101. Effect of elevated intracellular calcium concentration by ultrasound irradiation on exosome release from skeletal muscle

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[Dep. Rehab. Sci., Grad. sch. Health Sci., Kobe univ., Hyogo, Japan] [Aims] Therapeutic effect of exosomes from skeletal muscles are getting to be focused for the inflammation regulation. The action of acoustic cavitation is reported to facilitate the exosome release from cells. The aim of this study was to investigate the effects of ultrasound irradiation on the release of exosomes from skeletal muscle cells. [Methods] C2C12 myotubes were exposed to ultrasound of 0, 1.0, 2.0, and 3.0 W/cm² (1 MHz, 20% duty cycle) for 5 minutes. Extracellular vesicles (EVs) were isolated from the culture supernatant by ultracentrifugation, and the concentration of EVs and the positive rate of CD63, an exosome marker, were analyzed. P < 0.05 was considered statistically significant (Tukey Kramer test). [Results] Concentrations of intracellular calcium and EVs in culture medium were significantly increased by ultrasound irradiation of 3.0 W/cm², and more than 80% of the EVs were CD63 positive. Ultrasound irradiation did not induce cytotoxicity and kept the protein level in myotubes. [Discussion] Intracellular calcium is known to be a regulator of exosome release from cells. The results in the present study suggest the facilitatory effect of high-intensity ultrasound on exosome release via the elevated intracellular calcium level in myotubes. [Conclusion] Ultrasound irradiation can be a therapeutic regimen to promote the release of exosomes from skeletal muscles.

Keywords: exosome, ultrasonic irradiation, calcium

102. Skeletal muscle derived molecule X acts on liver lipid regulation

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[Grad. Sch. of Human Health Sci., TMU, Tokyo, Japan, 2Grad. Div. of Nutritional and Environmental Sci., Univ. Shizuoka, Shizuoka, Japan] [Aims] We have newly discovered the molecule X as a type of myokine, a physiologically active factor secreted from skeletal muscles. In previous studies, we identified the deficiency of molecule X, specifically in skeletal muscles on drosophila, significantly shortened lifespan. This suggests that molecule X expressed in skeletal muscles has some important function throughout the body. For further detailed functional analysis, we genetically modified mouse that over-expresses molecule X specifically in skeletal muscles (X-TG mouse). This study was conducted to clarify the effect of molecule X on the liver as a myokine. [Method] Microarray analysis of mRNA and lipidomics analysis from the liver of X-TG mice and wild-type mice was performed. Furthermore, accumulation of triglyceride in liver was examined by the Oil red O staining method. [Results] Microarray analysis showed the expression level of genes involved in fatty acid biosynthesis or metabolism was changed in the liver of X-TG mice. Furthermore, lipidomics analyses showed significantly higher levels of phosphatidylcholine and phosphatidyl-ethanolamine in X-TG mice. The amount of triglyceride in the liver of X-TG mice was lower than the wild type. These data suggest that the molecule X derived from skeletal muscle regulates the lipid synthesis in the liver. [Conclusion] Molecule X expressed in skeletal muscles is considered to be an important molecule that affects lipid regulation in liver.

Keywords: Myokine, Liver, Lipid metabolism

103. Contribution of heart rate to estimation of physical activity intensity in wheelchair users

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[1The University of Electro-Communications, Tokyo, Japan, 2University of Nagano, Nagano, Japan, 3Waseda University, Saitama, Japan, 4Tokyo Kasei University, Tokyo, Japan] [Aim] The aim of this research was to investigate how heart rate contribute to estimation of PA intensity in wheelchair users. [Methods] Nine individuals with SCI participated in the experiment, performing nine daily physical activities. During each activity, their energy expenditure (EE) were measured using Douglas bag method and subjects wore an accelerometer (MVP-RF8) and heart rate monitor (Polar OH-1) on their wrists. PA intensity was calculated by EE during physical activities divided into resting metabolic rate. Prediction models were developed by Random Forest, which is one of the machine learning algorithms, using features of the magnitude of 3 axis acceleration and heart rate values. These developed models were evaluated with the root mean square error (RMSE) and the coefficient of determination (R²). [Results] For the developed model 1 using the magnitude of 3 axis acceleration, RMSE was 0.51±0.19 METs, and R² was 0.86±0.05. For the developed model 2 using the magnitude of 3 axis acceleration and heart rate values, RMSE was 0.48±0.19, and R² was 0.90±0.06. [Conclusions] These results indicated that the developed model with 3 axis acceleration and heart rate values was more accurate for prediction of PA intensity. However, further studies are needed to improve the estimation accuracy in some specific activities.

