Point-of-Choice Prompts to Reduce Sitting Time at Work
A Randomized Trial

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Background: Prolonged sitting is prevalent in the workplace and is associated with adverse health markers.

Purpose: Investigate the effects of point-of-choice (PoC) prompting software, on the computer used at work (PC), to reduce long uninterrupted sedentary periods and total sedentary time at work.

Design: Assessor-blinded, parallel group, active-controlled randomized trial.

Setting/participants: A convenience sample of office workers from Glasgow, United Kingdom. Data were collected April to June 2010, and analyzed October 2010 to June 2011.

Intervention: The education group (n=14) received a brief education session on the importance of reducing long sitting periods at work. The PoC group (n=14) received the same education along with prompting software on their PC for 5 workdays, which reminded them to stand up every 30 minutes.

Main outcome measures: Sitting time was measured objectively using the activPAL™ activity monitor for 5 workdays at baseline and 5 workdays during the intervention. The number and time spent sitting in events >30 minutes’ duration were the main outcome measures.

Results: At baseline, participants spent 5.7±1.0 hours/day (76%±9%) of their time at work sitting. Of that time, 3.3±1.3 hours/day was spent sitting in 3.7±1.4 events >30 minutes. There was a significant difference between the groups in the change (intervention to baseline) of both the number (ANCOVA; −6.8%, p=0.014) and duration (−15.5%, p=0.007) of sitting events >30 minutes. During the intervention, compared with baseline, the PoC group reduced the number (paired t-test; −0.11 events/hour, p=0.045) and duration (−12.2%, p=0.035) of sitting events >30 minutes. However, there was no significant difference in total sitting time between groups (−4.4%, p=0.084).

Conclusions: Point-of-choice prompting software on work computers recommending taking a break from sitting plus education is superior to education alone in reducing long uninterrupted sedentary periods at work.

Trial registration: This trial was registered at ClinicalTrials.gov NCT01628861.


Introduction

Sedentary behavior, time spent sitting/supine,1–5 is a risk factor for morbidity and mortality, independent of physical activity.2,6–10 In addition, long uninterrupted sedentary events are independently associated with adverse health markers.11,12 Employees sit at work for ~77% of the time,13 mostly (51%) accumulated in periods longer than 30 minutes.14 Workplace interventions aiming to reduce sedentary behavior have not been reported, whereas those aimed at increasing physical activity do not decrease self-reported sitting time.15 The current study tested whether using prompting software on a personal computer (PC) used at work, in addition to education, re-
duced long uninterrupted sedentary periods and total sedentary time at work compared to education alone.

Methods

Design
This assessor-blind, parallel group, active-controlled randomized trial compared two groups of office workers. The education-only group received an education session on the adverse health effects of sitting for long periods. The point-of-choice (PoC) group received the same education along with prompting software on their PC reminding them to stand every 30 minutes.

Participants
A convenience sample of 30 healthy working adults was recruited via poster and e-mail in April–May 2010. All participants worked in an office at Glasgow Caledonian University, United Kingdom (UK), and could stand unassisted. There was no racial or gender bias in the selection of participants. Demographic information (age, gender, height, weight, occupational role, smoking status) was recorded. Ethical approval was obtained from Glasgow Caledonian University. Written informed consent was provided.

Baseline Measurement Period
Participants wore the activPAL™ (PAL technologies, UK) at work for 5 workdays. The thigh-mounted activPAL provides time-stamped acceleration, classified into sitting/lying, standing, and walking. The monitor is valid for adults and has greater sensitivity to change than other monitors. Participants recorded time of arrival (monitor application) and departure (monitor removal) from work in a diary. An e-mail reminding participants to wear the monitor was sent at the start of each workday.

Education
Immediately after the baseline measurement period, each participant individually received a short educational talk, read from a script, regarding the health risks of prolonged sitting, stating that standing every 30 minutes could be beneficial, and a short information leaflet was provided (Appendix A, available online at www.ajpmonline.org).

Group Assignment
Random number generation was used to place group assignment into sequentially numbered sealed opaque envelopes by a researcher not delivering the intervention. The next numbered envelope was opened by the researcher, immediately after the education session. Participants were either assigned to the education group (education only) or the PoC group (PoC plus education), and the participant was aware to which group they were allocated.

Prompting Software
Participants in the PoC group then additionally had prompting software (MyRestBreak 1.0, ©Vikram Sharma, www.my-rest-break.software.informer.com) loaded onto their PC, which was used during the 5-workday intervention period. An advice window (11X9 cm), reminding participants to take a break, appeared on the monitor, for 1 minute every 30 minutes from the time the PC was started. The window could not be minimized or moved, but participants could work in any opened windows around it.

 Intervention Measurement Period
The 5-workday intervention measurement period started immediately, concurrent with the intervention, following the same procedure as for the baseline measurement period.

