Ergonomics

ISSN: 0014-0139 (Print) 1366-5847 (Online) Journal homepage: https://www.tandfonline.com/loi/terg20

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**To cite this article:** Cheryl Haslam, Aadil Kazi, Myanna Duncan, Stacy Clemes & Ricardo Twumasi (2019) Walking Works Wonders: a tailored workplace intervention evaluated over 24 months, Ergonomics, 62:1, 31-41, DOI: 10.1080/00140139.2018.1489982

**To link to this article:** https://doi.org/10.1080/00140139.2018.1489982



Published online: 01 Nov 2018.

ERGONOMICS
2019, VOL. 62, NO. 1, 31–41
https://doi.org/10.1080/00140139.2018.1489982

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# Walking Works Wonders: a tailored workplace intervention evaluated over 24 months

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**ABSTRACT**

This article presents longitudinal data from 1120 participants across 10 worksites enrolled in Walking Works Wonders, a tailored intervention designed to increase physical activity and reduce sedentary behaviour. The intervention was evaluated over 2 years, using a quasi-experimental design comprising 3 conditions: tailored information; standard information and control. This study explored the impact of the intervention on objective measures (BMI, %Fat, waist circumference, blood pressure and heart rate) and self-reported measures of physical activity, sedentary behaviour, physical and psychological health. Interventions tailored to employees' stage of change significantly reduced BMI and waist circumference compared to standard and control conditions. Employees who received either a standard or tailored intervention demonstrated significantly higher work ability, organizational commitment, job motivation, job satisfaction and a reduction in intention to quit the organization. The results suggest that adopting a tailored approach to interventions is particularly effective in terms of improving health in the workplace.

**Practitioner Summary:** This study describes Walking Works Wonders, a tailored intervention, which aims to encourage physical activity in the workplace. The study evaluated Walking Works Wonders over a 2 year period and demonstrated that interventions are more effective in improving health outcomes where the information is tailored to employees' stage of change.

**Abbreviations:** BMI: Body mass index; DBP: Diastolic blood pressure; GHQ: General Health Questionnaire-12; GP: General Practitioner; HR: Resting heart rate; ITQ: Intention to quit; IPAQ: International Physical Activity Questionnaire; JM: Job motivation; JS: Job satisfaction; MET: Metabolic equivalent intensity level; OC: Organisational commitment; ONS: Office for National Statistics; OPAQ: Occupational Physical Activity Questionnaire; SBP: Systolic blood pressure; WAI: Work Ability Index; WC: Waist circumference

**ARTICLE HISTORY**
Received 24 January 2018
Accepted 12 June 2018

**KEYWORDS**
Stage of change; tailored workplace intervention; physical activity; sedentary behaviour

## Introduction

We are experiencing a sitting epidemic in the workplace, with ever-growing numbers of people employed in sedentary occupations spending much of their working day sitting.

This is a major public health issue as sedentary behaviour is associated with an increased risk of premature mortality (Wilmot et al. 2012; Biswas et al. 2015). Research has demonstrated that, even in physically active individuals, prolonged sitting is associated with an increased risk of premature mortality (Katzmarzyk et al. 2009). Sedentary behaviour is also an established risk factor for a wide range of chronic health conditions including obesity, diabetes, cardiovascular disease and cancer (Hamilton, Hamilton, and Zderic 2007; Gierach et al. 2009; Katzmarzyk et al. 2009; Lynch 2010; van Uffelen et al. 2010; Proper et al. 2011; Wilmot et al. 2012; Chau et al. 2013).

As work provides a major contribution to sedentary time on work days, the workplace has been highlighted as a key setting for interventions designed to reduce sedentary behaviour (Kazi 2013; Kazi et al. 2014; Mansoubi et al. 2014). Walking Works Wonders is a new tailored intervention designed to increase physical activity and reduce sedentary behaviour at work. It was evaluated over a 2-year period in 10 worksites across the UK. The longitudinal study investigated changes in physiological

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and psychological outcomes (measured at 6 monthly intervals), and this article presents the data across the 5 time-points: baseline, 6 months, 12 months, 18 months and 24 months.

The Walking Works Wonders intervention involves tailoring health information according to employee's readiness to change. This approach is based on the Stage of Change Model (Prochaska and DiClemente 1982, 1983) which was originally developed within the context of smoking cessation. The model assumes that behaviour change involves movement through stages:

i. precontemplation (resistance to recognising or modifying problem behaviour)
ii. contemplation (thinking about changing, but not ready to act)
iii. preparation (intending to change in the next 30 days, and/or having made plans to do so)
iv. action (changed behaviour, no longer than 6 months ago)
v. maintenance (changed over 6 months ago, working to consolidate gains made and avoid relapse)

According to the model, stage determines receptiveness to (and the effectiveness of) health education. Individuals in the pre-contemplation stage require information about the health risks associated with their current behaviour whilst those in later stages (contemplation/preparation) need practical advice on how to change their behaviour. The model has been applied to a wide range of health-related behaviours including: smoking cessation (Prochaska et al. 1993; Andersen and Keller 2002); maternal smoking cessation (Haslam 2000; Haslam and Draper 2000; Haslam and Lawrence 2004); exercise (Marshall and Biddle 2001; Kirk et al. 2003) and dietary behaviours (Povey et al. 1999).

