Does it work for everyone? The effect of the Take a Stand! sitting-intervention in subgroups defined by socio-demographic, health-related, work-related and psychosocial factors.
Abstract

Objective

Take a Stand! was a multicomponent workplace-based intervention reducing sitting among office-workers. This study tested whether the effect of Take a Stand! differed across subgroups.

Methods

A cluster-randomized controlled trial with objectively measured sitting-time as primary outcome evaluated Take a Stand! Main analysis was reanalyzed in strata defined by four levels of preselected factors: socio-demographic (e.g. sex); health-related (e.g. smoking); work-related (e.g. workhours); and psychosocial (e.g. motivation to change sitting).

Results

No notable differences in the effect was observed: across all assessed subgroups sitting time was ~60 min less after 1 month and ~40 min after 3 months in intervention as compared to control group.

Conclusion

There was no differential effect of Take a Stand! indicating that the intervention was effective in all groups. This knowledge is advantageous when disseminating similar interventions to different populations of office workers.

Medical Subject Headings (Medline / MeSH): sedentary lifestyle, workplace, work,

Keywords: sitting time, workplace, occupational sitting, intervention, sedentary behaviour,

subgroup analysis, randomized controlled trial
Introduction

Sitting for long periods has been associated with adverse health outcomes such as cardiovascular disease and all-cause mortality (1, 2). The workplace is an obvious interventional setting as many adults accumulate sitting time during working hours (3, 4) and the shared environment makes group-based interventions possible (5).

Recently, several workplace interventions e.g. sit-stand desks, active breaks, computer prompts and information have been tested and shown to be effective in reducing sitting time with reviews showing average reductions of 40 to 100 min less sitting per workday (6-8). Especially multi-component interventions including both environmental, organizational and educational strategies seem to be the most effective.

It is well-established by e.g. Owen et al. (9), that sedentary behavior is influenced by factors at several levels, which makes a socio-ecologic perspective relevant. De Cocker et al. (10) grouped factors related to occupational sitting time into levels of socio-demographic, health-related, work-related and psychosocial factors. Several studies have investigated factors influencing sitting time among office workers (11-13), employees (10, 14) and adults in general (15, 16); resulting in a number of factors correlated with high and low sitting time. For instance, men tend to sit more than women (16, 17), workers with private offices sit more than workers in shared offices (12), and sitting time increases with higher educational level (13-15). However, little is known about whether and how these same factors influence the effect of interventions intended to reduce sitting time.

This potential heterogeneity of effect sizes of an intervention can be explored in subgroup analysis (18-20). An example of such analysis of a sitting time intervention is Edwardson et al. (21) who found that participants above median age (42.5 years) reduced their total sitting time at 12 months.
by additional 45 minutes/workday compared to younger participants, while the effect was similar across strata of working hours, sex, age, and body mass index (BMI).

Such results are directly applicable for intervention dissemination (22) making it possible to target intervention activities to the specific groups, where they are found to be the most effective, and to adjust the intervention to better reach hard-to-influence subgroups. In cases where effect sizes are similar across groups, it justifies a broader implementation of the intervention.

Using a socio-ecologic perspective and the framework by De Cocker et al. (10) the present study aimed to assess how factors divided into socio-demographic (i.e. sex and education), health-related (i.e. smoking and physical activity), work-related (i.e. workhours and office size) and psychosocial (i.e. desire to change sitting time) were associated to the effect of the multicomponent workplace-based sitting-time intervention Take a Stand!. All factors were preselected and pre-hypothesized to be potentially associated to the intervention effect on sitting time.

Knowledge on heterogeneity of effects across subgroups is useful when disseminating Take a Stand!, and similar multicomponent workplace interventions, to different settings and populations in order to adjust and focus the intervention properly.

**Methods**

The sitting time intervention Take a Stand! was evaluated in a cluster-randomized controlled trial from November 2013 to June 2014 at four office-workplaces in Denmark and Greenland.

Results of the trial, including sitting behavior, anthropometry and musculoskeletal pain are reported in detail elsewhere (23, 24). In short, sitting time at work was reduced by 71 minutes/8-
hour workday after 1 month (CI95% -85 to -57) and 48 minutes/8-hour workday after 3 months (CI95% -62 to -34) in the intervention group compared to the control group. Sitting time was mainly replaced by standing time and there were no changes in moderate-to-vigorous physical activity or sitting time during leisure.

The study was approved by the local Ethics Committee in Denmark (H-6-2013-005) and in Greenland (project 20914-3, id: 2014-095402), and prospectively registered at www.clinicaltrials.gov (NCT01996176). Procedures were designed in accordance with the Helsinki Declaration.

Take a Stand!

