

# Symposium 20

## Exercise and Cardiometabolic Dysfunction

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### Chairpersons

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**Jong-Hee Kim**

Hanyang University, Korea

**Sewon Lee**

Incheon National University, Korea

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### Speakers

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**Oh Sung Kwon**

University of Connecticut, USA

**Jaehoon Seol**

University of Tsukuba, Japan

**Min-Hwa Suk**

Hanyang University, Korea

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### Panel Discussion

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**Kyeongho Byun**

Incheon National University, Korea

**Seungyong Lee**

Incheon National University, Korea



## Oh Sung Kwon

University of Connecticut, USA

### • Education

Period	Affiliation	Position
- 2013	University of Florida	Ph.D.
- 2009	East Carolina University	M.A.
- 2002	Seoul National University	M.A.
- 2000	Seoul National University	B.A.

### • Affiliations / Experience

Period	Affiliation	Position
- 2019-Present	University of Connecticut	Assistant Professor
- 2016-2018	University of Utah	Research Associate
- 2014-2016	University of Utah	Post Doctoral Fellow

### • Committee Memberships

- American College of Sports Medicine (ACSM)
- American Physiological Society (APS)

### • Publications

- The Receptor for Advanced Glycation End Products (RAGE) is involved in Mitochondrial Function and Cigarette Smoke-Induced Oxidative Stress. *Free Radical Biology and Medicine*, 195:261-269
- Aging and Endothelium-mediated Vascular Dysfunction: The Role of the NADPH Oxidases. *Journal of Physiology*, 601(3):451-467
- Regulation of Endothelial Function in Human Skeletal Muscle Arteries: Role of Adropin. *Journal of Physiology*, 597(7):1791-1804
- Quadriceps Muscle Atrophy After Non-invasive Anterior Cruciate Ligament Injury: Evidence Linking to Autophagy and Mitophagy. *Frontiers in Physiology*, 15:1341723
- Intramyocellular ceramides and skeletal muscle mitochondrial respiration are partially regulated by toll-like receptor 4 during hindlimb unloading. *Am J Physiol Regul. Integr. and Comp*, 311(5):R879-R887

**Symposium 20**

## **Impact of Progressive Dynamic Resistance Training on Skeletal Muscle and Vascular Function in Older Adults**

Oh Sung Kwon (University of Connecticut, USA)

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Resistance training results in significant improvements in skeletal muscle strength and mass in older adults. However, there is no consensus on the effect of resistance training on vascular endothelial function. Accordingly, the purpose of this study was to determine the effect of progressive dynamic resistance training on both vascular endothelial function as well as skeletal muscle function in older adults.

Twelve older adults (6 males and 6 females) aged  $71 \pm 4.2$  years (mean  $\pm$  SD) participated in this study, undertaking 12 weeks of dynamic resistance training. Prior to and following the training, subjects underwent testing of vascular function using flow mediated dilation (FMD) on brachial artery, passive leg movement (PLM) on femoral artery, and pulse wave velocity (PWV) and muscular function using handgrip, knee extension, and leg press.

As anticipated, handgrip maximal strength showed significant improvement in both hands before and after training (right hand:  $24.6 \pm 6.0$  vs.  $28.0 \pm 5.4$  kg,  $p < 0.001$ , RT PRE vs. RT POST; left hand:  $23.0 \pm 5.4$  vs.  $26.9 \pm 5.8$  kg,  $p < 0.001$ , RT PRE vs. RT POST). Additionally, 12 weeks dynamic resistance training enhanced leg press 1RM ( $43.5 \pm 10.8$  vs.  $55.7 \pm 14.6$  kg,  $p < 0.01$ , RT PRE vs. RT POST) and knee extension 1 RM ( $32.1 \pm 59.8$  vs.  $44.4 \pm 10.6$  kg,  $p < 0.01$ , RT PRE vs. RT POST). Interestingly, flow mediated dilation (FMD) was significantly improved with resistance training ( $4.5 \pm 0.5$  vs.  $6.0 \pm 0.6$  %,  $p < 0.05$ , RT PRE vs. RT POST). Furthermore, the passive leg movement (PLM)-induced peak leg blood flow was significantly enhanced with the training ( $222 \pm 40$  vs.  $358 \pm 51$  ml/min,  $p < 0.05$ , RT PRE vs. RT POST) Pulse wave velocity (PWV) significantly decreased after resistance training ( $12.6 \pm 0.7$  vs.  $10.7 \pm 0.9$  m/s,  $p < 0.001$ , RT PRE vs. RT POST).