Keywords: physical activity intensity, wheelchair, machine learning

104. Ketone bodies up-regulate mitochondrial respiration in skeletal muscle

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[1Faculty of Sports and Health Sci., Fukuoka Univ., Fukuoka, Japan, 2Institute for Physical Activity, Fukuoka Univ., Fukuoka, Japan] [Aims] Mitochondrial dysfunction in skeletal muscle is shown in patients with type 2 diabetes and obesity, then leading to reduced energy consumption. Although they are caused by dietary restrictions or body fat loss, but their physiological roles are still unknown. Therefore, we investigated the pleiotropic effect of ketone bodies on mitochondrial function and cellular lipid uptake in skeletal muscles. [Methods] C2C12 mouse myoblasts were incubated with 10mM of β-hydroxybutyrate (βHB) and acetocetate (AcA) for 18 hours. Cellular oxygen consumption was assessed by extracellular flux analyzer. Fatty acid related gene expressions were determined by real-time PCR. [Results] On the mitochondrial oxygen consumption in C2C12 cells, βHB significantly elevated basal respiration (P<0.05), proton leak (P<0.05) and ATP production (P<0.05). Fatty acid binding protein 3 gene expression which is involved in fatty acid transport in the cytoplasm was significantly increased by AcA (P<0.05). Although CD36 gene expression which uptake fatty acids into cells, was significantly increased by AcA (P<0.05), there was no significant difference in fatty acid transport protein 1 expression by ketone bodies. [Conclusions] Ketone bodies activate mitochondrial function and fatty acid metabolism in skeletal muscles. Ketosis may be key factor for increasing lipids consumption in patients with obesity and metabolic syndrome.

Keywords: Ketone, Muscle, Metabolism
105. **Effects of reduced SIRT1/PGC-1α pathway on the mitochondrial function in skeletal muscle under malnutrition condition**

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[Aims] SIRT1 alters skeletal muscle metabolism in response to nutritional status. In mild calorie restriction, the SIRT1 / PGC-1α pathway improves mitochondrial function by activation mitophagy. Meanwhile, changes in skeletal muscle metabolism under excessive calorie restriction accompanied by malnutrition are unknown. We examined the effects of the mitophagy and mitochondrial function via changes in the SIRT1 / PGC-1α pathway in malnutrition.

[Methods] Male Wistar rats were assigned randomly to control and malnutrition. The rats in the malnutrition group were provided with a low-protein diet, and daily food intake was limited to 50% for 12 weeks. The expression levels of SIRT1 and PGC-1α protein in the soleus muscle were determined, and the mitophagy factor (PINK1), oxidative stress (MDA concentration), and mitochondrial enzyme (CS and SDH) activity were analyzed.

[Results] The expression of PGC-1α and PINK1 protein was decreased in the malnutrition group. Malnutrition observed a decrease in PINK1 and increased MDA concentration, resulting in increased oxidative stress via mitophagy dysfunction. Additionally, CS and SDH activities were decreased, resulting in mitochondrial dysfunction in the malnutrition group. 

[Conclusions] These results suggest that Malnutrition inhibits the SIRT1/PGC-1α pathway in skeletal muscle, resulting in mitochondrial dysfunction induced by decreased mitophagy and increased oxidative stress.

