Moving Toward the Inclusion of Step-Based Metrics in Physical Activity Guidelines and Surveillance

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Physical activity (PA) is crucial to maintaining good physical and mental health and reducing the risk of chronic diseases. As such, many countries have developed national guidelines to promote PA among their populations, with the World Health Organization (WHO) guidelines [1] providing a blanket set of global recommendations. In the five years since the launch of the WHO Global Action Plan on Physical Activity [2] there has been progress in the number of countries with national PA guidelines and surveillance mechanisms, but significant surveillance data gaps remain, both nationally and globally. These gaps must be addressed if we are to reduce the burden of physical inactivity [3]. One critical data gap is the consistent measurement of PA and sedentary behavior metrics over time, including domain-specific behaviors.

Aligned to innovations in technology and increased adoption of mobile and wearable technology in recent years, there has been growing interest in using step count as a viable measure of ambulatory PA. Smartphones and wearables can continually and passively track steps in free living settings over long periods of time [4], making them an accessible and scalable tool by which to measure and promote PA behavior. Multiple mass media campaigns and nationwide PA programs advocate for individuals to accumulate 10,000 steps/day, because step counting is relatively simple to monitor and easy to understand. Tracking of step counts is often at the core of digital interventions to promote PA [5] because ubiquitous technology allows individuals to receive immediate feedback on their PA levels which in turn can motivate future activity. The aim of this editorial is to explore the reasons why current global and national guidelines on PA and sedentary behavior do not include a daily step count-based recommendation and suggest ways forward for the development of such recommendations.
Evidence-based guidelines

The 2020 WHO guidelines on PA and sedentary behavior were informed by evidence synthesis conducted in 2018 [6] and 2020 [1], which found insufficient evidence for the dose-response relationship between steps/day and health outcomes. Since then, several studies have been published to address this evidence gap. A recent meta-analysis of 15 international cohort studies using hip-worn accelerometers (totaling 47,471 adults) found that taking 8,000-10,000 steps/day for adults younger than 60 years old and 6,000-8,000 steps/day for adults over 60 years old was associated with progressively lower risk of all-cause mortality, respectively [7]. Further, the 50-60% lower risk in the higher versus lower steps per day quartiles is similar to the relationship observed for accelerometer-determined moderate-to-vigorous PA (MVPA) and all-cause mortality. Another study using wrist-worn accelerometer data from a cohort of 78,500 adults in the UK reported gradually reduced risk of all-cause, cancer, and CVD mortality up to approximately 10,000 steps/day [8]. These findings add empirical weight to earlier calls for a move towards step-based PA guidelines [9].

The rapidly growing evidence linking steps/day to health benefits is promising, but certain limitations must be addressed before step-based guidelines can be implemented. First, step counting is limited to ambulatory movement which raises three key issues: (1) other types of aerobic physical activity, such as cycling and swimming, are not captured or are captured inaccurately (2) strength- and balance-based aspects of the guidelines are not included, and (3) people who are non-ambulatory cannot partake. It is important to note, however, that walking is a commonly reported mode of exercise [10] and is a necessity for most activities of daily living. Second, the minimal and optimal number of steps needed for health varies for
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different population groups such as children, older adults, pregnant women, and people with
certain health conditions who may require different step count guidelines. Relying solely on
step count may promote a "one size fits all" approach to PA promotion, which may not be
appropriate for all groups. Third, step count alone gives a general indication of the total
amount of ambulatory activity in a day but does not capture the intensity of PA, which is a
critical determinant of health effects [8]. Here, step cadence can be used as a proxy for PA
intensity [11]. For example, studies have reported a strong relationship between cadence and
intensity, whereby taking ≥ 100 steps/min is approximately equivalent to MVPA [12], with
each 10 step/min increment up to 130 steps/min associated with an increase of 1 metabolic
equivalent (METs; i.e., 100, 110, 120, 130 steps/min associates with 3, 4, 5, 6, METs,
respectively) [13]. Other cadence-based metrics, such as peak 30-min cadence (average
steps/min for the 30 highest, but not necessarily consecutive, min/d) have also been linked
to reduced mortality and morbidity [8]. In a practical sense, walking cadence can be estimated
by simply counting the number of steps accumulated in a certain time window (epoch, e.g.,
one minute or 15 s epochs multiplied by four). Some newer consumer level wearable devices
provide instantaneous display of cadence on the watch face, which can facilitate self-
regulation of walking cadence to achieve MVPA thresholds or personalized targets. However,
in the absence of activity tracking devices, pace-based instruction such as asking people to
walk at a ‘usual’ or ‘fast’ pace could also assist people to walk at cadence associated with
health benefits. A recent meta-analysis reported that adults who were asked to walk at a self-
selected usual or fast pace naturally stepped at cadences averaging 117 and 127 steps/min,
respectively [14] suggesting that this pace instruction helps people to walk at an intensity
equivalent to MVPA.
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Physical activity surveillance

