

Physical Movement Habit Formation in Sedentary Office Workers: Protocol Paper

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Abstract: Engaging in physical movement has a number of mental and physical health benefits, and yet 45% of Australia's population do not meet the recommended guidelines for physical activity. The current study aims to develop an online habit-based intervention designed to reduce sedentary behavior within the workplace, using environmental cues to instigate simple behavioral changes. Participants in this study will include full time office workers who self-report as having a highly sedentary job and work from either a commercial office, home office, or a mixture of both. Participants will complete a habit-based intervention over a four-week period designed to reduce sedentary behavior by increasing habitual responses to simple physical movement behaviors cued by their environment. Analysis will involve mixed methods ANOVAs to test the efficacy of the intervention. A successful intervention will show a reduction in sedentary behavior as a response to habitual simple physical movement behaviors.

Keywords: sedentary behavior; physical activity; physical movement; habit; intervention



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1. Introduction

In current industrialized societies, health-risk behaviors, such as high levels of sedentary behavior, have been identified as leading causes of disease-related, preventable deaths [1–6]. With the increase in technology and decrease in physically demanding jobs, high levels of sedentary behavior and a general disengagement in physical activity are major global health concerns [7–13]. A particular subset of the population at risk of these concerns are those working in predominately sedentary jobs, such as office workers. Office workers are at particularly high risk for developing conditions related to poor circulation, posture issues, and vision deterioration resulting from computer usage and prolonged sitting [14–18]. As office workers often spend a large proportion of their day engaging in sedentary behavior at work, the workplace has become an opportunistic environment for targeting health-related behaviors [19–22].

Social cognition theories, such as the theory of planned behavior (TPB–Ajzen [23]), have been applied widely to understand the determinants of sedentary behavior and physical activity [24,25]. Central to many of these models is the premise that intention, which is assumed to be guided by conscious deliberation, is the most proximal predictor of behavior, where the stronger the intention, the more likely the behavior will be acted on [23,24,26–30]. However, it is well documented that the link between intention and behavior is not perfect and that there remains an intention–behavior gap [31]. This gap between intention and behavior highlights a particular concern for interventionists who aim to develop programs targeted at promoting health behaviors. As those who volunteer for interventions usually report higher intentions, this pragmatic challenge offers a potential

explanation to the general lack of long-term effects of behavior change interventions [32,33]. More recently, literature has looked at incorporating constructs that underpin nonconscious processes, such as habit and implicit attitudes, into models predicting sedentary behavior and physical activity and found these more automatic, nonconscious constructs to be important contributors to behavior [34–39].

Habit is defined as a psychological construct that is dependent on associations forming between consistent contextual cues and repeated behaviors [40–42]. A key feature of habitual actions is that they require less cognitive processing in comparison to intentional behaviors, making the behavior more accessible to perform [43,44]. Research on habit development suggests that it can take anywhere between 18 to 254 days for a behavior to become habitual, dependent on behavioral complexity [45,46]. Physical activity is considered a complex behavior as it requires numerous choices and conducive environmental factors for the behavior to be performed, rendering it more intentional [46–48]. For example, to perform physical activity, choices around clothing, transport, and timing need to be considered, along with favorable environmental factors such as the weather; in comparison to simple behaviors such as taking the stairs rather than an escalator when the opportunity presents itself. By focusing on forming habitual responses to cues within the environment that promote physical movement (i.e., stairs), one can increase the amount of movement performed during the day, thus limiting sedentary behavior without taxing cognitive load [49]. Furthermore, as simple behaviors are more conducive to habit formation, they also require less time to reach habit plateau [46]. This suggests that interventions looking to utilize habit formation towards simple behaviors should highlight the measurement of habit development during the early stages of the intervention [46]. As time constraints are often an influencing factor for attrition in physical activity interventions, this structure offers a unique method to counter this barrier [19,22,50].

Studies looking at developing interventions that are aimed at developing habits around performing physical movement should focus on four key aspects: the target behavior is personally relevant; the target behavior is considered a simple change to implement within pre-existing practices; the target behavior is realistic to action; and the target behavior can be monitored and assessed against behavioral goals [45,51]. Furthermore, when developing interventions, previous literature has looked at implementation techniques, comparing internet-based to in person delivery modes. While there appears to be advantages and disadvantages for each method, an internet-based delivery mode offers potential methods for countering common barriers associated with physical activity interventions, such as time constraints. As these barriers contribute to poor attrition rates within physical activity interventions, online interventions provide flexible delivery modes with the added opportunity to reach wider populations [52,53]. Hamilton, Fraser [49] conducted an online pilot study aiming to develop habits around simple physical activity behaviors (e.g., moving the wastepaper bin further away from the desk to encourage more steps) within the workplace, utilizing features outlined by Gardner et al. (2014, 2020). This study found positive trends for habit development among sedentary office workers over a six-week intervention, providing preliminary support for this model.

