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The Proceedings of the 20th Annual Meetings of Japan Society of Exercise and Sports Physiology
July 28 • 29, (Tsukuba)
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Exercise and event-related potential

Yoshiaki NISHIHIRA
Graduate School of Comprehensive Human Sciences,
University of Tsukuba

To the present, mechanisms to control human exercise and movements have been studied primarily using electromyography, the reaction time, brain wave frequencies, and evoked potential, but clarification of the central mechanisms concerning exercise and movements has been insufficient. However, studies on event-related potentials have been reported since the 1960s, and they have gradually revealed that it is effective for the evaluation of various activities of the brain related to attention, perception, and exercise. In this lecture, I am going to explain the contingent negative variation (CNV) discovered by Walter et al. in 1964, exercise-related brain potential, which appears 1-3 seconds before the beginning of voluntary actions and reaches a peak negative level about 100 msec before the onset of actions, reported by Kornhuber and Deecke in 1965, and the positive potential called P300, the amplitude of which increases in proportion to the uncertainty of the stimulus presented next, reported by Sutton et al. in 1965. These event-related potentials are applied to analysis of voluntary actions in the field of sports and exercise science, resulting in a number of reports. Particularly, the P300 potential is considered to reflect the perceptive processes of the brain, because its latency is prolonged when the stimulus is difficult to distinguish or when the subject is requested to perform a difficult task, and because its amplitude is increased as the subject is more confident, as the stimulus is more meaningful to the subject, and as the subject is more concentrated. It is, therefore, very useful in research of the relationship between exercise and dementia and is used as an important index for studying the relationship between exercise and perception. The amplitude of P300 measured on the scalp has been shown to be largest in the parietal region along the median line, but it varies widely among individuals and with age.

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Exercise enhances our cardiovascular fitness and hence our memory power become stronger and our lifespan longer; a unique interesting relation between the prefrontal cortex and exercise.

Kisou KUBOTA

In 2008 Patrick Haggard wrote that the neural activity for voluntary actions begins from the prefrontal cortex and their neural circuits are now identified by recent neuroscientific research. Although he did not mention about exercise actions such as walking or running, it is evident and is well known that during running and walking activates the prefrontal cortex and longevity is produced. I will tell my own experience. In late 60ies I began to work on the monkey prefrontal cortex and was able to publish a neurophysiological paper in the Journal of Neurophysiology, titled as “Prefrontal cortical unit activity and delayed alternation performance in monkeys (J. Neurophysiol. 34: 147-153, 1971). This is the first paper which describes single neuronal activities related to the learned task and showed the activity when the monkey started to perform the key press to obtain the juice reward to be delivered to the mouth. Immediately after this, I started to run to reduce my body weight. With running for one year and half I became slim, I may quit running but I was not able. If I did not run for two successful days, I became so unpleasant and I did not want to do research works. If I run more than 30 min, I become pleasant and vivid and felt happy.

My first research work on running and the brain appeared in 2001. Using fNIRS, changes of OxHb concentration of the frontal lobe were measured. While walking at a speed of 1Km/h on the tread mill, the lower limb motor area was activated bilaterally. This is the first evidence showing that the human motor areas are active during natural walking. In the second paper published in 2004 showed that running at 9 Km/h activated the dorsolateral prefrontal cortex bilaterally. Following these works, I worked how the prefrontal cortex influences the running performance. I coined a branching task; i.e., a task for which the frontal cortex is essential. Combining the Delayed Response task and a reversed form of GO-NO task were studied. If the running was continued for two months for 20-30 min running for 2-3 times per week, task performance became better, indicating that the frontopolar activities are improved.

Now it is 2012 and I am 80 years old, my running speed became very slow but my interest to the running research continues. I cannot predict when these end.
The relation of fitness to brain health, cognition, and scholastic achievement

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There is a growing public health burden of inactivity among children of industrialized nations. In recent years, children have become increasingly inactive, leading to concomitant increases in the prevalence of being overweight and unfit. Inactivity during childhood often tracks throughout life and has implications for the prevalence of several chronic diseases during adulthood. Of further interest is the absence of public health concern for the effect of physical inactivity on brain health and cognition. It is curious that this has not emerged as a larger societal issue, given its obvious relation to childhood obesity and other inactivity-related disorders that have captured public attention. Further, many school districts have minimized or obviated physical activity opportunities from the school day despite a growing literature indicating the benefits of physical activity to cognitive health and learning. Such educational practices are growing in popularity due to budgetary constraints and an increased emphasis placed upon student performance on standardized tests. For more than a decade, my research program has examined the relation of physical activity to brain health and cognition across the human lifespan, with particular interest in preadolescent childhood. My techniques of investigation involve a combination of neuroimaging (i.e., electroencephalography [EEG], magnetic resonance imaging [MRI]), behavioral assessments, and scholastic achievement in an effort to translate basic laboratory findings into everyday life. Central to this translational approach to science is the identification of etiological substrates of brain regions and networks that are changed via physical activity. As such, the overarching goal of my research is to determine factors that improve cognition, maximize health and well-being, and promote the effective functioning of individuals as they progress through the lifespan.

In this presentation, I intend to describe a program of research that utilizes correlational and longitudinal designs to investigate lifestyle factors such as cardiorespiratory fitness and central adiposity on neuroimaging, behavioral, and scholastic achievement measures in preadolescent children. Findings from these studies have indicated that greater aerobic fitness is positively related to brain structure and function, as well as better task performance and achievement. Alternatively, central adiposity appears negatively related to brain function, behavior, and achievement. Such findings are timely and important for public health concerns related to chronic disease prevention as a function of childhood inactivity and obesity. These findings link these pervasive societal concerns with brain health and cognition, and have implications for the educational environment and the context of learning.

Strategic / behavior scientific / medical scientific exercise prescription to improve the health behavior by behavior modification

Sotoyuki Usui
Department of Human Development and Sport Sciences, School of Human and Social Sciences, Tokyo International University

Recently, the final result of "3rd Public Health Measures (Healthy Japan 21)" have been reported. According to this, examinees of "specific medical examination" and "specific health guidance" as a national policy to promote the "health promotion" and "disease prevention" did not have many never. Part of the reason is that these were not made to those that consider the daily activities of local residents.

In modern society that values have diversified and many people are extremely busy in daily life, there are various lifestyle and also use personal time zone. From this fact, should be considered that health promotion programs ignored them will not be executed.

As one of the solution to this is that, strategically, applying the "behavioral science" to the traditional medical science for health promotion.

And, to make effective use of "behavior scientific / medical scientific health promotion programs" that was bound to it organically support from the family and friends of region and/or workplace is important.

In this educational lecture, I briefly described the behavioral science techniques to effectively exercise for health promotion and its evaluation method.

Key Words: health behavior, behavior modification, behavioral science techniques, health promotion
Reconsideration on Biological Functions Performed by Muscle Contraction

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Skeletal muscles produce body movements by contracting themselves and moving bones. It owes to the muscle contraction that we can make body movements. Recently, it has been suggested that skeletal muscles play biological more roles than only body movements, which are regulations of whole body glucose metabolism and secretion of bioactive molecules from muscles.

The capacity of skeletal muscles as a receiver of excess blood glucose is very large. The effect of muscle contraction in the uptake of blood glucose is as strong as that of insulin, which is only a humoral factor (hormone) enhances glucose uptake into the skeletal muscles. The muscle contraction-induced glucose uptake is regulated insulin independent intracellular signaling pathway, a (or some) contraction/exercise specific signaling pathway(s). Therefore, even in the case of diabetic patients who have insulin resistance as a result of impaired insulin signaling pathway, glucose transport is enhanced by muscle contraction equally to healthy people.

More recently, it has been pointed out that skeletal muscles possibly secrete bioactive molecules, such as hormones and cytokines, muscle contraction. The secreted molecules presumably act on the skeletal muscles themselves (autocrine effect) or act as a communicator with other organs over distance through blood circulation (endocrine effect). Although this possibility has been broadly recognized, in the current situation, methodologies and research models taken in the research area are sometimes too macro and rough in detail to verify it, and firm evidences obtained to date are yet scarce. In order to resolve this problem, the authors propose an approach combined with a contraction model of cultured skeletal muscle cells, mass spectrometry, DNA microarray, bioinformatics, genetics of drosophila.

Significance of daily physical activity in childhood based on the findings of animal experiments

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The recent decline in academic ability of Japanese children is commonly ascribed to the change in the educational system, known as “yutori kyouiku” in Japanese. An ancient proverb, “Strike while the iron is hot”, points out the importance of early childhood education while plasticity is high.

The prevalence of obese children in Japan has been increasing, and has increased almost 3-fold over the past 30 years; therefore, the numbers of diabetes mellitus (DM) and diabetic nephropathy (DN) patients have significantly increased. Recent data for Japan showed that the number of hemodialysis (HD) patients per capita was the highest worldwide with more than 13,000 patients with DN undergoing HD treatment every year. Therefore, preventative measures for obesity in children in Japan may be a matter of the utmost urgency. Factors such as lack of daily exercise and overeating have been identified as possible causes of increased obesity in children.

Using OLETF rats as a model of hereditary obesity, regular exercise and food-restriction (FR) treatments were performed from 5 to 20 weeks of age, which corresponds to the period of childhood in humans, and from 20 to 35 weeks of age, which corresponds to the period of growth and maturation in humans. Thereafter, subjects were inactive until the age of 45 weeks. Changes in body weight (BW), body fat (BF), and lean body mass (LBM) were measured at 7-week intervals throughout the experiment. After the completion of the experiment, levels of energy metabolism-related enzymes, including CS, SDH, and PFK, and UCP-3 and PPARδ mRNA expressions were measured in the skeletal muscle. After the completion of the FR treatment during childhood and both exercise and FR treatments during the growth and maturation period, BW and BF gradually increased, and no significant differences of these variables between the sedentary control group and the FR and exercise treatment groups were shown at the age of 45 weeks. However, the exercise treatment group during childhood maintained significantly lower levels of BW and BF, and a higher level of LBM, until the completion of the experiment. Furthermore, the activities of CS, SDH, and PFK, and UCP-3 and PPARδ mRNA expressions, in the skeletal muscle were significantly higher in the childhood exercise group than in the other groups.

This study suggests that inhibition of BW gain after regular exercise treatment during childhood contributed to increased skeletal muscle mass and enhanced energy expenditure by increasing the activities of energy metabolism-related enzymes and the mRNA expressions of UCP-3 and PPARδ. These results suggest that childhood exercise might reset BW set point, which is determined genetically. This study recommends childhood exercise to inhibit an increase in the prevalence of obese children.
Large arteries, and central arteries in particular, act as a conduit delivering blood to the tissues and organs, and have a buffering action to level off fluctuations in blood pressure created by cardiac pulsation and intermittent blood flow. An increased arterial stiffness results in a decline in this buffering capacity, causing increases in systolic blood pressure and left ventricular afterload. Furthermore, elevation of arterial stiffness has been identified as a powerful and independent risk factor for cardiovascular disease. Reduction in vascular endothelial function participates in increase in arterial stiffness. Many studies have demonstrated that aerobic exercise training induced a decrease in arterial stiffness and improved vascular endothelial function.

In this symposium, we discuss the relation between exercise training and arterial function, i.e., arterial stiffness and vascular endothelial function. First, Dr. Otsuki (Ryutsu Keizai University) introduces the scientific achievements in the field of exercise training and arterial stiffness. Second, Dr. Miura (University of Tokushima) describes the effects of habitual exercise and physical activity levels (i.e., time, duration, and volume) on vascular endothelial function. Third, Dr. Ogita (National Institute of Fitness and Sports) shows the data of exercise training under hypoxia and arterial function, i.e., arterial stiffness and vascular endothelial function. Finally, Dr. Miyachi (National Institute of Health and Nutrition) presents the data concerning various physical activities (i.e., low intensity physical activity and physical flexibility) and arterial stiffness.

There are many studies in the field of exercise training and arterial function. We would like to discuss the effect of exercise training on arterial function in this symposium.
S-I-3  The effects of exercise on vascular endothelial function as determined by flow-mediated vasodilation

Hajime MIURA
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The vascular endothelium plays an important role in the regulation of vascular tone and maintenance of cardiovascular homeostasis. Advance age is associated with generalized endothelial dysfunction, which is related to the initial stages of atherosclerosis. Several risk factors, including obesity, diabetes, dyslipidemia and lack of physical activity, have been identified as being determinants of endothelial function. Early evaluation of vascular failure is essential in order to intervene appropriately and to prevent the progression of the disease process. Many efforts have been made to assess vascular endothelial function. The easiest and most convenient method involves blood testing to measure endothelial-derived vasoactive substances and markers of endothelial damage. During the last decade, a noninvasive technique has been developed to measure the flow-mediated vasodilation of the brachial artery (FMD) using high-resolution ultrasonography. FMD allows repeated measurements to be taken over time in order to study the effectiveness of various interventions that may affect vascular health. FMD values serve as indices of nitric oxide-mediated endothelium-dependent vasodilator function in humans and are regarded as surrogate markers of cardiovascular disease. An FMD value is typically expressed as the maximum change in artery diameter after cuff release normalized to the baseline diameter. Previous studies have reported that physical activity is favorably associated with endothelial function determined by FMD in adults. Exercise intervention studies indicate that endothelial function is attenuated following short-term exercise training. It is suggested that the beneficial effects of exercise are mediated by exercise-induced enhancement of blood flow, which increases shear stress that simulates nitric oxide production and bioavailability.

