

FEET MEASURE HEALTH



Impact Objectives

- Investigate the effects of toe grip training on fall prevention and cognitive function of the elderly
- Build evidence-based training related to toe grip and establish it as an effective exercise programme for nursing care prevention

Feet measure health

Associate Professor Ryota Tsuyuguchi is part of a team focused on improving cognitive function in the elderly, and he talks about the main themes of his work and knowledge gaps he hopes to address



Can you begin by telling us how you became involved in sports science and health science research?

I have been the coach of the Osaka Sangyo University Athletic Association Men's Basketball Team for some time now. As regards to the injuries, athletes and coaches need to ensure that they do not ignore such issues. Over time, I started to wonder if there were any indicators or methods that could predict incidents and whether it was possible to use this information to help prevent foot and ankle sports injuries. In addition, the toes and soles of the feet are the only body parts that come into contact with the ground surface - only the toes move in the foot and the sole supports the weight.



Exercise of the athlete's toes and stimulation of the plantar feet improves performance

I started to think that for humans who walk on two legs, the function of the toes and the sensation of the sole of the foot are important. Ultimately, this was my impetus for starting my current research.

How did you embark on your current research project?

To conduct my current studies, I decided to enter the master's programme at Osaka Sangyo University and the latter half of a separate programme at Kansai Medical University, where I began research on the grip of the toes of the athletes and the elderly. During my time as a graduate student, I collaborated with researchers in health-related fields such as circulatory dynamics, metabolism, skeletal muscle function, arteriosclerosis, anti-ageing medicine, brain function and behavioural medicine. These fields gave me the insight I needed to realise the potential for my studies and how the findings might be used to benefit the elderly.

You are affiliated with the Faculty of Sports and Health Sciences at Osaka Sangyo University. Can you talk about the general approach to research ongoing in your department and team?

There are many themes which act independently from and in conjunction with all others. Some of the main themes include the relationship between toe grip strength and physical function, training related to toe grip, injury prevention for athletes, the improvement of athlete performance, fall prevention for the elderly and the improvement of cognitive function in the elderly. On the field of the men's basketball team of the athletic club, training related


to toe grip is carried out before and after practice to prevent injuries and improve performance. Moreover, in collaboration with the hospitals and elderly care facilities, we also provide training menus related to toe grip as part of the rehabilitation. We provide feedback for each.

What are the knowledge gaps that you hope to address with this research?

We would like to build evidence-based training related to toe grip and establish it as an effective exercise programme for nursing care prevention. We believe that it may be possible to contribute to the reduction of medical and nursing care costs by predicting future falls and preventing dementia. ●



Exercise of the toes and stimulation of the soles of the feet in the elderly can improve cognitive function and prevent falls



Fall prevention and cognitive function improvement

A team based within the Faculty of Sports and Health Sciences at Osaka Sangyo University is working on understanding the effects of toe grip training on preventing falls and increasing cognitive function in the elderly, hopefully leading to improved outcomes for the elderly, as well as additional benefits for athletes

It has often been said that the eyes are the window to the soul, but this is clearly meant in a metaphorical sense. In a more literal, scientific way, it can be said that the feet are the barometers of health. Indeed, there are sensory receptors in the toes and the soles of the feet that send a large amount of information to the brain. In this regard, there is an increasing belief that improving the sensitivity of the toes and the soles of the feet can be extremely beneficial in terms of preventing injuries and improving performance in athletes, as well as in helping to prevent falls and build cognitive function in the elderly.

It is with ideas such as these in mind that Associate Professor Ryota Tsuyuguchi has embarked on his latest research project. As a coach of the Osaka Sangyo University Athletic Association Men's Basketball Team, Tsuyuguchi was able to observe first-hand how important the feet are to performance and that led him to consider the wider

implications of improving the sensation in the toes and soles of the feet. Based within the Faculty of Sports and Health Sciences at Osaka Sangyo University in Japan, Tsuyuguchi forms part of a team interested in preventing injuries in athletes and improving cognitive function in the elderly. The team began their research with a simple thought: it might be possible that the beneficial effects of exercise can be obtained by conducting training related to toe grip. From there, the current project began.