The current study aims to develop an online habit-based intervention designed to reduce sedentary behavior within the workplace, using environmental cues to instigate simple behavioral changes. Four hypotheses are preregistered for the current study. Based on previous research, the primary objective is to test the effectiveness of the intervention on limiting occupational sedentary behavior and increasing occupational physical movement habits within the workplace. It is hypothesized that reported occupational sedentary behavior will have a decrease (H1) and reported occupational physical movement will have an increase (H2) across baseline (T1) and follow up points two weeks post baseline (T2) and four weeks post baseline (T3) in comparison to those in the control group. It is further expected that occupational physical movement habit will have an increase (H3) and occupational sedentary behavior habit will have a decrease (H4) across baseline (T1) and follow up points two weeks post baseline (T2) and four weeks post baseline (T3).

2. Experimental Design

The study is a randomized control trial, designed to reduce occupational sedentary behavior by forming habits towards physical movement within the workplace environment using an online intervention. The study is guided by the SPIRIT (Standard Protocol Items: Recommendations for Interventional Trials) statement [54] (see Appendices A and B). Participants are recruited from Australian Universities and the general public via email broadcast and provide informed written consent upon registration of their interest to participate. The intervention will be implemented online using Qualtrics software. After baseline data is collected, participants are randomly assigned to either the (1) control group or (2) intervention group electronically through the randomization function within Qualtrics software. Participants will be blinded to the study condition they are assigned to. Time points involve participants completing online surveys assessing social psychological and behavioral constructs at Time 1 (baseline; T1), Time 2 (two weeks postbaseline; T2), and Time 3 (four weeks post baseline; T3), see Appendix C. The intervention protocol is documented and registered on Open Sciences Framework (OSF) and will be updated upon any deviations (see Supplementary Materials). Full ethical approval was granted by the Griffith University Human Research Ethics Committee on 11 June 2020 and last updated on the 8 July 2022 (GU: 2020/401). Any adverse events that occur during the intervention will be documented and reported to the University ethics committee. All data are stored in a secure database accessible to the research team only, in accordance with Griffith University Research Ethics Committee protocol (GU: 2020/401). Data will be checked for errors and deidentified upon collection at T3, with all analyses conducted based on the principle of intention-to-treat [55]. The final data set will be analyzed, with findings written up for publication in peer-reviewed journals and industry reports and for presentation at scientific conferences, and the deidentified data made available on the OSF platform.

3. Procedure

3.1. Recruitment Procedures and Inclusion/Exclusion Criteria

Participants are recruited via the Griffith University email broadcast, University networks, and through social media advertisement. Participants are included if they are aged 18 years or older; self-describe as having a highly sedentary job (i.e., sit for at least 75% of the working day); and work full-time from either a commercial office, home office, or a combination of the two. Participants are excluded if they self-describe as not wanting to limit their sedentary behavior at work.

3.2. Sample Size

To test intervention effects, there is an intended recruitment of 226 participants. Based on previous research in this field and ongoing research within this population group [56], it is anticipated that there will be approximately a 25% attrition over the four weeks of follow-up for reasons such as changes in job status, vacancy, and failure to complete questionnaires. A total sample of approximately 180 completing participants (90/group) is required to detect a medium effect in habit development towards physical movement. This sample was calculated by a power analysis using WebPower program [57]. Significance level (alpha) was established at 0.05 to avoid a Type 1 error and effect size was determined at $f = 0.35$. This means that for a 95% chance of detecting a significant intervention effect at a four-week follow-up, approximately 90 participants are needed in each group.

3.3. Measurement

Data will be collected online via self-reported pre- and post-intervention questionnaires hosted on Qualtrics software. Baseline (T1) data will be collected upon registration for the intervention, T2 data will be collected two weeks post-baseline, and T3 data will be collected four weeks post-baseline (Figure 1).

