Is balance ability in college alpine skier reflected for competition levels?
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[Aims] Paillard and Noe (2006) showed that national-level soccer players demonstrated better balance ability than regional-level players. On the other hand, Noe and Paillard (2005) also showed that national-level alpine skiers displayed static balance ability inferior to that of the regional-level alpine skiers. Thus, the relationship between balance ability and competition levels is less clear. Therefore, the purpose of the present study was to investigate that the balance ability in college alpine skier related to competition levels. [Methods] Twenty male college skiers maintained quiet standing by both feet in upright position on a force platform with eyes opened and closed and while wearing or not wearing their ski boots. The root mean square (RMS) area and mean velocity of centre of pressure (COP) were calculated to assess the balance ability in each condition. The subjects were divided into the top group (n = 6) and sub group (n = 6) by the International Ski Federation points in Slalom.

[Results] Top and sub group had similar static balance ability for COP RMS area and COP velocity. Therefore, further research is needed to clarify the relationship between competition levels and dynamic balance ability in alpine skiers. [Conclusions] These results suggest that the balance ability such as COP RMS area and velocity in college alpine skier does not always reflect on the competition levels.

Keywords : alpine skiing, static balance ability, competition levels

Effect on the Gait during Subtraction Works on the Display of Mobile Device
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Objective: Walking while staring down at a smartphone has become a troubling pedestrian habit, even in Japan where it's called arukisumaho. Recently, serious accidents from walking while using smartphone were increased rapidly in Japan. The purpose of this study was to investigate the effects of the pedestrian performances during walking with subtraction works on a mobile device display.

Methods: Twelve healthy young women were participated in this study. We were asked all participations to walk twice the roundtrip of the straight path of 5m. The walking tasks consists of 3 sessions. First was walking with no task(control). Second session was walking and scrolling the subtraction works on a mobile device display(DP), then they have answered orally. Third session was walking and making a solution orally to the subtraction works during walking with subtraction works on a mobile device display.

Results and conclusions: Acceleration of DP was higher than the sagittal component, longitudinal component, right and left component in the control. The AWWL scores both control and DP were 13.9±2.3 and 41.4±5.9, respectively. Our data suggested that concentrating on display hinder to direct attention to feet and surroundings and it makes step width and step length are irregular. These results indicated that walking on scrolling display was required more attention compared with normal walking.

Keywords : display, subtraction works, gait

The Effect of Marathon on foot arch and toe flexor strength
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[Aims] Impact force on foot at the contact phase of running is known to be correspond to about three times of body weight. In addition, the more the running distance like marathon running, the impulse for foot is thought to be the more. Improvement of running form and/or attenuation of force by shoes may be thought to decrease these impact force and impulse. In addition, foot arch has also contributed to absorb impact forces during running. Foot arch is reported to be support by plantar intrinsic foot muscles and not be able to keep after fatigue of plantar intrinsic foot muscles. Speaking of plantar intrinsic foot muscles, toe flexor strength(TFS) also known as a function of plantar intrinsic foot muscles. Therefore, we hypothesis that decline in TFS and arch height had occurred as a result of fatigue in intrinsic foot muscle after marathon running. So, the aim of present study was to identify foot arch height and TFS after marathon running.

[Methods] Subjects were 9 healthy males who participated in a marathon event. Before and immediately after marathon running, TFS and foot morphological characteristic parameters (foot length, truncated foot length, dorsal height of 50% foot length (DORS), and navicular height (NAV)) were measured.

[Results] As a result of marathon running, not only TFS, but DORS in both sitting and standing condition were significantly decreased. On the other hand, no significant decrease in NAV were observed. [Conclusions] No significant decrease was observed in NAV after marathon, though significant decrease in TFS and DORS in both sitting and standing condition were significantly decreased.

