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Body worn monitors: a lot done, more to do

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Commentary

A recent commentary by Laverty et al compared two recent studies [1, 2] for physical activity (PA) outcomes on groups of older adults [3] and remarked that [1] had “ more accurate assessment of physical activity”. Examining the referenced studies we find that [1] measured PA by self-report and [2] by an electronic body worn monitor (BWM, accelerometry), which raises the question: is the comparison justifiable? Evidence has shown that self-report measures of PA underestimate compared to gold standard (defined as electronic-based devices) measures of PA, making it difficult to attempt for corrections when comparing studies [4]. This highlights the inconsistency within self-reported methods of PA. If we examine the self-report method in [1] we find that validity (accuracy) is modest but repeatability is high [5]. This means participants are reliable in under/overestimating their PA and therefore the self-report method is ‘reliably inaccurate’. We do not question the findings of [1] as meaning can still be derived from (large) data sets gathered in a reliable and therefore consistent manner, despite any inaccuracies. Nonetheless we conclude the comparison between studies is not justifiable.

However, comparing the studies [1, 2] creates further areas of discussion where clarity remains lacking. PA is often used interchangeably and incorrectly within the literature and is defined as ‘any bodily movement produced by skeletal muscles that result in energy expenditure’ (EE) [6]. Study [1] satisfied these requirements by trying to categorise PA within the activities of daily living and estimated EE related outcomes i.e. metabolic equivalents (METs). In contrast, the authors in [2] less accurately defined PA (albeit for their purposes) as periods of time in ambulatory behaviour (walking). By definition [1] adopted a more suitable approach for PA quantification, yet large heterogeneity is found in their methodology; use of a Compendium of PA which relies on general values, tailored for the group rather than the individual [7]. Conversely, [2] used an accelerometer which is sensitive to the individual but could only account for time spent in (general) ambulation, unable to outline the intensity/effort involved. The strength of one study is the weakness of the other. To date self-report remains unrivalled in large population based studies due to its ease of use and associated cost (minimal). Nevertheless, while self-report can rank PA it cannot adequately quantify PA [8]. Going forward, it seems the way is paved for BWM.

This leads to the question, why aren't BWM more readily adopted? Specifically for devices that can define activity (sitting, walking, etc) and log corresponding time; cost. Until recently commercial devices have retailed at hundreds of pounds. This is unattainable for any project where tens of devices would be required. Additionally, they run the risk of becoming a white elephant, an expensive acquisition with little return on analytical prowess. The latter is not a limitation of the device, more a lack of insight into analytical theory where novel/abstract thinking can yield interesting insight for community-based data [2, 9]. However, with the advocacy of open source development models the costs of these devices is beginning to tumble. Moreover, advances in technology afford the capture of high resolution data over long periods [10].

What does this all mean for the utility of BWM? Potentially, a (diagnostic) tool that provides individualised PA data from habitual behaviour, perhaps a better indicator of overall health compared to ad-hoc clinical assessments. BWM-based PA research is still a challenging construct to measure with little congruency on device attachment to measure holistic EE and associated EE cut scores [11]. In comparison, ambulatory related research is taking a clear and definitive path. Though ambulation can be considered to be one of many domains within PA, its characteristics are clearly defined by macro and micro descriptives of gait which have been shown to be sensitive to ageing and pathology [12]. These are useful and low cost descriptives that have become the focus of current research due to their non-invasive nature that can be accurately and reliably captured (separately) by a single BWM [2, 10]. Moreover, in harmonising current technology it is possible to capture both during prolonged recording, i.e. 7 day assessment of macro (ambulatory behaviour) and micro (step, stride, stance, swing times and; step length and velocity) characteristics. Additionally, harmonising numerous algorithms for a single BWM location facilitate the quantification of surrogate (bio) markers of physical capability [13].

In conclusion, it is important to be aware of how studies quantify PA. Though self-report can elude to numerous domains of PA, their subjectivity can make them 'reliably inaccurate'. BWM have the capability to offer accurate and personalised monitoring. Future work should adopt low cost BWM and focus on macro/micro gait assessment in the community from a single device or aim to use existing technology (e.g. phones) where data could be gathered and relayed on a real time basis.

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