular disease and type 2 diabetes. Relevant data suggests that most adults fail to achieve the level of physical activity needed to improve their health. Therefore, understanding
the reasons for the lack of physical activity levels is essential for developing a reduction in sedentary and thus preventing chronic acute illnesses. It is well known that physical activity is good for health, but little is known about the genetic and biological factors that may affect this complex behavior. Some studies have shown that diet-induced obesity may alter dopaminergic activity and thus reduce physical activity levels, suggesting that obesity and diet may be inversely related to dopamine signaling. Therefore, it is necessary to further study the correlation between obesity, dopamine and physical activity levels, and to explore the relationship between high-fat diet and body weight changes and physical activity levels.

Methods

Methods: Sixteen male Sprague-Dawley rats were randomly divided into two groups. The control group (n=8) was fed with basal diet for 8 weeks, and the high-fat group (n=8) was fed with high-fat diet for 8 weeks. To compare the difference in body weight and physical activity between SD rats fed with high-fat diet and normal diet, and the relationship between body weight and body activity level; in order to study the effect of obesity on exercise behavior, use the open field experimental recorder for each. The movements of the rats in the group were recorded (autonomic activity for 30 min), and the correlation between the effects of high-fat diet on body weight and spontaneous activities of SD rats was analyzed.

Results

RESULTS: High-fat diet and normal-fed rats were in energy intake (high-fat group 4583.94±349.85; control group 3201±298.58), body weight (high-fat group 406.23±29.35; control group 306.66±31.44) and Lee’s index (high-fat group 26.17 ± 0.57; control group 24.35 ± 0.97) were significantly different. There was a high correlation between energy intake and body weight in rats, correlation coefficient r=0.911 (p<0.01); correlation coefficient between body weight and physical activity level r = 0.576 (p < 0.05). In addition, by comparing the exercise time and average speed of rats in each group, the difference in exercise time between the two groups was not significant, and the average speed difference was significant (p<0.05); exercise time was significantly correlated with physical activity level, r = 0.734 (p<0.01); and the mean speed was also positively correlated with physical activity level, and the correlation coefficient was 0.660 (P<0.01).

Conclusions

Conclusions: Obesity is greatly affected by dietary factors, and long-term high-fat diets lead to a decline in physical activity, which in turn promotes further deterioration of obesity. This interaction can create a vicious circle between obesity and physical activity. Further research on the mechanisms of obesity, lack of physical activity and their interaction may provide a theoretical basis for increasing the level of physical activity in obese people.

PO-189

The Effects on Mitochondria of Exercise Intervention PINK1 RNAi Drosophila Model of Parkinson's Disease Progression

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Objective

This research were using PINK1 RNAi drosophila model as object to investigate the effects of the 3 weeks duration exercise intervention drosophila model of Parkinson's disease progression. Including mitochondria gather situation and mitochondria complex I activity and climbing activity and wing posture. Trying to prove that Exercise-training can help with the Parkinson disease’s symptom, and also to find out the mechanism of the result.

Methods

Two genotype were used in this research, the normal type VAS-mtGFPo Mhc/Mhc and the Parkinson type VAS-mtGFP/Cyo Mhc-RNAi/TM2 and all with fluorescent labeling mitochondria by GFP. The exercise-training last for 3 weeks, 5 times per week, we separated the Parkinson type in 4 groups by different training time: 0min per day, 30min per day, 60min per day
and 90min per day. The healthy type was control group. We measured the climbing ability and the wings posture every week, also used confocal microscope to watch the aggregation of mitochondria of the chest muscle every week. After 3 weeks training, we grinded all the drosophila to get the mitochondria, and measured the activity of mitochondria complex I. At last, we compared every index of each group with T-test by using SPSS 17.0 and the significance level as the criterion.

**Results**
1) The climbing ability: No significant difference found in first week, there was a significant difference between 0min group and 30min group in second week and there was a very significant difference between 0min group and 30min group in third week. (P<0.01).
2) Wing posture: There was a very significant difference between 0min group and 30min group in third week. (P<0.01).
3) Activity of mitochondria complex I: Because of the small sample of this experiment, we can’t get a appropriate concentration of mitochondria, but we still got some changes between 30min and 0min. 4) The pictures of mitochondria by confocal microscope: The 30min group has the least aggregations of the mitochondria but a lot aggregations were found in other pictures of other group.

**Conclusions**
1) The suitable Exercise-training can improve the climbing ability and the account of wing posture and extend the life span of drosophila model of Parkinson’s disease. 2) The suitable Exercise-training can relieve the situation of mitochondrial gathering and improve the activity of mitochondrial complex I.

**PO-190**

**Effect of Trunk Resistance Vest on Running Economy at Different Speed in Male Collegiate Students**

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**Objective**
Wearable resistance training is a common method utilized by athletic and fitness population during running. This method is demonstrated to have multiple athletic and health benefits despite of its potential risk for running technique. Running economy is a measure for running technique, which is defined as the oxygen uptake (VO2) at a given sub-maximal speed. The purpose of this study is to evaluate the effect of wearable resistance on running economy at different running speed in male collegiate students.

**Methods**
18 male collegiate students from Shanghai University of Sports (age: 22.4±2.4yrs, height: 177.4±7.5cm, body mass: 69.3±8.2kg, training experience: 4.6±1.6yrs, body fat: 13.3±4.7%) volunteered to perform one two four-stage incremental tests (8km/h, 10km/h, 12km/h, 14km/h) with and without a trunk resistance vest (10% of individual body mass). The duration of each stage was 5 min, and intermittent per stage was 1 min. A portable spirometric system (K4b², Cosmed, Italy) was utilized to measure the ventilator and heart rate index during the test. The running economy was calculated as the averaged VO2 in the last minute of each stage. The capillary blood was collected from the earlobe after each stage IBM SPSS Statistics 19 (IBM Corporation, USA) was used to carry out a one-way repeated measurement ANOVA analysis on the physiological results at different speeds, and Paired-T test was to statistical analysis the normal and trunk vest test at the same speed. P<0.05 was set as the significant level.

**Results**
Along with the increase of speed, VO2, heart rate, blood lactate concentration and RPE was increased significantly (P<0.05, except 12km/h and 14km/h without vest, and 8km/h and 10km/h with vest). The running economy was slightly lower in running with vest at each running speed compared with without vest (P>0.05). However, the blood lactic concentration with vest was higher than that without vest at all speed, with the difference significant at 14km/h (9.3±2.9
The RPE was significant higher with vest than without vest at each speed (P<0.05, except at 8km/h).

**Conclusions** Running with trunk resistance vest of 10% body mass is characterized with slightly better economy, although it induces a significant higher blood lactic concentration and RPE.

**PO-191**  
**Study On The Effect Of Exercise On Intestinal Flora And Its Mechanism**

**Objective** To explore the relationship between exercise and intestinal microbes, and to analyze the effect of exercise on intestinal microflora to affect the health, in order to provide a theoretical basis for the study of the future exercise and the intestinal microorganism.

**Methods** the PUBMED and Google academic articles were used to retrieve articles related to intestinal microorganism and exercise from June 1, 2008 to June 1, 2018. The key words: "Exercise" and "Microbiome (intestinal microorganism)". Inclusion criteria: (1) study on the correlation between intestinal flora and host.(2) The study of the effect of exercise intervention on intestinal flora. (3) exercise changes the intestinal flora and affects the physiological and pathological state of the host. A total of 76 Chinese and English related literatures were retrieved, and 32 articles were included in the final analysis according to the screening criteria.

**Results** there are several important correlations between the intestinal microflora and the host: (1) the intestinal microorganism has the function similar to the endocrine organ, which can produce a large number of hormones in the body, release it into the blood and play its role in the distal organ. (2) the immune system components in the host are directly or indirectly regulated by microbes, such as the metabolites of microbes that induce the expression of immune cells, promote or inhibit the occurrence of inflammatory reactions.(3) Intestinal microbes affect the metabolism of the body and participate in the synthesis of vitamins and the absorption of calcium and magnesium plasma. The effect of exercise on intestinal flora is mainly reflected in the following aspects: (1) the general influence of exercise on the intestinal physiology; reducing the digestion time of food in the gastrointestinal tract, thus affecting the composition of the intestinal flora. Exercise reduces gastrointestinal blood flow and affects gastrointestinal endocrine changes. (2) There were great changes in the intestinal microflora of obese mice induced by high fat diet. Exercise could normalize the abnormal groups of the mice and improve the anxiety induced by high fat diet. (3) The mice in the exercise group showed a higher concentration of n-butyric acid than those in the lack of exercise, suggesting that the change in the intestinal microbial environment caused by exercise may be an important reason for the improvement of gastrointestinal diseases. (4) Exercise to improve cardiopulmonary endurance can increase the diversity of intestinal flora, and the diversity of intestinal flora is positively correlated with host health and other related indicators. (5) Exercise affects the number and diversity of intestinal microflora and leads to changes in certain specific strains, and the changes in most specific strains are closely linked to the health level of the body and the production of chronic diseases.

**Conclusions** as a kind of non drug intervention with great potential and effective, exercise can regulate the number and diversity of the intestinal microorganism in the host, so as to improve the physiological and pathological state of the host and promote the health.
PO-192
Effects of Different Cryotherapy Models on Timing Sequence Recovery of Exercise Induced Muscle Damage in Middle and Long Distance Runners

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Objective Exercise induced muscle damage (EIMD) is one common physiological phenomenon in competitive sports and mass sports. Water immersion recovery and whole body cryotherapy (cryostimulation) (WBC) has become one of the fast recovery methods adopted by high level athletes in the world. The aim of this study was to compare the water immersion recovery and WBC from timing sequential recovery on EIMD, subjective scales, biochemical indicators, exercise performance indicators.

Methods Twelve middle and long distance runners from Beijing Sport University were recruited in this study (exercise performance is secondary level in China). All participants performed four models in four weeks which included rest control (CON), cold water immersion (CWI), contrast water therapy (CWT) and whole body cryotherapy (cryostimulation) (WBC) separated by one week. The subjects needed to complete the EIMD exercise program, includes two parts: the treadmill running and the jump step. The individual speed of treadmill running was based on the individual VO2max. running including 5 sets and total time is about 90 min. Every set consist of 6 min flat running, 6 min uphill running and 6 min downhill running. The speed of the treadmill was stable in different stages. The slope of the uphill running is (+6,+5,+4,+3,+2), and the slope of downhill running is (-8,-7,-6,-5,-4). The jump was performed 20 times separated by 30 s via special step (height is 40 cm). After the EIMD exercise program, the subjects were treated with different recovery methods immediately after exercise, 24 h, 48 h, 72 h after exercise, while CON group received no intervention. The CWI group was immerged in 15 °C cold water for 12 min, and the CWT groups was immerged in 15°C cold water for 1 min and 38°C hot water for 1 min with 6 cycles. The whole body cryotherapy (cryostimulation) group was immerged in special chamber (-110—-140°C) for 3 min. The three interventions were immerged body to the position of shoulders. The indexes including subjective scales (VAS scale, RPE scale, Borg scale, WHO deep sleep scale, PQSI scale), biochemical indicators (creatine kinase, lactate dehydrogenase, myoglobin, interleukin-6, C reactive protein, SICAM-1), exercise performance indicators (vertical jump height, grip, running distance). The indexes was collected in different periods (i.e. Before exercise, immediately after exercise, Post1h, Post 24h, Post 48h, Post 72h, Post 96h after exercise etc.).

Results (1) Subjective scales. From results of VAS scale, RPE scale, and Borg scale, the WBC had best recovery effects than the other three interventions (P<0.05). The recovery effect of the CWI group was similar with the CON group. From results of WHO deep sleep scale and PQSI scale, the WBC group had better recovery effects than CON group (P<0.05). (2) Biochemical indicators. From results of CK, Mb and SICAM-1, the WBC group had better recovery effect than the other three groups (P<0.05). In the LDH, the WBC group had similar effects with the CWT group (P>0.05). From results of CRP and IL-6, the WBC group had better recovery effects than the other three groups (P<0.05). (3) Exercise performance indicators. From results of vertical jump, WBC had lower decrease than the other three groups (P<0.05). From results of the grip, of the WBC and CWT groups have significant retentive effects than CON group (P<0.05), but there was no significant difference between CON and CWI groups (P>0.05).

Conclusions (1) Through combine the treadmill running and the jump step exercise program, Can effectively lead to human body appear the EIMD. (2) WBC has positive effects on the subjective scale, biochemical indicators, exercise performance indicators associated with EIMD. For middle and long distance runners EIMD, compared with CWI CWT, WBC effect is better. (3) CWI and CWT has a positive effect on some subjective scales, biochemical indicators, and exercise
performance indicators related to EIMD. However, the positive effect of CWI and CWT is lower than WBC in the extent of action and timing sequence. (4) For the middle and long distance runners EIMD timing sequence recovery effects, WBC have better effects. Followed by CWT, CWI effect is not significant.

PO-193
Physiology of Aerobic Exercise in Atherosclerosis

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Objective: Atherosclerosis is a progressive disease characterized by the accumulation of lipids, fibrosis, and local inflammation. Atherogenes can be regarded as a response to injury, with lipoproteins or other risk factors as the injurious agents. Although the mechanisms by which aerobic exercise reduces the development of Atherosclerosis is remain incompletely understood, studies on the physiological effects of exercise on atherosclerosis have been increasing rapidly, involving several major aspects, such as improving lipid metabolism, antioxidation, anti-inflammation, improving vascular endothelial dysfunction, etc.

Methods and results: Douglas R. Seals[1] has been summarized their work over the last 15 years related to one of the most potent available strategies for preserving vascular function: aerobic exercise. He found that aerobic exercise inhibits large elastic artery stiffening with aging and preserves endothelial function. Aerobic exercise protects aging arteries, not only by lowering the risk factor burden to which they are chronically exposed, but also by improving the intrinsic resistance of the arteries to existing levels of a variety of potentially harmful factors.

Dyslipidemia, oxidative stress and inflammation are the causes and developmental factors of vascular endothelial dysfunction and then result in Atherosclerosis. Although the mechanism of exercise-induced lipid changes is unclear, exercise may increase blood lipid consumption hence to decrease lipids levels[2]. It has been consistently showed that concentration of low-density lipoprotein cholesterol (LDL-C) increasing is associated with an increased risk of artery plaque and hemadostenosid[3]. High-density lipoprotein cholesterol (HDL-C) is a main and independent predictor of vascular endothelial dysfunction, which has been confirmed by many prospective studies on different racial and ethnic groups worldwide[4,5]. Moreover, triglycerides (TG) can enter the arterial wall with a mild to moderate increase concentration, and then accumulate at there, thus causing the possibility of atherosclerosis.

Endothelial dysfunction is associated with arterial oxidative stress because of excessive vascular superoxide production and reduced antioxidant defenses[6,7]. Aerobic exercise prevents exacerbation of vascular oxidative stress in response to these adverse factors, which allows the preservation of NO bioavailability and arterial function.

Immune and inflammatory responses have important effects on every phase of atherosclerosis, and many evidence shows that immunity plays a more important role in atherosclerosis by regulating its progression. Macrophages play an key role in the inflammatory response, and following their activation are involved with other immune cells in the advanced atherosclerotic lesion. Some percentage of the immune cells infiltrate the endothelial layer, with the infiltrating monocytes differentiating into macrophages. The macrophages and other immune cells lodging in the arterial wall can release superoxide and proinflammatory cytokines, stimulating inflammation and possibly contributing to a chronic low-grade inflammatory state. In general, oxidative stress and inflammation are the primary "macro-mechanistic" processes thought to be involved in mediating endothelial dysfunction, and aerobic exercise is believed to preserve/restore endothelial function. Changes in expression and activation of eNOS as a possible contributor to altered NO signaling. Inflammation and oxidative stress are mutually enhancing this processes, so it is not surprising that the development of chronic low-grade inflammation is a hallmark of primary vascular aging.
The most important of these endothelial-derived molecules is nitric oxide (NO), which exerts a provasodilatory and anti-coagulative, -proliferative, and -inflammatory protective effect on arteries [6,8,9]. Endothelial dysfunction can be defined as any alteration from the healthy endothelial phenotype and typically is associated with reduced NO bioavailability [6,8,9]. Aerobic exercise inhibits the development of excessive superoxide-dependent vascular oxidative stress via some combination of suppressing the upregulation of superoxide dismutase (SOD) and the NADPH oxidant enzyme system, preventing the uncoupling of eNOS, constraining mitochondrial superoxide production, and preserving endogenous antioxidant enzyme defenses. This restraint of superoxide-associated oxidative stress, along with induction of eNOS expression and activation, contribute to greater NO bioavailability.

**Conclusions:** Clinicians has always been excessively reliant on drugs to treat patients with Atherosclerosis. Recently, it is advocated to do aerobic exercise. Such knowledge should aid in preventing and treating dyslipidemia, oxidative stress, inflammation, vascular endothelial dysfunction while reducing the risks of atherosclerosis.

**PO-194**

**Treadmill Running Ameliorates Alcohol-Induced Malfunctioning of Intra- and Extra-Mitochondrial Enzymes in Liver of Aged Rats**

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**Objective** Alcohol consumption particularly at old age can cause severe liver damage through malfunctioning of vital organelles, including mitochondria. Exercise is known to improve the cellular functions against alcohol-induced adverse effects and oxidative stress. Nevertheless, whether exercise can promote mitochondrial function in old alcohol-fed rats remains unclear. In this study, we investigated the effect of exercise training on intra- and extra-mitochondrial enzyme activities in alcohol/ethanol treated rats.

**Methods** Young (3-month, n=24) and old (18-month, n=24) Wistar albino rats were equally divided into control, exercise, ethanol and combination of exercise plus ethanol treated groups. Following treadmill exercise (23 m/min, 30 min/day 5-day/wk) and ethanol (2 g/kg b.w.) treatment for 2 months, cytosol and mitochondrial enzyme activities, triglycerides and phospholipids were estimated in the liver of young and old rats.

**Results** We found ethanol intoxication significantly decreased (P<0.01) the hepatic intra- and extra-mitochondrial enzyme activities, including glucose-6-phosphate dehydrogenase (G6PD), succinate dehydrogenase (SDH), malate dehydrogenase (MDH) and glutamate dehydrogenase (GDH) in both young and old rats. However, exercise training considerably reversed the loss of these enzyme activities, and further maintained above control levels in respective age groups. Restoration of mitochondrial marker enzymes (SDH and GDH) with exercise against ethanol-loss was prominent in young compared to old rats, which indicates old rats are prone to alcohol-induced adverse effects. Alcohol-induced elevated LDH levels in both ages were slightly decreased by exercise plus ethanol treatment. We further noticed that amplified triglycerides and phospholipids were substantially decreased following treadmill exercise in both age groups. Decreased triglycerides level with exercise was prominent in young alcohol-fed rats than that of old.

**Conclusions** Our results imply that 2-month treadmill exercise training effectively ameliorated the ruined cytosol and mitochondrial enzyme activities in young and old ethanol-fed rats. Improved mitochondrial enzymes and decreased triglycerides with exercise training may protect the alcohol-induced liver damage.
PO-195
The Regulation of Vimentin in Skeletal Muscle Fibrosis Affected by High-load Exercise

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**Objective** Long-term movement could induce micro-damage of skeletal muscle, increase collagen significantly, and appear skeletal muscle fibrosis. Vimentin is one of the most important proteins in evaluating the fibrosis after muscle injury. TGF-β1 could up-regulate Vimentin expression, promoting cell migration and accelerating fibrosis and injury repair. This study mainly explored the role of TGF-β1/Vim in skeletal muscle fibrosis affected by a bout of high-load exercise. And we tried to find whether the expression of vimentin could regulate the regeneration of muscle fiber and the remodeling of connective tissue.

**Methods** SD rats were divided into 7 groups: control group, immediately, 6-hour, 12-hour, 24-hour, 48-hour and 72-hour after group. Western Blot was used to detect TGF-β1, vimentin, RhoA, ROCK1 and CTGF (connective tissue growth factor) expressions. Electron microscopy was used to observe the changes of collagen in skeletal muscle.

**Results** Vimentin protein expression increased quickly at 6-hour after exercise. At 48-hour, the vimentin expression reached the peak. And then the expression of vimentin gradually decreased. The expressions of TGF-β1, RhoA, ROCK1 and CTGF gradually increased after exercise. The peak of these expressions appeared at 12-hour respectively. Then these protein expressions declined slowly. Collagen in skeletal muscle became long and thick in 48-hour and 72-hour after exercise.

**Conclusions** A bout of high-load exercise could induce skeletal muscle fibrosis. RhoA-ROCK1 maybe affect TGF-β1/Vim expressions as main regulators, and then the protein expression vimentin could regulate the regeneration of muscle fiber and the remodeling of connective tissue as an important evaluation factor.

PO-196
The Neuroprotective Effects of Aerobic Exercise and Oral Resveratrol on Hippocampal Neurons in Diabetic Rats

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**Objective** The purpose of this study is to explore the effects of aerobic exercise combined with oral resveratrol on ethology and BDNF and CREB proteins of hippocampus neurons in diabetic rats, in order to provide a theoretical basis for revealing the neuroprotective mechanism of exercise and resveratrol.

**Methods** 45 male Sprague Dawley rats, aged 8 weeks, were randomly divided into 5 groups: normal control (NC), diabetes control (DC), diabetes exercise (DE), diabetes resveratrol (DR) and diabetes exercise and resveratrol (DER). Exercise-related groups performed 8-week swimming training (60min/d. 5d/week). Morris maze test, 7d. Escape latency time, strategy of finding platform performance, the protein expression of BDNF and CREB from hippocampus neurons were measured.

**Results** 1) Compared with DM, DR and RE groups, the escape latency of DRE group was significantly shortened (p<0.01), and the strategy of finding platform performance was remarkably
improved (p<0.05). 2) Compared with NC group, the protein expression of BDNF of DM group was obviously decreased (p <0.01), while in DRE group was improved significantly than that in DE group (p< 0.05). 3) The level of CREB expression in DM group clearly lower than in group NC (p<0.01), and the expression of CREB in DER and DE groups were remarkably increased (P <0.01).

**Conclusions** Eight weeks of swimming training and/or oral resveratrol could increase the expression level of BDNF and CREB protein in the hippocampal neurons of diabetic rats, and improve the ability of spatial learning from behavioral study. It is suggested that the aerobic exercise training and the SIRT1 mechanism of resveratrol perhaps improve the situation of high glucose and indirectly stimulate the expression of BDNF and CREB protein. As a result, that leads to improve the impair of learning and memory which caused by diabetes.

**PO-197**

**Research progress of exercise therapy on type 1 diabetes mellitus**

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**Objective** Type 1 diabetes mellitus (T1DM) is an autoimmune disease with a clear genetic basis, and early islet cell function appears clearly in recession or even lost. Insulin deficiency allows patients to rely on exogenous insulin for life, and long-term complications seriously affect quality of life and shorten life expectancy.

**Methods** This paper retrieves 1998-2018 years' literatures on "Sports" and "type 1 diabetes" through the PubMed database, and collate and analyze the progress of the research and induction of type 1 diabetes exercise therapy.

**Results** Numerous studies have shown that regular physical exercise can reduce the daily insulin dose in patients with T1DM. At the same time, they should master the contraindications in order to avoid the risks of movement. Currently a recommendation for all T1DM patients is engaging in at least 150 min/week of moderate to vigorous intensity aerobic exercise, sustainability or HIIT, combined with resistance training such as resistance machines and bands, as well as other stretching and balance exercises such as yoga, tai chi, 3 to 7 times per week which is depended on the physical condition of patients and exercise intensity, and resistance training can be performed on nonconsecutive days.