**Keywords:** Malnutrition, Skeletal muscle, Mitochondria

106. **The effects of ladder climbing resistance training on pyruvate metabolism**

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[Aims] The ladder climbing resistance training (RT) could stimulate glycolytic metabolism pathway. This study investigated whether RT could activate glycolysis and also pyruvate oxidation examined in fast- or slow-twitch muscles. 

[Methods] Male Wistar / ST rats at 9 weeks old were randomly assigned to control and RT group. RT was performed every other day for 5-week with a weight attached to a tail. At the first exercise session, the initial weight was 50% of the body weight, and after a 2min rest period, weights were increased by 30g for each climb. The second session, rats climbed with 50, 75, 90, and 100% of maximal load from the previous exercise session. This was repeated until 8 bout or exhaustion. 24 hours after the last training session, flexor hallucis longus (FHL) and soleus (SOL) were removed and used for analyzing transporter and enzyme protein expression.

[Results] In slow-twitch SOL, all of indexes MCT1, MCT4, GLUT4, LDH-A, -B, PDH, COX4 and MPC1 were increased with RT. In fast-twitch FHL, there were also significantly increased, even in PDK2 and PDK1. 

[Conclusions] Our ladder climbing RT could increase some of substrate transporters and its enzymes. Especially in fast-twitch FHL muscle, increased indexes related to pyruvate metabolism (MPC, PDH, PDP and PDK) and also increased COX4 and CS activity could lead to upregulate pyruvate oxidation capacity in mitochondria.

**Keywords:** resistance training, pyruvate oxidation, glycolysis

107. **Estimating energy cost of body Weight resistance exercise using a multistage exercise test**

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[Aims] The purpose of this study was to examine energy cost of body weight resistance exercises with slow movement in young men using a multistage exercise test.

[Methods] Fifteen men aged 21-29 years performed 3 exercises (heel-raise, squat, and push-up) at different frequencies (1, 2, 3, 4, 5, and 6 repetitions/min). Oxygen consumption was measured using indirect calorimetry; we then computed a simple linear regression between aerobic energy expenditure (EE) and repetition frequency.

[Results] The slope coefficient in the regression represents the energy cost of those exercises; we compared the extrapolated EE for a frequency of 10 repetitions/min.

[Conclusion] Gross EE increased linearly with repetition frequency in all subjects ($v = ax + b$). Energy cost was significantly greater in the case of the push-up than in the case of the squat ($v = 0.50 \pm 0.14$ (95% confidence interval [CI], 0.42-0.58); push-up: $0.77 \pm 0.20$ kcal (95% CI, 0.66-0.88); and the heel-raise elicited the lowest energy cost: $0.13 \pm 0.04$ kcal (95% CI, 0.11-0.15)). Extrapolated EE at 10 repetitions/min was $2.7 \pm 0.5$ kcal (2.3 metabolic equivalents [METs]), $6.3 \pm 1.4$ kcal (5.4 METs), and $9.2 \pm 2.1$ kcal (7.8 METs), respectively, according to the regression based on aerobic EE. These results will be useful for health professionals in prescribing resistance exercise programs improving muscle fitness and considering for weight management.

**Keywords:** resistance exercise, energy expenditure, slope

108. **In-Field Survey of Metabolic Equivalent (MET) Intensities during a Disaster Activity Emergency Fire-Fighter Support Team Training by Accelerometer and a Heart Rate Monitor**

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[Aims] The intensity of physical activity (MET) in fire-fighting rescue activities during a large-scale disaster is unclear. Thus, it is important to know the METs value during fire rescue activities while considering the energy requirements of fire-fighters operating in harsh conditions. 

[Methods / Method] The purpose of combining accelerometer (AC) with heart rate monitor (HR) methodology was to examine actual METs values in large-scale disaster activity training for fire-fighters. The Kanto block emergency fire brigade participating members joint activity and heart rate were measured for 24 hours.