In this presentation, I intend to describe the effects of habitual exercise and physical activity levels (i.e., time, duration, volume) on endothelial function in adolescent to elderly men. Additionally, I discuss the effects of short-term exercise training on endothelial function in middle-aged to older men. Evaluating FMD values obtained during acute exercise may be needed in order to establish an optimal exercise prescription for achieving an improved endothelial function. I also evaluate FMD responses under various exercise intensities. These findings might help to clarify the significance of exercise and training. A concerted effort at the federal and/or local policy level should be made to reinforce physical activity.

S-I-4  Hypoxic training and arterial stiffness

Futoshi OGITA
Department of Sports and Life Science
National Institute of Fitness and Sports

It is well accepted that physiological adaptation to regular aerobic exercise reduces cardiovascular risks, for example a decrease in blood pressure as well as arterial stiffness, and an improvement of vascular function. Also, hypoxia causes vasodilation either directly or indirectly through the produced metabolites such as nitric oxide and adenosine. Since such vasodilative responses induced by hypoxic stimulus are quite similar to the physiological responses evoked during aerobic exercise, we hypothesized that exercise under hypobaric hypoxia improves cardiovascular functions more effectively than that under normoxia.

To examine above hypothesis, twelve healthy males aged 23 to 37 (26 ± 6) years were matched for physical fitness into two groups and then randomized to groups that exercised under normobaric normoxia (N, n = 6) or hypobaric hypoxia (H, n = 6) to compare the effects of exercise under these conditions on cardiovascular responses. A whole body exercise was performed by both groups at an intensity of 50% VO2max in each condition for 30 min, 4 days per week for 4 weeks. As the results, the VO2max did not significantly change in both groups after 4 weeks of exercise training. Cardiovascular responses during cycling at 50% VO2max in N group did not significantly change, either. On the other hand, stroke volume (SV) and cardiac output (CO) significantly increased during the cycling exercise in H group (P < 0.05). Among the blood pressure responses during moderate cycling exercise, systolic blood pressure did not significantly change, whereas diastolic and mean blood pressure (MBP) significantly decreased in H group (P < 0.05). Total peripheral resistance calculated as MBP divided by CO also decreased significantly after the training. Furthermore, no significant changes were observed in brachial-ankle pulse wave velocity (baPWV) and flow-mediated vasodilation (FMD) in N group, whereas baPWV and FMD (%FMD) significantly decreased and increased, respectively (both, P < 0.01) in H group. Overall, these results imply that a decrease in peripheral resistance and blood pressure observed after the hypoxic training resulted from a reduction in arterial stiffness and an increase in vasodilatory activity. Furthermore, decreased peripheral resistance and blood pressure might contribute to a decrease in cardiac afterload, and consequently an increase in SV and CO.

The physiological mechanisms underlying cardiovascular responses or adaptations to exercise under hypoxia still remain obscure. In this symposium, we would like to discuss the physiological mechanism evoked with exercise under hypoxia, based on the data obtained in our laboratory.
It is well known that regular moderate to vigorous aerobic exercise prevents and reverses arterial stiffening, but the association between resistance training and arterial stiffness is unclear. This study was performed to conduct a systematic review and meta-analysis of randomised controlled clinical trials (RCTs) assessing the associations between resistance training and changes in arterial stiffness. Data from 185 reports of 8 RCTs (193 participants) were included. This meta-analysis suggests that high-intensity resistance training is associated with increased arterial stiffness in young subjects with low baseline levels of arterial stiffness.

Moreover, it is unclear whether light-intensity physical activity also attenuates arterial stiffening. We performed a cross-sectional study participating a total of 538 healthy men and women. Subjects in each age category were divided into either high-light or low-light physical activity groups based on daily time spent in light physical activity determined with a triaxial accelerometer. In the older group, carotid femoral pulse wave velocity was higher in the low-light physical activity level group than in the high-light physical activity level group, which suggested that longer time spent in light physical activity is associated with attenuation of arterial stiffening, especially in older people.

Fitness, especially cardiopulmonary fitness, has been identified as determinants of age-related arterial stiffening. Although flexibility is one of the components of fitness, the relationship between flexibility and arterial stiffness has never been reported. Using a cross-sectional study design, we tested the hypothesis that a less flexible body would have arterial stiffening. A total of 526 adults, 20 to 39 years of age (young), 40 to 59 years of age (middle-aged) and 60 to 83 years of age (older), participated in this study. Subjects in each age category were divided into either poor- or high-flexibility groups on the basis of a sit-and-reach test. In middle-aged and older subjects, baPWV was higher in poor-flexibility than in high-flexibility groups. In young subjects, there was no significant difference between the two flexibility groups. These findings suggest that flexibility may be a predictor of arterial stiffening, independent of other components of fitness.
Miniaturized hormone determination devices for doping test
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Biomolecular determinations in blood and urine samples are essential for early recognition, diagnosis and decision on courses of treatment. Clinical analysis has mainly been undertaken in remote laboratories using relatively large and expensive instruments such as autoanalyzer or an enzyme-linked immunosorbent assay. Therefore it usually takes a few days to know the analysis results. By using a miniaturized biosensor, it is estimated that the real-time or frequent monitoring of patient’s state and timely medial treatment saves numerous lives each year and reduces medical costs significantly.

Recently, many researchers have reported integrated analysis systems called lab on a chip or micro total analysis systems that are small, light, and capable of integrating all sample handling steps in the micro flow channels. These techniques may make it possible to undertake clinical measurements simply and rapidly at the bedside. Some researchers have reported on chip immunoassay methods that use micro channels combined with fluorescence, chemiluminescence, electrochemical and thermal lens microscope detection techniques. The most commonly used detection technique employs fluorescence. Unfortunately, this is not suitable for bedside monitoring since the system needs relatively high power and an expensive excitation light source and photomultiplier. In contrast, electrochemical detection is advantageous because it is inexpensive and easy to miniaturize while maintaining relatively high sensitivity. However the sensitivity and magnitude of the signal depends greatly on the flow rate and potential at a working electrode, and it is difficult to control these parameters in a small microchannel. In addition, the reduction in the response current that accompanies miniaturization requires improved electronics and shielding for the system. Immuno chromatography is a typical “Point of care testing” device which is commercially available. The immuno chromatography is widely used for detection of peptide, proteins and virus since the detection limit of the immuno chromatography is relatively low (around a few tens of ng/mL) without any detection instruments. However it is difficult to obtain quantitative results using the method.

We have developed new biomolecular determination methods based on surface plasmon resonance and electrogenerated chemiluminescence, and fabricated devices for human blood and urine samples. Highly sensitive biomolecular determinations were achieved with a portable miniaturized system, whose sensitivity is comparable to conventional huge medical analyzers. In this presentation, I intend to describe our new methods and devices with surface plasmon resonance and electrogenerated chemiluminescence techniques.

Forefront in gene doping and its detection technology
- A thought of a molecular geneticist about the risk in the introduction of foreign genes into human tissues -
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Gene doping is a technology, where motor function or performance is enhanced by the introduction of a DNA fragment. It utilizes the same principle as used in gene therapies that compensate the loss of gene function by introducing functional copies of the genes. These are based on recombinant DNA technologies.

I would like to introduce the principle of recombinant DNA technology and the possible examples that can be applied to gene doping. I will also mention about the technologies to detect the DNA fragments used in gene doping and its limitation for the detection. The dangers associated with the introduction of DNA fragments into the cells will be explained from the standpoint of a molecular geneticist. The ectopic gene expression regulation became possible in tissue culture experiments or experimental animals. However, the application to human is still in a premature stage.

There must be many arguments regarding gene doping in terms of sports physiology, or sports science. Here I would like to state my opinion purely in the light of molecular genetics. I must emphasize that the introduction of gene (DNA) fragments in to human bodies needs extreme caution and is in the premature stage, so that medical trials have been stopped due to its high risk.
The aspect of muscle training that is evaluated by magnetic resonance (MR)

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Purpose: Obtaining a series of magnetic resonance (MR) images, several studies adopt variation in the value of transverse relaxation rate (T2) as a measure of activity of objective muscle during preceding training session. The aim of the present study is to obtain a key to clarify the aspect of muscle training reflected by T2

Method: In addition to ordinary T2-weighted images, we obtained diffusion-weighted images. Intensity changes at each boxel in skeletal muscle were analyzed by the use of MATLAB software.

Results and Discussion: In both series of T2-weighted and diffusion-weighted images, we could detect at least two water components in skeletal muscle tissue. Relative fraction of these components varied coincidently against external perturbations with the water component of smaller T2 value corresponding to the water component of more limited translational diffusion. This is quite the opposite of the situation found in other tissues such as infarcted brain tissues.

Conclusion: In the case of skeletal muscle tissues, it would be appropriate to consider that a gain in rotational diffusion freedom generally accompanies a gain in translational diffusion freedom. This would help assignment of water component that is affected by the training of muscle.

Cellular doping” from a regenerative medicine perspective

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We are still in our early ages of regenerative medicine and successful examples are limited. The general aim of regenerative medicine is to supplement cellular component(s) which are hardly discriminated with the patient own cells, to provide functional recoveries. I would then like to point out that this very aspect is indeed heading toward a direction which might enable cellular doping in the future.

Our organs inherently possess certain degree of self-renewability. Wound healing after you’ve stabbed yourself and the busy activities of the osteoblasts and osteoclasts after a fracture represent such self-renewability. In contrast, what regenerative medicine is concerned is to replenish cellular components to organs which have very little self-renewal capabilities such as the brain or the heart. Therefore, as far as regenerative medicine is concerned, the goal is to attain functional recoveries at levels possessed before the diseases or insults. Conversely, cellular doping is mostly starting from a “normal” or non-diseased state and is aiming at increasing an organ’s normal capacity, such as stronger muscles. I foresee that this discrepancy in the goals for regenerative medicine and cellular doping would provide valuable implications in order to regulate and police such doping.

In a broad sense, regenerative medicine makes use of the two other modalities dealt in this symposium. Uncontrolled cell proliferation in our body would usually do more harm than good. Think about cancer. Our body, or our genome to be more exact, bears several measures to counteract such unscheduled changes in our internal milieu. Therefore, regenerative medicine has to transiently “disable” such measures. For this reason, to get sufficient functional recoveries by transplanting stem cells, we have to either “fortify” these stem cells to tackle such inherent obstacles, or to disable the counteracting measures of the host organs. The basic ideas leading to drug doping or gene doping originate from medicine. Therefore, we must stay alert to the possibilities that cellular doping could be derived from such benign attempts of regenerative medicine.

It is difficult to imagine that the idea of cellular doping would escape everybody’s mind forever. I therefore reckon that it is more reasonable to get prepared well beforehand for such malignant attempts. Through this talk, I hope to share the current state-of-the-art of regenerative medicine, and to get hints in regulating such attempts of cellular doping if sadly happening.
**Purpose:** We investigated changes in the metabolic state of quadriceps femoris (QF) muscles by transverse relaxation time (T2) on MRI after different cooling down exercises with different intensities followed by intense knee-extension exercise.

**Methods:** During the recovery session after intense knee-extension exercise, 8 healthy men performed three different types of cooling down exercise for 20 min with different intensities using a cycle [50%, 70%, and 100% of LT] and an inactive state. MR images of QF muscles were taken before trial of each day and at every 30 min, until 120 min after the recovery session.

**Results:** The T2 of m.rectus femoris and m.vastus medialis after recovery session with 50%LT and 70%LT, returned to the resting values before trial significantly earlier than those in inactive or 100%LT. The T2 of m.vastus lateralis and m.vastus intermedius with 100%LT returned to the resting values before trial significantly slower than those with another three conditions.

**Discussion:** Although the change of the T2 after cooling down exercise wasn’t uniform in exercised muscles, the results of this study suggest that cooling down exercises with an intensity below LT are more effective to recover QF muscles after intense exercise than those with intensity above LT or inactive.

**Key words:** cooling down exercise, lactate threshold, transverse relaxation time, metabolism

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**Purpose:** Recent years, a close relationship between ultrasound velocity and muscular viscoelasticity is reported. However, the reliability and reproducibility of the ultrasound velocity measurement has not been confirmed in human skeletal muscles. The purpose of this study is to clarify the intra rater and inter rater reliability of measurements of the revised ultrasound velocity in the extensor digitorum muscle.

**Methods:** The subjects were 13 male university students. An ultrasonograph (FAZONE-M, Fujifilm) was used. Separate analyses were conducted for data on the rest and 5-kg muscle contraction to assess inter rater reliability between the two raters (A and B) and intra rater reliability for five trials. The measurement of ultrasound velocity during isometric muscle contraction was as follows; muscle output was at rest, 5kg, 15kg, 25kg and maximum.

**Results:** Intra rater ICC for rest and 5-kg muscle contraction were 0.441 and 0.574 for A, 0.445 and 0.490 for B. Inter rater ICC ranged from 0.622 to 0.963 for rest, from 0.572 to 0.996 for 5-kg muscle contraction.

**Discussion:** Both intra rater reliability and inter rater reliability were good for rest and 5-kg contraction. Stable ultrasound velocity can be obtained during isometric muscle contraction. Ultrasound velocity can be expected as an indicator of hardening and swelling of the muscle.

**Key Words:** ultrasound velocity, forearm muscle, reliability, reproducibility, muscle contraction
Equations for estimating the energy expenditure of walking and running exercise by a triaxial accelerometer in females

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Purpose: The purpose of this study is to derive the equations for estimating the energy expenditure of walking and running exercise using the triaxial accelerometer method in adult females.