**Conclusions** So patients need to be clear how to safely increase their physical activity, and incorporate more independent physical activity into daily life.
**PO-198**

**Urinary metabolomics study on the anti-depression effect of different exercise modes on CUMS model rats**

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**Objective** To study the effects of different exercise modes on CUMS depression model rats by ¹H-NMR metabolomics technique, and to explore the mechanism of exercise anti-depression and to find the best exercise mode.

**Methods** Forty-eight male SD rats were divided into control group (group C), model group (group M), aerobic exercise group (group A), and resistance exercise group (group R), 12 per group. The group C was routinely rearred, chronic mild unpredictable stress + orphaned 8 weeks to establish a depression model of CUMS rats. In the 5th week of modeling, rats in group A and group R were trained in aerobic and resistance exercise for 4 weeks. The changes of body mass were observed during the experiment. The effects of exercise on the behavior of CUMS rats were observed by sucrose preference experiment and open field experiment. The levels of plasma BDNF, CORT and 5-HT were measured to reveal the pathological changes of the model. ¹H-NMR metabolomics techniques combined with multivariate statistical analysis methods were used to investigate the regulation of urinary endogenous metabolites and the regulation of metabolic pathways in CUMS depression rats.

**Results** 1) After four weeks of modeling, compared with the group C, the body weight, saccharide water preference rate, the crossing number and the number of erectings in the group M, group A and group R were significantly lower (P<0.05 or P< 0.01), indicating that the modeling was successful; after eight weeks of modeling, compared with the group C, the body weight, saccharide water preference rate, the crossing number and the number of erectings in the group M, was significantly lower (P<0.01). There was no significant difference in the group A and group R. 2) Compared with group C, the levels of BDNF and 5-HT in group M were significantly decreased (P<0.05 or P<0.01), the level of CORT was significantly increased (P<0.01), and the levels of BDNF, 5-HT and CORT in group A were not significantly different, the CORT levels were significantly increased in group R(P <0.01), BDNF and 5-HT levels were not significantly different; compared with group M, BDNF, 5-HT levels in group A were significantly increased (P <0.05) and the level of CORT was significantly decreased (P<0.01), the levels of BDNF and 5-HT in group R were significantly increased (P<0.01), but there was no significant difference in CORT level. Compared with group A, the levels of BDNF and 5-HT in group R were not significant, but CORT levels increased significantly (P<0.05). 3) A total of 14 potential biomarkers in the urine of CUMS depression model rats were found. Compared with group C, the levels of leucine, valine, lactic acid, citric acid, inositol, pyruvic acid, β-hydroxybutyric acid, acetoacetic acid, trimethylamine, pantothenic acid, β-hydroxyisovaleric acid, alanine and succinic acid in the urine of group M were significantly increased, and the level of α-ketoglutaric acid was significantly decreased (P<0.05 or P<0.01). Group A can significantly callback 8 potential biomarkers of leucine, lactic acid, citric acid, pyruvic acid, β-hydroxybutyric acid, alanine, lactic acid and pantothenic acid (P<0.05 or P<0.01), the group R can significantly callback the 6 potential biomarkers of lactic acid, acetoacetic acid, inositol, trimethylamine, β-hydroxy isovaleric acid and alanine. Two types of exercise can regulate urinary metabolites in depressed rats. 4) ¹H-NMR metabolic pathway analysis showed that aerobic exercise mainly improves the urine metabolism of depressed rats by regulating TCA cycle, pantothenic acid and COA biosynthesis, and pyruvate metabolism. The resistance exercise mainly improved the urine metabolism characteristics of depressed rats by regulating the synthesis and degradation of ketone bodies, pyruvate metabolism and inositol phosphate metabolism.
Conclusions Aerobic exercise and resistance exercise all can effectively improve depressive symptoms, adjust the urine biomarkers of depressed rats to varying degrees, which may be related to different metabolic pathways involved in exercise modes.

PO-199

Normal signal transduction pathways of rat habitual endurance exercise at different intensities

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Objective A signal transduction pathway is always signal-specific, but it becomes special in exercise physiology, especially for habitual exercise training. In this paper, the normal signal transduction pathways (NPs) of habitual endurance exercise of Sprague-Dawly (SD) rats at different intensities were studied in terms of self-similar algorithm.

Methods 1. SD rats were randomly divided into a control group with no exercise (Cont), a low-intensity exercise group (LI) at 15 m/min for 60 min, a medium-intensity exercise group (MI) at 25 m/min for 40 min, and a high-intensity exercise group (HI) 35 m/min for 30 min. The treadmill exercise began at 10 m/min for 10 min. The speed and time increased by 5 m/min and by 5 min respectively after every two days until the intensity was OK for LI, MI and HI groups. All rats in the exercise groups were trained for eight weeks. The muscle was collected two hours after the last training. The 20 parameters, the expression of PGC-1α, PI3K, AMPK, p38MAPK, SIRT1, IGF-1, Akt, mTOR, TFAM, NRF1 and NRF2 and the level of T, CS, SDH, β-HAD, MDH, HK, PK, LDH and HSL, were assessed. 2. The 20 dimension data sets were integratedly analyzed with self-similar algorithm.

Results 1. The first-order self-similarity held for the 20 dimension data sets between MI and HI groups. 2. There was one biomarker, PGC-1α, between Cont and LI groups with respect to HI group which parameters were used to be dimensionless for Cont and LI groups. 3. There were two biomarkers, PGC-1α and PI3K, between LI and MI or HI groups with respect cont group.

Conclusions The NP of LI group may be PGC-1α pathway, and the NPs of MI or HI group may be PGC-1α and PI3K pathways.

PO-200

Effects of aerobic exercise and fiber-enriched diet on gut microbiota in pre-diabetic patients with NAFLD

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Objective Compelling evidence suggests that gut microbiota can play a role in the development of the metabolic syndrome, which incorporates abdominal obesity, hypertension, hyperglycaemia and dyslipidaemia. It is known that effective lifestyle intervention (including increasing physical exercise and calorie-restricted diet) is the mainstay treatment for the majority of patients with non-alcoholic fatty liver disease (NAFLD) and prediabetes. However, the effect of aerobic exercise and dietary intervention on gut microbiota in pre-diabetic patients with NAFLD is largely unknown and needs to be elucidated. Thus, the aim of the study was to investigate whether gut microbiota composition would change after aerobic exercise training and a fibre-enriched diet intervention in pre-diabetic patients with NAFLD.
Methods We have conducted a randomized controlled trial in patients aged 50-65-year who have fulfilled the inclusion criteria (impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) and hepatic fat content >5.6%, NAFLD). The patients were randomly assigned to aerobic exercise (AEx), dietary intervention (Diet), aerobic exercise plus diet intervention (AED) or no intervention (NI) groups for an average period of 8.6 months (7-11 months). Among those participants, 78 provided fecal samples (AEx, n = 18, Diet, n = 22, AED = 21, and NI = 17). Progressive supervised aerobic exercise training (60-75% intensity) was given 2-3 times/week in 30-60 min/sessions, and the diet intervention was provided as lunch with 38% carbohydrate and diet fibre of 12g per day for 8.6-months. The hepatic fat content (HFC) was assessed by 1H MRS, glycated hemoglobin (HbA1c) and insulin sensitivity were assessed by conventional methods. Gut microbiota characterizations were determined with 16S rDNA-based high-throughput sequencing by Illumina Miseq platform.

Results The Simpson index showed that alpha diversity was significantly different in intervention groups compared with NI group after the intervention (AEx vs NI, p=0.070; Diet vs NI, p=0.014; AED vs NI, p=0.011). Simpson index had a negative trend with HFC change % after intervention (r=-0.254, p=0.053). Weighted UniFrac PCoA analysis revealed that the structure of gut microbiota in the intervention groups was significantly differed from that of NI group (AEx vs NI, p<0.01, Diet vs NI, p<0.05, AED vs NI, p<0.001). Interestingly, we found that Erysipelotrichi (which has been rPorted associated with NASH) was negatively correlated VO2max (r=-0.274, p=0.040). At genus level, Clostridium and Lactobacillus were positively correlated with HFC change after intervention (r=0.273, p=0.038; r=0.273, p=0.041 respectively).

Conclusions The exercise and diet intervention modified the structure of gut microbiota both in alpha and beta diversity. The Clostridium and Lactobacillus is related to energy metabolism and participated in the fermentation of carbohydrate which may be partly explain the positive correlation of gut microbiota with HFC change. However, the function of specific gut microbe needs to be further studied.

PO-201

Effects of tail suspension on the expression of FNDC5/Irisin protein in rat skeletal muscle

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Objective Irisin is a myokine secreted by skeletal muscle, and it is a type I membrane protein factor encoded by the protein 5(FNDC5) gene after cleavage and modification of the type III fibronectin component. Dependence of peroxisome proliferator-activated receptor gamma coactivator (PGC-1α). In this study, the potential association between skeletal muscle atrophy and irisin was explored by detecting changes in rat soleus and gastrocnemius irisin-related proteins during unloading.

Methods Twenty male 8-week rats were randomly divided into control group C (n=10) and suspension group T (n=10). The tail suspension system (TSS) was used to perform a 2-week tail suspension experiment on the T group. Two weeks after the tail suspension test, the weights of the rats and the wet weights of soleus and gastrocnemius muscles were measured. HE staining was performed under light microscope to observe the changes of muscle fiber area of skeletal muscle in each group. Western-blot was used to detect the protein expression of MURF1, PGC-1α and FNDC5 in soleus muscle and gastrocnemius muscle of each group.

Results (1) The soleus muscle and gastrocnemius muscle mass in T group decreased by 28.6% (P<0.05) and 25.8% (P<0.01), respectively. (2) The cross-sectional area of soleus muscle and gastrocnemius muscle fiber in T group decreased by 20.5% (P<0.01) and 25.2% (P<0.05), respectively. (3) The MURF1 protein expression in the gastrocnemius muscle and soleus muscle
in the T group was significantly higher than that in the C group ($P<0.01$). (4) The expression of PGC-1α protein in gastrocnemius muscle and soleus muscle of T group was significantly lower than that in group C ($P<0.05$). (5) The expression of FNDC5 protein in gastrocnemius muscle and soleus muscle in T group was significantly lower than that in group C ($P<0.05$).

**Conclusions**

After sole tail suspension for two weeks, the soleus and gastrocnemius muscles of the rats were obviously atrophied, and soleus muscle atrophy was more obvious. Skeletal muscle atrophy may be related to increased expression of MURF1. The decrease of FNDC5/Irisin content may be related to the occurrence of skeletal muscle atrophy, and PGC-1α also may be involved in this process.

**PO-202**  
**Correlation between exercise performance and muscle electrical activity in Exercise-induced Fatigue Rats**

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**Objective**  
Assess the muscle contraction ability of rats before and after exercise fatigue quantitatively, and analyze the correlation between exercise performance and muscle electrical activity. This study intends to provide a theoretical principle for exercise fatigue.

**Methods**

7 healthy adult male SD rats (300–350g) were used and trained for adaptive treadmill by running on the treadmill for 1 week and holding on a vertical rectangular railing (20×10cm, 10 iron bars) until it's mastered. After this training, we used rat grasping force tester (BioSEB GS3) to measure the maximum grasping force (MGF) of rat's limbs, each rat was carried out 3 times, bout interval is 2 minutes. In addition, the grasping bar time (GBT) was recorded 3 times, bout interval is 30 minutes. We let rats to grasp and hold on a vertical rectangular railing (20×10cm, 10 iron bars), evaluation of rat muscular endurance by grasping bar time (GBT), each rat was carried out 3 times, bout interval is 30 minutes; During the MGF and GBT test, motor unit recruitment and discharge frequency was predicted by measuring the EMG of extensor muscles of the right hindlimb and flexor elbow muscles of the right forelimb by wireless non-invasive miniature surface EMG tester (Italy, BTS FREEEMG), the max Root Mean Square (maxRMS) and Median Frequency (MF) parameter was used to evaluate motor unit recruitment and discharge frequency, respectively.

After these, the rats were allowed to have a one-day rest, and then had a load motion program on the treadmill (three levels' load: the first stage movement speed 8.2 m/min, exercise time 15 min; second stage speed 15 m/min, exercise time 15 min; third stage speed at 20 m/min, exercise to fatigue ) to build the rats EF model by monitoring the acceleration of the rat's sprint with a miniature wireless acceleration sensor (18g). 30 continuous sprint acceleration at the end of running was less than half of initial acceleration and the running posture of the rats changed to prostrate, and remained at the end of the runway for a long time. Later, quantitative correlational data analyses such as mean, Pearson correlation, analysis of one-way ANOVA and paired sample t test were performed in this study.

**Results**

(1) The rats' sprint acceleration of treadmill exercise at the end stage (the final 1/5 of the total time) decreased by 56.9% ($P < 0.01$) when compared with the early stage (the beginning 1/5 of the total time). (2) The MGF and GBT of EF decreased by 68.1% ($P < 0.01$) and 90.38% ($P < 0.01$), respectively when compared with the beginning EF; in addition, the EMG maxRMS and MF of hindlimb and forelimb of EF rats had significantly reduced ($P < 0.01$), and the rats’ MGF/GBT was positively correlated with EMG maxRMS/MF significantly (MGF: forelimb $r_{\text{maxRMS}} = 0.901, P < 0.01$, $r_{\text{MF}} = 0.761, P < 0.01$; hindlimb $r_{\text{maxRMS}} = 0.913, P < 0.01$, $r_{\text{MF}} = 0.783, P < 0.01$; GBT: forelimb $r_{\text{maxRMS}} = 0.922, P < 0.01$, $r_{\text{MF}} = 0.806, P < 0.01$; hindlimb $r_{\text{maxRMS}} = 0.908, P < 0.01$, $r_{\text{MF}} = 0.896, P < 0.01$).
Conclusions Exercise fatigue reduced the muscle strength, muscular endurance and muscle power of rates significantly, which may be related to the decreased recruitment, rhythm synchronization and discharge frequency of muscle motor units of forelimb flexor and hindlimb extensor.

PO-203

The Differences of 18~60 Years Old Adults’ Basal Metabolism depend on Their BMI in Nanjing

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Objective By comparing the differences of adults’ basic metabolic values depend on their BMI, we try to make clear the relationship between different somatotype and human daily total energy expenditure (EE) because basic metabolism accounts for the 60~70% of the EE. Then we can provide a reference including reasonable energy intake and suitable physical activity load for adults of different somatotype.

Methods A self-made health questionnaire was used to select these who are aged of 18~60 years old with no bad hobby and no bad habits (women were not in the period of menstruation), we totally recruited 181 volunteers of which 81 were normal somatotype (18.5≤BMI<24, 33 Male 39.76±12.23 years old, BMI21.90±1.40 vs Female 39.69±13.05 years old, BMI21.38±1.40) and 72 were overweight somatotype (24≤BMI<28, 49 Male 40±13.38 years old, BMI25.26±1.15 vs Female 40.61±10.72 years old, BMI25.53±1.09) and 28 were obese somatotype (28≤BMI, 18 Male 39.33±14.23 years old, BMI30.14±2.22 vs female 41±12.10 years old, BMI29.36±1.25), and the basic metabolic value was measured by respiratory chamber.

Results The basal metabolic values of male and female aged of 18~60 years old in Nanjing were 2077.10±262.12Kcal and 1682.87±203.69Kcal respectively. The basic metabolic values of male and female with normal BMI are 2046.41±242.73Kcal and 1628.65±184.28kcal respectively. The basic metabolic values of male and female with overweight BMI are 2061.10±232.90Kcal and 1741.10±220.14Kcal respectively. The basal metabolic values of male and female with obese BMI are 2176.92±350.64Kcal and 1809.20±175.82Kcal. The basic metabolic values of adults with different sex but in the same BMI all reached a statistically significant difference (P≤0.01). To those adults with same sex but in different BMI, the basic metabolic values between normal BMI and overweight BMI or obese BMI all reached a statistically significant difference for female (P≤0.05), but there were no statistically significant difference for male (P > 0.05).

Conclusions For 18~60 years old adults, it is important to actively control their weight if they find their BMI are overweight, especially for women, because women are significantly more easy to return to normal BMI compare with men, but the advantages depend on different sex will disappeared if they keep on develop into obese BMI.
PO-204

Exercise at the lactate threshold (LT) and above the LT increases phosphorylation of AMPK and Akt in rat skeletal muscle

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Objective A single bout of exercise can enhance glucose uptake in skeletal muscle. It is well established that AMP-activated protein kinase (AMPK) activation is required for stimulation of glucose uptake by exercise. After the initial phosphorylation of glucose by hexokinase, glucose is further utilized to mitochondrial oxidation during exercise. The direct or functional interaction between hexokinase and Akt may act to integrate glucose metabolism in working muscle. Hence, AMPK and Akt activation would be cooperatively regulated exercise-induced activation of glucose metabolism. Although exercise at the lactate threshold (LT) and above the LT sharply increase glucose uptake via increasing AMPK activity, whether LT exercise can also increase Akt activity is still unknown. Therefore, we examined the AMPK and Akt activity immediately after several intensities of exercise.

Methods Male wistar rats (250-270 g) were randomly assigned to 3 groups: Resting control (sedentary, n=16), Low-intensity exercise (LIE: 10 m/min for 30 min, n=8), LT intensity exercise 1 (LTE1: 17.5 m/min for 30 min, n=8), LT intensity exercise 2 (LTE2: 22.5 m/min for 30 min, n=8), and High-intensity exercise (HE: 27.5 m/min for 30 min, n=8). Immediately after each treadmill exercise, plantaris and soleus muscles were dissected.

Results LIE exercise did not change AMPK phosphorylation site (Thr172), indicator of AMPK activity, and Akt phosphorylation site (Ser473, Thr308), indicator of Akt activity, in these muscles compared with resting control. At and above LTE1 exercise increased the phosphorylation of AMPK in these tissues. At and above LTE2 exercise increased the phosphorylation of Akt in these tissues. Therefore, increasing AMPK and Akt activity immediately after LT exercise possibly involved with regulating glucose metabolism.

Conclusions Phosphorylation of AMPK and Akt is increased immediately after at and above LT exercise in rat soleus and plantaris muscle.

PO-205

Effects of Different Methods of Precooling on Sub-maximal Intensity Exercise in Heat and High Humidity

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Objective This study aimed to investigate the influence of using different precooling measures on the capacity of competition and the exercise performance in hot and humidity environment. The most effectual means of precooling will be recommended to help coaches and athletes to improve the ability and performance in training and matches.
Methods Ten male football (Rugby) players who came from the rugby team totally completed four experimental conditions in hot/humid conditions (38°C, 50% humidity). Initially, a 30-min precooling period consisting of either nothing to control (CONT, C); wearing cooling vest (4°C, V); ingesting of ice beverage (2.3 ml/kg of 4°C, I); or the mix method of combination of V and I (V+I, M). Following this, sub-maximal exercise (80% VO2max) of treadmill test occurred, until athletes exhausted

Results The running distance of M and V and I have a significant increase (P≤0.05) than CONT. The peak oxygen uptake of exhaustion was no significant difference between each other. After exercise, the change rate of heart rate ratio of M compared with CONT has a very significant decrease (P≤0.01). The core temperature of M and CONT has a significant increase (P≤0.05) in comparison. The surface temperature of I and M and V comparison with CONT has a very significant increase (P≤0.01). When participants exhaust, the RPE of M in comparison with CONT had significantly lower (P≤0.05). The RPB and the rating of thermal sensation of each condition were no significant difference. After exercise, the blood lactic concentration of each ones was no significant difference

Conclusions In hot and humidity condition, precooling has a promoting effect on the sub-maximal exercise. Precooling measures could improve the exercise performance and maintain the stability of functional status and physiology, especially the mix method

PO-206
Research Progress of Diabetic Rat Model with Hypertension

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Objective Diabetes mellitus coexisting with hypertension can accelerate and increase the occurrence and development of cardiovascular disease, stroke, diabetic nephropathy and retinopathy, and the establishment of corresponding animal models can provide the clinical evidence for hypertension with diabetes mellitus. The model of diabetic rats with hypertension was established in order to find the most reasonable model.

Methods Using the method of literature, the key words in Pubmed were: "diabetes mellitus"; "hypertension"; "rat"; The qualifying language for animal model is English, with a limitation period of 2008-2018. A total of 157 papers were collected and included into the standard: ① exclude the relevant model of renal hypertension; ② No other diseases other than diabetes and hypertension; A total of 42 studies were included.

Results There are 6 models of diabetes mellitus with hypertension in common use at present. ①Surgically induced bilateral renal artery stenosis in rats, followed by low-dose STZ intraperitoneal injection and feeding high-calorie diet. ②Special chemical (STZ or alloxan) directly injected into Spontaneously Hypertensive Rat (SHR) or combined with specific dietary induction; ③Hybridization of SHR and spontaneously diabetic rats; ④Inbred purebreds with a propensity to spontaneously diabetes, obese SHR and obese Zucker rats; ⑤Diabetes was induced by STZ injection with SHR in primary hypertensive rats. ⑥High-fat diet plus intraperitoneal injection of STZ into diabetic model combined with 1% NaCl water feeding.

Conclusions The preparation methods of several models have their own advantages and disadvantages. From the point of view of the pathogenesis of human diseases, it is more ideal to make inbred model with the tendency of spontaneous diabetes. From the point of view of economy and economy, the low-dose STZ intraperitoneal injection of SHR into diabetic hypertensive rat model is low cost, high model rate and convenient. The model rats with type 2 diabetes mellitus and hypertension were induced by high-fat diet plus STZ plus 1% NaCl by intraperitoneal injection of STZ in combination with drinking water. Relatively close to the course of human disease, the cost is lower, and it is the most widely used modeling method at present.
Conclusion: Different research targets correspond to different animal model vectors. In the future, we should try to establish a more perfect model of diabetes mellitus with hypertension, which is more similar to human disease, so as to provide a good platform for disease prevention and treatment.

PO-207

The Effects of 8-week Swimming Exercise at Different Loads on the Adipose Tissue Androgen Aromatization in Male Obese Mice

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Objective The study takes the aromatization of adipose tissue as the breakthrough point to probe the molecular mechanism of male sex hormone disorder produced by obesity and the effect and mechanism of different exercise loads in alleviating the male sex hormone disorder. The research aims to provide the experimental basis for investigating the mechanism of obesity and exercise produced or improved male sex hormone disorder, and to provide the theoretical basis for exploring the effective exercise load.

Methods A total of forty 3-week-old C57BL/6 male mice were randomly divided into normal control group feeding with normal diet and obesity model group feeding with high fat diet, ten mice for normal control group and thirty mice for obesity model group. We got rid of one mouse which weight did not reach the standard after 10-week of high fat diet. Obesity model group were randomly divided into obesity control group, moderate-load exercise group and high-load exercise group, nine mice for obesity control group and ten mice for moderate-load exercise group and high-load exercise group feeding with high fat diet. Moderate-load exercise group was assigned to 1time/d, 2h/time, 6d/w non-weight-bearing free swimming. High-load exercise group were assigned to 2times/d, 2h/time, 6d/w non-weight-bearing free swimming. After 8-week swimming training, there was one mouse died in each of the exercise group. After training, the sperm counts were observed by inverted microscope. The serum luteinizing hormone (LH), Follicle-stimulating hormone (FSH), Testosterone (T) and Estradiol (E₂) were tested with Elisa method. The genetic transcription and protein expression of the interleukin-6 (IL-6), Interleukin-6 Receptor (IL-6R) and aromatase in adipose tissue were detected by Real-time PCR and Western blot.