Following the successful application of the stage of change model to community health interventions, calls were made to apply the model to workplace interventions (Haslam and Haslam 2001; Haslam 2002). Whysall, Haslam, and Haslam (2005) developed a tool for assessing employee stage of change and used this to determine if tailored ergonomic interventions are more effective in reducing musculoskeletal disorders than standard ergonomic approaches. They demonstrated that tailored interventions were significantly more effective in changing behaviour and reducing musculoskeletal disorders in a diverse range of workplace settings (Whysall, Haslam, and Haslam 2006, 2007). Rothmore et al. (2017) investigated compensable injuries among workers who had received ergonomics advice tailored to stage of change compared to standard ergonomics advice. They demonstrated that those given tailored advice were less likely to report a compensable injury than those given standard advice.

Walking Works Wonders was developed through extensive user engagement, with employees, managers and representatives from occupational health, and the intervention adopted a stage of change approach (Kazi 2013). An initial evaluation of Walking Works Wonders (Kazi 2013) examined the impact of the intervention over 12 months. This paper provides an evaluation of Walking Works Wonders over the intervention period (12 months) and a further 12 months follow-up.

Health information was provided to employees through leaflets which offered standard or tailored advice. The leaflets were supplemented by posters, physical activity challenges and interactive environmental prompts. All additional site posters/challenges/environmental prompts were standardised. Only the leaflets given specifically to each employee were tailored to the stage of change. In order to test the effects of tailoring information, a quasi-experimental design was used with 3 conditions: standard information; staged information and control group. The research objectives were to:

1. Implement an intervention aimed at increasing physical activity and reducing sedentary behaviour in the workplace
2. Collect longitudinal repeated measures data (the same pre-determined outcome measures collected at baseline) at 6 months (mid-intervention) 12 months (end of the intervention) plus follow-up measures at 18 and 24 months to evaluate the long-term effectiveness of the intervention
3. Identify whether significant differences exist between changes in the outcome measures for the conditions (standard, staged and control)

## Methods

The intervention was evaluated using a quasi-experimental design with 5 measurement time-points over a period of 2 years.

### *Study design*

Results from randomised control trials are regarded as the gold standard in the hierarchy of research designs. However, research away from laboratories with real people in societies and social structures provides many challenges for evaluating the effectiveness of an

intervention. Research in organizations makes it virtually impossible to randomly allocate employees to different conditions, and a pragmatic approach to this intervention was adopted. WWW investigated whether an occupational physical activity intervention can be tailored to target health information according to an individual's readiness to change (staged intervention condition), and if this approach would be more effective than providing standard information (standard intervention condition), or no information at all (control condition). The 10 worksites were allocated to 1 of 3 conditions: staged intervention, standard intervention or control group (to ensure that no cross-contamination of material was possible between employees).

In the staged (tailored) condition, the health information was tailored according to recipients' readiness for change. Individuals thinking about increasing their levels of physical activity (contemplation/preparation) were provided with leaflets describing the benefits of physical activity and offering practical tips to increase daily levels of walking. Those not thinking about increasing their physical activity levels (pre-contemplation) were targeted with leaflets containing awareness raising information about the risks of inactivity. In the standard condition, participants received leaflets which offered generic physical activity advice already available via health promotion organisations. Those in the control group received no intervention material.

For the 2 intervention conditions (staged intervention and standard intervention), in addition to the leaflets administered at baseline and at 6 months, employees were encouraged to increase physical activity levels during the 12-month period via a series of themes introduced every few months. These themes included step count competitions, stair climbing, active commuting (themes were communicated to employees via emailed posters) and a new innovation entitled Walking Lunch. This involves placing a large map (1 metre diameter pinboard) on the wall in a communal area of a work site (e.g. reception area, break room, etc.). The map has a radius of 1.5 km and displays the surrounding areas of each work site, which is located in the centre of the map. Employees were encouraged to explore areas on the map to find cafés and restaurants, parks and picnic spots, commuting and walking locations, and places of interest, and record this information on multi-coloured tags pinned to the corresponding location on the map. The activity themes and Walking Lunch were received by both staged and standard conditions; the only factor that differed between the 2 conditions was the provision of information at baseline and at 6 months being either staged/tailored information or standard/generic advice.

### Sample

Ten work sites across the UK participated in the study. A large private sector telecommunications organization selected 8 of its work sites, while a medium size public sector local authority involved both of its work sites. Employees at each site were emailed an invitation to participate prior to the recruitment visit (baseline measurement), which contained study information and participant requirements. Posters were also placed around work sites and announcements were made via newsletters. Employees were encouraged to participate in the study with the offer of a free pedometer and feedback from an independent health assessment. Participants completed a questionnaire and undertook physiological and psychological measurements, repeated across: baseline, 6 months, 12 months, 18 months and 24 months.

### Sample size

A power calculation indicated that 180 participants would be required in each of the 3 conditions: tailored, standard and control, giving a total sample of 540. The sample size was based on a power calculation for a 3 condition, case-controlled study. This sample size would be necessary to detect a reduction in BMI of 0.3 $kg/m^2$. This level of difference was chosen based on a study by Haines et al. (2007) who evaluated the effects of a worksite programme promoting walking. Anticipating a high attrition rate, the study recruited more than double the sample size indicated by the power calculation achieving a sample size of 1120.

### Questionnaire measures

A questionnaire was used to collect self-report data on psychological outcomes, physical activity levels and sitting time. The questionnaire was available for participants in paper format or online. The beginning of the questionnaire included a foreword, which on the baseline health screening assessment provided participants with an introduction to the aims of the research. On subsequent revisits, the introduction was modified to notify employees that the questionnaire was only to be completed by those who had already been recruited and were participating in the research. This notification ensured any employees who were not taking part in the research, but may have been

forwarded the web-link by a colleague, would not complete the questionnaire.