Methods: The energy expenditure of walking and running exercise was calculated from measurements of oxygen intake. The subjects (n=6) attached a triaxial accelerometer at their waists. The acceleration of right-left direction, the acceleration of up-down direction, the acceleration of front-back direction, a synthesized acceleration of those three values were measured simultaneously during the walking and running exercise. The exercise was performed on the motor-driven treadmill in temperate room at 22.0°C and 50% relative humidity. Speeds of walking and running were 40 ~ 160 m/min.

Results: 1) A statistically significant correlation coefficient was obtained from the average synthetic acceleration and the energy expenditure (kcal/kg/minute) (r = 0.979, p<0.001). The equations was as follows: [The energy expenditure] = 0.026 + 0.126 \cdot x, where x is the average synthetic acceleration (G). SEE = 0.008.

2) A statistically significant correlation coefficient was obtained from the average synthetic acceleration and the METS (kcal/kg/hour) (r = 0.979, p<0.001). The equation was as follows: [METS] = 1.574 + 7.214 \cdot x, where x is the average synthetic acceleration (G). SEE = 0.501

Key Words: energy expenditure, Accelerometry, METS
Different effect of arm and leg aerobic exercises on arterial stiffness
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Purpose: The leg exercises such as running and cycling improve arterial stiffness because they increase blood flow to active muscles and increase shear stress. However, very few studies have been performed to measure arterial stiffness during arm exercises. Therefore the study aimed to compare the effects of acute aerobic arm and leg exercises on peripheral arterial stiffness.

Methods: In this randomized crossover study, 8 healthy subjects performed arm-ergometer (arm trial) and leg-ergometer (leg trial) exercises for 30 min at 50%VO₂max. Brachial systolic blood pressure (SBP) and diastolic blood pressure (DBP), heart rate (HR), and femoral-ankle pulse wave velocity (faPWV), were recorded before and at 5, 15, and 30 min after both trials.

Results and Discussion: The baseline hemodynamic values did not differ among 2 trials. In the leg trial, faPWV at 15 and 30 min after recovery, was significantly lower than that at rest, that is, before the trial. However, in the arm trial, the faPWV did not change throughout the trial. The absence of changes in arterial stiffness during the arm exercises may be attributable to complex interactions between changes in both the sympathetic nervous system and arterial smooth muscle tone during arm exercises.

Key Words: arm-ergometer exercises, leg-ergometer exercise, peripheral arterial stiffness

Acute Effects of low-intensity resistance exercise to exhaustion on arterial stiffness
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Purpose: Low-intensity resistance exercise did not change arterial stiffness. However, the effect of low-intensity resistance exercise to exhaustion on arterial stiffness is unknown. The purpose of present study was to investigate the acute effects of high, moderate and low intensity resistance exercise to exhaustion on arterial stiffness.

Methods: Eight healthy subjects (aged 25.5 ± 4.6 years) performed high (80%1RM), moderate (60%1RM) and low (40%1RM) intensity resistance exercise to exhaustion. High, moderate and low intensity resistance exercise was performed on separate days in randomized order. Carotid arterial compliance and β-stiffness index (via simultaneous B-mode ultrasound and applanation tonometry) were measured before, immediately after and 30 min after resistance exercise.

Results: Carotid arterial compliance decreased and β-stiffness index increased (P < 0.05) immediately and 30 min after high and moderate intensity resistance exercise. Although carotid arterial compliance decreased and β-stiffness index increased (P < 0.05) immediately after low-intensity resistance exercise, these did not change 30 min after low-intensity resistance exercise.

Discussion: These results suggested that low-intensity resistance exercise to exhaustion acutely increases central arterial stiffness and decreases central arterial compliance, but these effects returned for <30 min after the completion of resistance exercise.

Key Words: Resistance training, exhaustion, arterial stiffness
**O-08 Effect of short interval training on arterial stiffness**

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**Purpose:** Interval training is one of the useful training methods for improving arterial stiffness. However, it is still unclear whether short aerobic interval training (AIT) is more beneficial in this regard than continuous moderate exercise training (CMT). Therefore, we attempted to determine the effect of short aerobic interval training on arterial stiffness.

**Methods:** The study included 30 healthy men who were randomized to AIT group, training intensity of 80% VO₂max and 50% VO₂max, CMT group, training intensity of and 50% VO₂max, or a control (CON) group. AIT and CMT groups underwent an endurance training program (cycling on an ergometer), such that training volumes were equalized to similar amounts of workload per training session AIT group, (24.6min) and CMT group, (30min). Before and after training, brachial to ankle pulse wave velocity (baPWV) was obtained in the supine position using an automatic pulse wave form analyzer.

**Results and Discussion:** Changes ratio (Δ) of baPWV after training for the AIT, CNT and CON groups were -8.4±6.2%, -2.4±3.8% and -0.2±4.4 for CON respectively. ΔbaPWV decreased to a significantly greater extent in the AIT group than in the other groups. These results suggested that short AIT improved arterial stiffness. Thus, high-intensity exercise at 80% VO₂max may have a greater effect on increased shear stress and atrial natriuretic peptide levels after training than moderate exercise.

**Key Word:** baPWV, interval training, intensity

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**O-09 The relationship between systolic blood pressure and plasma citrulline and ornithine concentrations after high intensity resistance exercise**

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**Background:** High intensity resistance exercise (RE) induces not only increasing systolic blood pressure (SBP), but changes in plasma amino acids concentrations. Citrulline (Cit) and ornithine (Orn) participate in the synthesis of nitric oxide, so it may concern regulation of blood pressure during exercise. However, these relations remain unclear. **Purpose:** The purpose of this study was to investigate the relationship between SBP and plasma Cit and Orn concentrations after high intensity RE.

**Methods:** Eleven young men (23±1 yr) volunteered to participate in this study. Subjects performed 50 maximal eccentric exercise of the non-dominant arm's elbow flexors at 120°·s⁻¹. We measured plasma Cit and Orn concentrations and carotid-(cSBP) and brachial (bSBP) systolic blood pressures before and after high intensity RE. **Results:** cSBP and bSBP were significantly increased after RE. On the other hand, plasma Cit and Orn concentrations were significantly decreased after RE. We also found that the significant correlations between these two amino acids concentrations and two systolic blood pressures, respectively.

**Conclusion:** In the present study, plasma Cit and Orn concentrations were decreased after high intensity RE, and these amino acids may participate in regulation of SBP during and/or after high intensity RE.

**Key Words:** systolic blood pressure, citrulline, ornithine
**O-10 Pressor response to exercise stress in young men**

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**Purpose:** The purpose of this study was to examine the effect of the body mass index (BMI), percent body fat, and central obesity on the blood pressure (BP) response to exercise stress in lean and obese young normotensive men.

**Methods:** The subjects were categorized into 3 groups (lean, normal, and obese) based on the BMI, and each group had 7 subjects. They performed a static handgrip exercise test at 30% of the maximal voluntary contraction (MVC) for 2 min, followed by a 1-min period of posthandgrip circulation arrest. They also performed a graded cycling exercise test until exhaustion. The BP was continuously recorded in both tests.

**Results and Discussion:** There was no significant relationship between the magnitude of the BP response during the static handgrip exercise and BMI and percent body fat. However, the subjects with a smaller waist-to-hip ratio (WHR), an index of central obesity, showed greater BP responses quadratically (p<0.05). It was suggested that the relationship was affected, in part, by the handgrip force. On the other hand, the magnitude of the BP response during the cycling exercise test was significantly correlated with the BMI (p<0.05), and it was apparent that the BP increased proportionally to the BMI at the same relative exercise intensity (% heart rate reserve).

**Key Words:** blood pressure, lean, obesity, body mass index (BMI), abdominal visceral fat

**O-11 Combined effect of milk protein concentrate and resistance training on body composition in collegiate football players**

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**Purpose:** We investigated effect of milk protein concentrate and resistance training on skeletal muscle mass and fat mass in young athlete. **Methods:** Fourteen young men aged 20 years were recruited and randomized in a double-blind study. All subjects participated in resistance exercise training three times a week for 8 weeks. In each resistance training session, the subjects performed leg press, leg extension, leg flexion, chest press, lat pull down, abdominal crunch, and back extension at 3 sets of 8 RM (Repetition Maximum). All subjects consumed a milk protein concentrate supplement after training. The subjects received 400 mL of water containing either 30 g MILKA MPI or MILKA MCI 80 (NIPPON SHINYAKU CO., LTD.). Body composition was determined by dual energy X-ray absorptiometry (DXA) at baseline (pre-intervention) and post-intervention (week 8). **Results:** After the 8 week intervention, whole-body lean (skeletal muscle) mass significantly increased by 2.2% (p<0.0001), and total fat mass decreased by 4.6% (p=0.058). **Conclusion:** The combination of resistance training plus milk protein concentrate supplementation had a positive effect on body composition in collegiate football players.
**Purpose:** The purpose of the present study was to compare the effects of carbohydrate gel at different times before exercise on the metabolic response and exercise performance during 80 min of high-intensity intermittent cycling. **Methods:** Seven male triathletes completed four different trials in a randomized, placebo-controlled, double-blinded design (placebo ingestion immediately before the exercise (P0), carbohydrate ingestion immediately before exercise (C0), 45 min before the exercise (C45) or 120 min before the exercise (C120)).

**Results and Discussion:** Immediately before exercise, the serum insulin concentration was significantly higher in the C45 than in the other trials. Blood glucose concentration was significantly lower in the C45 than in the P0 and the C0 during the initial part of the exercise. During the exercise, the C0 showed the highest glucose concentration. During the latter half of the exercise period, the C0 and C120 revealed a significantly lower average rating of perceived exertion (RPE) compared with the P0. There was no difference in RPE between P0 and C45. These findings indicate that carbohydrate gel ingestion immediately before exercise resulted in a maintained higher glucose concentration and lower subjective fatigue, especially during the latter half of the 80-min exercise period. **Key words:** carbohydrate gel ingestion, prolonged exercise, blood glucose, subjective fatigue

**O-13 Mitigating effect of branched-chain amino acid supplemenations on the muscle soreness after swimming competition and marathon race**

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**Purpose:** Although a lot of previous studies have approved the effectiveness of branched-chain amino acid (BCAA) supplementation on delayed onset muscle soreness in experimental resistance exercise using squat and dumbbell procedures, it has not been established in the scene of field. The present study investigated the effect of BCAA supplementation on the muscle soreness after the swimming competition and marathon race under double blind study. **Methods:** Thirty-two university competitive swimmers and 22 civil marathon runners were randomly assigned to BCAA or placebo that ingested with or without 3.2g BCAA (Aminofeel®), respectively, three times a day, before the day (Pre), on the events day (Post), after one day (1st day) and after two days (2nd days). The muscle soreness and systemic fatigue were subjectively evaluated visual analogue scale (VAS) on Pre, Post, 1st day and 2nd days. The VAS was used to measure muscle soreness at seven and six regions in the swimming competition and marathon race, respectively. **Results:** In the swimming event, the VAS scores of neck, brachial, back, buttocks, loin, femur and systemic fatigue were significantly decreased on the 2nd days under the BCAA supplementation, whereas the mitigating effects on the VAS scores were not observed under the placebo group. In the marathon race, the VAS scores in all examined parts were significantly increased on Post compared to those on Pre, and BCAA supplementation significantly decreased the VAS score of the anterior surfaces of thigh and leg, loin and systemic fatigue increased by marathon by the 2nd day. **Discussion:** In addition to the experimental resistance exercises, the mitigated effect of BCAA supplementation on the muscle soreness and systemic fatigue after swimming competition and marathon race was also confirmed. **Key words:** BCAA, DOMS, muscle soreness, resistance exercise
The effect of medium-chain fatty acid on mitochondrial biogenesis regulation

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Purpose: The transcriptional peroxisome proliferator activated receptor coactivator-1α (PGC-1α) and peroxisome proliferator activated receptor α, δ (PPARα, δ) enhance metabolically relevant pathways, such as fatty acid oxidation and mitochondrial biogenesis in skeletal muscle. It has been reported that nutrients of long-chain fatty acid regulate the expression of PGC-1α. Although medium-chain fatty acid (MCFA) ingestion also increases the number of mitochondria in skeletal muscle, it remains unclear that PGC-1α expression is modulated by MCFA. The present study examined if the MCFA addition would increase the PGC-1α protein in skeletal myocytes. Methods: Rat skeletal muscle cells (L6 cells) were cultured and were differentiated in vitro. The L6 cells were treated with 0.5 mM, 1 mM, 2 mM octanoate (C8:0) solution containing 2% BSA or control solution (2% BSA) for 16-hour. After 16-hour incubation with each solution, the voltage-dependent anion channel (VDAC) protein and PGC-1α protein in L6 cells were measured by Western blotting. Results: VDAC protein in 2 mM octanoate addition was significantly higher than control (1.6-fold, vs. control, p < 0.05). There were no significant increases in PGC-1α protein by octanoate treatment. Conclusion: These results suggested that the MCFA do not regulate expression of the genes encoding the PGC-1α in skeletal muscle cells. It is, however, necessary to investigate if MCFA induces to transfer of PGC-1α from cytoplasm to nucleus and modulates expression of PPARαs protein in skeletal myocytes.

Key Words: skeletal muscle cell, MCFA, mitochondrial biogenesis, PGC-1α

Influence of low energy availability according to diet restriction and voluntary running on bone of male rats in growth phase

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【Introduction】We examined the influence of low energy availability on the bone of male rats in growth phase.

