

## EVIDENCE BEHIND 10,000 STEPS WALKING

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### ABSTRACT:

A recommendation to walk 10,000 steps/day is widely promoted among populations. This study aimed to review scientific evidence of 10,000 steps walking. English language articles between years 2000-2016 were searched from online databases; MEDLINE, CINAHL, and Google Scholar. The search terms were "10000 steps walking" AND "adults". Seventeen primary studies were reviewed. The studies supported benefits of 10,000 steps/day on body compositions, blood pressure and serum lipid levels. A 10,000 steps/day walking was considered as an alternative recommendation on physical activity for public health which comparable with 150 minutes/week of moderate-intensity physical activity. Various approaches included prize reinforcement, using a step counter (pedometer), family- and community-based interventions could increase a number of steps. Applying any interventions to achieve the recommendation should consider about accessibility, appropriate duration, and continuity of those approaches.

**Keywords:** Health benefits; Walking; 10,000 steps walking

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### INTRODUCTION

"Walking is man's best medicine" is a quote of Hippocrates [1]. It is also one of the effective physical activities to reduce risks of non-communicable diseases (NCDs) and to increase health benefits [2, 3]. Globally, physical activity guidelines recommend adults should participate in regular physical activity (PA) which based on type, intensity and duration of activities [4, 5]. Walking can be a moderate-intensity PA which beneficial to health [6]. Alternatively, step-based walking recommendations from around the world are emerging, and they are different in terms of amount of steps per day or steps per week [7]. The numbers of walking steps are translated as 1) 'sedentary lifestyle index' (<5,000 steps/day); 2) 'low active' (5,000-7,499 steps/day); 3) 'somewhat active' (7,500-9,999 steps/day); 4) 'active' (≥10,000 steps/day); and 5) 'highly active' (>12,500 steps/day) [8].

As a physically active level, a 10,000 steps/day walking becomes a commonly-acknowledged

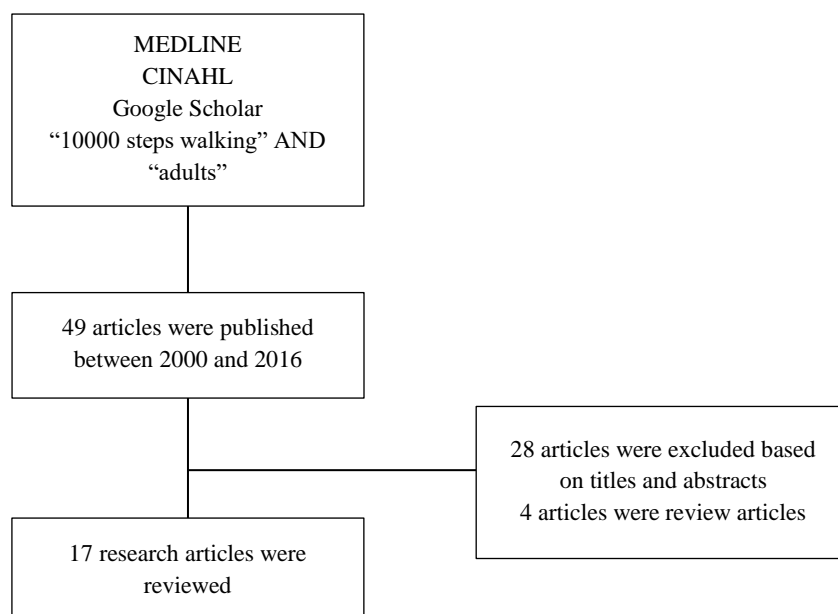
goal for daily fitness across the world through media [9, 10]. The target of achieving 10,000 steps/day is widely recognised in Japan [8]. The 10,000 steps/day walking is approximately equivalent to 300 and 400 kcal/day of energy expenditure (depending on walking speed and body size) [11]. The weekly energy expenditure from 10,000 steps/day for more than 3 days a week is comparable with energy use of 30 minutes of moderate-intensity PA on most days of the week which met a threshold associated with significant reductions in cardiovascular-related mortality (1,000 kcal/week) [12-14].

According to the emerging evidence regarding PA guidelines, moderate- to vigorous-intensity PA (MVPA) is recommended to maintain and improve cardiovascular functions; also reduce health-related risks [4, 5]. The step-based walking is considered as an appropriate approach to increase participation in health-related PA [15]. However, the benefits of and recommendations on a step-based walking approach or 10,000 steps walking are still controversial.

