A multicomponent intervention to reduce daily sitting time in office workers: the SMART Work & Life three-arm cluster RCT

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Scientific summary

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Scientific summary

Background

High levels of sedentary behaviour (e.g. sitting, reclining or lying, and expending ≤ 1.5 metabolic equivalents) have been linked to poor health outcomes, including type 2 diabetes, cardiovascular disease, some cancers and premature mortality. In addition to physiological health outcomes, high levels of sitting are detrimentally associated with cognitive function, mental health and a lower quality of life. Working-age adults spend around 60–70% of their workday sitting, with workdays being more sedentary than non-workdays; however, this can vary by occupation. Office workers spend 70–85% of their time at work sitting and accumulate a large proportion (40–50%) of this time in prolonged sitting bouts. Office workers also typically spend a large proportion of their leisure time sitting, compared with other occupations. In the workplace, lower levels of sitting have been linked to higher work vigour, higher job performance and lower presenteeism. Workplaces are, therefore, an ideal setting for implementing interventions to reduce daily sitting.

Current evidence shows a need for fully powered randomised controlled trials (RCTs) with long-term follow-up to test the effectiveness of interventions to reduce sitting. Previous work from our group, evaluating multicomponent interventions to address high levels of sitting in office workers, found that significant reductions in sitting time across the day were mainly driven by changes to workplace sitting and to not daily sitting, indicating that a whole-day approach to encourage reductions in daily sitting was needed to maximise the potential health benefits.

Objectives

The main aim of the study was to evaluate the clinical effectiveness and cost-effectiveness of the SMART Work & Life (SWAL) intervention (provided with and without a height-adjustable workstation) in a sample of desk-based office workers. If both interventions were shown to be effective in comparison with the control group, then a secondary aim would be to determine if one intervention was more clinically effective and cost-effective than the other.

Primary objective

To investigate the impact of the SWAL intervention, delivered with and without a height-adjustable workstation, on device-assessed daily sitting time compared with usual practice at 12 months' follow-up.

Secondary objectives

- To investigate the impact of the SWAL intervention, delivered with and without a height-adjustable workstation, over the short term (assessed at 3 months) and longer term (assessed at 12 months) on:
  - daily sitting time on any valid day (3 months) and on workdays and non-workdays
  - sitting time during work hours
  - daily time spent standing and in light and moderate or vigorous physical activity (MVPA) across any valid day, during work hours and on workdays and non-workdays
  - daily time spent stepping and number of steps across any valid day, during work hours and on workdays and non-workdays
  - markers of adiposity [i.e. body mass index (BMI), per cent body fat, waist circumference]
  - blood pressure
  - blood biomarkers [i.e. fasting glucose, cholesterol, triglycerides, glycated haemoglobin (HbA_{1c})]

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  - musculoskeletal health
  - psychosocial health (i.e. fatigue, stress, anxiety and depression, well-being and quality of life)
  - work-related health and performance (i.e. work engagement, job performance and satisfaction, occupational fatigue, presenteeism, sickness absence)
  - sleep duration and quality.

- To undertake a full economic analysis of the SWAL intervention.
- To conduct a mixed-methods process evaluation throughout the intervention implementation period (using qualitative and quantitative measures) with participants and workplace champions.

Methods

Design

A three-arm cluster RCT with a cost-effectiveness and process evaluation analysis. Follow-up measures were taken at 3 and 12 months.

Setting

Local councils in Leicester, Leicestershire, Greater Manchester and Liverpool, UK.

Participants

Participants were recruited from across participating councils (i.e. Leicester City Council, Leicestershire County Council, Salford City Council, Bolton Council, Trafford Council and Liverpool City Council). Participants were office-based employees (aged ≥ 18 years) who spent the majority (≥ 50%) of their day sitting, were at least 60% full-time equivalent and were able to walk without assistance. Employees who were pregnant, who already used a height-adjustable workstation or were unable to communicate in English were not eligible.

Participants were grouped into clusters either by a shared office space (although could be made up of different teams/departments) or if they were members of the same team but split into different office spaces. To be eligible, each cluster was required to have at least one participant willing to undertake the role of workplace champion and at least four participants in the cluster. Informed consent was obtained from participants before the baseline measurement session and verbal consent was confirmed at each follow-up.

