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

Mark A. Tully and Margaret E. Cupples

Background: Recent public health initiatives have promoted accumulating 10,000 steps per day. Little previous research has evaluated its effects in young adults. The aim of this study was to determine the effects of taking 10,000 steps per day on fitness and cardiovascular risk factors in sedentary university students. Methods: Healthy, sedentary students (mean age 21.16 ± SD 6.17) were randomly allocated to take 10,000 steps per day or to a control group who maintained their habitual activity. Members of the 10,000 step group wore a pedometer and reported daily step count in a diary. Outcome measurements (20-meter multistage shuttle run, BMI, and blood pressure) were measured before and after 6 weeks. Results: There were no significant differences between the groups at baseline. After 6 weeks, the 10,000 steps group were taking significantly more steps (8824.1 ± SD 5379.3 vs. 12635.9 ± SD 6851.3; P = .03). No changes were observed in fitness, or BMI (P > .05). Significant reductions in blood pressure (P = .04) in the 10,000 step group. Conclusions: A daily target of 10,000 steps may be an appropriate intervention in sedentary university students to increase their physical activity levels. The positive health benefits of simple everyday physical activity should be promoted among health professionals.

Keywords: pedometer, walking

Physical inactivity is a significant cause of mortality and morbidity worldwide. Every adult is recommended to accumulate at least 30 minutes of moderate intensity exercise, 5 days a week, but few people in Northern Ireland meet this target.

Recently, public health initiatives have included recommendations that individuals should aim to walk 10,000 steps per day, using pedometers as a standardized measurement of physical activity. This recommendation has largely been based on epidemiological data and there is limited data from randomized controlled trials (RCTs) of taking 10,000 steps per day. A recent systematic review identified 9 randomized controlled trials, of which 3 reported an assessment of the effects of walking 10,000 steps per day on physical activity and health. A range of outcomes were reported, from no effect on body mass index (BMI), waist and hip circumference, or blood pressure in people with type 2 diabetes, to a significant reduction in weight and systolic blood pressure in post-menopausal women. However, only 4 studies involved healthy participants and few included students.

None of the studies reported an examination of the effects on change in a validated measure of fitness, which is an independent risk factor for cardiovascular disease and has been shown to improve following moderate intensity walking programs.

Since two-thirds of university aged adults are inactive and pedometer determined steps reduce with age in adolescents, it would appear important to examine the effects of interventions to promote physical activity on health and fitness in this group. Previous research has shown that University students who use public transport instead of driving have higher levels of physical activity, which may help overcome the challenges of balancing study, work, and social commitments. This suggests that changes in physical activity in University students may be possible by adopting new behaviors, but this needs to be tested in a randomized controlled trial.

The aim of this pilot study was to determine the feasibility of conducting a pedometer intervention in the university setting and to provide data for a fully powered trial of the effects of accumulating 10,000 steps per day on fitness and risk factors for cardiovascular disease in healthy, sedentary, university students.

Methods

Study Design

141 medical, dental, and biomedical science students of Queen’s University Belfast were approached and asked to complete the long form of the International Physical
Activity Questionnaire (IPAQ)\textsuperscript{12} and indicate their willingness to participate in a walking program. Queen’s University is located in inner city Belfast and students and the campus is split over 2 sites, 1 mile apart. Seventy-one were classified as inactive or moderately active, of whom 31 were willing to participate and invited to a familiarization session (Figure 1). Twelve individuals attended this session at which the study was explained, and written informed consent sought. Individuals were excluded if they had any known disease that would prevent them taking regular exercise.

Those who consented to participate wore a pedometer (Oregon Scientific WA101, USA) for 7 days before entering the trial to ascertain preintervention activity levels. After the 7 days ‘preintervention’ outcome measurements were made and individuals were allocated to a ‘10,000 step’ exercise intervention or a control group using computer generated random numbers by a researcher not involved in the day-to-day running of the trial. Measurements were made at baseline (preintervention) and after 6 weeks (postintervention) in the university Physical Education Centre by the same researcher, who was blinded to the group allocation.

