

The 8th International Sport Science Symposium on
“Sport Sciences for the Promotion of Active Life”

Sport Sciences, 10, 66-80, 2013

Accepted for publication: 15 April 2013

【Symposium: Scientific Basis on Athletic Performance】

Why black athletes dominate certain sports: Nature and nurture?

Yannis Pitsiladis

Institute of Cardiovascular and Medical Sciences, College of Medical, Veterinary and Life Sciences,
University of Glasgow, Glasgow, UK

A look at the final medal tally at the XXX Olympiad in London reveals that certain nations enjoy particular success on the running track and the marathon. Compelling examples are that of east African athletes from Kenya and Ethiopia, with their domination of middle- and long-distance running and that of athletes from Jamaica and the USA, with their domination of sprint events. The London results have undoubtedly enhanced the concept that certain ethnic groups possess some inherent genetic advantage predisposing them to superior athletic performance. However, there is no genetic

evidence to suggest that this is the case, although research is ongoing and predominantly implicates environmental factors. Genetic studies of elite distance runners from Kenya and Ethiopia and elite sprinters from Jamaica, USA and Nigeria do not find that these athletes possess a unique genetic makeup; rather they serve to highlight the high degree of genetic diversity among ethnic groups. It is unjustified, therefore, to regard ethnic differences in sporting success as genetically mediated; to justify doing so one must identify the genes that are important, which until now has proven elusive.

Biomechanical Profile of World Top Sprinters

Yasuo Kawakami

Faculty of Sport Sciences, Waseda University, Japan

Recent advance in the performance of sprint event is remarkable, and black athletes have dominated world-class races. The characteristic trend of recent years is that tall runners, like Usain Bolt, have cut conspicuous figures in the sprint event. This trend was not seen in the past, and it was thought that long limbs were biomechanically disadvantageous for fast movements. Presently active runners seem to have overcome and broken this limitation in two ways: by developing large and strong muscles in the trunk and thigh, and by building up a stiff, resilient spring in the leg. Our work has shown

elastic properties of the muscle-tendon unit, pointing out the contribution of tendinous tissues as a spring. Tendon elasticity has been shown to relate to the exercise performance under mechanically and neurally controlled joint actions, leading to energy saving of muscle fibers and enhancing positive work of the muscle-tendon unit. Literature shows that this spring function is embedded in the distal muscles while proximal muscles are architecturally designed for actuation. The current world top sprinters are likely to possess in their muscles these functions at an awfully high level.

Physiology of the marathon: How fast might they go?

Edward F. Coyle

Human Performance Laboratory, University of Texas at Austin, USA

The world records for the men's and women's marathon continues to improve and we can speculate what it might be years in the future and what the ultimate limit to marathon performance might be. The current world record for men is 2:03:38 (Patrick Makau) and women is 2:15:25 (Paula Radcliffe). A physiological model illustrates how marathon velocity is a function of the lactate threshold VO_2 and running economy. The lactate threshold VO_2 is determined by VO_{2max} and technique. Furthermore, VO_{2max} is determined by stroke volume, muscle capillary density, hemoglobin content and aerobic enzyme activity. Running economy is very important but the factors that determine running economy are poorly understood. Cycling efficiency is related to the percentage of slow twitch muscle fibers yet, no such relationship has been established with running economy. Paula Radcliffe improved her running economy by 17% over an eleven year period which is the primary reason why she

improved her marathon time by over 30 minutes. Prediction of the ultimate marathon performance for a future man or women can be modeled by combining the best attributes into one individual. If in men, a given runner had a VO_{2max} of 84 ml/kg/min, and could run the marathon at 85% VO_{2max} and possessed superior running economy, it is predicted that a marathon time of 1:58 is possible. A woman with a VO_{2max} of 76 ml/kg/min, maintaining a pace of 88% VO_{2max} , with superior running economy, should be capable of running the marathon in 2:04. It is important to understand that to achieve these spectacular performances will not require physiological values that are out of the range of what has already been documented in top runners. These spectacular performance will likely be achieved by an athlete who does not have a weak link in the physiological chain of events and who has especially superior running economy.

