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Interrupting sedentary behaviour in the workplace through active breaks: a protocol study

Maria Scoppolini Massini ,[1] Giulio Senesi ,[1] Erika Pinelli ,[1] Raffaele Zinno ,[1] Salvatore Pinelli,[1] Cristian Balducci,[2] Laura Bragonzoni[1]

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[1]Department of Quality of Life Sciences, University of Bologna, Rimini, Emilia-Romagna, Italy
[2]Università degli Studi Gabriele d'Annunzio Chieti Pescara Facoltà di Psicologia, Chieti, Abruzzo, Italy

Correspondence to
Dr Giulio Senesi;
giulio.senesi2@unibo.it

ABSTRACT

Sedentary behaviour (SB) is linked to a higher risk of metabolic disorders, cardiovascular disease, all-cause mortality and musculoskeletal decline. Office workers (OW) are particularly vulnerable to prolonged SB due to the nature of their work. Incorporating active breaks (ABs), brief periods of physical activity (PA) during the workday may offer a promising strategy to interrupt SB in this setting. This protocol outlines the design of a non-randomised controlled study aimed at interrupting SB among OW by implementing ABs during working hours. The potential impact of ABs on changes in SB patterns and on physical and psychosocial outcomes will also be assessed. Participants in the study will self-select into an intervention group (IG) or a control group (CG). Both groups will be assessed at baseline (T0) and after 4 months (T1) using accelerometers, ad hoc questionnaires and validated tools. The IG will take part in a 4-month ABs programme, beginning with a counselling session with a kinesiologist. To monitor adherence, compliance, engagement and satisfaction, participants in the IG will complete daily surveys during the first and last 2 weeks of the intervention, keep a daily adherence diary throughout the study and complete a final ad hoc questionnaire to assess satisfaction with the ABs programme. Approval for this study was obtained from the Bioethical Committee of the University of Bologna. The findings could provide an important contribution to the scientific evidence supporting ABs interventions, highlighting their psychosocial and physical benefits in workplace settings.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Sedentary behaviour (SB) is linked to multiple health risks. Sedentary workers are especially vulnerable, and active breaks (ABs) have shown promise for reducing sedentary time and improving well-being, though the evidence remains limited.

WHAT THIS STUDY ADDS

⇒ This study will evaluate the effects of a video-based ABs intervention on SB and well-being among workers. It combines accelerometer data and both validated and ad hoc questionnaires to provide a comprehensive understanding of how daily ABs can influence SB and physical and psychosocial outcomes.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results could support the integration of ABs into workplace routines as an effective strategy to interrupt SB and improve workers' overall well-being, encouraging broader adoption in occupational well-being promotion programmes.

INTRODUCTION

Technological advancements have significantly transformed modern lifestyles; however, they have also been associated with a rise in sedentary behaviour (SB) and a concomitant decrease in physical activity (PA) levels. The widespread use of screens and digital devices has reduced daily physical effort, as active tasks and leisure activities are increasingly replaced by sedentary alternatives.[1–3]

To better understand the implications of these lifestyle changes, it is important to clarify what is meant by SB, PA and physical inactivity (PI). SB refers to any waking behaviour conducted in a sitting or reclining position, with an energy expenditure of ≤1.5 metabolic equivalent tasks (METs),[4] while PA is defined as any bodily movement produced by skeletal muscles that leads to a significant increase in energy expenditure above resting levels.[5] In 2020, the WHO published updated guidelines on PA and SB for individuals aged 5 and above. Regarding adults aged 18–64, the guidelines recommend engaging in at least 150–300 min per week of moderate-intensity aerobic PA, or at least 75–150 min per week of vigorous-intensity aerobic PA. It is also recommended to perform muscle-strengthening activities at least two times per week. Adults are further encouraged to limit SB, as replacing SB with PA of any intensity, including light-intensity activity, is associated with improved health outcomes.[5] In addition to these definitions, it is important to clarify the concept of PI, which, although often associated with

SB, represents a distinct condition. PI is defined as an insufficient level of PA to meet the established guidelines.[5]