Results 1. Compared with normal control group, weight, fat weight and body fat rate of mice in the obesity control group were significantly increased (P<0.01, P<0.01, P<0.05); Serum Luteinizing hormone (LH), Follicle-stimulating hormone (FSH), Testosterone (T) in the obesity control group were significantly decreased (P<0.05) and serum estradiol (E₂) was significantly increased (P<0.01); Sperm counts and sperm activity of mice in the obesity control group were significantly decreased (P<0.01); The genetic transcription levels of interleukin-6 (IL-6), Interleukin-6 Receptor (IL-6R) and aromatase in adipose tissue in the obesity control group were significantly increased (P<0.01) and the protein expression were significantly increased (P<0.05, P<0.01, P<0.05).

2. Compared with obesity control group, weight, fat weight and body fat rate of mice in the moderate-load exercise group were significantly decreased (P<0.01, P<0.05, P<0.05); Serum Luteinizing hormone (LH), Follicle-stimulating hormone (FSH), Testosterone (T) in the moderate-load exercise group were significantly increased (P<0.01, P<0.01, P<0.05) and serum Estradiol (E₂) was significantly decreased (P<0.01); Sperm counts and sperm activity of mice in the moderate-load exercise group were significantly increased (P<0.01, P<0.05); The genetic transcription and the protein expression of interleukin-6 (IL-6), Interleukin-6 Receptor (IL-6R) and aromatase in adipose tissue in the moderate-load exercise group were significantly decreased (P<0.01). Compared with
obesity control group, weight, fat weight and body fat rate of mice in the high-load exercise group were significantly decreased ($P<0.01, P<0.05, P<0.05$); Serum luteinizing hormone (LH), Follicle-stimulating hormone (FSH), Testosterone (T) and Estradiol ($E_2$) in the high-load exercise group have no significant differences ($P>0.05$); Sperm counts and sperm activity of mice in the high-load exercise group were also have no significant differences ($P>0.05$); The genetic transcription levels and the protein expression of interleukin-6 (IL-6), Interleukin-6 Receptor (IL-6R) and aromatase in adipose tissue in the high-load exercise group have no significant differences ($P>0.05$).

3. Compared with moderate-load exercise group, weight, fat weight and body fat rate of mice in the high-load exercise group were significantly decreased ($P<0.05$); Serum luteinizing hormone (LH), Follicle-stimulating hormone (FSH), Testosterone (T) in the high-load exercise group were significantly decreased ($P<0.01$) and Serum Estradiol ($E_2$) have no significant differences ($P>0.05$); Sperm counts and sperm activity of mice in the high-load exercise group were significantly decreased ($P<0.01$); The genetic transcription levels of interleukin-6 (IL-6), Interleukin-6 Receptor (IL-6R) and aromatase in adipose tissue in the high-load exercise group were significantly increased ($P<0.05, P<0.01, P<0.01$); The protein expression of Interleukin-6 (IL-6), aromatase in adipose tissue in the high-load exercise group were significantly increased ($P<0.01$), but Interleukin-6 Receptor have no significant differences ($P>0.05$).

4. IL-6 correlated positively with aromatase ($r=0.776, P<0.01$) and Estradiol ($E_2$) ($r=0.414, P<0.05$) and correlated negatively with Testosterone (T) ($r=-0.572, P<0.01$); IL-6R correlated positively with aromatase ($r=0.435, P<0.01$) and Estradiol ($E_2$) ($r=0.486, P<0.01$) and correlated negatively with Testosterone (T) ($r=-0.562, P<0.01$) and positively with Estradiol ($E_2$) ($r=0.435, P<0.01$).

Conclusions
1. Eighteen weeks of high fat diets for male mice led to serious obesity and facilitated the inflammation in adipose tissue. The up-regulation of gene and protein expression of adipose tissue IL-6 stimulated aromatization and prompted testosterone converted into estrogen, leading to sex hormone disorder.
2. Long-term moderate-load exercise reduced the body fat effectively and inhibited the gene and protein expression of adipose tissue IL-6. Meanwhile, it inhibited the aromatization and improved sex hormone disorder associated with obesity.
3. Long-term high-load exercise reduced the body fat significantly, but had no effect on aromatization which was mediated by adipose tissue IL-6, nor relieved male sex hormone disorder associated with obesity.

**PO-208**

**Does High Serum MG53 Level Associates with Better Cardiorespiratory Function?**

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**Objective** To investigate the association between the endogenous human serum MG53 level and cardio-respiratory function in response to graded exercise test (GXT).

**Methods** Sixteen healthy male volunteers (23.1±2.9yrs, 169.5±6.0cm in height, 63.2±5.9kg in weight, 12.2±3.1% in %FAT, 53.2±5.4ml/min/kg in VO$_{2\text{max}}$) fully acknowledged and signed informed consent and participated in this study. Fasting blood samples were drawn before each VO$_{2\text{max}}$ test, serum MG53 was measured by ELISA kits (LifeSpan, USA). Two VO$_{2\text{max}}$ tests were performed on each of these sixteen participants with cycle ergometer, and they had a 7 weeks regular physical training (all individuals performed a same routine summer camp exercise training) between the two tests. Difference between groups was determined by UNIANOVA and the correlation coefficient ($r$) between the cardiorespiratory parameters and serum MG53 value was determined by pearson test.
Results

Results were divided into 3 groups according to serum MG53 levels, they are Low serum MG53 (n=5, 0.60±0.45 ng/ml) group (L), Medium serum MG53 (n=6, 2.08±0.75 ng/ml) group (M) and High serum MG53 (n=4, 4.23±1.80 ng/ml) group (H). There is no significant difference between M and L when comparing end tidal gas component. However, we found M had higher red blood cell count (RBC) than L (4.98±0.22 vs 4.65±0.31 *10^{12}/L, p<0.01), higher hemoglobin (Hb) than L (155.3±7.6 vs 141.5±8.1 g/L, p<0.01), and higher hematocrit (HCT) than L (46.6±2.1 vs 43.1±2.6 %, p<0.01). Moreover, we found that H had higher ventilation threshold (VT) than L (47.5±6.5 vs 38.6±2.8 ml/min/kg, p<0.01) and M (47.5±6.5 vs 42.5±2.8 ml/min/kg, p<0.05).

Similarly, we found H had higher VO_2max than L (59.6±4.7 vs 51.6±6.7 ml/min/kg, p<0.05), higher workload at VT than L (13.2±3.7 vs 11.1±1.7 Watts, p<0.05), higher RBC than L (5.20±0.18 vs 4.65±0.31 *10^{12}/L, p<0.01), higher Hb than L (158.8±4.2 vs 141.5±8.1 g/L, p<0.01), and higher HCT than L (47.4±1.5 vs 43.1±2.6 %, p<0.01).

Correlation analysis demonstrated that VO_2max (r=0.43, p<0.05), workload at VT (r=0.41, p<0.05), RBC (r=0.53, p<0.01), Hb (r=0.57, p<0.01) and HCT (r=0.47, p<0.01) are positively correlated with Serum MG53.

Conclusions

It suggested that human serum MG53 level might be positively correlated with cardiorespiratory parameters that have been tested (e.g. VO_2max, workload at VT, RBC, HCT and Hb).

PO-209
Exercise and dietary intervention reduce myocardial oxidative stress in male rats with metabolic syndrome

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Objective

Both aerobic exercise and alimentary control relieve oxidative stress (OS). However, there may be different modes. The objective of this study is to identify the effects of OS in metabolic syndrome (MS) rats and explore the mechanisms involved in aerobic exercise and alimentary control.

Methods

Seventy rats were used. Eight rats were randomly chosen for the control group, while the remaining rats were subjected to MS using a high-fat diet for 18 wk. The MS model rats were subsequently divided into the MHC (model control with high-fat diet), MRC (model control with routine diet), MHE (model training with high-fat diet) and MRE (model training routine diet) groups for 12 wk. The chemotactic factor macrophage chemotactic protein-1 (MCP-1), the adherence factor plasminogen activator inhibitor I (PAI-1), the oxidative stressor oxidized low density lipoprotein (ox-LDL), and the antioxidative factor endothelial nitric oxide synthase (eNOS) were tested in the serum; moreover, the expressions of MCP-1, PAI-1, and eNOS and the regulatory factor of OS Peroxisome proliferator-activated receptor-alpha (PPARα) were detected in the myocardium.

Results

OS related markers in serum had changes following the interventions of aerobic exercise and/or diet control. Compared with C, the ox-LDL, MCP-1 and PAI-1 in the MS rats exhibited significant decreases (P<0.05/0.01), and the eNOS had a significant increase (P<0.05).

Compared with MHC, the diet intervention alone significantly increased eNOS; when interventions of aerobic exercise but not diet control (MHE) were applied, they significantly decreased ox-LDL, MCP-1 and PAI-1 (P<0.01); the applied interventions of both aerobic exercise and diet control (MRE) decreased ox-LDL, MCP-1 and PAI-1 and significantly decreased eNOS (P<0.01). The MRE compared to MHE exhibited significant changes in MCP-1 and eNOS (P<0.01). The mRNA levels of the processing markers of OS in the myocardium.

Compared with C, the MS rats had significant increases in the chemotactic factor MPC-1 (P<0.05) and the adhesion factor PAI-1 (P<0.01), which indicated that MS rats exhibited enhanced OS. Moreover, the MS rats had an increased antioxidant marker of eNOS, which was not
significant, and the regulatory factor of PPARα decreased ($P < 0.01$). Compared to MHC, the MRC rats exhibited decreased MPC-1 ($P > 0.05$) and PAI-1 ($P < 0.05$) and increased eNOS ($P < 0.01$) and PPARα ($P > 0.05$); moreover, the MHE and MRE rats decreased more in MPC-1 and PAI-1 ($P < 0.01$) with increased eNOS and PPARα ($P < 0.01$). Compared to MHE, the MRE rats had a further decrease in MPC-1 ($P < 0.01$) and PAI-1 ($P > 0.05$) with increased eNOS ($P < 0.05$) and PPARα ($P > 0.05$).

**Conclusions** OS increased in MS rats. Moreover, aerobic exercise and alimentary control could decrease OS to reduce the damage in MS rats. The OS regulatory factor PPARα, which could mediate the expression of OS-related genes, such as MCP-1, PAI-1, and eNOS in cardiovascular tissues, was only enhanced by aerobic exercise and not by diet control.

**PO-210**

**Aerobic physical training in cool environment protects rat brain against oxidative damage during rest and exercise in heat through the increased expression level of HSP70**

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**Objective** The purpose of the study was to explore the mechanism underlying physical training in cool environment (20°C) improving tolerance to exercise-heat stress.

**Methods** Rats were randomly divided into aerobic exercise group (AE group) and control group (C group). Rats of AE group undertook 5 weeks aerobic physical training in cool environment, rats of C group were kept sedentary. Through Western blotting method, the expression of HSP70 in rats motor cortex of both groups was detected. The hydroxyl radical scavenging capacity (HRSC), malondialdehyde (MDA), superoxide dismutase (SOD) activity, xanthine oxidase (XOD) and glutathion peroxidase (GPX) in rat motor cortex were detected immediately after 1h heat exposure or exhaustive exercise in heat (38-40 °C). The exhaustion time and changes of rectal temperature during exhaustive exercise were recorded.

**Results** Results showed that, the HSP70 expression of AE group is higher than C group ($P < 0.05$). After 1h heat exposure or exhaustive exercise, the XOD and MDA of AE group are all lower than C group ($P < 0.05$). The HRSC, SOD and GSH-PX of AE group are all higher than C group ($P < 0.05$). At 30, 45 and 60 min time point, the rectal temperature of AE group are all lower than C group ($P < 0.05$). The exhaustion time of AE group is higher than C group ($P < 0.05$).

**Conclusions** Our results suggest that the enhanced expression of HSP70 and the decreased rise rate of core temperature, may result in the lower oxidative damage in rat brain, this may be one important factor for physical training in cool environment improving tolerance to exercise-heat stress.
Effect of acupuncture intervention on the changes of cytoplasmic and mitochondrial Ca²⁺ concentration following eccentric contractions in rat skeletal muscle

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Objective The purpose of this study was to evaluate the effect of acupuncture intervention on the changes of cytoplasmic and mitochondrial Ca²⁺ concentration following eccentric contractions (ECC) in rat skeletal muscle.

Methods 24 healthy male Wistar rats were randomly divided into 4 groups: control group (C, n=6), electrical stimulation group (E, n=6), electrical stimulation group with acupuncture intervention (EA, n=6), electrical stimulation group with acupuncture + TRP channel inhibitor Gd³⁺ (EAI, n=6). The animal model of eccentric induced skeletal muscle injury was established by electrical stimulation on spinotrapezius muscle of anaesthetised rats in vivo, that is to say, the intact spinotrapezius muscle of adult Wistar rats was exteriorized, and tetanic eccentric contractions (100 Hz, 10 sets of 50 contractions) were elicited by electrical stimulation during synchronized muscle stretch of 10% resting muscle length. Cytoplasmic Ca²⁺ accumulation were determined by loading the muscle with fura 4-AM using fluorescent imaging in vivo, and mitochondrial Ca²⁺ concentration were determined by loading the muscle with fura 2-AM using fluorescent imaging in vitro, and recorded changes of muscle maximum tetanic force.

Results (1) In vivo, compared with the C, cytoplasmic Ca²⁺ accumulation increased more rapidly during ECC in the E (P < 0.001). Acupuncture intervention significantly reduced cytosolic Ca²⁺ accumulation in the EA compared with the E (P < 0.01), and we discovered that muscle deformation generated by acupuncture intervention induced a robust Ca²⁺ spark response confined in close spatial proximity to the sarcolemmal membrane in intact muscle fibers. Although no significant differences between the EA and EAI, Gd³⁺ abolished the majority of cytoplasmic Ca²⁺ accumulation decrease during ECC in the EAI and a robust Ca²⁺ spark response disappeared compared with the EA.

(2) In vitro, compared with the C, mitochondrial Ca²⁺ concentration did not elevations in MCC in the E. EA cytoplasmic Ca²⁺ increased rapidly above the C and E (P < 0.01), respectively, but EAI significantly attenuated the increases in mitochondrial Ca²⁺ concentration compared with the EA (P < 0.01). (3). Compared with the C, maximum tetanic force was significantly lower in the E after ECC (P < 0.01). EA maximum tetanic force increased rapidly compared with the E after ECC (P < 0.05), but EAL abolished the majority maximum tetanic force increase after ECC (P < 0.05).

Conclusions (1) Eccentric contraction caused cytoplasmic Ca²⁺ accumulation, but mitochondrial Ca²⁺ concentration decrease.

(2) Acupuncture can effectively reduce cytosolic Ca²⁺ overload, following by mitochondrial Ca²⁺ concentration increase, which in turn abnormally high cytoplasmic Ca²⁺ levels are buffered by the mitochondria, and improved muscle function, and the effect was associated to the TRP channels.
PO-212
Progression in rehabilitation of Upper Crossed Syndrome
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Objective At present, there is a growing number of potential people in the country who are prone to upper crossed syndrome (UCS), and compared with other musculoskeletal diseases, the etiology and treatments of the syndrome are still at an initial stage. On the other hand, the syndrome is a transitional stage between the normal cervical vertebra and cervical spondylosis, so it may be one of the important factors of cervical spondylosis which becomes younger in average age and happens more frequently. Domestic researches for UCS are not sufficient. There is no clear and unified conclusion on the pathogenesis of the disease, and there is also no systematic and efficient standard for its treatment. Therefore, the study of the UCS will help people fully understand the occurrence of cervical spondylosis, the mechanism of muscle imbalance and neck pain, it could lead to new further treatments of physical therapy and exercise therapy.

Methods A literature search was conducted for UCS studies using CNKI, Wan Fang database, VIP database, Pubmed, web of science, EMBase, Cochrane Library. The Medical Subject Headings search terms used included rehabilitation therapy, neck pain, head pain, etiology, treatment, and combined keywords using upper crossed syndrome and UCS. According to the characteristics of the different databases, there is a joint search method for the keywords and free words. Two authors independently extracted relevant data according to the proposed inclusion and exclusion criteria, and then carry out full text reading after the literature that may be qualified or cannot be confirmed, so as to identify the literature that needs to be included. In the end, 40 literatures were finally included.

Results The causes of UCS may have bad posture, abnormalities of respiratory patterns, psychological factors, over excitation of sympathetic nerve, abnormalities of proprioception, acute and chronic injury. And, once that balance is broken, without interference, the neck and shoulders will form a vicious circle, and the human body's stress reaction will form osteophyte in the corresponding place, and damage intervertebral disc. According to the studies, all treatment methods have certain effects such as massage, acupuncture, strength training, breathing training, nerve sensation training, cognitive-behavioral therapy and so on.
1. Bad posture can cause the cervical vertebra physiological curvature to disappear, neck muscle length changes, abnormal tension, force imbalance. It can be treated with exercise therapy, including corrective training, north European walking, etc. We need to use strength training, posture correction, elastic band training and so on, to strengthen the relatively weakened or elongated muscles, and make the joints and muscles of shoulder or neck work under the correct rhythm, followed by the bone-setting manipulation (traction therapy, joint mobilization, Chinese traditional vertebra restoration method) can also have a good effect by solving problems such as abnormal cervical vertebra curvature, local nerve compression, small joint disorders and limited range of motion in a joint.
2. Abnormal breathing patterns make the accessory respiratory muscles constantly perform low load contraction, which gradually causes muscle fatigue. For some people with respiratory disorders or difficulties, in order to breathe more smoothly, will take a head forward posture to alleviate the resistance of the airway, so that they can not fully complete the original function of the accessory respiratory muscle. To this, abdominal respiration training can regulate the balance of the major respiratory and accessory respiratory muscles function, and reduce the excitability of sympathetic nervous, thus relaxing the dominant muscles.
3. Most psychological problems are characterized by progressive and concealed, which not only have a negative impact on people's psychology, but also can not be ignored in physiology. Psychological effects may change the neurotransmitter, 5-HT and corticotropin releasing factors in the body, which causes the human body to suffers the muscle pain, the tension, the movement.
uneasiness manifestation. It is the first time that the human body has suffered from muscle pain, nervous and fidgety movements. Therefore, some scholars proposed to use the cognitive-behavioral therapy (CBT) to carry on the improvement to this problem. It includes specific behavior and cognitive corrections to correct body and mental abnormalities.

4. At present, some researchers have found that the neural sensation, especially the abnormalities of proprioception, is closely related to the abnormal postures. For UCS, long term abnormal posture, the abnormal signals that feed back to the proprioception are gradually weakened and eventually ignored or considered normal by the brain center. Therefore, the proprioception should be reactivated under the correct posture. The correct feedback signal can be activated by proprioception training and Kinesio taping. And the Kinesio taping can make indirect effect on the sensory system, at the same time it can reduce the pressure of local tissue and speed up the blood circulation. This can accelerate the metabolism of muscle and help the recovery of muscle fatigue.

5. Most of these causes of UCS will lead to pain, inflammatory, fascia adhesion. Chinese traditional methods of rehabilitation and physiotherapy are commonly used in treatment. Massage therapy, Chinese acupuncture treatment including acupuncture point injection therapy, and Chinese needle-knife therapy can play a role in warming Yang and eliminating cold, reducing swelling and relieving fatigue. Chinese needle-knife therapy by cutting muscle fascia, stripping, relaxation, unclogging, promoting blood circulation, etc. It is necessary to adjust the biomechanics of the human body and restore the balance of motion. The Chinese herbal medicine can make the human body live blood for pain and pain, and it can be applied outside, taken inside and combined with other treatment methods. Medium and low frequency treatment, infrared treatment, waxwork and other physical therapy methods, using sound, light, cold, heat, electricity, magnetic force (motion and pressure) and other physical factors for treatment, aiming at local or systemic functional disorders or diseases of the human body. The physical factors therapy is non-invasive and non-drug treatment, which is necessary to restore the original physiological functions of the body.

6. China has a variety of martial arts since ancient times, including Baduanjin exercise, five-animal exercises and Tai Chi. With the aim of physical fitness and relatively gentle physical activity as the basis, the physical and mental state need combine body, breath and heart adjustment, which play a role in strengthening the body, adjusting breathing and maintaining health.

Conclusions In summary, traction therapy, Chinese traditional needle-knife have high requirements for equipment and venues, and are expensive and not suitable for public use. The Chiropractic therapy, joint mobilization and Chinese traditional vertebra restoration method have high risks, and the requirements on the experience and technique of the operator are higher. And Other treatments have their own characteristics. Therefore, in the actual treatment process, various factors should be considered comprehensively to carry out treatment. Treatment of primary and secondary order, consider, from the pathogenesis of UCS should give top priority to posture correction, daily lifestyle management, including breathing training, strength training, relaxation therapy, second along with Chinese acupuncture and physical therapy, such as nerve sensation training, finally martial arts, as an education and mission project, guide the patient carry out the rehabilitation by themselves. It is still not clear how to prevent UCS and what treatment sequence should be used to treat different causes of UCS at home and abroad, which need to make further study.
PO-213
Influences of Exercise on Circulating Irisin in Overweight or Obese Individuals: a system review

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Objective Irisin is a newly identified myokine, which is mainly secreted by skeleton muscle, adipose and cerebellar. It is shown to be related to some physiology process. The aim of this study is to evaluate the influence of exercise on circulating irisin concentrations in overweight or obese individuals.

Methods Searches were performed on nine online electronic databases including PubMed, EMBase, The Cochrane Library, web of science, Ebsco, CNKI, VIP, CBM and Wan-Fang Data databases. The search items were irisin, fibronectin type III domain-containing protein 5, FNDC5, exercise, training, physical activity, obesity, overweight, obese, body mass index, BMI, adiposity and fat. Randomized controlled trials (RCT) or clinical controlled trials about the effect of exercise on circulating irisin concentrations in overweight or obese individuals in English or Chinese were eligible for the study. The trials compare exercise intervention with no intervention, or combined interventions of exercise and other with other intervention(s), and the exercise intervention is not one acute time. Besides, the trial objects belong to overweight or obese regardless of the judgement’s indicator. According to the criteria, the data extracted by two research independently. If there was disagreement, discussion between all the authors were used to settle. The risk of bias among the included studies was assessed by the Cochrane Collaboration Risk-of-Bias tool, which consists of seven domains and each one was judged to ‘unclear risk’ ‘low risk’, or ‘high risk’ following the recommendations detailed of the Cochrane handbook. Lastly an analysis about the final studies was done.