Participants were asked to record their name and email address at the beginning of the questionnaire. These details were important because the intervention materials, notifications of future health screenings and the Internet web-link to complete questionnaires for future revisits were sent via email. On the questionnaire for the revisits, participants were requested to ensure they recorded the same email address that was used to contact them by the researcher. The email address was also used to match responses for each participant with their results from previous readings. Each email address was allocated to an identification number, which ensured the results remained confidential as only the researchers had access to these details. The questionnaire comprised ten sections:

- demographic characteristics (age, gender, Office for National Statistics [ONS] job categories, and weekly and monthly hours worked)
- evaluation of participants' readiness to change their physical activity levels
- Domain Specific Sitting Time Questionnaire (Miller and Brown 2004; Marshall et al. 2010)
- International Physical Activity Questionnaire (IPAQ) (Craig et al. 2003)
- Occupational Physical Activity Questionnaire (OPAQ) (Reis et al. 2005)
- Work Ability Index (WAI) (Tuomi et al. 1988)
- General Health Questionnaire 12 (GHQ) (Goldberg and Williams 1988)
- Organizational Commitment (OC) scale (Cook and Wall 1980)
- Job Motivation (JM) scale (Warr, Cook, and Wall 1979)
- Job Satisfaction (JS) and Intention to Quit (ITQ) scales from the Michigan Organizational Assessment Questionnaire (Cammann et al. 1979).

The methods used to score the above scales are described in the companion paper Kazi et al. (2018).

Stage of change was assessed via a series of yes/no questions:

1. Are you planning to increase the amount of physical activity/exercise you do?
   a. If yes, are you planning to increase the amount of physical activity/exercise you do within the next 6 months?
   b. If yes, are you planning to increase the amount of physical activity/exercise you do within the next month?
2. Have you recently increased your levels of physical activity/exercise?
   a. If yes, did you make this change (within the last 6 months/more than 6 months ago)

Those responding 'yes' to question 1 and 'yes' to question 1a and 1b were categorised as in the preparation stage. Those responding 'yes' to 1 and 'yes' to 1a but 'no' to 1b were classed as in contemplation. Those responding 'no' to 1 and 'no' to 2 were classed as in pre-contemplation, providing their reported levels of activity were not meeting current activity guidelines. Those responding 'no' to 1 and 'no' to 2 were classed as in maintenance if their reported levels of activity were meeting activity guidelines. Those responding 'no' to 1 and 'yes' to 2 were classed as in action if they made the change less than 6 months ago or maintenance if they had made the change more than 6 months ago.

Self-reported physical activity levels were recorded using the IPAQ short version. Research has shown self-reported physical activity using the IPAQ is comparable to results using objective criterion instruments such as accelerometers (Bauman et al. 2009). The IPAQ has also been used as an outcome measure in previous intervention research (Ferreira et al. 2005). The scoring protocol for the IPAQ short was followed, which was downloaded from the IPAQ website *(sites.google.com/site/theipaq)*.

Physical activity at work was measured using a modified version of the Occupational Physical Activity Questionnaire (OPAQ). The OPAQ is a 7-item measure that identifies the average time per week spent in three occupational activity categories: (a) sitting or standing; (b) walking; and (c) heavy labour. For each category, participants were asked if they performed any of these activities and if they did, to identify the number of hours they performed each activity during a usual working week. For the purposes of this questionnaire, the question that assessed sitting or standing activities at work was edited to read standing activities at work. Sitting time at work was omitted because data on sitting time at work were collected by the Domain Specific Sitting Time Questionnaire. Participants were also asked to indicate the distance they travelled to work and their usual method of travel to work.

### *Physiological measurements*

An accurate measure of height (in centimetres) was required at each measurement time-point in order to

Table 1. Demographic means and SDs[a] for the total sample at baseline, plus gender, ethnicity, and marital status based on allocation to each intervention condition.

Means ± SD

| | Total sample | Male | Female | *p* Value *t*-tests | Standard | Staged | Control | *p* Value ANOVA |
|---|---|---|---|---|---|---|---|---|
| Age (years) | 42.2 ± 10.3 | 42.3 ± 10.4 | 41.63 ± 10.4 | 0.262 | 43.7 ± 10.1 | 42.1 ± 10.5 | 39.6 ± 9.9 | .001 |
| Height (cm) | 170.7 ± 9.8 | 177.3 ± 7.2 | 163.2 ± 6.6 | 0.001 | 172.3 ± 9.9 | 169.4 ± 9.9 | 170.9 ± 9.6 | .001 |
| Weight (kg) | 78.3 ± 16.3 | 84.7 ± 14.6 | 70.9 ± 15.1 | 0.001 | 80.8 ± 16.1 | 75.3 ± 16.3 | 79.8 ± 15.4 | .001 |
| Weekly hours | 36.4 ± 5.6 | 37.6 ± 4.6 | 35.0 ± 6.3 | 0.001 | 36.0 ± 5.4 | 36.7 ± 5.7 | 36.7 ± 5.4 | .078 |
| Monthly hours | 147.6 ± 39.5 | 154.7 ± 36.8 | 139.1 ± 40.8 | 0.001 | 146.9 ± 36.3 | 148.2 ± 41.7 | 147.3 ± 40.9 | .935 |
| Total METs p/wk | 1826 ± 1745 | 2058 ± 1868 | 1557 ± 1550 | 0.001 | 1823 ± 1817 | 1865 ± 1653 | 1749 ± 1801 | .720 |

