

ORIGINAL ARTICLE

Walking to Meet Physical Activity Guidelines in Knee Osteoarthritis: Is 10,000 Steps Enough?

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Abstract

Objective: To study if step goals (eg, walking 10,000 steps a day) approximate meeting the 2008 Physical Activity Guidelines for Americans.

Design: Cross-sectional observational cohort.

Setting: Community.

Participants: People with or at high risk of knee OA (N=1788).

Interventions: None.

Main Outcome Measures: Objective physical activity data were collected over 7 consecutive days from people with or at high risk of knee OA participating in the Multicenter Osteoarthritis Study. Using activity monitor data, we determined the proportion that (1) walked $\geq 10,000$ steps per day, (2) met the 2008 Physical Activity Guidelines, and (3) achieved both recommendations.

Results: Of the subjects studied (mean age \pm SD, 67 \pm 8y; mean body mass index \pm SD, 31 \pm 6kg/m²; 60% women), 16.7% of men and 12.6% of women walked $\geq 10,000$ steps per day, while 6% of men and 5% of women met the 2008 Physical Activity Guidelines for Americans. Of those walking $\geq 10,000$ steps per day, 16.7% and 26.7% of men and women, respectively, also met the 2008 Physical Activity Guidelines.

Conclusions: Among this sample of older adults with or at high risk of knee OA, walking $\geq 10,000$ steps a day did not translate into meeting public health guidelines. These findings highlight the disparity between the number of steps believed to be needed per day and the recommended time-intensity guidelines to achieve positive health benefits.

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More than 1 in 10 adults over the age of 60 in the United States have knee osteoarthritis (OA), a painful form of arthritis and the most common cause of functional limitation in older adults.^{1,2} Knee OA

is an important public health problem in the United States given its increased prevalence with aging and links to disability and all-cause death.³⁻⁵ At present, there are no curative or disease-modifying agents for OA. Rather, the goals of treatment are to reduce pain and functional limitation through pharmacologic, non-pharmacologic, or surgical (eg, joint replacement) means.

Walking is the most common form of exercise employed by older adults,⁶⁻⁸ and walking-based exercise programs improve pain and functional limitation in people with symptomatic knee OA.^{9,10} A pedometer is a simple tool to objectively quantify walking (steps/d), and when used in conjunction with a step goal, for example, walking 10,000 steps a day, has been found to be effective in increasing physical activity and improving health outcomes, such as body mass index (BMI) and blood pressure.¹¹ In the most recent guidelines for prescribing exercise, the

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American College of Sports Medicine¹² recommends walking at least 7,000 steps a day for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness. Moreover, the popular press promote a goal of at least 10,000 steps per day in order to meet physical activity guidelines.^{13,14}

On the one hand, the recommendation for attaining health benefits from physical activity specifies both a time and intensity of activity. In particular, the 2008 Physical Activity Guidelines for Americans from the Department of Health and Human Services (DHHS)¹⁵ recommends all adults attain at least 150 minutes per week of moderate-intensity physical activity in at least 10-minute increments. The DHHS views this as a public health recommendation given that it incorporates the most up-to-date data on health benefits associated with physical activity.¹⁶ Furthermore, other national^{12,17,18} and international organizations¹⁹ have adopted similar guidelines. It is noteworthy that the DHHS specifies that this same recommendation applies to older adults, as well those with disabilities, hence the recommendation applies to people with knee OA.¹⁵ On the other hand, a goal of walking 10,000 steps per day specifies the overall amount of physical activity without any intensity requirement and has been found to more effectively promote physical activity than the DHHS recommendation.^{20,21} Nevertheless, it is not known if steps per day goals can serve as a reasonable proxy to meet the DHHS time-intensity guidelines. For example, it is unclear if rehabilitation professionals can expect the DHHS time-intensity guidelines to be achieved by recommending a step count goal of 7000 or 10,000 steps per day. This is important to understand, because there is a clinical need to encourage physical activity in a manner tied to positive health outcomes for people with knee OA.²²

Thus, the purpose of this study was to determine if people who walk at least 7000 or 10,000 steps per day also meet the DHHS time-intensity guidelines. We also estimated the number of steps per day that best discriminates meeting the time-intensity guidelines.

Methods

Multicenter Osteoarthritis Study

The Multicenter Osteoarthritis Study (MOST) is a large multicenter longitudinal cohort study of community-dwelling participants who have or are at high risk for knee OA.²³ The MOST cohort at baseline included adults aged 50 to 79 years who were recruited from communities in and surrounding Birmingham, Alabama and Iowa City, Iowa. Study criteria, based on risk for knee OA, included the presence of known risk factors, such as being ≥ 50 years of age, being a woman, reporting a previous knee injury or operation, and having a body weight in excess of the median weight for each age- and sex-specific group, based on data from the Framingham OA Study.²⁴ The MOST protocol was approved by the institutional review boards at the University of

Iowa, University of Alabama at Birmingham, and the University of California San Francisco. All participants in the MOST provided informed consent.

Analysis subsample

This particular analysis focused on a subset of the MOST cohort, restricted to the 1788 individuals who provided objectively monitored physical activity data (method of measurement will be subsequently discussed) collected at the 60-month follow-up exam between May 2009 and January 2011. This was the first study visit in the MOST in which objective physical activity data were collected.

Physical activity monitor

Steps per day and time and intensity variables used to assess achievement of the 2008 Physical Activity Guidelines for Americans were simultaneously assessed using a physical activity monitor.^a We used a small (70 × 50 × 20mm; 38g), waterproof, self-contained device that attaches to the ankle and records the number of strides taken every minute while providing no feedback to the user. To calculate steps, strides are doubled. The physical activity monitor has high concurrent validity in comparison with several reference standard measures of step frequency in older adults, high convergent validity in comparison with Medical Outcomes Study 36-Item Short-Form Health Survey scores among participants with OA, and high test-retest reliability in adults.^{25,26} Furthermore, the physical activity monitor accurately measures moderate walking speeds with a cadence > 100 steps per minute.²⁷

Each study participant was fitted with the physical activity monitor and given written and verbal instructions for attaching the monitor each morning and removing it at bedtime for 7 consecutive days (plus part of the day that the participant received the device and the day it was returned). To determine whether participants wore the monitor long enough to be counted as a full day, we adopted a published method for processing accelerometry data.²⁸ We defined 10 hours of monitoring as the minimum amount of time needed to identify a valid day. The 10-hour requirement represents more than 66% of waking hours and has been used as a threshold in studies of physical activity in the general adult population²⁹ and people with knee OA.²⁸ Time worn was determined from the first step recorded in the morning to the last step recorded in the evening. To exclude times participants may have taken the activity monitor off during the day, we omitted times where the monitor registered no steps for 180 consecutive minutes during the day, which is consistent with previous literature in knee OA populations.^{28,30} Finally, we restricted our sample to those participants who had a minimum of 3 valid days of data, because previous studies have found this to be the minimum number of days needed to establish a reliable estimate of physical activity.^{25,31}

Steps per day

Steps per day benchmarks (eg, walking 10,000 steps/d) are based on waist-mounted pedometers and are known to count fewer steps when compared with an ankle-mounted activity monitor.³² Because pedometers, which are less expensive and more readily accessible, are more likely to be used in clinical and public health applications, we converted steps per day from activity monitor

List of abbreviations:

BMI	body mass index
CI	confidence interval
DHHS	Department of Health and Human Services
MOST	Multicenter Osteoarthritis Study
OA	osteoarthritis
ROC	receiver operating characteristic

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