[Results] The METs values were examined for 16 activities. Based on the characteristics of HR and AC, we examined 3 activities that are thought to contain numerous low-intensity activities and 13 activities that are thought to contain a number of medium- and high-intensity activities in combination with HR and AC. 

[Discussion] In the future it might be possible to examine METs values more accurately by correcting for activities that are underestimated by the AC method using the HR method.

**Keywords:** fire-fighter, Metabolic equivalent (MET) intensities, heart rate
109. Dietary intake during regular work by firefighters
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[Background] For firefighters engaged in dealing with complex disasters, diets during regular work are very important in adjusting daily conditions. However, the dietary intake including micronutrients has not been clarified. [Purpose] Clarify the nutrient intake during regular work by investigating the dietary intake. [Method] For 55 firefighters who work 24 hours a day on duty, weight conversion is performed using meal recording paper and photographic method, and nutritional value calculation for 780 regular works was calculated. Regarding micronutrients, the intake ratio was calculated with respect to the recommended intake amount of the Japanese dietary intake standard (2015 version). [Result] The average energy intake during 24 hours was 1667 ± 434 kcal, and the intake ratio of most micronutrients to the recommended amount did not reach 100%. The average value of minerals whose intake ratio was less than 100% with respect to the recommended amount was 55.8%, and the average value of vitamins was 47.9%. [Conclusion] Energy intake of firefighters during regular work was low, and micronutrients were also deficient. Therefore, it is necessary to improve the quantity and quality of food in order to keep the condition of firefighters better.
[Keywords]: fire-fighter, dietary intake, micronutrients

110. Different Effects on Lipid Metabolism of Low Carbohydrate Diet on Obese and Non-Obese Mice
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[Aim] The safety and efficacy of a low-carbohydrate (LC) diet in obese and non-obese conditions are not fully understood. This study investigated the effects of a moderate LC diet (40% carbohydrate diet) on metabolic conditions in obese and non-obese mice using hepatic mRNA expression profiles and protein expression of metabolic-related enzymes. Methods: C57BL/6 male mice were fed an eight-week high-fat diet to induce obesity. Non-obese mice were fed a control diet for the same period. Then, both the obese mice and non-obese mice were fed an LC diet (PFC energy ratio: 40, 16, 44) and control diet (PFC energy ratio: 20, 16, 64) for 13 weeks. Results: The obese mice on the LC diet had significantly lower body weight gain and visceral adipose tissue weight than those that were on the control diet. In the hepatic mRNA expression metabolic profiles, obese mice on the LC diet had increased Sirt1 expression and decreased Fabp4, Gpx1, and Sod1 expression. In addition, obese mice on the LC diet had significantly up regulated acetyl-CoA carboxylase (ACC) phosphorylation than those on the control diet. In the non-obese mice, there were no differences between mice on the LC diet and those on the control diet; however, the non-obese mice on the LC diet tended to have decreased phosphorylated ACC and AMP-activated protein kinase (AMPK). Conclusion: The effects of an LC diet varied according to the state of obesity at the time of implementation, suggesting that up regulated lipid metabolism occurs only in obese conditions.
[Keywords]: Low-Carbohydrate Diet, Obese Mice, Lipid Metabolism

111. Mechanism of gradual increase in energy metabolism after palatinose administration-Analyses using obese rats-
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[Aims] We previously reported that Pala induces hyper energy metabolism in obese rats for 6 h after oral administration. However, the mechanism underlying the hypermetabolism/persistence following the oral administration of Pala is unknown. Pala and Sug solutions were orally administered to OLETF and LE rats, and the transition of energy metabolism-related genes in the liver, visceral fat, and skeletal muscle following administration was observed over time. We also investigated whether the administration of Pala is followed by hyper energy metabolism, and whether it affects the expression levels of metabolism-related genes. Methods: The rats were divided into OLETF-Pala, Sug, CW, LE-OLETF-Pala, Sug, and CW administration groups at 25 weeks of age, and each solution was orally administered. Blood was sacrificed before and after 1, 4, and 6 h of administration. The expression levels of PPARα, PPARγ, PPARδ, PPARδ, UCP2, and UCP3 genes were determined. Results: The gene expression levels of hepatic PPARα in the OLETF-Pala group were significantly higher than those of Sug and CW, after 1 to 4 h of administration. Additionally, the gene expression levels of PPARγ in the visceral fat were significantly high after 4 to 6 h of the administration of Pala. Conclusions: The results elucidated that the gene expression levels of PPARα in the liver and PPARγ in visceral fat increased following Pala administration.
[Keywords]: Energy metabolism related genes, Liver, Visceral fat