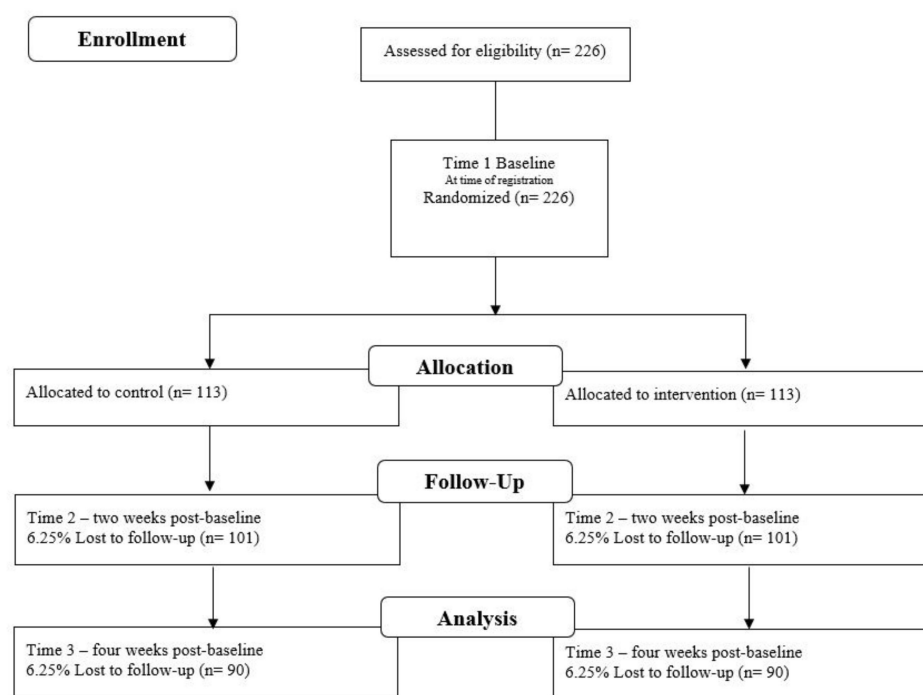


Figure 1. Flow of Participants Through the Intervention.

3.4. Demographic Measures

Demographic data will be collected at baseline and will include age (in years), gender (male, female, non-binary, and prefer not to say), residential postcode, current marital status (married registered, de-facto relationship, widowed, divorced, separated, never married), workplace environment (commercial office, home office, mixture of commercial and home office), occupation, education level, family taxable income range, and ethnicity.

3.5. Measured Variables

The primary outcome variables will assess the effectiveness of the intervention on limiting occupational sedentary behavior and developing habits towards occupational physical movement within the workplace. The Occupational Sitting and Physical Activity Questionnaire (OSPAQ) is used to measure occupational sedentary behavior and occupational physical movement. The OSPAQ has been validated for use with both commercial office and home office working populations [58–60]. To measure the construct of habit for occupational sedentary behavior and physical movement the four-item Self-Report Behavioral Automaticity Index is used [61]. For occupational physical movement habit, participants will be asked to rate their agreement with the following statements “Do you agree that doing occupational physical movement as part of your daily work routine is something: I do automatically; I do without having to consciously remember; I do without thinking; I start doing before I realize I am doing it”, measured on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). To measure habit to engage in occupational sedentary behavior, participants will be asked to rate their agreement with the following statements “Do you agree that engaging in occupational sedentary behavior as part of your daily work routine is something: I do automatically; I do without having to consciously remember; I do without thinking; I start doing before I realize I am doing it”, measured on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). Similar items have been used in previous research [23,49,62].

3.6. Study Conditions

3.6.1. Control Group

Participants in the control group are provided with an information sheet adapted from the World Health Organization recommendations on physical activity as well as the Canadian guidelines on sedentary behavior [63]. The World Health Organization recommends adults should aim to do more than 150 min of moderate to vigorous physical activity over the week [13]. Canadian guidelines for sedentary behavior involve limiting sedentary time to eight hours or less and breaking up long periods of sitting as often as possible, along with replacing sedentary behavior with additional physical activity [63]. The information pertains to the risks of increased sedentary behavior and the health benefits of increased movement during the day.

3.6.2. Intervention Group

Along with the information sheet, participants allocated to the intervention group will be provided with a digital poster outlining the positive normative beliefs of other office workers towards movement in the workplace. This poster is developed based on previous literature [49] and guided by literature on the social norms approach [25,64–67]. Along with this poster, participants are provided with the ‘10 Top Tips’ poster, which includes 10 simple behaviors that can be performed within the workplace to increase movement during the day. Participants are prompted to choose tips that they are confident they could perform and write an action plan outlining where, when, and how they intend to implement their chosen tips, along with a coping plan of how they intend to overcome potential barriers to behavioral production. Following this, participants will be asked to write an encouraging statement to instigate their self-efficacy towards achieving their tips. Furthermore, participants will be provided with a self-monitoring tick sheet that can be used to monitor their behavioral progress. The intervention group is encouraged to print their action and coping plans as reminders of their intentions and to email the self-monitoring tick sheet to the first author at the end of each week.

4. Data Analyses

To assess the effect of the intervention on reducing occupational sedentary behavior and increasing occupational physical movement; as well as the interventions effect on increasing occupational physical movement habit and its effects on decreasing occupational sedentary behavior habit, four mixed methods 2 (condition/group) \times 3 (time) ANOVA's will be conducted. To assess the overall effects of the intervention, group (control or intervention) will be used as the between-subjects independent variable; time (baseline/T1, T2 and T3) will be used as the within-subjects independent variable with occupational sedentary behavior, occupational physical movement, occupational physical movement habit, and occupational sedentary behavior habit as the dependent variables. Each ANOVA will use an adjusted alpha level of 0.0125 to protect from inflation of type I error. Results, however, will report on any effects using the conventionally accepted significance cut-off level of 0.05 as well as the pre-specified cut-off level of 0.0125. Where an ANOVA indicates a significant time*group interaction for either of the dependent variables, a simple effects analysis will be conducted.