**Outcome Measurements**

Height (Seca Leicester stadiometer, Germany) and body mass (Seca 761 scales, Germany) were measured. Waist and hip circumferences were measured using standard procedures. Aerobic fitness was estimated using the 20-m multistage shuttle run and calculated predicated VO\textsubscript{2max} using the equation of Flouris et al.\textsuperscript{13} Blood pressure (BP) and heart rate were taken after a 5-minute resting period in the seated position, as the average of 2 measurements, with a 1 minute interval between, using a Digital Sphygmomanometer (Omron M5-I, Japan).

**Statistical Analyses**

As there are no previous pedometer interventions in this population, a sample size calculation was estimated on the findings on a previous study of a stair climbing intervention in university aged adults.\textsuperscript{14} It was estimated that a 15% change in predicted VO\textsubscript{2max} within the intervention group could be detected with 80% power with 8 subjects in the 10,000 step group. Data were analyzed using the computer program SPSS v14.0.

![Figure 1 — Flow of participants through the trial.](image-url)
differences were compared using independent $t$ tests and within group changes using paired $t$ tests. The extent of change (difference of pre- and postintervention measurements) between the groups was compared using independent $t$ tests. The Research Ethics Committee, Queen’s University, Belfast approved the study (September 2006).

**Interventions**

Participants in the 10,000 step group were asked to accumulate 10,000 steps per day and to wear a pedometer (Oregon Scientific WA101, USA) every day for 6 weeks, chosen to ensure the intervention could be completed in a single semester, thus avoiding any potential seasonal differences in how participants respond. Control group participants were asked to wear their pedometer every day for 6 weeks and record the number of steps they took per day without modifying any aspect of their lifestyle.

All participants were asked to complete weekly diaries recording the number of steps they took per day. Every 2 weeks diaries were returned to the researcher, who posted new ones and phoned or emailed participants to resolve any difficulties.

**Results**

Twelve inactive or moderately active first and second year students (10 females and 2 males) agreed to participate and were randomly allocated to one of the groups. All participants completed the trial. The mean age of participants was 21.16 (SD ± 6.17) years.

There were no significant differences in daily step counts between the groups at baseline (Table 1).

All participants in the 10,000 step group met their daily goal and significantly increased their daily step count over the course of the study (Table 2). There were no significant differences between the groups for any of the other outcome measurements at baseline (Table 2). Adherence with the program, measured as the number of days of data that was returned on the diaries as a percentage of the total number of days in the program, was 84.9%.

Following the 6-week walking program, there was a significant reduction in BP in the 10,000 step group which was not observed in the control group (Table 2). There were no changes in fitness or anthropometric outcomes.

**Discussion**

This study demonstrates that it is feasible to conduct a pedometer intervention in the university setting and that translating the emerging recommendation of walking 10,000 steps per day into a 6-week, unsupervised walking program leads to a significant increase in physical activity in sedentary university students. The results can be used to inform a sample size calculation for a fully powered trial.

Our finding of a significant increase in number of steps per day among the intervention group who were given a step goal of 10,000 steps per day, is in keeping with a recent systematic review published after our study began. This suggests that individuals seeking to increase their physical activity may be assisted through advice to aim for 10,000 steps per day. Of interest was the finding of no change in fitness in the 10,000 step group. Fitness is an independent risk factor for heart disease and has been shown to improve following interventions promoting self-paced moderate intensity walking. Our intervention offered no advice regarding speed of walking. Health professionals providing physical activity advice may therefore need to stipulate the speed of walking to gain additional health benefits. However, the lack of change in fitness may be related to the relatively short duration of the intervention and should be confirmed in longer studies.

