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ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/terg20

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To cite this article: Haroun Zerguine, Venerina Johnston, Ana D. Goode & Genevieve N. Healy (2024) Pilot implementation and evaluation of the Sit-Stand *e*-Guide: an *e*-training program on the use of sit-stand workstations, Ergonomics, 67:12, 1845-1862, DOI: 10.1080/00140139.2024.2354379

To link to this article: https://doi.org/10.1080/00140139.2024.2354379

ERGONOMICS
2024, VOL. 67, NO. 12, 1845–1862
https://doi.org/10.1080/00140139.2024.2354379

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RESEARCH ARTICLE

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Pilot implementation and evaluation of the Sit-Stand *e*-Guide: an *e*-training program on the use of sit-stand workstations

Haroun Zerguine[a,b], Venerina Johnston[b,c,d], Ana D. Goode[e] and Genevieve N. Healy[e,f,g]

[a]SafeWork SA, Adelaide, Australia; [b]School of Health and Rehabilitation Sciences, The University of Queensland, St Lucia, Brisbane, Australia; [c]School of Health and Medical Sciences, University of Southern Queensland, Ipswich, Australia; [d]Centre for Health Research, University of Southern Queensland, Darling Heights, Australia; [e]School of Human Movement and Nutrition Sciences, The University of Queensland, St Lucia, Brisbane, Australia; [f]Baker Heart and Diabetes Institute, Melbourne, Australia; [g]School of Physiotherapy and Exercise Science, Curtin University, Perth, Australia

ABSTRACT

The 'Sit-Stand *e*-Guide' *e*-training program, designed to promote appropriate use of sit-stand workstations (SSWs), was evaluated for usability, acceptability and impact on various outcomes among SSW users. Participants from a large municipal organisation (25% male; mean age 45 [SD = 10.6] years) completed questionnaires pre-training (T0, $n=57$), immediately post-training (T1, $n=50$), and four weeks (T2, $n=46$: primary endpoint) and twelve months later (T3, $n=30$). High usability, acceptability and usefulness scores were reported at T1. Median [IQR] knowledge (4.4/5 [0.9]) and confidence (4.6/5 [1.0]) significantly increased at T1 compared to baseline (2.8 [1.2]; 3.3 [1.4]) and maintained at T2 and T3. At T2, mean [SD] sitting time (5.3 [1.2] h/workday) and low back discomfort (2.4 [2.3]) significantly decreased compared to baseline (6.1 [1.3] h; 3.4 [2.5] discomfort), SSW usage increased (1.4 [1.4]–2.8 [1.7] transitions), with no significant changes in work performance. Some behavioural changes were sustained at T3. The Sit-Stand *e*-Guide was acceptable and effective; evaluation across diverse workplaces and workers is now needed.

PRACTITIONER SUMMARY

This study evaluated a novel, evidence-based *e*-training program to support the appropriate use of sit-stand workstations. The Sit-Stand *e*-Guide showed high usability, acceptability and effectiveness in enhancing workers' knowledge and awareness of sedentary behaviour and the use of their sit-stand workstation. It also improved sit/stand behaviour and low back discomfort. However, for long-term benefits, yearly refresher training is recommended.

ARTICLE HISTORY
Received 11 July 2023
Accepted 7 May 2024

KEYWORDS
Sit-stand desk; hybrid; workplace; office ergonomics; sedentary

1. Introduction

Sit-stand workstations (SSWs) have gained significant attention in recent years as a promising solution to mitigate the negative health and wellbeing effects of prolonged sitting for desk-based workers (Bailey 2021; Baukens, Hermans, and Daenen 2019). These workstations allow individuals to alternate between sitting and standing positions while performing their work tasks. Systematic reviews have identified that installation of such desks can result in substantial (averaging 1.5 h/8-h workday) and sustained (at least 12 months) reductions in workplace sedentary time, particularly when installation occurs as part of a multicomponent approach including education and organisational-level strategies (Chu et al. 2016; Shrestha et al. 2018). Correspondingly, there has been a large uptake of these desks among desk-based organisations. A recent survey of 270 furniture purchasing decision-makers revealed that 80% had invested in SSWs for their staff (Zerguine et al. 2022). Moreover, since the start of the COVID-19 pandemic, an online-only manufacturer and retailer of SSWs in Australia experienced a 400% surge in sales, with over 90% of the orders being delivered to home addresses (Keating 2020), while a global market research report showed that SSWs sales are projected to reach $2.8 billion by 2025 with an annual growth of over 10% (Research and Markets 2017). Given this substantial increase in uptake, attention to the appropriate use of SSWs is needed to fully maximise the advantages of such equipment and minimise the potential harms of incorrect use (Callaghan et al. 2015; Waters and Dick 2015).

From an ergonomic perspective, improper adjustment of the SSW when seated or standing could lead

CONTACT Genevieve N.Healy g.healy@uq.edu.au School of Human Movement and Nutrition Sciences, The University of Queensland, Connell Building, St Lucia, Brisbane, QLD 4072, Australia

Supplemental data for this article can be accessed online at https://doi.org/10.1080/00140139.2024.2354379.

to musculoskeletal discomforts, such as in the forearm and wrist (Ebara et al. 2008). From a behavioural perspective, replacing prolonged sitting with prolonged standing, which has been reported in workplaces (Chau et al. 2014), could result in several negative impacts including musculoskeletal pain in the lower back and feet, cardiovascular problems, physical fatigue, and pregnancy-related health outcomes (e.g. pre-term birth and spontaneous abortion) (Waters and Dick 2015). On the other hand, the appropriate use of SSWs has been found to be effective in increasing postural variability and decreasing short-term low back discomfort (Agarwal, Steinmaus, and Harris-Adamson 2018; Ognibene et al. 2016), while long-term use of SSWs (greater than 3 months) has shown benefits for some cardio-metabolic risk indicators (Alkhajah et al. 2012; Healy et al. 2013), without negatively impacting productivity (Chu et al. 2016; Gao et al. 2018; MacEwen, MacDonald, and Burr 2015; Peterman et al. 2019).

Research interventions have often used training and/or education about appropriate SSW use as part of their multi-component intervention to address workplace sedentary behaviour (Shrestha et al. 2018). This training has varied in both amount and scope, ranging from simple, brief instructions (e.g. 2-min verbal instruction on its use (Alkhajah et al. 2012)) to extensive education (e.g. 3-h training with opportunities to apply the skills and tips to maintain skills delivered by the researcher (Riddell and Callaghan 2020), with the majority providing some form of passive education (e.g. providing participants with a brochure that includes basic workstation adjustment/physical ergonomics aspect) (Chambers, Robertson, and Baker 2019). However, this education and training does not seem to be widespread outside of the research context (Hall et al. 2019; Renaud et al. 2020), which has implications for the appropriate use and implementation of SSWs. Indeed, a survey conducted with furniture purchasing decision makers found that most perceived the majority of their employees did not use their SSWs appropriately (Zerguine et al. 2021).

A 2023 review highlighted that existing, publicly available online training programs for desk-based workers were primarily focused on the workstation adjustment for standard desks, without covering SSWs or considering the underlying principles for achieving the desired behaviour change associated with SSWs (i.e. regular transitions between sitting and standing) (Zerguine et al. 2023). Further, while the evaluation of existing SSW training programs has considered outcomes such as behaviour change, musculoskeletal discomfort, work performance, productivity, and knowledge and confidence in using SSWs (Agarwal, Steinmaus, and Harris-Adamson 2018; Chambers, Robertson, and Baker 2019; Robertson, Ciriello, and Garabet 2013), assessment of design-related outcomes such as usability, acceptability, usefulness, and engagement with the training content are typically overlooked (Zerguine et al. 2023). These design-related outcomes are important in ensuring effective training delivery and identifying areas for enhancement (Kirkpatrick and Kirkpatrick 2016).

To help address these evidence gaps, the Sit-Stand *e*-Guide was developed. The Sit-Stand *e*-Guide is a novel, evidence-based and co-designed *e*-training program that incorporates both ergonomics and behavioural change aspects to support the appropriate use of SSWs (Zerguine et al. 2024). The *e*-training was created following the instructional system design model ADDIE (Analysis, Design, Development, Implementation and Evaluation) (Gibbons, Boling, and Smith 2014). *The primary aim* of this pilot implementation and evaluation study, conducted within a single organisation, was to assess the usability, acceptability and usefulness of the Sit-Stand *e*-Guide; and, explore the short-term (4-week: primary endpoint) pre-post changes in knowledge and confidence, behaviour, musculoskeletal and general health and work performance following the training. *Secondary aims* were to explore: findings separately for the home and workplace environment (given the increasing number of workers working from home (Griffiths et al. 2021), and the different influences on behaviour when working in the home environment (Clark, Brakenridge, and Healy 2022; Niven et al. 2023); and, the long-term (12 months) impact of the training (given that use of SSWs has been reported to decline over time (Huysmans, Srinivasan, and Mathiassen 2019; Renaud et al. 2018). Findings are expected to inform: the feasibility of implementing the training within an organisation; whether the program warrants broader evaluation and implementation across a number of organisations (i.e. is there evidence that the training is effective and acceptable); and, what changes (if any) to the training may be needed prior to such further implementation.