Sample size

To detect a 60-minute difference in average daily sitting time between the intervention groups and the control group [assuming a sitting time standard deviation (SD) of 90 minutes, 90% power, a two-tailed significance level of 5%, an average cluster size of 10 (range 4–38), an intraclass correlation coefficient of 0.05, the number of clusters being inflated by a factor of 1.23, allowing for one cluster drop out per arm and a 40% loss to follow-up/non-compliance with the activPAL (PAL Technologies Ltd, Glasgow, UK)], the required sample size was 690 participants from 72 clusters. Testing two intervention arms independently with the control arm was also taken account of as part of the sample size calculation.

Interventions

The SWAL intervention is a multicomponent intervention grounded in several behaviour change theories, which aims to reduce daily sitting in office workers. The SWAL intervention includes organisational-level behaviour change strategies (e.g. management buy-in), environmental-level behaviour change strategies (e.g. relocating waster bins, printers) and group-/individual-level behaviour change strategies (e.g. education, action-planning, goal-setting, addressing barriers, group coaching, challenges, self-monitoring) that are delivered by workplace champions.

After all baseline measures were carried out, clusters were randomised to one of the following three conditions: (1) SWAL only, (2) the SWAL intervention with the addition of a height-adjustable workstation (i.e. SWAL plus desk) or (3) the control group. Randomisation was stratified by area (i.e. Leicester, Salford or Liverpool) and cluster size [i.e. small (< 10 people) or large (≥ 10 people)]. A team independent to the research team were responsible for training the workplace champions, but two members of the research team distributed resources to the workplace champions and were, therefore, unable to be blinded to allocation arm.

Main outcome measures

Primary outcome

Outcome measures were collected at baseline and at 3 and 12 months by researchers who underwent relevant training. The primary outcome was difference in average daily sitting time (measured using the activPAL device) compared with usual practice at 12 months' follow-up.

Secondary outcomes

Secondary outcomes from the activPAL device were analysed for the following four different time periods: (1) all waking hours (i.e. daily variables) on any valid day, (2) work hours only, (3) daily variables on workdays and (4) daily variables on non-workdays. Variables included sitting, standing and stepping time, time in prolonged sitting bouts, light physical activity and MVPA, number of steps and number of sit-to-stand transitions. The Axivity accelerometer (Axivity Ltd, Newcastle upon Tyne, UK) worn on the wrist was used to assess physical activity intensity, as well as sleep duration and efficiency.

Data were collected on adiposity (i.e. BMI, fat percentage, waist circumference), and blood pressure and finger prick blood samples were collected to measure HbA_{1c}, cholesterol (i.e. high-density lipoprotein, low-density lipoprotein and total), triglycerides and fasting blood glucose. At each measurement session, a questionnaire booklet queried self-reported sitting behaviours, musculoskeletal health, self-reported sleep, psychosocial variables, work-related health and performance, organisation social norms, cohesion and support, and dietary behaviours.

The primary outcome analysis was performed using a linear multilevel model, using the complete-case analysis. Several sensitivity analyses were conducted, including intention to treat (ITT), per protocol, standardising waking and work hours, and the effect of a different number and type of valid activPAL days. Prespecified subgroup analyses were undertaken to investigate if the intervention had a different effect by area, cluster size, full-time/part-time workers, sex, age and BMI.

Economic evaluation

The economic analysis consisted of the following:

- a descriptive assessment of resource use, costs and outcomes
- a cost-effectiveness analysis with costs and quality-adjusted life-years (QALYs) estimated within the trial period and extrapolated over the individuals' lifetimes, with a decision-analytic model from the public sector perspective in the base case
- a series of sensitivity, scenario and threshold analyses considering the impacts of key uncertainties on base-case findings
- a secondary cost–consequence and cost-effectiveness analysis based on observed differences between secondary outcomes within the trial period.

Process evaluation

A full process evaluation was carried out to assess recruitment, intervention implementation and participation, intervention sustainability, intervention contamination and unexpected events arising from the intervention and study. Qualitative and quantitative data were collected using a range of questionnaires (at 3 and 12 months), focus groups (at 12 months), interviews (at 15 months) and office observations (at 3 and 12 months).

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Results

Recruitment

A total of 78 clusters (756 participants) were randomised into the study [control arm, 26 clusters (n = 267); SWAL-only arm, 27 clusters (n = 249); SWAL plus desk arm, 25 clusters (n = 240)]. All clusters (100%) were followed up at 3 and 12 months, with 87.7% (n = 663) of participants seen at 3 months and 77.8% (n = 588) of participants seen at 12 months.

