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## **A Discussion of the Method of Selective Training of the Rhomboid Muscles**

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The purpose of this study was to discuss the method of selective training of the rhomboid muscles. The study participants included 6 men who were college students and had no history of shoulder pain or any pathological disorders. The participants performed a rowing exercise (scapular adduction) at 0°, 45°, and 90° shoulder abduction. We assessed the activities of the rhomboid major and minor muscles (RMJ and RMN, respectively) by using fine-wire electromyography (EMG) and those of the serratus anterior (SA) and upper, middle, and lower (UT, MT, and LT) trapezius muscles by using surface EMG. The rectified and smoothed EMG data were normalized as

a percentage of the maximal voluntary contraction (%MVC). The activity of the RMN and RMJ increased with increase in the degree of shoulder abduction. Moreover, at 45° shoulder abduction, the activity of the RMN was significantly greater than that of the other muscles ( $P < 0.05$ ). The researchers of a previous study thought that the rhomboid muscles participate in the stabilization of scapular movements; however, not much evidence is available in this regard. These findings suggest that selective training of the rhomboid muscles may have an effect on scapular adduction at 45° shoulder abduction.

## **Knee and Trunk Kinematics During Anticipated and Unanticipated Side-step and Crossover-step Cutting Tasks**

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The purpose of this study was to compare kinematics of the knee and trunk orientation between anticipated and unanticipated condition during cutting tasks. Seven healthy athletes performed three anticipated tasks, including running straight, side step cutting (ANS) and crossover cutting (ANC), and three

unanticipated tasks, running straight, side step cutting (UNS) and crossover cutting (UNC). An eight-camera high speed motion analysis system was used to record the lower limb and trunk movements three dimensionally. A three segment model was created including trunk, thigh and shank of the left lower

extremity using the point Cluster Technique (PCT). We analyzed each variable at the time of 100msec before foot contact, the time of foot contact, and the peak value at stance phase. The UNS task result in greater knee abduction angle at 100 msec before foot contact compare to ANS ( $p < 0.05$ ). During anticipated task, trunk lateral orientation tilted toward step direction than unanticipated task during both maneuvers. Neither the knee abduction nor external tibial rotation

angle at peak value was different between anticipated and unanticipated condition. But the trunk lateral orientation shifted toward opposite to the stepping direction during sidestep cut. Therefore, the trunk CoM would be shifted to same direction and this would increase the knee abduction moment. Therefore unanticipated sidestep cut would be risk factor of non-contact ACL injuries.

### **The attractive factors affecting the geographic distribution of J-League season ticket holders in the probabilistic gravity model**

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Having the ability to predict geographic distribution of season ticket holders is an important task for marketing strategy of J-League clubs. The purpose of this study was to examine the attractive factors affecting the geographic distribution of J-League season ticket holders in the probabilistic gravity model. The data of seven clubs' season ticket holders was used for analysis. 15 cities in Kanto area were selected for estimating the parameters. Based on a review of literature, five conceptual models of attractive factors were proposed. Least squares was used to estimate the parameters in the log-transform regression analysis for the models. We found that the addition of attractive

factors increased model's accuracy compared to the model of distance only. And the model of the distance with last year's club ranking had the best accuracy (adjusted  $R^2 = .773$ ) compared with other models. The last year's club ranking was related to probability with which spectators from area 'i' buying season ticket at club's location 'j'. And this means that higher ranking clubs have more ability to pull in more spectators geographically. The results indicate that the geographic distribution of J-League season ticket holders is affected by the distance from stadium and last year's club ranking as the attractive factors.

### **The relation between resting energy expenditure and body size in Japanese female collegiate athletes**

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The purpose of the present study was to evaluate how body size is related to resting energy expenditure (REE) in Japanese female collegiate athletes. Seventy-six athletes (age  $20.1 \pm 1.2$  years, height  $161.7 \pm 5.3$  cm, body mass (BM)  $56.0 \pm 8.9$  kg, lean body mass (LBM)  $44.6 \pm 5.8$  kg) were participated in the study and classified into three groups according to their body size; 22 small-size (S), 40 medium-size (M) and 14 large-size (L) athletes. Systemic and regional (skeletal mass (SM), fat mass (FM), bone mass, residual mass (RM)) body compositions were estimated by using DXA. The REE was measured by

an indirect calorimetry. There were remarkable differences in REE (S:  $1093 \pm 143$ , M:  $1226 \pm 201$ , L:  $1450 \pm 209$  kcal/day), and systemic and regional body compositions. However, no differences were observed REE in terms of kcal/kg LBM/day among the three groups (S:  $28.0 \pm 2.7$ , M:  $27.8 \pm 4.2$ , L:  $27.3 \pm 3.2$  kcal/kg LBM/day). REE was correlated with LBM ( $y = 25.8x + 77$ ,  $r = 0.76$ ,  $p < 0.01$ ) in all subjects. These data suggest that the REE (kcal/day) in Japanese female collegiate athletes with wide ranges of body size is associated with body mass, particularly with LBM.

