


Energy expenditure as a marker of physical activity intensity in chronic obstructive pulmonary disease

Chronic Respiratory Disease
Volume 18: 1–3
© The Author(s) 2021
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/14799731211059922
journals.sagepub.com/home/crd


Mark W Orme^{1,2} 

“Lack of activity destroys the good condition of every human being” - Plato

The recognition for the importance of physical activity (PA) for better health has been long documented, from the Philosophers of Ancient Greece to the seminal works of Jeremy Morris.¹ In the context of chronic obstructive pulmonary disease (COPD), a simple Pubmed search for “PA COPD” demonstrates the ever-growing interest in this field; yielding 136 and 642 results in 2000 and 2020, respectively.

Physical activity is traditionally defined from a physiological perspective as “*any bodily movement produced by skeletal muscles that results in energy expenditure (EE)*”.² More recently, a more holistic approach to defining PA has been posited; “*PA involves people moving, acting and performing within culturally specific spaces and contexts, and influenced by a unique array of interests, emotions, ideas, instructions and relationships*”.³ The former definition lends itself to a quantitative approach and has contributed to the development of technologies to assess objectively-measured (device-based) PA. The latter incorporates a more qualitative element which is seldom captured in the objectively-measured PA field.

As highlighted by these definitions, attempting to measure PA is intrinsically complex. A plethora of tools have been developed, ranging in accuracy and feasibility, from questionnaires to inclinometers and accelerometers. The range of methods available to measure PA allows us to describe patient behaviour and evaluate interventions. In the current issue of the journal, Brito et al.⁴ combined two commonly used PA monitors in the COPD literature (SenseWear Armband (SWA) and Dynaport)⁵ to examine EE as a marker of PA, during postures of reclining, sitting, standing and walking. By using EE as a marker of PA intensity, the article opens up an important debate in the literature – namely ‘A Tale of Two *IntenCities*’⁶ – relative versus absolute intensity PA.

Whilst Brito et al.⁴ are modest in their justification of examining EE as a reflection of PA intensity, the premise of relative intensity matches the familiar notion of individually-tailoring exercise training, such as during pulmonary rehabilitation to ensure patients walk at a prescribed pace. The evaluation of objectively-measured PA intensity during daily life is limited to a ‘one size fits all’ approach, with little acknowledgement of influencing characteristics, such as exercise capacity or body composition, to data interpretation. The authors found that EE/minute walking was a better predictor of being physically active than time spent walking to the ACSM criteria. As the authors highlight, physically active patients expending more energy during walking than physically inactive patient is indeed intuitive. This speaks to the value of expanding the assessment of PA beyond variables such as steps/day or time spent walking. Brito et al.⁴ perform an interesting coupling of data (posture and EE) to dig deeper into intensities of different postures and behaviours. The authors report higher EE/minute values for walking and standing compared with sitting and reclining for patients classified as physical active; while physically inactive patients presented similar EE/minute values across postures. The authors hypothesise that this difference may be due to lower intensity walking combined with a higher basal metabolic rate from increased ventilatory demand. As the SWA was worn only during

¹Department of Respiratory Sciences, University of Leicester, Leicester, UK

²Centre for Exercise and Rehabilitation Science (CERS), NIHR Leicester Biomedical Research Centre-Respiratory, University Hospitals of Leicester NHS Trust, Leicester, UK

Corresponding author:

Mark W Orme, Department of Respiratory Sciences, University of Leicester, Leicester, UK.

Email: mwo4@leicester.ac.uk



Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

waking hours, it poses the interesting idea of anchoring EE/minute during waking behaviours against EE/minute during sleep to compute a truly relative PA intensity assessment. This proposition opens up the possibility of exploring relative PA intensity using historical SWA data from 24-hour protocols.

By highlighting the potential usefulness of relative intensity PA and combining this with postures, the work of Brito et al.⁴ may also inspire the field to expand the interpretation of sedentary behaviours (SBs; reclining and sitting in this study). Indeed, the minute-by-minute data collected by the SWA (with higher resolutions possible with other devices) offers the potential for further insight into the different types of SB.⁷ For example, active sitting, defined as “any waking activity in a sitting posture characterized by an EE > 1.5 METs” (e.g. seated bicep curls) and passive sitting, defined as “any waking activity in a sitting posture characterized by an EE ≤ 1.5 METs” (e.g. sitting reading), may be differentiated through such device deployment as Brito et al. Such quantitative insight may better reflect the real life meanings of SB for people. We are aware that individuals with COPD assign different meanings to sitting, including how sitting is ‘enabling’ them to participate in more PA, by resting on a bench.⁸ When we consider again the newer PA definition, it perhaps becomes possible to use ever-advancing PA monitoring technologies to reflect not only physiology, but the real world complexities and meanings behind physical behaviours.