Data Treatment
Data treatment was conducted by a researcher blinded to the allocation of the participant. Data were classified into sitting, standing, and walking by proprietary software (version 5.9.1.1, PAL technologies, UK); subsequent data processing was performed by custom software (visual basic for applications in Excel). Reported diary information was used to determine the start/end of each workday. Sedentary periods crossing the reported start/end of the workday were included if most of the sedentary period was within stated work hours and no more than 10 minutes was outside. The minimum data requirement for inclusion was 2 workdays, of at least 4 hours’ duration, in each of the measurement periods.

Total time sitting and the number of sitting events (equivalent to the number of breaks in sitting) were used as outcome measures to represent overall sedentary behavior at work. A prolonged sitting event was defined as ≥30 minutes, fitting the timescale of the intervention. The number of prolonged sitting events and the duration of prolonged sitting events were used to represent prolonged sedentary behavior. Outcome measures were standardized by dividing them by the duration of the workday.

Statistical Analysis
Statistical analyses were performed on the standardized outcome measures using SPSS (PASW 18.0). Demographic information and baseline outcome measures were compared between the two groups, using independent samples t-test (normal continuous data, assessed by Kolgorov–Smirnov test) and chi-square test (categoric data). Changes in outcome measure (intervention–baseline) were assessed using paired t-tests, whereas the difference in change in outcome (intervention–baseline) between the two groups was compared using ANCOVA, with the respective baseline as covariate. Between-group standardized effects size and post hoc sample size were calculated.

Results
Thirty participants were recruited (Figure 1). Of 278 workdays monitored, 11 were excluded from analysis because of a short reported workday (n=3); technical difficulties (n=3); or nonwear (n=5). Two participants were excluded because of insufficient data. The median number of workdays analyzed was 5 (21 participants) at baseline and 5 (18 participants) during the intervention. Measurement periods <4 days were 2 workdays (two participants, baseline) and 3 workdays (one participant baseline, one participant intervention). The inclusion/exclusion of sitting events crossing the reported start/end of the workday resulted in a net reduction of 77.8 hours (3.9%).

The mean (±SD) duration of a workday was 7.5 ±0.8 hours/day (median 7.6 hours/day; range 4.0–12.1 hours/
Baseline Sedentary Behavior
At baseline, participants spent (M±SD [range]) 5.7±1.0 hours/day (76%±9% [2.4–9.8 hours/day, 46%–96%]) at work sitting, in 26±10 events (3.4±1.2 events/hour [7–67, 0.9–18.3 events/hour]). Participants had 3.7±1.4 (0.49±0.18 events/hour [0–8, 0.00–1.21 events/hour]) prolonged sitting events, which lasted 3.3±1.3 hours/day (55%±20% [0.0–7.2 hours/day, 0%–97%]). There were no statistical differences between groups at baseline.

Effect of the Intervention on Sedentary Behavior
The only within-group differences were for the number (−0.11 events/hour) and duration (−12.2%) of prolonged sitting events (Table 1). There was no between-group difference (estimated marginal mean difference PoC−education [95% CI], p-value) in total sitting time (−4.4% [−9.6%, 0.6%], p=0.084). There were significant between-group differences in the total number of sitting

Table 1. Sedentary behavior of participants

<table>
<thead>
<tr>
<th>Group</th>
<th>BL (M±SD)</th>
<th>Int (M±SD)</th>
<th>Change (Int-BL)</th>
<th>Difference (PoC-Ed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sitting time (hours/day [%])</td>
<td>PoC+Ed</td>
<td>5.9±1.0</td>
<td>5.6±1.1</td>
<td>−0.3±0.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(78.1±6.9)</td>
<td>(75.0±9.9)</td>
<td>(−3.1±7.0)</td>
</tr>
<tr>
<td></td>
<td>Ed-only</td>
<td>5.6±1.0</td>
<td>5.7±0.9</td>
<td>0.1±0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(74.0±11.0)</td>
<td>(76.4±8.0)</td>
<td>(2.4±6.6)</td>
</tr>
<tr>
<td>Number of sitting events (events/day [events/hour])</td>
<td>PoC+Ed</td>
<td>26±11</td>
<td>28±9</td>
<td>1.6±5.3*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.4±1.1)</td>
<td>(3.7±1.0)</td>
<td>(0.3±0.5)</td>
</tr>
<tr>
<td></td>
<td>Ed-only</td>
<td>25±9</td>
<td>23±10</td>
<td>−2.4±5.7*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.3±1.3)</td>
<td>(3.1±1.4)</td>
<td>(−0.3±0.7)</td>
</tr>
<tr>
<td>Number of prolonged sitting events (events/day [events/hour])</td>
<td>PoC+Ed</td>
<td>3.5±1.4</td>
<td>2.7±1.3</td>
<td>−0.8±1.6*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.47±0.19)</td>
<td>(0.36±0.19)</td>
<td>(−0.11±0.19)</td>
</tr>
<tr>
<td></td>
<td>Ed-only</td>
<td>3.8±1.4</td>
<td>3.9±1.2</td>
<td>0.1±0.9*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.50±0.48)</td>
<td>(0.52±0.15)</td>
<td>(0.02±0.12)</td>
</tr>
<tr>
<td>Duration of prolonged sitting events (hours/day [%])</td>
<td>PoC+Ed</td>
<td>3.1±1.2</td>
<td>2.3±1.4</td>
<td>−0.8±1.4*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(51.9±19.3)</td>
<td>(39.7±21.2)</td>
<td>(−12.2±19.3)</td>
</tr>
<tr>
<td></td>
<td>Ed-only</td>
<td>3.5±1.5</td>
<td>3.6±1.3</td>
<td>0.1±0.7*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(58.5±20.5)</td>
<td>(59.7±17.4)</td>
<td>(1.2±7.9)</td>
</tr>
</tbody>
</table>

