# 第 3 回 Tsukuba Global Science Week (TGSW)
# スポーツ科学分野の講演

# Lectures for Sport Sciences, Tsukuba Global Science Week (TGSW)

平成 26 年 9 月 28 日から 30 日の日程で、筑波大学主催による第 3 回 Tsukuba Global Science Week がつくばキャンパスにて開催されました。今回は、スポーツ科学の分野を設け、海外からの招待者も含め、5 名の先生方による講演が行われました。講演者と講演日時、講演者は次の通りでした。各講演者の予稿集を掲載しました。

3rd Tsukuba Global Science Week (TGSW)

Session: Health and Sport Sciences
Date and time: Sep.30, 2014 9:00−12:25
Venue: 5C216

Program

9:00−9:05　Introduction Dr. Michiyoshi Ae (University of Tsukuba)

(1) Biomechanics / Sports Technology (9:05−10:50)
Chair: Dr. Michiyoshi Ae (University of Tsukuba)
9:05−9:40　Dr. Jill Mcnitty-Grey (University of Southern California)
9:40−10:15　Dr. Takeshi Asai (University of Tsukuba)
10:15−10:50　Dr. Andy Harland (Loughborough University)

10:50−11:10 Break

(2) Health Science (11:10−12:20)
Chair: Dr. Seiji Maeda (University of Tsukuba)
11:10−11:45　Dr. Tomohiro Okura (University of Tsukuba)
11:45−12:20　Dr. Hyon Park (Kyung Hee University)

12:20−12:25　Closing statement Dr. A. Nakagawa (University of Tsukuba)

## Improving the Biomechanics of Aerial Skills performed by Olympic Athletes

**Jill L. McNITT-GRAY [*] , PhD, FASB [*]**

Satisfying mechanical objectives of sports-specific tasks requires effective interaction between the neuromuscular system, the musculoskeletal system and the environment. Analysis of complex aerial skills, such as those requiring the generation of linear and angular momentum, indicates that the nervous system organizes the human body into a number of operational subsystems that are coordinated according to priorities specific to the individual performer. By determining multi-joint control strategies used by elite athletes across different tasks, we can advance our understanding of the biomechanics and facilitate learning and improvements in performance. The acquisition of evidence for modifications in movement technique requires systematic experimentation conducted in realistic contexts, including the Olympic Games. The combination of laboratory-based experimentation and dynamic modeling with evidence from field-based studies allows us to determine how athletes are generating the forces causing the observed movements and ascertain why certain factors affect performance. These quantitative results acquired under realistic conditions can then be used as a basis for designing skill progressions used to improve performance for athletes at all skill levels. As part of this talk, we will discuss how knowledge of flight and contact phase biomechanics can be used to improve the performance of Olympic level divers and gymnasts during competition.

## Research and Development of Sport Equipments at the University of Tsukuba

**ASAI Takeshi** [**] , FUJII Norihisa [**] , KOIKE Sekiya [**] and AE Michiyoshi [**]

Research projects related to sport fluid engineering are being conducted at the University of Tsukuba, as a part of the 'Multi-support Project', sponsored by Ministry of Education, Culture, Sports, Science and Technology, Japan.

For example, research and development related to bicycle competitions, including the areas of competitive bicycle frames, wheels, helmets, and wear, have been conducted jointly with many affiliated companies. The sport wind tunnel at the University of Tsukuba has been used to examine the aerodynamic characteristics of sport products, in order to improve the performance of competitive bicycles. In the case of competition wear, examinations include ways to delay the boundary layer separation on the back surface of an athlete, the turbulence effects on the lower body caused by pedalling, and the rectification of the air flow from the stomach region to the back, and findings have been implemented.

In addition, in the research and development for ski jump suits, the fabric resistance of ski jump wear was measured using an airfoil tool, and a full scale mannequin was used to analyze the aerodynamic characteristics of ski jump suits, while taking into consideration the forms and sewing portions of the latest ski jump suits. Furthermore, computational fluid dynamics was employed to analyze the flow velocity distribution and pressure distribution of an athlete during flight phase of ski jump, for the purpose of improving ski jump suits. The developed ski jump suits were worn by all the Japanese athletes who participated in the 2014 Winter Olympics at Sochi in Russia, where the ski jump team won a silver medal (men's individual large hill) and bronze medal (men's team large hill), and the Nordic combined team won a bronze medal.