### **Effects of different dietary fat content on muscle mitochondrial enzyme activities and endurance performance in rats**

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This study was conducted to obtain information about the effect of different dietary fat content on muscle mitochondrial enzyme activities and endurance performance in rats. Rats were fed for 4 weeks either 1) low-fat diet (12.5% calorie from fat; LF) or 2) normal-fat diet (25% calorie from fat; NF) or 3) high-fat diet (40% calorie from fat; HF) or 4) Supra high-fat diet (60% calorie from fat; SHF). While no significant difference in body weight was observed between 4 groups, intra-abdominal fat weight was significantly higher in the SHF group rats compared

with that in the LF group rats ( $p < 0.05$ ). Citrate synthase activity in plantaris muscle did not differ between groups. However, 3-hydroxyacyl-CoA dehydrogenase activity in plantaris muscle of the SHF group rats was significantly higher than that of the other groups ( $p < 0.05$ ). Rats in HF and SHF groups were able to run significantly longer than the group fed LF or NF. These results suggested that moderate high-fat diet (40% calorie from fat) can improve endurance exercise capacity without an increase in intra-abdominal fat in rats.

### **Factors influencing individual difference in the jump performance enhancement induced by counter-movement**

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The execution of a counter-movement prior to the main exercise, during which the muscle fibers work almost isometrically by leaving the task of storing and releasing elastic energy to tendon (muscle-tendon interaction) enhances the performance outcome. The purpose of the present study was to reveal musculotendinous factors influencing individual differences in the performance enhancement. Sixteen healthy males performed jumps using only the ankle joint with and without a counter-movement. During the exercise, an ultrasonography technique was used to record the fascicle behavior of the gastrocnemius muscle, and the tendon length change was computed. These data were combined with tendon force to calculate the mechanical work done by the fascicles

and tendon. The mechanical work done by muscle-tendon unit increased with the execution of the counter-movement, and its magnitude was correlated with the extent of increase in the elastic energy utilized by the tendon ( $r=0.60$ ,  $p<0.05$ ), but not with the size of difference in the mechanical work done by the fascicles. The elastic energy utilized by the tendon was not correlated with tendon stiffness determined separately. These results indicate that the greater performance enhancement by a counter-movement is derived from the better usage of elastic energy through muscle-tendon interaction during the stretch-shortening cycle, regardless of the tendon properties.

### **Angular momentum and changing runner's orientation in curved sprinting**

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The purpose of this study was to describe the angular momentum of the runner's body about the center of mass (CM) during the maximum-effort sprinting on a curved runway. Ten male collegiate sprinters were asked to sprint along the 2nd lane on an official 400m track. The performances were recorded with four high speed cameras. The DLT algorithm was used for 3D reconstruction and the angular momentum of the whole body about the principal axes passing through the CM was calculated. The results showed that the runner's body possessed throughout the stride cycle an inward-directed component ( $5.8\pm 1.6\text{kgm}^2/\text{s}$ ) and a cranially-directed component ( $2.0\pm 0.7\text{kgm}^2/\text{s}$ )

of angular momentum. The antero-posterior component of angular momentum changed its sense from forward- to backward-direction during the right ground contact phase. These results suggest (a) that the runner's body changes its orientation continuously to face forward along the curved runway and (b) that the angular impulse exerted on the body during the right ground contact phase changes the direction of the forward somersaulting angular momentum possessed primarily by the limbs, so that the runners could maintain the plane of the limbs' rotary motion in the tangential direction to the curved runway.

## Gender differences in running: A stride at a straight-to-curve transition

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The purpose of this study was to identify the risk factors of running injuries, typically prevalent in females specifically at the knee, by examining gender differences in lower extremity joint kinematics and kinetics during the running at a straight-to-curve transition (RUN<sub>SCT</sub>). Eleven female and eleven male runners participated in this study. Three-dimensional marker positions and ground reaction forces were simultaneously recorded with a motion analysis system while the subjects performed RUN<sub>SCT</sub> at a constant speed of 3.5m/s. Kinematic and kinetic variables were

analyzed for the stance phase of the right leg. Female runners demonstrated significantly greater values of the maximum knee abduction and hip adduction angles. The abduction component of the maximum resultant joint moment at the knee was found to be significantly greater in males, whereas that for the internal rotation component was found to be greater in females. Our initial expectation of higher stress of the female runners' knees was partly supported by the higher knee internal rotation moment, which might be the risk factor of female running injuries.