5. Expected Results

This study trials a workplace-based intervention aiming to reduce occupational sedentary behavior and increase occupational physical movement through developing habits towards increasing simple physical activity behaviors throughout the workday. To date, limited interventions have used habit formation theory to reduce sedentary behavior and promote physical movement within workplace settings [68]. This theory-driven, multi-component intervention aims to address this gap by providing simple behavioral changes to increase the level of general, opportunistic movement within a sedentary population. A successful intervention will reduce sedentary behavior by developing habitual responses

to simple physical activity behaviors, lessening the cognitive demand related to complex physical activity [46]. The successful intervention will be easily translatable to the general population and may be modified to suit other highly sedentary populations.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/mps5060094/s1>, Supplementary File S1 (PDF).

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Institutional Review Board Statement: Full ethical approval was granted by the Griffith University Human Research Ethics Committee on 11 June 2020 and last updated on the 8 July 2022 (GU: 2020/401). Any adverse events that occur during the intervention will be documented and reported to the University ethics committee.

Informed Consent Statement: Informed consent is obtained upon registration of their interest to participate from all subjects involved in the study.

Data Availability Statement: Results will be written up and peer reviewed for publication. The study is preregistered on the Open Science Framework platform (OSF, registration number: DOI 10.17605/OSF.IO/JASTP).

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. SPIRIT Checklist



SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents *

Section/item	Item No	Description	Addressed on page number
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	1
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry	2
	2b	All items from the World Health Organization Trial Registration Data Set	Appendix B
Protocol version	3	Date and version identifier	1
Funding	4	Sources and types of financial, material, and other support	17

Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	1
	5b	Name and contact information for the trial sponsor	1
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities	17
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)	16
Introduction			
Background and rationale	6a	Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention	3
	6b	Explanation for choice of comparators	3
Objectives	7	Specific objectives or hypotheses	5
Trial design	8	Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory)	6
Methods: Participants, interventions, and outcomes			
Study setting	9	Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained	6
Eligibility criteria	10	Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists)	6
Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered	9
	11b	Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease)	N/A
	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests)	9
	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial	N/A

Outcomes	12	Primary, secondary, and other outcomes, including the specific measurement variable (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended	7
Participant timeline	13	Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure 1)	Appendix C
Sample size	14	Estimated number of participants needed to achieve study objectives and how it was determined, including clinical and statistical assumptions supporting any sample size calculations	7
Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size	6
Methods: Assignment of interventions (for controlled trials)			
Allocation:			
Sequence generation	16a	Method of generating the allocation sequence (eg, computer-generated random numbers), and list of any factors for stratification. To reduce predictability of a random sequence, details of any planned restriction (eg, blocking) should be provided in a separate document that is unavailable to those who enrol participants or assign interventions	6
Allocation concealment mechanism	16b	Mechanism of implementing the allocation sequence (eg, central telephone; sequentially numbered, opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned	6
Implementation	16c	Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions	6
Blinding (masking)	17a	Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how	6
	17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	N/A
Methods: Data collection, management, and analysis			
Data collection methods	18a	Plans for assessment and collection of outcome, baseline, and other trial data, including any related processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known. Reference to where data collection forms can be found, if not in the protocol	9
	18b	Plans to promote participant retention and complete follow-up, including list of any outcome data to be collected for participants who discontinue or deviate from intervention protocols	7

Data management	19	Plans for data entry, coding, security, and storage, including any related processes to promote data quality (eg, double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol	6
Statistical methods	20a	Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol	12
	20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	N/A
	20c	Definition of analysis population relating to protocol non-adherence (eg, as randomised analysis), and any statistical methods to handle missing data (eg, multiple imputation)	9
Methods: Monitoring			
Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed	N/A
	21b	Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial	N/A
Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct	6
Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	17
Ethics and dissemination			
Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	6
Protocol amendments	25	Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators)	6
Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	6
	26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	N/A

Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial	6
Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	17
Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators	6
Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation	N/A
Dissemination policy	31a	Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions	6
	31b	Authorship eligibility guidelines and any intended use of professional writers	13
	31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	6
Appendices			
Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	19
Biological specimens	33	Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable	N/A

* It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons “Attribution-NonCommercial-NoDerivs 3.0 Unported” license.