Keywords : Foot arch, Toe flexor strength, Marathon

Heritability estimates of muscle strength-related phenotypes
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The purpose of the present study was to clarify the heritability estimates of human muscle strength-related phenotypes (H2-msp). A systematic literature search was conducted using PubMed (through Aug 22, 2016). Studies reporting the H2-msp for healthy subjects in a sedentary state were included. Random-effects models were used to calculate the weighted mean heritability estimates. Moreover, subgroup analyses were performed based on phenotypic categories (e.g., grip strength, isometric strength, jumping ability). Sensitivity analyses were also conducted to investigate potential sources of heterogeneity of H2-msp, which included age and sex. Twenty-four articles including 58 measurements were included in the meta-analysis. The weighted mean H2-msp for all 58 measurements was 0.52 [95% confidence intervals (CI): 0.48, 0.56], with high heterogeneity (I² = 91.0%, p < 0.001). Subgroup analysis showed that the heritability of isometric grip strength, other isometric strength, isometric strength, isokinetic strength, jumping ability, and other power measurements was 0.56 (95% CI: 0.46, 0.67), 0.49 (0.47, 0.52), 0.49 (0.32, 0.67), 0.49 (0.37, 0.61), 0.55 (0.45, 0.65), and 0.51 (0.31, 0.70), respectively. The H2-msp decreased with age (p < 0.05).

In conclusion, our results indicate that the influence of genetic and environmental factors on muscle strength-related phenotypes is comparable. Moreover, the role of environmental factors increased with age. These findings may contribute towards an understanding of muscle strength-related phenotypes.

Keywords : Heredity, Muscle strength, Meta-analysis
525. **Association between bone mineral density and vitamin D receptor Fok1 polymorphism in female athletes**

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The osteoporosis is one of the problems for health in female populations and athletes. Previous studies have shown that vitamin D receptor (VDR) Fok1 polymorphism is associated with osteoporosis in general populations but not in female athletes. [Aims] The aim of this study was to investigate the association between VDR Fok1 polymorphism and bone mineral density (BMD) in female athlete. [Methods] In present study, 187 female athletes volunteered to participate. BMD of the whole body and lumbar spine (L2–L4), femoral neck was measured by using a Lunar iDxa dual-energy X-ray absorptiometer. The VDR Fok1 polymorphism (rs228570) was performed by the TqMan SNP Genotyping Assay. [Results] The frequencies of the Fok1 genotypes in FF, Ff, ff were 44.9%, 41.7%, 13.4%. No significantly differences were observed in BMD of whole body, lumbar spine and femoral neck among Fok1 genotype groups. There was the tendency that f allele is associated with stress fracture develop using logistic-regression analysis (odds ratio; 1.63, 95% confidence interval; 0.97 to 2.72, P=0.06). [Conclusions] There was no association between BMD and the VDR Fok1 polymorphism in the female athlete. The f allele of VDR Fok1 polymorphism may be associated with the stress fracture.

**Keywords**: osteoporosis, stress fracture, women

526. **The relationship between COL5A1 BstUI polymorphism and physical flexibility and arterial stiffness**

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[Aims] COL5A1 plays an important role in configuration of other abundant fibrillar collagens supporting many tissues in the tendons, ligaments, muscles and/or blood vessels. The purpose of present study was to investigate the association between COL5A1 BstUI polymorphism and physical flexibility and arterial stiffness in sedentary population. [Methods] The participants (age: 20-80 years, 140 male and 292 female) in this study were 432 healthy men and women who were not actively involved in regular physical exercise. Genotyping for the COL5A1 BstUI polymorphism (rs12722) was performed by using a TaqMan SNP genotyping assay (Applied Biosystems). All participants were divided into 3 groups based on their age (20-39 years, 40-59 years and ≥60 years) and performed sit and reach test and brachial-ankle pulse wave velocity (baPWV), an index of systemic arterial stiffness. [Results] There was no significant difference between sit and reach test and genotype models (CC vs. CT+TT) in each age group. In 40-59 years, CT and TT group has higher baPWV than CC group. [Conclusions] Our results suggested that T allele in COL5A1 BstUI genotype is associated with arterial stiffness in sedentary population but only in 40-59 years.