【Method】Sprague-Dawley rats (4 weeks, n=32) were divided into 4 groups: control (Con: n=7), restriction (R: n=8), Exercise (Ex: n=8), restriction+exercise (REx: n=9) groups after 1 week preliminary breeding. Con and Ex were fed ad libitum, R and REx were fed 70% restriction of ad libitum intake. Exercise were voluntary running used rotation vehicle cage. BMD of tibia was measured by DXA, femoral strength was tested in three-point bending. The experimented period was 3 months.

【Result】Body weight and abdominal fat were significantly lower in REx than other groups (p<0.001). Running distance was lower in REx than Ex group (p<0.001). Femora strength and BMD of tibia were significantly lower in REx than other groups (p<0.001, p<0.001). There were significantly positive correlation between BMD of tibia and energy availability in Ex and REx (r=0.995).

【Discussion】Low energy availability according to diet restriction and voluntary running decreased bone strength and BMD of male rat in growth phase.
Comparison of anaerobic threshold during graded exercise between in the morning and in the afternoon

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Purpose: The purpose of the present study was conducted to determine the relationships between the ventilatory volume, double product (DP) and cardiac parasympathetic nervous system modulation during graded exercise in the morning and afternoon. Methods: Volunteering to participate in this study were 10 healthy Japanese males, who gave their informed consent prior to participation. Each subjects performed graded exercise consisting of 90 seconds of exercise at pedaling rate of 60 rpm. The intensity of exercise was started at 10 watts and was increased 10 watts at every step of the graded exercise. Both experimental tests were performed in the morning (9-10 a.m.) and the afternoon (4-6 p.m.). HR, BP, ventilatory volume and cardiac autonomic nervous system activity were measured at each exercise step. The VT, DPBP and HFBP were calculated by the equation to define the relationship between exercise workload and each parameter. The VT, DPBP and HFBP were used as index of anaerobic threshold (AT).

Results and Discussion: The VT, DPBP and HFBP in the morning were significantly lower than in the afternoon. These data suggested the possibility that an AT index showed a change in days. At intensity of DPBP, HR, SBP and DP in the morning were significantly lower. During graded exercise in the morning, the anaerobic metabolism was provided at HR, SBP and DP are low values. In conclusion, the AT in the morning was reached at a lower exercise intensity than exercise in the afternoon.

Key words: circadian rhythms, AT, graded exercise

Effects of dietary modification and habitual exercise on weight loss, abdominal girth and vital age

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Introduction: We have been conducting diet and/or exercise interventions for weight loss of obese persons since 1983, and nowadays can make an estimate of -8 kg, -8 cm, and -8 yr on the average in weight, abdominal girth, and vital age, respectively, at the beginning of the intervention. At this conference, we report a summary of intervention effects obtained by diet only (DO), exercise only (EO), and diet plus exercise (DE) interventions.

Methods: Participants were 228 obese, middle-aged men (50.3 ± 9.8 yr). Groups DO and DE participated in weekly dietary sessions (1680 kcal/d) and groups EO and DE engaged in 90-min structured exercise sessions on 3 times/week. Weight, abdominal girth and vital age were measured and estimated at before and after interventions.

Results: The average reductions of weight were -8.5 kg, -6.9 kg, and -2.5 kg for groups DE, D, and E, respectively; and those of abdominal girth were -11.2 cm, -7.7 cm, and -3.5 cm, respectively. The effects on vital age were -11.7 yr, -6.3 yr, and -7.1 yr, respectively. Among various components of vital age equation, physical fitness improved in all the groups. Blood pressures decreased most in group DE. It is concluded that a combined intervention of proper diet and well-balanced exercise has the greatest effects on almost all health- and fitness-related variables.
**O-18 Influences of single nucleotide polymorphisms on muscle strength and body composition in Japanese elderly women**

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**Purpose:** Single nucleotide polymorphisms (SNPs) are concerned with physical characteristics and some diseases. The purpose of the present study was to investigate SNPs associated with muscle strength and body composition in Japanese elderly women. **Methods:** Japanese elderly women (n = 164) were genotyped for SNPs selected of the growth hormone receptor (GHR), insulin-like growth factor 1 receptor (IGFR-1), and zinc finger protein 91 ciliary neurotrophic factor (ZFP91-CNTF) genes using a real-time PCR. The thickness of the vastus medialis muscle (VM), isometric strength of the knee extensors, hand grip strength, toe grasping power, fat mass, body fat percentage, and body mass index (BMI) were measured. **Results and Discussion:** The subjects with the AA or AG genotype for the GHR had significantly lower VM thickness, knee extensor isometric and hand grip strength, and toe grasping power. The subjects with the GG homozygote for the IGFR-1 had significantly lower VM thickness. The subjects with the TT homozygote for the ZFP91-CNTF had significantly lower toe grasping power and larger fat mass, body fat percentage, and BMI. These results suggested that the SNPs of the GHR and IGFR-1 genes are associated with the volume and strength of skeletal muscles in Japanese elderly women, whereas the ZFP91-CNTF genes are associated with muscle power and fat mass.

**Key words:** SNPs, muscle strength, body fat mass

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**O-19 Association of ALDH2 gene polymorphism with alcohol drinking behavior in athletes**

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**Purpose:** ALDH2 is the key enzyme in eliminating acetaldehyde after drinking alcohol. The missense mutation at position 1510 with a G to A transition in exon 12, changing the codon GAA encoding glutamic acid (Glu) at position 487 into lysine (Lys) codon (AAA). It causes diminished activity of the enzyme, leading to the accumulation of circulatory toxic acetaldehyde. It has been reported that ALDH2 polymorphism (SNP) affects the alcohol drinking behavior, however, the contribution of the ALDH2 SNP for athletes is unknown. The aim of the present study was to investigate the relationship between ALDH2 SNP and behavioral pattern for alcohol drinking in athletes.

**Methods:** ALDH2 SNP was genotyped into 3 groups (wild type: Lys/Lys, heterozygous mutant: Lys/Glu, homozygous mutant: Glu/Glu) using DNA samples from a total of 39 female athletes by real time PCR. The alcohol consumption was compared between wild type and mutant type.

**Results and Discussion:** Compared to wild type, alcohol consumption was significantly smaller in mutant type (22.6±4.4 mL/week vs 8.4±3.6 mL/week, p<0.05). The level of alcohol consumption is greatly influenced by genotypes of ALDH2 in female athletes. The genotype analysis for ALDH2 would be useful in evaluating the conditioning of athletes.

**Key Words:** ALDH2, polymorphism (SNP), athlete
Changes in interhemispheric inhibition from active to resting primary motor cortex during a fine-motor manipulation task

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Purpose: The effects of performing a fine-motion manipulation (FM) task as a sensorimotor task on interhemispheric inhibition (IHI) from active to resting primary motor cortex (M1) were examined in 10 right-handed subjects. Methods: Transcranial magnetic stimulation (TMS) was delivered to evoke a motor evoked potential (MEP) from the first dorsal interosseous (FDI). In the paired pulse paradigm, the test stimulus (TS) was applied to the left M1. And the conditioning stimulus (CS) was also applied to the right M1. Five different CS intensities were tested. The TS intensity was adjusted to evoke a control MEP of approximately 1mV. The interstimulus interval was set to 10ms. As a sensorimotor task, and FM task (using chopsticks to pick up, transport, and release glass balls) and index finger abduction task (control task) were adopted. These tasks were performed using non-dominant left hand. Results and Discussion: Significantly increased IHI from the active to the resting M1 was observed during the FM task. The present findings suggest that the increased IHI observed during the FM task could be the neural mechanism responsible for reducing short interval intracortical inhibition in the ipsilateral M1. Also this increased IHI was not dependent on MEP amplitude evoked by CS and phase movement of the task. These results suggest that the transcallosal and corticospinal projections are distinct.

Key words: Fine-motion manipulation task, Ipsilateral motor cortex, Interhemispheric inhibition, TMS

Modulation of somatosensory processing during dual tasks: an event-related potential study

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Purpose: Everyday life often requires the performance of two or more tasks simultaneously. The amplitudes of the event-related potentials (ERPs) have been associated with the amount of attentional resources. We here report the modulation of ERPs elicited in a somatosensory oddball task performed simultaneously with a visuomotor force tracking task.

Methods: The amplitude of the P300 elicited in the oddball task was decreased in the dual task condition compared with the oddball-only condition, and further decreased in the force-decreasing phase compared with the increasing phase, but was not altered by the concurrently performed isometric contraction. The tracking speed did not affect the P300 or N140 amplitudes whereas the P300 amplitude was decreased when the change in tracking direction was unpredictable. A correlation analysis of single-trial P300 latency and RT showed that the dual-task condition produced a stronger coupling of the P300 and RT. The amplitude of the P300 showed a complex pattern of change with dual-task repetition, which is different in the time course from so-called habituation. Thus, dual-task repetition may allow an adaptive allocation between qualitatively-different tasks available.
Modulation of reciprocal Ia inhibition between Ia inhibitory interneurons and corticospinal neurons

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Purpose: The purpose of this study was to investigate the extent to which corticospinal input on Ia inhibitory interneuron influences the strength of disynaptic reciprocal Ia inhibition. Methods: Soleus (Sol) H-reflex was measured in healthy subjects. In first, the amount of reciprocal Ia inhibition was determined via short-latency (1-3 ms condition-test interval) suppression of Sol H-reflex by conditioning stimulation of common peroneal nerve. In second, Sol H-reflex was conditioned by transcranial magnetic stimulation (TMS) applied to motor cortex (Sol hot spot) at varying condition-test interval (-6, -4, -2, 0, 10 ms). Results: The extent of reciprocal Ia inhibition decreased when Sol H-reflex amplitude was not suppressed by conditioning TMS at C-T intervals around -2-0 ms. In contrast, reciprocal Ia inhibition increased when Sol H-reflex amplitude was suppressed by conditioning TMS during same C-T intervals. Discussion: Our results suggested that strength of reciprocal Ia inhibition is related to corticospinal input on Ia inhibitory interneuron. The short-latency inhibitory effect on test reflex conditioned by TMS is presumed disynaptic reciprocal inhibition which is mediated by Ia inhibitory interneurons. Thus, our findings may indicate that individual differences in reciprocal Ia inhibition is caused by excitability of corticospinal descending neurons.

Key Words: Reciprocal Ia inhibition, Corticospinal neurons, Soleus H-reflex

Modulation of somatosensory evoked potentials during force generation and relaxation

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Purpose: For the control of voluntary movement, the appropriate integration of sensory and motor signals is essential. The purpose of this study was to identify the neural mechanism of sensorimotor integration during precisely controlled force generation and force relaxation in a visuomotor tracking task. Methods: Subjects were instructed to track a target line with a line that represented their own force generated by grip movement with the right hand as accurately as possible during concurrent electrical stimulation. The target force line moved up continuously from 0 to 20% of maximal voluntary contraction (MVC) (the force generation phase: FG phase) and moved down from 20 to 0% of MVC (the force relaxation phase: FR phase) in 7s at a constant velocity. We separately obtained somatosensory evoked potentials following electrical stimulation of the median nerve at the wrist in each phase. Results and Discussion: During the visuomotor tracking task, compared with the stationary condition, the N30 at Fz and P27 at C3’ showed a significant reduction in amplitude in the FG and FR phases. In addition, the N30 and P27 were significantly smaller in amplitude in the FG than FR phase. Although the average amount of force exertion was the same in the FG and FR phases, the modulation of SEP amplitude was larger in the FG phase. These results indicated that sensorimotor integration in the somatosensory area was dependent on the context of movement exertion. Keywords: SEPs, gating, sensorimotor integration, tracking
The effects of endurance exercise training on sympathetic neural regulation of circulation during exercise

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**Purpose:** Recent studies indicated that endurance exercise training decreases muscle sympathetic nerve activity (MSNA) responses during handgrip or one leg exercise. There has been no study if the endurance exercise training attenuates MSNA response during large muscular exercise. Our aim was tested whether MSNA response during submaximal exercise was altered by the exercise training.

**Methods:** Seven of endurance trained (T) and ten of healthy students (UT) were participated in this study. Their peak oxygen uptake (VO2peak) was 55±2 mL/kg/min in T and 47±2 in UT. Subjects were informed about the objects, and written consent was obtained. The subject performed two submaximal bicycle exercises (40%VO2peak and 60%VO2peak) for 15-min. MSNA, heart rate (HR), and blood pressure (BP) were measured throughout the experiment. MSNA was recorded from the right median nerve using the microneurography and was quantified as bursts per minute.

**Results and Discussion:** MSNA at rest was lower in T than in UT. During exercise MSNA increased in both 40% and 60%VO2peak in TG, while only 60%VO2peak in UT. The MSNA response during exercise was grater in T compared with UT. HR was not different between T and UT in either exercise intensities. In 40%VO2peak diastolic BP was lower in T than in UT, but the same in 60%VO2peak. MSNA response during exercise was enhanced by endurance exercise training. The different result from the previous studies may be due to the different exercise method was used.

**Key Words:** MSNA, blood pressure, oxygen uptake

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**O-24** Change in Executive Function before and after a Bout of Exercise in Preadolescent Girl

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**Purpose:** The purpose of this study was to examine the effect of a bout of exercise on executive function in preadolescent girl. **Methods:** Nineteen healthy female subjects aged 10.9±0.7 years participated in 2 examinations. In study-1, the changes in 4 cognitive task achievements before and after 20 minutes of treadmill running at the intensities of 40%, 60% and 80%HRreserve.