| | | Standard | | Staged | | Control | |
|---|---|---|---|---|---|---|---|
| | | *n* | % | *n* | % | *n* | % |
| Gender | Male | 267 | 61.9 | 211 | 44.8 | 123 | 56.4 |
| | Female | 164 | 38.1 | 260 | 55.2 | 95 | 43.6 |
| Marital status | Single | 79 | 18.4 | 121 | 25.7 | 47 | 21.8 |
| | Married | 264 | 61.5 | 233 | 49.6 | 111 | 51.4 |
| | Civil Partnership | 2 | 0.5 | 4 | 0.9 | 2 | 0.9 |
| | Cohabiting | 57 | 13.3 | 72 | 15.3 | 42 | 19.4 |
| | Separated | 9 | 2.1 | 13 | 2.8 | 3 | 1.4 |
| | Divorced | 18 | 4.2 | 25 | 5.3 | 10 | 4.6 |
| | Widowed | 0 | 0.0 | 2 | 0.4 | 2 | 0.5 |
| Ethnicity | White[b] | 398 | 93.3 | 389 | 83.1 | 178 | 82.4 |
| | Asian[c] | 20 | 4.7 | 50 | 10.8 | 31 | 14.4 |
| | Black[d] | 7 | 1.5 | 20 | 4.2 | 4 | 1.8 |
| | Mixed[e] | 2 | 0.5 | 9 | 1.9 | 3 | 1.4 |

[a]Table includes significance values of the *t*-tests and ANOVA assessing gender and intervention group differences
[b]White (British, Irish, other).
[c]Asian or Asian British (Indian, Pakistani, Bangladeshi, Chinese, other).
[d]Black or Black British (Caribbean, African, other).
[e]Mixed (White and Asian, White and Black, other mixed)

calculate BMI. Height was measured (without shoes) using the Leicester Height Measure, which is a portable plastic stadiometer consisting of a footplate, four-piece vertical ruler and a movable head.

Body weight, BMI and %body fat were measured using a Tanita Body Composition Analyser (Tanita UK Ltd, Model: BC-418 MA, Middlesex, UK) that measures body fat using 8-point bio-impedance analysis. Percentage body fat measured using the Tanita BC-418 has been shown to correlate highly with the reference measure of dual-energy X-ray absorptiometry (DXA) (Pietrobelli et al. 2004). Waist circumference was assessed using anthropometric tape at the midpoint between the upper edge of the iliac crest and the inferior border of the last palpable rib.

Resting blood pressure and heart rate were measured using the validated Omron Intellisense M7 Upper Arm monitor. Two readings were taken after a period of quiet sitting; each reading was separated by a minimum of 30 seconds and the mean of the two readings used in the analyses. If the readings were significantly different, a third reading was taken to collect a more accurate average. If any abnormal readings were identified (e.g. high blood pressure), participants were provided with a referral letter that requested them to visit their GP for further consultation. If this was identified at the baseline health screening, participants were asked to confirm their GP agreed to their participation in this research, and GPs were asked to send a signed confirmation letter to the researchers.

### Data handling and analyses

Access scripting was used to match responses using the participant identification number and all data were imported into SPSS Statistics (v22.0) for analyses. To investigate statistically significant differences between all 5 measurement time-points for each intervention condition, linear mixed-model analyses were used to explore significant changes over time.

## Results

There was a high level of attrition between baseline and mid-intervention measurements which then stabilised for the return health assessment visits. Return rates, calculated as a percentage from the baseline number recruited were as follows: 33.2% at mid-intervention; 22% end of intervention; 19.1% at 18 months; and 14.4% at 24 months. There were several issues (e.g. organizational restructuring, site changes, security issues, etc.) that affected the practical delivery of the intervention in some worksites. These issues had the

**Table 2.** Means ± SDs for each intervention group (standard, staged, control) at each time-point during and post intervention.