112. Effects of the menstrual cycle on muscle glycogen during high-intensity intermittent exercise until exhaustion in healthy women
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[Aims] The purpose of this study was to investigate the effects of the menstrual cycle on muscle glycogen during high-intensity intermittent exercise until exhaustion in eumenorrheic women. [Methods] Eleven women performed high-intensity exercise until exhaustion on a cycle ergometer during the early follicular phase (E-FP), the late follicular phase (L-FP), and the luteal phase (LP). Muscle glycogen concentration evaluated using 13C-magnetic resonance spectroscopy, serum estradiol, and serum progesterone were measured at before exercise (Pre), immediately after exercise (Post0). [Results] The serum estradiol was significantly higher in L-FP compared with E-FP and LP (p <0.01), and the serum progesterone was significantly higher in LP compared with E-FP and LP (p <0.01). The changes in muscle glycogen concentration utilized during exercise were significantly greater in L-FP than E-FP (p <0.05). [Conclusion] The results of this study suggested that menstrual cycle effect muscle glycogen utilization during high-intensity intermittent exercise until exhaustion in eumenorrheic women.
[Keywords]: estradiol, the late follicular phase, muscle glycogen
114. Impact of carbohydrate intake after endurance exercise on breath acetone levels and performance recovery
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[Aims] To determine the impact of carbohydrate (CHO) intake after endurance exercise on breath acetone level and recovery of endurance performance. [Methods] Eight males conducted two trials, consisting of either low CHO trial (LCHO trial) or high CHO trial (HCHO trial). In each trial, subjects came to the laboratory at 8:00 following an overnight fast and commenced glycogen depleting exercise (EX1, interval exercise until exhaustion). Immediately after and 30 min after EX1, subjects consumed either high CHO meal (2.4 g per body weight) in HCHO trial or low CHO meal (0.6 g per body weight) in LCHO trial. A two h of recovery period was set after EX1 to evaluate changes in breath acetone level and serum total ketone body concentration. At 2 h after completing EX1, subjects performed cycling exercise at 65% of VO2max (EX2) to evaluate endurance performance. [Results] Time to exhaustion during EX2 was significantly longer in HCHO trial than in LCHO trial (p = 0.02). Immediately after EX2, LCHO trial presented significantly higher breath acetone level compared with HCHO trial (p < 0.001). Furthermore, a significant inverse correlation was observed between breath acetone level at 105 min after EX1 and time to exhaustion during EX2 (r = -0.711, p = 0.047). Serum total ketone body concentration was significantly higher in LCHO trial than in HCHO trial at 120 min after EX1 (p = 0.01). [Conclusion] Insufficient CHO intake after endurance exercise increased breath acetone level during post-exercise, with delayed recovery of endurance performance.