## Relationship between ball control and hand and fingers movements in baseball pitchers

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Pitch control is an important skill for baseball pitchers. In the present study, we investigated the relationship between pitch control and the movements of hand and fingers during ball release. Four collegiate baseball pitchers threw 30 pitches from the mound of official height as fast and accurate as possible to the center of strike zone (0.70 m above the ground). The motions of hand, fingers, and ball were recorded using three high-speed cameras. The other high-speed

camera was used to record the motion of the catcher. Hand angle at the ball release in the plane, made by pitcher-catcher and vertical directions, was closely correlated with vertical component of ball position at the catcher ( $p < 0.001$ ). In conclusion, it was suggested that pitching a baseball into the strike zone requires a pitcher to complete the ball release within the time accuracy of 1-2 ms.

## The effect of menstrual cycle on cardiovascular and subjective responses during prolonged sub maximal exercise in the heat

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This study was examined 1) the effects of menstrual cycle on, and 2) the effects of fluid ingestion on cardiovascular and subjective responses during prolonged submaximal exercise for young women in the heat in the different phases of menstrual cycle. Five healthy young women (age=21.6±0.7yr,  $\dot{V}O_{2max}=34\pm 3\text{ml/kg/min}$ ) with regular menstrual cycle completed four trials consisting of 90 minutes cycling exercise at 50%  $\dot{V}O_{2max}$  in the heat (temperature; 30°C, humidity; 50%) during the follicular phase (FP) and luteal phase (LP) of their menstrual cycles with or without fluid ingestion.

During cycling exercise,  $\dot{V}E$ ,  $\dot{V}O_2$ ,  $\dot{V}CO_2$ , respiratory exchange ratio (RER), heart rate (HR), body core temperature (BCT) and rating of perceived exertion (RPE) were measured every 15 minutes. RER, BCT, RPE-Overall and RPE-Legs were significantly higher in the LP than in the FP all over the cycling exercise. These data suggest that physiological strains were increased in the LP compared to the FP by higher BCT and RER during prolonged submaximal exercise in heat condition. Although fluid ingestion did not decrease RPE, it inhibited the increase in BCT.

## Functional differences in the activity of hamstring muscles with increasing running speed

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In this study, we examined hamstring muscle activation during different running speeds, so as to provide scientific data to better understand the functional characteristics of each hamstring muscle. Eight healthy male track and field athletes (20.1 ± 1.1 years) performed treadmill running at 50%, 75%, 85%, and 95% of their maximum velocity. Lower extremity kinematics of the hip and knee joint were calculated. The surface electromyographic activities of the biceps femoris (BF) and semitendinosus (ST) muscles were also recorded. Increasing the running speed from 85% to 95% significantly increased the activation of the hamstring muscles during the late swing phase (BF, p

< 0.05; ST, p < 0.01), while lower extremity kinematics did not significantly change. During the middle swing phase, the activity of the ST was significantly greater than that of the BF at 75%, 85%, and 95% running speed (p < 0.001, p < 0.01, and p < 0.05, respectively). Statistically significant peak activation time differences between the BF and ST were found during 95% running (p < 0.05 at stance phase, p < 0.01 at late swing phase). Significant differences in the activation patterns between the BF and ST muscles were observed as the running velocity increased, indicating that complex neuromuscular coordination patterns occurred during the running

cycle at near maximum sprinting speeds.

## **Relationship between reaction force and velocity during the V2-skate technique in cross-country skiing -roller ski study-**

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The use of the “V2-skate” technique in cross-country skiing can determine success or failure. The purpose of this study was to examine the impact of different pole and ski reaction forces on several velocities during V2-skate. Five elite female skiers were fitted with a sensor system for measuring specific forces. The velocity, cycle length, cycle rate, pole and roller ski contact time, and peak, mean, and lowest ski reaction forces were analyzed at several velocities. The cycle rate and peak kick force increased with velocity ( $P < 0.05$ ). The cycle length, mean force, and pole and glide contact time in high-speed trials were

significantly different from those in medium-speed trials ( $P < 0.05$ ). The lowest ski reaction force was significantly different from that in the medium-speed trials ( $P < 0.05$ ). The main findings of the study are as follows: (1) elite skiers increased their velocity as the cycle length and cycle rate increased; (2) the cycle length was increased at high velocities by increasing the propulsive forces during poling and the kick phase; (3) the cycle rate was increased at high velocities by increasing pole and ski contact times; and (4) counter movement was used to increase velocity.