The intervention Take a Stand! is described in details elsewhere (23) but in short it consisted of five elements: i.) appointment of local ambassadors and management support; ii.) environmental changes; iii.) a lecture; iv.) a workshop aiming at ensuring local adaptation at individual, office and workplace level; and v.) e-mails and text messages. Through all elements the focus was reducing sitting by using a sit-stand desk, breaking up prolonged periods of sitting, having standing and walking meetings, and setting common goals at the office level. Control participants were instructed to behave as usual.

Study population

At each of the four participating workplaces, four to six offices (clusters) with 6-33 participants (mean 17) participated, totaling 317 participants. Inclusion and exclusion criteria, recruitment process, details on included offices and randomization procedure are described elsewhere (23). In short, eligible individuals had to be ≥18 years old, work >4 days/week, and without pregnancy,
sickness or disability, which could affect the ability to stand or walk. All participants had sit-stand desks, as this is standard in Denmark. Offices were randomized at a ratio of 1:1 for intervention or control.

Data collection and processing

Socio-demographic factors included sex, age, education and marital status. Health-related factors were smoking, BMI, self-rated health, sickness absence, stress (measured with Cohens Perceived Stress Scale (PSS)(25)), leisure time sitting and physical activity (self-reported and measured). Work-related factors were tenure, meeting frequency, workhours, tiredness after work, being a manager and office size. Finally, psychosocial factors were ‘desire to change sitting time’ and ‘perceived need for a project on sitting time’.

All factors were assessed by questionnaire at baseline, except BMI, which was obtained through anthropometric measurement and activity variables, which were measured by accelerometer. Questionnaire data (web-based) was collected at baseline before randomization and included among others the above-mentioned measures. Anthropometric measures were taken at baseline before randomization and included height and weight (details on measurement methods are reported elsewhere (23)). Activity measures were collected at baseline and after 1 and 3 months by an ActiGraph GT3X+ accelerometer. Details on the activity monitor and data processing are published elsewhere (23), but in short participants wore the accelerometer 24 hrs/day for 5 days on the front of the thigh. During this period participants kept a log of sleeping and working hours. Data were processed using Acti4 software (26-28), which compiles total minutes spent sitting/reclining, standing, walking, climbing stairs, running and cycling. To be eligible, days should include at >4 hrs of work or >4 hrs of leisure.
Multilevel mixed-effects linear regression was conducted in STATA/IC-14.0 (StataCorp, College Station, TX, USA). The outcome was sitting-time at work was the outcome and to allow for differences in intervention effect between follow-up assessments an interaction term was included between randomization status (intervention or control) and time of assessment (baseline, 1- and 3-months follow-up). This model also included the interaction between the assessed factor and randomization. To assess the effect of the factor another model was run, which included a three-factor interaction term between randomization, time and the assessed factor. Those two models were compared using maximum likelihood-ratio test.

To account for repeated measurements at the participant level, fixed effect of workplace and a random intercept was included in all analyses. Figure 1 shows the equation for the statistical model with the three-factor interaction.

Results

Participant characteristics

Of 317 participants (66% females, median age 47 years), the main part (67%) had tertiary education and were cohabiting with a partner or spouse (79%) (table 1). Sixty-five percent reported being physically inactive during leisure time. Objectively measured physical activity showed that 29% did not fulfill recommendations on 30 min daily physical activity. Of all participants, 16% were managers and 30% had more than 6 meetings per week. In general, factors were evenly distributed by intervention and control group; however, a larger percentage (76%) of the intervention group
had tertiary education compared to the control group (57%).

Socio-demographic factors

Figure 2 shows changes in sitting time in the intervention group compared to the control group, as seen the difference was about 60 min less sitting in the intervention group after 1 month and 40 minutes after 3 months across all strata of sex, age, education and marital status.

Health-related factors

The health-related factors included in the analyses were smoking, obesity, self-rated health, sickness absence, stress, leisure time sitting, and self-reported and measured leisure time physical activity. None of these factors affected sitting time reductions (figure 2).

Participants with obesity (as compared to overweight or normal weight) and participants with high levels of leisure sitting (as compared to leisure sitting below median) had greater reductions in sitting time both after one and three months; however, with overlapping confidence intervals.

Work-related factors

In strata of work-related factors (tenure, meeting frequency, workhours, office size, tiredness after work and being a manager), changes in sitting time during the intervention period did not seem to differ notably (figure 2).

Psychosocial factors
Whether participants wanted to change workplace sitting at baseline or felt a need for at project on sitting time at baseline did not affect the effect of the intervention on sitting after 1 and 3 months (figure 2).

Discussion

We investigated whether the effect of the sitting time intervention Take a Stand! differed in subgroups defined by socio-demographic, health-related, work-related and psychosocial factors. We found that intervention effects were generally similar across subgroups of all tested factors.