Appendix B. SPIRIT World Health Organization Trial Registration Data Set

Data category	Information ³²
Primary registry and trial identifying number	OSF.IO 10.17605/OSF.IO/JASTP
Date of registration in primary registry	6 June 2022
Secondary identifying numbers	N/A
Source(s) of monetary or material support	School of Applied Psychology, Griffith University
Primary sponsor	School of Applied Psychology, Griffith University
Secondary sponsor(s)	Menzies Health Institute Queensland, Griffith University
Contact for public queries	Kailas Jenkins, PhD Candidate. kailas.jenkins@griffithuni.edu.au
Contact for scientific queries	Kailas Jenkins, PhD Candidate, School of Applied Psychology, Griffith University
Public title	Workplace Physical Movement Program
Scientific title	Physical Movement Habit Formation within Office Workers: Protocol Paper
Countries of recruitment	Australia
Health condition(s) or problem(s) studied	Sedentary behaviour
Intervention(s)	Intervention: habit program; Control: education
Key inclusion and exclusion criteria	Ages eligible for study: ≥ 18 years. Full time office workers, work from either a commercial office, from home or a mixture of both.
Study type	Interventional allocation: randomized; Intervention model: parallel assignment; Masking: blind (subject); Primary purpose: behaviour change
Date of first enrolment	July 2022
Target sample size	250
Recruitment status	Recruiting
Primary outcome(s)	Developing habits towards simple physical movement behaviours within the workplace
Key secondary outcomes	Reduction in sedentary behaviour

Appendix C. SPIRIT Schedule

Table A1. SPIRIT Schedule Figure. Study timeline and data collection time points.

TIMEPOINT	T1 (Baseline)	T2 (Week 2)	T3 (Week 4)
ENROLLMENT:			
Eligibility screen	X		
Informed consent	X		
Confirm eligibility	X		
INTERVENTION			
Assessments:			
Demographic information	X		
The Occupational Sitting and Physical Activity Questionnaire	X	X	X
Self-Report Behavioral Automaticity Index	X	X	X