2. Methods

2.1. Design

The Sit-Stand *e*-Guide was implemented within a large municipal organisation based in Queensland, Australia which had recently moved into a new purpose-built building furnished with SSWs. This organisation actively participated in both the co-design and development phases of the *e*-training (Zerguine et al. 2024). Data were collected prior to training and up to three time points

post training. Ethical approval to conduct this study was obtained from The University of Queensland ethics committee (approval number: 2021/HE001776) and all participants provided informed consent prior to participation.

2.2. Participants

Eligible participants were desk-based workers from the organisation using a SSW (at the workplace and/or at home) for at least three days per week. Participant recruitment was coordinated through the onsite liaison person who distributed an email about the study to all staff at the organisation. This email included a brief overview of the *e*-training, a summary of participants' involvement in the study and a link to the online participant information sheet and eligibility questions. A target sample of 50 participants was set by the researcher team representing 10% of the total eligible sample in the organisation ($N = 500$ employees) aligning with Connelly (2008) guidelines for pilot studies, noting that all eligible staff could take part in the training. The liaison person was informed about the target sample size, and a reminder email was sent two weeks after the initial announcement. Recruitment for new participants ceased four weeks after the initial advertisement of the study (November 2022) and once the target sample was obtained.

2.3. About the Sit-Stand e-Guide

The iterative development of the Sit-Stand *e*-Guide has been described in full elsewhere (Zerguine et al. 2024). In brief, the training was co-designed and developed following the ADDIE instructional system design process (Gibbons, Boling, and Smith 2014) supported by a participatory approach (Zamenopoulos and Alexiou 2018) involving end-users and experts. The process commenced with workshops with end-users, including staff with regular access to SSWs, supervisors and managers from the host organisation. These workshops intended to identify the learning needs and desired training content and outcomes. Based on this input, a storyboard was developed through an iterative process with subject matter experts in ergonomics, sedentary behaviour, health and safety, musculoskeletal injury prevention and behavioural change. Peer-reviewed literature was regularly consulted throughout the process of content development to ensure the program included contemporary evidence and information.

A variety of learning activities (e.g. scenarios; reflection activities) were designed based on behavioural change techniques (Michie et al. 2013), learning theories including behaviourism, cognitivism and constructivism (Ertmer and Newby 2013) and best practices in pedagogy (Khalil and Elkhider 2016) to enhance knowledge retention and skills implementation. Visual and interactive features such as videos, additional resources, and links to external reputable and relevant sites were also used to engage users with the content. On completion of the training, users were able to download a one-page interactive PDF guide to assist in the development of SMART (Specific, Measurable, Achievable, Relevant, and Time-Bound) goals, with a list of suggested strategies for using their SSW and taking regular breaks at work. This *e*-training covered both the ergonomics and behavioural change aspects of SSWs and consisted of the four following modules. Each module takes about 10 min to complete. Table 1 presents an overview of the four modules, topics covered, example learning activities and the relevant behavioural change techniques and learning theories applied.

2.4. Data collection

Data was collected via online surveys at four-time points: baseline before the training (T0), immediately after the training (T1), four weeks post-training (T2), and 12 months post-training (T3) with T2 the primary endpoint. Full surveys may be found in Supplemental Materials. The link to the T0 survey became available following confirmation of consent and eligibility. The T0 questionnaire collected information on participant characteristics (socio-demographic; work); training expectations; knowledge and confidence in using the SSW; SSW usage; sitting, standing and moving behaviour; and, health, wellbeing and performance. At the end of the T0 questionnaire, the link to the Sit-Stand *e*-Guide was provided. Once participants completed the *e*-training, they were directed to immediately complete the T1 questionnaire, which repeated the knowledge, confidence and training expectation questions and also asked about the usability, acceptability and usefulness of the training. Four weeks and then twelve months after completion, participants were contacted by the research team to complete the T2 and T3 questionnaires, respectively. Here, any changes in work arrangements were captured, while the knowledge and confidence; SSW usage; sitting, standing and moving behaviour; and, health, wellbeing and performance questions were repeated. The use of the interactive PDF, as well as open text feedback on it, was also collected at T2 and T3.

The evaluation was based on the four levels of the new Kirkpatrick model (Alsalamah and Callinan 2022;

Table 1. Overview of the Sit-Stand e-Guide modules and the theoretical basis of learning activities.

Modules	Topics	Example of learning activity	Learning theory	BCTs
Overview	• Learning objectives • Audience	/	/	/
Module 1: Sedentary behaviour – Health and wellbeing at work (~10 min)	• Definition of sedentary behaviour • Prolonged sitting • Prolonged standing • Physical activity • Benefits and tips to stand up, sit less and move more	*Embedded activity* – Sitting calculator Staff can reflect on the periods and overall sitting time during the day.	Cognitivism	Feedback on the behaviour
Module 2: Sit-stand workstation set-up (~10 min)	• Definition and types of SSWs • Optimal adjustment of the workstation when seated • Optimal adjustment of the workstation when standing • Tips for using the SSW	*Skills application* Staff was given an opportunity to implement the skills learnt and adjust their colleague's workstation.	Constructivism	Behavioural practice/ rehearsal
Module 3: Strategies for behaviour change (~10 min)	• The influences on behaviour at work • Explore the influences of sedentary behaviour in your workplace • SMART Goals	*Sorting activity* Staff group cards of the different influences on sitting behaviour either as "barrier" or "enabler".	Constructivism	Problem-solving, Feedback on behaviour
Module 4: Troubleshooting/ Hazards/Further information (~10 min)	• Troubleshoot when discomfort arises • Responsibilities and considerations • Common issues at the workplace • Pros and cons of each SSW type • Myths about SSWs	*External resources and hyperlinks* Staff can access documents given to download which provide evidence on the impact of prolonged sedentary behaviour.	Constructivism	Credible source
Thank you	• Download the Sit-Stand interactive PDF Guide	*Knowledge retention guide and goal Worksheet* Staff develop SMART goals to regularly use the SSW and take active breaks during the day.	Behaviourism and Cognitivism	Goal setting, Instruction on behaviour, Self-monitoring of behaviour

Kirkpatrick and Kirkpatrick 2016), with assessment undertaken of usability, acceptability and usefulness (Level 1), knowledge and confidence (Level 2), sitting/standing/moving behaviour (Level 3), and employees' health, well-being, and work performance (Level 4). Changes in knowledge and confidence were assessed at four-time points as this was expected to change in the short-term but the longer-term change in knowledge is rarely assessed. Changes in health behaviours and work performance were assessed at three-time points as these outcomes likely need more time to embed. All four questionnaires were hosted by the Qualtrics®XM platform (Qualtrics 2019). An incentive of a chance of winning one of three $AU100 gift cards was offered to staff who completed all surveys two times; at four weeks and 12 months.

2.5. Measures

Individual, job and SSW characteristics: Age (years), sex, job category, job classification, and number of days working at the workplace, from home and overall, during the last week were collected at T0. Participants were asked about the number of days per week they have access to SSW, whether it is for individual or shared use, and the type of SSW used. Questions were asked separately for working at the workplace and/or from home as applicable. At T2 and T3, participants were asked about any changes that occurred in their employment status in addition to the same questions from T0 regarding the number of days working at the workplace, from home and overall.

Training experience and expectation (T0): Participants were asked to rate their familiarity with online training at the workplace on a 7-point Likert scale (very unfamiliar (1) to very familiar (7)). Participants were also asked if they received any training on SSW, had undertaken any other office ergonomics training and/or training on sitting less and moving more at work, and the mode of delivery of each of these training (if selected) – (6 options). Expectations regarding the *e*-training program were assessed via three items on a

5-point Likert scale (strongly disagree (1) to strongly agree (5)): the content relevant to the work, the benefits of participating outweigh the disadvantages; and, whether participating offers the opportunity to use the workstation more effectively. The items in this part were adapted from previous evaluations of *e*-learning programs (Douma et al. 2017; Te Pas et al. 2016). The mean value of each item was reported.

Usability, acceptability, and usefulness (T1): Usability, acceptability, and usefulness of the training program were measured by asking participants to rate their agreement using a 5-point Likert scale of strongly disagree (1) to strongly agree (1) on 18 items grouped into five categories: content and learning activities (4 items), learning activities (3 items), expectations (3 items), perceived usefulness (3 items), and information quality (5 items). These items were extracted and edited based on the user experience-based *e*-learning acceptance model (Zardari et al. 2021). The mean value of each category was reported with a higher mean reflecting greater usability, acceptability, or usefulness. A free-text option was provided for any additional feedback on each of the five categories above. To assess each module of the *e*-training, participants were asked to rank the four modules based on the content (from most to least relevant) and their level of engagement (from most to least engaging).

