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Living a Long Life is a Multi-Step Process

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There is a strong link between physical activity and health.[1] Historically, large-scale epidemiological studies have used self-report surveys to capture physical activity measures (eg, type and intensity). In the past 20–30 years, large cohort studies have increasingly adopted devices, such as pedometers, accelerometers, and consumer-marketed activity trackers, to measure physical activity. Device-based physical activity measures alleviate some limitations of self-reporting by increasing measurement objectivity and accuracy. Additionally, device-based measures often show stronger associations with health outcomes than do self-reported measures,[2] showcasing their value in understanding how physical activity affects health. Unlike self-report, device-based measures can capture steps, which are easily understandable and can be effective for goal setting and motivation to increase physical activity levels.[3] Moreover, steps can be used to assess both physical activity volume (eg, steps per day) and intensity (eg, steps per min).[4]

Although previous research has shown associations between stepping and health,[5] the study reported in *The Lancet Public Health* by Amanda Paluch and colleagues[6] accumulated additional evidence suggesting that daily step counts are strongly associated with mortality, regardless of age or sex. Moreover, the authors analysed stepping rate data from seven of 15 included studies to assess the effect of physical activity intensity on mortality. Given the popularity of consumer-marketed activity trackers and smartphone applications capable of measuring steps, evidence-based step goals for different populations are likely to facilitate increasingly individualised and targeted interventions, which might help people increase physical activity and thereby improve their health.

Paluch and colleagues should be commended for collating data from international samples and including unpublished studies to reduce risk of publication bias affecting findings. Nonetheless, several considerations are warranted when interpreting these results. First, the included studies sampled physical activity data at a single timepoint, with most being recorded over approximately a week. Although such measurement is consistent with other studies using device-based measures, the association between a single timepoint assessment and typical physical activity levels and temporal trends is unknown. Measures such as cardiorespiratory or muscular fitness (eg, maximum rate of oxygen consumption [VO_2 max] and grip strength) might be more representative of overall physical activity levels than measuring steps at one timepoint. Second, the included studies used an assortment of measurement devices worn at various body locations (eg, wrist and hip). Past research suggests that device type and wear location affect accuracy of step counting, with ankle-worn devices having highest accuracy and wrist-worn devices often mischaracterising steps when arm and leg movement are not coordinated (eg, housework and cycling).[7,8] Thus, interpreting associations between steps and mortality are complicated by use of different device brands and placements. Third, this meta-analysis focused on the association between physical activity and all-cause mortality. Although physical activity is associated with reduction of many hypokinetic diseases, the focus on all-cause mortality dilutes the potential impact that steps might have on specific diseases. Fourth, some of the meta-analyses were done using small datasets, with stepping intensity outcomes based on only five to seven of the 15 included studies. The authors' interpretation of the results given the available data seems appropriate, but caution should be used in translating these results until additional studies can bolster these important findings. Finally, in the meta-analysis, studies were statistically weighted on the basis of the number of deaths reported in each study, which is necessary and appropriate to allow greater statistical influence from studies with more robust results. However, in several of the analyses, one study contributed considerable (eg, >30%) analytical weight. Regardless, the direction of the change was consistent among all studies, and sensitivity analyses showed that no single study overly affected the results.

Despite these study considerations, Paluch and colleagues' study offers important evidence that steps are strongly associated with mortality and provides age group-specific step targets for reducing risk of mortality. In future research, increased interest in personal physical activity tracking through consumer-marketed activity monitors and smartphones

might allow for substantial increases in data on physical activity and health, which would have been unimaginable until recently.[9] For example, one study used over 68 million days of smartphone data from over 700 000 people in 111 countries to understand regional trends in physical activity and highlight intervention targets.[10] Although privacy and security are important considerations, leveraging such data could substantially improve our understanding of associations between physical activity and health and to identify those with the greatest need for intervention.

The results of the study by Paluch and colleagues are in concordance with other previously published data on physical activity intensity and health and might provide an alternate target for researchers, clinicians, and public health officials when trying to increase physical activity and thereby improve personal and population health.

We declare no competing interests.

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1 Morris JN, Heady JA, Raffle PA, Roberts CG, Parks JW. Coronary heart-disease and physical activity of work. *Lancet* 1953; **262:** 1111–20.
2 Celis-Morales CA, Perez-Bravo F, Ibañez L, Salas C, Bailey ME, Gill JM. Objective vs. self-reported physical activity and sedentary time: effects of measurement method on relationships with risk biomarkers. *PLoS One* 2012; **7:** e36345.
3 Bassett DR Jr, Toth LP, LaMunion SR, Crouter SE. Step counting: a review of measurement considerations and health-related applications. *Sports Med* 2017; **47:** 1303–15.
4 Tudor-Locke C, Rowe DA. Using cadence to study free-living ambulatory behaviour. *Sports Med* 2012; **42:** 381–98.
5 Hall KS, Hyde ET, Bassett DR, et al. Systematic review of the prospective association of daily step counts with risk of mortality, cardiovascular disease, and dysglycemia. *Int J Behav Nutr Phys Act* 2020; **17:** 78.
6 Paluch AE, Bajpai S, Bassett DR, et al. Daily steps and and all-cause mortality: a meta-analysis of 15 international cohorts. *Lancet Public Health* 2022; **7:** e219–28.
7 Toth LP, Park S, Springer CM, Feyerabend MD, Steeves JA, Bassett DR. Video-recorded validation of wearable step counters under free-living conditions. *Med Sci Sports Exerc* 2018; **50:** 1315–22.
8 Nelson MB, Kaminsky LA, Dickin DC, Montoye AH. Validity of consumer-based physical activity monitors for specific activity types. *Med Sci Sports Exerc* 2016; **48:** 1619–28.
9 Wright SP, Hall Brown TS, Collier SR, Sandberg K. How consumer physical activity monitors could transform human physiology research. *Am J Physiol Regul Integr Comp Physiol* 2017; **312:** R358–67.
10 Althoff T, Sosič R, Hicks JL, King AC, Delp SL, Leskovec J. Large-scale physical activity data reveal worldwide activity inequality. *Nature* 2017; **547:** 336–39.