Together, our data support that dynamic resistance training may enhance vascular function concomitantly with skeletal muscle function.



## Jaehoon Seol

University of Tsukuba, Japan

### • Education

Period	Affiliation	Position
– 2017-2020	University of Tsukuba, Japan	Ph.D.
– 2015-2017	University of Tsukuba, Japan	M.S.
– 2013-2015	University of Tsukuba, Japan	Research Student in Physical Education
– 2006-2013	Myeongji University, Korea	B.S.

### • Affiliations / Experience

Period	Affiliation	Position
– 2024-Present	University of Tsukuba, Japan	Assistant Professor
– 2024-Present	National Center for Geriatrics and Gerontology, Japan	Visiting Researcher
– 2021-Present	International Institute for Integrative Sleep Medicine, Japan	Visiting Researcher
– 2023-2023	National Institute of Occupational Safety and Health, Japan	Researcher
– 2021-2023	Japan Society for the Promotion of Science, Japan	JSPS Postdoctoral Fellowship

### • Committee Memberships

- Korean Society Exercise Nutrition
- BMC Geriatrics, Part of Springer Nature
- Korean Academy of Kinesiology

### • Publications

- Validation of sleep-staging accuracy for an in-home sleep electroencephalography device compared with simultaneous polysomnography in patients with obstructive sleep apnea. *Scientific Reports*, 14(1):3533
- Relationship between rest-activity rhythms and cardiorespiratory fitness in middle-aged workers: A cross-sectional study with non-parametric analysis using accelerometers worn on the thigh. *BMC Public health*, 24(1):62
- Association between electroencephalogram-based sleep characteristics and physical health in the general population of middle age. *Scientific Reports*, 13(1):21545
- Bidirectional associations between physical activity and sleep in older adults: a multilevel analysis using polysomnography. *Scientific Reports*, 12(1): 15399
- Distinct effects of orexin receptor antagonist and GABAA agonist on sleep and physical/cognitive functions after forced awakening. *PNAS*, 116: 24353-24358

**Symposium 20**

## **Sleep, Metabolic Diseases, and the Role of Physical Activity in Middle and Older Individuals**

Jaehoon Seol (University of Tsukuba, Japan)

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Sleep is a critical physiological activity that everyone engages in, comprising one-third of our daily lives. Numerous studies have demonstrated that sleep deprivation can lead to various health problems, with a well-established link to metabolic diseases, including cardiometabolic risk.

Modern life patterns vary widely, and many people are unable to secure sufficient sleep due to night shifts, overtime work, and irregular sleep schedules, leading to chronic sleep deprivation and social jetlag. Older adults often experience a decrease in deep sleep, an increase in light sleep, and frequent nighttime awakenings. These changes in sleep patterns can lead to various health-threatening conditions, including insomnia-related disorders.

Conversely, abundant physical activity in daily life positively impacts both cardiometabolic risk and sleep. The presenter has explored the relationship between physical activity and sleep among middle-aged and older adults through large-scale epidemiological surveys using questionnaires, quantitative assessments with accelerometers, and both quantitative and qualitative sleep evaluations using polysomnography and portable electroencephalography devices.

In this symposium, the presenter will introduce recent research findings on the relationship between sleep and cardiometabolic risk. Furthermore, the effects of physical activity on sleep and cardiometabolic risk among middle-aged and older adults will be discussed. Additionally, the presenter will address the relationship between rest-activity rhythms, cardiometabolic risk, and cognitive function in middle-aged and older adults, a topic that has garnered significant attention in sleep medicine in recent years.