Knowledge and confidence (T0, T1, T2, T3): Knowledge was measured through 15 items covering: workstation setup (7 items) and troubleshooting (1 item) when sitting and standing; sedentary behaviour (6 items); and, benefits of SSWs (1 item). Confidence was measured through 11 items by repeating the knowledge items on workstation setup (7 items) and troubleshooting (1 item) and adding items on the use of the standing option (1 item), number of sit/stand transitions during the day (1 item), and frequency of taking mini breaks every 30 min (1 item). A 5-point response Likert scale (very poor (1) to very good (5)) and (not confident at all (1) to completely confident (5)) was used for knowledge and confidence, respectively, where a higher score reflects greater knowledge. Questions were developed by the research team based on the *e*-training content specifically for this study.

SSW usage (T0, T2, T3): Participants were asked to estimate the number of sit/stand transitions per day, their percentage of standing at their SSW per day, and their reason(s) for using the standing option. These questions were asked separately for working at the workplace and from home, as applicable. The mean value was reported for the number of sit/stand transitions and the percentage of standing at work.

Sitting, standing and moving behaviour (T0, T2, T3): The Occupational Sitting and Physical Activity Questionnaire (OSPAQ) was used to assess sitting, standing, walking and heavy labour over the last 7 days (Chau et al. 2012). Percentage of sitting in long bouts more than or equal to 30 min (Clark et al. 2021) and the number of breaks in sitting per 1-h (Clark et al. 2011) were also asked, as was a modified sitting strategy array questionnaire (Clark et al. 2021). This sitting array questionnaire was modified to include an addition six items to capture strategies specifically on SSWs (total of 16 items). Participants chose the number of times they completed each strategy from 0 to 10+ times per day. The mean value was used in reporting the OSPAQ and prolonged sitting, while the frequency and variety scores were reported for siting strategies. All measures were asked separately for working at the workplace and from home and weighted scores (weighted for time in each location) were used to report the overall values, with overall considered the primary findings.

Musculoskeletal and general health (T0, T2, T3): A numeric rating scale was used to assess musculoskeletal discomfort in nine body regions (neck/shoulders, arms, hands/fingers/wrist, upper back, lower back, hips, buttocks, legs, and feet) (Childs, Piva, and Fritz 2005). Participants were asked to rate their discomfort during the last 7 days in each body region from (0-no discomfort to 10-worst discomfort imaginable). Participants were also asked to rate their discomfort on a similar scale when using the SSW in general, when standing, and when sitting. The questions were asked of both the workplace and at home if applicable. The mean value was reported, with a higher mean reflecting greater discomfort. Current physical health and mental health were rated by participants on a 5-Likert scale (poor (1) – excellent (5)) (Ahmad et al. 2014; Jürges, Avendano, and Mackenbach 2008).

Work performance (T0, T2, T3): The Health and Work Performance Questionnaire (HPQ) by the World Health Organisation was used to assess work performance (Kessler et al. 2003). Participants were asked about their expected number of hours to work in a typical 7-day week, the total hours worked over the last 7 days, and their usual and overall performance over the past 7 days on a scale (0 – worst performance, 10 – top performance). Absolute and relative absenteeism and presenteeism were scored based on the HPQ guide (Kessler et al. 2003). The score for absolute absenteeism is bound by the actual hours worked, ranging from a negative lower limit when a person exceeds expectations to an upper limit equal to their expected work hours. Relative absenteeism score

varies from a negative value, signifying working more than expected, to 1.0, indicating constant absence.

Sit-*Stand interactive PDF Guide – post-training printout (T2)*: Participants were asked if they utilised the sit-stand interactive PDF guide provided after the training, and, if so, if they achieved their SMART goals. Participants were asked open-ended questions to report on the barriers/challenges impeding them from achieving their SMART goals and facilitators/enablers that helped them to achieve their SMART goals. Participants were asked to return their completed PDF guide.

2.6. Data analysis

The survey data was exported from Qualtrics®XM and then coded and analysed using the Statistical Package of Social Science (SPSS for Windows, Version 28.0, 2022). Individuals' emails were used to match data at the four-time points. Descriptive statistics were used to summarise personal and job characteristics, with differences between study completers and dropouts tested using independent samples t-tests for continuous variables and chi-square tests for categorical variables. Descriptive statistics were also used to summarise data on their sitting, standing and moving goals and the strategies used, as collected by the sit-stand interactive PDF guide.

For the primary aim: Usability, acceptability, usefulness and training expectations were examined using descriptive statistics with content analysis used to analyse the open-text responses. The non-parametric Friedman test was used to analyse the differences in knowledge and confidence scores across three time points (T0, T1, T2), with Wilcoxon post-hoc tests used when significant differences were observed. Bonferroni adjustment on Wilcoxon results was applied. Paired t-tests were used to evaluate whether the intervention led to changes in the means of continuous outcomes between T0 and T2 (primary endpoint) for SSW usage, behaviour, health and performance. Parametric tests have been shown to be robust to analysis of Likert scale data (Norman 2010), nevertheless, non-parametric Wilcoxon signed ranks test was conducted to check this assumption. The weighted mean for the overall outcome was calculated from both workplace and work-from-home data where applicable. Assumptions for paired t-tests (normality of change, absence of outliers) were checked using the Shapiro-Wilk test, as well as examining skewness, kurtosis and checking histograms for outliers. To test assumptions regarding the use of ordinal data in parametric tests, specifically for behaviour, health and work performance outcomes, the non-parametric Wilcoxon signed ranks test was also performed as a sensitivity analyses, reporting medians and interquartile range and z-values.

For the secondary aims: Exploratory analyses were conducted to examine changes separately for the workplace and the home environment, as well as the long-term (12-month) changes from pre (T0) to post (T3) training.

For ease of reporting, findings are summarised across outcomes with all timepoints included in the summary and Tables as appropriate. Statistical significance was accepted at $p < 0.05$ with Cohen's d (Cohen 1988) also reported to understand size of the effect where appropriate, with $d \leq 0.2$ (small effect), $0.2 < d < 0.5$ (moderate effect), $0.5 < d < 0.8$ (large effect), $d \geq 0.8$ (very large effect).

3. Results

3.1. Individual, job and SSW characteristics

3.1.1. Baseline participant and work characteristics

A total of 57 participants completed the baseline survey (T0), 50 (88%) completed the training and the immediate post-training survey (T1), 46 (82%) completed the 4-week post-training survey (T2), and 30 (53%) completed the 12-month post-training survey. Table 2 shows that most participants at the baseline were either professionals (61%) or clerical and administrative workers (38%) who had worked with the organisation for over three years (58%). The majority of participants (75%) were general employees, with no senior managers involved. All participants spent some of their working time at the workplace with the majority combining time at work and home ($n = 36$, 63%), averaging about one day a week at home (0.9 [0.9] days). Comparing the 46 participants at T2 with the 11 who dropped out, study completion was significantly ($p < 0.05$) associated with being in management, having more days working in the workplace and fewer days working from home, and working only from the workplace. Furthermore, while not reaching statistical significance, the completers were more likely to be male (28% vs 9%, $p = 0.15$) compared with the dropouts. Similarly, comparing the 30 participants at T3 with the 27 who dropped out, study completion was significantly ($p < 0.05$) associated with having more days working in the workplace rather than at home.

All participants who completed the T2 ($n = 46$) and T3 ($n = 30$) surveys reported no changes to their employment status. In terms of work arrangement, all participants remained working from the workplace with fewer working from home ($n = 26$, 56%) at 4 weeks

and ($n=16$, 53%) at 12 months compared to baseline ($n=36$, 63%). No changes were observed on the average days of working from the workplace (4.2 [0.9] days; 4.3 [0.9] days) and working from home (0.7 [0.9] days; 0.6 [0.8] days) at 4 weeks and 12 months respectively compared to baseline.

3.1.2. SSW access when working at the workplace and from home

Prior to training, many participants had access to the SSW for their individual use in the settings in which they worked (Table 3). Of the 57 who reported some work at the workplace, nearly all (98%) had access to a SSW at work, almost always the electric-fully adjustable type ($n=55$, 98%) for their individual use (54, 96%). Of the 36 who reported working from home, only some ($n=10$, 28%) had access to a SSW at home. As in the workplace, these were almost always for individual use ($n=9$, 90%), but of more varied types. The number of days working with access to a sit-stand workstation was (mean[SD]) 4.3 [1.3] days/week at the workplace and 1.0 [2.1] days/week at home, consistent with the limited amount of working from home. Access to SSWs among the 4-week and 12-month survey participants was broadly similar to baseline, with all participants working at the workplace ($n=46$ at T2 and $n=30$ at T3) having access to a SSW for individual use and an electric fully adjustable type ($n=45$, 98% at T2 and $n=29$, 97% at T3).