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[*] Departments of Biological Sciences and Biomedical Engineering University of Southern California, Los Angeles, CA

[**] Faculty of Health and Sport Sciences, University of Tsukuba, Japan

## Sports technology and performance; how athletes of all standards can benefit

**Andy HARLAND** *

Technology plays an ever increasing role in sport, from training and conditioning aids, through enhanced equipment used in competition to performance analysis and feedback systems. In his talk Dr Harland will reflect on recent technological developments in sport and discuss how these have affected sports performance. He will consider the role that technology might play in future and explore the boundaries between technological advantage and unfair advantage. Drawing on case studies from his own group's research, Dr Harland will discuss how partnership based, athlete centred approaches to research have led to successful outcomes in a range of individual and team sports. He will also discuss how the public appetite for technology is important in driving advances in sports technology and how the needs of elite athlete compare to those of recreational athletes and why it is important to consider both.

## A novel fall- and dementia-exercise program for successful aging of older adults

**OKURA Tomohiro, PhD** **

To prevent physical frailty and a decline in cognitive function in older adults, regular physical activity and exercise training are considered indispensable. We have developed a novel exercise program for preventing falls and dementia called “Square-Stepping Exercise” (SSE), which can induce functional activation of the brain.

The purpose of this study was to investigate the longitudinal effect on the physical and cognitive functions of community-dwelling, older, Japanese adults who regularly performed the SSE over 3 years.

Our study had 2 groups: the SSE Group ($n = 40$; mean age 70.2 ± 3.6 years) in which participants voluntarily continued the SSE program once or twice per week for 3 years, and the Control (C) Group ($n = 40$; mean age 70.1 ± 3.6 years) who were randomly selected from the basic resident register. We evaluated physical performance with 7 performance tests and assessed cognitive function using the 5-cog test.

In the SSE Group, results of the 5-repetition sit-to-stand (SIS) and timed up-and-go (TUG) tests improved significantly over 3 years (SIS: 7.0 to 6.4 sec; TUG: 5.7 to 5.4 sec, trend $P < 0.05$). On the other hand, no changes were observed in the C Group. There were also significant differences between the two groups when we look at the change in SIS and TUG results from year 2 to year 3: SIS (2nd year: 5.8 vs. 7.2 sec; 3rd year: 6.4 vs. 7.2 sec, $P < 0.05$) and TUG (2nd year: 5.1 vs. 5.7 sec; 3rd year: 5.4 vs. 5.9 sec, $P < 0.05$) (SSE Group vs. C group, respectively). Furthermore, 5-cog test scores in the SSE Group increased significantly over 3 years while no change was observed in the C Group (SSE 69.7 to 84.1, $P < 0.05$; C 69.3 to 76.3, not significant). The scores of the 5-cog test indicated a significant difference in the third year between the SSE and C groups (84.1 vs. 76.3 points, $P < 0.05$).

These results suggest that regular and voluntary participation in SSE by older adults over three years could help them maintain or improve their physical and cognitive functions.

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* Director, Sports Technology Institute, Loughborough University, UK

** Faculty of Health and Sport Sciences, University of Tsukuba

# Application of Korean Red Ginseng or Some Specific Ginsenocides as a Nutritional Ergogenic

**HYON Park, Ph.D.** *

Ginseng, which is often called the root of life, is a deciduous perennial plant which has a very long history of use for the promotion of health, especially in far eastern countries and in Europe. From 11 ginseng species, Korean ginseng is known to be the highest-quality one that contains the largest variety of ginsenocides, efficacy components of ginseng, as around 32 out of 37 known ginsenocides so far. A processed form as of red ginseng is the popular product in the market, and its Korean FDA certified efficacies are as follows; 1) enhances the immune system, 2) aids in recovery from fatigue, 3) promotes blood circulation, and 4) promotes memory functions. Other studies on Korean ginseng have proposed additional efficacies: control over blood sugar level and vast improvement on male sexual function.

Korean red ginseng or other purified ginsenocides as Rg1, Rg3, Rb1, and Rh1, have been tested as an ergogenic for athletic performance for decades. Effects on the attenuation of negatives caused by lipid-peroxidation, the increase of immune function, and the ability of faster recovery from severe physical activity are agreed in most of studies on animals and human subjects. On the other hand, supporting evidences of performance improvement have not produced enough result to be accepted yet, but some results of possible beneficial effects of specific purified ginsenocides on physical performance have been shown in several recent well-designed(randomized, double-blind, placebo-controlled, and crossover) studies. Proposed mechanism of effects involves several biochemical processes of oxidative stress buffering and anti-inflammatory works of applied ginsenocides.

We still need to look deeper on ginseng and its efficacy components, ginsenocides, on optimum dose, types, and timing to use them as safe and recommendable nutritional ergogenic supplements. This presentation will cover from the general information of ginseng to the application of ginseng as an ergogenic with various scientific evidences.

**Key words:** Korean red ginseng, ginsenocides, health, physical performance, ergogenics

* Professor at the Department of Sports Medicine, Kyung Hee University, Korea