**Results:** Although no significant positive effect was found, WCST (Wisconsin Card Sort Test) category errors significantly increased after 80% HRreserve running. Higher aerobic capacity of the subjects showed significantly less category errors of WCST. In study-2, three cognitive task achievements were evaluated before and after the 90 minutes cheerleading training at the intensity of 53.7±4.5%HRreserve including some rests and communications with other people. Significant improvement in scores of Stroop test was found after the training.

**Conclusions:** Those results indicate that 1) high intensity of exercise may decrease executive function, 2) 90 minutes of cheerleading training may enhance executive function in preadolescent girl, and 3) the change in cognitive task achievements depends on each subject’s aerobic capacity.
Effect of different frequency of electrical nerve stimulation on change in the ipsilateral primary motor cortex excitability

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Purpose: The present study investigated the effect of three different frequencies (1, 2 and 3Hz) of electrical nerve stimulation (ES) over the peripheral nerve on lasting change in the ipsilateral primary motor cortex (ipsi-M1) using transcranial magnetic stimulation (TMS)

Methods: Subjects were asked to maintain relaxing their both arms throughout all of experimental sessions. Total number of 600 stimuli were delivered to each subject in response to each frequency (1, 2 and 3Hz) as an intervention to produce the lasting change in the ipsi-M1. One stimulus consisted of five trains at 20 Hz that delivered on the left ulnar nerve. Intensity of ES was set to evoke 0.5ms of M-wave in peak to peak amplitude in the left FDI. MEPs were recorded from right FDI and APB employing single pulse TMS. To investigate after effect of three different frequencies of interventions, MEPs were corrected at before intervention and four time points of the after intervention (immediately, 10, 20, 30 min).

Results: Excitatory and inhibitory changes in the ipsi-M1, i.e., MEP in the Rt FDI, were significantly outlasted until 30 min after the intervention in response to each frequency of ES. Excitatory changes in the ipsi-M1 were produced by ES at both 1 and 3Hz conditions, in contrast, inhibitory change in the ipsi-M1 was produced by ES at 2Hz condition.

Discussion: The bidirectional lasting changes in the ipsi-M1 excitability can be produced by short burst ES that depend on the frequency of ES.

Key Words: TMS, Electrical nerve stimulation, Ipsilateral primary motor cortex

Is aerobic exercise capacity related to cerebral blood flow velocity in postmenopausal women?

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Purpose: Age-related decrease in cerebral blood flow velocity is a risk factor for cognitive decline. Recently, a cross-sectional study demonstrated that physically active individuals exhibit higher cerebral blood flow velocity than their sedentary peers. However, the relation between aerobic exercise capacity and cerebral blood flow velocity is unclear. Therefore, the purpose of the present study was to examine whether aerobic exercise capacity is associated with resting cerebral blood flow velocity in postmenopausal women.

Methods: Healthy, sedentary postmenopausal middle and older women volunteered to participate in this study. Peak oxygen uptake was measured as aerobic exercise capacity. Subjects were divided into high fitness group and low fitness group, dividing line set at the median value of peak oxygen uptake. We measured resting middle cerebral blood flow velocity using transcranial Doppler ultrasonography in high fitness and low fitness groups.

Results: The blood flow velocity of middle cerebral artery in high fitness group was significantly greater than in low fitness group. Furthermore, peak oxygen uptake was positively correlated with the blood flow velocity of the middle cerebral artery at rest.

Conclusion: We concluded that aerobic exercise capacity is related to resting cerebral blood flow velocity in postmenopausal women.

Keyword: cerebral blood flow, peak oxygen uptake, aging, postmenopausal women
The effects of exercise under hypoxia on cognitive function
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Purpose: Moderate exercise appears to improve cognitive function. However, it is unclear how exercise under hypoxia affects cognitive function. The purpose of this study was to examine whether a decrease in cerebral oxygenation during exercise under hypoxia attenuates the beneficial effects of exercise on cognitive function.

Methods: Ten participants performed the cognitive task at rest and during exercise at various fractions of inspired fraction of oxygen (FIo2: 0.209, 0.18, and 0.15). Exercise intensity corresponded to 60% peak oxygen uptake under normoxia. Cognitive function was evaluated by the speed of response (reaction time) and error rate. Cerebral oxygenation was monitored over the prefrontal cortex during the cognitive task using near-infrared spectroscopy.

Results: Cerebral oxygenation gradually decreased as the FIo2 level decreased. The decrease in cerebral oxygenation was prominent during exercise. However, the reaction time significantly decreased during moderate exercise independent of FIo2 level (P < 0.01).

Discussion: The present results suggest that moderate hypoxia does not attenuate the beneficial effects of exercise on cognitive function. Exercise under moderate altitude hypoxia may not necessarily compromise cognitive function.

Key Words: Cognitive function, Exercise, Hypoxia, Cerebral oxygenation

Different effects of low and high exercise intensities on capillarity and metabolic activity in slow and fast muscles
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Purpose: To clarify the different effects of low and high exercise intensities on capillarity and metabolic activity in slow and fast muscles.

Methods: 5-week-old male Wistar rats were divided into three groups: low-intensity exercise (LI; lactate = 2.4±0.1mmol/L, running speed of 15m/min, 0 degree incline, 60min/day), high-intensity exercise (HI; lactate = 3.7±0.1mmol/L, 20m/min, 20 degree incline, 30min/day), and sedentary control (Con) groups. The rats in the LI and HI groups ran on a rodent treadmill 5 times per a week for 3 weeks. The soleus and plantaris muscles were removed, and analyzed the capillary to muscle fiber ratio (C/F ratio) and SDH activity of muscle fiber with alkaline phosphatase, ATPase and SDH stains.

Results and Discussion: In the soleus muscle, the C/F ratio and SDH activity of the LI and HI groups were significantly higher than those of the Con group. In addition, the C/F ratio and SDH activity in the HI group were significantly higher than those in the LI group. In those of the plantaris muscle, the HI group was significantly higher than the Con group although the LI group was not significantly different from the Con group. These results indicate that fiber type-specific recruitment associated with the exercise intensity induce the different adaptations between slow and fast muscles.

Key words: exercise intensity, muscle fiber types, capillarity, metabolic activity
Low-intensity prolonged exercise increases MCT1-associated chaperone protein CD147 in skeletal muscle

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Purpose: CD147 is a broadly expressed plasma membrane glycoprotein containing two immunoglobulin-like domains and a single charge-containing transmembrane domain. This protein specifically interacts with proton-linked monocarboxylate transporter (MCT)1 and MCT4, that play a fundamental role in metabolism. We have found that low-intensity prolonged exercise (LIS) increases MCT1 protein but not MCT4 in rat epitrochlearis. We examined the effect of acute bouts of exercise on CD147 protein in rat skeletal muscle.

Methods: Male SD rats (100-130g) were divided into 3 groups: resting control, high-intensity intermittent swimming exercise (HIS) or low-intensity prolonged swimming exercise (LIS). The HIS rats swam for fifteen 20s period with 20s rest between bouts with a weight equal to 18% of their body mass. The LIS rats swam without load in two 3h sessions separated by 45min of rest. Paired epitrochlearis muscle were dissected out immediately, 5, 10, 18, and 24 hours in the period after completion of the exercise.

Results: CD147 protein was increased immediately after LIS and remained elevated until 24h post-exercise. HIS did not increase CD147 protein at any time points.

Discussion: These results suggest that one bout of LIS rapidly increases an MCT1-associated chaperone protein CD147 in skeletal muscle, but it is unlikely that acute bout of exercise at high-intensity rapidly upregulates CD147 protein.

Key Words: acute exercise, CD147, MCT1

Changes in HIF-1α, its target genes and miRNA during exercise training in rat cardiac and skeletal muscles

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Purpose: Hypoxia inducible factor (HIF)-1α plays critical roles in exercise-induced adaptive changes. The present experiments were designed to examine the time-course changes in HIF-1α, its target genes and miRNA in the early stage of exercise training in rat cardiac and skeletal muscles.

Methods: Exercise training by running lasted for up to 10 days at 25m/min on a 20% gradient, 15-42 min/day. Soleus (SO) and deep red section of gastrocnemius (Gr) muscles and left ventricle (LV) were excised and RNA was isolated. Reverse transcription was performed, and mRNA and micro RNA levels were determined by real-time PCR method.

Results: Exercise training significantly enhanced mRNA level of HIF-1α after 3 days in SO, after 3 and 10 days in Gr, and after 10 days in LV. VEGF mRNA content increased significantly in SO and Gr after 3 days and in LV after 6 and 10 days of the training. PHD2 mRNA level was significantly increased in SO after 6 and 10 days and in Gr and LV after 10 days of the training. The training significantly increased transcription factor, PU.1 mRNA expression in SO and Gr after 3 days and in LV after 10 days. In LV, expression of mir20b, targeting HIF-1α, was significantly decreased after 6 and 10 days of training.

Conclusions: The present results suggest that exercise training enhances transcription of HIF-1α and its target genes, and it may initiate a negative feedback loop that leads to hydroxylation and subsequent degradation of HIF-1α. PU.1 and mir20b may contribute to these adaptive changes during early stage of endurance exercise training.
**O-32** The effect of middle and low frequency electrical stimulation on capillary regression in rat deep muscles

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**Purpose:** The decrease of capillary-to-fiber ratio (CF ratio) was induced by inactivity, which lead to exercise intolerance. Although electrical stimulation (ES) is used to prevent muscle atrophy, the ES with low frequency cannot elicit muscle contraction in the deep layer due to high impedance. In the present study, we investigated the difference between low and middle frequency on capillary regression in rat deep muscles. **Methods:** Male SD rats were divided into four groups: control (Cont), hindlimb unloading (HU), HU plus low frequency ES (l-ES), and HU plus middle frequency ES (m-ES) groups. After 2 weeks, the soleus muscles were removed and analyzed by ATPase activity. In addition, VEGF protein expression in soleus muscles was quantified by Western blot. **Results and Discussion:** The CF ratio in the HU group was significantly lower than that in the Cont group. The value in the l-ES group was significantly higher than that in the HU group. In addition, the value in the m-ES group was significantly higher than that in the l-ES group. The VEGF protein expression in the m-ES group was 21% higher than that in the l-ES group. These results suggested that middle frequency ES is more effective to prevent capillary regression in deep muscles than low. **Key words:** middle frequency electrical stimulation, capillary regression, hindlimb unloading.

**O-33** Comparison of preventive effects of electrical stimulation using square and sine waveforms on disuse atrophy in the deep muscle of rat hindlimb

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**Purpose:** The aim of the present study was to compare the effects of electrical stimulation using square and sine waveforms on prevention of muscle atrophy in the deep layer of rat calf muscles. **Methods:** Rats were randomly divided into the control, hindlimb unloading for 2 weeks (HU), and HU plus electrical stimulation (ES) groups. The animals in the ES group were stimulated electrically using square waveform on the left (DC-ES) and using sine waveform on the right (AC-ES) calves twice a day during the unloading period. The soleus muscles were removed and their transverse sections were stained for ATPase activity. **Results and Discussion:** The HU group exhibited significantly decreased cross-sectional areas (CSAs) of type I and IIA fibers compared with the control group. The CSA's of type I and IIA fibers in the AC-ES group were significantly larger than those in the HU and DC-ES groups although there were no significant differences between the HU and DC-ES groups. The electrical stimulation using sine waveform is more effective on prevention of atrophy in the deep layer of the muscle than that using square waveform because sine waveform composed of alternating current can pass capacitors, e.g., the skin and subcutaneous adipose, easily than square waveform composed of direct current. These results indicate that sine waveform can prevent atrophy in the deep muscle of hindlimbs. **Key words:** muscle atrophy, Electrical stimulation, Sine waveform.
Protein kinase C-dependent regulation of mammalian target of rapamycin signaling in skeletal muscle

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Purpose: The protein kinase C (PKC)-dependent regulation of mammalian target of rapamycin (mTOR) activity and subsequent protein synthesis/cell growth has been suggested, however, the exact molecular mechanisms underlying this regulation are poorly defined in skeletal muscle. The purpose of this study was to determine the regulatory mechanism in PKC-dependent pathway leading to mTOR activation in skeletal muscle cells.

Methods: C2C12 myoblasts were treated with PKC activator phorbol 12-myristate 13-acetate (PMA), co-incubated with/without PKC-specific inhibitor bisindolylmaleimide I (BIM-I) or mTOR-specific inhibitor rapamycin.

Results and Discussion: PMA treatment resulted in an activation of mTOR signaling and phosphorylation of upstream regulator tuberous sclerosis complex 2 (TSC2) at S664 site (ERK-specific residue). PKC-specific inhibitor BIM-I prevented PMA-induced mTORC1 activation and TSC2-S664 phosphorylation. Overexpression of Ras homolog enriched in brain (Rheb), a downstream target of TSC2 and an mTOR activator, was sufficient to activate mTOR signaling. We also identified that, in the absence of Rheb with using siRNA knock down, PMA-induced activation of mTOR signaling was significantly prevented. These observations demonstrated that in C2C12 myoblasts, the PKC-dependent activation of mTOR is mediated through TSC2 phosphorylation and its downstream target Rheb.

