Do all daily metabolic equivalent task units (METs) bring the same health benefits?

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In physical activity (PA) and exercise science, the prevailing view is that the health effect of PA is mainly determined by the accumulated *rate* of energy spent on PA over the day. Accordingly, generations of PA guidelines are based on the *rate* of energy spent during different tasks of PA, termed 'metabolic equivalent tasks' (abbreviated to 'METs') (see table 1). Accumulated daily METs (expressed in, for example, MET-hours or MET-minutes) are probably the most common in health-related measure of PA. But do daily METs really 'tell the whole story' of the health effects from PA?

The report of the 2018 US Physical Activity Guidelines Advisory Committee[1] represents the most up-to-date guidance on physical activity and health. Despite multiple novel elements, these guidelines encompass (eg, influence of PA on sleep and fatigue) the thinking that *all METs are the same*, no matter the context they are accrued in, still remains. But the evidence behind 'the more daily METs—the better' is generally limited to specific domains and intensities of PA. Some of the most authoritative information on dose-response of PA and mortality risk is limited to recreational moderate-intensity to vigorous-intensity PA (MVPA).[2] However, in high-income, middle-income and low-income countries alike, the majority of daily METs is spent in non-recreational settings (occupation, transportation, housework), and low-income countries spend less time in MVPA than high-income countries.[3]

PA at work is shown to not provide the same health gain as recreational PA,[4] and the health effects of light-intensity PA, where most METs are spent, are largely unknown. This suggests that the health effects of PA do not depend merely on total duration and the loading of the cardiorespiratory and muscular systems, which primarily determines the daily METs.

A number of crucial PA attributes beyond daily METs for health are either unexplored or have received very little attention, for example:

1. Improvements in cardiorespiratory fitness (CRF) requires PA of relatively high intensity (>60% of maximal CRF). Thus, large volumes of daily METs at a lower intensity may improve metabolic fitness, but not CRF (due to insufficient stimulus on the cardiorespiratory system to adapt for higher PA demands). Workers in manual jobs (eg, cleaners) measured to walk about 20000 steps per day still have poor CRF.[5] On the contrary, high-intensity interval training for very short time improves CRF despite low total METs spent.
2. Office workers are recommended to sit less and stand more. Substituting sitting with standing over several working hours may increase daily METs to some extent. However, in an occupational setting, high durations of stationary standing at work (eg, in manufacturing production lines, hair dressers and service sector) are also documented to increase the risk for musculoskeletal[6] and circulatory[7] problems.
3. The PA time pattern is important for its health effects. Prolonged bouts of lack of movement are associated with all-cause mortality risk independent of daily METs.[8]
4. Types of sports and exercise requiring dynamic use of large muscle mass (eg, swimming and racquet sports) are associated with lower all-cause and cardiovascular disease mortality risk compared with sports of similar METs that do not occupy the entire body.[9]

These lines of evidence suggest that promotion of more PA during recreation, work, transportation or domestic life will not give the same return of investment in health.

In the last four to five decades, we caught merely a glimpse of the huge potential of PA for health benefits. Although self-reported PA time and MET measuring methodologies have produced an extremely important evidence base, they have important limitations, such as inability to capture incidental PA of light intensity and posture, differential measurement error by PA domain, and relatively poor validity and accuracy. Today's measuring technologies are both feasible and accurate enough for large-scale collection and detailed characterisation of the health attributes of many aspects of PA that are virtually unexplored.[10] In the not-so-distant future, such technologies could revolutionise what we know about PA and health by tightly integrating METs with different PA dimensions, such as postures and types of PA. This technology combined with modern collaboration platforms like consortia, global networks and prospective meta-analysis platforms offers tremendous potential for making our discipline—PA, Exercise and Health—a model health-related scientific field. But

Table 1 Examples of types of physical activities resulting in different categories of metabolic equivalent tasks (METs)

MET categories	≤1.0 to ≤1.5	<1.5 to <3.0	≤3.0 to <6	≤6
Physical activity categories	Sedentary+standing	Light-intensity physical activity	Moderate-intensity physical activity	Vigorous physical activity
Examples of physical activities	Lying, sitting and stationary standing	Slow walking (<4 km/h)	Moderate and fast walking (4–7 km/h)	Very fast walking (>7 km/h)
	Sitting quietly (eg, watching television and car driving) and standing (eg, during computer work)	Sitting tasks with moderate effort (eg, operating heavy machinery) and standing with minor effort (eg, active workstation)	Bicycling or walking for transportation and most manual labour (eg, garbage collecting, carpentry, bricklaying or masonry)	Running, swimming, bicycling for exercise, carrying heavy loads or moderate loads up a flight of stairs

This one-dimensional MET-based categorisation has been the general framework for the physical activity recommendations.

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little value will be realised without better collaboration and tighter communication between researchers of all PA subdisciplines, including public health, occupational health, epidemiology, computer science, statistics and engineering.

Acknowledging the possibility that *not all daily METs are the same* in our scientific inquiry is an important step towards realising the full potential of *bodily movement* for promoting health.

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REFERENCES

1 Physical activity guidelines advisory commitee. *Physical activity guidelines advisory commitee scientific report 2018*. Washington, DC, USA: Department of Health and Human Services, 2018.
2 Arem H, Moore SC, Patel A, *et al*. Leisure time physical activity and mortality: a detailed pooled analysis of the dose–response relationship. *JAMA Intern Med* 2015;175:959–67.
3 Lear SA, Hu W, Rangarajan S, *et al*. The effect of physical activity on mortality and cardiovascular disease in 130 000 people from 17 high-income, middle-income, and low-income countries: the PURE study. *The Lancet* 2017;390:2643–54.
4 Holtermann A, Krause N, van der Beek AJ, *et al*. The physical activity paradox: six reasons why occupational physical activity (OPA) does not confer the cardiovascular health benefits that leisure time physical activity does. *Br J Sports Med* 2018;52.
5 Korshøj M, Krustrup P, Jespersen T, *et al*. A 24-h assessment of physical activity and cardio-respiratory fitness among female hospital cleaners: a pilot study. *Ergonomics* 2013;56:935–43.
6 Coenen P, Parry S, Willenberg L, *et al*. Associations of prolonged standing with musculoskeletal symptoms—a systematic review of laboratory studies. *Gait Posture* 2017;58:310–8.
7 Waters TR, Dick RB. Evidence of health risks associated with prolonged standing at work and intervention effectiveness. *Rehabil Nurs* 2015;40:148–65.
8 Diaz KM, Howard VJ, Hutto B, *et al*. Patterns of sedentary behavior and mortality in U.S. middle-aged and older adults: a national cohort study. *Ann Intern Med* 2017;167:465–75.
9 Oja P, Kelly P, Pedisic Z, *et al*. Associations of specific types of sports and exercise with all-cause and cardiovascular-disease mortality: a cohort study of 80 306 British adults. *Br J Sports Med* 2017;51:812–7.
10 Schneller MB, Pedersen MT, Gupta N, *et al*. Validation of five minimally obstructive methods to estimate physical activity energy expenditure in young adults in semi-standardized settings. *Sensors* 2015;15:6133–51.