Results The search identified a total of 855 possible articles. Of those, 364 were removed as duplicates, and the remaining 491 were screened for the titles and abstracts. The full-texts of 56 trials were retrieved to assess for eligibility. After the evaluation, four articles of RCTs were retained for the final system review from the year of 2015 to 2017, producing 6 study estimates. The assessments class of methods quantality of them are A. All the research subjects are more than 18 years old, and in one study subjects are men, men and women in two, women in three. The types of exercise intervention are dissimilar, such as strengthen or endurance exercise (including high intensity interval training, HIIT). In the duration of exercise, three studies are 8 weeks, and two for 12 weeks, one for 24 weeks. In circulating irisin, the detection methods of all is enzyme-linked immunosorbent assay, and three are in plasm, three in serum. Furthermore, the concentration unit in five studies is ng/ml, and one is µg/ml. Bonefate suggests that aerobic exercise with the frequency of 3 times per week for 24 week maintains plasma FNDC5/irisin of middle-age obese men, same as 8 weeks aerobic exercise for overweight/obese adults by Kim, but three is an opposite result from Wu, which proved that aerobic exercise of twelve weeks ascends serum irisin of young obese women. HIIT of eight or twelve weeks ascends serum irisin in sedentary obese women or young obese women according to Tofighi or Wu suggestion. Moreover, resistance exercise of 8 weeks significantly increases plasma irisin of overweight/obese adults From Kim’s study.

Conclusions The study about effect of exercise on circulating irisin levels in overweight or obese individuals is not sufficient to come to a positive result, although the quality assessments of current evidences are high. Basing on the available literatures, exercise can maintain or improve circulating irisin levels in overweight or obese individuals. The effect needs to be illustrated by further RCTs with large sample size.
PO-214

Women's Freestyle Wrestling Athletes Prepare for Urine Ten Evaluation Before the National Games

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Objective Urine routines inspection was used as a kind of non invasive test method, which was used widely in the biochemical monitoring of athletes. The urine routine was monitored for nearly eight months prior to the 13th National games in this study, to find out the routine changes in urine of Hubei women’s freestyle wrestlers during training cycle and pre-match preparation period.

Methods The study was conducted on 22 female freestyle wrestlers in Hubei province, with an average age of 22 years, and 2 athletes of national master level, with professional training period of 5 to 12 years. There are 3 athletes of 48 kg, 5 athletes of 53 kg, 5 athletes of 58 kg, 7 athletes of 63 kg, 1 athlete of 69 kg and 1 athlete of 75 kg. The test instrument is Kyoto PU-4210 urine analyzer. Urine test indicators include: GLU, PRO, BIL, URO, PH, S.G., BLD, KET, NIT, LEU. The urine sampling test method is divided into two parts. Urine sampling time during convalescence training: from the preparation period of the 13th national games to the pre-competition, the test was conducted on an empty stomach in the morning of the second day of rest every week. Namely: the continuous sampling of morning urine from August 2016 to April 2017, taking the middle urine sample at 7:20 every Monday morning, a total of 425 times. Urine sampling time during training period: from the preparation period of the 13th national games to the pre-competition, the test will be conducted immediately after the actual training. During the period from August 2016 to April 2017, samples were taken according to the training arrangement. After the actual training, urine samples were taken from the middle section and 288 person-times were tested in total. Search and sort out relevant literature to understand the research status. Statistical software SPSS19.0 was used for data processing and paired sample t test was used.

Results The results showed that the indicators of the ten positive urine test rates in the training period were: BLD 19.8%, S.G. 17.7%, PRO 14.9%, KET 12.8%, URO 4.5%, WBC 3.8%, BIL 3.1%. The indicators of positive morning urine detection rate during convalescence were: PRO 11.1%, BLD 8.9%, S.G. 7.6%, KET 4.2%, URO 1.9%, WBC 3.0%, BIL 1.2%. The results of ten subjects in training and convalescence were compared, and the indicators of recovery from fast to slow were successively: S.G. 80.4%, PRO 58.1%, BLD 56.1%, KET 48.6%, WBC 36.4%, BIL was 33.3%, URO 30.7%.

Conclusions According to the analysis of the change of ten monitoring indexes of female freestyle wrestlers, wrestling is a violent antagonistic sport. The features of the event determine that the energy metabolism of wrestling is an anaerobic, aerobic and metabolic mix and alternation, and anaerobic metabolism is the main sport. The characteristics of the event can lead to different positive reactions in the ten items of urine.

1. The PRO, BLA, S.G. and KET should be regarded as the main indexes because of the high positive ration. This study shows that routine urine test can be used for female freestyle wrestlers to accurately grasp the characteristics of the program, provide technical support, and adjust the training program of coaches.

2. The PRO index can be used as a sensitive index to evaluate the training intensity. During the training, there is no adaptive state, and the urine protein shows a plus sign (+) for many times, and cannot be completely recovered in the morning. It reminds the coach to control the amount of exercise and exercise intensity properly.

3. The hematuria caused by exercise training is called motor hematuria. The probability of the occurrence of urinary occult blood is relatively high after the high-intensity training, which can be used as a sensitive index to evaluate the training amount of female athletes after removing the interference factors such as physiological periods.
4. The urine specific gravity index is mainly used to understand the concentration and dilution function of the kidney. The increased urine specific gravity of athletes can be seen in the large amount of sweating and dehydration during training. The specific gravity is related to the amount of drinking water. Excessive drinking water leads to low urine specific gravity, and attention should be paid to rehydration after daily training and training.

5. The KET index was positive to different degrees, reflecting the load of endurance training, indicating the imbalance of body electrolyte, and paying attention to electrolyte supplement during and after daily training.

PO-215
Effect of 30%, 50% and 70% VO2 max treadmill exercises on gut microbiome in hypertensive mice

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Objective Gut microbiome has a significant impact on human health through the interaction with host and environment, which is closely related to a series of chronic diseases. The diversity of gut microbiome and its metabolic disorder are the risk factor of hypertension. The changes of gut microbiome structure and abundance are closely related to the pathogenesis of hypertension, in which Bifidobacterium and lactic acid bacteria can bind with the hypertensive substances to show the hypotensive therapy. However, the diet and exercise have great impact on the structure and function of gut microbiome, and of which aerobic exercise could increase the ratio of gut beneficial bacteria to harmful bacteria effectively. The effect of treadmill exercise on gut microbiome of hypertensive mice was studied in this paper, which provided a theoretical basis for the prevention and treatment of hypertension by gut microbiome.

Methods SPF Kunming mice were fed with 8% high salt diet for 6 weeks to make the hypertension model. Compared with the blood pressure of mice before the formal experiment, The standard was that the blood pressure of the experimental mice was increased by SBP >15% or DBP > 5%, which was indicated the model of hypertension was established successfully. The motion slope and velocity of the maximum oxygen uptake of 30%, 50%, and 70% were measured respectively. The mice were divided into 4 groups randomly according to their body weight, 10 mice/group. The 30% VO2 max, 50% VO2 max, and 70% VO2 max were exercised for 6 weeks as well as the control group. The mice were divided into cages and fed in accordance with the national standard rodent diet. The blood pressure of mice was measured weekly by tail pressure method (Tail-cuff). The abundance of Bifidobacterium, Bacteroides, Lactobacillus and Enterobacter in the gut microbiome of mice feces were tested by 16S sequencing every two weeks. The ratio of Firmicute / Bacteroides (F/B ratio) was also measured by sequencing as a parameter to reflect the disorder of gut microbiome. The ratio of Firmicutes / Bacteroides is almost equal 1, and the present study found that the F/B increased significantly in the hypertensive group. Real-time PCR was used to detect the changes of plasma inflammatory factors IL-1β, IL-6 and TNF-α. The previous study had shown that the intestinal disorders can lead to an increase in pathogenic bacteria, further leading to the inflammation. Finally, the experimental data were analyzed by independent sample t-test.

Results (1) After six weeks of exercise intervention, the blood pressure (132.87mm Hg±5.23mm Hg) of the exercise group was significantly lower than the control group (99.57mm Hg±7.47mm Hg), especially in the 50%VO2 max mice. (2) Compared with the rest group, the abundance of gut microbiome in the exercise group was increased, among which the number of Bifidobacteria, Lactobacillus, and Bacteroides were increased significantly, of which 50% of VO2 max group increased most significantly, and the number of Enterobacter was less than the control group (p<0.05). (3) Compared with the control group, the ratio of F/B in the exercise groups were lower than the control group, but the 50% VO2 max group was decreased most
obviously ($p < 0.05$). (4) Compared with the control group, the plasma levels of IL-1β, IL-6 and TNF-α in exercise groups were significantly lower than the control group ($p < 0.05$).

**Conclusions**  
(1) The aerobic exercise could change the abundance and structure of gut microbiome in hypertensive mice, increase the beneficial bacteria *Bifidobacteria* and *Lactobacillus* in the intestinal tract of mice, and reduce the ratio of *Firmicutes/Bacteroides*, improving the gut microbiome disorder. (2) The aerobic exercise could alleviate the inflammatory reaction of the body by regulating the structure of gut microbiome of hypertensive mice, improving the blood pressure of mice; (3) 50%VO2 max was the most significant exercise intensity to improve the abundance and structure of gut microbiome in hypertensive mice.

**PO-216**

**Anabolic signalling in individual muscle fibres following resistance exercise in combination with amino acid intake**

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**Objective** Human muscle consists of a mixture of fibres with different contractile and metabolic properties, type I (slow-twitch) and type II (fast-twitch) fibres. Little is known about the effect of anabolic stimuli, in particular nutrition, on the molecular response in the different fibre types. Here, we examine the effect of resistance exercise and essential amino acid (EAA) supplementation on mTOR signalling in individual type I and type II human muscle fibres.

**Methods** Five strength-trained male subjects performed two sessions of leg press exercise (10 x 10 repetition at 62-85 % of 1RM). During exercise and recovery, the subjects ingested an aqueous solution with EAA (290 mg/kg) or flavoured water (placebo). Muscle biopsies were taken from the vastus lateralis before and 90 min after exercise. The biopsies were freeze-dried and single fibres dissected out and weighed (range 0.9 – 8 ug). The fibres were individually homogenized and analysed for proteins in the mTOR pathway using Western blot. Membranes were repeatedly stripped and fibres were identified as type I or type II following incubation with antibodies against the different myosin isoforms.

**Results** Exercise led to a significant increase in mTOR and p70S6k1 phosphorylation and a fall in eEF2 phosphorylation, similar in both fibre types. There was a large variation between individual fibres; some fibres were highly activated whereas others were not activated at all despite the heavy exercise performed. Intake of EAA caused a 2- to 6-fold higher increase in mTOR and p70S6k1 phosphorylation in both type I and type II fibres as compared to intake of placebo, with no difference between the fibre types. The phosphorylation of eEF2 was not affected by intake of EAA. The total expression of p70S6k1 and eEF2 was 145% and 155% higher in type II than in type I fibres ($P<0.05$), respectively, whereas no difference between the fibre types was observed for mTOR protein.

**Conclusions** The response to heavy resistance exercise regarding mTOR signalling was similar in type I and type II fibres in trained subjects, but with a large variation between single fibres of both types. Furthermore, ingestion of EAA enhanced the effect of resistance exercise on phosphorylation of mTOR and p70S6k1 in both fibre types.
Objective As a new training method, KAATSU Training has become a popular training method because of its obvious training effect, short period and high safety. In this paper, the acute and long-term response of the KAATSU downhill walking Training is discussed to explore its effect on muscle growth, and to provide a theoretical basis for the scientific pressurization of athletes, rehabilitation groups and fitness groups.

Methods (1) acute effects: 8 healthy male subjects received pressure and non-pressure slow downhill walking training at the same time and in good physical condition. Pressure in the pressure group was 240mmhg, and pressure bands were tied in the non-pressure group but no pressure. The downhill slope is 16%, the speed is 3km/h, and stride slow walk on the treadmill. Forearm venous blood was taken 15 minutes before training and 15 minutes after training. The concentration of growth hormone (GH), insulin (In), cortisol (C), blood testosterone (T), creatine kinase (CK) and UREA in blood samples were tested respectively. The fingertip blood lactate (Lac) was taken 2 minutes after training, and the subjects' subjective fatigue feelings (RPE) were recorded immediately after training. The changes of surface electromyography (EMG) during training were recorded, and changes of heart rate were recorded every 2 minutes. The thigh and calf circumference were measured before and after exercise.

(2) long-term effects: 14 healthy male subjects were randomly divided into the experimental group (KAATSU group 240mmhg, n=8) and the control group (no KAATSU group, n=6), with a slope gradient of 16% and a speed of 3km/h. 2 weeks for 10 days from Monday to Friday. The first week of Monday and the second week of Friday is the same as the acute effects test. At other times, the circumference of the thigh and the calf before and after the training were measured, the heart rate and the subjective fatigue feeling immediately after the exercise were recorded.

Results (1) The muscle circumference increased immediately after exercise in both groups. The change of thigh circumference after exercise in the KAATSU group was significantly higher than that in the non-KAATSU group (P<0.05).

(2) There were no significant changes in growth hormone, insulin, cortisol, testosterone, creatine kinase and blood urea before and after exercise (P>0.05), and no changes in creatine kinase 24 hours after training.

(3) The exercise heart rate of the pressure group was slightly higher than that of the control group, and the surface electromyography of the KAATSU group was significantly higher than that of the non-KAATSU group (P<0.05).

(4) There was no significant difference in subjective fatigue and blood lactic acid between the two groups (P>0.05).

(5) After two weeks of KAATSU downhill training walking, the muscle circumference of the leg in the KAATSU group was significantly higher than that of the control group (P<0.05).

Conclusions (1) One-time downhill walking training can increase muscle circumference and the KAATAU group was more obvious.

(2) KAATSU downhill walking training can increase muscle without causing muscle damage.

(3) KAATSU downhill walking training can collect more muscle fiber.

(4) Under the KAATSU downhill walking training, the concentration of lactic acid is low, the subjective feeling is easy. The heart rate is slightly higher than the quiet level, which will not cause fatigue and will not affect the blood sugar level.

(5) Long-term KAATSU downhill walking training can promote muscle growth.
PO-218
Study on the effect of weight loss in High temperature and High humidity

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Objective The effects of aerobic exercise on body weight loss in different environments were studied by comparing the changes of relative indexes between high temperature and high humidity and general environment. To provide certain reference basis for weight loss in aerobic training before competition of heavy competitive athletes.

Methods Eight male freestyle wrestlers in Beijing were chosen as the research objects. The body weight, energy metabolism and serum ions were measured before and after one time aerobic exercise (50min, 65%VO₂max) in general environment (23°C/40%humidity), high temperature and high humidity (33°C/60%humidity). The data were statistically processed by SPSS19.0 software, and Paired-Samples T Test was selected for statistical analysis.

Results Under the same physiological load, one time aerobic exercise was carried out in high temperature and high humidity and general environment, the weight of high temperature and high humidity group decreased 1.91%, the amplitude was slightly larger than that of general environment group. The energy metabolism in the hyperthermia and humidity group was 1.52g higher than that in the normal temperature and humidity group, the energy expenditure at 2 hours after exercise was 0.95% higher than that in the normal temperature and humidity group, and the energy metabolism during 8 hours sleep was 14.86% higher than that in the normal temperature and humidity group (p<0.05). Na⁺ and Cl⁻ were significantly higher after general environmental exercise than before (P<0.05), while K⁺, Mg²⁺ were slightly lower than before exercise. After high temperature and humidity exercise, Mg²⁺ was significantly lower than that before (P<0.01). K⁺ decreased slightly, Na⁺, Cl⁻, Ca²⁺ was slightly higher than that before exercise. According to the change of ion index, aerobic exercise may have little adverse effect on the balance of internal environment under the condition of high temperature and high humidity, which can be improved by the supplement of electrolyte drink.

Conclusions In high temperature and high humidity environment, aerobic exercise has a relatively good effect on weight loss. In order to reduce the change of internal environment, electrolyte drink can be added in the process of weight loss aerobic training. Athletes can withstand the weight reduction and control training at different ambient temperatures, subjectively accept the thermal environment. Therefore, the choice of high temperature and high humidity aerobic exercise in fast weight loss stage will be an effective means of weight loss before competition.

PO-219
Clinical rehabilitation of external humeral epicondylitis by ginger moxibustion and its combination therapy

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Objective External humeral epicondylitis, also known as “tennis elbow”, is a chronic motor inflammation caused by non-normative movement or excessive pressure and torsion of the forearm tendon and bone. The external humeral epicondylitis occurs mostly in tennis, badminton, table tennis, fencing, throwing, gymnastics and other sport programs. Because it has the highest
incidence in tennis, everyone is used to call it "tennis elbow". Those who have repeatedly used force to do elbow activities in daily life, such as housewives, bricklayers, woodworkers, etc., are also susceptible to this disease. Therefore, the disease affects a large number of occupations and sports. The conventional medical surgery leads to a large wound area and a long recovery time, which is easy to shorten the sportlife of the patient. The conservative Chinese medicine ginger moxibustion therapy could clear the meridians and organs by stimulating the acupoint of the human body. This moxibustion therapy has the advantages of small trauma, low cost, comprehensive treatment and small side effects by adjusting the blood, and would not bring inconvenience to patients' daily life and normal exercises. This paper aims to use a conservative treatment-Traditional Chinese medicine ginger moxibustion and its composite therapy to rehabilitate the external humeral epicondylitis systematically and compare the rehabilitation effects of different compound therapy to provide a basis for tennis elbow's rehabilitation.

**Methods** Eighty-four tennis elbow patients were divided into three treatment groups and one control group randomly, subject and observer-double-blind, third-party evaluation. The treatment groups included a group of ginger moxibustion named A, a group of floating needle combined with ginger moxibustion named B, and a group of Yunnan BaiYao aerosol combined with ginger moxibustion named C, the control group named D, 21 people/group. In the treatment group A, acupuncture points were taken from A'shi, Quchi and Hand Sanli, ginger moxibustion treatment, 5 moxibustion columns/time, once every other day, 5 times as a course of treatment, observe the effect after two courses; The group B was first treated with floating needles at three acupoints, and after 2 minutes treated as group A, 5 moxibustion columns each time, once every other day, 5 times as a course of treatment, observe the effect after two courses as well; The group C was first sprayed on Yunnan Baiyaaoaerosol in three acupoints, two minutes later, treated as group A, use 5 moxibustion columns each time, once every other day, 5 times as a course of treatment, observe the effect after two courses. The control group was treated with ginger laser treatment at the same acupoints, keep as the same treatment as group A, observe the effect after two courses. The shoulder-arm-hand disability score (DASH) was use for the main observation index, and pain (VAS), painless grip strength (PFGS) and pressure pain threshold (PPT) were meanwhile used as secondary observation indicators.

**Results** Four sets of experimental data were submitted to Shandong University of Traditional Chinese Medicine. The analysis of results showed that patients in treatment groups improved their function and relieved the pain significantly much better than the ginger-fake laser control group within 3-12 months of treatment completion. In the treatment group, the total effective rate of the group A--treated with ginger-free moxibustion was 80%, and the total effective rate of the group C --treated with Yunnan Bai Yao aerosol combined with ginger moxibustion was 85%, and the total effective rate of the group B--treatment with floating needle combined with ginger moxibustion was 92%, but the total effective rate of the control group was 10%.

**Conclusions** The clinical recovery evaluation and index assessment results showed that ginger moxibustion and its combination therapy had significant curative effects on patients suffering external humeral epicondylitis. The addition of auxiliary means also promoted the rehabilitation effects, further proving the Traditional Chinese medical effects. The method could significantly improve the rehabilitation of external humeral epicondylitis. The research made a bold exploration for the multi-organizational cooperation mode of TCM compound therapy in the field of sport injury habilitation, and opened a new way for its application of clinical research.
PO-220
Target Mitochondria Metabolism and Energy Expenditure in Muscle Atrophy, Sarcopenia and Cachexia

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Objective Muscle atrophy is a common and clinically important outcome of many diseases and hospitalization bed rest. Mechanical unloading of skeletal muscles may result in a rapid loss of muscle mass and mitochondrial dysfunction. And the recovery from disuse muscle atrophy is usually complete in young healthy adults but is delayed and often incomplete in older patients. However, the mechanisms underlying poor recovery of aged muscle following disuse remain to be delineated. Recent evidence suggests that mitochondrial energetics play an important role in regulation of muscle mass. To this end, we employed multiple approaches to address the role of mitochondrial function and metabolism in muscle atrophy and sarcopenia. And we are also engaged to develop novel mitochondria-targeted antioxidant peptides to mitigate this mitochondria-related functional impairment by ROS and improve the recovery from muscle atrophy and cachexia.

Methods Tail Suspension Hind Limb Unloading for adult mice (6-month-old) and aged mice (22-24 month old). Cardiometabolic Phenotyping: Measurement of fat and lean mass (g) is accomplished using a LF90II TD-NMR (Bruker, Madison, WI). Locomotor activity measurements are obtained using a Promethion Mouse Multiplexed Metabolic System (Sable Systems International, Las Vegas, NV). Mitochondrial Respiration: Respirometry assays were conducted using an Oxygraph-2k (Oroboros Instruments, Innsbruck, Austria). Mitochondria H2O2 emission was measured with Amplex Red reagent which reacts with H2O2 to produce the stable fluorescent compound resorufin. Resorufin fluorescence was monitored using a Fluorometer. A continuous, spectrophotometric assay was utilized to measure mitochondrial calcium retention capacity (CRC) within soleus fiber bundles. RNA Sequencing and Informatics, KEGG Pathway and Upstream Regulator Analysis, Real-Time Quantitative PCR. Multidimensional mass spectrometry-based shotgun lipidomics was employed to measure and characterize the lipid patterns in mouse soleus muscle. Metabolomics Acylcarnitines A panel of acylcarnitines was quantitated by LC/MS/MS (Agilent 1290 HPLC/6490 triple quadrupole mass spectrometer). Amino Acids. Quantitation of amino acids was achieved using LC/MS/MS (Agilent 1290 HPLC/6490 triple quadrupole mass spectrometer).

Results Old mice have impaired early recovery of soleus mass following unloading induced muscle atrophy. And mitochondrial function and metabolism does not improve during early recovery in aged Mice. Divergent metabolomic response was found between adult and aged Mice during unloading and recovery. However, transcriptomic response to unloading and reloading is similar in adult and aged Mice.

Conclusions Here, we report that aged mice with low muscle mass and low glucose clearance rate also display poor early recovery of muscle mass after disuse muscle atrophy. We used unbiased and targeted approaches to identify changes in energy metabolism gene expression, metabolite pools and mitochondrial phenotype and show for the first time that persistent mitochondrial dysfunction, dysregulated fatty acid β-oxidation and elevated H2O2 emission occur concomitantly with poor early recovery of muscle mass following a period of disuse in old mice. Importantly, this is linked to more severe whole-body insulin resistance, as determined by insulin tolerance test. Our findings also showed cellular metabolic changes during muscle atrophy and sarcopenia may induce higher production of oxygen radicals that play a significant role in the progression of age-related sarcopenia. These findings suggest that muscle fuel metabolism and mitochondrial energetics could be a focus for mining therapeutic targets to improve recovery of muscle mass following periods of disuse. We are engaged to develop novel mitochondria-targeted antioxidant peptides to mitigate this mitochondria-related functional impairment by ROS.
and improve the recovery from muscle atrophy and cachexia. Co-administration of other targeted compounds was also promising to improve recovery from muscle atrophy and cachexia.

PO-221

Acute whole-body vibration increases energy expenditure and skeletal muscle microvascular perfusion

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Objective Insulin resistance and cardiometabolic disease are associated with decreased muscle microvascular perfusion which impairs nutrient delivery to the muscle. Impaired glucose and insulin delivery contributes to lower glucose uptake into the skeletal muscle. Exercise increases muscle microvascular perfusion, however, cardiometabolic disease patients are not always willing or able to undertake regular exercise. Objective: Whole-body vibration (WBV) has previously been shown to increase energy expenditure and limb bulk blood flow, however whether WBV increases skeletal muscle microvascular perfusion is not known.