This study reviewed the current evidence toward benefits, recommendations on the step-based walking and interventions to reach and maintain the

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**Figure 1** Searching results

daily goal of 10,000 steps per day. This review consisted of both experimental and observational studies to fulfil the gap of knowledge of the 10,000 steps walking. The findings of this study might be the additional information and an alternative recommendation on PA among adult populations.

## METHODS

The online databases were searched from MEDLINE, CINAHL, and Google Scholar on 20<sup>th</sup> April 2016. The keywords comprised “10000 steps walking” AND “adults”. Only English language articles between years 2000-2016 were reviewed. Secondary studies, including systematic and narrative reviews, were excluded.

The 49 articles were found from the online databases. Twenty-eight articles were excluded based on titles and abstracts. Four systematic reviews and narrative reviews were excluded. A total of 17 articles were assessed (Figure 1).

## RESULTS

### Relevant studies

The relevant studies were shown in Table 1.

### Benefits of 10,000 steps walking

Many studies investigated benefits of 10,000 steps walking on body compositions. A study in adults, aged 20 to 70, represented a 3 cm loss in waist circumference after 6 months of a 10,000 steps/day walking programme [22]. A longer

programme (9 months) showed significant improvements in body weight (-2.4 kg), body mass index (BMI) (-0.8 kg/m<sup>2</sup>), percentage body fat (-1.9%), fat mass (-2.7 kg), waist circumference (-1.8 cm), and hip circumference (-1.9 cm) [27].

Improvements of blood pressure were the benefits which found in several studies. According to a study among university students, a 6-week 10,000 steps/day walk could significantly reduce systolic blood pressure (SBP) (120.00±15.62 mmHg versus 111.75±9.80 mmHg; P=0.04) and diastolic blood pressure (DBP) (79.00±8.23 mmHg versus 71.56±8.34 mmHg; P=0.04) [26]. Sorous et al. also showed a significance of blood pressure improvement (SBP and DBP decreased 5.57 and 4.03 mmHg every 3 months, respectively) among adults aged 20 to 65 years after the 6 months of 10,000 steps/day walking [21].

For bone health, a 10,000-step daily walk was sufficient to maintain bone mineral density (BMD) in 49 to 64 years old adults [29]. Several studies found significant improvements in blood tests [24, 27, 30]. High-density lipoprotein (HDL) increased significantly (3 mg/dl) after a 36-week-10,000 steps/day walking [27]. This finding, an increase in HDL, was similarly found in older Australians, aged 55 to 85 years [30]. Even a low-intensity exercise which consisted of walking 10,000 steps three times per week with any walking speed for 8 weeks could elevate HDL and reduce low-density lipoprotein (LDL) [24].

**Table 1** Relevant studies

Titles	Author(s)	Year of publication	Study design	Sample size	Summary
1. A pilot randomised controlled trial evaluating motivationally matched pedometer feedback to increase physical activity behaviour in older adults [16]	Strath et al.	2011	Randomised controlled trial	81	A pedometer feedback intervention with individually matched motivational messaging was an effective intervention strategy to increase PA behaviour.
2. Short-term effects of using pedometers to increase daily physical activity in smokers: a randomised trial [17]	Kovelis et al.	2012	Randomised controlled trial	76	Physically inactive smokers improved their daily physical activity level by using a pedometer.
3. A randomised study of reinforcing ambulatory exercise in older adults [18]	Petry et al.	2013	Randomised controlled trial	45	The participants in the reinforcement condition walked an average of about 2,000 more steps/day than participants in the control condition.
4. A randomised controlled trial of continuous activity, short bouts, and a 10,000 step guideline in inactive adults [19]	Samuels et al.	2011	Randomised controlled trial	43	A 10,000 steps/day recommendation could increase the largest step counts compared to a continuous 30 minutes/day and an accumulating the total of 30 minutes/day recommendation.
5. Effects of "10,000 steps Ghent": a whole-community intervention [20]	De Cocker et al.	2007	Non-randomised controlled	1,682	Multiple strategies using a central theme of 10,000 steps/day could increase PA levels.
6. Effects of a 6-month walking study on blood pressure and cardiorespiratory fitness in U.S. and Swedish adults: ASUKI Step Study [21]	Soroush et al.	2013	Non-randomised controlled	355	Walking more than 10,000 steps/day approached a significance for changes in systolic blood pressure.
7. U.S. cohort differences in body composition outcomes of a 6-month pedometer-based physical activity intervention: the ASUKI Step Study [22]	Walker et al.	2014	Non-randomised controlled	142	A 10,000 steps/day walking programme changed the body composition measures.
8. Maintaining high activity levels in sedentary adults with a reinforcement-thinning schedule [23]	Andrade et al.	2014	Non-randomised controlled	61	Monitoring plus reinforcement-thinning schedule could increase the number of walking steps.
9. Low-intensity exercise exerts beneficial effects on plasma lipids via PPAR $\gamma$ [24]	Butcher et al.	2008	Non-randomised controlled	34	The exercise programme (walking) could significantly decrease total cholesterol and increase high-density lipoprotein (HDL).