References

1. Mokdad, A.H.; Forouzanfar, M.H.; Daoud, F.; Mokdad, A.A.; El Bcheraoui, C.; Moradi-Lakeh, M.; Kyu, H.H.; Barber, R.M.; Wagner, J.; Cercy, K. Global burden of diseases, injuries, and risk factors for young people's health during 1990–2013: A systematic analysis for the Global Burden of Disease Study 2013. *Lancet* **2016**, *387*, 2383–2401. [\[CrossRef\]](#) [\[PubMed\]](#)
2. Noble, N.; Paul, C.; Turon, H.; Oldmeadow, C. Which modifiable health risk behaviours are related? A systematic review of the clustering of Smoking, Nutrition, Alcohol and Physical activity ('SNAP') health risk factors. *Prev. Med.* **2015**, *81*, 16–41. [\[CrossRef\]](#) [\[PubMed\]](#)
3. Nylander, C. Protective Factors, Health-Risk Behaviours and the Impact of Coexisting ADHD among Adolescents with Diabetes and Other Chronic Conditions. Ph.D. Thesis, Universitatis Upsaliensis, Uppsala, Sweden, 2016.
4. WHO. *World Health Statistics 2015*; World Health Organization: Geneva, Switzerland, 2015.
5. Amler, R.W.; Eddins, D.L. Cross-sectional analysis: Precursors of premature death in the United States. *Am. J. Prev. Med.* **1987**, *3* (Suppl. 5), 181–187.
6. Conner, M.; Norman, P. *EBOOK: Predicting and Changing Health Behaviour: Research and Practice with Social Cognition Models*; McGraw-Hill Education: London, UK, 2015.
7. Brownson, R.C.; Boehmer, T.K.; Luke, D.A. Declining rates of physical activity in the United States: What are the contributors? *Annu. Rev. Public Health* **2005**, *26*, 421–443. [\[CrossRef\]](#)
8. Borodulin, K.; Laatikainen, T.; Juolevi, A.; Jousilahti, P. Thirty-year trends of physical activity in relation to age, calendar time and birth cohort in Finnish adults. *Eur. J. Public Health* **2008**, *18*, 339–344. [\[CrossRef\]](#)
9. Kirk, M.A.; Rhodes, R.E. Occupation correlates of adults' participation in leisure-time physical activity: A systematic review. *Am. J. Prev. Med.* **2011**, *40*, 476–485. [\[CrossRef\]](#)
10. Matthews, C.E.; Chen, K.Y.; Freedson, P.S.; Buchowski, M.S.; Beech, B.M.; Pate, R.R.; Troiano, R.P. Amount of time spent in sedentary behaviors in the United States, 2003–2004. *Am. J. Epidemiol.* **2008**, *167*, 875–881. [\[CrossRef\]](#)
11. Straker, L.; Mathiassen, S.E. Increased physical work loads in modern work—A necessity for better health and performance? *Ergonomics* **2009**, *52*, 1215–1225. [\[CrossRef\]](#)
12. WHO. *Obesity: Preventing and Managing the Global Epidemic: Report of a WHO Consultation on Obesity, Geneva, 3–5 June 1997*; World Health Organization: Geneva, Switzerland, 1998.
13. Bull, F.C.; Al-Ansari, S.S.; Biddle, S.; Borodulin, K.; Buman, M.P.; Cardon, G.; Carty, C.; Chaput, J.-P.; Chastin, S.; Chou, R. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br. J. Sport. Med.* **2020**, *54*, 1451–1462. [\[CrossRef\]](#)
14. Emanuele, P. Deep vein thrombosis. *Aaohn J.* **2008**, *56*, 389–394. [\[CrossRef\]](#)
15. Hemingway, H.; Shipley, M.J.; Stansfeld, S.; Marmot, M. Sickness absence from back pain, psychosocial work characteristics and employment grade among office workers. *Scand. J. Work Environ. Health* **1997**, *23*, 121–129. [\[CrossRef\]](#) [\[PubMed\]](#)
16. Higham, W. The Work Colleague of the Future A Report on the Long-Term Health of Office Workers. 2019. Available online: https://assets.fellowes.com/skins/fellowes/responsive/gb/en/resources/work-colleague-of-the-future/download/WCOF_Report_EU.pdf (accessed on 30 October 2020).
17. Hitosugi, M.; Niwa, M.; Takatsu, A. Rheologic changes in venous blood during prolonged sitting. *Thromb. Res.* **2000**, *100*, 409–412. [\[CrossRef\]](#) [\[PubMed\]](#)
18. Loh, K.; Redd, S. Understanding and preventing computer vision syndrome. *Malays. Fam. Physician Off. J. Acad. Fam. Physicians Malays.* **2008**, *3*, 128.
19. Dugdill, L.; Brett, A.; Hulme, C.; McCluskey, S.; Long, A. Workplace physical activity interventions: A systematic review. *Int. J. Workplace Health Manag.* **2008**, *1*, 20–40. [\[CrossRef\]](#)
20. Parry, S.; Straker, L. The contribution of office work to sedentary behaviour associated risk. *BMC Public Health* **2013**, *13*, 296. [\[CrossRef\]](#) [\[PubMed\]](#)
21. Rhodes, R.E.; De Bruijn, G.-J. Automatic and motivational correlates of physical activity: Does intensity moderate the relationship? *Behav. Med.* **2010**, *36*, 44–52. [\[CrossRef\]](#)
22. Salmon, J.; Owen, N.; Crawford, D.; Bauman, A.; Sallis, J.F. Physical activity and sedentary behavior: A population-based study of barriers, enjoyment, and preference. *Health Psychol.* **2003**, *22*, 178. [\[CrossRef\]](#)
23. Ajzen, I. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. [\[CrossRef\]](#)
24. McEachan, R.R.C.; Conner, M.; Taylor, N.J.; Lawton, R.J. Prospective prediction of health-related behaviours with the theory of planned behaviour: A meta-analysis. *Health Psychol. Rev.* **2011**, *5*, 97–144. [\[CrossRef\]](#)
25. Prapavessis, H.; Gaston, A.; DeJesus, S. The Theory of Planned Behavior as a model for understanding sedentary behavior. *Psychol. Sport Exerc.* **2015**, *19*, 23–32. [\[CrossRef\]](#)
26. Symons Downs, D.; Hausenblas, H. Exercise behavior and the theories of reasoned action and planned behavior: A meta-analytic update. *J. Phys. Act. Health* **2005**, *2*, 76–97. [\[CrossRef\]](#)
27. Armitage, C.J.; Conner, M. Efficacy of the theory of planned behaviour: A meta-analytic review. *Br. J. Soc. Psychol.* **2001**, *40*, 471–499. [\[CrossRef\]](#) [\[PubMed\]](#)
28. Hagger, M.; Chatzisarantis, N.; Biddle, S. A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of additional variables. *J. Sport Exerc. Psychol.* **2002**, *24*, 3–32. [\[CrossRef\]](#)