Methods Methods: Eleven healthy participants (5 males, 6 females; Age: 33 ± 1.9 years) stood on a WBV platform (Galileo Sport, Novotec Medical GmbH, Pforzheim, Germany) for 3 min at 12.5 Hz which was compared to standing without vibration. Thigh muscle (vastus lateralis) microvascular perfusion was assessed by contrast-enhanced ultrasound (iU22, Philips Medical, North Ryde, NSW, Australia) by infusing Definity® microbubbles (Lantheus Medical Imaging, N. Billerica, USA) intravenously and measured for 3 min following WBV. Oxygen consumption (Metamax, Cortex Biophysik GmbH, Leipzig, Germany) was measured while standing prior to WBV and during the third minute of WBV.

Results Results: Compared with standing without vibration, 3 min of WBV more than doubled muscle microvascular perfusion (0.73 ± 0.17 vs 2.87 ± 0.81 AI/sec, p<0.05) which remained elevated above baseline for 3 min after cessation of WBV. Oxygen consumption modestly but significantly increased while undergoing WBV (282 ± 0.013 vs 419 ± 0.023 mL/min, p<0.05).

Conclusions Conclusion: This is the first study to show that WBV significantly increases muscle microvascular perfusion in healthy adults. We are currently undertaking studies to determine if this WBV may be of benefit in populations with impaired microvascular perfusion, such as type 2 diabetes, for improving cardiometabolic health.

PO-222

The regulation mechanism of bcl-2 family on autophagy, apoptosis of motor skeletal muscle cells

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Objective To summarize the localization and regulation mechanism of Bcl-2 family on autophagy and apoptosis of exercise skeletal muscle. In order to provide new Intervention idea for metabolic diseases, sports injuries and post-game recovery of sports skeletal muscle.

Methods In the academic network of , CNKI, CQVIP, Wanfangshujuzixuyanxitong-xueshuqikan, Elsevier Science Direct, and Journals@Ovid Full Text and other academic journals, search for Chinese and foreign literatures such as Bcl-2 protein, skeletal muscle, autophagy and apoptosis, and sort more than 170 articles. More than 50 articles are in line with the requirements, and the final reference is 49 articles.
Results 1) The regulation of Bcl-2 family proteins on apoptosis of exercise skeletal muscle autophagy was divided into localization and streaming regulation; 2) Bcl-2 is located in the endoplasmic reticulum and binds beclin-1 to form a complex. Through stimulating ampk-ulk1/akt-mtor pathway, FoxO, GAMKK underground, etc., the release signal of motor stress interferes with the decomposition of bcl-2-beclin-1 complex, releasing Beclin-1, activating autophagy; 3) The bcl-2 family protein is located in the mitochondrial membrane, exercise stress releases apoptotic signals → BH3s activation or liberation of pro-apoptotic subfamily activity → recruitment of Bcl-2 family translocation to MOM → Bcl-2 family protein oligomerization → formation into MOMP→ finally promotion of cytochrome C Release → activates apoptosis; 4) On the other hand, the Bc-2 family cooperates with intracellular Ca2+ signaling; the JNK phosphorylation pathway; the P53 gene and the ubiquitin protein Atg12 are streaming between autophagy and apoptosis.

Conclusions Autophagy and apoptosis of skeletal muscle cells can eliminate ROS caused by oxidative stress, damaged organelles, misfolded proteins and severely damaged cell tissues, in order to maintain normal energy metabolism of muscle cells, control inflammatory damage, and improve Skeletal muscle cell movement adaptability. The Bcl-2 family is a major regulatory protein that controls apoptosis. It can also target and regulate autophagy in the endoplasmic reticulum. In addition, in coordination with multiple signaling factors, streaming between autophagy and apoptosis. It can be regarded as an important target protein for the intervention of skeletal muscle motor injury and improvement of skeletal muscle motor ability.

PO-223
Effects of long-term exercise on executive function for young people

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Objective Executive function is a cognitive control process that monitors, adjusts and plans task activities. Relevant studies have shown that exercise have positive impacts on executive function of human body, but previous studies mostly focus on children or elderly, the study of young people is not in-depth. This study explores whether exercise affects the executive control function of young people by comparing who have the habit of exercising all the year round with who have been sedentary.

Methods 12 graduate students from the Graduate School of Capital University of Physical Education and sports were taken as participants. According to the exercise habits, 6 participants with long-term exercise habits were divided into exercise group and 6 participants with sedentary and low-activity habits were divided into control group. The E-prime software was used to program classic arrows Flanker task to measure the execution control function of participants. The formal experimental procedure was divided into four blocks. The first and third blocks were consistent tasks, the second and fourth blocks were inconsistent tasks. The SPSS23.0 was used to analyze the experimental data.

Results The behavior data were analyzed with 2 (exercise habit group)*2 (task type) repeated measurement ANOVA to investigate the responsiveness of different exercise habits to flanker task. The results showed that for accuracy, the main effect of task type was significant F (1,10) = 21.729, P = .001, 2 = .685, and the interaction effect between task type and group was significant F (1,10) = 7.519, P = .021, 2 = .429, indicating that the participants with long-term exercise habits had higher accuracy than those who with sedentary. The accuracy of consistent tasks is higher than inconsistent tasks. For response time, the main effect of task type was significant F (1,10) = 5.277, P = .044, 2 = .345; the interaction effect of task type and group was not significant F (1,10) = .107, P = .751, 2 = .011, indicating that there were differences in response time between participants in the process of accomplishing consistent and inconsistent tasks, but there was no
significant difference in the reaction time between participants with long-term exercise habits and sedentary.

**Conclusions** Long-term exercise may have positive effects on executive function of young people, especially on accuracy of completing cognitive process, and the related brain mechanisms need to be further studied.

**PO-224**

Heart rate variability to assess ventilatory threshold in overweight young men

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**Objective** The individualized training intensity is important in the prevention of overweight and obesity. Our study compared heart rate (HR), oxygen uptake (VO\(_2\)), and work load (WL) corresponded to the anaerobic threshold during an incremental cycling test between ventilatory (VT) and heart rate variability threshold (HRVT) methods. Further, we examined the validity of three heart rate variability analyses to assess VT in overweight young men.

**Methods** Sixteen overweight young men (age 21.1±1.7 years, height 175.3±5.5 cm, weight 84.0±6.7kg, body mass index 27.3±1.2 kg/m\(^2\), VO\(_{2\text{peak}}\) 33.6±4.3ml/min/kg) performed a gradual exercise test on a cycle ergometer (Lode Corival, Lode B.V., Groningen, Newtherlands). The protocol started at 30 W for 2 minutes with subsequent increments of 30 W every 2 minutes until exhaustion. During test, gas exchanges (VO\(_2\), VCO\(_2\)) and ventilation (VE) were measured by breath-by-breath using Metamax 3B portable analyzer (CORTEX, Biophysik GmbH, Leipzig, Germany). The ventilatory threshold (VT) was identified as the point at which VE for O\(_2\) began to rise without a concomitant rise in ventilator equivalent for CO\(_2\). The R-R intervals were continuously recorded using a Polar RS800cx HR monitor (Kempele, Finland). HRV data were further analyzed by Kubios HRV analysis software (Kuopio, Finland) based on time-domain (RMSSD), Poincare plots (SD1) and time-varying spectral (fHF×HFP) methods. Data were analyzed using SPSS 22.0. Normal distribution of variables was verified by Kolmogorov-Smirnov test. The relationship between HRVT variables and VT was assessed using paired t-test and Pearson’s production correlation. The magnitude of concordance between the methods was further evaluated by Bland-Altman plots.

**Results** No significant difference was witnessed in HR, VO\(_2\), and WL related to AT between HRVT and VT methods (P<0.05). The relationships were found between the methods to determine the AT for all variables analyzed (r=0.40-0.91). Additionally, the Bland-Altman plots revealed that findings showing narrow limits of agreement present for fHF×HFP and the VT whilst the association between RMSSD, SD1 and VT showed wider limits.

**Conclusions** The estimation of the HRVT, especially derived through the time-varying spectral (fHF×HFP), may be a noninvasive and more robust method to determine the VT, which could be used to adapt individualized training intensity to overweight young men for training prescription.
PO-225

An overview of probiotics on the ergogenic effect

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Objective The paper provides an overview of probiotics on the ergogenic effect, which is prepared to demonstrate that moderate doses of probiotics have many benefits for the physical exercise, the development of related probiotic functional food is of great benefit to the majority of sports people.

Methods While probiotics as one of the most popular nutritional supplements, many studies have shown that probiotics mixture (mainly lactic acid bacteria and bifidobacterium) are supplemented can improve intestinal microflora, reduce intestinal permeability, control endotoxin transport and reduce the incidence of intestinal leakage; Promoteing the metabolism of short-chain fatty acids (SCAFs), provide metabolic energy, enhance muscle strength and endurance, optimize muscle fiber composition, improve anti-fatigue ability; Improving the ability of immune regulation, such as reducing upper respiratory tract and gastrointestinal tract infection symptoms; Reducing the oxidative stress level, increasing the scavenging rate of superoxide anion radical, reducing capacity and iron ion chelating activity can alleviate the oxidative stress after heavy exercise; Supplementation of probiotics can reconstruct intestinal flora, and intestinal flora can affect bone health and enhance calcium absorption; Ther studies have confirmed that probiotics can regulate emotional disorders through the hypothalamus-pituitary-adrenal axis and relieve anxiety and depression, which also contributes to the mental health of the exercise population.

Results In addition, the amount of exercise, the variety of probiotics, the quantity of supplementation and the time of supply in the reference literature are different. Therefore, the experimental results are different, and the mechanism remains to be further studied.

Conclusions Moderate doses of probiotics have many benefits for the physical exercise, the development of related probiotic functional food is of great benefit to the majority of sports people.

PO-226

FUNCTION INDEX CHANGE TREND OF FIGHTING EVENTS-GROUP ATHLETES DURING WEIGHT REDUCTION BEFORE COMPETITION: A META-ANALYSIS

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Objective The aim of this meta-analysis was to assess the function index change trend of some fighting event-group athletes during weight reduction before competition.

Methods Pub Med, MEDLINE, EBSCO, CNKI, Wanfang and VIP were searched to collect the scientific literatures about the change trend of body composition and function index of wrestling, judo and taekwondo athletes during weight reduction before the competition. The quality of literature was critically appraised, and data were extracted by 2 reviewers independently. Meta-analysis was conducted for eligible literatures.

Results A total of 14 studies were included in this meta-analysis. Stata software was used for data processing to observe the trend of body composition and function index during the process of weight reduction before competition. The average weight of athletes in judo, wrestling and taekwondo decreased by 5.23kg and the body fat percent decreased by 2.13% on average. Testosterone decreased by 3.93nmol/L on average and cortisol increased by 68.55nmol/L on
average. Hemoglobin decreased by 1.84g/L on average and blood urea decreased by 0.026 mmol/L on average. It was also found that the body weight and the body fat percent decreased significantly during the fast control period (P < 0.05), the decrease of the body fat percent during the fast control period was significantly higher than that in the slow control period. Testosterone decreased significantly (P < 0.01) during the slow control period and continued downward trend until pre-competition. Hemoglobin in the fast control period and pre-competition significantly lower than that before weight control (P < 0.05). The level of blood urea in fast control period was significantly higher than that in slow control period (P < 0.01).

Conclusions The decrease of body weight and body fat percent was concentrated in fast control period to pre-competition stage. Testosterone levels began to decline at the slow control period and lasted until the pre-competition. It is inconsistent with the expected results of coaches and athletes. We need further research for reasons.

PO-227
Effects of accumulated exercise with different intensities on insulin resistance in mice

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Objective The aim of this study was to investigate the effect of 8-week moderate-intensity and high-intensity accumulated exercise on insulin resistance in mice, compared with the moderate intensity continuous exercise with equal workload, which will provide an experimental reference for seeking a more reasonable and effective exercise program to break sedentary behavior and improve metabolic diseases such as IR.

Methods Eighty 4-week-old C57BL/6J mice were randomly divided into normal diet group (group C) and high-fat diet group (group H), fed with different diet. At the 10th weekend, insulin resistance model was judged by OGTT curve (AUC) and fasting blood glucose. All mice with insulin resistance were randomly divided into four groups: IR control group (IC), IR moderate-intensity continuous exercise group (IE), IR moderate-intensity accumulated exercise group (IM), IR high-intensity accumulated exercise group (IH), retained normal diet control group (C), with 12 mice for each group. All groups were fed with normal feed. The three exercise-related group performed an 8-week’s treadmill exercise program with equal workload (involved preparation and relaxation activities, 0° platform slope, 5 days/week). For IE group, mice run 50 min continuously with the velocity of 11 m/min. For IM group, mice exercised 12.5 min per session, total 4 sessions per day, with 3-hour’s interval and the velocity of 11 m/min. The IH group performed an alike exercise program with IM group, except the running speed (19 m/min) and exercise time (7.5 min). On the 8th weekend of exercise, FBG, OCTT, FINS, HOME-IR, and ISI were tested for each groups.

Results 1. Compared with group C, body weight, FBG and OGTT-AUC were significantly increased in group H (P<0.05 or P<0.01). 76% mice were induced to insulin resistance successfully. 2. Before and after exercise intervention of 8 weeks, there were no significant changes in body weight and OGTT-AUC, while the FBG was significantly increased in IC group (P<0.05). Body weight, FBG, and OGTT-AUC significantly decreased in IE group, IM group and IH group (P<0.05 or P<0.01). 3. After 8 weeks of exercise intervention, the FBG in the IE group, IM group, and IH group were significantly lower than that in C group (P<0.05 or P<0.01). Compared with the IC group, the FBG, FINS, OGTT-AUC, and HOME-IR in IM group, IH group and IE group were lower than those in the IC group (P<0.05 or P<0.01). Compared with the IE group, the body weight and HOME-IR index of IH group were significantly lower than those in IE group (P<0.01). Compared with IH group, the HOME-IR in IH group was lower than that in IM group (P<0.05); There was no significant difference between IM group and IE group.
Conclusions 1. Chronic moderate-intensity continuous exercise, moderate-intensity accumulated exercise, and high-intensity accumulated exercise all can effectively improve the glucose metabolism and insulin resistance in IR mice. 2. Compared with moderate-intensity accumulated exercise and moderate-intensity continuous exercise, the high-intensity accumulated exercise with equal workload is more effective in reducing the body weight and improving insulin resistance in IR mice.

PO-228
Cancer immunotherapy impedes skeletal muscle repair

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Objective To observe the difference of the capacity of skeletal muscle repair and the corresponding immune response in melanoma mice treated with cancer immunotherapy after acute skeletal muscle contusion.

Methods 96 males C57BL/6 mice were used in this experiment. They were divided into control group and injury group. The control group included normal control group (C group, n = 8), tumor control group (T group, n = 8) and tumor immunotherapy group (A group, n = 8). The skeletal muscle injury group was divided into normal injury group (D group, n = 24), tumor mice injury group (DT group, n = 24) and cancer immunotherapy injury group (DA group, n = 24). B16 cells were injected subcutaneously into the dorsum of C57/BL mice to prepare melanoma mice model. Immunotherapy is the injection of anti CTLA-4 and anti PD-1 antibodies. The model of gastrocnemius muscle contusion was established. At different time points after damage, mice were sacrificed. The gastrocnemius muscle of mice was made into cryosections. After HE staining and Mason staining, the regeneration of skeletal muscle and the healing of fibrotic scar were observed. The expression of CD8 T Cells and Regulatory T Cells (Treg) were detected by immunofluorescence.

Results
1. H&E staining of muscle slices at 7 days after injury showed that myofibers in the non-injured muscles are polygonal in shape with peripheral nuclei. Quantitative evaluation of the skeletal muscle in the cancer immunotherapy injury group (DA group) showed that the number of centrally nucleated fibers was significantly lower than that in the other injury groups (D group, DT group) and there was an enlarged interstitial space. Immunotherapy leads to greater muscle degeneration: vacuolated myofibers could be seen. Collagen deposition was detected by Masson trichrome staining, and collagen deposits were found in the injury group. However, the regenerated muscles of the cancer immunotherapy injury group (DA group) showed more collagen deposits than those of the other injury groups (D group, DT group), no collagen deposits were found in the control group.

2. On 14 day after injury, the density of muscle fibers in the other injury groups (D group, DT group) was higher than that in immunotherapy group (DA group), which was about 1.5 times of that in immunotherapy group (DA group). The other injury groups (D group, DT group) showed a larger proportion of regenerated muscle fibers with different diameters, whereas the cancer immunotherapy injury group (DA group) had fewer regenerated muscle fibers. Compared with the control group, the mice in the other injury groups (D group, DT group) still had a small amount of collagen deposits, the mice in the cancer immunotherapy injury group (DA group) had more collagen deposits.

3. On 21 day after injury, the average diameter on 21 day higher than that on day 7 in the three injury groups. The mean muscle fiber diameter in the other injury groups (D group, DT group) was significantly larger than that in the immunotherapy injury group. In addition, the regenerated muscle fibers in the other injury groups (D group, DT group) showed better organization and
basically returned to normal compared with the immunotherapy group (DA group). There were still some collagen deposits in the immunotherapy group (DA group) mice, but no collagen deposits were found in the other injury groups (D group, DT group) mice.

4. Immunofluorescence staining showed that CD8 T cells were continuously expressed and no Treg cells were found in the immunotherapy group (DA group) mice at 7, 14 and 21 days after contusion. In the other injury groups (D group, DT group), Treg and CD8 T cells were expressed in skeletal muscle tissue adjacent to the regenerated muscle fibers on 7 days. On day 14, a small number of CD8 T cells and a large number of Treg cells infiltrated the damaged muscles. On day 21, almost no CD8 T cells were detected, and Treg cells continued to express. There was no expression of Treg cells and CD8 T cells in the control group.

Conclusions Cancer immunotherapy will delay the repair of damaged skeletal muscle and reduce the capacity of skeletal muscle repair and regeneration.

PO-229
Exercise, myocardial insulin resistance and myostatin

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Objective Myostatin (MSTN) is a member of the TGF-β superfamily and is a negative regulator of skeletal muscle growth. MSTN is also expressed in other tissues such as heart and fat. The purpose of this study was to elucidate the occurrence of myocardial IR caused by myocardial MSTN expression, and to elucidate the regulation of MSTN expression by exercise and improve myocardial IR status and myocardial interstitial fibrosis.

Methods The literatures on exercise, myocardial IR, and myocardial MSTN published in recent years were reviewed and summarized.

Results 1. Myostatin, which is rarely expressed in myocardium under normal conditions, the appropriate amount of MSTN expression has anti-cardiac hypertrophy, and excessive MSTN expression can cause various cardiovascular diseases. In the IR state, the expression of myocardial inflammatory factors is increased, and MSTN is highly expressed. MSTN acts on the myocardium through various pathways, leading to the occurrence of myocardial fibrosis. In the IR state, possible pathways for inducing high expression of MSTN include: (1) inflammatory factor TNF-α is elevated, and MSTN expression is induced by P38MAPK and NF-KB; (2) The transcription factor Smad-2/3/4 up-regulates the MSTN promoter activity; (3) Glucocorticoid up-regulates MSTN expression; (4) IGF-1 up-regulates MSTN expression via p38MAPK and transcription factor MEF-2; (5) AngII up-regulates MSTN via Ang1 receptor, p38MAPK and MEF-2; (6) urotensin-II and urocortin can stimulate MSTN expression; (7) The ERK-1/2-MEF-2 pathway up-regulates MSTN expression.

3. Possible pathways by which MSTN acts on the myocardium include: (1) MSTN induces Smad2/3 overexpression; (2) MSTN activates the NF-KB pathway; (3) MSTN activates miR-1 expression, inhibits HSP70, and decreases pAkt levels; (4) MSTN inhibits the PI3K-Akt pathway, leading to induction or damage of the downstream pathway. Regular endurance exercise and resistance exercise improve myocardial IR and myocardial interstitial fibrosis involved in MSTN. This effect is mainly dependent on exercise can effectively improve the body’s chronic inflammatory state, down-regulate the MSTN superior inducer, resulting in a series of cascade reactions.

Conclusions 1. MSTN expression in myocardial tissue is dose-dependent, proper expression of MSTN in the myocardium can prevent cardiac hypertrophy, and overexpression of MSTN can lead to various cardiovascular diseases. 2. Under the hyperglycemia and inflammation state, it can induce high expression of MSTN. After high expression of myocardial MSTN, it can participate in myocardial IR and can lead to myocardial interstitial fibrosis. 3. Exercise can effectively improve the chronic inflammatory state of the body, down-regulate the level of MSTN induction, improve myocardial IR status and IR-induced myocardial interstitial fibrosis.
PO-230

The Comprehensive Review of Physical Training of Chinese Ice Hockey Players

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Objective Research purpose: This research aims at giving an comprehensive summary of the current situation of physical training of Chinese ice hockey team and helps to grasping the key points of their physical training, innovating the specific training methods, and improving the competitive performance of sports teams.

Methods Research methods: “Literature research” is the main method of this research. The authors have consulted CNKI, WWW, Wiper net, Knowledge Base of Sports Resources, EBSCO host and some other databases and analyzed 45 valuable articles in total.

Results Research result: The research results can be analyzed from three aspects—physical stamina requirement of players, training theories or methods, and physical fitness evaluation of players.

1 Physical stamina requirement of players
Ice hockey is an aperiodic sport with a repeated alternately of high, medium and low intensity, which is characterized by intermittent high intensity exercise and high antagonism. The sports’ mode is 70: 2: 30, which means players have 70 seconds to play and two minutes to rest each time, and the whole match will take 30 minutes. The blood urea, creatine kinase and serum testosterone of players will significantly change after the competition. Most of their heart rate will be above 70 percent of the maximum rate and some athletes’ blood lactic acid value will reach to 17.1 mmol / L. Therefore physical stamina training is necessary for them.

2 Training theories or methods
2.1 Characteristics of physical training load and periodicity
Athletes’ physical training presents periodic changes. Specifically, their competitive state presents a pattern of formation, maintenance and temporarily fading with the change of training load. According to the theory of cycle and the principle of competitive sports training, some domestic researchers have established an annual cyclical training structure for the national women hockey team, and have achieved ideal results in practice. The annual cyclical training structure consists of 5 levels, 3 periods, 7 phases, 9 middle cycles and several different types of small cycles. In preparation for the 21st Vancouver Winter Olympics, the national women hockey team have accepted 482.5 hours physical training, accounting for 47 percent of the total training volume.

2.2 Strength quality
The special strength of ice hockey consists of maximum strength, speed strength and endurance strength. Both land and ice strength training are included, which have their own advantages and disadvantages. During the preparation period, Canadian fast strength training method, which is a kind of land strength training, can be used in general strength training stage, and the combination of land and ice training methods can be adopted in special strength training stage. And the method of simulating competition scene with the combination of special tactics is usually needed for the purpose of developing special strength. Step compression, impact exercise, waist load and skate weighting can effectively enhance the special strength while hooting strength requires special training methods.

2.3 Speed quality
The speed of ice hockey include “simple and complex reaction speed”, “thinking process speed”, “starting speed”, “paragraph speed”, “fast braking of action”, “fast completion of technical action and convergence speed of action”. Therefore speed training should strictly control the training mode, frequency, interval time, and the stability of speed and the mechanism of energy metabolism system should be considered firstly. The usually methods are: repeated training, speed changing training, race and game training.
2.4 Endurance quality
The endurance quality of hockey athletes consists of general endurance and special endurance quality. The general endurance training mainly needs aerobic methods, while the specific endurance training includes aerobic and anaerobic mixed training, anaerobic phosphate training and anaerobic glycolysis training. Endurance training is carried out at all stages of the season and both ice training and land training are needed. Methods of developing general endurance include uniform running, intermittent running, fartleke running, swimming and ball games.