【 Keynote Lecture 】

Blood lactate concentration as a tool in the athletic field

Hideo Hatta

Department of Sports Sciences, The University of Tokyo, Japan

Lactate had long been recognized as a final and waste product of glycolysis with the major metabolic fate of conversion to glucose in the liver after transportation from skeletal muscle. However, we now understand that lactate is an intermediate of carbohydrate metabolism. The produced lactate is converted to pyruvate by lactate dehydrogenase in cytosol and is oxidized in mitochondria for ATP synthesis. Oxidation is the major pathway for lactate metabolism particularly during and after exercise when a great deal of ATP production is required. Fatigue had long been explained by the accumulation of lactate but recent researches had found that fatigue is caused by multiple factors. Reduced muscle glycogen concentration is one of the major causes of fatigue during and after endurance type exercise. As muscle lactate is produced mainly from muscle glycogen, production of lactate is reduced when muscle glycogen concentration is reduced. Marathoners get tired with reduced muscle glycogen content and concomitant less production of lactate toward end of the race. Blood lactate concentrations in soccer players during game are also reduced in second half of game. Lactate

can counteract potassium induced decline in muscle contraction, thus lactate can reduce fatigue. Recently it is reported that lactate can be considered as a signal molecule to induce various adaptations in tissues such as increase in mitochondria and angiogenesis. Blood lactate concentration can be a “measure” of muscle fatigue with normal glycogen contents. But it does not mean that production of lactate is the production of cause of fatigue and waste. Blood lactate concentration is not always high in fatigued condition. Lactate is transported by lactate transporters MCT (Monocarboxylate transporter) which play important roles for lactate utilization. MCT1 exists mainly in red muscles (slow-oxidative and fast-oxidative fibers) and heart, plays a role for lactate uptake from circulation to skeletal muscle. MCT4 exists mainly in white muscles (fast-glycolytic fibers) and is responsible for a role to release lactate from muscle to outside. Exercise training and chronic muscle contraction can increase muscle MCT1 and MCT4 protein leading to increased oxidation of lactate during and after exercise. Therefore, MCT1 and MCT4 are important for lactate metabolism during and after exercise.

【 Young Investigator's Symposium 】

**A comprehensive approach to study kinematics and muscle activity
of sport specific movements**

Hendrik Enders

Human Performance Laboratory, Faculty of Kinesiology, University of Calgary

In the last decade new analysis tools have been applied in sport sciences that allow analyzing an entire data set rather than discrete variables. One approach is to use a principal component analysis (PCA) in order to decompose sport specific movements into individual movement patterns.

We used PCA to analyze kinematic whole body movement patterns during running at five different speeds and EMG during cycling at different power outputs.

The relative variability (RV) was computed for all experimental conditions (running/cycling) in order to determine how sport specific movement patterns are controlled by the human body.

As speed increases the RV of speed dependent

movements decreases. Speed independent movements show a minimum RV at the preferred running speed.

PCA applied to the EMG data showed that muscle activation patterns could be separated into low and a high RV. Generally, the RV decreases as the power output is increased by the athlete.

The key finding of both studies indicates that the main movement patterns show a low variability indicating efficient control strategies of the human body irrespective of the movement that is analyzed. Movement patterns demonstrating a low variability are aspects that contribute and regulate movement performance (e.g. speed or power).

The instance of subacromial impingement during front crawl swimming

Tanghuizi Du¹, Toshimasa Yanai²

¹Graduate School of Sport Sciences, Waseda University

²Faculty of Sport Sciences, Waseda University

Shoulder pain is the most common problem in competitive swimming. The subacromial impingement is a proposed mechanism to explain shoulder pain experienced by swimmers. The purpose of the study was to determine the instances at which the subacromial structures were experiencing impingement during swimming. The subacromial structure was considered be impinged when glenohumeral joint configuration exhibited in front crawl exceeded the so called “boundary range of motion”, that is, the anatomical range of motion permitted to the individual’s glenohumeral joint. Nineteen members of men’s collegiate swimming team participated in the study. Each subject underwent two test sessions, a boundary range of motion measurement and a swimming motion

