Could you outline your research on the relevance of falls in elderly populations within the context of healthy ageing?

Today, ageing of the global population is unprecedented and increasing. In order to reduce healthcare and insurance costs, as well as costs associated with days away from work, the focus on healthy ageing is of utmost importance. With backgrounds in mechanical engineering and ergonomics, as well as musculoskeletal and neuromuscular biomechanics, our focus is on providing and improving healthcare technologies that foster independent living throughout society. Our vision is not only to identify intrinsic and functional parameters that are critical for effectively performing activities of daily living, but also to evaluate the outcomes as functional biomarkers for identifying individuals that have motor-related deficits.

What are the main objectives of your study on elderly and first-time fallers?

A popular practice in fall management is to incorporate a subject’s history of falling into the statistical predictions. While this simple parameter is critical for estimating prospective fall risk, it only provides information about elderly individuals that are repeat fallers. However, we believe that identifying and quantifying motor-related deficits could be highly effective for predicting first time fallers, and therefore important for reducing fall-related injuries and fostering healthy ageing. We therefore focus on identifying intrinsic motor-related deficits that might have an impact on effective task performance. In general, this is achieved by extracting functional domains from a wide variety of task-related parameters, which are then validated against retrospective falls. Our approach therefore uses fall history, obtained after the end of measurements, as an outcome parameter – rather than a predictor – to validate our estimations of prospective fall risk.

What are the most significant consequences of falling both for individuals and healthcare systems?

Although hip and vertebral fractures only result from about 5 per cent of injurious falls in the elderly, they account for the majority of socioeconomic costs, including healthcare costs and loss of working days. Falls that result in a fracture might actually be fatal in about 20 per cent of the cases, with most of these fall victims dying within a year of the event.

Why did you choose muscle strength, muscular control, standing balance, and mean and variability of gait as your four functional domains?

While muscle strength governs the maximum force that can be produced voluntarily by the muscle, control of the muscle is far more important for providing an accurate and steady outcome for the task at hand. Standing balance and variability of movement patterns are indirectly associated with stability during standing and walking. Conceptually, extremely high levels of variability during a task lead to situations that would require the involved muscles to produce correspondingly large forces and moments that can counteract or balance out such a deviation. Additionally, mean parameters of gait capture relevant parameters of function that not only quantify a subject’s overall ability to perform a task but that are also easy for clinical personnel to understand and check, therefore providing an additional quality to the assessments. What is interesting is that the combination of these parameters – strength, stability and control – seems to offer a comprehensive measure for functional ability that is predictive of neuromotor deficits and impairments, as well as providing a functional basis for predicting fallers and non-fallers.

To what extent have screening tools for the identification of individuals with a high risk of falling contributed to the prevention of falling and injury?

Regardless of the screening tool used, the single best predictor of fall risk is still the history of falling. However, in our opinion, such an approach has very low predictive and therefore low preventive value for first-time fallers. Looking ahead, it is really important that fall risk identification and prediction platforms focus on the prevention of falls and consequent injuries. Moreover, while our recent investigation focused on assessing the functional status of elderly women, in future we would like to assess the role of sensory modalities on task performance and their efficacy towards independent living in the elderly population at large.
IN A WORLD with a rapidly ageing population, falls among the elderly represent a significant global health challenge, as well as a threat to healthy ageing. Multiple studies have highlighted that falls impose a sizeable socioeconomic burden in many Western countries, totalling an estimated 1 per cent of annual national healthcare expenditure. According to the US Centers for Disease Control and Prevention (CDC), falls are the leading cause of fatal and non-fatal injuries among older adults, and the most common cause of traumatic brain injury. Indeed, some 20 to 30 per cent of people who fall suffer moderate to severe injuries – lacerations, fractures and head traumas – resulting in hospitalisation, the loss of mobility and sometimes even death. In addition to being a worrying cause of mortality in the elderly population, injuries incurred as a result of falling can make it very difficult for individuals to move around or live independently.

With the recent UN census estimating that the population of elderly individuals over the age of 60 will reach approximately 2 billion by 2050, it is essential that researchers and clinicians work together to develop robust strategies for the promotion of healthy ageing. Encouragingly, recent years have seen advances in the creation of screening tools for the identification of elderly individuals at high risk of falling, enabling them to benefit from targeted preventive therapies. However, these screening tools can be difficult to design due to the enormous range of different risk factors for falls. As such, current approaches are varied and can range from the subjective clinical assessment of function and self-reported questionnaires, to rigorous laboratory evaluations of motion tasks.

TECHNOLOGICAL DEVELOPMENTS

To date, the most accurate and commonly used predictor for falling involves examining the patient’s prior history. According to statistics, individuals who have already experienced a fall are three times more likely to fall again than those who have not. However, the obvious shortfall with this method is that it cannot be used to identify individuals at high risk of a first-time fall. There is therefore an urgent need to develop a screening indicator that assesses fall risk among the elderly without relying on fall history and that takes into account environmental, intrinsic and external factors as possible fall triggers.

In response, researchers at the Institute of Biomechanics at ETH Zürich are attempting to develop innovative healthcare technologies that facilitate independent living and thus advance healthy ageing. Professor Dr William Taylor is one of these researchers and, with a strong background in mechanical engineering, ergonomics and musculoskeletal and neuromuscular biomechanics, he recently led a collaborative study that focused on assessing fall risk based on the identification of motor-related deficits in over 80 women aged between 60 and 85. In the study, four functional domains were tested – muscle strength, muscular control, standing balance and mean and variability of gait – and participants were classified as fallers, non-fallers and prospective first-time fallers. By measuring the muscular movement and control of the participants, the researchers were able to pinpoint functional impairments at an early stage.

CHARTING THE METHODS

In the study, the elderly participants were asked to perform specific force production, static standing and walking tasks – all of which were conducted on the same day. The force production tasks, carried out using the knee extensor and ankle plantarflexor muscles, enabled the researchers to obtain measurements for muscle strength and control. In the strength measurement task, participants were instructed to push against an attachment connected to a force measurement device with their maximum force, while seated. As for the muscle control task, participants were asked to produce different levels of force according to the varying target force profiles displayed on a screen.

The balance assessment involved the participants standing with each foot placed on two adjacent multi-sensor force platforms. The tasks – which took 30 seconds to complete – were conducted with eyes open and then closed, and participants repeated each task three times. In the walking assessment, the participants were instructed to walk across a straight walkway measuring 20 m. The parameters measured included step length, cadence, temporal symmetry, gait speed and walking time.
Important strides in identifying and predicting individuals at high-risk of falling...