Key Words: mTOR, PKC, TSC2, Rheb

Signaling in the differentiation from myoblast to brown adipocyte is stimulated by swimming exercise

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Aim: Recently, there has been growing evidence that PRDM16 is shown to act as a bidirectional switch to drive the differentiation of Myf-5-expressing mesenchymal stem cells into the brown adipocytes. The aim of the current study is to test whether exercise modifies this differential event.

Methods: Male C57BL/6j mice were randomly divided into 3 groups: sedentary control group, acute swimming group and acute running group. Several parts of skeletal muscles were extracted and used for analysis of both mRNA and protein which might be concerned with this event.

Results and Discussion: Expression of UCP-1 mRNA, a specific marker of brown adipocyte, and PRDM16 mRNA were detected only in interscapular muscles in each group. Swimming group induced a significant increase in PRDM16 mRNA compared with control group, whereas there was no significant change in running group. Moreover, levels of PRDM16 and C/EBP-b (which is a significantly key regulator for switching of PRDM16) were higher in swimming group than in control group. These results suggest that swimming exercise has powerful effects on differentiation event of Myf-5-expressed myoblasts into brown adipocytes, suggesting that swimming exercise is clinically useful as newly anti-obesity treatment.

Key words: differentiation, brown adipocyte, swimming exercise
Effects of spontaneous exercise on neuronal activity associated with stress response in obese rats

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Purpose: Previously studies have shown that forced exercise such as treadmill running in obese rats strongly increased the activation of several brain regions associated with stress response. However, the relationship between spontaneous exercise, which is known to be a mild stressor for rats, and its stress response in obese rats are unclear. In this study, we examined the effects of spontaneous wheel running on activation of the several brain regions related to stress response in obese and lean Zucker rats. Methods: The rats were housed individually in the cages with or without an attached running wheel. Physically active rats were allowed voluntary access to their wheels for 2 weeks. We assessed the expression of c-Fos, which is well known as a functional marker of neuronal activity. This assessment was performed using immunohistochemistry in various brain regions associated with stress response and affection, such as the prefrontal cortex, paraventricular nucleus of the hypothalamus, central nucleus of the amygdala and dorsal raphe nucleus. Results and Discussion: Two weeks of spontaneous wheel running did not increase the expression number of c-Fos in all brain regions compared to sedentary conditions in both obese and lean rats. These results indicate that spontaneous running is not an intense stressor even in obese rats, suggesting that spontaneous exercise might be recommended as exercise modality for obese people to improve physical health without excessive stress response.

Effect of running training on stress-induced activation of neurons in the medullary raphe region of rats

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Purpose: We have demonstrated that running training attenuates stress-induced hyperthermia. It is known that the neurons expressing vesicular glutamate transporter 3 (VGULT3) in a medullary raphe region including the rostral raphe pallidus and raphe magnus (rRPa/RMg) play a primary role in thermoregulatory functions. The present study was performed to determine whether voluntary running training attenuates stress-induced activation of VGULT3-expressing neurons in the rRPa/RMg of rats. Methods: Twelve Wistar male rats (6 weeks old) were randomly assigned to control (C, n=6) and voluntary running (WR, n=6) groups. WR group was allowed voluntary access to a running wheel. After 10 weeks of voluntary running training, the effect of 60 min exposure to restraint stress on body temperature was assessed in both groups using a telemetry system. Percentages of Fos-immunoreactive population in VGULT3-immunoreactive neurons in the rRPa/RMg of both groups exposed to stress were observed and used as a marker of activation of VGULT3-expressing neurons in the rRPa/RMg. Results and Discussion: Stress-induced hyperthermia in WR group was significantly attenuated compared with that in C group. The percentage of Fos-immunoreactive population in VGULT3-immunoreactive neurons in the rRPa/RMg was significantly lower in WR group than in C group, suggesting that voluntary running training attenuates stress-induced activation of VGULT3-expressing neurons in the rRPa/RMg. These results suggest that voluntary running training may attenuate stress-induced hyperthermia by modulating stress-induced activation of VGULT3-expressing neurons in the rRPa/RMg. Key words: stress-induced hyperthermia, exercise training, medullary raphe
Effects of exercise type performed under hypobaric hypoxic conditions on blood pressure and arterial stiffness

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Purpose: The present study aimed to examine the effect of exercise type performed under hypobaric hypoxic conditions on blood pressure and arterial stiffness.

Methods: Thirty-eight male healthy adults (24±3 yrs) were assigned to 4 groups. They had aquatic (AE) or cycling exercise (CE) at the intensity of around 50%V̇O₂max for 30 minutes/training session under normobaric normoxic (N) or hypobaric hypoxic conditions (H) corresponding to 2500m above sea level for consecutive 5 days. Before and after the training, systolic (SBP), diastolic (DBP) and mean blood pressure (MBP) were determined at rest and during cycling exercise at 50%V̇O₂max. Also, arterial stiffness was assessed by brachial-ankle pulse wave velocity (baPWV) and flow mediated vasodilation (FMD), respectively.

Results: After the consecutive 5 days training, no significant changes were observed in all measured values for N-AC, N-CE, and H-CE. Blood pressure at rest did not change significantly in H-AE, either. However, SBP and MBP during exercise decreased significantly after the training (P<0.05), furthermore, baPWV and FMD (%FMD) significantly decreased and increased (both P < 0.01) in H-AE, respectively.

Discussion: Our findings suggest that exercise under hypobaric hypoxia induces a decrease in blood pressure and arterial stiffness within a relatively short period more effectively than exercise under normoxia, and that the induced vascular adaptations might vary by the exercise type.

Keywords: aquatic exercise, cycling exercise, blood pressure, arterial stiffness

Response of venous outflow from head during cycling exercise at low intensity in women

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Purpose: The arterial inflow to the head increases during brief dynamic exercise at low intensity, which does not cause the elevation of core and skin temperature. The purpose of this study was to investigate whether the increase in the venous outflow from the head was also obtained in parallel with the change in the arterial inflow to the head during dynamic exercise at low intensity.

Methods: Nine female subjects participated in this study. After collection of baseline data for 5 min, each subject carried out dynamic cycling exercise at 30% of peak oxygen uptake for 5 min. Blood velocity and vessel diameter of superior vena cava and right and left subclavian veins were measured by ultrasound technique, and then blood flow was calculated from both parameters. In addition, the venous outflow from the head was defined as the difference of blood flow between superior vena cava and both subclavian veins.

Results and Discussion: During exercise, blood flow of superior vena cava was unchanged from baseline level, while blood flow of subclavian vein increased from baseline level. Thus, the venous outflow from the head decreased from baseline level during exercise. These results suggest that, during brief cycling exercise at low intensity, the venous outflow from the head decrease, and this response differs from the arterial inflow to the head.

Key Words: Cutaneous vascular conductance, Subclavian vein, Superior vena cava, Ultrasound technique
**Relation of cardiovascular fitness and physical activity to cardiovascular disease risk factor in middle-aged males**

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**Purpose:** Our aim was to determine whether current cardiovascular fitness or weekly physical activity was more important for lowering CVD risk factors regardless of ages in healthy Japanese men.

**Methods:** 338 men participated in our study. Most of them live in Toyota City. Weekly physical activity was measured by an accelerometer attached to the subject’s waist for one week. Meanwhile, to determine cardiovascular fitness, VO2 max was estimated by the sub-maximal cycle test. Major CVD risk factors included TG, TC, HDL-c, LDL-c, Apo A-I, Apo B, systolic blood pressures, and body fat content.

**Results and Discussion:** The relationship between cardiovascular fitness and physical activity were positively related in men with a high degree of significance. Conventional CVD risk factors, as well as their simple correlations with cardiovascular fitness and physical activity, were found. Most of the individual risk factors were more closely associated with cardiovascular fitness, than with physical activity in men after the data was age adjusted. The evidence indicated that the reduction of selected CVD risk factors are more closely linked to improved cardiovascular fitness than to physical activity in men.

**Key words:** Fitness, Physical activity, Cardiovascular disease (CVD), Lipoproteins, Apo lipoproteins.

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**Effects of amplitude and frequency of transvascular pressure on vasodilation in rat soleus feed arteries**

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**Purpose:** The purpose of this study was to evaluate the effect of amplitude and frequency of transvascular pressure on vasodilation in rat soleus feed artery.

**Methods:** Rat soleus feed arteries were isolated and mounted on micropipettes in a sealed chamber. Arteries were pressurized to 80 mmHg. External pressure (0 – 250 mmHg) was applied for 1 sec, and as a series of 1 to 10 repeated 1 sec pulses with 1 sec between pulses. Luminal diameter was measured using an inverted microscope.

**Results and Discussion:** The intact soleus feed arteries increased diameter by 5 to 25 % of control after 1 pulse of 250 mmHg external pressure. For the series of ten 1 sec 250 mmHg external pressure pulses, dilation began after the first pulse and continued until luminal diameter reached its maximum 28 % following the end of the 10th external pressure pulse. Graded increases in 1 sec of external pressure from 60 to 250 mmHg elicited significant increase in luminal diameter of soleus feed arteries. Increase in transvasculare pressure between 20 to 40 mmHg had no effects on dilation of feed arteries. After removal of the endothelium with air, these significant increased in luminal diameter during external pulse pressure was decreased significantly. These results show the vaso dilatation was elicited by 1 sec external pressure of 60 mmHg and the dilatation was endothelium dependent.

**Key Words:** rapid vasodilatation, transvascular pressure, endothelium-dependent and -independent vasodilatation, myogenic response
Effect of muscle metaboreflex on cardiac contractility following isometric handgrip exercise

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Purpose: The ratio of the first derivative (dP/dt) of a carotid artery pulse to the developed pressure (P), (dP/dt)/P, is an easily measurable, noninvasive index of cardiac contractility even in moderate exercise. We examined the effects of muscle metaboreflex on cardiac contractility following isometric handgrip exercise by using this index.

Methods: Eighteen healthy participants were subjected to isometric handgrip exercise, which was performed at 30 % of maximal voluntary contraction for 2 min, followed by relaxation or by arrested circulation of the forearm.

Results and Discussion: During isometric handgrip exercise, mean blood pressure (MBP), heart rate (HR), pulse wave velocity (PWV), augmentation index normalized to a heart rate of 75 rpm (AIx@75), and (dP/dt)/P increased maximally during 90-120 s period, and returned rapidly toward the control value after the end of exercise. While arterial occlusion of the exercising arm was performing at suprasystolic cuff pressure for 2 min immediately after the end of exercise, which maintains muscle metaboreflex, MBP, PWV, and AIx@75 sustained significant increases, but HR and (dP/dt)/P returned rapidly toward the control value. Moreover, Protocol x time interactions were detected for MBP, PWV, and AIx@75 (P <0.001), indicating a different time course of these measures, but were not detected for heart rate and (dP/dt)/P. These results suggest that muscle metaboreflex following isometric handgrip exercise does not influence cardiac contractility.

Key words: carotid artery pulse, dP/dt/P, forearm ischemia

The effects of compression garments on thermoregulatory response during exercise in the heat

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Purpose: This study examined the effects of wearing graduated compression tights (CG tights) on cutaneous vasodilatory and sweating responses to increasing core temperature during exercise in the heat.

Methods: Subjects performed cycle exercise at 60% of peak oxygen uptake in the heat (30°C, 50% relative humidity) for 45 min. In this study, the effect of wearing CG tights (CG trial) was compared with that of wearing non-compression tights (Con trial). During the experiments, esophageal temperature (Tes), forearm vasculature conductance (FVC) and chest sweat rate were measured continuously.

Results and Discussion: To estimate the relationship between core temperature and thermoregulatory responses, FVC and sweat rate were plotted against Tes. The Tes threshold for vasodilation did not differ between the two trials, but the sensitivity (the slope of Tes-FVC relation) and the peak value of FVC were significantly higher in the CG trial than in the Con trial. Sweating response to increasing core temperature did not differ significantly between the trials. These results suggest that wearing CG tights enhances cutaneous vasodilatory response to increasing core temperature during exercise in the heat.

Key words: Compression garments; Hyperthermia; Thermoregulation; Exercise in the heat
**P-07** Changes of heart rate, parasympathetic nervous system and urinary electrolyte during walking in water

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**Purpose:** It is well known that the circulatory system is affected by physical characterization of water. Previous studies demonstrated that increase of venous return by physical characteristics of water caused decrease of heart rate. The purpose of this study was to investigate the relevancy to heart rate, parasympathetic nervous system and urinary electrolyte during walking in water.

**Method:** Seven Japanese healthy men were participated in this study; age: 22±1 yrs, height: 171±7cm, body weight: 67±5 kg. They walked one hour at their discretion of walking speed in swimming pool. Heart rate, parasympathetic nervous system and urinary electrolyte were measured at rest, in exercise and after exercise. The water level was waist and water temperature was thirty degree Celsius.

**Results and Discussion:** Urinary volume was 49±18.0ml (at rest), 85±38.6ml (in exercise) and 66±27.6ml (after exercise). These decreases were statistically significant (p<0.05). Heart rate of mean value was 94±17 bpm. The walking speed was 2.1±0.4 Km/h. Distance of walking was 2,100±359 m. The concentration of magnesium and calcium was significantly decreased after exercise (p<0.05). The parasympathetic nervous activities (lnHF) were 5.9±1.3 at rest and 6.3±1.7 after exercise. These data suggest that walking in water is reduced of the cardiovascular load.

**Key words:** heart rate, parasympathetic nervous system, urinary electrolyte, walking in water

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**P-08** The effect of lactate beverage in the changes of blood lactate concentration during a constant load exercise

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**Purpose:** This study was to investigate the changes of blood glucose and lactate concentration during a constant load exercise corresponding to lactate threshold (LT). In addition, we examined the effect of lactate beverage ingestion prior to exercise on blood lactate concentration.