3.2. Training experience and expectations

At baseline, participants reported high familiarity with online training (74% were familiar–very familiar) (Supplemental Material 1) with the majority receiving no training on SSWs (84%) or on sitting less and moving more (95%). Participants set high expectations about the training with median scores ranging from 4 to 5 out of 5 in regard to the relevance of the content to their work and building skills to use SSW more effectively, with a high majority of participants agreeing or strongly agreeing that the content would be relevant (86%), build skills to use SSWs effectively (98%) and would have benefits that outweigh the disadvantages (94%). The majority of participants wanted to improve their knowledge as well as their skills in applying this knowledge in relation to SSWs, with all skills generally supported with the exception of wanting to be able to assess colleagues' workstations (19%). Other skills mentioned in the open text field were practical strategies with tips and tricks to stand more, and skills to decrease discomfort at the workstation and gain confidence when standing. The number of skills participants indicated they hoped to improve ranged from 1 to 7 (all skills) with a median of 5.

3.3. Usability, acceptability and usefulness

A total of 50 participants completed the training program, often in a single session ($n=40$, 70%) and sometimes across multiple sessions (data on the number of

Table 2. Baseline participants and work characteristics.

Individuals and job characteristics	T0 ($N=57$)	T1 ($N=50$)	T2 ($N=46$)	Dropouts[a] ($N=11$)	p-Value[a]	T3 ($N=30$)	Dropouts[b] ($N=27$)	p-Value[b]
Age, years, mean (SD)	45.3 (10.6)	45.7 (10.6)	45.9 (10.3)	43.0 (11.8)	0.41	45.6 (8.4)	45.4 (8.5)	0.95
Sex, male n (%)	14 (24.6%)	14 (28.0%)	13 (28.3%)	1 (9.1%)	0.15	9 (30%)	9 (33.3%)	
Job category n (%)					0.50			0.39
Managers and professionals	35 (61.4%)	32 (64.0%)	27 (58.7%)	8 (72.7%)		16 (53.3%)	15 (55.6%)	
Administrative and other employees	22 (38.6%)	18 (36.0%)	19 (41.3%)	3 (27.3%)		14 (46.7%)	12 (44.4%)	
Job classification n (%)					**0.03**			0.69
Middle management	14 (24.6%)	14 (28.0%)	14 (30.4)	0		6 (20%)	6 (22.2%)	
General employees	43 (75.4%)	36 (72.0%)	32 (69.6)	11 (100%)		24 (80%)	21 (77.8%)	
Tenure n (%)					0.58			0.07
Less than 1 year	14 (24.6%)	11 (22.0%)	10 (21.7%)	4 (36.4%)		3 (10%)	3 (11.1%)	
1–3 years	10 (17.5%)	9 (18.0%)	8 (17.4%)	2 (18.2%)		6 (20%)	6 (22.2%)	
More than 3 years	33 (57.9%)	30 (60.0%)	28 (60.9%)	5 (45.5%)		21 (70%)	18 (66.7%)	
Employment status, Full-time n (%)	50 (87.7%)	44 (88.0%)	41 (89.1%)	9 (81.8%)	0.61	24 (80%)	22 (81.5%)	0.17
Usual workdays per week, days/week, mean (SD)	4.9 (0.5)	4.9 (0.4)	4.9 (0.3)	4.6 (0.8)	0.25	4.8 (0.4)	4.8 (0.3)	0.92
Work at the workplace, days/week, mean (SD)	4.0 (1.0)	4.1 (1.0)	4.2 (0.9)	3.1 (0.9)	**0.001**	4.3 (0.9)	4.0 (0.9)	**0.02**
Work from home, days/week, mean (SD)	0.9 (0.9)	0.9 (0.9)	0.7 (0.9)	1.5 (0.9)	**0.01**	0.6 (0.8)	0.9 (0.8)	**0.04**
Work setting					**0.04**			0.09
Only workplace, n (%)	21 (36.8%)	19 (38.0%)	20 (43.5%)	1 (9.1%)		14 (46.7%)	13 (48.1%)	
Workplace and home, n (%)	36 (63.2%)	31 (62.0%)	26 (56.5%)	10 (90.9%)		16 (53.3%)	14 (51.9%)	

[a]p-Value for the difference between completed T2 vs dropped out. [b]p-Value for the difference between completed T3 vs dropped out. **Bolded** values indicate statistical significance ($p<0.05$).

sessions >1 was not available). The average (mean[SD]) time completion of the overall training was 37 [15.1] min, with the shortest completion time being 10 min and the longest being 73 min. The average completion time of each module ranged between approximately 8 to 10 min, with optional Module 4 being the shortest (8 [4.5]), followed by Module 3 (9.3 [3.7]), Module 2 (9.6 [4.0]), and Module 1 (10 [4.5]) min. At T1, participants reported high usability, acceptability and usefulness with median scores ranging from 4.3 to 4.6/5. Nearly all participants (>90%) agreed on all items, except learning activities (83%), and only one participant disagreed on the usability, acceptability and usefulness of the content and learning and learning activities (Table 4).

When ranking each module on the content and level of engagement, Module 1 on sedentary behaviour and health and Module 3 on strategies for behaviour change were rated the most informative ($n = 17$, 34% and $n = 14$, 28%) and most engaging ($n = 15$, 30% and $n = 16$, 32%) respectively of the four modules (Supplemental Material 2). The majority of participants ranked Module 4 on troubleshooting and other hazards the least informative ($n = 38$, 76%) and the least engaging ($n = 34$, 68%). Module 2 on workstation adjustment was ranked the second least informative ($n = 19$, 38%) and engaging ($n = 18$, 36%).

3.31. Feedback on the training program

A total of 18 participants provided free-text feedback on the training as part of the T1 questionnaire. Overall, feedback was positive, with participants noting that the content was very useful and applicable to their work: *'Training actually exceeded my expectations as I found some really good and practical advice that made me think outside the norm'*. Some participants highlighted the relevance of content and learning activities: *'this training actually had good, new information that I had not heard/been told before. It was surprisingly engaging'. 'I'd never considered SMART goals for sit/stand behaviour. That was great'. 'Having to put an amount of time to each activity I spend sitting was a real eye-opener and has been a motivator to consider my at home and at work behaviours'.*

A few participants highlighted some technical difficulties with the training such as playing the videos embedded in the training: *'The videos took a very long time to load. I'm unsure if it was a technical issue at this end'*, or when progressing sections of the training: *'I couldn't work out how to progress in module one from the infographic… I had a 'finish this module before moving' message'*.

Some participants made suggestions to improve the training: *'it would be good to highlight the information that is missed to progress to the next section of the module'*, or the content: *'Perhaps talking about seat width etc. issues for tall people/short people'. 'More brevity needed'*.

3.4. Knowledge and confidence

Friedman test revealed a significant difference ($p < 0.001$) across all areas of knowledge and confidence on the three-time points (T0, T1 and T2). Prior to the training, knowledge levels were on average moderate-to-high, with an overall median [IQR] score of 2.8 [1.2] where a score of 5 reflects the greatest knowledge (Table 5). Post hoc tests showed that training led to a significant ($p < 0.017$) and a large increase in knowledge both immediately after the training (1.6, $z = 5.24$) and to a lesser extent 4 weeks (1.2, $z = 5.09$: primary endpoint) compared to prior the training. This was seen in all areas of knowledge, with the areas of lowest initial knowledge increasing more than the areas of high initial knowledge. Similarly, a significant increase in all

Table 3. Participants' access to SSWs when working at the workplace or from home at T0, T2 and T3.

	Baseline (T0) $N = 57$		Follow-up (T2) $N = 46$		Follow-up (T3) $N = 30$	
Work setting	Workplace ($n = 57$)	Home ($n = 36$)	Workplace ($n = 46$)	Home ($n = 20$)	Workplace ($n = 30$)	Home ($n = 16$)
Access to SSW, Yes, *n* (%)	56 (98.2%)	10 (27.8%)	46 (100%)	7 (35.0%)	30 (100%)	5 (31.2%)
[a,b]Type of access to SSW, *n* (%)						
Individual use	54 (96.4%)	9 (90.0%)	45 (97.8%)	6 (85.7%)	29 (96.6%)	4 (80%)
Shared use	2 (3.6%)	1 (10.0%)	1 (2.2%)	1 (14.3%)	1 (3.4%)	1 (20%)
[b]Type of SSW *n* (%)						
Electric fully adjustable SSW	55 (98.2%)	5 (50.0%)	45 (97.8%)	4 (57.1%)	28 (93.1)	5 (100%)
Manual wind-up fully adjustable SSW	0	1 (10.0%)	0	0	0	0
Electric desktop converter	1 (1.8%)	0	1 (2.2%)	0	1 (3.4%)	0
Manual hydraulic (lever) desktop converter	0	2 (20.0%)	0	1 (14.3%)	1 (3.4%)	0
Portable height adjustable desk	0	1 (10.0%)	0	0	0	0
Other	0	1 (10.0%)	0	2 (28.6%)	0	0
[a]Days/week access to SSW, mean (SD)	4.3 (1.3)	1.0 (2.1)	4.5 (1.1)	1.4 (2.3)	0	0

[a]Excludes those who did not work in the setting. [b]Excludes those who did not have a workstation.

areas of confidence scores was found at T1 and T2 compared to baseline scores.