29. Hamilton, K.; van Dongen, A.; Hagger, M.S. An extended theory of planned behavior for parent-for-child health behaviors: A meta-analysis. *Health Psychol.* **2020**, *39*, 863. [\[CrossRef\]](#) [\[PubMed\]](#)
30. Hagger, M.S.; Cheung, M.W.-L.; Ajzen, I.; Hamilton, K. Perceived behavioral control moderating effects in the theory of planned behavior: A meta-analysis. *Health Psychol.* **2022**, *41*, 155–167. [\[CrossRef\]](#) [\[PubMed\]](#)
31. Rhodes, R.E.; de Bruijn, G.J. How big is the physical activity intention–behaviour gap? A meta-analysis using the action control framework. *Br. J. Health Psychol.* **2013**, *18*, 296–309. [\[CrossRef\]](#) [\[PubMed\]](#)
32. Brawley, L.R.; Rejeski, W.J.; King, A.C. Promoting physical activity for older adults: The challenges for changing behavior. *Am. J. Prev. Med.* **2003**, *25*, 172–183. [\[CrossRef\]](#)
33. Rhodes, R.E.; Rebar, A.L. Conceptualizing and defining the intention construct for future physical activity research. *Exerc. Sport Sci. Rev.* **2017**, *45*, 209–216. [\[CrossRef\]](#)
34. Conroy, D.E.; Maher, J.P.; Elavsky, S.; Hyde, A.L.; Doerksen, S.E. Sedentary behavior as a daily process regulated by habits and intentions. *Health Psychol.* **2013**, *32*, 1149. [\[CrossRef\]](#)
35. Gardner, B.; de Bruijn, G.-J.; Lally, P. A systematic review and meta-analysis of applications of the self-report habit index to nutrition and physical activity behaviours. *Ann. Behav. Med.* **2011**, *42*, 174–187. [\[CrossRef\]](#)
36. Brand, R.; Ekkekakis, P. Affective–reflective theory of physical inactivity and exercise. *Ger. J. Exerc. Sport Res.* **2018**, *48*, 48–58. [\[CrossRef\]](#)
37. Rhodes, R.E. Multi-Process Action Control in Physical Activity: A Primer. *Front. Psychol.* **2021**, *12*, 797484. [\[CrossRef\]](#) [\[PubMed\]](#)
38. Rollo, S.; Gaston, A.; Prapavessis, H. Cognitive and motivational factors associated with sedentary behavior: A systematic review. *AIMS Public Health* **2016**, *3*, 956. [\[CrossRef\]](#) [\[PubMed\]](#)
39. Phipps, D.J.; Hannan, T.E.; Rhodes, R.E.; Hamilton, K. A dual-process model of affective and instrumental attitudes in predicting physical activity. *Psychol. Sport Exerc.* **2021**, *54*, 101899. [\[CrossRef\]](#)
40. Lally, P.; Gardner, B. Promoting habit formation. *Health Psychol. Rev.* **2013**, *7* (Suppl. 1), S137–S158. [\[CrossRef\]](#)
41. Webb, T.; de Bruin, M. Monitoring interventions. *Handb. Behav. Chang.* **2020**, 537–553. [\[CrossRef\]](#)
42. Hagger, M.S. Habit and physical activity: Theoretical advances, practical implications, and agenda for future research. *Psychol. Sport Exerc.* **2019**, *42*, 118–129. [\[CrossRef\]](#)
43. Förster, J.; Jostmann, N.B. What is automatic self-regulation? *Z. Für Psychol.* **2015**, *220*, 147–156. [\[CrossRef\]](#)
44. Wood, W. Habit in personality and social psychology. *Personal. Soc. Psychol. Rev.* **2017**, *21*, 389–403. [\[CrossRef\]](#)
45. Gardner, B.; Thuné-Boyle, I.; Iliffe, S.; Fox, K.R.; Jefferis, B.J.; Hamer, M.; Tyler, N.; Wardle, J. ‘On Your Feet to Earn Your Seat’, a habit-based intervention to reduce sedentary behaviour in older adults: Study protocol for a randomized controlled trial. *Trials* **2014**, *15*, 368. [\[CrossRef\]](#)
46. Lally, P.; Van Jaarsveld, C.H.; Potts, H.W.; Wardle, J. How are habits formed: Modelling habit formation in the real world. *Eur. J. Soc. Psychol.* **2010**, *40*, 998–1009. [\[CrossRef\]](#)
47. Kaushal, N.; Rhodes, R.E. Exercise habit formation in new gym members: A longitudinal study. *J. Behav. Med.* **2015**, *38*, 652–663. [\[CrossRef\]](#) [\[PubMed\]](#)
48. Kaushal, N.; Rhodes, R.E.; Meldrum, J.T.; Spence, J.C. The role of habit in different phases of exercise. *Br. J. Health Psychol.* **2017**, *22*, 429–448. [\[CrossRef\]](#) [\[PubMed\]](#)
49. Hamilton, K.; Fraser, E.; Hannan, T. Habit-based workplace physical activity intervention: A pilot study. *Occup. Med.* **2019**, *69*, 471–474. [\[CrossRef\]](#) [\[PubMed\]](#)
50. Malik, S.H.; Blake, H.; Suggs, L.S. A systematic review of workplace health promotion interventions for increasing physical activity. *Br. J. Health Psychol.* **2014**, *19*, 149–180. [\[CrossRef\]](#)
51. Gardner, B.; Lally, P.; Rebar, A.L. Does habit weaken the relationship between intention and behaviour? Revisiting the habit–intention interaction hypothesis. *Soc. Personal. Psychol. Compass* **2020**, *14*, e12553. [\[CrossRef\]](#)
52. Wantland, D.J.; Portillo, C.J.; Holzemer, W.L.; Slaughter, R.; McGhee, E.M. The effectiveness of Web-based vs. non-Web-based interventions: A meta-analysis of behavioral change outcomes. *J. Med. Internet Res.* **2004**, *6*, e40. [\[CrossRef\]](#)
53. Cugelman, B.; Thelwall, M.; Dawes, P. Online interventions for social marketing health behavior change campaigns: A meta-analysis of psychological architectures and adherence factors. *J. Med. Internet Res.* **2011**, *13*, e17. [\[CrossRef\]](#)
54. Chan, A.-W.; Tetzlaff, J.M.; Altman, D.G.; Laupacis, A.; Gøtzsche, P.C.; Krleža-Jerić, K.; Hróbjartsson, A.; Mann, H.; Dickersin, K.; Berlin, J.A. SPIRIT 2013 statement: Defining standard protocol items for clinical trials. *Ann. Intern. Med.* **2013**, *158*, 200–207. [\[CrossRef\]](#)
55. Montori, V.M.; Guyatt, G.H. Intention-to-treat principle. *Cmaj* **2001**, *165*, 1339–1341.
56. Andersen, L.L.; Sundstrup, E.; Boysen, M.; Jakobsen, M.D.; Mortensen, O.S.; Persson, R. Cardiovascular health effects of internet-based encouragements to do daily workplace stair-walks: Randomized controlled trial. *J. Med. Internet Res.* **2013**, *15*, e127. [\[CrossRef\]](#) [\[PubMed\]](#)
57. Zhang, Z.; Yuan, K.-H. *Practical Statistical Power Analysis Using Webpower and R*; Isds Press: Granger, IN, USA, 2018.
58. Dillon, K.; Hiemstra, M.; Mitchell, M.; Bartmann, N.; Rollo, S.; Gardiner, P.A.; Prapavessis, H. Validity of the occupational sitting and physical activity questionnaire (OSPAQ) for home-based office workers during the COVID-19 global pandemic: A secondary analysis. *Appl. Ergon.* **2021**, *97*, 103551. [\[CrossRef\]](#) [\[PubMed\]](#)
59. Jancey, J.; Tye, M.; McGann, S.; Blackford, K.; Lee, A.H. Application of the Occupational Sitting and Physical Activity Questionnaire (OSPAQ) to office based workers. *BMC Public Health* **2014**, *14*, 762. [\[CrossRef\]](#) [\[PubMed\]](#)