SB has been associated with detrimental effects on fasting glucose levels, fasting insulin, triglycerides, high-density lipoprotein cholesterol and waist circumference.[6] It is also linked to an elevated risk of developing diabetes, cardiovascular mortality and all-cause mortality.[7] Furthermore, SB may negatively impact mood,[8] cognitive function, depressive symptoms, physical functioning, disability and health-related quality of life in adults[9] and hasten the secondary ageing of skeletal muscle power.[10] On the other hand, engaging in regular PA is a well-established protective factor in both the prevention and management of non-communicable diseases, including cardiovascular conditions, type 2 diabetes and certain cancers such as breast and colon cancer.[11–13] Additionally, PA supports mental health,[5 14] helps delay the onset of dementia[5 15] and plays a role in maintaining a healthy body weight[5] as well as promoting overall well-being.[5 16]

In this context, office workers (OW) represent a population at particularly high risk of SB, as they may spend up to 82% of their working day seated.[17–19] Therefore, workplaces have the potential to support public health initiatives and address global health challenges by implementing a variety of health promotion strategies.[20] In light of this, a possible workplace intervention to interrupt SB and reduce related risks is active breaks (ABs): brief periods of PA to interrupt SB, integrated into the workday. Batista-Ferreira *et al*[21] reported that ABs were effective in reducing the proportion of individuals spending more than 10 hours per day in SB, decreasing from 31% to 14%. Moreover, the scientific literature suggests that performing brief physical exercise to interrupt SB can improve postprandial glycaemia, insulin responses, cardiovascular parameters and blood pressure. There appear also to be benefits for cognitive functions and in counteracting the negative impact of SB on brain health; however, this potential should be explored further through well-designed studies before drawing definitive conclusions.[22–24] Moreover, ABs appear to be beneficial in reducing post-lunch sleepiness,[21] perceived stress,[21] pain/discomfort[21 25] and the incidence of new-onset neck and low-back pain among high-risk OW,[26] as well as perceived fatigue.[25] ABs could also contribute to improvements in employees' mood.[25]

Although the potential benefits of ABs are increasingly acknowledged, scientific research has only recently begun to investigate this type of intervention. Consequently, further studies are needed to better understand the physical and psychosocial effects that ABs may have on sedentary workers. Building on a previous pilot study protocol conducted by the research team,[27] this non-randomised controlled study aims to interrupt SB among OW by implementing ABs during working hours as an intervention strategy. The hypothesis is that introducing a workplace intervention aimed at interrupting SB and promoting well-being through the integration of ABs will result in changes in SB patterns and improved perceived physical and psychosocial well-being among OW.

MATERIALS AND METHODS

Study design

The study design is a non-randomised controlled study, characterised by including a control group (CG) and an intervention group (IG).

The study has received approval from the Bioethical Committee of the University of Bologna (Prot. n. 0312121). It will be conducted in accordance with the ethical standards outlined in the Declaration of Helsinki and its subsequent amendments.

Participant recruitment

The study will be proposed to employees of both public and private organisations through direct contact, institutional email communication and advertisements on social media platforms. Participants will be enrolled in the study only after providing written informed consent. They will be allowed to self-select into either the CG or the IG. The sole inclusion criterion is current employment status. Only individuals with medical or physical conditions that prevent them from engaging in PA will be excluded from participation.

Sample size

The sample size was calculated using G*Power (version 3.1.9.7) for a repeated-measures design (within–between interaction), with two groups (intervention vs control) and two measurement points (baseline and post-intervention). Assuming a medium effect size (f=0.25), an alpha of 0.05, a power of 0.80 and a correlation among repeated measures of 0.5, a minimum total of 34 participants (17 per group) is required to detect significant differences over time between groups. To account for potential dropouts, the sample size was increased by 20%, resulting in a final target sample of 41 participants.

Intervention group

Before starting the ABs programme, participants in the IG will take part in a 30-min counselling session conducted by expert kinesiologists. The counselling session aims to provide participants with all the technical and practical information needed to carry out the study. Initially, participants will receive an explanation of the assessment tools and the corresponding timelines for their completion. Subsequently, all the indications for the correct execution of the ABs will be provided, starting with safety information (how to perform the exercises safely) and then with all the technical indications (how to perform the exercises correctly). Subsequently, a link to a shared online folder containing the ABs videos will be sent to the participants. Once the material has been received, the 4-month ABs programme can begin.