The exploratory analyses showed that the increase in knowledge and confidence scores across all areas has maintained to a lesser extent compared to prior the training (Table 5).

3.5. SSW usage and sitting, standing and moving behaviour

Prior to the training, participants reported a low number of sit/stand transitions (alternating between sitting and standing using the SSW) (1.4 [1.4] per day) and overall use of the upright position of the desk (12 [15]% of the day). Four weeks post-training, a significant and large increase was found in the number of sit/stand transitions (2.8 [1.7]) and the overall amount of use of the SSW in the upright position (20 [13%]) per day compared to baseline. The average self-reported daily sitting time at work at baseline was 76%, equivalent to approximately 6 h per 8-h workday, with participants reporting that 69% of this time occurred in prolonged, unbroken, continuous bouts of 30 min or more. The training resulted in a significant and moderate decrease in daily sitting time at 4 weeks (to 67%) with an associated increase in standing time (from 13% to 20%) compared to baseline (Table 6). This reduction is approximately equal to a reduction in work sitting time of 48 min and an increase in work standing time of 35 min per 8-h workday. A small (1.6%) and non-significant improvement in moving time was observed overall. The training also resulted in a significant and moderate decrease in the percentage of sitting time accrued in prolonged unbroken bouts (from 69% to 52% overall), accompanied by an increase in the number and frequency of strategies used to break up prolonged sitting. Findings were similar when considered by location of the work (workplace; home), except for the number of stand/stretch breaks in 1 h of sitting at home, which had a small and non-significant decrease at 4 weeks.

The exploratory analyses showed that for participants that completed the 12-month post-training survey ($n = 30$), there was a slight but non-significant increase in the number of SSW transitions (1.9 [1.5]) and upright position (15.4 [13.4]%) as compared to baseline (1.6 [1.6] and 14.6 [15.3]%) respectively. Similarly, a slight but non-significant decrease in sitting time (5.5%, ~26 min per 8-h workday) and prolonged sitting bouts (9%) was observed. Standing and moving time also slightly increased by 2.6% and 3% respectively, but these changes were not statistically significant (Supplemental Material 3).

3.6. Musculoskeletal and general health

Prior to the training, the highest musculoskeletal discomfort was reported in the neck/shoulders (3.5 [2.6]) and lower back (3.4 [2.5]) regions (Table 7). Four weeks after the training, a significant and moderate decrease in low back pain (−1.4, 95% CI [−1.7; −0.4]), hips (−0.8, [−1.4; −0.1]) and buttocks (−0.6, [−1.1; −0.1]) were observed. A small decrease in discomfort in the neck/shoulder area and general discomfort when using SSW was found but this was not statistically significant. The small improvements observed in physical and mental health following the training were not statistically significant.

No statistically significant or large changes in musculoskeletal discomfort occurred at T3 as compared to baseline (Supplemental Material 4).

3.7. Work performance

Prior to the intervention, participants worked slightly more hours (almost 6 h extra) than expected over their last 4 weeks (average absenteeism −5.9 [40.1] h), however, there was wide variability between participants. Relative absenteeism (−0.2 [0.9]) indicated that this was approximately 18% of their expected work hours. The average work performance for participants at baseline was 72.4 [12.1] (on a scale out of 100), with participants reporting they had almost similar performance (1.0 [0.1]) to other participants (about 98% performance compared to other employees). Overall, there were no significant changes in absenteeism and presenteeism at 4 weeks after training compared to baseline, though the confidence intervals for absolute absenteeism included potentially large changes (Table 8).

Table 4. Usability, acceptability and usefulness of the training program.

Usability, acceptability, and usefulness (scores/5)[a]	Median (IQR) ($N = 48$)	% Agree or strongly agree[b]	Neither agree nor disagree	% Disagree/ strongly disagree
Overall program experience (3 items)	4.33 (4–5)	93.3%	6.7%	0
Content and Learning Materials (4 items)	4.62 (4–5)	95.5%	2.8%	1.7%
Learning activities (3 items)	4.33 (4–4.6)	83.0%	15.3%	1.7%
Expectations (3 items)	4.66 (4–5)	96.7%	3.3%	0
Perceived usefulness (3 items)	4.33 (4–5)	96.7%	3.3%	0
Information quality (5 items)	4.60 (4–5)	96.8%	3.2%	0

[a]Items included positive statements about the training and rated from 1- strongly disagree to 5- strongly agree. [b]% of responses with "4- agree" or "5- strongly agree".

Table 5. Changes in knowledge and confidence scores at T1, T2 and T3 compared to T0.

Scores	T0 (N = 56)	T1 (N = 48)	T2 (N = 45)	[a]p for overall difference	[b]p for difference T1 to T2		T3 (N = 29)	[c]p for difference T0 to T3	
					Z value	p-Value		Z value	p-Value
[d]Overall knowledge (1–5), Median (IQR)	2.8 (1.2)	4.4 (0.9)	4.0 (1.0)	≤0.001	2.22	0.026	4.0 (1.2)	4.71	≤0.001
Sit/stand and health	3.0 (1.2)	4.0 (1.0)	4.0 (0.6)	≤0.001	1.14	0.252	4.0 (1.5)	4.07	≤0.001
Sit/stand behaviour	2.6 (1.3)	5.0 (1.0)	4.0 (0.7)	≤0.001	2.90	0.004	4.0 (1.5)	4.50	≤0.001
SSW benefits	2.5 (1.0)	5.0 (1.0)	4.0 (0.6)	≤0.001	3.01	0.003	4.0 (1.0)	4.49	≤0.001
SSW adjustment	3.3 (1.5)	4.3 (1.0)	4.0 (1.0)	≤0.001	1.38	0.166	4.0 (1.0)	4.58	≤0.001
[e]Overall confidence (1–5), Median (IQR)	3.3 (1.4)	4.6 (1.0)	4.3 (0.8)	≤0.001	0.96	0.338	4.4 (0.9)	4.21	≤0.001
Sit/stand behaviour	3.3 (1.3)	4.6 (1.0)	4.3 (1.0)	≤0.001	1.27	0.202	4.6 (1.0)	4.15	≤0.001
SSW adjustment	3.5 (1.4)	4.6 (1.0)	4.2 (1.0)	≤0.001	0.59	0.555	4.5 (1.0)	4.11	≤0.001

[a]Friedman Test results, significant ($p < 0.05$). [b]Bonferroni adjustment applied to Wilcoxon sing-rank test, significant ($p < 0.017$). [c]Wilcoxon sign-rank test, significant ($p < 0.05$). [d]Knowledge was rated from 1-very poor to 5-very good. [e]Confidence items were rated from 1-Not confident at all to 5-completely confident.

The exploratory analyses showed similar findings were observed at 12 months (Supplemental Material 5).

3.8. Sit-stand interactive guide – learning application

A total of 33 (72%) participants returned their sit-stand guide. Almost half of these participants reported achieving their SMART goals occasionally ($n = 15$, 45.5%), some most of the time ($n = 9$, 27.3%) or half of the time ($n = 6$, 18.2%), while a minority never achieved their SMART goals ($n = 3$, 9.1%). Based on the returned sit-stand interactive guide data, all participants set goals of reducing sitting time by an average of 27% (SD = 12.3) (~2.1 h/8-h workday) and increasing their standing and moving time by 19% (SD = 9.7) (~1.5h/8-h workday) and 7% (SD = 9.6) (35 min/8-h workday), respectively. The most common strategies chosen for using the sit-stand workstation were: setting a timer on the phone, computer, or smartwatch as a reminder to stand up (20/33, 60.6%); standing when feeling tired and/or uncomfortable (18/33, 54.5%); and, raising the desk at the end of the day ahead of the next work day (16/33, 48.5%). The top three strategies selected by employees for taking active breaks were: drinking more water with additional trips to the water cooler or bathroom (18/33, 54.5%); eating lunch away from the desk (17/33, 51.3%); and taking a gentle arm, back and leg stretches between sitting and standing (15/33, 45.5%) (Table 9).