3 Assessment and diagnostic methods of ice hockey player
The physical fitness of athletes is mainly monitored by testing method, which mainly tests general physical fitness and special physical fitness, and such tests are carried out at different stages. There are also researchers on the physical characteristics of athletes in aspects of the body shape, function and quality.

Conclusions
Research conclusion: The purpose of ice hockey physical training is to improve sports performance, enhance energy supply ability of metabolic system, and reduce injury. Such training should accord with its special characteristics and adopt the periodic training structure arrangement. And also should focus on the strength, speed, endurance, reasonable proportion of training arrangement on ice and land. The current physical fitness evaluation which includes general and special physical fitness still needs further study.

PO-231
Nitric oxide generation in red blood cells induced by exercise
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Objective Vascular endothelial nitric oxide synthase (NOS) is considered to be the main enzyme source for NO production in blood vessels, and studies have shown that RBC may also express NOS and produce NO. The purpose of this study was to summarize the expression of NOS in vascular red blood cells caused by changes in hemodynamics, and to improve the bioavailability of NO, and to lay a theoretical foundation for exploring the mechanism of exercise to improve vasodilation.

Methods A literature review method was used to analyze related studies on exercise and RBC-NOS published in recent years.

Results Intravascular NO is one of the most important vascular signaling molecules, which has the function of relaxing blood vessels. NO is produced during the conversion of L-arginine into L-citrulline, which is mainly dependent on the regulation of vascular eNOS. RBC can express NOS under certain action, and RBC-NOS is mainly located on RBC membrane and cytoplasm. The regulatory mechanisms of RBC-NOS and eNOS have similarities and differences: RBC-NOS and eNOS are both dependent on Ca\(^{2+}\) regulation and phosphorylation of Serine 1177 via the PI3K pathway; however, since red blood cells do not have nuclei, endoplasmic reticulum and Golgi, they do not have other mechanisms of action of eNOS. Therefore, the vascular endothelium is not the only source of NO production. Red blood cells, white blood cells and platelets can produce NO. The amount of NO produced by red blood cells is significantly higher than that of white blood cells and platelets. It is another major source of NO production in blood vessels. The level of wall shear stress is the main determinant of NOS expression in blood vessels: On the one hand, exercise training can cause hemodynamic changes, increased shear stress, and induce changes in eNOS and RBC-NOS levels, increase NO bioavailability, and participate in the regulation of vasodilation. On the other hand, moderate-intensity exercise causes NO produced by RBC to increase red blood cell deformability and participate in vascular regulation.
Conclusions
1. Erythrocyte is an enzyme source that relies on hemodynamics to release NO from the blood vessel wall. It is regulated by Ca^{2+} and phosphorylates ser^{1177} through the PI3K pathway to participate in the regulation of the body.

2. Hemodynamic changes caused by exercise training can simultaneously induce the expression of eNOS and RBC-NOS, increase the bioavailability of NO, and jointly mediate vasodilation.

PO-232
The Mechanism Of LIL combined with AZD8055 On The Glutamine Addiction Of CT26 Cells

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Objective
The photobiomodulation of low-intensity lasers can activate many pathways and molecules, which involved in tumor growth, invasion, metastasis, and resistance to drugs or radiation therapy, but studies of low-intensity lasers on tumor cell addiction, have not been reported. Numerous studies have shown that changes in plasma and muscle glutamine levels can occur when the body undergoes prolonged exercise (>1 hour) or overtraining. AZD8055 is a dual inhibitor of mammalian rapamycin complex (mTORC1/mTORC2 that inhibits phosphorylation of mTORC1 (p70S6K and 4E-BP1), mTORC2 (AKT) and downstream proteins. Based on the experimental model of glutamine addiction in laboratory, we chose the worst conditions to cause super-proliferation of CT26 cells and simulate the drug resistance of solid tumors. The purpose is to study tumor deterioration from the perspective of tumor cell function. Under the state, the effect of low-intensity laser combined with AZD8055 on the proliferation of glutamine addiction in CT26 cells is also the development of exercise intervention tumors, and the experimental basis is proposed from the perspective of nutrient metabolism.

Methods
This experiment used a pre-experimental glutamine addiction model to culture mouse colon cancer CT26 cells after horse serum shock, and used different intensity 640±15 nm low-intensity lasers from light-emitting diode arrays (red light at 640±15 nm from Light emitting diode array, RLED), 15 min/day; different concentrations of AZD8055 (0 ~ 100μM) on different proliferative CT26 cells at different times. Cell proliferation was detected by MTT assay; mRNA levels of proliferation-related genes were detected by RT-PCR; protein levels were detected by western blot. The data were analyzed by SPSS21.0 statistical software and self-similarity index analysis. Among them, the statistical significance level was set at 0.05, P<0.05 was different; P<0.01 was significant difference. In the self-similarity index analysis method, \(L>0.8\) is a significant difference.

Results
1. CT26 cells were incubated at Gln7.94 mM until the 8th day, and AZD8055 was added at different concentrations. Compared with no inhibitor, and at 6 h, the cells were significantly increased when the concentration of AZD8055 was 0.001 μM, 1 μM, 10 μM and 100 μM. (P<0.01); at 12h, the cells were significantly inhibition when the of AZD8055>0.5μM (P<0.01).
2. From the growth inhibition rate analysis, at 48 h and 72 h, the inhibition rate exceeded 50%, when the concentration of AZD8055 was 100 μM (61.01% and 87.46%), when< 0.1 μM, the cells were proliferation occurred at 48 h and 72 h, and it is drug resistance.
3. When AZD8055 combined with low-intensity laser treatment of CT26 cells, CT26 cells had different degrees of proliferative effects at different time points: 12h, 24h, 48h and 72h. Especially at 48h, the light intensity of LIL2 to LIL8 had a significant proliferative effect on CT26 cells (L≥0.8).
4. Compared with the control group (0 hours without inhibitor), the CT26 cells were treatment with AZD8055 1μM, the mRNA level of the gene GLUT1 was significantly down-regulated in all time periods (P<0.01). When the LIL(2.17 mW/cm\(^2\)) combined AZD8055 (1μM) significantly promoted the proliferation of CT26 cells at 24h and 48h. It is related to up-regulated of protein expression in all time points: at 6h and 12h, the pMEK protein and the pMEK/ MEK were significantly up-
regulated ($P<0.01$). At 24h, the expression of GLUT1 protein was up-regulated ($P<0.01$), MEK protein, pERK protein and ERK/pERK were significantly up-regulated ($P<0.01$). At 48h, the GLUT1 protein, MEK protein, pERK protein and pERK/ERK were up-regulated ($P<0.01$).

**Conclusions**

1. The minimum inhibitory concentration of AZD8055 on super-proliferative CT26 cells was 0.5 μM, and the super-proliferative state showed more obvious drug resistance.
2. When low-intensity lasers combined with AZD8055 treated CT26 super-proliferating cells, CT26 cells are not sensitive to AZD8055, while low-intensity lasers promote CT26 cells proliferation by up-regulating MEK/ERK signaling pathways.

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**PO-233**

**Effects of different exercise on autophagy and inflammation in visceral adipose tissue of obese**

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2. Hebei Normal University

**Objective**

To compare the effectiveness of endurance exercise and resistance exercise in fat reduction, then to examine the impact of exercise on autophagy activity and inflammation response in visceral adipose tissue in obesity, finally to explore the relationship between autophagy and inflammation in adipose tissue after exercise.

**Methods**

42 obese mice were randomly divided into four groups as follows: high fat diet group (HC, n=9), normal diet group (NC, n=9), normal diet combined with endurance exercise intervention group (NE, n=12), and normal diet combined with resistance exercise intervention group (NR, n=12). NE and NR group conducted treadmill and ladder climbing exercise respectively for 8 weeks. Then to detect the gene and protein expression of autophagy, inflammation, ER stress and antioxidant markers using RT-PCR and WB, in addition, TEM and IHC were used to observe the autophagosome in visceral adipose tissue.

**Results**

BW, Lee’s index and BFI were significantly decreased in all three intervention groups, and there is a great decreasing in the two exercise group, but no difference between them. Atg5, Becn1 expression and LC3II/I were decreased significantly in NE and NR group compared with HC, meanwhile p62 expression were significantly increased. When compared with NC group, p62 expression were significantly increased in NE and not happened in NR group. Becn1 mRNA expression increased and p62 protein expression decreased significantly in NR group when compared with NE group. IL-1β was decreased significantly in NC, NE and NR group compared with HC. In addition, IL-6 and IL-10 protein expression increased significantly both in NE and NR group. When compared with NC group, IL-6 and IL-10 protein expression increased and IL-1β was decreased significantly both in NE and NR group except IL-6 protein expression in NR group. IL-6 increased and IL-10 decreased significantly in NR group when compared with NE group. Finally we found that IL-10 showed a negative correlation with almost every autophagy markers used in this study.

**Conclusions**

The effectiveness of 8wks different exercise intervention had no difference in fat reduction. The autophagic activity of visceral adipose tissue was inhibited after exercise, especially after aerobic exercise. Autophagy and inflammation enjoy the same trend before and after exercise intervention in visceral adipose tissue in obesity, and the IL-10 is the most sensitive factor in reflecting the relationship between autophagy and inflammation.
PO-234
Effects Of Irises On Exercise To Improve Obesity
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Objective Iirisin is a protein encoded by the target gene FNDC5 of peroxisome proliferator-activated receptor gamma coactivator in skeletal muscle. The secretory protein produced by shearing modification can promote the transformation of subcutaneous white fat into brown fat. As a kind of exercise-mediated muscle factor and potential fat factor, Iirisin is closely related to obesity, insulin resistance, glucose and lipid metabolism, metabolic syndrome and so on. As an important preventive and therapeutic means of obesity, exercise plays a role in affecting irisin? Through the analysis of the effect of irisin on exercise intervention in obesity, this paper aims to lay a theoretical foundation for irisin to become a new way of thinking and a new target of treatment of obesity.

Methods A computer-based search of the literature on "Research Progress in the Effects of Irisin on Exercise-induced Obesity" was conducted in the Sportdiscussussussand CNKI databases from 2012 to 2017. The key words were "obesity; exercise; Irisin; brown fat". Inclusion criteria were original research, Meta analysis and systematic review. Exclusion criteria: repetitive studies. A total of 86 articles were included in the review.

Results (1) exercise can significantly improve obesity, insulin resistance, metabolic syndrome and other diseases;(2) Irisin can induce white fat Browning, increase body heat production, reduce body weight, and promote the expression of UCP1 by p38MAPK/ERK signaling pathway. Exogenous Irisin can significantly reduce obesity in mice induced by high-fat diet and improve insulin resistance.(3) whether it is one-time exercise or long-term exercise, endurance exercise or resistance exercise, moderate and low-intensity exercise or high-intensity exercise will increase the expression of irisin in skeletal muscle, blood or fat. However, the influence of different exercise intensity and different exercise modes on the expression of irisin is not regular, and the influence and mechanism of different exercise modes and exercise intensity on the expression of irisin between different species and different tissues have not been reported.

Conclusions Exercise can significantly improve the occurrence and development of obesity, and the effect may be achieved by promoting the secretion and expression of irisin in skeletal muscle.

PO-235
Correlation Analysis between Blood Cell Viability, Five Elements and Competition Performance of Elite Men’s Rowers
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Objective To observe the national elite male rowers blood, red blood cell activity and serum copper, zinc, calcium, magnesium and iron content of the five elements, and compared with the ordinary people. Aimed to investigate the between athletes, athletes and ordinary differences between the two sets of indicators and to explore the impact of element contents in red blood cell activity and five factors. Trying to bring two sets of indicators and specific combining ability, used in training on the monitoring function, and for the future to provide some references for further study.
**Methods**

It was included 22 athletes and 22 ordinary men, as the research object, in the collection of blood, measuring red blood cell activity in the blood content of the five elements, simultaneous measurement of physical indicators, will be doing all the data at the differences between the two groups compared to the group to do correlation analysis. The recent record of 2000m, 6000m rowing Dynamometer test results, and red blood cell activity associated with the five elements of content analysis.

**Results**

1. Athletes indicators related to aerobic exercise were significantly higher than ordinary people. The white blood cells of athletes group were average. It shows that athletes have high aerobic capacity, while white blood cells are more stable than normal people.
2. The members of the national rowing men's iron, magnesium content was significantly higher than ordinary group, the iron content is higher than the normal reference value; blood calcium levels were significantly lower than ordinary people, and lower than the normal reference value.
3. The total number of red blood cells and the number of living cells was very significant positive correlation in two groups subjects; Red blood cell activity and red blood cell diameter is proportional, and red blood cell roundness in inverse proportion to the relationship; from this experiment a special ability to see red blood cell activity and there is no correlation.
4. In both groups, hemoglobin was positively correlated with iron content, while iron was positively correlated with copper content.

**Conclusions**

1. Increasing the number and volume of red blood cells can effectively increase the activity of red blood cells; red blood cell activity has no correlation with specific ability, and can not be used as an indicator to determine specific ability.
2. The content of iron and magnesium in rowers is higher than that in ordinary people, which indicates that the adjustment of aerobic capacity and nerve control is very effective. The lower calcium content indicates that the injury caused by calcium loss should be prevented and the urgency of calcium supplementation should be emphasized.
3. In training, we should pay attention to increasing hemoglobin content and aerobic capacity by supplementing iron. We can further consider the effect of supplementing copper to promote iron supplementation.

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**PO-236**

The research about the evaluation index on cardiac reserve of female athletes

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**Objective**

How well the heart and cardiovascular system operate will directly influence the ability that female athletes bear the training and competition load. The accurate evaluation of heart and cardiovascular system is the important part of female athletes training processes monitor and medical supervision. Nowadays, there are many evaluation index to assess the condition of the heart and cardiovascular system. Due to the differences of tested mechanisms, there are huge differences lay between the focus of index to show the cardiac function of female athletes. As a result, to clarify the significance of different evaluation index will be benefit to accurately evaluate the cardiac function of female athletes. This research clarifies different significance of different index to evaluate female athletes’ cardiac function by comparing two indexes (CRI, HRr) to evaluate the cardiac contractility of female athletes in different programs, and also offers grounds for accurately applying these two indexes to evaluate female athletes’ cardiac function.

**Methods**

The study subjects of this research are the female athletes from sports team in Hubei province. We select 63 female athletes whose ages are between 14 and 18 and average age is 17±1.6. They have been trained to play basketball game, soccer, badminton or table tennis for more than four years. This research applies quantitative exercise experiment to get the cardiac index \(--Cl_2 (Cl=CO/BSA)\) after the female athletes’ doing sports. We can compare the
difference between the cardiac indexes during the female athletes doing sports and they becoming calm and the work done by exercise load (PP) to get the cardiac reserve index (CRI). The formula of this process is CRI=PP/(CI₂-CI₁)/10. We can also dividing CRI by cardiac function index to get heart recovery rate (HRr). We divide CRI by CFI to get the value of HRr. CFI=(HR₁+HR₂+HR₃-200)/10. Thereinto, HR₁, HR₂, HR₃ respectively mean the athletes’ heart rates when they are calm, when they just finish doing sports and when they are in restoration stage. Data assessment and statistical analysis was performed in this research, using the value of female athletes’ CRI and HRr in different programs.

Results

There are huge differences between the average CRI values of female athletes in different programs. Among them, the highest value is 11.13±1.1, which is the average CRI values of female athletes who play soccer. And the lowest one is 7.56±0.7, which is the average CRI values of female athletes who play table tennis. The values of CRI of female athletes in basketball group and badminton group are 10.07±0.9 and 7.82±0.8 respectively. However, there is no significant difference between the values of female athletes’ HRr in different groups. The values are 0.94±0.05 (women’s basketball), 0.97±0.06 (women’s football), 0.93±0.04 (women’s table tennis), 0.97±0.08 (women’s badminton) respectively.

Conclusions

The phrase “cardiac reserve” means the ability that cardiac output can increase according to the need of the body’s metabolism. When people do some vigorous exercise, sympathetic will be active, and adrenalin production will increase. At the same time, cardiac output will increase because of the increasing of heart rate reserve and mental efforts. The cardiac storage function can be more comprehensive reflected by the indexes such as heart rate and SV when people doing sports and being calm. Cardiac reserve includes heart rate reserve and cardiac contractile capacity reserve. This research shows the condition of female athletes’ cardiac reserve by using ultrasonic cardiography to directly test the change of cardiac output before and after people doing sports. Using this method, we can get more straightforward results. Considering the big change of female athletes’ height and weight during puberty, we use the change of cardiac index to replace it of cardiac output. In this way, we can make the assessment index more unique. When people do the same amounts of exercise, the ones whose heart rate and cardiac output increase less have greater heart reserve. Therefore, we can compare the work done by the exercise (PP) and the difference of cardiac index CI₁ and CI₂ to get cardiac reserve index (CRI). The research result shows that there are significant differences between the average value of female athletes’ CRI in different programs. We can get the conclusion that the CRI has the typical item features. So we can apply CRI to be the assessment index which reflects the item features of female athletes. We can also apply CRI in selecting youth athletes of different programs. We can divide CRI by heart functional index to get HRr. Heart functional index can be figured out by calculating the HR₁, HR₂, HR₃. It can reflect the heart health status of athletes. This research also shows that there is no significantly difference between female athletes’ HRr in different programs. But this research do not include the data of normal women. As a result, we still need to compare the test result of female athletes and that of normal women in the further research. According to the result of this research, it is more reasonable and accurate to apply HRr to be the health assessment index of female athletes’ cardiac function.
PO-237

Application of low-load blood flow restriction training in elderly chronic diseases

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Objective
Objective: Low-load blood flow restriction training (It's also called KAATSU) refers to the stimulation of skeletal muscle growth and muscle strength with low-load training intensity when the blood flow of the proximal venous vessels of the limbs is restricted for a short time. Thereby improving the muscle function of the skeletal muscle. KAATSU uses a low training load (20% IRM), which can play a medium to high load training effect. It is suitable for older people with weaker constitution, less skeletal muscle strength, and different degrees of aging muscle loss (sarcopenia). Therefore, there have been more and more studies on KAATSU intervention in chronic diseases in the elderly in recent years. This study systematically reviews the recent progress in the application of KAATSU in chronic diseases in the elderly, and provides a theoretical basis for the widespread application of KAATSU in the intervention of chronic diseases in the elderly.

Methods
Method: Enter keywords in the websites of CNKI, CQVIP, Elsevier Science Direct, and Journals @Ovid Full Text, Pub Met, etc: “KAATSU, chronic disease”/“blood flow restriction, older”, a total of more than 3000 articles were searched, Screening of 98, At last, more than 40 literatures meeting the standards were analyzed and summarized.

Results
1) Applied to skeletal muscle atrophy: KAATSU can significantly increase the cross-sectional area of skeletal muscle muscles, strengthen muscle strength, improve muscle contraction function, effectively prevent and interfere with sarcopenia, Especially for stroke patients with rehabilitation and long-term bed caused by muscular atrophy of disuse has a good clinical effect.
2) Application to osteoporosis: KAATSU can improve bone mineral density, stimulate bone cell activity and improve bone health, but it is not yet certain whether to improve Senile osteoporosis. Future research should be combined with nutritional supplements to comprehensively evaluate its therapeutic effect.
3) Applied to cardiovascular and cerebrovascular diseases: Long-term KAATSU can effectively improve blood lipid metabolism, optimize cardiovascular function parameters, It doesn't activate the thrombin system, and has no significant negative impact on cardiovascular function in the elderly, the application effect is good in cardiovascular and cerebrovascular diseases such as atherosclerosis and hypertension.
4) Application to metabolic syndrome: KAATSU can promote fat breakdown, reduce BMI, body fat percentage, insulin resistance index, glycosylated hemoglobin index, and improve diabetes and senile obesity in the elderly.
5) Others: There are a few studies showing that KAATSU can improve the daily activities of patients with Alzheimer's disease, promote the remodeling of bone tissue in elderly patients with osteonecrosis, and intervene with the muscle atrophy of patients with certain chronic heart diseases.

Conclusions
Conclusion: KAATSU is an effective exercise method for the elderly and has a good application prospect in comprehensive prevention and intervention of chronic diseases in the elderly. It deserves popularization and application. Future research could try to used in chronic diseases such as chronic obstructive pulmonary disease and senile osteoarthritis.
PO-238
Research on Norm Construction and Evaluating Levels of 20-m Running in Preschool Children

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Objective The study tested young children's 20-m running in Chengdu, analyzed the characteristics of change in age and gender, to construct the norm and evaluation system of the 20-m running of young children and provide the basis for assessing children's sports ability and physical fitness. The results can used as one of the children's physical fitness evaluation content.

Methods The stratified random sampling method was used to select kindergarten children in from 25 kindergartens in a district of Chengdu, and totally, 3089 children of 3-6 years old were tested. The best scores by two trials were used as the 20-m running performance.

Results With the growth of the age, young children's 20 m running is gradually increased. There are significant differences in the mean values of boys and girls aged 3, 4, 5 and 6 (F = 228.696, F = 366.477, P < 0.01). Compared with boys and girls of the same age group, boys are superior to girls, and there is no significant difference between boys and girls aged 6 (F = 0.879, P > 0.05). The differences in other groups were statistically significant (F=0.138, F=0.204, F=0.133, P < 0.01). The percentile 10, 25, 50, 75, 90 values of the 20 m running of young children were recorded, respectively, and according to the statistical percentile method to divide the evaluation grade standards, the test results of the 10th, 25th, 75th and 90th percentage site test results were selected to develop the five-level rating system of children's 20 m running.

Conclusions With the growth of the age, young children's 20 m running is gradually increased, and there are significant differences between groups. It is suggested that the flexibility of nervous processes, the coordination of the body, the flexibility of joints and muscles, and the strength and endurance of muscles are gradually enhanced in children. Constructed the norm and five-grade evaluation system of preschool children's 20 m running, and provided the basis for formulating the grade standard of preschool children's physique evaluation in the future.

PO-239
Lipidomic analysis of blood serum from prepubertal boys with different BMI

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Objective Childhood obesity is a worldwide health problem which may causes metabolic diseases such as hyperglycemia, hyperlipidemia, hypertension and hyperuricemia. It is well know that lipid metabolites regulate fatty acid and glucose homeostasis. Lipidomics is the comprehensive analysis of lipid metabolites which include their quantitation and metabolic pathways. The intention of this study is to identify the circulating lipid species which are altered in obese prepubertal boys.

Methods A total number of 72 boys aged 10.28 ±0.69 years old were included into this study, and divided into normal(NC), overweight(OW) and obese group(OB). The degree of maturation of all boys were measured by bone age and sex hormones. Then we measured the form indexes,
blood lipids, blood glucose level to identify the current state of all boys. Serum indexes were detected by CLIA and ELISA methods. A lipidomic method was established by using a Waters Acquity UPLC-Class liquid system combined with Waters Xevo G2-SQ-TOF mass spectrometry system. The identification and analysis of lipid metabolites were accomplished by using MassLynx 4.1, Progenesis QI software and LipidMaps database. Statistical analyzes were performed using SPSS22.0 software.

