The step count conundrum

Mark Hamer, Ph.D.; Joanna M Blodgett, Ph.D.

Institute of Sport Exercise and Health, Division Surgery Interventional Science, University College London, London, UK.

Correspondence: Mark Hamer, Institute of Sport Exercise and Health, 170 Tottenham court road, W1T 7HA London. E-mail: m.hamer@ucl.ac.uk

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For many years, the physical activity field has grappled with the important issue of dose-response, that is, how much activity is needed to prevent major disease outcomes [1]. The wealth of existing evidence on dose-response relationships has crucially helped inform international guidelines on physical activity and health [2]. Step count has been used as a popular approach to provide physical activity targets for the general public as it can be communicated in a way that is easily digestible and can be simply monitored (e.g. pedometer, smart phone, etc). Many people are familiar with the recommendation of 10,000 steps a day, but there is little empirical evidence to support this guidance [3].

In the current issue, del Pozo Cruz and colleagues [4] performed a meta-analysis to investigate dose-response associations between step count and mortality, hypothesizing that the relationship may be non-linear. They included 10 cohort studies (n= 30,172 participants; 1,985 deaths over a median follow-up of 8.75 years) and assessed the non-linear associations with a restricted cubic spline model. Their results did support a non-linear association more akin to an 'L-shaped' curve. There was an 8.5% mean risk reduction every 1,000 steps/day up to around 7,500 steps/day, after which the curve flattened somewhat. Several key issues should be highlighted. Firstly, the included studies largely contained older adults thus findings may not be widely generalizable to the adult population. Second, four of the studies had limited (4 – 6 years) mortality follow-up, which introduces the possibility of reverse causation – thus we may expect true effect estimates to be diluted in studies with shorter follow up periods [5]. Third, as is the case in most cohort studies the step count data were collected only once at baseline and may not be representative of habitual physical activity behavior, although repeatability studies have demonstrated stability of step-counts over 2-3 years [6]. Notwithstanding, the meta-analytic approach used by del Pozo Cruz et al is a powerful approach and the results were compelling.

A key conclusion from these analyses was that no lower threshold exists for health benefits of movement (steps). This message has biological plausibility as previous controlled trials have shown robust effects of walking on a number of cardiovascular risk factors, although exact dose-response patterns remained unclear [7]. The present results are also comparable with previous dose response curves generated from meta-analyses of observational data using self-reported physical activity. Notably, in an analysis of 6 pooled cohorts with over half a million adults, a 20% lower risk of mortality was observed in participants reporting some activity but below the recommended guideline (0.1 to <7.5 MET hr/wk) [1]. An L-shaped curve was also observed, with progressively smaller incremental benefit at higher levels of activity exceeding the guidelines.

It should be noted that del Pozo Cruz and colleagues [4] conducted an investigation of step volume but did not take intensity into account. The present physical activity guidelines [2] emphasise the importance of moderate – vigorous intensity activity. The general adult population would typically be able to achieve this level of intensity through brisk walking. Crucially, associations between step count and mortality may not be consistent across age groups. The absolute energy cost of walking and other daily activities is higher in older adults than younger adults [8], therefore the benefits of 7500 steps in reducing mortality risk may vary depending on the dynamic interaction between step intensity and age. Hence, a single recommendation for step count may not be appropriate for all adults. Further empirical evidence is needed to determine if step targets should be adjusted for factors that influence activity energy expenditure including age, sex, body composition and ethnicity. Regardless, recent papers have demonstrated associations of step volume and mortality persist after accounting for intensity of stepping [9].

Nevertheless, this does highlight the need to present clear and consistent physical activity messages to the public. One might argue that having daily step targets in addition to public health messages around exercise time and intensity (i.e. 30 min/d moderate – vigorous intensity activity) creates confusion. Technological advancement of fitness trackers and smartwatches has seen a shift from simple pedometer-based step counters to more complex accelerometer-based devices. These devices can capture more detailed metrics of an individual's daily activity such as intensity, energy expenditure and cardiometabolic fitness, with more advanced devices monitoring data related to sleep, respiration, temperature and heart rate.

It is, however, important to consider the persuasive evidence showing simple pedometers [10] and activity trackers [11] that provide continuous self-monitoring and feedback are presently one of the most effective community -based interventions to improve physical activity. These data perhaps suggest simple concepts are most effective in the context of population wide physical activity promotion. Ongoing growth in smartphone and activity tracker usage has produced a valuable opportunity for clinicians to prescribe daily step count targets and promote self-regulation using activity trackers. Although these technologies are widely available, there are inevitably social and age-related divides, thus strategies to promote inclusion such as digital health literacy will be crucial. Clinically relevant changes to physical activity behavior at a population level will only be achieved if these technologies are widely adopted.

In summary, the findings from del Pozo Cruz and colleagues [4] challenge the commonly held belief that 10 000 steps per day is needed to yield health benefits, suggesting that no lower threshold exists for health benefits and only marginal gains are achieved beyond 7,500 steps/day. Promotion of a lower step target may provide a more realistic and achievable goal

for the public. In line with prior evidence, population wide longevity gains might be maximized simply by shifting away from the least-active end of the step count distribution.

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