| | | Baseline | | | Mid-intervention | | | End of intervention | | | 6m Follow up | | | 12m Follow up | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Standard | Staged | Control | Standard | Staged | Control | Standard | Staged | Control | Standard | Staged | Control | Standard | Staged | Control |
| Physiological | BMI | 27.2 ± 4.6 | 26.2 ± 5 | 27.2 ± 4.8 | 26.9 ± 4.1 | 25.5 ± 4.6 | 26.6 ± 4.2 | 26.0 ± 4.0 | 25.6 ± 4.5 | 26.6 ± 3.8 | 26.1 ± 3.6 | 25.2 ± 4.5 | 26.3 ± 3.2 | 26.1 ± 3.6 | 24.7 ± 3.8 | 25.5 ± 3.6 |
| | Fat % | 28.4 ± 8.9 | 29.1 ± 9.1 | 29.4 ± 9.4 | 26.4 ± 8.2 | 26.9 ± 8.1 | 26.7 ± 9.1 | 25.7 ± 8.6 | 26.8 ± 8.3 | 25.1 ± 8.2 | 25.4 ± 8.3 | 27 ± 8.0 | 27.7 ± 9.4 | 24.0 ± 8.0 | 25.6 ± 7.5 | 27.7 ± 9.5 |
| | WC | 92.9 ± 13.2 | 88.1 ± 13.7 | 91.9 ± 12.5 | 93.4 ± 12.0 | 88.0 ± 14.0 | 91.2 ± 13.3 | 90.7 ± 11.7 | 87.7 ± 14.0 | 91.4 ± 12.2 | 91.3 ± 10.4 | 86.9 ± 14.2 | 89.2 ± 9.5 | 91.5 ± 11.2 | 85.3 ± 12.7 | 87.0 ± 12.9 |
| | SBP | 131.6 ± 16.4 | 128.6 ± 16.7 | 129.2 ± 15.1 | 132.0 ± 15.2 | 124.4 ± 16.9 | 128.1 ± 13.4 | 133.1 ± 14.6 | 130.1 ± 17.2 | 132.7 ± 12.4 | 133.4 ± 14.9 | 130.3 ± 16.3 | 132.3 ± 13.9 | 130.1 ± 13.0 | 126.1 ± 16.5 | 132.1 ± 16.8 |
| | DBP | 79.2 ± 10.4 | 77.8 ± 10.1 | 77.4 ± 10.2 | 81.1 ± 11.2 | 75.6 ± 10.6 | 76.4 ± 9.7 | 78.2 ± 9.4 | 77.6 ± 10.6 | 76.5 ± 10.3 | 77.9 ± 9.8 | 76.9 ± 9.2 | 79.9 ± 11.5 | 75.4 ± 9.3 | 75.2 ± 9.7 | 79 ± 10.9 |
| | HR | 66.6 ± 11.0 | 67.0 ± 10.8 | 69.3 ± 12.6 | 64.7 ± 11.0 | 64.8 ± 11.8 | 64.8 ± 10.5 | 64.8 ± 11.7 | 67.1 ± 12.1 | 63.0 ± 11.1 | 65.8 ± 12.9 | 66.0 ± 14.3 | 64.0 ± 13.6 | 63.0 ± 11.0 | 66.2 ± 12.9 | 64.5 ± 13.6 |
| Psychological | WAI | 42.4 ± 4.1 | 42.3 ± 4.7 | 41.7 ± 4.9 | 32.4 ± 10.8 | 31.1 ± 12.1 | 30.6 ± 12.3 | 42.7 ± 4.5 | 42.8 ± 3.8 | 41.7 ± 5.4 | 36.3 ± 15.9 | 32.9 ± 18.6 | 17.0 ± 21.5 | 43.3 ± 3.8 | 41.9 ± 4.4 | 42.9 ± 2.0 |
| | OC | 10.7 ± 4.9 | 11.1 ± 5.1 | 11.6 ± 5.2 | 9.7 ± 5.6 | 10.2 ± 5.8 | 10.3 ± 6.3 | 9.9 ± 5.3 | 11.8 ± 5.5 | 11.2 ± 5.6 | 8.6 ± 5.8 | 7.9 ± 6.0 | 6.1 ± 7.2 | 9.9 ± 3.6 | 11.5 ± 5.2 | 9.1 ± 4.3 |
| | JM | 5.4 ± 1.2 | 5.3 ± 1.3 | 5.0 ± 1.4 | 5.3 ± 1.2 | 5.3 ± 1.3 | 5.2 ± 1.3 | 5.4 ± 1.3 | 5.3 ± 1.4 | 5.3 ± 1.3 | 4.5 ± 2.2 | 4.3 ± 2.5 | 3.1 ± 3.1 | 5.3 ± 1.3 | 5.1 ± 1.4 | 5.2 ± 1.6 |
| | ITQ | 46.4 ± 7.8 | 46.6 ± 8.1 | 43.6 ± 8.8 | 41.0 ± 4.4 | 39.6 ± 5.3 | 39.9 ± 5.3 | 46.4 ± 7.3 | 45.7 ± 8.1 | 45.0 ± 8.4 | 38.8 ± 17.7 | 36.7 ± 20.9 | 24.4 ± 24.6 | 46.1 ± 6.9 | 46.0 ± 9.1 | 43.1 ± 12.1 |