3.9. Sensitivity analyses

Some of the paired models to address the primary aim did not meet the assumptions of the paired t-test, displaying non-normality in the form of excessive kurtosis, but not excessive skewness. Alternative non-parametric test (Wilcoxon signed rank test) results are provided as Supplemental Material 6. All of these tests, bar one, showed the same conclusions as the paired t-tests, which were presented despite the limitations to help better compare the results across outcomes. The exception was for neck pain, where the paired t-test had shown a modest and non-significant ($p = 0.09$) reduction in mean neck pain of 3.5 [2.6] at T0 to 3.0 [2.5] at T2, whereas this reduction was significant on the Wilcoxon signed rank test ($z = -2.01$, $p = 0.04$), with a median of 4.0 (IQR = 5.0) at T0 dropping to 2.0 (IQR = 3.0) at T2.

4. Discussion

The Sit-Stand *e*-Guide is a novel *e*-training program that was co-designed and developed to support the appropriate use of SSWs from both ergonomics and behavioural change aspects. This study reported on the pilot testing of this *e*-training within a single organisation in terms of its usability, acceptability, usefulness and short (4 weeks – primary endpoint) and long-term (12 months) impact on behaviour, musculoskeletal and general health, and work performance. The findings showed that the Sit-Stand *e*-Guide was highly usable and acceptable, with the training resulting in a significant increase in employees' knowledge and confidence in relation to sedentary behaviour and SSWs. Employees significantly decreased their sitting time at work and increased their standing time and their usage of their SSW 4 weeks after the training compared to baseline. The findings also showed a significant decrease in self-reported low back pain at 4 weeks after the training compared to baseline with

Table 6. Behaviour changes at four weeks post-training compared to baseline (T2 vs T0) for working from the workplace, working from home and overall.

Scores	T0 (*N* = 42)	T2 (*N* = 42)	Change (T2–T0) 95% CI	d[a]	*p*-Value
SSW transitions, *n* transition/day, mean (SD)					
Overall (*n* = 45)	1.4 (1.4)	2.8 (1.7)	1.4 [0.9; 1.9]	0.91	**0.001**
WFW (*n* = 45)	1.4 (1.4)	2.8 (1.7)	1.4 [0.9; 1.9]	0.88	**0.001**
WFH (*n* = 6)	1.7 (1.6)	3.2 (2.2)	1.6 [0.7; 2.4]	1.97	**0.005**
Use of the upright position, %/day, mean (SD)					
Overall (*n* = 45)	12.0 (14.8)	20.2 (12.8)	8.2 [4.8; 11.7]	0.71	**0.001**
WFW (*n* = 45)	11.9 (14.7)	20.0 (12.8)	8.1 [4.6; 11.6]	0.70	**0.001**
WFH (*n* = 6)	21.6 (22.5)	25.0 (16.7)	3.3 [−10.2; 16.9]	0.26	0.555
#OSPAQ overall, %, mean (SD)					
Sitting	75.7 (16.8)	66.7 (15.9)	−9.0 [−14.5; −3.5]	−0.51	**0.002**
Standing	12.7 (13.5)	20.1 (12.0)	7.3 [3.1; 11.5]	0.54	**0.001**
Moving	11.6 (9.0)	13.3 (9.3)	1.6 [−1.1; 4.4]	0.19	0.234
OSPAQ WFW (*N* = 42), %, mean (SD)					
- Sitting	75.6 (17.3)	65.3 (15.7)	−10.2 [−15.5; −4.9]	−0.60	**0.001**
- Standing	12.7 (13.4)	20.6 (11.5)	7.9 [3.8; 11.9]	0.60	**0.001**
- Moving	11.7 (9.8)	14.1 (9.7)	2.4 [−0.5; 5.2]	0.26	0.101
OSPAQ WFH (*N* = 13), %, mean (SD)					
Sitting	80.0 (13.2)	73.4 (16.9)	−6.8 [−16.7; 3.4]	−0.40	0.177
Standing	9.6 (9.0)	16.9 (16.1)	7.3 [−1.3; 15.9]	0.51	**0.089**
Moving	10.4 (9.0)	9.7 (6.5)	−0.6 [−5.8; 4.5]	−0.08	0.782
#Overall sitting accumulation mean (SD)					
% Sitting in prolonged unbroken bouts	69.0 (24.8)	51.9 (27.9)	−17.1 [−26.0; −8.1]	−0.60	**0.001**
Standing/stretch breaks in 1h sitting (1–5)	1.1 (1.1)	1.7 (1.1)	0.5 [0.1; 1.0]	0.37	**0.022**
#Sitting strategy frequency (0–10)	1.4 (0.7)	3.7 (3.9)	2.2 [1.0; 3.5]	0.57	**0.001**
Sitting strategy variety (0–16)	5.7 (2.9)	8.5 (3.0)	2.8 [1.0; 3.5]	0.98	**0.001**
WFW sitting accumulation mean (SD)					
% Sitting in prolonged unbroken bouts	69.0 (24.8)	51.9 (27.9)	−16.1 [−25.7; −6.6]	−0.53	**0.001**
Standing/stretch breaks in 1h sitting (1–5)	1.1 (1.1)	1.7 (1.1)	0.6 [0.1; 1.1]	0.40	**0.012**
Sitting strategy frequency (0–10)	1.5 (0.7)	4.1 (5.2)	2.6 [1.0; 4.3]	0.50	**0.002**
Sitting strategy variety (0–16)	6.5 (2.8)	9.7 (2.9)	3.2 [2.0; 4.3]	0.88	**0.001**
WFH sitting accumulation mean (SD)					
% Sitting in prolonged unbroken bouts	73.8 (25.3)	48.8 (33.0)	−25.0 [−43.3; −6.6]	−0.82	**0.012**
Standing/stretch breaks in 1h sitting (1–5)	1.7 (1.4)	1.6 (1.4)	−0.1 [−0.6; 0.5]	−0.08	0.776
Sitting strategy frequency (0–100)	1.4 (0.8)	1.9 (1.0)	0.4 [0.1; 0.8]	0.76	**0.018**
Sitting strategy variety (0–16)	5.1 (2.8)	6.8 (3.4)	1.7 [0.2; 3.3]	0.70	**0.026**

WFW: work from the workplace; WFH: work from home. #The overall scores and/or % are calculated using weighted average scores from working from at the workplace or from home. [a]Size of change expressed as a Cohen's d (<0.2 = small, 0.2–0.5 = moderate, 0.5–0.8 = large, >0.8 = very large effect).

no significant changes in work performance or general health found. Collectively, these findings indicate that the Sit-Stand *e*-Guide is fit-for-purpose and, with some slight modifications, ready for broader implementation and evaluation.

4.1. Usability, acceptability and usefulness

One of the main aspects of evaluating training is gaining users' feedback on the usability and usefulness of the content. Existing online office ergonomics training programs have rarely assessed these aspects (Zerguine et al. 2023). The Sit-Stand *e*-Guide received high usability, acceptability and usefulness scores from users. Although these high scores may not necessarily mean that the training would be effective, they are an important indicator of training quality and success (Kirkpatrick and Kirkpatrick 2016). Learners' engagement is a fundamental aspect of *e*-learning/online training success-related knowledge attainment and skill acquisition (Gegenfurtner, Zitt, and Ebner 2020). Further, users' feedback helped in identifying the strengths, weaknesses and gaps in the design, content, and learning activities that could help in improving the *e*-training for future use. One of the aspects that received a poorer rating from participants was the learning activities. Although a variety of learning activities (e.g. scenarios, reflections, sorting activities) based on behavioural change strategies were used, the choice of these activities was based on the limitations of the authoring tool (Articulate Rise) and the web hosting of the training program. This limitation may be improved if the training is hosted in an alternate learning management system. The learning management system enhances the delivery of training programs and materials and offers flexibility in the type of learning activities and embedded assessments in the training (Cavus and Alhih 2014). Further, a different learning management system could also solve some of the technical difficulties that participants reported when completing the training (such as video playing, and progress through the training). Future research could

Table 7. Changes in musculoskeletal and general health at four weeks post-training compared to baseline (T2 vs T0).