As an adjunct to the PA and SB data, the authors point out that patients classified as physically active wore the activity monitors for more than 2 hours longer on average per day than those physically inactive (783 ± 72 and 659 ± 182 min/day, respectively). Without any adjustment for wear time, such differences can have a big impact on group comparisons. Inevitably, an individual or group that wears an activity monitor for longer has a greater opportunity to accumulate more time across SB and PA intensities. As people with COPD spend the majority of their time sedentary, as noted by the authors, the impact of wear time will be even more pronounced. Simple adjustments for wear time which are commonly applied are adding wear time as a covariate or calculating the percentage of time in each behaviour/intensity with recalculation to a common wear time duration. In the case of this study, using a percentage adjustment, the difference in time walking/day between active and inactive groups would be reduced to 14 min/day rather than 24 min/day on average. However, we know that people do not have a consistent level of free-living PA across the day,^{9,10} even as an inpatient,¹¹ which makes current approaches to wear time adjustments inadequate. Even with recent statistical advances such as compositional data analysis,¹² there remains a need to derive a more sophisticated method to adjust for differences in activity monitor wear time.

For those involved in the measurement of PA in COPD, Brito et al.⁴ provide an interesting approach to evaluating PA intensity; considering the suitability of relative PA intensity in line with the personalised care provided by clinical services such as pulmonary rehabilitation. Overall, Brito et al.⁴ present a thought-provoking study which could help progress PA and SB research in COPD.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Mark W Orme  <https://orcid.org/0000-0003-4678-6574>

References

1. Morris J, Heady J and Raffle P. *lancet CR-T*, 1953 undefined. Coronary heart-disease and physical activity of work. [Internet]. Elsevier. Available from: <https://www.sciencedirect.com/science/article/pii/S0140673653914950> (cited 2021 Oct 13).
2. Caspersen C, Powell K and Christenson GM. reports GC-P health, 1985 undefined. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep* [Internet] 1985; 100: 126–131. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/pmc1424733/> (cited 2021 Oct 13).
3. Piggin J. What Is physical activity? A holistic definition for teachers, researchers and policy makers. *Front Sport Act Living* 2020; 2: 72.
4. Brito IL, Schneider L, Hirata RP, et al. Energy expenditure per minute walking and in different body positions and its association with the classification as physically active or inactive in daily life in individuals with COPD. *Chron Respir Dis* 2021; 18: 14799731211053331.
5. Byrom B and Rowe DA. Measuring free-living physical activity in COPD patients: deriving methodology standards for clinical trials through a review of research studies. *Contemp Clin Trials* 2016; 47: 172–184.
6. Soren Brage MRC Epidemiology Unit University of Cambridge. *A tale of two intensities*.
7. Tremblay MS, Aubert S, Barnes JD, et al. Sedentary behavior research network (SBRN) – terminology consensus project process and outcome. [Internet]. *Int J Behav Nutr Phys Act* 2017; 14(1): 1–17. Available from: <https://ijbnpa.biomedcentral.com/articles/10.1186/s12966-017-0525-8> (2017 Jun 10 cited 2021 Oct 13).

8. Weedon AE, Saukko PM, Downey JW, et al. Meanings of sitting in the context of chronic disease: a critical reflection on sedentary behaviour, health, choice and enjoyment. *Qual Res Sport Exerc Health* [Internet] 2019; 12(3): 363–376. Available from: <https://doi.org/10.1080/2159676X20191595105>. <https://www.tandfonline.com/doi/abs/10.1080/2159676X.2019.1595105> (May 26 cited 2021 Oct 13).
9. Hecht A, Ma S, Porszasz J, et al. Methodology for using long-term accelerometry monitoring to describe daily activity patterns in COPD. *COPD* [Internet], 6, 2009, p. 121. Available from: </pmc/articles/PMC2862250/>. ([cited 2021 Oct 13].
10. Demeyer H, Burtin C, Van Remoortel H, et al. Standardizing the analysis of physical activity in patients with COPD following a pulmonary rehabilitation program. *Chest* [Internet]. 2014; 146(2): 318–327, Available from: <https://pubmed.ncbi.nlm.nih.gov/24603844/> (cited 2021 Oct 13).
11. Orme MW, Harvey-Dunstan TC, Boral I, et al. Changes in physical activity during hospital admission for chronic respiratory disease. *Respirology* [Internet] 2019; 24(7): 652–657, Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/resp.13513> (cited 2021 Oct 13).
12. Chastin SFM, Palarea-Albaladejo J, Dontje ML, et al. Combined effects of time spent in physical activity, sedentary behaviors and sleep on obesity and cardio-metabolic health markers: a novel compositional data analysis approach. *PLoS One* [Internet] 2015; 10(10): e0139984. Available from: <https://dx.plos.org/10.1371/journal.pone.0139984> (cited 2020 Nov 5).