One size does not fit all – application of accelerometer thresholds in chronic disease

Response to: Physical activity of UK adults with chronic disease: cross-sectional analysis of accelerometer-measured physical activity in 96706 UK Biobank participants.

Grace Olivia Dibben, Rod Taylor, Hayes Dalal, Melvyn Hillsdon.

We would like to take this opportunity to respond to the recent publication from Barker et al., comparing physical activity (PA) of those with and without chronic disease from the UK Biobank participants. [1] We commend the authors for raising awareness of the issues associated with low levels of PA in patients with chronic disease, and highlight the importance for clinicians to pay more attention to PA levels of those with chronic disease, and encourage adequate PA to accrue the associated health benefits. The authors conclude that those with chronic disease have lower PA levels than their healthy peers. Figure 1 shows that cardiovascular disease participants had the second lowest number of minutes per week of moderate activity. Figure 2 in the paper shows that people with heart failure have one of the lowest levels of PA of all the chronic diseases, 44% lower than healthy counterparts. However, we would like to draw attention to a fundamental limitation of this study.

The accelerometer cut points the authors have used to classify activity into moderate (100mg) or vigorous (400mg) intensity have been applied to all participants, both with and without chronic disease. These cut points are derived from a small study of 30 healthy adults [2], and have been used in a number of studies including those of older adults and patients with heart failure.[3-4] The issue lies in applying the same intensity thresholds to all participants, as this assumes that energy expenditure is the same for all i.e. an activity that generates a vector magnitude between 100-400mg requires 3-6 METs for everyone, and does not take into account an individual's exercise capacity.

Within the discussion the authors hypothesise that in some cases, the disease may be directly responsible for lower PA due to reduced exercise capacity, where limitations to cardiopulmonary function or musculoskeletal dysfunction occur secondary to the disease. In fact, in this subset of participants, it is likely that energy expenditure will not be the same as their healthy peers, because of the aforementioned reasons, and often require more energy to complete a given activity.[5-6] Therefore, application of cut points developed in younger, healthier populations to older people or those with chronic disease affecting exercise capacity risks researchers underestimating time spent in MVPA.

The authors perform sensitivity analysis to account for this by allowing ±25mg change in the thresholds for moderate and vigorous intensity PA, and conclude that this changed the absolute minutes per week of activity, but differences between healthy and diseased subgroups remained. However, we have conducted an accelerometer calibration study in heart failure patients, which is currently in preparation for publication, and have derived acceleration values that relate to moderate intensity activity in patients with heart failure. The value of 100mg used in the paper by Barker et al. is more than double the value that we observed, which strongly implies the amount of MVPA undertaken by this population is underestimated, and PA intensity is being misclassified.

We do not dispute that PA levels of those with chronic disease are lower than those of their healthy counterparts however, we believe the magnitude of the difference between these two groups may be exaggerated with the application of the same intensity thresholds. The exaggeration may be two fold, where applying an accelerometer threshold of 100mg may be too low for healthy participants

and therefore overestimating the amount of MVPA, and too high for those with chronic disease, therefore underestimating the amount of MVPA.

With National PA recommendations still based on the amount of time spent in MVPA, and with the increasing use of accelerometers in population health research, it is vital that accelerometer data is interpreted correctly, particularly in people with chronic disease. If a threshold that is too high is used to classify accelerometer data and for clinicians to make PA recommendations that may be too difficult for these participants to perform, they will become demoralised, demotivated and less likely to make the behaviour change that is so important for their health.[7]

References

1. Barker J, Smith Byrne K, Doherty A, et al. Physical activity of UK adults with chronic disease: cross-sectional analysis of accelerometer-measured physical activity in 96706 UK Biobank participants. *International Journal of Epidemiology* 2019; 1-8.

2. Hildebrand M, van Hees VT, Hansen BH, Ekelund U. Age group comparability of raw accelerometer output from wrist- and hip-worn monitors. *Med Sci Sports Exerc* 2014;46(9):1816-1824.

3. Dalal HM, Taylor RS, Jolly K, et al. The effects and costs of home-based rehabilitation for heart failure with reduced ejection fraction: The REACH-HF multicentre randomized controlled trial. Eur J Prev Cardiol [Internet]. 2018 Oct 10 [cited 2019 Mar 6];26(3). Available from: https://journals.sagepub.com/doi/10.1177/2047487318806358. doi.org/10.1177/2047487318806358.

4. Menai M, van Hees VT, Elbaz A, Kivimaki M, Singh-Manouz, Sabia S. Accelerometer assessed moderate-to-vigorous physical activity and successful ageing: results from the Whitehall II study. Scientific Reports [Internet] 2017 [cited 2019 Apr 05]; 7. Available from: https://www.nature.com/articles/srep45772.

5. Hall KS, Howe CA, Rana SR, Martin CL, Morey MC. METs and accelerometry of walking in older adults: standard versus measured energy cost. Med Sci Sports Exerc 2013; 45(3):574-82.

6. Spruit MA, Wouters EFM, Eterman RA, et al. Task-related oxygen uptake and symptoms during activities of daily life in CHF patients and healthy subjects. Eur J Appl Physiol 2011; 111: 1679-86.

7. American College of Sports Medicine: ACSM's Guidelines for Exercise Testing and Prescription. 2010, Philadelphia, PA: Lippincott, Williams and Wilkins, 8