Keywords: breath acetone, ketone body, endurance performance

115. The establishment of a method for calculating lactate production using blood lactate concentration during exercise in mice
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[Aims] It has been suggested that lactate (LAC) production induce the effects of exercise. The Blood LAC concentration is determined by balance between production in skeletal muscle and uptake in peripheral tissues. Then, it may be possible to calculate the amount of LAC uptake and production from the blood LAC concentration. However, the method has not been established. [Methods] C57BL/6 mice were divided into 3 groups; a control (CON) and 3-weeks (3EX) or 6-weeks (6EX) treadmill endurance training group. A LAC tolerance test was performed following i.p. injection of sodium LAC (1 g/kg of body weight) to determine the ability to take up LAC in peripheral tissues. The blood LAC concentration was measured for 60 minutes after the injection. Then, the mice performed an incremental exercise test (increased from 10 to 40 m/min by 5 m/min). Running was 2 min and interval was 2 min between session (measuring the blood LAC concentration). We calculated LAC production rate at each intensity using calculated LAC uptake capacity and rate. [Results] The blood LAC concentration in the exercise test was significantly lower in the 6EX group at 35, 40 m/min. Calculated LAC production rates were significantly lower in the 6EX group at 25, 30 m/min. [Conclusion] We established the method of calculating amount of LAC production using blood LAC concentration during exercise. Further, 6-weeks endurance training reduced LAC production rate at the same intensity.

Keywords: Lactate production, Glycolysis, Parameter estimation
117. Combined effect of endurance training and Vitamin C administration on glucose tolerance in obese mouse

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[Purpose] To examine the combined effects of endurance training and vitamin C administration on glucose tolerance in mice with high-fat diet-induced obesity. [Methods] Male C57BL/6J mice (8 weeks of age) were fed a high-fat diet (60% fat/kcal) for 16 weeks to induce obesity. At 20 weeks of age, they were assigned to weight-matched sedentary (SED), endurance training (TR), vitamin C administration (VC), and endurance + vitamin C administration (TR+VC) groups. Endurance training was conducted 5 days/week for 12 weeks (8–20 m/min, 60 minutes). Vitamin C (500 mg/kg) was orally administered to the VC and TR+VC groups 30 minutes before every exercise bout. After the intervention, an intraperitoneal glucose tolerance test (1.0 g/kg glucose) was performed. [Results] After a 12-week training period, the body weight of the TR and TR+VC groups were significantly decreased compared with that in the SED group. Similarly, the fasting blood glucose levels in the TR and TR+VC groups were significantly lower than those in the SED group. In the glucose tolerance test, the glucose levels 60 minutes after glucose injection in the TR+VC group were significantly lower than those in the SED and TR groups. Additionally, the glucose area under curve in the TR+VC group was significantly lower than that in the SED group. [Conclusion] Combined treatment comprising endurance training and vitamin C administration might be effective in improving glucose tolerance in mice with high-fat diet-induced obesity.

Keywords: Exercise, Antioxidant, glucose tolerance

118. Effects of a single and continuous arginine intake on fatigue during constant-load exercise and subsequent short-term exercise performance

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[Aims] This study examined the effects of a single and continuous oral intake of L-arginine (Arg) supplementation on fatigue and exercise performance. [Methods] Sixteen healthy young men (mean ± SD, 23 ± 3 years) participated in a randomised, double-blind, crossover study. For the acute trials, the participants consumed a 200 mL of water containing either Arg (5000 mg) or placebo (Pla; Arg was replaced with dextrin). After 60 min rest, the participants performed cycling exercise at 75% of heart rate reserve for 60 min followed by a 15-min cycling performance test. The participants continued to consume each designated supplement 2 times per day for 13 days. For the chronic trials, the participants repeated the same protocol as the acute trials at day 15. After a 14-day wash-out period, the participants changed the supplement and repeated the same protocol as above. [Results] In both acute and chronic Arg trials, plasma arginine and ornithine concentrations increased compared with both acute and chronic Pla trials (p < 0.05). Plasma ammonia concentration decreased in the chronic Arg trial compared with both acute Arg and Pla trials (p < 0.05). There were no differences in mean power output during a 15-min cycling performance test between the chronic Arg and Pla trials. [Conclusions] These results indicated that although a single and continuous intake of Arg did not influence on cycling performance, a continuous intake of Arg attenuated ammonia concentration in the chronic Arg trial.

