

Validation protocol for walking speed as extracted from various sensor systems that measure human body motion for the healthcare sector

Protocole de validation de la vitesse de marche extraite de divers systèmes de capteurs mesurant les mouvements du corps humain pour le secteur des soins de santé

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Foreword

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This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 3, *Anthropometry and biomechanics*.

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Introduction

Walking speed is recognized as being a reliable predictor of healthy function for people of all ages, and in particular for the elderly, and has been referred to as one of the “vital signs” of physical health and as one of the predictive factors of future health and death.^{[1]-[4],[11]-[14]} Studies of community-dwelling older adults (65 years and older: mean \pm standard deviations age $74,2 \pm 2,9$ years for one study^{[4],[11]} and $74,1 \pm 5,7$ years for another^{[5],[11]}) have shown that walking speeds faster than 1,0 m/s suggest healthier **agingageing**, while walking speeds slower than 0,6 m/s suggest an increased likelihood of poor health and function^{[4],[5],[11],[15]}.

In the healthcare sector, measuring walking speed by using a stopwatch and a tape measure is the gold standard (hereafter, reference method).^{[6]-[8],[16]-[19]} Recent new technologies enable walking speed to be measured using various sensor systems (e.g. wearable sensors, environment-embedded sensors).^{[9],[10],[19],[10]} These technologies offer possible improvements on the reference method in healthcare for measuring walking speed, such as being able to measure walking speed during daily living.^{[10],[10]} Measurements taken during daily living could produce a more accurate health index due to decreased examiner influence and the ability to measure walking speed for longer distances and more frequently than in a clinical setting. Further, sensor systems can be utilized to establish a fatigue index in the work environment.

There is, however, no fixed standard to validate walking speed measured by such new technologies against the reference method. Therefore, users of such systems (e.g. physicians, therapists, ergonomists) cannot compare the accuracy between different systems based on the same evaluation protocol.

The intent of this document is to provide manufacturers of sensor system technologies with a standard means of validating and reporting walking speed values against the values provided by the reference method for measuring walking speed in the healthcare sector.

There are several different fundamental technologies underlying commercially available sensor systems that measure walking speed. This document covers these technologies, including accelerometer-based systems, depth-sensor-based systems and **GPS-global positioning system (GPS)**-based systems.

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