**Table 1** Relevant studies (cont.)

Titles	Author(s)	Year of publication	Study design	Sample size	Summary
10. The effect of two different health messages on physical activity levels and health in sedentary overweight, middle-aged women [25]	Pal et al.	2011	Non-randomised controlled	32	A 10,000 steps/day guideline was more effective than a 30 minutes/day walking for increasing the number of steps.
11. UNISTEP (university students exercise and physical activity) study: a pilot study of the effects of accumulating 10,000 steps on health and fitness among university students [26]	Tully et al.	2011	Non-randomised controlled	31	A 10,000 steps/day walking might be an appropriate intervention in sedentary university students to increase PA.
12. Effects of a 10,000 steps per day goal in overweight adults [27]	Schneider et al.	2006	Before-and-after interventional	56	A 10,000 steps/day walking resulted in weight loss over 36 weeks in previously sedentary, overweight/obese adults.
13. Walking to meet physical activity guidelines in knee osteoarthritis: is 10,000 steps enough? [28]	White et al.	2013	Cohort	1,788	The analysis supported 7,910 steps/day (for men) and 9,040 steps/day (for women) as optimal steps/day cut-points, and 100 steps/minute was considered as a moderate-intensity PA.
14. Maintaining femoral bone density in adults: how many steps per day are enough? [29]	Bowyer et al.	2011	Cohort	105	A walking speed greater than 1.32 m/s for 10,000 steps/day was sufficient to maintain a healthy bone mineral density.
15. How many steps are enough? Dose-response curves for pedometer steps and multiple health markers in a community-based sample of older Australians [30]	Ewald et al.	2014	Cross-sectional	2,458	Most of the health benefit was achieved by 8,000 steps/day.
16. Steps per day required for meeting physical activity guidelines in Japanese adults [31]	Cao et al.	2014	Cross-sectional	940	A 7,700-8,000 steps/day walking was comparable with 150 minutes/week MVPA.
17. Achieving the daily step goal of 10,000 steps: the experience of a Canadian family attached to pedometers [32]	Choi et al.	2007	Cross-sectional	4	'Get off the chair' was emphasised to meet the daily step goals.

### **Recommendations on 10,000 steps walking among adult population**

As the global recommendations on PA, adults should have at least 150 minutes/week of MVPA [5]. To compare with the time-based recommendations, Cao et al. investigated the optimal steps per day needed to meet the current PA recommendations by using accelerometer-based monitoring [31]. This study recruited 940 adults (460 men and 480 women), aged between 20 and 69 years, in Japan. The analysis consisted of linear regression analysis, and the results showed overall population needed 7,716 steps/day to meet the recommendation, 150 minutes/week of MVPA [31]. Men needed a slightly lower number of steps per day to meet the recommendation compared with women (7,523 steps/day versus 7,905 steps/day) [31]. According to the study of Cao et al., 10,000 steps/day walking extended beyond the recommended number of steps.

To meet the PA recommendations, in terms of quality, walking at greater than 100 steps/minute was considered as a moderate-intensity PA [28]. For quantity, although both step-based and time-based goals could elevate the number of walking steps, a step-based achievement was more effective than a time-based achievement to reach a 10,000 steps/day goal. The studies showed that a 10,000 steps/day goal could increase more walking steps compared to 30 minutes/day recommendations [19, 25].

### **Interventions to reach and maintain 10,000 steps walking**

Meeting a 10,000-step per day goal in public health needed specific interventions. Previous studies investigated outcomes of prize reinforcement systems, including monetary prize; gift cards; food items; and clothing, for increasing steps per day to 10,000 steps [18, 23]. One study recruited sedentary adults, aged 18 years and over, and the participants were encouraged to achieve 10,000 steps/day over 12 weeks of the programme. The subjects who participated in the prize reinforcement system had the potential to maintain a higher rate of ambulatory activities compared to the control group [23]. In sedentary older adults with mild to moderate hypertension, the prize reinforcement interventions showed the similar trend that the programme could increase the participants' walking steps compared to the control group after a 12-week intervention [18].

