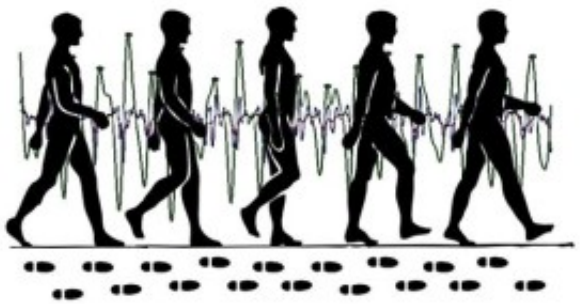
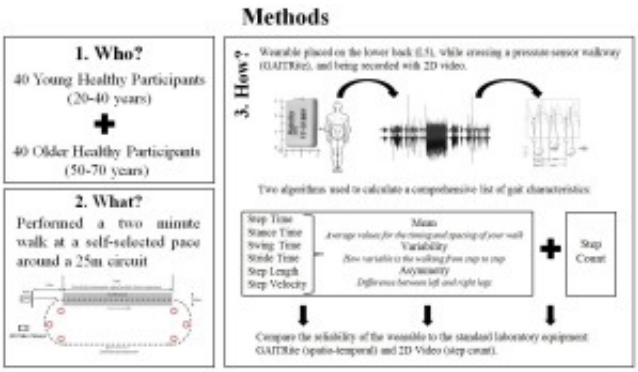
Wearables: walking the walk

How you walk, or your ‘gait’, is a simple test that can provide highly accurate and objective data about ones cognitive decline, falls status, quality of life and general health. Therefore, accurate measurement of gait is becoming increasingly important as a robust method to determine many aspects of health. Traditionally, spatio-temporal gait analysis has been restricted to the clinic/laboratory, where expensive systems and technical expertise are required to measure numerous characteristics (e.g. step time and step length) during a walk. This is because the means to quantify those characteristics are quite complex. Such exclusiveness has driven the demand for clinically appropriate wearables (body worn monitors) that will allow cost-effective and easy assessment of gait in both controlled (clinic) and free-living (community) environments. The popularity of modern wearables has been driven by companies with black box methods of analysis. However, numerous limitations are present with such systems; validation on a small number of people during restrictive testing protocols and quantifying limited/inappropriate gait characteristics of little use in clinical practice.



In this study the authors investigated the use of a low-cost accelerometer-based wearable (AX3, Axivity, Newcastle, UK) worn on the lower back and two gait algorithms (the means to decode the information from the signals) for gait analysis compared to standard laboratory references (instrumented walkway and video) using a robust testing protocol in 80 younger and older adults. The aims were simple but answered important questions within the field: (1) the evaluation of a low-cost wearable with algorithms to accurately quantify gait and (2) algorithm and protocol examination to understand limitations of previous studies.

The authors found that step count and mean values between the wearable and laboratory references agreed excellently and worked equally well for walking in straight lines or around a curved path. However, for the more clinically sensitive characteristics (e.g. step to step fluctuations of step time) the wearable and references were able to differentiate young and older participants equally well, but the most sensitive characteristics for identifying these groups was different for each method.



Thus, it was important to consider why such differences occurred. Although both systems measure gait, the way in which this happens is fundamentally different. For example, in comparison to the intermittent footfalls of the instrumented walkway, the primary purpose of the wearable is to continually track the body resulting in a constant signal that is representative of whole body movement. The resulting signal analysis of the wearable therefore represents the trajectory of the person rather than just their heel strikes as detected by the walkway. As such, the characteristics reported by the wearable are best estimates due to its location and the biomechanical properties affecting any calculations should be considered.

The wearable and its algorithms used in this study form a useful means for the purposes of assessing gait in healthy adults. This is promising as clinical gait analysis with wearables transitions into free-living environments. The results also highlight caution in the choice of reference system for validation studies and that further refinement of algorithms is recommended to optimise wearable applicability.

This is important as the proposed wearable methodology may be suitable for long-term monitoring of people in real life. Accurate step count and spatio-temporal gait characteristics can be important outcomes that can be used to evaluate the effectiveness of lifestyle-based interventions, rehabilitation strategies, inform long-term trial effectiveness (e.g. pharmaceutical) and public health recommendations where adults often fail to meet basic physical activity guidelines.

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Publication

Instrumenting gait with an accelerometer: a system and algorithm examination.
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