Abstract

Primary objective of this thesis is to present the development of an easy to use instrumented device which has the ability to detect sarcopenia among older people. Sarcopenia, among older people, is age-related decrease in muscle mass which results in to loss of muscle strength and functional performance.

Ageing is a complex process which requires older people to maintain their physical, social and cognitive health. It is important to detect decline in any of these abilities as early as possible in order to stop and then reverse the functional decline. Decrease in functional ability and geriatric assessment is being done using different functional screening tests that are internationally known and suggested by the World Health Organisation (WHO).

Our study begins with geriatric screening of about 120 older people to detect if their health is being declined. We used different functional screening tests along with their basic characteristics like age, height, weight and gender etc. and observed that the major reason of health decline of older people is decrease in their physical performance due to loss of skeletal muscle mass and power. Estimated prevalence of Sarcopenia in India is 17.5% which is higher than many other countries. According to the standard algorithm proposed by European Working Group on Sarcopenia EWGSOP2, the three aspects required to be tested are muscle mass, muscle strength and physical performance, in order to diagnose Sarcopenia,

The aim of this thesis is to determine the prevalence of Sarcopenia and to choose a screening test that can best estimate the muscle mass, muscle strength and physical performance of a subject. Short physical performance battery (SPPB) is found to be one of the most appropriate generic screening tests for elderly. It consists three tests that measure balance, walking speed and muscular performance while standing up from chair. In our study, we developed a machine learning based solution to detect Sarcopenia, where it was found that the SPPB test gives the best performance in detecting Sarcopenia in elderly as compared to TUG and Gait Velocity.

One of the component of SPPB is the Five-times Sit-To-Stand test that is often used as stand-alone test. The 5 times sit-to-stand (5STS) is designed to assess muscular capacity, where the time to perform consecutive 5STS, typically measured using a hand-held stopwatch is used as an outcome measure.

With experiments, we found that physical performance and muscle power are highly correlated to the STS time. Some recent studies have shown that muscle strength and muscle mass are highly correlated, leading to an indirect relation of STS time with muscle mass too. Hence, STS test can give us estimates for the three aspects for Sarcopenia, as laid down by EWGSOP2. With these benefits, STS test becomes an obvious choice for Sarcopenia detection and determining muscle strength and physical performance. However, manually measuring the time of STS using stopwatch can lead to human errors.This encouraged us to design an instrumented version of STS.

Towards this, we design and validate a novel instrumented chair with two objectives 1) To determine whether our instrumented chair is more accurate to other instrumented solutions in measurement of STS time. 2) To evaluate the capabilities of the instrumented chair in determining different phases of STS.

With a detailed experimentation over sufficient elderly subjects, it was seen that our iSTS chair could accurately measure STS time compared to an human expert, with better performance than three

other instrumented versions of the STS; force plate, Kinect sensor, and standard RGB camera. Further, we propose various techniques to identify phases of the STS movement by using iSTS chair and it was seen that the iSTS chair design is better than other instrumented solutions to detect the individual phases too. With the accurate estimates of STS, the device has an added advantage that it is economic and easily portable.

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