measurement. A simplified kinematic model composed of right scapula, right humerus and thorax was used to describe the shoulder configuration. An electromagnetic tracking device was used to record the movements of the three segments by determining of the position and orientation of sensors. Three sequential Euler angles, representing horizontal abduction angle, elevation angle, and internal rotation angle, were used to express the glenohumeral joint configuration exhibited in two test sessions. The results showed that subacromial impingement occurred for $11.7 \pm 10.8\%$ of the stroke time. Subacromial impingement was observed in most subjects during the initial pull phase (n=12) and the second half of recovery phase (n=13).

Research of characteristics of plantar pressure distribution in obesity children

Xiaofeng Zou

Jilin University

Subjects: Choose 60 boys of 7 years old as the subject of the study, with 30 as control group, and 30 as obese.

Methods: Height and weight were measured to calculate BMI. The plantar pressures were obtained using The footscan® pressure platform (RSscan, Belgian) to calculate the peak force and pressure experienced under areas of each child's feet during static and dynamic conditions.

Results: While standing, the static plantar pressure peak of the obese group is significantly higher ($p < 0.01$), and the foot-ground contact area is bigger ($p < 0.01$), the pressure peaks increase thereupon ($p < 0.05$). Similarly, while

walking, Obese children are characterized by walking with a significant increase of the whole foot contact ($p < 0.01$) and a significant decrease ($p < 0.01$) of Landing phase and Push off phase; The impulse value of plantar pedals at the inside and the lateral heel, arch, the 2nd and the 3rd -5th metatarsal heads are significantly higher ($p < 0.01$).

Conclusions: The analysis of the static standing and natural walking of obese children shows that it's greatly increases the risk of foot pains and impede the enthusiasm of obese children in taking part in the sports.

Overload Training Inhibits Phagocytosis and ROS Generation of Peritoneal Macrophages: Role of IGF-1 and MGF

Weihua Xiao, Peijie Chen

Shanghai University of Sport

We tested the hypothesis that overload training inhibits the phagocytosis and the reactive oxygen species (ROS) generation of peritoneal macrophages (MΦs), and that insulin-like growth factor-1 (IGF-1) and mechano growth factor (MGF) produced by macrophages may contribute to this process. Rats were randomized to two groups, sedentary control group (n=10) and overload training group (n=10). Rats of overload training group were subjected to 11 weeks of experimental training protocol. Blood sample was used to determine the content of hemoglobin, testosterone and corticosterone. The phagocytosis and the ROS generation of MΦs were measured by the uptake of neutral red and the flow cytometry respectively. IGF-1 and MGF mRNA levels in MΦs were determined by Real-time PCR. In addition, we evaluated the effects of IGF-1 and MGF peptide on phagocytosis and ROS generation of MΦs in vitro. The data showed that overload training significantly decreased the body weight (19.3%, $P<0.01$), the hemoglobin (13.5%, $P<0.01$), the

testosterone (55.3%, $P<0.01$) and the corticosterone (40.6%, $P<0.01$) in blood. Moreover, overload training significantly decreased the phagocytosis (27%, $P<0.05$) and the ROS generation (35%, $P<0.01$) of MΦs. IGF-1 and MGF mRNA levels in MΦs from overload training group increased significantly compared with the control group (21-fold and 92-fold, respectively; $p<0.01$). In vitro experiments showed that IGF-1 had no significant effect on the phagocytosis and the ROS generation of MΦs. Unlike IGF-1, MGF peptide impaired the phagocytosis of MΦs in dose-independent manner. Additionally, MGF peptide of some concentrations (i.e., 1, 10, 50, 100ng/ml) significantly inhibited the ROS generation of MΦs. These results suggest that overload training inhibits the phagocytosis and the ROS generation of peritoneal macrophages, and that MGF produced by macrophages may play a key role in this process. This may represent a novel mechanism of immunosuppression induced by overload training.