**Keywords**: COL5A1, sit and reach, arterial stiffness

527. **Association between uncoupling protein (UCP) gene polymorphism and fat mass in judo athletes**

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[Aims] Previous studies have reported that uncoupling protein (UCP) gene polymorphism is associated with obesity and body mass index (BMI). UCP plays a key role in the thermogenic function and influences the resting energy expenditure. Considering the high difference in individual body fat percentage in judo athletes, it is suggested that a genetic factor is associated with fat mass. The purpose of this study was to investigate the association between UCP gene polymorphisms and body composition of judo athletes. [Methods] The study included 102 male judo athletes from a top-level university in Japan. They were classified into three groups on their age (20-39 years, 40-59 years and ≥60 years) and performed sit and reach test and brachial-ankle pulse wave velocity (baPWV), an index of systemic arterial stiffness. [Results] There was no association between BMD and the VDR Fok1 polymorphism in the female athlete. The f allele of VDR Fok1 polymorphism may be associated with the stress fracture.

**Keywords**: osteoporosis, stress fracture, women

528. **Changes in junior athletes’ athletic ability, and relationship with genetic polymorphism**

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[Aims] Among studies of the relationship between athletic ability and genetic polymorphism, few have evaluated the connection between children’s athletic ability and genetic polymorphism. The objective of this study was to investigate the relationship between changes in junior athletes’ athletic ability and the ACTN3 and ACE polymorphisms. [Methods] The drop jumps (DJ), continuous rebound jumps (RJ), steps (ST), and 20-m dashes of 3rd-6th grade elementary school students, composed of 18 boys and 26 girls who were members of sports clubs, were measured and compared at the start of the study and four months later. PCR-RFLP was used to analyze genetic polymorphisms. [Results] For ACTN3, 17% of boys had the RR, 44% had the RX, and 39% had the XX; for girls, 23% had the RR, 46% had the RX, and 31% had the XX. For the ACE polymorphism, 39% of boys had the II, 33% had the ID, and 28% had the DD; for girls, 50% had the II, 42% had the ID, and 8% had the DD. For ACTN3, a significant increase in ST was observed among boys with the XX genotype. For girls, a significant increase was observed in DJ for the RR and RX genotypes of the ACTN3 gene. For the ACE gene, there was a significant increase in DJ for the ID genotype and a significant increase in DJ and ST for the II genotype. [Conclusion] Since significant increases were observed in DJ and ST among the participants for the ACTN3 and ACE genes, these genes may affect changes in the athletic ability in terms of both, strength and the nervous system.

**Keywords**: actn3, ace, athletic ability
529. **Effect of muscle fiber composition on the ACTN3 protein expression levels in human skeletal muscle**

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[Background] The Alpha-actinin (ACTN) 3 protein is expressed in type II fibers. However, the relationships between the proportion of type Ila and IIX muscle fiber and the ACTN3 protein expression levels in human skeletal muscle remains unclear. [Aim] The aim of this study was to examine the relationships between the ACTN3 protein expression levels and muscle fiber composition in human skeletal muscle. [Method] Thirty male subjects who have R allele of ACTN3 gene participated in this study. The muscle biopsies were obtained from vastus lateralis muscle. ACTN3 and 2, and Total ACTN protein expression levels were analyzed using western blotting. The composition of MHC isoforms was evaluated by SDS-PAGE. After that, all subjects were divided into two groups based on the composition of type IIX fiber (High-IIX group and Low-IIX group). [Result] There were no differences in the composition of type II fibers between two groups. However, the ACTN3 protein expression levels were significantly higher in High-IIX group than Low-IIX group (0.83±0.14 vs 0.59±0.18, p<0.01). There were no relationship between the proportion of type II muscle fiber and ACTN3 protein expression levels. However, a liner positive correlation was found between the proportion of type IIX fiber and the ACTN3 protein expression levels (r=0.46, p<0.01). [Conclusion] The result of this study suggest that the ACTN3 protein expression levels may be mainly affected by the proportion of type IIX fiber.