The 4-month ABs programme, previously developed using a codesign methodology with potential end-users,[28] will be implemented for end-users via videos. Each video

Table 1 Example sequence of exercises that could be performed during the first active break of the day

Exercises	Repetitions
Shoulder protraction and retraction	5
Shoulder elevation and depression	5
Plantar and dorsal flexion of the ankle	10
Chair squats	10
Step touch	10
Diaphragmatic breathing	5

ABs, active breaks.

will feature a single ABs section comprising a combination of exercises such as breathing, balance, activation, muscle strengthening and stretching. Each video will have a maximum duration of 5 min. Three ABs videos will be available during the workday (across the early part of the working day, approximately midday and the later part of the working day) during the five working days of the week. ABs are structured to align with the rhythms of the workday. The first break of the day focuses on activation to prepare the mind and body for optimal work performance. The second break consists of low-intensity exercises. The third and final break of the day primarily includes stretching and relaxation exercises to unwind muscles after a full workday. No equipment will be required to perform the exercises, as the ABs are designed to be executed using office furniture such as a desk and chair.[27] Table 1 presents an example sequence of exercises that could be performed during the first active break of the day.

Participants in the IG will be assessed after the counselling session (baseline, T0) and immediately after completion of the 4-month ABs programme (T1) using different assessment tools. In addition, participants will be invited to complete a daily survey during the first 2 weeks and the final 2 weeks of the ABs programme, and an adherence diary during the 4-month ABs programme. Figure 1 illustrates the timeline of the IG.

Control group

Participants in the CG will not engage in the ABs programme and will continue their usual daily working routines without implementing ABs. To assess outcomes, participants in the CG will be assessed at baseline (T0) and immediately after completion of the 4-month control period (T1) using a range of assessment tools. Figure 2 illustrates the timeline of the CG.

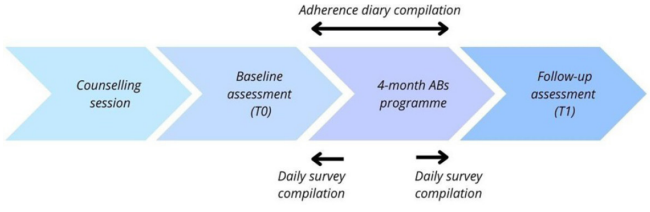

Figure 1 Timeline of the intervention group. ABs, active breaks.

Figure 2 Timeline of the control group.

Primary outcome

The primary outcome of this study is the interruption of SB in the workplace context. To evaluate this outcome, adherence to the ABs programme will be assessed. Specifically, participants in the IG will be asked to complete a self-monitoring diary each time they perform an active break throughout the entire 4-month intervention period. Adherence will be calculated as the percentage of ABs sessions completed, based on the self-monitoring diary, relative to the total number of scheduled sessions.

Secondary outcomes

The secondary outcomes of this study aim to evaluate the effectiveness of introducing ABs during working hours in changing SB patterns (pre-intervention and post-intervention), as well as changes in perceived physical and psychosocial well-being, perceived well-being in the workplace and overall satisfaction with the ABs programme. To assess these outcomes, the following instruments will be used.

The ActiGraph (WGT3X-BT) accelerometer captures and records high-resolution human activity information.[29] Both IG and CG participants will wear the ActiGraph[30 31] for five consecutive working days (Monday to Friday) at two time points: baseline (T0) and after 4 months (T1). The device must be worn during working hours and may be worn optionally during the rest of the day. It will provide data on sedentary time, PA levels and movement patterns.[30]

The Nordic Musculoskeletal Questionnaire (NMQ)[32] is a standardised tool used to assess the presence and distribution of musculoskeletal symptoms in nine body regions over specific time frames (last 12 months and last 7 days). It allows for the identification of areas of discomfort and their impact on daily activities and work.

The International Work Addiction Scale (IWAS-7)[33] measures work addiction tendencies through seven items that explore the behavioural and psychological dimensions of compulsive overworking. It provides insight into maladaptive work-related behaviours.

The Job-related Affective Well-being Scale (JAWS)[34] assesses the frequency of both positive (eg, enthusiasm, contentment) and negative (eg, anxiety, depression) affective experiences related to the work environment. It includes 20 items scored on a Likert scale.

The Copenhagen Burnout Inventory (CBI)[35] evaluates burnout across three dimensions: personal burnout, work-related burnout and client-related burnout. The

scale captures physical and emotional exhaustion linked to both individual and occupational demands.

The Stress Indicator Tool (SIT),[36] developed by the UK Health and Safety Executive, measures psychosocial risk factors in the workplace across domains such as workload, control, managerial support and relationships.

All these assessment tools will be administered to both the IG and CG at both T0 and T1.