Any move towards using consumer device-based measures of PA within surveillance systems that monitor adherence to guidelines has thus far been hampered by concerns over the feedback devices provide that may influence the observed behavior, as well as the representativeness, validity, reliability, and comparability of the data across studies [15]. Furthermore, complexities around safe data sharing, access, and storage in line with varying data protection policies around the world causes added anxiety. In-depth discussions of these points can be found elsewhere [4,16]. Here, we outline some possible solutions to these challenges. First, remote representative sampling via smartphones could already be possible in some countries given current smartphone penetration rates [17]. Considering rising smartphone ownership across the world, opportunities for such will continue to increase in high income and LMICs alike. Second, research conducted in the lab [18] and in free-living settings [20] supports the validity and reliability of step tracking data from certain consumer-grade devices. These data appear to be comparable to a research-grade accelerometer, which has been shown to underestimate steps by around 20% [19]. Assuming these findings are applicable to other consumer and research-grade devices, estimates of stepping are likely to be conservative, which could be considered when using devices in general for surveillance purposes. Third, with appropriate consent from data owners (i.e., individual users) it is already possible to access step count data from smartphones and wearables via APIs [4]. In summary, opportunities to collect population level step count data already exist, but we lack reasonable agreement on how to safely share, access, store and use these data at scale for population PA surveillance purposes.
Device based surveillance of stepping is in its infancy and there are many unknowns. A certain degree of consensus on the above issues is needed for step-based PA surveillance to monitor adherence to any step-based guidelines. Long term public-private partnerships (involving academics, government, guideline developers, and industry) and an appropriate regulatory framework will be needed to help governments or national NGOs implement the safe collection and use of step count data from consumer-grade devices. Indeed, examples of such collaborations are beginning to emerge; Google recently announced Open Health Stack - a suite of open-source building blocks built on an interoperable data standard - developed in partnership with the WHO [20]. A standardized and well-coordinated approach to PA surveillance will be a major contributor towards step-based PA guidelines.

Conclusions

Given the popularity of walking and the ease with which steps/day can be measured, step-based PA guidelines could reach a wider audience and aid the promotion of PA. Although several challenges need to be overcome, it is important that key stakeholders (researchers, practitioners, policy makers, and industry) strongly consider the benefits of leveraging existing and future technologies to advance PA surveillance in parts of the world that, to date, are largely unreached, e.g., LMICs. Despite the challenges, choosing not to take advantage of the masses of data captured by consumer-grade devices is a missed opportunity. Importantly, step-based guidelines should not be seen as a substitute for more comprehensive PA guidelines that include recommendations for strength and balance exercise and limiting sedentary behavior. Rather, step count recommendations should be seen as an adjunct, or component of, PA guidelines. Ultimately, stepping based targets offer more options to populations and individuals on how to set PA-related goals and monitor progress. Such
Step-based guidelines and surveillance tailored approaches to PA promotion, taking into account individual needs and preferences, are likely to be the most promising.

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