Note: Data shown in each cell are M±SD for both the actual value of the outcome measure per day and for the standardized outcome measure (shown in parentheses). All statistics were performed on standardized data. Outcome measures of time spent sitting have units of hours/day (% of workday); outcome measures of events have units of events/day (events per hour at work). Prolonged sitting was defined as sitting continuously for >30 minutes. The PoC+Ed group received a computer prompt to stand every 30 minutes plus verbal and pamphlet education. The Ed group received verbal and pamphlet education. Bold indicates significance.
*Difference in outcome measure significantly different between the groups (p<0.05)
**Outcome measure significantly different at intervention compared to baseline (p<0.05)
BL, baseline measurement period; Change (Int-BL), within-group change in outcome at the intervention measurement period compared to baseline; Ed, education; Difference (PoC-Ed), between-group difference in outcome measure of the change (intervention–baseline); Int, intervention measurement period; PoC, point-of-choice
events (0.54 events/hour [0.07, 1.02], \( p = 0.027 \)) and for the number (−0.14 events/hour [−0.25, −0.03], \( p = 0.012 \)) and duration (−15.4% [−26.2%, −4.5%], \( p = 0.007 \)) of prolonged sitting events.

Standardized effect sizes between groups of the change in outcome (intervention−baseline) were small (number of sitting events, 0.44) or moderate (total sitting time, 0.60; number of prolonged sitting events, 0.69; total time sitting in prolonged events, 0.68). Post hoc calculations indicated that 44 individuals per group would be required to show a significant (80% power, \( p = 0.05 \)) difference between groups in total sitting time.

**Discussion**

Measured objectively, there was no difference on total time spent sitting. However, both the number of and the time spent sitting in prolonged sitting periods (>30 minutes’ duration) were reduced in the PoC-plus-education group and differed in comparison to the lack of change in the education-only group. To our knowledge, this is the first RCT to investigate the effects of an intervention specifically targeted to reduce adverse sedentary behavior in the workplace.

One workplace intervention aiming to increase physical activity through incidental activity demonstrated a nonsignificant self-reported reduction in sitting at work of 15 minutes, \( p = 0.03 \), a similar absolute level to the present study (17 minutes). Three nonworkplace interventions aimed at reducing sedentary behavior demonstrated pre–post reductions in objectively measured sitting from 3.2% to 4.3%. These reductions are of a similar magnitude to that of the PoC group in the current study (−3.1%), despite the studies using different activity monitors (activPAL \(^{18,20}\), actigraph \(^{20}\), SenseWear armband \(^{21}\)) and interventions (behavioral \(^{18,20}\), TV-lockout \(^{21}\)), in different populations (older adults \(^{20}\), overweight/obese adults \(^{18,21}\)). Only one of these studies included a control group. \(^{21}\)

The PC prompt used in the present study was related to the time the PC was switched on in the morning, and not necessarily to the sitting behavior of the participant. Despite this, prolonged sitting was reduced in the PoC group compared to the education-only group, although whether participants were responding specifically to the prompts, or using them as general reinforcement to the education is unclear.

**Limitations and Strengths**

A limitation of the present study is its small sample size. The PoC group was significantly older than the education group. Adults tend to become more sedentary as they get older \(^{22}\); however, the potential effect of age on compliance with the intervention is unclear. There are no evidence-based guidelines on the appropriate maximum period of sitting duration for health. The recommendation to stand every 30 minutes was selected from the range of informal recommendations that exist (20 minutes, \(^{23}\) 30 minutes, \(^{24}\) 55 minutes \(^{3}\)). There is no evidence that altering sedentary patterns to fit this recommendation will have health benefits.

The duration of the intervention was short (3–5 workdays) and there was no long-term follow-up. There was no process evaluation to ascertain if the intervention was delivered as intended or whether participants found the intervention useful. Strengths of this paper were the novel intervention paradigm, the assessment of patterns of sedentary behavior, \(^{5,14}\) and the use of an objective measurement of sedentary behavior. \(^{16,19,22,25}\)

**Conclusion**

A health promotion intervention specifically targeting sedentary behavior at work—point-of-choice prompts on work computers reminding individuals to take a 1-minute break from sitting every 30 minutes—reduced the number of, and time spent in, prolonged (>30 minutes) uninterrupted sitting periods compared to education alone.

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**References**

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Appendix

Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.amepre.2012.05.010.

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