| | GHQ | 34.8 ± 3.7 | 35.1 ± 4.0 | 34.0 ± 4.1 | 31.3 ± 10.8 | 30.4 ± 11.6 | 30.1 ± 12.2 | 34.9 ± 4.0 | 33.9 ± 4.0 | 33.2 ± 5.4 | 29.5 ± 12.7 | 27.0 ± 14.9 | 17.6 ± 17.5 | 34.1 ± 4.4 | 34.0 ± 5.0 | 32.6 ± 5.4 |
| | JS | 2.7 ± 1.5 | 2.9 ± 1.6 | 3.4 ± 1.9 | 2.5 ± 1.6 | 2.4 ± 1.9 | 2.6 ± 1.9 | 2.4 ± 1.3 | 2.9 ± 1.6 | 2.9 ± 1.5 | 2.3 ± 1.7 | 1.8 ± 1.6 | 1.1 ± 1.3 | 2.6 ± 1.4 | 2.8 ± 1.4 | 3.3 ± 1.9 |
| MET-mins | Walking | 752.0 ± 903.4 | 888.1 ± 825.9 | 802.0 ± 868.4 | 1029.5 ± 1219.1 | 801.1 ± 927.9 | 748.6 ± 900.6 | 1151.2 ± 1305.7 | 1378.6 ± 1669 | 818.8 ± 908.6 | 1334.4 ± 3343.1 | 1679.2 ± 4777.3 | 1832.2 ± 5978.0 | 1086.5 ± 1321.4 | 1495.3 ± 1927.2 | 462.0 ± 517.2 |
| | Moderate PA | 338.8 ± 676.1 | 290.5 ± 620.2 | 221.7 ± 470.4 | 468.1 ± 828.5 | 302.5 ± 679.7 | 551.4 ± 1135.4 | 437.1 ± 906.1 | 439.2 ± 1013.2 | 365.7 ± 787.2 | 456.2 ± 860.4 | 616.4 ± 3687.4 | 535.2 ± 1397.1 | 767.8 ± 1427.5 | 543.4 ± 1264.1 | 1142.5 ± 1646.7 |
| | Vigorous PA | 733.4 ± 1164.1 | 685.5 ± 1054.3 | 725.5 ± 1160.8 | 870.0 ± 1393.5 | 834.6 ± 1117.9 | 875.8 ± 1767.4 | 802.3 ± 1419.8 | 789.3 ± 1101.6 | 1203.8 ± 1727.6 | 860.3 ± 2320.3 | 1055.4 ± 1776.6 | 998.4 ± 2325.5 | 814.9 ± 1180.2 | 886.8 ± 1575.3 | 2690.0 ± 3520.0 |
| Workday sitting time | Transport | 56.1 ± 57.8 | 59.8 ± 43.9 | 46.4 ± 52.9 | 42.2 ± 38.9 | 56.1 ± 43.9 | 41.1 ± 38.4 | 47.6 ± 41.6 | 61.1 ± 42.2 | 43.6 ± 36.1 | 42.9 ± 36.2 | 49.9 ± 47.1 | 34.8 ± 46.3 | 58.9 ± 80.9 | 62.0 ± 41.0 | 67.5 ± 56.8 |
| | Work | 372.4 ± 125.9 | 373.3 ± 125.2 | 385.7 ± 107.0 | 345.2 ± 151.3 | 343.7 ± 149.2 | 330.7 ± 89.2 | 381.6 ± 110.7 | 395.5 ± 89.5 | 376.4 ± 115.8 | 337.7 ± 165.1 | 301.5 ± 176.9 | 168.0 ± 184.7 | 387.5 ± 80.9 | 375.0 ± 79.9 | 352.5 ± 74.8 |
| | TV | 94.7 ± 64.7 | 89.9 ± 70.0 | 103.8 ± 69.4 | 89.3 ± 61.8 | 79.8 ± 62.3 | 89.2 ± 62.3 | 98.1 ± 68.9 | 84.5 ± 61.9 | 107.8 ± 67.3 | 81.7 ± 67.4 | 77.4 ± 67.5 | 38.4 ± 62.2 | 122.6 ± 82.7 | 92.7 ± 60.7 | 120.0 ± 90.7 |
| | Home PC | 51.7 ± 74.6 | 58.9 ± 101.0 | 65.6 ± 93.1 | 50.2 ± 67.3 | 56.7 ± 102.4 | 54.2 ± 86.7 | 60.9 ± 84.2 | 64.6 ± 102.5 | 52.4 ± 66.3 | 45.1 ± 74.3 | 44.7 ± 76.2 | 28.4 ± 73.6 | 60.0 ± 75.9 | 43.3 ± 60.0 | 62.5 ± 85.2 |
| | Leisure | 43.8 ± 56.8 | 46.5 ± 65.8 | 39.4 ± 51.9 | 35.8 ± 53.4 | 38.0 ± 51.2 | 37.6 ± 51.7 | 42.5 ± 55.5 | 51.9 ± 58.0 | 42.6 ± 60.6 | 39.9 ± 51.0 | 32.7 ± 48.3 | 27.4 ± 48.8 | 39.9 ± 48.5 | 51.3 ± 55.8 | 30.0 ± 45.4 |
| | **Total** | 603.0 ± 152.2 | 599.7 ± 162.3 | 615.9 ± 142.9 | 615.1 ± 115.5 | 613.4 ± 145.6 | 633.8 ± 135.8 | 607.4 ± 144.2 | 616.6 ± 133.9 | 615.9 ± 184.5 | 608.3 ± 124.0 | 625.4 ± 122.3 | 531.7 ± 199.4 | 648.0 ± 134.7 | 604.6 ± 138.2 | 632.5 ± 145.5 |