-
60. Chau, J.Y.; Van Der Ploeg, H.P.; Dunn, S.; Kurko, J.; Bauman, A.E. Validity of the occupational sitting and physical activity questionnaire. *Med. Sci. Sport. Exerc.* **2012**, *44*, 118–125. [[CrossRef](#)]
 61. Gardner, B.; Abraham, C.; Lally, P.; de Bruijn, G.-J. Towards parsimony in habit measurement: Testing the convergent and predictive validity of an automaticity subscale of the Self-Report Habit Index. *Int. J. Behav. Nutr. Phys. Act.* **2012**, *9*, 102. [[CrossRef](#)]
 62. Phipps, D.J.; Hagger, M.S.; Hamilton, K. Predicting limiting ‘free sugar’ consumption using an integrated model of health behavior. *Appetite* **2020**, *150*, 104668. [[CrossRef](#)]
 63. Ross, R.; Chaput, J.-P.; Giangregorio, L.M.; Janssen, I.; Saunders, T.J.; Kho, M.E.; Poitras, V.J.; Tomasone, J.R.; El-Kotob, R.; McLaughlin, E.C. Canadian 24-Hour Movement Guidelines for Adults aged 18–64 years and Adults aged 65 years or older: An integration of physical activity, sedentary behaviour, and sleep. *Appl. Physiol. Nutr. Metab.* **2020**, *45*, S57–S102. [[CrossRef](#)]
 64. McAlaney, J.; Bewick, B.; Hughes, C. The international development of the ‘Social Norms’ approach to drug education and prevention. *Drugs Educ. Prev. Policy* **2011**, *18*, 81–89. [[CrossRef](#)]
 65. Perkins, H.W. College student misperceptions of alcohol and other drug norms among peers: Exploring causes, consequences, and implications for prevention programs. *Des. Alcohol Other Drug Prev. Programs High. Educ. Bringing Theory Into Pract.* **1997**, *1*, 177–206.
 66. Perkins, H.W. The emergence and evolution of the social norms approach to substance abuse prevention. *Soc. Norms Approach Prev. Sch. Coll. Age Subst. Abus. A Handb. Educ. Couns. Clin.* **2003**, *1*, 3–17.
 67. Dempsey, R.C.; McAlaney, J.; Bewick, B.M. A critical appraisal of the social norms approach as an interventional strategy for health-related behavior and attitude change. *Front. Psychol.* **2018**, *9*, 2180. [[CrossRef](#)] [[PubMed](#)]
 68. Lock, M.; Post, D.; Dollman, J.; Parfitt, G. Efficacy of theory-informed workplace physical activity interventions: A systematic literature review with meta-analyses. *Health Psychol. Rev.* **2021**, *15*, 483–507. [[CrossRef](#)] [[PubMed](#)]