**Method:** The subjects were collegiate soccer players. Firstly, graded load exercise test was conducted using bicycle ergometer. Secondly, subjects performed constant load exercise corresponding to LT calculated from the first exercise for 30 minutes. This exercise test was performed twice. Once with ingestion of lactate beverage (intake group), the other is exercising with ingestion of beverage water (control group).

**Result and Discussion:** Blood lactate concentration during exercise was significantly decreased in the intake group compared with the control group. However, blood glucose concentration during exercise did not show significant difference between the two groups. From these results, there is a possibility that the exogenous lactate could save the energy supply from the glycolytic pathway.

**Key Words:** blood lactate concentration, blood glucose concentration, lactate beverage.
Serum interleukin-6 responses to the two 400-meter swimming in recreational college swimmers

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Purpose: The aim of this study was to investigate the effect of the two 400-m swimming on serum IL-6 levels.

Methods: Eight male swimmers completed the two 400-m swimming, at interval of 1 hour, in the free-style stroke. Blood samples were collected before, immediately after, and 30 min after swimming, on the first and second swimming, respectively.

Results and Discussion: Blood lactate concentration elevated to about 4 mmol/l after each swimming. After the first swimming, serum IL-6 increased about 1.5-fold, (1.205±0.756 to 1.852±0.603 pg/ml, p<0.05), in the second swimming, serum IL-6 also increased about 1.5-fold, (1.289±0.689 to 1.952±1.439 pg/ml, NS). These results suggest that a brief swimming (5 to 6 min) at the exercise intensity to the onset of blood lactate accumulation (4 mmol/l) may increase serum IL-6 1.5-fold. Although the increase in IL-6 in the circulation may be digested and absorbed enough in 30min. And we speculate that blood glycogenic amino acid was more oxidized than the other amino acid.

Key Words: Interleukin-6, the onset of lactate accumulation, 400-m swimming
Effect of endurance exercise training on serum sex-hormones levels in obese adult men

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Purpose: It has been reported that obesity influences to blood sex hormone levels in men. The aim of the present study was to examine whether endurance exercise training has beneficial effects on blood sex hormones levels in obese men.

Methods: The effect of a 12-week endurance exercise training with the intensity equivalent to 70-85% max heart rate of each subject on serum DHEA-S, testosterone, and estradiol concentrations in 19 adult obese men (46.2±10.8 years).

Results and Discussion: The serum testosterone level at baseline was lower than the mean value in healthy men. The serum total testosterone concentration increased significantly by the exercise training. However, neither the serum DHEA-S concentration nor that in estradiol changed significantly by the exercise training. In conclusion, the 12-week moderate-intensity endurance exercise training improves lowered serum testosterone level in obese adult men.

Key Words: testosterone, obese men, endurance training

Effect of amino acid supplement on fat oxidation during submaximal endurance exercise

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Purpose: This study examined the effect of oral amino acid supplement (AAS) ingestion on fat oxidation during submaximal ergometer bicycle endurance exercise.

Methods: Ten young healthy males (age: 20 +/- 0.9 yr) performed submaximal endurance ergometer bicycle exercise with loads corresponding to anaerobic threshold (AT) (56.5 +/- 11.3% of peak oxygen uptake) for 60 min. They drank either a 380 ml supplement containing amino acids or a lemon-flavored placebo at 60 min before starting exercise in a double-blind design. Subjects were instructed to maintain 60 rpm for pedaling revolutions. Expired gas was collected by breath-by-breath method for calculating oxygen uptake and carbon dioxide emission and used for calculating the amount of fat oxidation by Frayn (1983)’s method. Wash-out period was set over a 1-wk.

Results and Discussion: Fat oxidation increased with exercise time during submaximal endurance exercise for 60 min in both conditions. A mount of fat oxidation during exercise was significantly greater in AAS condition than that in P condition (t = 2.03, p = 0.037). In conclusion, oral AAS ingestion before exercise may be useful for enhancing fat oxidation during exercise.
Does voluntary wheel-running increase endurance capacity in a rat model of heart failure?

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Purpose: The aim of this study was to examine whether voluntary wheel-running exercise increase endurance capacity in a rat heart failure model. Methods: One-month-old male Wistar rats underwent an aortic-banding operation. Blood pressures and voluntary wheel-running distance for 10 days were measured 2, 4, 6, 9, 12 and 18 months after the operation. Moreover, endurance capacity, evaluated by increment in blood lactate just after treadmill exercise, was examined before and after the 3 week-voluntary exercise, 18 months after the operation. Results and Discussion: In aortic-banding (Band) and sham-operation (Sham) groups, voluntary wheel-running distance for 10 days was gradually decreased as the rats aged. There was no difference in this running distance between both groups throughout the experimental period. Systolic/diastolic blood pressures in “Band” were gradually decreased 6 months later, and were significantly lower than those in “Sham” 6-18 months after the operation. Eighteen month later, endurance capacity was significantly lower in “Band” than in “Sham”. However, endurance capacity in both groups could be enhanced by the 3 week-voluntary exercise. To conclude, these results suggest that daily light exercise such as walking is a potential strategy for improving endurance capacity in patients with heart failure.
P-15  Weighting adjustment and timing control of load balance among upper and lower limbs in a lateral body weight-shifting task

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**Purpose:** This study examined the characteristics of weighting adjustment of load balance and its timing control among the upper and lower limbs in a lateral body weight-shifting task, which is usually used in rehabilitation. To this end, we measured the respective weighted loads on the 4 limbs, likely inter-limb coordination, and the weighting timing of the 4 limbs.

**Methods:** Twenty-three healthy participants performed a 3-sec lateral body weight-shifting task under 4 conditions: 2 target amounts (one- and two-third of the body weight) in 2 weight-shifting directions (left and right). They were allowed to use light touch support with their upper limbs placed on a pair of horizontal parallel bars. Adjustments of loads in inter-limb coordination were analyzed in terms of inter-limb correlation coefficients and then the relationships between the accuracy (constant errors) of load adjustments on the target lower limb. The timing of load adjustments among the 4 limbs was also analyzed by a 3-way ANOVA.

**Results and Discussion:** Our results showed that the inter-limb coordination may impede the adjustment accuracy of target load balance between the 2 lower limbs, although this was the case for the leftward shifting condition alone. Our results also showed that the light touch support by the upper limbs often occurred initially in the opposite side of the target lower limb, suggesting that the upper limb opposite to the target lower limb may be initially used in adjusting load balance between the 2 lower limbs.

**Key Words:** inter-limb coordination, timing, a lateral body weight-shifting task

P-16  Effect of Low Intensity Exercise on Metabolic Activity of Skeletal Muscle in Type II Diabetic Rats

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**Purpose:** The purpose of the present study was to investigate the effects of low intensity exercise on the metabolic activity in diabetic rats skeletal muscles.

**Methods:** Eleven-week-old male Spontaneously Diabetic Torii rats were used as type 2 diabetic animal (DB) and age-matched male Sprague-Dawley rats were used as non-diabetic animal (SD). All rats were assigned to non-exercise and exercise groups. The rats in exercise groups (SDEx and DBEx) ran on treadmill for 1 h a day, 5 times a week.

**Results and Discussion:** At 25 weeks of age, glucose and HbA1c levels were significantly higher in the DB group than in the SD group. In contrast, these levels were significantly lower in the DBEx group than in the DB group. For the cross sectional area and SDH activity of the muscle fiber in the gastrocnemius muscle, although the values in the DB group were significantly lower than those in the SD group, the values in the DBEx group were significantly higher than those in the DB group. These results suggested that the aerobic exercise could counteract the possible changes that appeared in skeletal muscle of type 2 diabetic.

**Key words:** type II diabetes, skeletal muscle, low intensity exercise
Effects of heat stress on collagen deposition in regenerating skeletal muscle

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Purpose: It has been reported that delay in muscle regeneration involved in redundant collagen synthesis. Heat stress can promote rapid and accurate skeletal muscle regeneration. We examined effects of heat stress on collagen deposition during muscle regeneration.

Methods: Male Wistar rats were randomly divided into non-heat and heat groups after crush injury for extensor digitorum longus muscle (EDL). In the heat group, hot packs (42°C) were applied immediately after injury, and continued for 20 min. The EDL were dissected 2 and 4 weeks after injury and sectioned on cryostat. These sections stained with HE and Elastica-van Gieson stains. Next, these sections were investigated for ratio of regenerating fibers with central nucleus, cross-sectional area (CSA) of the muscle fibers and ratio of collagen fiber area.

Results and Discussion: In the heat group at 2 and 4 weeks after injury, the ratio of regenerating fibers with central nucleus was lower and CSA of the muscle fibers was clearly larger than control. These results indicate heat stress could have promoted muscle regeneration and acquisition of larger CSA of the muscle fibers. In the heat group at 4 weeks after injury, the ratio of collagen fiber area was clearly low. This result indicates heat stress could have prevented collagen deposition. The results suggest that heat stress accelerate acquisition of the larger muscle fibers via promoting muscle regeneration, resulting in prevention of redundant collagen deposition.

Key words: heat stress, regeneration, skeletal muscle

Fundamental study concerning evaluation of muscle viscoelasticity using ultrasound velocity

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Purpose: It is known that ultrasound velocity depends on viscoelasticity of the tissue. Several studies have used this principle to confirm that ultrasound velocity in normal and abnormal tissues. However, there have been few reports on the application of this method to sports medicine. The purpose of this experiment was to carry out basic measurements on the difference in ultrasound velocity in muscles, tendon, and bone.

Methods: The subjects were nine healthy male university students. Ultrasound velocity of each tissues measured using ultrasonograph with correction of sound velocity (FAZON-M Fujifilm). In muscle tissues, we measured ultrasound velocity with the probe placed parallel (0 degrees), oblique angle (45 degrees), and perpendicular (90 degrees) to muscle fiber orientation.

Results and Discussion: Ultrasound velocity of each tissue was 1641.5 ± 10.4 m/s in the tibial bone, 1622.9 ± 13.5 m/s in the Achilles tendon, 1590.5 ± 12.5 m/s in the gastrocnemius medial head, and 1584.8 ± 9.7 m/s in the soleus. In the gastrocnemius medial head, ultrasound velocity was 1593.2 ± 9.6 m/s for parallel, 1588.1 ± 10.6 m/s for oblique angle, 1585.1 ± 12.7 m/s for perpendicular to muscle fiber orientation. These results suggest that ultrasound velocity depends on the angle of the probe relative to muscle fiber orientation, and that viscoelasticity of individual muscles can be quantified from ultrasound velocity.

Key Words: muscle viscoelasticity, ultrasound velocity, muscle fiber orientation, correction of sound velocity
The responses of myostatin, follistatin, and satellite cell in rat skeletal muscle during compensatory hypertrophy
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Purpose: It is well known that myostatin (MSTN), a negative regulator of muscle growth, functions to inhibit satellite cell activity. Meanwhile, follistatin (FLST) is known to antagonize the function of myostatin. However, conflicting results have been reported among studies on the alteration of MSTN and FLST by exercise. The present study was performed to assess the responses of MSTN, FLST and satellite cell in overloaded (hypertrophied) plantaris muscles. Methods: Wistar strain male rats (8-week-old) underwent unilateral surgical ablation of the gastrocnemius muscle (FO) while the contralateral hindlimb was used as an internal control (Con). After 1 and 2 weeks, plantaris muscles were removed, weighted rapidly frozen in liquid nitrogen. The expressions of MSTN and FLST were assessed by Western blotting. Satellite cells were identified by Pax7 immunostaining.

Results & Discussion: Plantaris muscle mass and plantaris muscle weight-to-body weight ratio increased at any observed point after the imposition of overload. Although there were no significant differences in overloaded period, MSTN expression in FO muscles was significantly lower than that in Con muscles. The percentage of Pax7-positive nuclei in FO muscles was significantly greater compared with Con muscles. However, the FLST levels showed no significant difference in any experimental period. Our findings indicate that inhibition of MSTN due to other MSTN binding proteins besides FLST contribute to the hypertrophic response to muscle overload by regulating satellite cells.

Key Words: Myostatin, Follistatin, Hypertrophy

Satellite cells distribution along muscle fiber during development in rats
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Purpose: Satellite cells (SCs) are muscle stem cells capable of increasing myonuclear numbers according to muscle fiber hypertrophy and elongation during postnatal development. To investigate the distribution properties of SCs within muscle fibers, histochemical staining was performed in longitudinal sections of rat muscles.

Methods: Diaphragm, Soleus and Extensor digitorum longus (EDL) muscles were taken from 1, 2 and 3 week-old wistar male rats (18-60g), and then fiber type composition and cross-sectional area were measured in transverse section. In longitudinal sections of muscles, numbers of myonuclei and SCs/100 um muscle fiber length were determined by immunohistochemical procedure. Furthermore, relative expressions of mRNAs of Pax7, MyoD, hepatocyte growth factor (HGF) in each muscle were measured by real time RT-PCR systems.

Results and Discussion: The numbers of myonuclei tended to be higher in tendon-muscle and neuromuscular regions, while the numbers of SCs were not significantly different among all regions. Although no changes were found in the numbers of myonuclei, the number of SCs was significantly decreased with development. Furthermore, the relative expression in mRNAs of Pax7, HGF, MyoD were decreased with development. These findings indicate that SC was remarkably activated in the tendon-muscle region, and the activation was decreased with postnatal development in all muscles.