Keywords: L-arginine, ammonia, cycling performance

119. Effects of rapid weight loss on skeletal muscle and gastrointestinal protein metabolism

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[Background] In weight-based competition, rapid weight loss is practiced for many athletes. However, the effects on each organ have not been fully clarified. [Purpose] The purpose is to clarify the effects of rapid weight loss on skeletal muscle and gastrointestinal protein metabolism. [Method] The rats were divided into a rest group and an exercise group. The exercise group was given a 30-minute daily swimming exercise for 4 weeks. Each group (rest group/exercise group) was further divided into a control group and a rapid weight loss group. The rapid weight loss group was subjected to rapid weight loss by dietary restriction for 3 days and water restriction for 1 day. [Result] The rest weight of rats was significantly decreased by rapid weight loss in both groups. Skeletal muscle weight was not reduced by rapid weight loss. On the other hand, the weight of the small intestine was significantly reduced by the rapid weight loss. Large intestine weight was not reduced by rapid weight loss. LC-3 mRNA expression was elevated in skeletal muscle but not in the small intestine. In the large intestine, only the exercise group increased due to rapid weight loss. Furthermore, MuRF-1 mRNA expression did not change in soleus muscle, but increased in EDL due to rapid weight loss. [Discussion/Conclusion] It was suggested that rapid weight loss degrades digestive tract proteins rather than skeletal muscle.

Keywords: Rapid weight loss, Protein, Skeletal muscle

120. The response of fatty acid binding protein 4 to incremental exercise in endurance-trained and strength-trained athletes

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[Aims] Fatty acid binding protein 4 (FABP4) is mostly expressed in adipocyte, and is involved in fat metabolism. However, few studies reported the response of FABP4 to incremental exercise. We aimed to determine the response of FABP4 to incremental exercise between endurance-trained and strength-trained athletes. [Methods] Eleven endurance-trained athletes (E) and 11 strength-trained athletes (S) (age: 20.7±1.1 years) were recruited. Body composition, muscle strength, and aerobic capacity were measured. After 12-h fasting, incremental exercise was performed. Venous blood was drawn at rest and after immediately the incremental exercise to measure the concentration of free fatty acid (FFA), glycerol, and FABP4. [Results] Body composition, muscle strength, and aerobic capacity differed significantly between the E and S group (p < 0.05). FFA concentration did not change significantly during the incremental exercise in the two groups (p > 0.05). Glycerol concentration increased significantly during the exercise in both the two groups (p < 0.05), whereas increment in glycerol concentration was similar between the two groups(p > 0.05). Additionally, FABP4 concentration also increased significantly during the exercise in both the two groups (p < 0.05), whereas increment in FABP4 concentration did not differ between the two groups(p > 0.05). [Conclusions] Despite non-circulating FABP4 concentration increased during incremental exercise, the increase did not differ between endurance-trained and strength-trained athletes.

Keywords: fat metabolism, high-intensity exercise, lipolysis
121.

Effects of green tea extract on fat oxidation in women with eumenorrhea

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[Aims] This study aimed to investigate the effects of acute GTE ingestion on fat oxidation at rest in women with eumenorrhea.

[Methods] Six women with eumenorrhea were recruited. A randomized double-blind crossover study was conducted using either GTE (total, 968 mg polyphenols included 407 mg epigallocatechin gallate) or a placebo (PLA; total, 1200 mg maltodextrin) in capsule form. Subjects ingested capsules at lunch and dinner the day before late) or a placebo (PLA) in capsule form. Oxygen consumption (VO2) and carbon dioxide excretion (VCO2) were measured using breath-by-breath analysis in the supine position for ten minutes. Based on VO2 and VCO2, we calculated the oxidation of carbohydrates and fats using a stoichiometric equation. The experiment was performed during the middle luteal phase. Blood levels of estradiol and progesterone were assessed. [Results] The ovarian hormone levels and E/P ratio were significantly higher in the PLA than in the GTE (estradiol, p<0.05; progesterone, p<0.01; E/P ratio, p<0.05). Fat oxidation was not different between the GTE and PLA. However, GTE tended to increase FFA compared with PLA (p<0.10). [Conclusions] Acute ingestion of GTE 24 hours prior may increase fat oxidation in women with eumenorrhea during the early follicular phase.