BMI: body mass index; DBP: diastolic blood pressure; Fat %: fat percentage; GHQ: General Health Questionnaire; HR: resting heart rate; ITQ: intention to quit; JM: job motivation; JS: job satisfaction; OC: organizational commitment; PA: physical activity; SBP: systolic blood pressure; WAI: Work Ability Index; WC: waist circumference.

Table 3. Linear mixed model test of fixed effects for predicting impact of standard/staged intervention condition.[a]

| | | Intercept | | | | |
|---|---|---|---|---|---|---|
| | | Control | Standard | Sig. | Staged | Sig. |
| Physiological | BMI | 27.15 | −0.06 | 0.882 | −1.05 | 0.007* |
| | Fat % | 29.28 | −1.15 | 0.127 | −0.31 | 0.672 |
| | WC | 91.73 | 0.99 | 0.362 | −3.88 | 0.001** |
| | SBP | 129.08 | 1.97 | 0.115 | −1.52 | 0.220 |
| | DBP | 77.14 | 1.50 | 0.064 | −0.04 | 0.961 |
| | HR | 68.64 | −2.10 | 0.021* | −1.78 | 0.047* |
| Psychological | WAI | 41.45 | 0.82 | 0.029* | 0.77 | 0.039* |
| | OC | 42.87 | 2.52 | 0.001** | 2.64 | 0.001** |
| | JM | 33.70 | 0.96 | 0.003* | 1.20 | 0.001** |
| | ITQ | 3.16 | −0.53 | 0.001** | −0.32 | 0.010* |
| | GHQ | 11.18 | −0.80 | 0.033* | −0.20 | 0.590 |
| | JS | 4.99 | 0.34 | 0.001* | 0.28 | 0.007* |
| MET-mins | Walking | 797.09 | 68.64 | 0.780 | 67.95 | 0.091 |
| | Moderate PA | 273.05 | 88.99 | 0.065 | 27.27 | 0.568 |
| | Vigorous PA | 784.61 | −38.39 | 0.667 | −78.88 | 0.371 |
| Workday sitting time | Transport | 44.57 | 6.57 | 0.29* | 13.93 | 0.001** |
| | Work | 357.72 | 7.33 | 0.376 | 5.96 | 0.476 |
| | TV | 97.22 | −2.85 | 0.495 | −10.36 | 0.014* |
| | Home PC | 58.89 | −6.73 | 0.208 | −2.24 | 0.678 |
| | Leisure | 38.47 | 2.92 | 0.406 | 6.14 | 0.084 |
| | **Total** | 616.70 | −7.23 | 0.456 | −11.09 | 0.260 |

aReported as estimates of mean parameters (standard error).
*$p < .05$, **$p < .001$

potential to negatively impact on employees' interest to continue in the research and therefore may have had an impact on return rates.

Table 1 shows the demographic characteristics of the participants, including results from *t*-tests used to identify gender differences, and one-way analyses of variances (ANOVA) used to explore differences between participants in the 3 conditions. Independent *t*-tests demonstrated that average height, weight, weekly hours worked, monthly hours worked and the total metabolic equivalent of task (MET) minutes per week were significantly greater in males in comparison to females.

Table 2 summarises the health outcomes for each intervention group at each measurement time-point during and post-intervention.

Low numbers of returning control participants at the 6-month post-intervention point resulted in a fluctuation in the mean WAI score. The mean WAI was reduced by several respondents with particularly low scores at this measurement point.

Table 3 displays the results from the linear mixed-model analyses assessing the effects of the standard and staged intervention conditions when compared to the control group (intercept).

The staged intervention group showed a significant reduction in BMI over the duration of the intervention period, including post-intervention in comparison to the standard intervention group and control group (intercept). The results show that participants provided with tailored health information were more likely to have reduced BMI by $-1.05\,kg/m^2$ over the course of the measurement period.

There were no significant differences in Fat% for either of the intervention conditions when compared to the control group. This demonstrates that even though a reduction in BMI was observed, this was most likely due to an overall weight reduction rather than specifically fat reduction. In contrast, waist circumference was significantly lower for the staged intervention group in comparison to the standard intervention group, which may indicate reductions in visceral fat.

Table 3 also shows there were no significant differences in blood pressure outcomes (systolic or diastolic) for the duration of the intervention period in either of the intervention groups. However, for both intervention groups, there were significant improvements (reductions) in resting heart rate.

In terms of psychological outcomes, significant differences in both intervention groups (standard and staged) were seen in comparison to the control group. The results show that employees receiving either standard or tailored intervention material demonstrated significantly higher self-reported work ability, organizational commitment, job motivation, job satisfaction and a reduction in intention to quit the organization.

While both the staged and standard interventions reduced total sitting times compared to controls, the differences failed to reach significance. The results showed a significant increase in sitting time for both standard and staged groups for the domain of transport in comparison to the control. However, the staged intervention group showed a significant reduction in sitting time while watching TV compared to the control group.

Table 4 shows the percentage of participants in each stage of change by intervention condition and at each stage of the intervention and follow up.

For participants in the standard intervention condition, a chi-squared goodness of fit test indicated significant differences in the proportion distribution of participants for each stage at mid-intervention and end of intervention measurements compared to baseline. At 6 months there were fewer workers in contemplation and action and more participants in the maintenance stage ($\chi^2 = 70.68$, $p < .001$). By 12 months there were fewer employees in preparation and more in the maintenance stage in comparison to baseline ($\chi^2 = 30.20$, $p < .001$).

For participants in the staged intervention condition, a chi-squared goodness of fit test indicated that

Table 4 Stage of change classifications by intervention condition at each stage of the intervention and follow up (%).

| Intervention condition | Stage of change | Baseline | Mid-intervention | End of intervention | 6 m Follow up | 12 m Follow up |
|---|---|---|---|---|---|---|
| Standard | Precontemplation | 20.9 | 21.6 | 28.4 | 20.2 | 30.5 |
| | Contemplation | 14.5 | 11.2 | 15.9 | 13.5 | 11.9 |
| | Preparation | 54.0 | 46.2 | 34.1 | 49.4 | 33.9 |
| | Action | 9.7 | 4.2 | 9.1 | 9.0 | 20.3 |
| | Maintenance | 0.9 | 16.8 | 12.5 | 7.9 | 3.4 |
| Staged | Precontemplation | 16.7 | 19.4 | 20.9 | 25.0 | 26.9 |
| | Contemplation | 16.4 | 7.4 | 20.8 | 12.4 | 9.7 |
| | Preparation | 55.9 | 42.6 | 34.7 | 39.1 | 36.5 |
| | Action | 8.1 | 13.0 | 4.2 | 18.8 | 19.2 |
| | Maintenance | 2.9 | 17.6 | 19.4 | 4.7 | 7.7 |
| Control | Precontemplation | 14.5 | 21.1 | 23.5 | 23.1 | 25.0 |
| | Contemplation | 13.6 | 8.5 | 13.7 | 15.3 | 12.5 |
| | Preparation | 56.1 | 42.3 | 51.0 | 23.1 | 50.0 |
| | Action | 13.5 | 4.2 | 2.0 | 30.8 | 12.5 |
| | Maintenance | 2.3 | 23.9 | 9.8 | 7.7 | 0.0 |

at 6 months there were fewer workers in contemplation and more in maintenance ($\chi^2 = 22.31$, $p < .001$). At 12 months there were fewer workers in preparation and more in maintenance in comparison to baseline ($\chi^2 = 30.20$, $p < .001$).