THE TOES AND SOLES OF THE FEET

It has long been known that exercise is an essential part of maintaining and improving health, but this is true only in a general sense. What is particularly novel about Tsuyuguchi and the team's current investigations is the focus on the toes and the soles of the feet. 'The improved sensation in the toes and soles of the feet helps improve the physical function, leading to injury prevention and improved

performance for athletes,' outlines Tsuyuguchi. 'Moreover, it will likely lead to prevention of falls and dementia in the elderly, and we believe that this has high clinical significance as a new method in the field of nursing care prevention. Training related to toe grip can be easily and safely carried out anywhere, even by elderly people.' ►



Feet are the barometer of health

The toes are not typically exercised daily, but research has shown that toe function can be improved by training related to toe grip. Fascinatingly, there is a suggestion that training interventions related to conscious toe grip might affect brain metabolism and brain nerve activity, thereby contributing to the improvement of cognitive function. Of course, there is a limit to how much cognitive function can be improved through simply exercising, but it is believed that because toes grip is not a function that is often used, consciously moving the toes in specific ways might have a positive impact on nerve activity.

TOE GRIP TRAINING

Training related to toe grip allows stimulation from the toes to travel through the cortex and then the spine, into the brain stem, white matter and finally the cerebral cortex. Tsuyuguchi explains this can improve the cranial nerve activity in the primary somatosensory cortex in the parietal lobe and which may contribute to improve cognitive function. 'The parietal

CHALLENGES AND OPPORTUNITIES

As with any scientific investigation, the research has not been without its specific challenges. 'In goal-directed planning, low-load tasks can be processed using neural regulation and brain activation is seen as the load increases. However, when the limits of neural control are exceeded during high-load tasks, the execution ability and brain activation also decreases,' observes Tsuyuguchi. 'Elderly people are individually affected by ageing and previous studies have suggested that individual differences arise due to variability in neural regulation, so we believe that there is a room for consideration regarding protocols for training interventions.'

Still, despite these challenges, Tsuyuguchi and the team are excited about the future directions this research could take. Muscle strength and dexterity can be improved by training related to toe grip. Both are necessary to prevent falls and it is better to press on the foot at three points: the big toe ball, the little toe ball and the heel. To utilise

'We believe that this has high clinical significance as a new method in the field of nursing care prevention'

association cortex in the parietal lobe is the part that controls the integration of visual, sensory and linguistic information, as well as the recognition and judgement of space and time,' he describes. 'The improvement in points for the time orientation and place orientation parts of the mini mental state examination (MMSE) suggests that the brain nerve activity in the parietal association cortex and in the parietal lobe may have improved.'

The team's studies have been far-reaching and they have studied virtually all age sectors of society. Tsuyuguchi highlights some of the most interesting findings which have shown that the output of the motor association cortex in the frontal lobe was strengthened and the function of the A10 nerve nucleus was improved, suggesting that the prefrontal cortex was also affected. Of course, humans walk on two legs, so the toes and soles of the feet are the only contact surfaces with the ground. Thus, the ability to grip the toes is necessary to maintain a stable standing posture. Toe grip ability plays a major role in walking activities and in maintaining balance, it is also considered to be an important element that is deeply related to the activities of daily living of humans and motor ability.

the three points, it is thought that dexterity to move the toes freely is required. Flexing the toes requires dexterity and power cannot be exerted unless the toes are bent, so dexterity in the toes is also necessary. It may not stop you from tripping, but after tripping with muscle strength and dexterity, it is possible to keep your footing without falling.

FUTURE FOCUS FOR RESEARCH

With these points in mind, training related to toe grip will improve the ability of the toes and soles to grasp the ground. Thus, it is believed that the activation of mechanoreceptors on the soles of the feet, which serves as sensory organs for postural control will improve toe grip function to ensure support and safety. 'Many sensory nerve endings are distributed in the forefoot and it is assumed that information from more mechanoreceptors leads to fall prevention. It is possible that training related to toe grip stimulates the sole of the foot, which excites the receptors and improves spinal reflexes,' says Tsuyuguchi. 'Moreover, by moving the centre of gravity forward through training of toe grip, it will encourage autonomic posture adjustment through the spinal reflexes, which may also

be an effective approach in the prevention of falls.'

However, although there are reports using objective indicators to evaluate cognitive function, there have been no studies using markers that indicate cognitive function in the blood, so the team believes that blood tests can provide evidence of the mechanism by which cognitive function improves. This will form part of the future of the research, which will be of particular benefit to the elderly. ●

Project Insights

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BIO

Associate Professor Ryota Tsuyuguchi is based at the Faculty of Sports and Health Sciences, Osaka Sangyo University, Japan. He specialises in sports science, health sciences, health education, fall prevention and cognitive function. Currently, Tsuyuguchi is engaged in education at Osaka Sangyo University as well as the coach of the men's basketball team of the Athletic Association who won the 2023 Kansai Student Basketball League (Division 1) for the first time.