**Results**
(1) The waist-to-hip ratio, bone age and HDL-c levels were significant lower in OW and OB groups. The TG level was significant higher in OB group. The DHEA and SHBG levels were significant higher in OW and OB groups and the other sex hormones are not.
(2) In this study, 153 most significant different lipid metabolites were founded, including 3 diacylglycerol, 32 triglyceride, 1 Phosphatidyl choline, 1 Phosphatidylinositol, 3 Sphingomyelin, 1 Ceramide which significant higher in OW&OB group; 4 diacylglycerol, 17 Phosphatidic acid, 32 Phosphatidyl cholines, 4 Phosphatidylinositol, 13 Phosphatidylserine, 18 Phosphatidyl ethanolamine, 3 Phosphoglycerides, 13 Sphingomyelin and 6 Ceramide which significant lower in OW&OB group.

Among all these metabolites, 8 lipids (fold change ≥5) were founded as the significant biomarkers related prepubertal obesity, including 1 Phosphatidyl choline, 1 phosphatidylserine, 2 sphingomyelin and 4 Triglyceride. What’s more, the level of SM(d16:1/24:0) and TG(15:0/17:1/20:3) which measured by UPLC-QTOF/MS are highly positive correlated with the level of serum SHBG; PC(18:0/0:0) and TG(16:1/18:0/20:3) are highly negative correlated with serum SHBG.

**Conclusions**
Overweight and obese prepubertal boys showed disorder in lipid metabolism and bone growth. The lipidomic results showed lower SHBG level is related with the disorder of lipid metabolism. We suggest that further studies on these metabolites could help us gain a better understanding of the relationship between obesity and growth disorder.

**PO-240**

**Discussing and Exploring about Mobile Quick Recovery Strategy for General Games——Quick Recovery Measure Applied on the 13th National Games**

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**Objective**
Multiple quick recovery methods are used in the training and competition fields to explore quick recovery programs appropriate for application at the competition site, search for quick recovery form appropriate for competition characteristics of partial programs, and provide more science and technology measures for preparing for large sport, quickening the recovery of the athletes at the competition site, improving competitive capability and enhancing training and competition performance.

**Methods**
Athletes in Beijing participating in partial programs of the 13th National Games are taken as the research object. According to training and competition characteristics of the program, and in combination with competition rules and conditions at the competition site, practice research is used to try to use nutritional supplement, whole-body cryotherapy (WBC), hyperbaric oxygen recovery, deep muscle stimulate (DMS), intermittent pneumatic compression (IPC) and music therapy and others at the training and competition sites, explore positive and effective quick recovery solutions, and establish a mobile quick recovery strategy for general games.

**Results**
According to research results of all events in Beijing before the game, nearly 70% of sports teams are in urgent need of corresponding quick recovery support and guarantee; it’s proven through practice and application in the 13th National Games, mobile quick recovery
strategy can be used during preparation before the game, so as to activate the muscle in an accelerated way, improve nerve excitability and enhance warm-up effect; in the break of many matches in one day, it can be used to calm down, quickly supplement energy substances, speed up the elimination of metabolites, relieve muscle fatigue, quickly restore physical functions, and prepare well for the next match; if competition is required in consecutive days, it can be used during recovery after the end of daily competition, to timely supplement energy substances consumed in competition, eliminate metabolites, improve sleep, accelerate anabolism, fully restore physical functions and ensure good state in the competition.

Conclusions With the principle of quickening muscle relaxation and fatigue elimination and in the form of "quick recovery mobile service station", during preparation before competition, interval and after the competition, mobile quick recovery strategy can be used, i.e. multiple quick recovery measures are used at the competition site to promote fatigue elimination and physical recovery of the athletes, achieve good results, provide strong operability and good promotion value, so as to provide a new thought and selection for preparing for large games, speeding up recovery of athletes at the competition site, improving competitive capability and enhancing training and competition performance.

PO-241
Applied Research on Enhancing Respiratory Muscle Strength of Synchronized Swimmers by Using Respiratory Muscle Trainer

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Objective In research to date, powerbreath training to be tested were useful to improve the athletics' ability for training the breathe muscles, by the way to optimizing the Breathing technique. To further improve the synchronize swimming athletes' powerbreath of Beijing, enhancing the athletics level and express ability of whole team, to succeed in the finals.

Methods Six synchronize swimming athletes were the subjects of our research, the training takes place after the strength training, two times per week, 10 times of five weeks, the training frequency were 24~32 per minutes. At this stages we tested the changes of the breathe muscle by use the CHEST H-101 and Powerbreath K3 before and after the training. All the data were analyzed using SPSS17.0 software.

Results The research results shows, training the breathe muscle by spirotiger is the useful training methods to improve the synchronize swimming athletes’ powerbreath. By five weeks training, the synchronize swimming athletes’ lung volume capacity were significantly increased from 4.38L to 4.54L after powerbreath training, the rate of the enhancing were 3.65%. FVC were significantly increased from 4.38L to 4.54L after powerbreath training, the rate of the enhancing were 3.65%. MVV were significantly increased from 122.2L/min to 127.1L/min, the rate of enhancing were 4.0%. the strength of inspiratory muscle were significantly increased from 110.6cmH2O to 125.6cmH2O. the flow of inspiratory muscle were significantly increased from 6.2L/S to 6.8L/S. All the datas shows that the power of the breathe muscles were enhancing efficenicy after five weeks systematic training, and the variation rate of individual research shows that there were difference between the individuls.

Conclusions After five weeks systematic breathe muscle training, FVC and MVV were significantly increased, shows the synchronize swimming athletes’ respiration muscle strength were significantly increased; the index were significantly increased of the strength of inspiratory
muscle also shows that the breath muscle training were efficiency, and the training plan is helpful to enhancing the synchronize swimming athletes' powerbreath.

**PO-242**  
**Exercise Delays Alzheimer's Disease Through Enhancing Lysosomal Function**

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**Objective**  
Alzheimer's disease (AD) is a progressive neurodegenerative disease characterized by aggregation of amyloid-β (Aβ) peptides. Reduction of progressive accumulation of Aβ will delay the progression of AD. As a main digestive organelles in cells, lysosome is crucial to clear the harmful proteins from extracellular and intracellular. Recent evidences have shown that exercise improves cognitive function of AD, but the reason is not very clear. This manuscript is to study the effect of long-term running exercise training on lysosomal function in mouse brain and explore its relationship with the progress of Alzheimer's disease.

**Methods**  
The APP/PSEN1 transgenic mice were used as the AD model to examine the relationship between AD, exercise and lysosomes. The mice were trained on a treadmill from the 5 months old, 60 min/day and 5 days/week for 5 months. The Lashley water maze and the novel object recognition test were used to estimate the cognitive ability of the mice; the balance beam and the rotating rod experiment were used to estimate motor coordination. The Aβ accumulation was measured with brain section and immunochemistry. The effects of long-term exercise on lysosomal function of cerebral cortex, striatum and hippocampus were measured. Among them, the autophagy/lysosome associated proteins level was determined by Western blot and the autophagy vacuoles and lysosome were observed through electron microscope. TFEB nuclear translocation was determined by Western blot and Immunofluorescence. The transcription of the TFEB-regulating genes were determined by quantitative PCR (qPCR).

**Results**  
Long-term exercise improved the cognitive ability and physical coordination of AD transgenic mice. Exercise reduced Aβ accumulation through increase the clearance of Aβ and affected little on the production of Aβ. Exercise, not only increased the colocalization of lysosomes with Aβ, but also increased the mature type of lysosomal protease cathepsin D and cathepsin L. In the meanwhile, exercise promoted the nuclear translocation of TFEB, a master transcriptional regulator of lysosomal biogenesis and autophagy, and increased the transcription of genes associated with the biogenesis of lysosome.

**Conclusions**  
Long-term exercise training delays the progress of Alzheimer's disease through activating function of lysosome and enhancing the biogenesis of lysosome. Exercise may be a therapeutic approach for the treatment of Alzheimer's disease.

**PO-243**  
**Effects of HIIT on FTO protein expression and its relationship with glucose and fat metabolism**

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**Objective**  
FTO (Fat mass and obesity-associated) is associated with increased risk of obesity and type 2 diabetes incurrence. Studies have shown that the expression of FTO protein in skeletal muscle and adipose tissue is related to the oxidation rate of whole body substrate. With the increase of age, the body's carbohydrate oxidation rate decreases, the fat oxidation rate increases, and at the meanwhile the expression of FTO protein in skeletal muscle decreases and
that in adipose increases. HIIT is very helpful for inhibiting obesity, insulin resistance and type 2 diabetes. So the purpose of this study is to investigate the effect of HIIT exercise on the expression of FTO protein in rats and its relationship to glucose and fat metabolism.

**Methods**

20 Male, 3-week-old SD rats were randomly divided into two groups, each group has 10 rats. C group: sedentary; HIIT group: high-intensity intermittent training group (85% ~ 90% VO₂max exercise for 6min, 50% VO₂max exercise interval 4min, repeated 6 times. 5 times/week, 4 weeks). All subjects were maintained in a free facility with constant temperature of 25°C, light-dark cycle of 12/12 h and free access to water. 48 hours after the last exercise, all samples were taken with an overnight fast. The expression of FTO protein in skeletal muscle and adipose tissue was measured by Western Blot. Serum insulin was tested by ELISA; Estimation of blood glucose was tested by Glucose oxidase method.

**Results**

1. The expression of FTO protein in skeletal muscle was significantly higher than that of group C (P <0.01); The expression of FTO protein in adipose tissue of HIIT group was significantly lower than that of group C (P <0.05); 2. Serum insulin levels of group HIIT was significantly lower than that of group C (p <0.01); And the blood glucose of group HIIT was significantly lower than that of group C (p <0.01). 3. Serum LDL-C of group HIIT was significantly lower than that of group C (p <0.01), and serum HDL-C of group HIIT was significantly higher than that of group C (p <0.01); 4. Correlation analysis showed that serum insulin level was negatively correlated with skeletal muscle FTO protein expression (R = -0.454, p < 0.05). Correlation analysis showed that serum LDL-C levels was positively correlated with adipose tissue FTO protein expression (R=0.559, p < 0.05) and serum HDL-C levels was negatively correlated with adipose tissue FTO protein expression (R=-0.474, p < 0.05).

**Conclusions**

1. HIIT can increase the protein expression of FTO in rat skeletal muscle and decrease the expression of FTO protein in adipose tissue; 2. HIIT can regulate glucose metabolism and lipid metabolism in rats; 3. The regulation of glucose metabolism by HIIT may be related to the increase of FTO protein expression in skeletal muscle. The regulation of lipid metabolism may be related to the reduction of FTO protein expression in adipose tissue.

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**PO-244**

**Effect of resveratrol on preventing iron overload in liver of mice**

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**Objective**

To investigate the mechanism of resveratrol improving iron overload in liver of mice and its effect on alleviating liver oxidative damage.

**Methods**

40 male Balb/Cj mice, 2 months old, were randomly divided into 4 groups, Quiet control group (group C), sucrose iron group (group I), resveratrol group (group R), resveratrol + sucrose iron group (group IR), 10 in each group. Group IC and group IR were intraperitoneally injected with sucrose iron solution (100mg/5mL) once every two days, 75uL each time; R group and IR group were intragastrically resveratrol (Res), dissolved in 1% DMSO solution, each time 30mg / Kg; Group C and IC group were intragastrically administered with 1% DMSO solution once daily for 30 mg/Kg. After the end of the intervention for 8 weeks, the mice were dissected and taken. Perls’ staining was used to observe the distribution of iron in the liver of mice; biochemical kit for serum glucose, serum iron (SI), total iron binding capacity (TIBC), liver iron, liver superoxide dismutase (T-SOD), liver malondialdehyde (MDA), total liver oxidative capacity (T-AOC); enzyme-linked immunosorbent assay (ELISA) for detection of serum ferritin (SF), octahydroxydeoxyguanosine (8-OHdG); Western blot detection of FPN1 protein expression in liver; the expression of Hepcidin in liver was detected by PCR.

**Results**

(1) Perls’ staining results: 8 weeks of iron sucrose caused a significant increase in iron content in mouse hepatocytes, and Res decreased the amount of iron ions in hepatocytes; (2)
Results of iron metabolism index: 8 weeks of sucrose iron had a significant increase in liver iron, SI, TIBC and SF ($P<0.01$), and Res intervention reduced liver iron ($P<0.05$) and SF ($P<0.01$). The content of TIBC ($P<0.01$) and SI ($P<0.05$) increased, and the iron supplement and Res interacted with the effects of liver iron, SI and TIBC; (3) Results of glucose metabolism index: iron overload increased glucose level in mice ($P<0.01$), Res decreased glucose level, iron overload reduced liver glycogen storage in mice ($P<0.05$), iron supplement and Res, there is no interaction on the effects of glucose metabolism indicators; (4) Oxidation index results: 8 weeks of sucrose iron significantly inhibited liver T-SOD and T-AOC activity ($P<0.01$), increased liver MDA and 8-OHdg activity ($P<0.01$), and Res promoted liver T-AOC ($P<0.01$) and T-SOD activity increased, and the liver 8-OHdg ($P<0.01$) and liver MDA activity were decreased. The effects of iron supplement and Res on 8-OHdg and T-AOC were interactive ($P<0.01$); (5) 8 weeks of sucrose iron inhibited the expression of FPN1 protein in the liver of mice, and the intervention of Res could enhance the expression of FPN1 protein; iron supplement and Res had no interaction with the expression of FPN1 and Hepcidin in liver.

Conclusions 8 weeks of sucrose iron caused iron overload in the liver of mice, and increased oxidative stress in the liver. Res can alleviate iron overload, reduce oxidative stress and improve glucose metabolism. The main reason is that Res inhibits Hepcidin expression in liver and promotes FPN1 expression and promotes The liver iron is released, thereby reducing the state of iron dPOsition.

PO-245 Sex differences in the change of amino acid and cortisol concentration after marathon race

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Objective As we all know, marathon exercise can induce dramatic changes in amino acid and hormone concentration in the plasma. However, little attention has been given to the role of sex in metabolic changes.

Methods We compared the changing rates of amino acid and hormone after marathon running in male and female runners. Twenty-seven female (mean age: 41±15 years) and 66 male (mean age: 40±16 years) non-professional runners performed a marathon race. Amino acid and cortisol levels were assessed before and at 1h after race.

Results At pre-race and post-race, cortisol concentrations in female runners were lower than in males. Cortisol increased in all subjects at post-race but the rising rate was substantially higher ($P<0.05$) in females [median (range): 3.5 (21~ -0.25)] than in males [median (range): 2.09 (14.3~ -0.43)]. Post-race, the glycogenic amino acid concentrations of Arg, Asn, Gly, Ile, Met, Ser and Thr were significantly decreased in females and males. But females have higher decreased rate ($P<0.02$) [median (range):Arg -45% (12%~ -69%), Asn -42% (25%~ -72%), Gly -45% (5%~ - 73%), Ile -35% (16%~ -64%), Met -28% (48%~ - 62%), Ser -34% (17%~ -58%), Thr -33%(32%~ - 52%)] than males [median (range):Arg -35% (65%~ -64%), Asn -29%(46%~ -59%), Gly -33% (13%~ -64%), Ile -23% (37%~ -57%), Met -14% (92%~ -52%), Ser -23% (21%~ -56%), Thr -17% ( 84%~ -58%). This is because, during exercise, cortisol has the function of inducing gluconeogenesis to maintain plasma glucose supply.

Conclusions There is significant sex differences in the change of cortisol and some glycogenic amino acid concentration before and after marathon race, which has potential value for training and nutrition supplement in marathon running.
PO-246
Effects of different exercise patterns on TWEAK and its signal in rat skeletal muscle

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Objective To study the effects of different exercise patterns on TWEAK and its downstream NF-kB/ MuRF1 in rat skeletal muscle, and to explore the relationship between TWEAK and skeletal muscle metabolism by different exercise interventions.

Methods Thirty-two male Sprague-Dawley rats aged 12 weeks were randomly divided into 4 groups: quiet group, high-intensity intermittent swimming group, medium-intensity continuous swimming group, and ladder-moving group, with 8 rats in each group. The exercise group adopted high-intensity intermittent swimming training, medium-intensity continuous swimming training, and ladder training, and trained for 5 days per week for 8 weeks. The right gastrocnemius muscle of the rat was taken the next day after the last training. The expression of TWEAK, NF-KB, MuRF1 proteins was detected by Western Blot.

Results 1. The gastrocnemius muscle mass index exercise group was higher than the quiet group. 2. Compared with the quiet group, the expression of TWEAK in the exercise group was reduced, and the reduction in the ladder exercise group was more significant. 3. Compared with the quiet group, the expression of NF-KB and MURF1 was decreased in the exercise group, and the reduction in the ladder exercise group was more significant.

Conclusions TWEAK may be involved in skeletal muscle catabolism. All three exercise patterns can alleviate skeletal muscle atrophy in rats, and the effect of ladder movement is more significant.

PO-247
Effect of exercise and Siyeshen upon hippocampal cytochrome c and caspase-3 of diabetic rats

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Objective To observe the effects of aerobic exercise and Siyeshen water extract on cytochrome c (Cyt c) and caspase-3 in hippocampus of diabetic rats and to explore the possible mechanism of improving diabetes.

Methods Healthy male Wister rats fed with high fat and high sugar and combined with streptozotocin to establish type II diabetes model. They were randomly divided into 4 groups: diabetic control group, exercise group, Siyeshen group and exercise+Siyeshen group, and another normal control group, with 6 rats in each group. After aerobic exercise (15m/min, 5°slope, 60min, every other day) or/and Siyeshen (200mg/kg) gastrointestinal administration for 8w, the expression of Cyt c and caspase-3 in hippocampus of each group were detected by immunoblotting, and mRNA expressions were detected by RT-PCR.

Results Compared with the normal control group, the mRNA and protein expressions of Cyt c and caspase-3 in the hippocampus of the diabetic control group were significantly increased (P<0.05). Compared with the diabetic control group, the blood glucose level of exercise group and exercise+ Siyeshen group decreased (P<0.05), the mRNA and protein expression of Cyt c and caspase-3 decreased significantly (P<0.05), but there were no significant changes in the
mRNA and protein expression of Cyt c and caspase-3 between Siyeshen group and diabetic control group ($P > 0.05$).

**Conclusions** Exercise and exercise combined with Siyeshen can inhibit cytochrome c release and reduce caspase-3 protein expression, which may be related to the improvement of blood glucose levels in diabetic rats.

**PO-248**

**Isokinetic Assessment of Lower Extremities in Chinese Elite Male Figure Skaters**

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**Objective** Figure skating is a kind of sport that is a unique combination of art and athleticism. In recent years, the increased emphasis on jumping skills has become apparent, the number of quadruple jump in 2018 winter Olympic game was 2.2 times in short program and 2.5 times in long program in the top six male figure skating athletes’s program choreography compared with the 2014. The demand for more jumping skills has resulted in an increased demand for lower extremity strength, power, and “power endurance” to achieve high-difficulty skills while fatigued. But there are few researches about the strength characteristics of figure skaters.

Present research project aimed to analyse the characteristic of lower extremities strength of Chinese elite male figure skaters.

**Methods** 13 nationally ranked male figure skaters volunteered for this study ([M±SD] n=13, height 175.0±5.8 cm, weight 67.9±7.9 kg, age 21.5±2.9 yrs). The datas were collected from 2009-2013 years. All of the athletes landing by the right leg. The dynamic strength of hip and knee were obtained using a Isomed2000 isokinetic dynamometer system (D&R Ferstl GmbH, Hemau, Germany). Datas were recorded with computer system. Hip strength were tested in the lying position, the testing side thigh was fixed on the adapter, the range of movement was 10-100 degrees. Knee strength were tested in the siting position, the testing side calf was fixed on the adapter, the range of movement was 10-90 degrees. The other part of body were fix by the aid system. Both test speed used were 60 deg/sec. Used spss19.0 to analyze the datas. Used pair-t test to analyze the differences between left and right. Significance level is P≤0.05

**Results** The maximal knee extensor torque of left (2.82±0.39Nm/kg) was lower (L/R: 0.946±0.077) than right (2.99±0.39Nm/kg) ($P=0.024$). the maximal hip extensor torque of left (5.17±0.56Nm/kg) was higher (L/R: 1.079±0.107) than right (4.81±0.54Nm/kg) ($P=0.023$). the maximal hip flexor torque of left (2.18±0.30Nm/kg) was lower (L/R: 0.925±0.105) than right (2.37±0.37Nm/kg) ($P=0.02$). There was no difference between left (1.64±0.19Nm/kg) and right (1.69±0.20Nm/kg) knee flexors. Three athletes had been found imbalance (20% difference between left and right) in hip muscle. The Flex/Ext ratio of left hip (0.423±0.049) was lower than right (0.497±0.078 ($P=0.001$)). The Flex/Ext ratio of knee was no difference between left (0.590±0.081) and right (0.568±0.054).

**Conclusions** The results obtained in this study show that the hip muscle differences were the major difference of Chinese elite male figure skaters. Coaches should pay more attention to hip strength training in future.
PO-249
Investigation On Dietary Nutrition Status of Chinese Elite Male Young Soccer Player
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Objective To evaluate the dietary nutritional status of Chinese Elite male young soccer player through the knowledge, attitude, behavior (KAP) survey and an adjusted dietary balance index (DBI).

Methods Explored the dietary nutritional status of 30 Chinese Elite male young soccer players through the knowledge, attitude, behavior (KAP) survey. Diet status of 30 Chinese Elite male young soccer players was collected by food-weighing method. The dietary index of DBI-low bound score (LBS), DBI-high bound score (HBS) and DBI-diet quality distance (DQD) in the adjusted DBI-07 system and nutrient analysis were used to evaluate the dietary quality of athletes.

Results The average score of nutrition knowledge (general nutrition and sports nutrition knowledge) in the KAP questionnaire of Chinese Elite young players was 16.90±2.49, and the average score of nutritional attitude was 14.07±2.27. The mean score of the dietary behavior was 39.67±2.65. The total score average was 70.63±4.58. The results of the dietary intake survey showed that the percentage of calorie intake of Chinese Elite male young soccer players who eat three meals a day and snacks were 24.19%, 34.93%, 27.43%, and 13.45%. The proportion of energy intake of carbohydrates, fats, and proteins to total energy were 54.93%, 32.18%, and 11.53%, respectively. The results of the dietary quality survey showed that the median score of LBS of Chinese Elite male young soccer players was 21, the proportion of players with low level of intake was 83.3%, and the proportion of people with moderate and high levels of inadequacy was 16.7%. The median of HBS was 7.5, 90.0% of players had low levels of dietary intake in excess, and 10.0% of players had moderate levels of dietary intake in excess. The median of DQD was 34.5. Among the players, 46.7% of athletes have low-level dietary imbalances, and 53.3% of players had moderate-to-high-level dietary imbalances.

Conclusions The score of nutritional attitudes and dietary behaviors of 30 Chinese elite male young soccer players are relatively better than that of nutrition knowledge. Young soccer players have unreasonable dietary behaviors. Excessively intake too much fat in the three major nutrients and snacks. The intake of protein, vitamin A, vitamin C, calcium, iron and zinc was inadequate. In terms of dietary intake, most players have high-level dietary imbalances, and players have inadequate dietary intake and excessive dietary intake.