The intervention also led to a significant reduction in blood pressure among this group of younger adults. Blood pressure was included as an outcome measure to test the effects of walking on cardiovascular health in university aged adults. Although none of the subjects in this study were hypertensive (BP >140/90 mmHg), the American College of Sports Medicine states that the positive relationship between cardiovascular risk and blood pressure occurs with blood pressure as low as

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**Table 1 Baseline Comparison of Outcome Measurements in 10,000 Step and Control Groups**

<table>
<thead>
<tr>
<th></th>
<th>10,000 step group (n = 8)</th>
<th>Control group (n = 4)</th>
<th>Comparison at baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of steps per day</td>
<td>8824.1 (5379.3)</td>
<td>7263.8 (2837.5)</td>
<td>0.14</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>64.31 (17.35)</td>
<td>67.00 (13.77)</td>
<td>0.79</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.66 (6.55)</td>
<td>23.61 (3.13)</td>
<td>0.99</td>
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<tr>
<td>WHR (cm)</td>
<td>0.83 (0.04)</td>
<td>0.83 (0.04)</td>
<td>0.55</td>
</tr>
<tr>
<td>Predicted VO₂max (ml/kg/min)</td>
<td>34.14 (4.62)</td>
<td>32.05 (4.59)</td>
<td>0.52</td>
</tr>
<tr>
<td>Systolic BP (mmHg)</td>
<td>120.00 (15.62)</td>
<td>131.67 (11.85)</td>
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</tr>
<tr>
<td>Diastolic BP (mmHg)</td>
<td>79.00 (8.23)</td>
<td>86.33 (8.50)</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>10,000 step group (n = 8)</td>
<td>Control group (n = 4)</td>
<td>Between group difference P</td>
</tr>
<tr>
<td>--------------------------------</td>
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</tr>
<tr>
<td></td>
<td>Preintervention Mean (SD)</td>
<td>Postintervention Mean (SD)</td>
<td>Change within group P</td>
</tr>
<tr>
<td>Number of steps per day</td>
<td>8824.1 (5379.3)</td>
<td>12635.9 (6851.3)</td>
<td>0.00*</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>64.31 (17.35)</td>
<td>63.50 (17.11)</td>
<td>0.22</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.66 (6.55)</td>
<td>23.37 (6.50)</td>
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<tr>
<td>WHR (cm)</td>
<td>0.83 (0.04)</td>
<td>0.82 (0.11)</td>
<td>0.25</td>
</tr>
<tr>
<td>Predicted VO₂max (ml/kg/min)</td>
<td>34.14 (4.62)</td>
<td>31.77 (6.34)</td>
<td>0.86</td>
</tr>
<tr>
<td>Systolic BP (mmHg)</td>
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<td>111.75 (9.80)</td>
<td>0.04*</td>
</tr>
<tr>
<td>Diastolic BP (mmHg)</td>
<td>79.00 (8.23)</td>
<td>71.56 (8.34)</td>
<td>0.04*</td>
</tr>
</tbody>
</table>

* P < .05 within groups, post intervention versus baseline.

** P < .05 comparison of extent of change between groups.
115/75 mmHg. Although the changes observed in this study were not clinically significant, they are in keeping with that found in a systematic review of the effects of walking on blood pressure in mainly middle aged and older adults by Kelley et al.\(^\text{16}\)

Given the importance of lifestyle in modifying cardiovascular risk,\(^\text{14}\) and that health professionals who are themselves physically active are more likely to promote physical activity among their patients,\(^\text{18}\) it is necessary to identify methods of increasing physical activity in health professionals. The findings of this study suggest that a pedometer intervention may be a suitable intervention early in their careers.

**Study Limitations and Strengths**

Previous research has demonstrated that 70% of students do not meet the previously recommended level of exercise.\(^\text{8}\) The current study indicates that pedometer interventions may be an acceptable approach to address this problem. However, Bravata et al.\(^\text{12}\) recognized that there is a need to determine if the effects of pedometer based interventions, like those demonstrated in the current study, can be maintained long term. The data presented here demonstrate that pedometers are a feasible method of promoting increases in physical activity in the university setting. The study needs to be replicated in a larger sample to confirm the findings in a fully powered trial.

**Conclusions**

A daily target of 10,000 steps may be an appropriate intervention in sedentary university students to increase their physical activity levels. However, the sustainability of such a behavior change still needs to be assessed.

**Acknowledgments**

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**References**