At baseline, the mean age of participants was 44.7 (SD 10.5) years, 72.4% were female, 69.7% were white and mean BMI was 26.5 kg/m^2 (SD 5.9 kg/m^2). The percentage of time spent sitting was 64.2% ± 8.3% of daily wear time, with 51.9% ± 12.1% of daily sitting time accrued in prolonged bouts (≥ 30 minutes). Participants spent the majority of their time at work sitting (74.3% ± 11.7%) and over half of this time was accumulated in prolonged bouts (51.5% ± 19.0%).

Primary outcome

Valid accelerometer data were available for 547 (72.4%) participants for the primary outcome analysis. In the complete-case analysis, at 12 months, significant differences between groups were found in daily sitting time, with participants in the SWAL-only and SWAL plus desk arms sitting for 22.2 minutes per day [97.5% confidence interval (CI) –38.8 to –5.7 minutes/day; p = 0.003] and 63.7 minutes per day (97.5% CI –80.0 to –47.4 minutes/day; p < 0.001) less, respectively, than participants in the control group.

Secondary outcomes

SMART Work & Life plus desk was more effective than SWAL only by 41.7 minutes per day (95% CI –56.3 to –27.0 minutes/day; p < 0.001). For activPAL-assessed behaviours, there were numerous significant differences between the intervention groups and the control group.

Work hours

Differences were observed for prolonged sitting at 3 and 12 months for both intervention groups. In favour of the SWAL plus desk group, differences were observed for sitting time at 3 months, standing time at 3 and 12 months, and stepping time at 12 months.

Workdays

Differences were observed for sitting time and prolonged sitting at 3 and 12 months for both intervention groups, for standing time at 3 and 12 months for the SWAL plus desk group and for stepping time at 3 months for the SWAL-only group.

Non-workdays

No differences were observed.

From the quantitative questionnaires, there were small beneficial differences in stress, well-being and vigour at 12 months for both intervention groups, and in pain in the lower extremity, social norms and support at 12 months for SWAL plus desk group.

Sensitivity analyses

Sensitivity analyses showed similar results to the primary analyses.

Subgroup analyses

For most subgroups, there were no significant interaction effects. For sitting time during work hours, there was a significant interaction for age, with the SWAL plus desk intervention having a greater effect for those aged ≥ 46 years.

Health economics

The average programme cost of the SWAL-only and SWAL plus desk interventions was £80.59 and £228.31 per ITT participant, respectively. Within trial, the SWAL-only intervention was found to have 0.84243 QALYs, £643 in public costs and an incremental cost-effectiveness ratio (ICER) of £12,091 per QALY. The SWAL plus desk intervention was dominated by SWAL only and control (0.84187 QALYs, £748 public costs). Over a lifetime horizon, the SWAL only and SWAL plus desk interventions had 17.80344 and 17.80766 QALYs, respectively, and ICERs of £4985 and £13,378 per QALY, respectively. Cost-effectiveness results were highly sensitive to age, longevity of treatment effect and costs.

Process evaluation

The process evaluation showed that the extent of intervention delivery and engagement varied considerably across clusters. Participants viewed the intervention very positively, although it was clear that usefulness of the different components varied across participants, indicating that a 'one size fits all' approach does not work and that different strategies will work for different people. Participants in both intervention groups identified many strategies that they adopted to reduce and break up their sitting time, which included standing and moving activities. These strategies were reported at work and at home, but participants did acknowledge that it was more of a challenge to reduce and break up sitting time at home. The favourable changes seen in the intervention groups for stress and well-being were supported, with participants reporting several benefits, such as feeling more energised and being more alert, focused and productive, and many participants in the SWAL plus desk group also reporting attenuation of previous musculoskeletal issues and fewer aches and pains.

Conclusions

Our SWAL intervention, provided with and without a height-adjustable workstation, was effective, with both groups sitting less than the control group in the short and longer term. The addition of the height-adjustable workstation was found to be three times more effective than the intervention provided on its own. Reductions in sitting time were replaced largely by increases in standing time, and changes in daily behaviour were driven by changes occurring during work hours on workdays. From the questionnaires, there were small beneficial changes for the intervention groups for levels of stress, well-being, vigour and pain the lower extremity, findings that were supported by the process evaluation.

Our process evaluation data showed that the intervention was seen in a positive light and workplace champions and participants engaged with our intervention, but this did vary considerably across clusters and by intervention strategy.

The economic evaluation found that the SWAL-only and SWAL plus desk interventions are potentially cost-effective strategies for promoting the health of office workers in the UK.

Trial registration

This trial is registered as ISRCTN11618007.

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