Keywords: Menstrual cycle, Fat metabolism, Green tea extract

122.

Estimation of energy intake levels using the blood index for male athletes

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[Aim] In the field of sports, a brief method is required to investigate the energy intake (EI) levels for continuous dietary support. The purpose of this study was to identify blood markers to estimate the status of EI in male athletes. [Method] The subjects were 27 male athletes who had joined the University’s sports club. Height, body weight, and body fat percentage of the athletes were measured early in the morning. For the dietary survey, a total of three consecutive days: two days with training, followed by one day without training, were set as the survey days, and athletes were requested to submit their dietary record by providing photographs and recordings. The basal metabolic rate (BMR) was estimated from the lean body mass obtained using the BMR estimation formula (Japan Institute of Sports Sciences formula). The daily EI/BMR ratio was used as an index for determining EI levels. A formula for estimating EI status by multiple regression analysis was generated using blood markers. [Results] From the results of multiple regression analysis, multiple blood markers were selected, including thyroid hormone and general biochemical tests. The formula consisting of those multiple blood indices showed a significant correlation with EI/BMR. [Conclusion] It was suggested that male athletes’ EI status could be estimated using a formula consisting of multiple blood marker indices.

Keywords: energy intake, biomarker, athlete

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Changes in bone mineral density associated with a blood condition suspected to be energy deficient

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[Aims] Athletes who compete in endurance events are more likely to be in a state of energy deficiency. The IOC’s “Relative Energy Deficiency in Sport (RED-S)” states that RED-S causes health problems to blood biochemical indicators, bones, endocrine system, etc. In fact, a lack of energy may show changes in the blood composition with a decrease in hemoglobin even when iron stores are sufficient due to impaired iron metabolism, which may be accompanied by bone fragility in athletes with this blood condition.

[Methods] Thirty-eight male college student athletes competing in endurance events underwent blood biochemistry testing and total body composition measurement by the DXA method early in the morning on an empty stomach. After screening those who exhibited a blood condition with a suspected energy deficiency over a 7 months period, changes in bone mineral density, sex hormones, and other factors in the affected individuals were examined. [Results] A significant reduction in body weight and lean mass suggested a possible energy deficient state. He showed significant changes such as decreased hemoglobin and elevated ferritin, but no changes in bone density or testosterone, suggesting that he may not have had a severe energy deficit. [Conclusions] There was no significant change in bone mineral density, but a long-term study is needed in the future.

Keywords: RED-S, BMD, Blood biochemical indicators

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Relationship between psychological competitive ability and nutritional intakes among collegiate male swimmers: a longitudinal study

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[Aims] For athletes, prudent diet is one of the essential elements for improving performance. It is known that eating behavior is affected psychological aspects. However, there are limited studies on the psychological effects of healthy athletes on maintaining proper nutrient intake. The aim of this study was to evaluate longitudinally the relationship between psychological traits regarding competitive-nutritional intakes among collegiate swimmers. [Methods] Thirty-three male swimmers who belonged to the T Univ. Swimming team were participated in this study. They conducted the dietary survey (food frequency questionnaire) and psychological survey (Diagnostic Inventory of Psychological-Competitive Ability for Athletes: DIPCA) once a month from Sept. 2019 to Mar. 2020. The relationship between the intra-personal changes in two variables were analyzed using Pearson correlation coefficient. [Results] There were significant differences in amounts of nutrient intakes except for vitamin B₁₂, B₉, and vitamin K during evaluation period. The DIPCA scores were not significant different during the period. The DIPCA score for Mental stability and Concentration was negatively correlated with various nutrient intakes. The total DIPCA score and score for Confidence were positively correlated with some vitamin intakes. [Conclusions] In male college swimmer, high psychological competitive ability was associated with their nutrient intakes.

Keywords: Swimmer, Nutrition Intake, DIPCA