Effects of taekwondo program on cystatin C and physical fitness in metabolic syndrome: Age and sex differences

Seung-Taek Lim

Dong-A University

Here we report the findings from two studies which examine the effects of taekwondo program on metabolic syndrome risk factors, kidney function and physical fitness in children (Study 1) and older women (Study 2) with metabolic syndrome. Eight boys and older women were assigned to supervised taekwondo program intervention group (60min/session on 5 days/week for children and 40min/session on 3 days/week for older women) and eight boys and older women were assigned to a control group (participants were advised to maintain their normal lifestyle during the study). The results of study 1. Showed that body weight, body mass index, fat mass percentage, VO₂max (ml/min/kg), waist circumference, glucose, total cholesterol

and cystatin C were significantly improved in taekwondo group. In the study 2. showed that total muscle mass, VO₂max (ml/min/kg), blood pressure, glucose, cystatin C and glomerular filtration rate were improved in taekwondo group. These data demonstrate that: 1) regular taekwondo is considered positive effects in reducing triacylglycerol and waist circumference by reduction of body fat mass and glucose concentrations decreased by increased free fat mass. In addition, cystatin C showed a correlation between metabolic syndrome risk factors in elderly women who increased muscle mass and reduction body fat mass, improvement of physical fitness.

Determinants of sport participation in Germany

Kirstin Hallmann

Institute of Sport Economics and Sport Management, German Sport University Cologne

With an increase in concern for such health issues as obesity epidemics, the health and well-being of citizens has become extremely important (Downward & Riordan, 2007) and the role of sport participation in improving these areas of citizens' lives has become integral for policy makers. The literature analysing the determinants of sports participation has grown considerably (e.g., Lera-López & Rapun-Gárate, 2011). Economic theories have often been employed to explain sport participation. A majority of recent work has adopted the Beckerian approach (Becker, 1965, 1974) for sport participation research (Downward &

Rasciute, 2010).

The purpose is to test the applicability of this approach for different sports and to depict profiles for sport participants in different sports. Based on data from different sport participation surveys with an overall sample size of $n=26,263$, the determinants for practising different sports were tested using regression analyses. The findings suggested that different sports have diverse determinants. For example, the typical tennis player tends to be male, well-educated, and a native of the country. The results indicate that the employed model is appropriate in predicting sport participation in different sports.

The Effectiveness of Relationship Marketing Activities Applied to Amateur Baseball Clubs

Kisung Kwon

Seoul National University

With increasing attention to sports and group activities for leisure time, the number of clubs and members has dramatically increased in the amateur baseball industry. With the boom of amateur baseball clubs, corporations have attempted to apply relationship marketing strategies to amateur baseball clubs in hosting amateur baseball club tournaments in Korea. However, those corporations do not seem to place true confidence in relationship marketing strategies. With these backgrounds, the purpose of this study is to propose and examine a causal model explicating positive relationships among three relationship marketing activity factors, the perceived relationship quality and consumer loyalty toward the corporation. To test the causal

model, a survey was conducted during an amateur baseball club tournament hosted by the on-line shopping service providing corporation as a relationship marketing effort. More than 152 responses were collected, and the data were analyzed with AMOS 18 for conducting confirmatory factor analyses (CFA) and examine structural equation modeling (SEM) method. The results show that perceived relationship marketing activity factors positively influenced on perceived relationship quality with the event-hosting corporation, which in turn positively affected consumer loyalty toward the company. With these results, this study confirmed the practical effectiveness of relationship marketing strategies.

Mucosal immune function and exercise in wheelchair athletes

Christof Leicht

Loughborough University

The production of salivary secretory immunoglobulin A (sIgA) is the major function of the mucosal immune system. sIgA has been described as ‘the first line of defence’ against pathogens and antigens presented at the mucosa, such as cold-causing viruses. Consequently, individuals who present depressed levels of sIgA are more susceptible to upper respiratory symptoms. By far the majority of research in the area of exercise immunology has focused on able-bodied athletes and until recently, only few studies have investigated mucosal immune responses in wheelchair athletes. Some of these individuals have high level spinal cord injuries (SCI) that can affect their sympathetic nervous system (SNS), and as a result, potentially alter

their mucosal immune response to exercise. However, despite missing central control, these wheelchair athletes show responses thought to be governed by the SNS, such as increases in sIgA secretion as a result of acute exercise. Similarly, chronic exercise responses in athletes with high level SCI are comparable to able-bodied athletes, as decreases in sIgA during periods of heavy training have been reported in both populations. It therefore appears that the loss of central control of effector organs via the SNS may be compensated. This may be by way of enhanced spinal reflex activity, adapted parasympathetic nervous system activity, or increased sensitivity of receptors involved in autonomic pathways.