Using a pedometer as objective monitoring could have a positive effect in increasing walking steps to reach a level of 10,000 steps/day. This

approach represented a positive finding that using a pedometer in inactive cigarette smokers for 1 month could significantly increase steps/day of the participants from 7,670 (6,159-9,402) steps/day to 10,310 (9,483-11,110) steps/day ( $P<0.001$ ) [17]. To increase effectiveness of using a pedometer, individualised motivational feedback and motivational feedback plus telephone feedback could increase on average 1,684 steps/day ( $P<0.001$ ) and 2,013 steps/day ( $P<0.001$ ), respectively, compared to using only a pedometer after a 12-week intervention [16].

An intervention, 'get off the chair' campaign, for a whole family, including walking at brisk pace; grocery shopping, window shopping in a shopping centre; going to an entertainment centre; and attending parties might be an effective approach to increase daily steps [32]. For a community-based intervention, multiple strategies consisted of local media campaign, environmental approaches, pedometer sale and loan services, and local PA projects were implemented in Ghent, Belgium, and its results showed an 8% increase in the number of people reaching 10,000 steps/day after one year intervention [20].

### **DISCUSSION**

The recent studies found a wide range of 10,000 steps/day walking benefits. Body compositions, blood pressure, and lipid profiles were commonly positive findings in those studies. Benefits of interventions were found in various age groups from young to older adults. Moreover, a 10,000 steps/day walking at greater than 100 steps/minute could be an appropriate level to achieve the current PA recommendations. Recommendations regarding 10,000 steps goal should specify the exact number of steps rather than the amount of time. The evidence supported interventions included prize reinforcement, using a pedometer with or without individualised feedback, encouraging to increase steps/day in family, and multistrategy community-based intervention were effective schemes to reach and maintain 10,000 steps walking.

Walking was considered as a popular, acceptable, and accessible PA among populations [15, 33]. Many studies showed positive outcomes of 10,000-step/day walking in sedentary or physically inactive populations [24, 26]. Additionally, in general populations, many benefits on health were found [21, 22, 34]. On the other hand, increasing PA raised musculoskeletal injury risks [35], however,

walking was a low-risk PA (minor injury and low injury rates) [36].

Reaching the step-based recommendation might need an instrument such as pedometer to measure the objective data [37]. Using a pedometer, especially a traditional pedometer, was limited by several factors [38, 39]. Presently, smartphone pedometer applications could be substitutions of traditional pedometers in the free-living setting [40]. Nevertheless, accuracy among different smartphone pedometer applications was still controversial [41].

The key to success of any 10,000 steps/day interventions might include an appropriate duration and continuity of interventions. The previous studies showed that the number of steps per day decreased by time after interventions [18, 23]. Increasing accessibility to interventions, such as building PA friendly environment, also was a supportive factor to achieve the goal [20].

Barriers to achieving 10,000 steps per day included several layers based on the social ecological model [42]. Functional limitations and low self-efficacy were individual barriers. For environmental issues, lack of perceive and actual environmental supports for walking were also obstacles. In addition, unsupportive regional and community policies could be considered as barriers to achieve the 10,000 steps walking [43].

The strengths of this study were the coverage of recently primary evidence and comparison between a 10,000 steps/day approach and time-based PA recommendations. However, this study was a narrative review which not summarised statistics of all studies. Another weakness was using the expansive search terms which leading to nonspecific and missing data.

In summary, a 10,000 steps/day walk should be promoted to populations, especially in physically inactive populations. Beyond the scope of this study, any health promotion campaigns in the future should consider behavioural and motivational aspects to meet this step-based goal [44].

## CONCLUSIONS

The recent studies support benefits of 10,000 steps/day on body compositions, blood pressure and serum lipid levels. A 10,000 steps/day walking is considered as an alternative recommendation on PA for public health. Various approaches included prize reinforcement, using a pedometer, family- and community-based interventions can increase a number of steps to meet the step-based goal.

Applying any interventions to achieve the recommendation should consider about accessibility, appropriate duration, and continuity of those approaches.

## CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this article.

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