Key words: Satellite cell, Pax7, development
**Purpose:** The purposes of the present study were: 1) to investigate the acute psychophysiological effects of walking; and 2) to assess global executive functions in healthy elderly adults before and after walking.

**Methods:** Twenty (10 women, 10 men) healthy older adults (70.50 ± 3.3 years) were participated in this study. Salivary alpha-amylase (sAA) activity was measured before and after walking using a hand-held monitor (Nipro Co., Japan). Mood states were measured immediately before and after walking using 30-item Profile of Mood States (POMS)-Short Form. Participants were asked to respond as to how they felt “right now”. Wisconsin Card Sorting Test (WCST) was also performed before and after walking to assess executive functions.

**Results and Discussion:** “Tension-anxiety”, “anger-hostility” and “confusion” scores significantly improved after walking compared to those before walking. The changes in sAA activity before and after walking correlated positively with the differences in the number of total errors (TE) \((r=0.498, p<0.05)\) and perseverative errors of Nelson (PEN) \((r=0.591, p<0.01)\), respectively. In short, it is suggested that walking can improve mood, however, too much increase of sAA levels after walking may cause the decline of executive functions in elderly people.

**Key Words:** salivary alpha-amylase (sAA), perseverative errors, POMS, WCST
Does the strenuous exercise affect selectively brain function?

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Purpose: Many previous studies reported that strenuous exercise impaired brain function. However, it is unclear that the negative effects of strenuous exercise on brain function occur at general or specific brain function. Therefore, this study investigated the effects of strenuous exercise on interference control, which was one of higher brain function, using modified flanker task.

Methods: Undergraduate and graduate students (n = 9, age range: 18-23) participated in the study. This study consisted of control condition without cycle exercise and exercise condition. The two conditions were randomly conducted on a different day. In control condition, each participant carried out a modified flanker task. In exercise condition, they performed same cognitive task as those in the control condition immediately after exhaustive exercise. The modified flanker task consisted of five arrowheads. The target arrowhead was surrounded by flanker arrowhead that either pointed in the same direction (incongruent stimulus: <<<<< or >>>>>> or the opposite direction (<<<<<< or >>><>). Experimental trials consisted of 60 congruent and 60 incongruent stimuli with left and right target arrowheads occurring with equal probability. The participants were instructed to press a button with their thumbs as quickly as possible corresponding to the direction of the centrally presented target arrowhead.

Results and Discussion: We will present our research results at this conference.
Changing in event-related potentials and reaction time of female long-distance runners following various durations of acute exercise

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**Purpose:** To investigate the effects of acute exercise on cognitive processing in the CNS, some recent studies have focused on the P3 of event-related brainpotentials (ERP). The exercise duration In this study, the influence of exercise duration on the P300 component of the ERPs and Reaction time were investigated.

**Methods:** Nine healthy female long-distance runners, 19-22 years of age, participated in the experiment. They performed an auditory oddball task in a control condition, and again after 10, 30, and 60 minutes of pedaling exercise. The exercise intensity in all conditions was 55%HRmax. The EEG was recorded from Fz, Cz, Pz, C3, C4 with cap electrodes according to the International 10-20 system.

**Results and Discussion:** The P300 amplitude increased significantly after 30 min of the exercise (30 min condition) compared to the control condition, 10 min condition and 60 min condition. However, the P300 latency and reaction time were not significantly different among the four conditions. The results suggested the moderate exercise initially facilitates cognitive process due to change in arousal level; however, the facilitative effects of exercise may be cancelled by the prolonged exercise. In conclusion, the findings of this study suggest that differences in exercise duration have different influences on cognitive processes.

Intensity-specific activities of serotonin neurons in raphe nucleus and CRF neurons in paraventricular nucleus are related to feeding behavior in rats.

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**Purpose:** Our goal in this study was to examine the effect of different intensity of exercise on feeding behavior and related neural activities in rats.

**Methods:** We exposed 8w-old male rats to treadmill running for 30 min in different exercise intensities (0, 15, 25 m/min). Following the exercise, rats had ad libitum access to normal pellet. Food consumption was measured 1h, 2h, 24h after exercise. To examine the neuronal activity induced by exercise using immunohistochemistry, brains were removed 90min after the exercise.

**Results:** 1h and 2h after exercise, the rats which were exposed either to high or low intensity of exercise consumed significantly less amount of food compared to the group without experience of exercise. No difference of food consumption was seen among three groups 24h after the exercise. Low-intensity group showed significantly increased expression of c-Fos in 5-HT neurons in raphe nucleus compared to other two groups. Significantly higher expression of c-Fos in CRF neurons in paraventricular nucleus compared to the group without exercise was seen only in the group of high-intensity exercise.

**Discussion:** Although both low-intensity and high-intensity exercise temporary inhibit feeding behavior, it seems that different mechanisms are recruited to inhibit feeding behavior when different intensities of exercise was experienced, considering the fact that distinct neural activities were seen in different intensity of exercise.
The effect of muscle relaxation task on movement-related cortical potential

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Purpose: Activities in our daily life is a series of voluntary movement, the muscle relaxation as well as muscle contraction has an important role in execution of complex movement. We examined the effects of a muscle relaxation task on the brain activities by comparing the movement-related cortical potential (MRCP) the dominant and non-dominant hands.

Methods: Nine healthy right-handed volunteers participated in this study. EEG activity was recorded with Ag/AgCl electrodes at Fz, FCz, Cz, C3, C4, and Pz. The subject maintained 30\%MVC for at least 5 sec before relaxation movement. Subjects performed 120 trials for each task. To obtain the MRCP, the EEG was averaged during the period from 2000 ms before to 500 ms after the EMG onset.

Results: The MRCP onset time in the non-dominant handgrip task occurred earlier than that in the dominant handgrip task. This difference in MRCP latency suggests that the non-dominant hand required earlier preparation for executing movement than the dominant hand.

Keywords: movement-related cortical potentials (MRCPs), voluntary muscle relaxation, dominant, non-dominant

The association of childhood obesity and cognitive flexibility

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Purpose: The global epidemic of childhood obesity has become a major public health concern. Yet, evidence regarding the association between childhood obesity and cognitive health has remained scarce. This study aimed to examine the association between childhood obesity and cognitive flexibility.

Methods: Preadolescent children between 7 and 9 years performed compatible and incompatible stimulus-response conditions of a modified flanker task. Data were analyzed with multiple regression analysis, controlling for confounding variables.

Results and Discussion: Analyses revealed that BMI was negatively associated with executive control, as children with higher BMI exhibited longer reaction time for the incompatible condition requiring extensive amounts of cognitive flexibility. By contrast, no relation of BMI to performance was observed for the compatible condition requiring smaller amounts of executive control. These data suggest that childhood obesity is negatively and selectively associated with executive control in preadolescent children. Given that executive control has become a major public health concern, the present study provides an empirical basis for the negative relationship between childhood obesity and scholastic performance.

Key Words: childhood obesity, cognitive flexibility, cognitive health
Effects of lifestyle intervention using an activity monitor and Twitter on steps and physical activity
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Purpose: This study aimed to examine the effects of intervention using an activity monitor and Twitter on daily physical activity. Methods: Twenty-one healthy men and women (37 ± 13 yrs) were matched for physical characteristics into two groups, and then randomized to Normal intervention group (N, n = 11) and Twitter intervention group (T, n = 10). In both groups, the intervention period was 6 weeks. The subjects in the N wore only an activity monitor (Lifecorder EX). Meanwhile, the subjects in the T were asked to tweet about their daily steps or physical activity in addition to wearing an activity monitor, and also an observer read through each subject’s tweet and commented about lifestyle or physical activity. Results: Daily steps were significantly higher in the T than in the N (T 11305 ± 2061 vs. N 9152 ± 2329 steps/day, P < 0.01). Amount of physical activity (i.e., daily total METs · hour = Ex/day) at the intensity of 3 METs or more was also significantly higher in the T than in the N (T 3.7 ± 1.1 vs. N 2.4 ± 0.8 Ex/day, P < 0.01). In addition, throughout the intervention period, no significant change of steps was observed in the N (from week 1 8975 ± 2868 steps/day to week 6 9009 ± 3070 steps/day). In contrast, steps in the T were gradually increased from week 1 8542 ± 3158 steps/day to week 6 12700 ± 3935 steps/day (P < 0.01).

Discussion: These findings indicate that the lifestyle intervention using an activity monitor and Twitter could effectively induce an increase in daily physical activity compared with normal intervention.

Key words: lifestyle intervention, Lifecorder EX, Twitter, Social networking service, Internet

Effects of a combined treatment with exercise and antihypertensive drugs on blood pressure and morphological findings of the kidney in obese rats
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Purpose: The present study was conducted to examine the effects of combined treatment with exercise and antihypertensive drugs on blood pressure (BP), body weight (BW), blood lipids, urinary albumin (Alb) excretion, and morphological findings of the kidney in OLETF rats complicated with hypertension. Angiotensin converting enzyme (ACE) inhibitor, captopril (Capt), and calcium antagonist, azelnidipine (Azel), were used as antihypertensive drugs. Method: Male OLETF rats were assigned to the OLETF-Sed, -Ex, OLETF-Capt, c-Ex & Capt, OLETF-Azel, and -Ex & Azel groups. Exercise treatment was administered using a rotatory wheel. The rats underwent each treatment for 10 weeks from 21 to 30 weeks of age. OGTT was performed in the morning after 1-night fast before and directly after the 10-week treatment. The animals were sacrificed by bloodletting under anesthesia within 1 week after the completion of post-treatment OGTT. Result and Discussion: The -Ex group showed no hypotensive effects, and showed development of diabetic nephropathy. On the contrary, both OLETF-Capt and OLETF-Azel groups had a protective effect on the kidney; moreover, the combination treatment exercise and antihypertensive drugs enhanced the improvement of glucose-fatty metabolism without development of nephropathy.

Key words: antihypertensive drugs, urinary albumin, captopril, calcium antagonist, diabetic nephropathy
Characteristics of old adults' self-estimation of their own mobility in a TUG (timed up & go) test

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Purpose: This study examined the accuracy and characteristics of old adults' self-estimation of their own mobility. To this end, we measured old adults' self-estimation as well as actual performance of the TUG (timed up & go) test, in which participants were asked to stand up from a chair, walking to turn around a 3-m distant marker, and to then return to and sit on the chair as fast as possible.

Methods: Participants were 213 old adults. The participants were first asked to estimate the assumed time (estimated time; ET) elapsing to complete a trial of TUG test using by stopwatch and then performed an actual trial of TUG test (actual time; AT). This was performed twice and both the ET and AT were measured.

Results: A some 70 % of participants showed shorter ETs than ATs, indicating over-estimation of TUG mobility. The over-estimation group showed a significantly shorter mean ET than that of the under-estimation group, with no significant differences appearing in AT and age between the over- and under-estimation groups. Furthermore, the older adults who expressed a lack of confidence in their own ability tended to overestimate (shorter ETs) more than did confident old adults.

Discussion: Our results suggested that older adults tended to have dissociation (over-estimation) between self-estimation and actual physical ability in mobility.

Keywords: Older adults, self-estimation of mobility, TUG test

The study of the velocity and the accuracy in experienced kendo practitioner's attack.

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In kendo, it is very important to digest the countless sensory information within an extremely short period of time before discharging the attack. So far a lot of studies conducted on kendo have been on historical researches or coaching methodologies. In addition, researches from an exercise physiological point view, such as adapting reaction task and MCV (motor nerve conduction velocity) of experienced kendo practioners, have already been reported in great detail. The findings of these studies show that perhaps the faster reaction process of the brain and MCV of experienced kendo practioners are the results of years of training. However, until now, these researches used experimental task and methodologies, that are far apart from an actual situation in kendo. Only few investigations have been conducted on the accuracy of the attack or on information processing in the central nervous system from the time one is faced with an opponent to the moment of the attack. Therefore, the purpose of this study is to clarify the velocity of the attack and its accuracy. The experiment will also look at the neurological state before the attack. The subjects of the experiment will be experienced kendo practioners with 13 years(±2) of experience and regular people.

Keywords: kendo, velocity, accuracy
The effect of morning and evening exercises on blood pressure and heart rate variability during night sleep.

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Purpose: The purpose of this study was to examine blood pressure and cardiac autonomic activity responses during night sleep to exercise in the morning and evening. Methods: The subjects were nine normotensive healthy male students. They performed a treadmill running at 60% of maximal oxygen consumption for 30 min from 8:00 (ExAm) and 16:00 (ExPm), respectively. Throughout the night sleep on the exercise day, the blood pressure was measured every hour, and the heart rate was measured beat by beat, followed by frequency domain analysis for estimating the cardiac autonomic activity. A no-exercise experiment was also performed for comparison.

Results and Discussion: The averaged systolic blood pressure during night sleep was not significantly different among all three conditions. The averaged diastolic blood pressure during night sleep had a tendency to be lower in ExAm than Cont; on the other hand, it was significantly higher in ExPm than Cont (p<0.05). The heart rate variability measures suggested a predominance of sympathetic activity in ExAm compared with Cont. Such a change in the cardiac autonomic balance was not related to the blood pressure response. These results suggest that the effect of exercise on the blood pressure response during night sleep depends on the time of day that the exercise is performed, irrespective of the cardiac autonomic activity.

Key Words: endurance exercise, night sleep, blood pressure, heart rate variability