Scores	T0 (*N* = 45) Mean (SD)	T2 (*N* = 45) Mean (SD)	Change 95% CI	d[a]	*p* Value
[b]Musculoskeletal discomfort (0–10)					
Neck/shoulder pain	3.5 (2.6)	3.0 (2.5)	−0.5 [−1.2; 0.1]	−0.26	0.091
Arm pain	1.0 (1.5)	1.2 (1.5)	0.1 [−0.5; 0.7]	0.05	0.712
Hands and finger pain	1.6 (2.0)	1.4 (1.9)	−0.1 [−0.8; 0.5]	−0.06	0.685
Upper back pain	2.1 (2.4)	2.3 (2.4)	0.1 [−0.6; 0.7]	0.03	0.845
Lower back pain	3.4 (2.5)	2.4 (2.3)	−1.0 [−1.7; −0.4]	**−0.47**	**0.003**
Hips pain	2.7 (2.7)	1.9 (2.4)	−0.8 [−1.4; −0.1]	**−0.36**	**0.019**
Buttocks pain	2.0 (2.2)	1.4 (1.7)	−0.6 [−1.1; −0.1]	**−0.34**	**0.026**
Legs pain	1.7 (2.0)	1.8 (1.7)	0.1 [−0.6; 0.8]	0.04	0.797
Feet pain	2.3 (2.4)	1.8 (1.9)	−0.5 [−1.2; 0.1]	−0.55	0.090
[b]Discomfort with SSW (0–10)					
In general	2.1 (1.9)	2.0 (1.9)	−0.1 [−0.7; 0.4]	−0.08	0.602
In the seated position WFW	2.6 (2.3)	2.2 (2.1)	−0.4 [−1.0; 0.2]	−0.20	0.210
In the seated position WFH	1.8 (1.9)	2.0 (2.2)	0.2 [−0.4; 0.8]	0.15	0.487
In the upright position WFW	2.2 (2.0)	2.0 (1.9)	−0.2 [−0.7; 0.4]	−0.11	0.516
In the upright position WFH	1.3 (1.7)	1.6 (1.6)	0.2 [−0.5; 0.9]	0.16	0.509
[c]Physical health (1–5) ((1 item)	2.9 (0.9)	3.0 (0.9)	0.1 [−0.1; 0.4]	0.15	0.323
[c]Mental health (1–5) (1 item)	3.1 (1.1)	3.2 (1.0)	0.1 [−0.1; 0.4]	0.14	0.349

WFW = Work from the workplace, WFH = Work from home. [a]Size of change expressed as a Cohen's d (<0.2 = small, 0.2–0.5 = moderate, 0.5–0.8 = large, >0.8 = very large effect). [b]Discomfort was rated from 0 (no discomfort) to 10 (worst discomfort imaginable). [c]Physical and mental health were rated from 1 (poor) to 5 (excellent).

Table 8. Changes in work outcomes at four weeks post-training compared to baseline (T2 vs T0).

Work outcomes	T0 (*N* = 46) Mean (SD)	T2 (*N* = 46) Mean (SD)	Change (95% CI)	d[a]	*p*-Value
[b]Absolute absenteeism: *missed expected hours over 4 weeks*	−5.8 (40.2)	5.6 (56.0)	11.4 [−8.3; 31.2]	0.17	0.249
[c]Relative Absenteeism: *missed hours as a proportion of expected*	−0.2 (0.9)	−0.1 (0.7)	0.1 [−0.2; 0.5]	0.12	0.439
[d]Absolute Presenteeism: *Work performance (0 worst −100 top)*	72.4 (12.1)	69.8 (12.9)	−2.6 [−6.1; 0.7]	−0.24	0.123
[i]Relative Presenteeism: *Work performance vs others (performance/performance of usual workers)*	1.0 (0.1)	1.0 (0.2)	0.1 [−0.1; 0.1]	0.12	0.441

[a]Size of change expressed as a Cohen's d (<0.2 = small, 0.2–0.5 = moderate, 0.5–0.8 = large, >0.8 = very large effect). [b]Absolute absenteeism has a negative lower bound (if the person works more than expected) and an upper bound equal to the number of hours the person is expected to work. [c]Relative absenteeism ranges between a negative number (works more than expected) and 1.0 (always absent). [d]Absolute presenteeism has a lower bound of 0 (total lack of performance during the time on the job) and an upper bound of 100 (no lack of performance during the time on the job). [i]Relative presenteeism ranges between 0.25 as the worst relative performance (25% or less of other workers' performance) and 2.0 as the best performance (200% or more of other workers' performance).

investigate the user experience under different learning management systems.

In terms of the training content, participants were highly satisfied, with a few recommending greater details on chair selection for workers of varying anthropometrics (e.g. taller and shorter workers). These topics will be considered in the next iteration of the training. The content related to troubleshooting (Module 4) was ranked the least engaging and useful. As this was not unexpected, possible explanations might be because the module was optional, it did not include interactive learning activities or was only relevant to workers with an interest in the topics included. The different skills that employees were hoping to improve seemed to be covered in the training. Participants set high expectations about the training, and the preliminary results indicate that these expectations were met with the Sit-Stand *e*-Guide.

4.2. Knowledge and confidence

Interviews with desk-based workers (Ojo et al. 2019) and workplace furniture purchasing decision-makers (Zerguine et al. 2021) identified a lack of knowledge as a barrier to breaking up sitting time. In the current study, participants' knowledge and confidence from the *e*-training significantly improved immediately after the training, with this improvement maintained at 4 weeks and at 12 months after the training. Participants improved their knowledge and confidence in both the behavioural and physical ergonomics aspects of SSWs. These findings are broadly similar to previous studies that provided office ergonomics training programs delivered online (Dalkılınç and Kayihan 2014) or face-to-face (Robertson et al. 2009). Here, an evaluation of an *e*-learning office ergonomics training program found a significant

Table 9. Strategies for SSWs and taking active breaks reported in the sit-stand interactive guide ($N = 33$).

Strategies for using SSW	*n* (%)[a]
Set a timer on my phone, computer, or smartwatch to remind me to stand up	20 (60.6%)
Stand when feeling tired and/or uncomfortable.	18 (54.5%)
Raise my desk at the end of the day to help remind me to start standing each morning	16 (48.5%)
Stand up at regular intervals	14 (42.4%)
Raise my desk when leaving the room or taking breaks.	12 (36.4)
Stand up for each phone call (consider ordering a headset).	8 (24.2%)
Stand up when visiting a colleague at their desks.	7 (21.2%)
Stand up for checking or writing emails	6 (18.2%)
Stand up after completing a work task.	5 (15.2%)
Stand together whilst speaking	4 (12.1%)
Raise my desk when colleagues come to talk to me.	2 (6.1%)
Strategies for active breaks	
Drink more water so you have to go to the water cooler (and bathroom) more often	18 (54.5%)
Eat my lunch away from my desk	17 (51.3%)
Take gentle arms, back and leg stretches between sitting and standing	15 (45.5%)
Walk to my colleague's desk instead of phoning or emailing	13 (39.4%)
Go for a short walk after finishing a certain task	13 (39.4%)
Take regular short walk breaks outside the building	10 (30.3%)
Walk to the printer/fax/photocopier/rubbish bin	7 (21.2%)
Vary my work tasks to change posture frequently throughout the day	7 (21.2%)
Go for a short walk at lunchtime	6 (18.2%)
Walk-and-talk – Have walking meetings when you can	3 (9.1%)
Stand up during meetings	3 (9.1%)
Stand at the back of the room during long presentations	3 (9.1%)
Take part in lunchtime stretches/exercise sessions	3 (9.1%)

[a]The percentage of respondents ($N = 33$).

increase in office ergonomics knowledge scores immediately after the training (Dalkılınç and Kayihan 2014). Similarly, Robertson et al. (2009) delivered training via a multimedia slide presentation with a practice session, reporting a significant increase in knowledge of overall office ergonomics, posture, and workstation adjustment. Knowledge in both studies was developed based on the content of the training delivered and assessed at baseline and immediately after the training. The sustained improvements in knowledge and confidence observed in the current study reflects the relevance and quality of the *e*-training. The suitability of the learning activities within the training was based on learning theories (Ertmer and Newby 2013) and best practices in pedagogy (Khalil and Elkhider 2016) resulting in enhanced knowledge retention.

4.3. SSW usage and sitting, standing and moving behaviour

The training resulted in a significant beneficial change in sedentary behaviour and the use of SSWs. This suggests that there was a meaningful translation of knowledge and confidence into application. Similar conclusions were drawn in a previous study that evaluated the impact of an *e*-learning office ergonomics program, with a significant increase in employees' knowledge of office ergonomics leading to significant changes to working posture and workstation adjustment 45 days after completing the training (Dalkılınç and Kayihan 2014). The Sit-Stand *e*-Guide resulted in an increase in both the number of SSW transitions and the use of the upright position, with sitting time showing the greatest beneficial change in behaviour. These behavioural changes are consistent with previous research that evaluated SSW training programs (Riddell and Callaghan 2020; Robertson, Ciriello, and Garabet 2013). A training intervention of a 1.5 h lecture on SSW use resulted in an increase in the use of the standing option of the desk, with participants standing 60 min longer 15 days after the training compared to pre-training (30 min) (Robertson, Ciriello, and Garabet 2013). Similar results were found by Riddell and Callaghan (2020) who tested a 3h comprehensive SSW training program and found a significant increase in sit-stand transitions and a significant decrease in sitting time (53%) 4 weeks after the intervention compared to baseline (80%). Sit-stand transitions in that study were measured objectively using an accelerometer attached to each participant's desk and sitting time was assessed using the OSPAQ questionnaire. Thus, SSWs accompanied with training programs have often resulted in positive changes in sedentary behaviour and the use of SSWs with comprehensive training resulted in greater changes.

