Measuring Habitual Walking Speed of People With Type 2 Diabetes

Are they meeting recommendations?

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Revised physical activity guidelines for individuals with type 2 diabetes recommend at least 150 min/week of moderate-intensity aerobic physical activity (40–60% of VO2max or 50–70% of maximum heart rate) and/or 90 min/week of aerobic exercise (>60% of VO2max or >70% of maximum heart rate) (1). In a structured exercise program or in the laboratory setting, levels of physical activity can be closely monitored; however, self-directed walking is the most common and most acceptable form of physical activity (2,3) to people with type 2 diabetes, and little is known about self-paced walking speed (and therefore intensity). A walking speed of 4.0 km/h is widely accepted as moderately intense physical activity (4). Numerous studies examining the beneficial effects of physical activity for people with type 2 diabetes exist (rev. in 1,5). Few, however, have directly measured walking speed.

Previous research (6,7) demonstrated efficacy in increasing physical activity of participants using the First Step Program (FSP), a pedometer-based, self-paced walking program designed to help people with type 2 diabetes increase their steps per day. Despite the increase in physical activity, improvements in health outcomes were modest. In contrast, the implementation of the FSP in a worksite setting involving healthy adults resulted in significant reductions in weight, BMI, waist girth, and resting heart rate (8). We hypothesize that a slower walking speed in the people with type 2 diabetes may contribute to the smaller improvements in health-related outcomes in this population. Therefore, the objective of this study was to determine self-paced walking speed and other characteristics of ambulation in a group of people with type 2 diabetes who had recently completed the FSP.

RESEARCH DESIGN AND METHODS — A convenience sample of 19 participants with type 2 diabetes (11 men, 8 women) were recruited after they had completed the FSP, a 16-week pedometer-based lifestyle program for individuals with type 2 diabetes designed to increase steps per day. Eligible participants were diagnosed with type 2 diabetes, aged 40–70 years, not taking insulin, without physical limitations, not currently enrolled in another physical activity program, and accumulating <8,800 pedometer-determined steps/day. The 3-day average pedometer-determined physical activity following the FSP was 9,344 steps/day.

Ambulation data were collected by participants wearing an Activity Monitoring Pod 331 (AMP) (Dynastream, Cochrane, Alberta, Canada) for 3 consecutive days during waking hours. The AMP is worn above the ankle in a neoprene pouch. Sensors within the AMP detect the angular velocity of the leg; an algorithm in the AMP calculates mean velocity and length of that stride. The AMP classifies activity into three categories: 1) Inactive: sitting, lying, or standing (i.e., when the wearer did not take any steps for at least 20 s), 2) Active: movement that includes those associated with daily tasks such as walking to a filing cabinet or cleaning house, or 3) Locomotion: intentional ambulation where the wearer took at least 20 consecutive steps (e.g., walking in the shopping mall). Within the active and locomotion categories, step count, average speed, average cadence, duration, and total distance traveled were calculated. Only data in the locomotion category are presented herein. Data were downloaded from the device to a computer using manufacturer-supplied software. Data were not normally distributed; therefore, the median and 25th and 75th percentiles were calculated. Independent treadmill testing has shown the AMP accurately reflects walking speeds between 0 and 6.9 km/h.

RESULTS — Participant characteristics were as follows: age 54.1 ± 7.7 years (50.3–57.8), BMI 33.4 ± 4.9 kg/m² (31.0–35.7), and HbA1c 6.7 ± 0.9% (6.3–7.2) (means ± SD [95% CI]). Characteristics of walking in the locomotion category are shown in Table 1. The median speed of walking in locomotion was 3.3 km/h. Physical activity ranged from 4,508 to 29,979 steps/day, and locomotion walking speed ranged from 2.2 to 4.7 km/h; these variables were positively associated (r = 0.6, P = 0.01). All but one of the subjects walked ≥4.0 km/h for at least 1 min during the monitoring period.

CONCLUSIONS — The median walking speed of this cohort was 3.3 km/h and thus does not meet the walking speed commonly accepted as moderately intense physical activity (4). This is one of the first studies to directly measure self-paced walking speed in people with type

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Abbreviations: AMP, activity monitoring pod; FSP, First Step Program.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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2 diabetes who have recently completed a behavior modification program intended to increase physical activity. The number of daily steps taken is close to a popular public health goal of 10,000 steps/day, and the time spent in locomotion approximates current recommendations for physical activity (9–11). The low walking speed observed in this study suggests that health benefits may not be fully achieved, even though participants approximate popular volume recommendations.

Although participants in this study walked at a slow absolute speed, it is possible their relative exertion reached 40–60% \( V_{\text{O2max}} \). Relative intensity of walking was not measured in this study and is an important measurement to consider in future studies. The relative intensity of self-paced walking of individuals with type 2 diabetes is not known. The modest improvements in physiological outcomes achieved in the FSP suggest that self-paced walking in people with type 2 diabetes may not approach the absolute intensity recommended for health benefits.

Numerous devices for monitoring ambulatory activity have been developed (12). The pedometer has gained wide acceptance as a cost-effective reliable measure of steps per day (13,14), but it has a limited ability to capture more extensive characteristics of walking such as speed. The AMP is a novel device suitable for collecting detailed ambulatory information, although it may be less accessible to a broad population due to its relatively high cost (~$1,600 CDN) and the technical knowledge required to operate the device. Combining a pedometer with a stopwatch may be a feasible way to monitor walking speed.

The FSP employs the simple message of walk more steps per day. The slow walking speed observed (3.3 km/h) and the limited time spent at this intensity after completing the FSP suggests that this aspect of walking may need specific instruction in order to optimize health benefits derived from self-paced walking. If relative intensity appears to be a limiting factor, participants may benefit from additional conditioning to manage the demands of increased walking speeds.

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References


Table 1—Median, 25th, and 75th percentiles of 3-day averaged ambulatory characteristics obtained from an AMP*

<table>
<thead>
<tr>
<th>Ambulation characteristic</th>
<th>Median</th>
<th>25th percentile</th>
<th>75th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total daily steps</td>
<td>9,150</td>
<td>5,394</td>
<td>11,469</td>
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<tr>
<td>Locomotion steps</td>
<td>5,331</td>
<td>2,444</td>
<td>7,015</td>
</tr>
<tr>
<td>Locomotion walking speed (km/h)</td>
<td>3.3</td>
<td>2.9</td>
<td>3.7</td>
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<tr>
<td>Locomotion cadence (steps/min)</td>
<td>106</td>
<td>102</td>
<td>111</td>
</tr>
<tr>
<td>Time spent in locomotion (min)</td>
<td>49.4</td>
<td>26.1</td>
<td>58.5</td>
</tr>
<tr>
<td>Distance in locomotion (km)</td>
<td>2.7</td>
<td>1.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Time spent at or above 4.0 km/h (min:sec)</td>
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<td>02:06</td>
<td>27:25</td>
</tr>
</tbody>
</table>

* \( n = 19 \) subjects.