For participants in the control condition, a chi-squared goodness of fit test indicated that at 6 months there were fewer participants in preparation and more in maintenance ($\chi^2 = 40.30$, $p < .001$). However, these differences were not maintained by the end of intervention, as there was no significant difference in the proportion of employees for each stage of change compared to the baseline assessment ($\chi^2 = 5.16$, $p < .271$).

## Discussion

This longitudinal study aimed to evaluate the effectiveness of a tailored workplace physical activity intervention compared to a standard condition and control condition implemented in 10 different worksites across the UK. The results showed that the tailored intervention group demonstrated significant reductions in BMI over the duration of the 12 month intervention period and the 12 month follow-up period in comparison to the standard intervention and control group. In addition, waist circumference was significantly lower for the staged intervention group in comparison to the standard intervention and control group, which is indicative of reductions in visceral fat. The findings provide new evidence that tailored interventions are more effective in improving health outcomes in the workplace. These results support the calls for adopting ergonomics interventions which align with workers' stage of change (Haslam and Haslam 2001; Haslam 2002),

There were no significant differences in blood pressure outcomes for the duration of the intervention period in either of the intervention groups. However, for both intervention groups, there were significant improvements (reductions) in resting heart rate. Employees who received either standard or tailored intervention material demonstrated significantly higher self-reported work ability, organizational commitment, job motivation, job satisfaction and a reduction in intention to quit the organization. These results suggest that physical activity interventions have a positive impact on employees' job attitudes and psychological wellbeing.

Both staged and standard interventions reduced total sitting times, but the differences failed to reach significance. Both conditions showed a significant increase in sitting times during transport (a domain where employees may have limited control) whereas the staged intervention demonstrated a significant reduction in sitting times while watching TV (where they would have control).

A strength of this study is that it was longitudinal, and the intervention was evaluated over a 2-year period incorporating a wide range of objective physical measurements as well as self-reported health and psychological outcomes. The companion paper Kazi et al. (2018) reporting the findings of the baseline phase of this study recommends targeting future interventions to according to gender, job role, sector and geographical location. This was not possible in this instance as this research was the longitudinal phase of the study and was constrained by the sample recruited at baseline. As work sites were allocated to intervention conditions it was not possible to match the samples across the conditions. The tailored condition comprised more female participants (55%) compared to control and standard conditions (43% and 38%, respectively) and this may have contributed to the outcomes.

Another limitation of the study was the initial high level of attrition from baseline to mid-intervention. This was due to a number of organisational changes that were outside the control of the study. Such factors are inherent in organisational research. The attrition levels stabilised for the additional visits which enabled sufficient samples in all conditions to conduct the long-term evaluation.

This paper describes the development and evaluation of a new intervention, designed to increase physical activity and reduce sedentary behaviour in the workplace. The intervention involves tailoring health information to the individual employee. This approach assumes that when attempting to change behaviour, one size does not fit all, and success is greater when interventions align with peoples' beliefs. This longitudinal study, conducted across 10 worksites compared tailored, standard and control conditions and showed that while both tailored and standard interventions reduced resting heart rate and improved psychological wellbeing, the tailored approach was more effective in reducing BMI and waist circumference compared to standard information and control conditions.

Sedentary work is a major public health concern with high levels of sitting associated with an increased risk of premature mortality and a wide range of chronic health conditions. This study has shown that interventions tailored to employees' stage of change are more effective in reducing BMI and waist circumference than standard approaches and this is an important finding. Kearns et al. (2014) investigated the burden of chronic disease associated with overweight and obesity in the adult population and estimated that a 1 unit reduction in BMI at a population level would lead to substantial gains in terms of reduced prevalence of chronic diseases. The present study demonstrated a reduction in BMI of 1.05 $kg/m^2$ which suggests that tailored workplace physical activity interventions have the potential to reduce the burden of chronic diseases.

We would argue that sitting at work should be considered alongside other risk exposures in the workplace. Where employees are spending protracted periods of sitting at work, risk assessments should be undertaken to determine what measures may be put in place to ameliorate this important health risk. Detailed risk assessments may allow occupational health initiatives to better target physical activity interventions to job roles and sectors where sedentary behaviour is more prevalent.

The workplace is an ideal arena for targeting health information and intervening to improve health and wellbeing. The baseline results of this longitudinal study reported in the companion paper, Kazi et al. (2018) have highlighted important gender, job role, sector and geographical differences in sedentary behaviour in the workplace. This information may be used to inform future workplace health initiatives enabling interventions to be more specifically targeted and more effective in improving health outcomes. The results of this present study indicate that tailoring information to employees' stage of change is more effective than standard approaches in improving health in the workplace. These results provide important insights for future workplace physical activity interventions and offer considerable scope to counteract increasing levels of obesity and improve the health and wellbeing of the sedentary workforce.

## Funding

This study was part of a 5-year research project funded by the New Dynamics of Ageing Programme (RES-353-25- 0006; RCUK, led by ESRC).

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