In addition to these instruments, two ad hoc 5-point Likert scale questionnaires will be used to assess Perceived Well-being in the Workplace (PWW) and Satisfaction with the ABs Programme (SWP). The first will be administered to both IG and CG at T0 and T1, while the second will be administered exclusively to participants in the IG at T1.

To assess daily engagement and compliance, IG participants will complete brief daily surveys at the end of each workday during two consecutive weeks at both the beginning and the end of the 4-month ABs programme.

Finally, sociodemographic characteristics and participant information will be collected for both the IG and CG at both T0 and T1.

The tools that will be used to assess the primary and secondary outcomes (in both IG and CG) and the timing of their use are summarised in table 2.

Table 2 Participants' information, primary and secondary outcome measures for IG and CG

IG	T0	T1
Sociodemographic parameters		
Date of birth	X	X
Gender	X	X
Participants' information		
Height	X	X
Weight	X	X
Assessment tools		
Self-monitoring diary	4-month ABs period	
ActiGraph	X	X
NMQ	X	X
IWAS	X	X
JAWS	X	X
CBI	X	X
SIT	X	X
PWW	X	X
SWP		X
Daily survey	First 2 weeks*	Final 2 weeks*
CG	**T0**	**T1**
Sociodemographic parameters		
Date of birth	X	X
Gender	X	X
Participants' information		
Height	X	X
Weight	X	X
Assessment tools		
ActiGraph	X	X
NMQ	X	X
IWAS	X	X
JAWS	X	X
CBI	X	X
SIT	X	X
PWW	X	X

*It refers to the 4-month ABs programme period.
CBI, Copenhagen Burnout Inventory; CG, control group; IG, intervention group; IWAS, International Work Addiction Scale; JAWS, Job-related Affective Well-being Scale; NMQ, Nordic Musculoskeletal Questionnaire; PWW, Perceived Well-being in the Workplace; SIT, Stress Indicator Tool; SWP, Satisfaction With the ABs Programme; T0, baseline; T1, 4-month follow-up period.

Safety

All necessary measures will be taken to ensure the safety of participants during both the assessment sessions and the implementation of the ABs programme. The research staff will provide clear and tailored explanations regarding the nature of the assessments and how to perform each activity safely and correctly. Prior to the start of the intervention, all participants assigned to the IG will attend a 30-min counselling session led by expert kinesiologists. This minimises the risk of injury and promotes a safe and informed engagement with the intervention throughout the study period.

Statistical analysis

Descriptive statistics will be used to summarise sociodemographic characteristics and outcome variables.

Accelerometer data will be downloaded and analysed using ActiLife software (version 6.0).[30]

Differences between the IG and CG will be tested using independent samples t-tests for continuous variables and χ^2 tests for categorical variables. Scoring of validated questionnaires will follow the respective official scoring protocols. Where available, reference values and normative tables will be used to interpret scores in relation to clinical thresholds or population norms, allowing a contextualised interpretation of results.

To assess the effectiveness of the ABs programme, linear mixed models will be employed to analyse whether within-subject changes in the IG may explain the differences from T0 to T1, therefore shedding light on aspects of the mechanism of change promoted by the ABs programme.

Normality of continuous outcome variables will be assessed using the Kolmogorov–Smirnov test. Where necessary, data transformations (eg, logarithmic) will be applied to meet the assumptions of parametric analysis. Alternatively, robust estimators will be used.

In addition, exploratory analyses will be conducted within the IG to examine associations between ABs

adherence (eg, number of ABs completed) and changes in outcomes, adjusting for average accelerometer daily wear time and baseline scores.

DISCUSSION

The present protocol study provides a comprehensive plan to interrupt SB among OW through a 4-month ABs programme. SB is increasingly recognised as a major health concern, particularly in workplace settings, where prolonged sitting is common.[21 37–39] Batista-Ferreira *et al*[21] have demonstrated that ABs can be effective in reducing time spent in SB; however, further studies are needed to confirm and expand on these findings. Through our study, we will be able to quantitatively assess, via a self-monitoring diary, the extent to which participants interrupt their SB during the 4-month ABs programme. Furthermore, the use of accelerometers before and after the 4-month ABs programme will enable us to evaluate the effectiveness of the ABs programme in changing SB patterns.