**Keywords:** ACTN3 genotype, Muscle Fiber Composition, Human Skeletal Muscle

530. **Study on Peroxiredoxin 6 as a novel myokine**

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[Aims] Myokines were recently identified as hormones derived from skeletal muscle. We demonstrated previously that various types of redox proteins (e.g., thioredoxins, peroxiredoxins, and glutaredoxins) are released from skeletal muscle. Here we investigated the secretion mechanism of the novel myokine Peroxiredoxin 6 (Prdx6), and we evaluated its physiological significance. [Methods] To measure the Prdx6 secretion from myotubes, we used culture medium of mouse C2C12 myotubes with or without electric pulse stimuli for 1 hr. To investigate Prdx6’s physiological importance, we generated muscle-specific Prdx6-knockdown Drosophila melanogaster (Prdx6 KD). We used the flies’ climbing activity, spontaneous activity, and longevity as indices of the Prdx6 KD behavioral phenotype. [Results] We detected Prdx6 in the culture medium of unstimulated C2C12 myotubes. The amount of secreted Prdx6 was not affected by pulse-induced contraction. The climbing activity and the spontaneous activity of the Prdx6 KD flies were not significantly different from those of the controls, but the longevity was significantly shortened in the Prdx6 KD. [Conclusions] Prdx6 is constitutively secreted from skeletal muscle cells. Muscle-specific knockdown of Prdx6 in D. melanogaster shortened their lifespan, suggesting that Prdx6 in the skeletal muscle is a physiologically important protein.

**Keywords:** myokine, peroxiredoxin, contraction

531. **Improvement in iron status improved the endurance capacity in female collegiate soccer player**

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[Aims] The prevalence of iron deficiency (ID) among Collegiate Division I female soccer players and how their iron nutrition status impacts the endurance capacity has not been revealed. The purpose of this study was to determine the relationship between ID and endurance performance among female soccer players in Japan. [Methods] Nineteen Division I female soccer players participated in the pre-post-tests (blood and Cooper’s endurance tests) with two-month intervals. Iron related indicators, serum vitamin B1 (VB1), and albumin (ALB) were analyzed. Results of the pre-test, and dietary advice if needed, were given to each subject after a month. [Results] At pre-test, no subject was below the standard reference range in red blood cell count, hemoglobin, VB1, and ALB. However, when ferritin and transferrin saturation were assessed by the generalized linear model, significant positive associations were observed. When the change [(Post - Pre)/Pre] in iron indicators on Cooper’s endurance performance among female collegiate soccer players in Japan. [Aim] The prevalence of iron deficiency (ID) among Collegiate Division I female soccer players and how their iron nutrition status impacts the endurance capacity was suggested to improve the endurance performance. Thus, the iron status should be assessed and maintained even without anemic symptoms to enhance endurance performance.

**Keywords:** iron status, endurance performance, soccer

532. **The Association of Fit-Fat Index with Incident Diabetes in Japanese Men: A Prospective Cohort Study**

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[Aims] The purpose of this study was to examine the association between combined cardiorespiratory fitness (CRF) and waist-to-height ratio (WHR) in the form of the fit-fat index (FFI) and the incidence of type 2 diabetes (DM) among apparently healthy Japanese men. [Methods] This study was conducted on 5,014 men aged 18-59 years old, who had a health check up with no history of major chronic disease at baseline. CRF was measured using the cycle ergometer test, and maximal oxygen uptake was estimated. Results 7.6% of the men developed DM. The mean follow-up period was 5.3 years. HR and 95% CI for the incidence of DM across baseline quartiles of FFI were obtained using the proportional hazards model while adjusting for age, BMI, SBP, smoking, alcohol intake, and family history of DM. Subsequent models tested for the relationships of BMI, WHR, and CRF with incident DM. All models were adjusted to mitigate multicollinearity. The HR for developing DM across baseline quartiles of FFI were 1.0 (referent), 0.77 (0.59-1.02), 1.02 (0.67-0.92), and 0.54 (0.36-0.82) (P for trend = 0.001). Consistent and progressive independent associations were observed between CRF and DM incidence (P for trend = 0.005) but not for BMI or WHR. [Conclusions] The findings align with the previous investigations of FFI, in which FFI was found to associate with DM and other health outcomes to a greater extent than fitness or fatness alone. A single index combining CRF and WHR may be more useful because it can indicate improvements in either or both of the measures.

**Keywords:** cardiorespiratory fitness, waist-to-height ratio, body mass index