## Min-Hwa Suk

Hanyang University, Korea

### • Education

Period	Affiliation	Position
– 2008	Seoul National University	Ph.D.
– 2002	Seoul National University	M.A
– 2000	Seoul National University	B.A.

### • Affiliations / Experience

Period	Affiliation	Position
– 2020-Present	Seoul National University of Education	Part-Time Lecturer
– 2019-Present	Hanyang University	Adjunct Professor
– 2017-2020	Sungkyunkwan University (Samsung Medical Center)	Researcher

### • Committee Memberships

- Korean Society for the Study of Obesity
- Seoul Yoga Association
- Korean Society Exercise Nutrition

### • Publications

- Lee, J., Suk, M. H., Yoo, S., & Kwon, J. Y. (2023). The Decline of Physical Activity with Age in School-Aged Children with Cerebral Palsy: A Single-Center Cross-Sectional Observational Study. *Journal of Clinical Medicine*, 12(13), 4548
- Suk, M. H., & Kwon, J. Y. (2022). Effect of equine-assisted activities and therapies on cardiorespiratory fitness in children with cerebral palsy: a randomized controlled trial. *Journal of Integrative and Complementary Medicine*, 28(1), 51-59
- Lee, J., Suk, M. H., Yoo, S., & Kwon, J. Y. (2022). Physical activity energy expenditure predicts quality of life in ambulatory school-age children with cerebral palsy. *Journal of Clinical Medicine*, 11(12), 3362
- Suk, M. H., Park, I. K., Yoo, S., & Kwon, J. Y. (2021). The association between motor capacity and motor performance in school-aged children with cerebral palsy: An observational study. *Journal of Exercise Science & Fitness*, 19(4), 223-228
- Suk, M. H., Jang, H. S., Lee, J. W.(2020). Comparison of the Daily Fitness Test in Nursing Home Residents and Community-Dwelling Residents Elderly Women. *Exercise Science*, 29(4), 409-415

**Symposium 20**

## **Exercise Recommendation Algorithm for Improving Functional Movement: Focusing on Individuals with Obesity**

Min-Hwa Suk (Hanyang University, Korea)

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Obesity is highly associated with chronic diseases such as type 2 diabetes, ischemic heart disease, hypertension, and atherosclerosis, as well as musculoskeletal disorders (Flegal, Kit, Orpana, & Graubard, 2013). While physical activity interventions can lead to overall improvements in physical condition, individuals with a high body mass index (BMI) may exhibit reduced range of motion in various joints (Park, Ramachandran, Weisman, & Jung, 2010).

Reduced range of motion can result in the weakening of the kinetic chain system or dysfunction of connective tissues related to the human movement system. Damage to body tissues can trigger inflammatory responses, which in turn activate the body's pain receptors, initiating protective mechanisms. This leads to increased muscle tension and muscle spasms. Consequently, adhesions (knots or trigger points) begin to form in the soft tissues. These adhesions weaken the tissue, transforming it into inelastic tissue (unable to stretch), thereby reducing the normal elasticity of the soft tissues. This alters the length-tension relationship of the muscles, leading to muscle imbalances and potential injuries (Clark & Lucett, 2010).

When obese individuals with decreased normal elasticity of soft tissues or muscle imbalances and injuries experience pain during exercise, they tend to stop exercising. Repeated movements with poor posture cause pain, so proper movement is essential to exercise without pain. It is necessary to first improve the function of movement or range of motion to enable pain-free exercise before proceeding with an exercise program. It will present a comprehensive exercise algorithm that has been designed for this purpose. This algorithm carefully considers the individual's physical capabilities, presence of pain, and gradual progression.

### Reference

- Flegal, K. M., Kit, B. K., Orpana, H., & Graubard, B. I. (2013). Association of all-cause mortality with overweight and obesity using standard body mass index categories: a systematic review and meta-analysis. *JAMA* 309(1), 71-82.
- Park, W., Ramachandran, J., Weisman, P., & Jung, E. S. (2010). Obesity effect on male active joint range of motion. *Ergonomics*, 53(1), 102-108.
- Clark, M., & Lucett, S. (Eds.). (2010). *NASM essentials of corrective exercise training*. Lippincott Williams & Wilkins.