## **Corticospinal excitability during motor imagery**

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We investigated whether corticospinal excitability during the imagery of an action with an external object was influenced by actually touching the object. In the first experiment, corticospinal excitability was assessed by motor evoked potentials (MEPs) in the first dorsal interosseous (FDI) muscle elicited by transcranial magnetic stimulation over the contralateral motor cortex during imagery of squeezing a ball (4cm) - with or without passively holding the ball. The MEPs amplitude during the imagery when the ball was held

was larger than that when the ball was not held. The MEPs amplitude was not modulated just by holding the ball. In the second experiment, we examined MEPs during imagery of pinching a small ball (2cm) - with or without passively holding the ball. The MEPs amplitude in agonist muscle during the imagery when the ball was held was larger than that when the ball was not held. These findings suggest that passively holding objects increased corticospinal excitability during motor imagery of handling the object.

## Regional Effects of Stadium Innovation and a Possibility of Regional Innovation

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This study chooses the Hiroshima Municipal Stadium, which opened in 2009, as a subject of innovation and aims to clarify, on the basis of fieldwork, the economic and regional strategic effects that the stadium had on the local area and the regional innovation that it possibly facilitated. An original agent fostering innovation is called an innovation actor. The sports industry has many such innovation actors that bring about innovative changes in local areas, as illustrated by new sports (e.g., Nordic walking), new facilities (e.g., stadiums), new organizations (e.g., local professional sports clubs or fan clubs), new leagues (e.g., independent leagues), new networks (e.g.,

collaboration between major sports), and new mega sports events (e.g., The Olympic Games). Such actors induce a chain of innovations in local areas (Harada, 2008). However, no existing study investigates the influence of a new facility as a possible actor. Interviews were carried out with stakeholders such as the media, real estate agents, tourism companies, and railway companies, who were selected on the basis of a preliminary survey. Analysis on the data collected showed certain economic effects and the possibility of inducing regional innovation in the future. It also showed that there were many factors hindering the development of these effects and the possibility.

## A role of auditory feedback in sensory-motor learning of speaking

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The purpose of this study is to investigate the role of sensory feedback (visual feedback, somatosensory feedback, auditory feedback, ...) in the sensory-motor learning. In this study, we focus on auditory feedback during speaking, and we examine the effects on speech articulatory movements by altered auditory feedback. Auditory feedback signal was altered in real time so that the speech timing is locally modified. PSOLA (Pitch Synchronous Overlap and Add) method was used for the time-scale modification with maintaining natural sound quality. The temporal perturbation on the auditory feedback signal was applied at the beginning

of the transition of semi-vowel /ya/ and vowel sequence /ia/ with the interval of 50 ms. Experiments were conducted to study effects on the temporal articulatory compensation for the time-scale modification scale from 0.5 (shortening) to 1.8 (lengthening). The compensation was quantitatively examined in terms of the transition duration, the maximum and average velocities of the formant frequencies. The results showed that compensatory temporal response mostly occurs for lengthening the transition interval and little for shorting it.



## **Biomechanical analysis of sport performances for defensive soccer players: three-dimensional motion reconstruction from uncalibrated video sequences**

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*Introduction:* Assessment of athletes' movement on field is an important task for sports coaches to enhance athletes' performance. The purpose of this study was to apply a model-based image matching technique for human motion to assess athletes' sports performance in competitive game. *Methods:* Defensive movement in competitive soccer games were recorded using more than four uncalibrated digital video cameras. Two series of defensive movement images were chosen as the analysis object. The series of images were analyzed using 3D computer graphic software Poser 4. The knee, hip, and trunk joint angle were analyzed for a defensive movement on each subject. *Results:* The typical defensive motion was sidestep or backward

cutting responding to offensive players. The movement with excessive forward trunk inclination and slightly-flexion of the hip tended to prolong the ground contact time during cutting movement on one-to-one situation. *Discussion:* These results suggested that defensive players were required to keep their posture suboptimal, such as suitable trunk position with deep hip flexion, for quick movement during cutting. To control and stabilize posture may be one of the key points for achieving high performance. These data provide a glimpse into players' movement in competitive soccer games. Moreover, this method may work as the bridge between field coaching staff and scientific support team.