The conditioning tests for CBA elite basketball players

Shaohui Jin

Laboratory of Training theory, Physical Education and Training Department,
Tsinghua University, Beijing, China

The professional basketball is a very demanding sport. Chinese Basketball Association (CBA) league has at least 34 games in one season. Since there are more and more player exchanges with NBA, CBA is tough for every player in the league. During the pre-season preparation period, we designed and applied a series of biochemistry and conditioning tests for FOSHAN team, which contain blood cells,

hormones, speed, agility and different abilities of jumping and frequency. There are 15 senior and 22 junior players involved in this testing. Although it is the first time for the team to have this kind of precise conditioning test, the results still help us to define the weakness of players and provide valuable advices for the conditioning training and selection of players.

The effect of limited absolute frequency of self-controlled feedback on motor skill performance and learning

Min-jen Tsai, Hank Jwo

National Taiwan Normal University

Traditional feedback researches were executed with the feedback scheduled by researchers. Self-controlled feedback paradigm proposed an alternative manner which allows learners to regulate their feedback schedules by their own decision. It was proved that self-controlled feedback was a robust learning variable in motor skill learning. However, recent researches have indicated that the manipulation of self-controlled feedback contains the lack of limitation of feedback frequency might lead learners to depend on augmented feedback by requesting feedback frequently, thus the neglect of internal feedback might be the consequence of the practice. The guidance effect of high frequency feedback might be detrimental to motor skill learning. Present study is designed to examine the effect of limited absolute frequency self-controlled feedback on motor skill performance and learning. Twenty-four adults will be recruited as the participants, and

randomly assigned to self-controlled feedback group and limited absolute frequency self-controlled feedback group. Identical feedback schedule will be adopted as the manipulation of traditional self-controlled feedback studies but with the limitation of absolute frequency up to 50% for the limited absolute frequency self-controlled feedback group. All participants will be required to practice an arm abducent movement to produce forces on a slide block to cause it glide on a glossy plane and stop on a target distance as accurate as possible. The effect of feedback manipulation on retention and transfer tests will be examined by t-test. The performance of acquisition phase will be examined by one-way ANOVA. It is expected to find that the limited absolute frequency self-controlled feedback would result in superior learning and poorer performance compared with traditional self-controlled feedback

Muscle relaxation of the foot reduces the corticospinal excitability of hand muscles via intracortical inhibition

Kouki Kato

Graduate School of Sport Sciences, Waseda University

Not only muscle contraction but also relaxation plays an important role in the performance of body movement. The objective of this study was to clarify how the relaxation of one muscle influences on corticospinal excitability in other remote muscles by using single-pulse transcranial magnetic stimulation (TMS) (Exp.1). Contribution of short interval intracortical inhibition (SICI) was also analyzed with double-pulse TMS (Exp.2). Ten participants volitionally relaxed their right feet from dorsiflexed position in response to an auditory signal. Single (Exp.1) and double (Exp.2) TMS was given on the hand area of the

left primary motor cortex at different time before and after the onset of the relaxation. Motor evoked potentials (MEPs) were recorded from their right extensor and flexor. In Exp.1, the MEP amplitudes of the hand muscles decreased just after the onset of the foot relaxation. Moreover, SICI in the hand area augmented just after the onset of foot relaxation in Exp.2. The result of Exp.2 suggested the decrease in MEP in response to single pulse TMS was produced in the cortical area. Our findings indicated that muscle relaxation of foot increases SICI and hence may assist in reducing cortical excitability in hand muscles.