Another important focus of this study is the evaluation of physical and psychosocial well-being, two key domains known to be negatively affected by prolonged SB, particularly in OW,[40–42] which have significant implications for health and job performance.[43]

To investigate the physical dimension, we will adopt the NMQ.[32] OW often experience pain and tension in the cervical, lumbar and shoulder regions due to prolonged sitting.[44 45] The NMQ enables us to map symptoms across nine anatomical regions and observe changes over time. Previous studies have shown that ABs, especially those incorporating postural changes and stretching, are effective in reducing musculoskeletal pain and discomfort.[46 47] Therefore, if post-intervention scores on the NMQ indicate a reduction in reported symptoms, this would confirm the utility of ABs as a helpful strategy for musculoskeletal disorders in the workplace.

OW are also particularly vulnerable to a range of psychosocial challenges, including emotional strain, burnout, organisational stress and compulsive work behaviours, often exacerbated by prolonged sedentary time and high cognitive demands.[48 49] To capture these dimensions, the study integrates four validated self-reported instruments. The JAWS[34] evaluates emotional responses to the work environment, while the CBI[35] measures personal and job-related exhaustion, the crucial dimensions of burnout. The SIT[36] identifies common workplace stressors such as excessive workload, low support and poor role clarity, which may affect compliance with the ABs programme, and the IWAS[33] explores patterns of compulsive overworking. ABs, by introducing moments of PA, may provide protective benefits across multiple domains. They can improve emotional well-being, reduce fatigue, alleviate perceived stress and support the regulation of work rhythms, ultimately promoting healthier and more sustainable work experience for sedentary employees.[21 25 40 50]

Existing literature also highlights the potential of ABs to promote a healthier and more productive work environment.[21 46 51] To explore these aspects in greater depth, the two ad hoc questionnaires (PWW, SWP) will be included in the evaluation strategy to broadly assess perceived workplace well-being and, for the IG only, satisfaction with the ABs programme.

This protocol study presents limitations. The 4-month intervention may be affected by seasonal factors such as holiday periods and worker fatigue. These contextual elements may lead to a decline in adherence and engagement over time, particularly during the later stages of the intervention. The risk of participant dropout or reduced compliance must therefore be considered when interpreting the final outcomes. Moreover, in our study, a direct measurement of SB reduction is not possible. We assessed the interruption of SB through participants' adherence to the ABs programme (as reported in the self-monitoring diary) and evaluated the effectiveness of ABs during working hours in changing SB patterns. To accurately measure a reduction in SB, it would be necessary to either administer specific validated questionnaires or have participants wear accelerometers also during the ABs programme. Future studies should take these aspects into consideration to enable a more comprehensive assessment of SB pattern changes and the long-term impact of ABs interventions.

Despite these limitations, this study could provide an important contribution to the growing field of workplace-based ABs interventions.

CONCLUSION

This non-randomised controlled study provides a comprehensive plan to interrupt SB among OW through the implementation of an ABs programme, assess changes in SB patterns before and after the intervention, and evaluate changes in perceived physical and psychosocial well-being, perceived well-being in the workplace as well as satisfaction with the ABs programme. The findings of this study could provide an important contribution to the scientific evidence supporting ABs intervention, showing also the psychosocial and physical benefits of this kind of workplace intervention.

Contributions Conceptualisation: MSM, GS, EP, RZ, SP, CB and LB. Study design and methodology: MSM, GS, CB and LB. Writing—original draft: MSM, GS, CB and LB. Writing—review & editing: MSM, GS, EP, RZ, SP, CB and LB. Supervision: LB and CB. Project administration: LB. All authors read and approved the final manuscript. LB is the guarantor.

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Competing interests None declared.

Patient and public involvement Potential end-users were previously involved in the codesign of the ABs programme.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants, and the local bioethical committee approved this study: protocol N. 0312121. Participants gave informed

consent to participate in the study before taking part. The study processes will follow the protocol, and any protocol amendments will be submitted to the University of Bologna Bioethics Committee. All documents will be kept confidential. The study results will be disseminated through conference presentations, publications in peer-reviewed journals and other dissemination channels, including social media. All disseminated materials will preserve the anonymity of study participants.

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ORCID iDs
Maria Scoppolini Massini https://orcid.org/0009-0007-9644-6048
Giulio Senesi https://orcid.org/0009-0005-6954-2689
Erika Pinelli https://orcid.org/0000-0001-7451-3739
Raffaele Zinno https://orcid.org/0000-0001-6797-6049

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