PO-250
Study on the effects of bone marrow-derived stem cells were used in chronic hyperactivity rats to cardiac injury treatment
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Objective Purpose of research: overload and long-term overtraining can cause hypoxic and hypoxic damage to the myocardial structure of the body. In recent years, studies have shown that the stem cells promote angiogenesis in vivo, resistance to apoptosis, myocardial stem cell
mobilization, and promote its proliferation in paracrine effect, such as vascular distribution. By animal experiments, this study explore MSCMs role in the improvement of heart function and its molecular mechanism to sports injury prevention and postoperative rehabilitation is of great significance of the heart, heart research provides the basis for the motion at the same time support.

**Methods**

Wistar rat model of excessive swimming training. Grouping: rats were randomly divided into 4 groups (n=10), quiet feeding group (Q), general training group (ET), over-training group (OT), and MSCMs transplant-over-training group (MOT). Source and preparation of stem cells: the rat autologous bone marrow was extracted 1 day before surgery, and the bone marrow mononuclear cells were isolated by Ficoll density gradient centrifugation. Methods of stem cell transplantation: perfusion via coronary artery in MOT group rats; Test indicators and methods: cardiac tissue was taken after the end of 1d training (group Q, ET and OT), MEF2A factor was tested by real-time, gata-4 expression was tested by Western blot, and LVEF value was observed by cardiac color doppler ultrasound (before, after 1w, after 2w and after 3w, respectively).

**Results**

MEF2A factor, gata-4 expression and LVEF value of the three groups of samples were detected: (1) compared with MEF2A factor in general training group (ET) and quiet group (Q), gata-4 expression was slightly improved, but there was no significant difference (P>0.05). After 3w, the increase of LVEF value presented significant differences (P<0.05)between the two groups. (2) comparison between the over-training group (OT) and the quiet group (Q) showed significant differences in MEF2A factor, gata-4 expression, and LVEF decreased value (P<0.05) between the two groups after 2w and the quiet group (Q). Cardiac tissue was taken after 2w to observe the expression of MEF2A, and gata-4 was compared with the silent group (Q) without significant difference (P>0.05).

**Conclusions**

(1) based on the test data of general training group (ET), reasonable and scientific aerobic exercise can effectively enhance the cardiac function and improve the cardiac activity ability. (2) according to the test data of over-training group (OT), overloading and long-term over-training can lead to hypoxia of heart function and decrease of vitality, resulting in hypoxia and ischemia of the motor heart and damage of cardiac function. (3) according to the observation and test data of the MSCMs transplant-over-training group (MOT), MSCMs transplantation can effectively improve the cardiac function of sports injuries, enhance the cardiac vitality, and repair damaged cells and tissues to a certain extent. It can effectively prevent and treat heart injury caused by overtraining. At the same time, it provides animal experimental research support for the research of sports heart in sports medicine.

**PO-251**

The Research on the Effects of Resistance Training on the Stress of Skeletal Muscle Endoplasmic Reticulum and Mitochondrial Autophagy in Aging Rats

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**Objective**

By establishing a resistance training model, the researchers observed the effects of resistance exercise on the endoplasmic reticulum stress and mitochondrial autophagy-related factors in aging rats and further discussed the physiological mechanism of resistance movement in preventing and delaying senile skeletal muscle decay.

**Methods**

20 adult rats and 20 aged rats were randomly divided into two groups. The adult group was divided into the control Group C and the Sports Group E Group, the elderly group were divided into the control group OC Group and the Sports Group OE Group, 10/group. The eight-week tail-loading ladder training method was used to intervene the suitable resistance training for rats in the exercise group. During this period, rats in the control group did not exercise any
training activities and ate normally. The relative expression of PINK1, PARKIN, LC3, PERK/EIF2A and Caspase-12 mRNA in gastrocnemius muscle of rats were detected by quantitative PCR after the experiment. The expression of Pink1/parkin protein in gastrocnemius muscle of rats was detected by Western Blot method. High performance liquid chromatography was performed to detect the ATP production of rat gastrocnemius mitochondria, and the obtained data were collected and analyzed.

**Results** (1) Compared with group C, the expression of PINK1 protein and parkin protein of gastrocnemius muscle in OC Group decreased significantly (p<0.05). PINK1 protein and Parkin protein in OE Group increased significantly (p<0.01) compared with OC Group. (2) Compared with group C, the expression of Pink1mRNA, PARKIN mRNA and Lc3 mRNA in OC group showed a downward trend (p<0.05), and the expression of Pink1 mRNA, PARKIN mRNA and Lc3 mRNA in Group E showed an ascending trend (p<0.01). Compared with OC, the expression of Pink1 mRNA, PARKIN mRNA and Lc3 mRNA in OE group increased and had significant difference (p<0.01). (3) Compared with group C, the expression levels of perk mRNA, eif2a mRNA and Caspase-12 mRNA in the gastrocnemius of rats in Group E were significantly lower (p<0.01), and the expression of perk mRNA in OC Group had a significant upward trend (p<0.05). Compared with OC Group, the expression levels of perk mRNA, eif2a mRNA and Caspase-12 mRNA in OE group showed significant decrease (p<0.01). (4) There was a small increase in mitochondrial ATP production in Group E rats and Group C, but there was no significant difference. The mitochondrial ATP production in Group C was significantly higher than that in OC Group, and had significant difference (p<0.01). After 8 weeks' training, the mitochondrial function of the OE group was restored to normal, and the ATP production in the OC group increased significantly, there was significant difference (p<0.05).

**Conclusions** The resistance training can improve the function of mitochondria and activate the autophagy, which can improve the abnormality of mitochondria autophagy caused by skeletal muscle decay. Resistance training can reduce the extent of endoplasmic reticulum stress, suggesting that skeletal muscle decay can be slowed down by prolonged exercise.

**PO-252**

**The Physical Health Characteristics and Its Causes Analysis of Female Dance Students**

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**Objective** Dance is an art form with the body as the carrier, the long-term systematic dance training will make a certain effect on the physical health. By comparing the physical health test results of the female college students majoring in dance with female general students, this research will analyze the characteristics of physical health of female dance students and its influencing factors, and provide the basis of dance can promote the physical health of women, which can help dance to play a role in promoting the national physical and mental health.

**Methods** The physical health data of female students majoring in dance in Beijing dance academy and female students majoring in liberal arts in a normal university in Beijing in 2018 were analyzed and studied. The physical test indexes include: (1) body morphology indexes: height, weight; (2) body function indexes: vital capacity; (3) Physical Fitness indicators: reaction selection time, sit and reach, standing long jump, 50m run, 800m run, sit-ups. SPSS17.0 software was used to process the data, and independent sample T test was used to compare and analyze the data of the two groups, and P<0.05 was taken as a significant difference.
Results  The physical health test results of female students majoring in dance and ordinary female students are as follows: (1) BMI: The former is 19.58±1.72kg/m^2; the latter is 20.43±2.86kg/m^2. (2) Vital Capacity: The former is 2613.19±546.7ml; the latter is 2597.12±449.34ml. (3) 50m Run: The former is 8.94±0.952s; the latter is 9.48±0.62s; 800m Run: The former is 244.4±30.6s; the latter is 238.1±22.2s; Sit-and-Reach: The former is 28.34±4.14cm; the latter is 18.86±6.62cm; Standing Long Jump: The former is 180.04±17.79cm; the latter is 162.73±16.39cm. One Min Sit-Ups: The former is 40.52±6.5times; the latter is 29.44±8.02times. In addition to the Vital Capacity, the test results of other indicators all showed significant differences (P<0.05).

Conclusions  (1) Compared with ordinary college students, female students majoring in dance have a lower BMI. As a physical activity, dance can stimulate bone growth; At the same time, the daily dance training increases the energy consumption of the body, besides that, dance students must limit the daily diet to control the weight to meet the special dance figure requirements. (2) The lung capacity of female students majoring in dance is slightly higher than that of ordinary students, but the difference is not significant, which indicates that the training of dance has no obvious effect on the lung capacity. (3) The strength, speed, flexibility and other physical indicators of female students majoring in dance were all significantly higher than those of ordinary students. As far as strength is concerned, lower limb ability is an important part of dance training, long-term dance training will improve the explosive power of lower limb and body coordination, so female dancers performed well in the standing long jump. Dance major students have a higher score of one-minute sit-ups, because the strength of lumbar and abdominal muscle group is also an important content of dance training, it has been improved to a certain extent after a long period of training. The complex and diverse changes in the speed and spatial position of dance movements are conducive to the improvement of the speed quality and the flexibility of the nervous system. Therefore, female students majoring in dance are relatively faster in the 50-meter running. Dance has a really high requirement for flexibility, which is also an important content of dance training. After a long-term training, the flexibility of students majoring in dance has been greatly improved, which is reflected an obvious advantages in the value of the sit-and-reach.

However, female dance majors did not have an advantage in lung capacity and 800-meter running, indicating that their lung functions and endurance capacity were at a general level. In the dance training, there are more intervals during the movements and less continuous movements for a long time, which has little effect on improving the function of the aerobic metabolism system. This suggests that students majoring in dance should carry out targeted aerobic exercise to improve their endurance.

To sum up, on the whole, female students majoring in dance have a relatively high level of physical health, especially with advantages in body shape, muscle strength and flexibility. It shows that the beneficial effect of long-term dance training on physical health. Therefore, how to incorporate dance into the national physical health system as an important means to promote national health, and how to take certain measures to encourage the public to actively participate in dance activities to bring the health functions of dance fully play are worthy of more attention and deeper research.
Objective Caffeine supplementation is a commonly used nutritional practice. Exogenous metabolites from caffeine, such as paraxanthine, theobromine and theophylline, are eventually excreted through urine. Yet, it is less clear whether caffeine would induce endogenous metabolites altered during exercise. Urine metabolomics is a non-invasive method, which mainly focus on alterations of endogenous metabolic profiles caused by diseases, drugs, and lifestyle and nutritional interventions as well. Therefore, the purpose of the present study was to examine the effects of supplementation with caffeine in a well-designed high intensity interval training (HITT). We identified significant alterations in urinary metabolite levels and revealed key metabolic pathways involved in caffeine supplementation in HITT.

Methods We performed a randomized, double-blind, placebo-controlled crossover study. Twelve women basketball players (age: 19.12 ± 2.64 years, mass: 174.73 ± 5.18 kg, height: 62 ± 5.09 kg, with 8.50±2.11 years training period for basketball) were randomized to placebo (PLA) or caffeine (CAF) with dosage of 3mg on the basis of body weight (kg) 45min before a field HITT test. The test was repeated after three days when players were crossed over to the alternate test. The test began with a 30 min warmup, followed by a high intensity intermittent exercise trail with incremental load for about 25min, and a cool-down. Players are familiar with the test program which included 55 sets of dribble shuttle-run, pass, shoot, and rebound with basketball with a distance of 1540m (55 × 28m), the interval between two sets was gradually reduced. Performance (completed time), heart rates immediate (HR_{0_{min}}) and 1 min (HR_{1_{min}}) after test, blood lactate (BLa), proteinuria and ratings of perceived exertion (RPE) were collected during each protocol. Urine samples were obtained before and 1 h after of the test. 1H-NMR spectra (Bruker AVANCE III HD 600MHz) were obtained and then processed by NMR spectra (MestReNova 9.0). The binning values of NMR spectra are imported into MATLAB, and the peaks are aligned with the icoshift algorithm. Then concentrations of the aligned metabolites were calculated by converting the integral area of proton signals with that of the TSP. Pattern recognition was performed to the processed NMR data, including principal component analysis (PCA) and orthogonal partial least squares discriminant analysis (OPLS-DA). Characteristic metabolites were identified that contribute most to the metabolic pattern between groups according to the OPLS-DA models. Finally, we analyzed the metabolic pathway by importing characteristic metabolites with concentrations into the Enrichment Analysis (MetaboAnalysis 3.0) to determine the metabolic pathways with the greatest disturbance related to caffeine during exercise. Moreover, the main effects of exercise, caffeine and the interaction between exercise and caffeine were determined by Repeated measure GLM analysis (Spss 22.0).

Results (1) Compared with PLA, CAF had no significant difference in the completed time (25.9 min vs. 26.8 min). Repeated measured analysis showed that there was significant overall time effect on the routine training monitoring parameters, while no statistically group differences in HR_{0_{min}}, HR_{1_{min}}, BLa (199.02±21.36 vs.189.00±22.38 bpm; 148.02±12.60 vs.148.02±20.34 bpm, and 8.89±2.23 vs. 9.52±2.91 mmol/L, respectively). For the qualitative indexes, the positive rate of urine ketone bodies was increased, while RPE did not change. (2) We identified 32 metabolites in urine sample. PCA showed distinct differentiation of metabolic patterns between each two groups in the four groups (PLA_{before}, PLA_{post}, CAF_{before}, CAF_{after}). By using OPLS-DA, we found that the urine metabolic profiles were differences in between caffeine supplementation group and placebo group during the test. OPLS-DA revealed the identified metabolites of
exercise and caffeine respectively, among them, lactate, butyric acid, isobutyric acid, 3-hydroxybutyric acid and pyruvic acid could be used as metabolic biomarkers in the HITT response. Supplementation of caffeine increased the production of fat metabolites in urine compared to the PLA. Enrichment analysis showed that the disturbed metabolic pathways shared by PLA and CAF were purine metabolism, glycolysis, insulin signal transduction, galactose metabolism, gluconeogenesis, glucose-alanine cycle, sphingolipid metabolism, alanine metabolism and citric acid cycle. Yet, when compared to the PLA, CAF enhanced fat metabolism and increased pyruvate metabolism, cysteine metabolism and mitochondrial electron transport. These results suggest that caffeine could promote fatty acid metabolism and amino acid metabolism to improve aerobic metabolism and to reduce oxidative stress, and thus promote exercise capacity. (3) Covariance analysis showed that there were significant individual-specific effects of caffeine supplementation.

**Conclusions** Caffeine supplementation during HITT promoted the fat metabolism, and upregulated the TCA, pyruvate metabolism and mitochondrial electron transfer. It is suggested that caffeine could, to some extent, promote energy supply shift from anaerobic metabolic to an aerobic manner, and the enhancement of fat oxidation would be beneficial to glycogen storage for intensively long-duration exercise. Moreover, there are obvious individual differences in caffeine response on sports.

**PO-254**

The effect of four weeks hypoxic resistance training on myostatin and follistatin expression in skeletal muscle of rats

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**Objective** Loss of skeletal muscle weight is a common phenomenon in hypoxic environment. It has been recognized that resistance training can reduce hypoxia-induced skeletal muscle atrophy, but its molecular mechanism is still unclear. Myostatin is a major factor that inhibits muscle growth and differentiation, and Follistatin can inhibit Myostatin. Therefore, this study is to clarify the effect of 4-week hypoxic resistance exercise on Myostatin and Follistatin gene expression in skeletal muscle of rats.

**Methods** Twenty four 8-week-old male SD rats were randomly divided into normoxic control group (group C: 6 rats), normoxic exercise group (group R: 6 rats), hypoxic control group (group H: 6 rats) and hypoxic exercise group (group HR: 6 rats). Rats in each hypoxic group were fed in a hypoxic chamber (atmospheric hypoxia) with oxygen concentration of 12.7% (simulated 4000m altitude). Rats in each exercise group were trained according to the rat’s resistance training program developed in our laboratory. After all the intervention, DEXA was used to analyze the body composition. The soleus, extensor digitorum longus and biceps brachii muscles of rats were taken and the wet weight of individual muscles was measured. The data were processed by SPSS17.0 statistical software. The expression level of skeletal muscle mRNA was expressed as "median (25-75%)", and the data of body composition and muscle wet weight were expressed as "mean±standard deviation". The differences between the groups were evaluated using a one-way analysis of variance (ANOVA) test. The significance level for the study was less than 0.05.

**Results** Body composition analysis after 4 weeks of hypoxic intervention showed that the body weight of rats in group H decreased significantly (p=0.012), and the muscle mass decreased more significantly (p<0.001). But resistance exercises obviously reduced the muscle atrophy (p<0.01) caused by hypoxia. After analyzing the changes of the wet weight of individual muscles, it was found that the wet weight of biceps brachii in HR group was significantly higher than that in
H group (p=0.048). After 4 weeks of hypoxic intervention and hypoxic resistance exercise, the expression of Myostatin mRNA in individual muscles of each group changed differently. The expression of Myostatin mRNA in soleus muscle of H group was significantly higher than that of C group (371.2%) after 4 weeks of hypoxia intervention. Myostatin mRNA expression in soleus and biceps brachii of HR group was significantly lower than that of H group (591.1% and 478.4% respectively). However, there was no significant difference in the expression level of Myostatin mRNA in the extensor digitorum longus between each group (p=0.259). The change of Follistatin mRNA expression in different groups also showed a different trend. The expression of Follistatin mRNA in soleus muscle and biceps brachii was significantly different among groups (p=0.003, p=0.004, respectively). However, there was no significant difference in the expression level of Follistatin mRNA in the extensor digitorum longus between each group (p=0.734).

Myostatin mRNA/Follistatin mRNA ratio (M/F) showed a more significant difference. The M/F ratio of soleus muscle in group H was significantly lower than that in group C (p<0.001), but the M/F ratio in group HR showed a higher trend than that in group H (p=0.051).

**Conclusions** Hypoxic exposure results in an increase in Myostatin mRNA expression in skeletal muscle, but hypoxic resistance exercise reduces such an increase. On the contrary, the level of Follistatin mRNA expression in skeletal muscle decreased after hypoxic exposure, and hypoxic resistance exercise could slow down the decline. As a result, rat resistance exercise significantly slowed down hypoxia-induced muscle atrophy. In conclusion, the mutual restriction between Myostatin and Follistatin is one of the main links of resistance exercise to reduce hypoxia-induced skeletal muscle atrophy. However, the process of resistance training to reduce the hypoxia-induced skeletal muscle atrophy is very complex. There are many molecular signaling pathways involved, which need further study.

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**PO-255**

**Effects of Endurance Exercise on Liver AMPK/SIRT1/p53 Pathway In Aging Mice**

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**Objective** We research the effects of aerobic endurance exercise on proteins of AMPK, SIRT1,p53 and Ac-p53 in senility mice liver to explore the mechanism of exercise anti-aging.

**Methods** Thirty male C57BL/6J mice(twenty-four months old) were randomly divided into two groups: the sedentary control group (C) and exercise group (E). On a normal diet, the mice in group E performed moderate intensity activity (twelve m/min for sixty min/day on a treadmill for twelve weeks). Following the exercise treatment, the protein expressions of AMPK, SIRT1, p53 and Ac-p53 in senility mice liver was detected by Western blot (WB).

**Results** Compared with group C, the AMPK ,SIRT1 and p53 protein expressions in mice liver were significantly increased in group E(P<0.05,P<0.01,P<0.05 respectively). Yet, the value of Ac-p53/p53 declined significantly(P<0.05).

**Conclusions** The aerobic endurance exercise could increase both AMPK and SIRT1 protein expressions in the liver of aging mice, as also as the p53 protein expression.But, the reduced Ac-p53/p53 value by SIRT1 deacetylation suggested that p53 activity was inhibited.
PO-256
Changes of Apoptosis and autophagy in pre-motorized mouse liver tumor cells

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Objective Malignant tumors are a serious threat to human health due to their serious mortality. Studies have shown that exercise can affect the occurrence and development of tumors. We all know that exercise is an important way to improve the aerobic oxidative capacity of cells, so we did an experiment to understand the status of apoptosis and autophagy-related proteins in pre-motorized mouse liver tumor cells and their morphological features.

Methods C57BL/6J male mice (7-month-old) were randomly divided into two groups: control group (C) and early endurance training group (E). Group C was fed normally for 7 weeks. After 7 weeks of moderate-intensity treadmill training in Group E, the mice were constructed into two groups, which were: control group (C) and control tumor group. CT), exercise group (E), and exercise tumor group (ET). Hepa1-6 liver cancer cells were used, and the mice were inoculated intraperitoneally. After successful tumor formation, the samples were taken for subsequent experiments. Western blotting was used to detect the content of apoptosis-related proteins and autophagy-related proteins in each group, and the changes of liver tissue in different groups were observed.

Results Changes in apoptosis-related proteins in each group: Compared with group C, the expression levels of BCL-2 and BAX in hepatocytes in group E and CT were significantly increased.(P<0.05,P<0.01). Compared with CT group, BCL-2 and Bax were significantly increased in ET group (P<0.05,P<0.01). Compared with group E, both BCL-2 and Bax in ET group were significantly increased (P<0.05,P<0.01). Compared with group C, the ratio of BCL-2 to BAX in group E was significantly higher (P<0.05), and the ratio of CT group was significantly lower(P<0.01). Compared with CT group, the ratio of ET group was significantly lower (P<0.01); Compared with the E group, the ratio of the ET group decreased significantly (P<0.01). Autophagy-related protein changes in each group: Compared with group C, the expression of LC3II in hepatocytes of group E and CT was significantly increased (P<0.01). Compared with CT group, LC3II was significantly increased in ET group (P<0.05); Compared with the ET group, LC3II was significantly increased (P<0.05). Compared with group C, Beclin-1 was significantly decreased in CT group (P<0.05). Compared with CT group, Beclin-1 was significantly decreased in ET group (P<0.05). Compared with group E, Beclin-1 was significantly decreased in ET group. (P<0.05). Morphological characteristics: Compared with group C, there was no significant change in liver in group E. The volume of liver in CT and ET group was greatly increased, and there was hard tissue on the liver lobe, and the hard tissue was brittle, loosely arranged and easy to fall off; compared with CT group, The liver volume of the ET group was slightly smaller and the amount of hard tissue was less.

Conclusions Apoptosis of cells depends on the ratio between the anti-apoptotic protein BCL-2 and the pro-apoptotic protein BAX. Our experimental results show that early exercise training can promote the occurrence of tumor cell apoptosis to a certain extent, up-regulate the level of autophagy in tumor cells, and slow down the growth of tumors to some extent.
PO-257
Simultaneously enhanced autophagy and mTOR pathway in skeletal muscle by voluntary weightlifting training in mice

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Objective Despite the significant biological and clinical relevance of resistance exercise training, our understanding of the molecular mechanism underlying functional and metabolic adaptations remains elusive.

Methods A novel weightlifting cage was manufactured by our lab and mice were trained to complete a single bout of (one single night), a short-term (10 days), and a long-term (8 weeks) weightlifting exercise. Aurora plat was applied to measure muscle function. RNA and protein sample was isolated from gastronomies muscle. Illumina plat was applied to rPOrt RNAseq data and Protein expression was detected by western bolt.

Results Using RNAseq in a novel mouse voluntary weightlifting model, we show that a single bout of weightlifting activities led to significant transcriptome responses in recruited muscles for genes that function in protein phosphorylation, modification, metabolic processes and skeletal muscle differentiation, which were validated by RT-PCR for Fn14, Dscr1 and Nr4a3 mRNAs. Long-term training led to significant increases of muscle mass and strength as well as profound improvement of whole body glucose metabolism. Importantly, weightlifting training resulted in enhanced autophagy (increased Lc3 and decreased p62/Sqstm1 proteins) with improved insulin signaling along with enhanced expression of mTOR pathway (increased raptor, 4e-Bp-1 and p70S6k proteins) and protein synthesis (increased puromycin incorporation by SUnSET assay) in skeletal muscle.

Conclusions We therefore for the first-time rPOrt simultaneously enhanced autophagy and mTOR pathway with profound contractile and metabolic adaptations following resistance training in mice.
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