Importantly, the current study also explored the long-term (12 months) impacts of the training. Although generally remaining in a beneficial direction, the level of change did regress towards the baseline, though remained statistically significant for breaks in sitting time and the number of sitting-reduction strategies. This reduction in effectiveness in the long term is consistent with other workplace sitting-reduction interventions, including those of SSWs (Chambers, Robertson, and Baker 2019). Notably, multicomponent interventions, which incorporate SSWs, have been shown to be the most effective on behaviour when combined with individual and organisational level support for change (Shrestha et al. 2018). Thus, these results suggest that the multiple levels of influence on behaviour (e.g. organisational, social environment, intrapersonal) need to be addressed to achieve the cultural support needed for sustained change. Staff may also benefit from a regular training refresher, such as on a yearly basis, to support this change. Future research could explore the acceptability and frequency of such training boosters.

Prolonged sitting is considered an important hazard to address in the workplace (Healy et al. 2012), and this has significantly decreased in this study from 69% to 52% per workday. Participants indicated using a greater variety of strategies to break up their sitting time, with these strategies used more frequently after the training as compared to baseline (from once per day at T0 baseline to almost four times per day 4 weeks after the training). These results were anticipated given employees were provided with a range of strategies in the sit-stand interactive PDF guide to use their SSW and take regular active breaks. Further, the greater variance in sitting strategies can be explained by the individualised aspect of sedentary behaviour; employees may choose a specific strategy based on personal preferences, the task performed or their health condition. This aspect has been reflected in a previous study that conducted focus groups with employees with SSWs who revealed using the standing option depending on the task/activity they perform, the time of the day (e.g. early morning, afternoon) or discomfort threshold (e.g. pain, fatigue) (Wilkerson, Bhochhibhoya, and Dragicevic 2021). Practically, this suggests employees should be provided with a menu of strategies for using their SSWs and taking regular breaks relevant to the task performed, SSW types and work schedules and environment (Stephens et al. 2018).

4.4. Musculoskeletal health and work performance

A significant decrease in musculoskeletal discomfort was reported in the lower back, hips, and buttocks after 4 weeks. These findings are consistent with a previous study showing that employees who were trained on the use of their SSWs had less discomfort in the lower back region compared to those who did not receive training (Robertson, Ciriello, and Garabet 2013). This reduction in low back discomfort is supported by current evidence from a systematic review of laboratory-based studies that identified that the use of SSWs led to a significant reduction in low back pain (Agarwal, Steinmaus, and Harris-Adamson 2018). Interestingly, the decrease in hips and buttocks discomfort has not been identified in previous studies. Discomfort in these areas may be related a poor adjustment of the chair and prolonged seated posture (Curran et al. 2015). A possible explanation in this study is that employees may have not been aware of the proper adjustment of their chair which was improved following guidance provided in the Sit-Stand *e*-Guide. Further, this decrease in discomfort might also be linked to less time spent sitting and the increased use of the standing option of their desk that eased hips and buttocks discomfort. Overall, although proper adjustment of the workstation is an important aspect in preventing some musculoskeletal problems in office workers (Amick et al. 2003; Hoe et al. 2018), it is worth acknowledging the complexity and the multifactorial nature of musculoskeletal problems (Macdonald 2012). It is also worth noting that changes had largely returned to baseline by 12 months. Practically, this suggest a more holistic approach using a system-based framework needs to be applied to address work-related sources of musculoskeletal problems including the physical, psychosocial and organisational aspects (Macdonald and Oakman 2015).

For work outcomes, there were no significant or large changes found in absenteeism and work performance in either the short or long term after training. Similar findings were reached in Robertson, Ciriello, and Garabet (2013) study that provided a 1.5h training program on SSW and found no significant differences in performance outcomes between trained and untrained groups after 15 days. This is also consistent with the findings from a scoping review that investigated the effects of SSWs as part of multicomponent interventions, which found that out of the 21 studies that assessed work outcomes, only four found a significant positive impact of SSW on work performance (Chambers, Robertson, and Baker 2019). Importantly, several systematic reviews have also shown that the use of SSWs has no negative impact on work performance and productivity (Chau et al. 2010; Chu et al. 2016; Commissaris et al. 2016; Gardner et al. 2016; Neuhaus et al. 2014; Shrestha et al. 2018; Tew et al. 2015), noting that the majority of studies were conducted in a laboratory-based setting with more studies needed in a real-world setting. There is also an inconsistency in the measurement tools of productivity and work outcomes in these studies with work performance often assessed based on the number of hours worked and total volume and/or quality of work (Karakolis and Callaghan 2014). For a better understanding of the impact of the use of SSWs on work outcomes, future studies need to address other aspects of work outcomes such as engagement, satisfaction, communication, or creativity. Further, these findings may be somewhat linked to the several limitations of the HPQ questionnaire (Koopmans, Bernaards, et al. 2014). The short recall period (7 days) in the HPQ questions may reduce the statistical power and introduce some amount of bias in responses, while the low responsiveness may be due to ceiling and floor effects in the scales (Koopmans, Coffeng, et al. 2014).

4.5. Strengths and limitations

A strength of this study was that it tested a novel *e*-training program in a non-experimental (i.e. free-living) environment, and participants were employees who had all been provided with similar SSWs by their organisation. Most previous studies were laboratory-based or conducted with workers who had been provided with a SSW as a part of an intervention. The collection of free-living data enhances the external validity of the findings. Another strength of this study was the relatively low dropout (8% immediately; 20% at 4 weeks) with no attrition bias observed. The exploration of the long-term impacts provides insights into the sustainability of the training effects, noting that there were differences in the characteristics of those who remained in the study at 12 months.

This study has several important limitations. The most obvious limitation is the study design without a control group. Although appropriate for this exploratory phase, which was intended to provide preliminary data on the training program and inform the design of further studies, it does threaten the internal validity of the study and limits the conclusions that can be drawn on the impact/effectiveness of the training. The analysis of the OSPAQ questions did not consider their compositional nature (i.e. change in one behaviour would necessarily result in change in another). Moreover, this pilot test evaluation has only occurred at a single workplace with a sample of 57 participants which limits the generalisability of findings to other workplaces and organisations. Selection bias could have also occurred since participation was voluntary, and individuals interested in the *e*-training program may have been more inclined to take part in the study. However, it is noteworthy that, apart from the observed higher representation of female staff (75.4%) compared to the overall female representation within the organisation (46.4%), the age (mean 45.3 years), employment status (full-time 87.7%), and tenure (>3 years 56%) of the study participants did not differ significantly from the demographics of the entire workforce of organisation (mean age 43.5 years; full-time 85.5%; >3 years 57.6%). Further, all measures were self-reported, which are subject to recall, social desirability or response bias. Recall bias may have affected the accuracy of the data collected, particularly if participants had difficulty remembering their behaviours over time. Social desirability bias may have led to overreporting of engagement in the *e*-training program or underreporting of sedentary behaviours. Response bias may have also influenced the results if participants provided answers that were not truthful or accurate. Future evaluation should therefore consider using objective measures such as activity monitors to assess sitting, standing, and moving time as well as desk devices to record an accurate usage of the desk (e.g. number sit/stand transitions during the day). Further, the results from this study should not be regarded as universally applicable until the *e*-training undergoes broader evaluation with a more diverse sample of workplaces from different industry sectors and ultimately different countries. This will help better understand the adaptability of the training to different cultural contexts.

5. Conclusion

This pilot implementation and evaluation study provides important insights into the Sit-Stand *e*-Guide and the merits of undergoing further evaluation. This novel *e*-training program received positive feedback from employees regarding its usability and acceptability. Notably, the training resulted in a significant reduction in sitting time, enhanced the use of SSWs and led to a reduction in the lower back, buttocks and hips discomfort over 4 weeks, with some of these changes maintained at 12 months. These promising findings underscore the importance of advancing to the next phase of a large-scale evaluation of the *e*-training across a diverse range of organisations from different sizes and industry sectors. This phase will help better understand the adaptability of the *e*-training to different cultural contexts and prepare the Sit-Stand *e*-Guide for broader uptake.

Acknowledgements

The authors acknowledge Dr Elisabeth Winkler for providing high-level expertise and advice on the development of measures and data analysis in this study. The authors are also grateful for the support provided by the OHS team at the municipal organisation to host the training and all staff who volunteered their time to participate in the evaluation.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

HZ was supported by The University of Queensland Research Training Scholarship. GNH is supported by the Australian Medical Research Future Fund (MRFF) Emerging Leadership Fellowship [#1193815]. A Medibank Better Health Foundation grant [R14-0984] was accessed to support consultation with learning design and training for the researcher HZ.

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