Edwardson et al. (21) included subgroup-analysis on worksite, working hours, sex, age and BMI when reporting results of a multicomponent sitting time intervention among office workers. The intervention was in several aspects like Take a Stand! as it included information on health consequences of sitting, goal setting and sit-stand desks. In addition, participants received individual coaching sessions. At 12 months, sitting time in the intervention group was reduced by 83 minutes/8h workday as compared to the control group. Subgroup analyses showed similar effects on workplace sitting at 12 months across the assessed subgroups, which is parallel to the findings in the present study.

Steenstra et al. (22) published a subgroup-analysis of return to work among low back pain patients. The tested ergonomic intervention included worksite assessment and work modifications and showed to be more effective for workers above 44 years and workers who had previous sick leave the past 12 months, while the effect did not differ in subgroups defined by e.g. gender, work type and pain score. Thus, they concluded that the intervention should be directed at workers >44 years or with previous sick leave. In our study, neither age nor other factors modified the sitting
time effect of the Take a Stand! intervention. Consequently, our analysis infers that the Take a
Stand! intervention, or similar multicomponent sitting time interventions at the office workplace,
might be able to reduce sitting time among all subgroups of office workers, without further
adjustments towards specific groups. Thus, it seems that, when targeting sitting time, office
workers could be treated as one uniform group.

The strengths of the present study include the large number of participants and the
randomized controlled design making it possible to compare intervention and control group directly
during the follow-up period. In addition, several factors were analyzed; both socio-demographic,
health-related, work-related and psychosocial. Furthermore, these factors were assessed at
baseline before randomization and separated in time from the outcome, which was measured after
one and three months. Finally, sitting time was measured objectively with accelerometers on the
thigh, which is considered one of the most valid measures of sitting (29).

A main limitation was that even though the number of participants was high, power
calculations were not done with the aim of dividing participants into subgroups; therefore, we had
limited power to identify small differences between subgroups. Furthermore, due to power
considerations, we were not able to combine factors, thus we do not know whether the effect
differed in across specific combinations of subgroups e.g. whether there was a stronger effect
among middle-aged women or among stressed managers. Finally, for some of the tested factors,
variation within the study population was small making it harder to detect differences statistically.
For example, for self-rated health, no participants rated their health to be ‘bad’; consequently,
participants with excellent/very good self-rated health were compared to participants with
good/less good health but it might be that the intervention worked differently for workers with bad
self-rated health. However, people of poor health were not in the target group of the intervention due to healthy worker bias and our inclusion criteria requiring people to be able to stand and walk.

Several interventions have been implemented to reduce sitting time among office workers, and it seems that multicomponent interventions are effective (6-8). However, larger long-term studies are suggested as the next step (8). When designing such studies, it is relevant to know whether specific subgroups should have additional focus or need separate interventions. Take a Stand! included different types of office workers from workplaces representing a diversity of participants regarding age, sex and education, and a diversity of working conditions, e.g. different office sizes and meeting frequencies. Therefore, we were able to assess subgroups across 20 different factors and our results support that office workers could be treated as one group and interventions could be tested and implemented at larger scale across subgroups of workers. Even though we included both public and private workplaces, as well as workers with different work tasks, we did not have enough variety to assess different effects in these groups. Hence, future studies could assess the effect in subgroups of workers from different sectors and with different work tasks (e.g. call-center workers, workers with customer/citizen interaction or office workers with teaching responsibilities) to assess how multicomponent interventions work in these different groups. Additionally, specific subgroups with high/low effect could be identified by combining several factors, enabling the possibility for further tailoring of the intervention in future studies. Furthermore, it would be interesting to assess whether these interventions would be effective in other groups of adults e.g. receptionists, teachers, students, cashiers or drivers.
Conclusion

The intervention Take a Stand! effectively reduced workplace sitting in subgroups of office workers defined by socio-demographic, health-related, work-related and psychosocial factors. As the intervention was similar to other multicomponent interventions tested across the world, this knowledge might help when disseminating other interventions to other workplaces with different compositions of workers.


Figure legends

Figure 1: equation for the statistical model with the three-factor interaction. \( \mu ij \) is sitting time at work for person \( i \) in workplace \( j \) and \( X \) is the factor being tested.

Figure 2: workplace sitting in the intervention group compared to the control group. P-values for maximum likelihood ratio test comparing the full model including three-factor interaction with the same model including only two-factor interactions.

List of abbreviations:

BMI – body mass index

RCT – randomized controlled trial

CI95% – 95% Confidence Interval

PSS – Cohens Perceived Stress Scale

MVPA – Moderate-to-Vigorous Physical Activity