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Sedentary behaviour and health at work: an investigation of industrial sector, job role, gender and geographical differences

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ABSTRACT

This article presents baseline data from 1120 employees across 10 worksites enrolled in a workplace physical activity intervention. The study provides new data on physical activity, sedentary behaviour, and health and highlights gender, geographical, job type and industrial sector differences. Sitting at work accounted for more than 60% of participants' total daily sitting time on work days. Weekly and monthly hours worked, body mass index (BMI) and waist circumference were significantly higher for workers in the private sector compared to the public sector. Employees in sales and customer services had significantly higher BMI scores and significantly lower scores for workability index (WAI), job satisfaction, organisational commitment and job motivation, compared to other groups. This study provides further evidence that work is a major contributor to sedentary behaviour and supports the pressing need for interventions particularly targeting private sector industries and sales and customer service sectors.

Practitioner Summary: Work accounts for more than 60% of the daily sitting time. Private sector employees had higher BMIs than those in the public sector and employees in sales and customer services had higher BMIs and poorer health compared to other occupations, suggesting that these groups should be targeted in workplace interventions.

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; TV: Television; WAI: Work Ability Index; WC: Waist circumference

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Workplace intervention; health risks; physical activity; sedentary behaviour

Introduction

The gradual shift from manufacturing to service industries, combined with technological advances has resulted in increasing numbers of people employed in sedentary occupations (Sherwood and Jeffery 2000). Research by Kazi et al. (2014) demonstrated that UK employees spend more time sitting at work than they spend sleeping at night.

Prolonged sitting is associated with an increased risk of premature mortality (Wilmot et al. 2012; Biswas et al. 2015) and high levels of sitting cannot be compensated for by leisure-time physical activity, even if activity levels exceed current guidelines (Katzmarzyk et al. 2009). Sedentary behaviour should not be viewed as simply the absence of physical activity or as the extreme lower end of the physical activity continuum (Owen, Bauman, and Brown 2009). Increased sitting time is associated with an increased risk of obesity, the metabolic syndrome, type 2 diabetes, some cancers and cardiovascular disease (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).

Research by Hamilton, Hamilton, and Zderic (2007) reported that sedentary workers expend 700 kcals per day compared to the 1400 kcals per day expended by workers who spend large amounts of time standing

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(e.g. retail sector employees). A longitudinal survey of Naval personnel indicated that the health risk related to high BMI and waist circumference in 2011 was predicted by low levels of physical activity in 2007, and participants who had more physically demanding work in the 2007 survey were more likely to be in the 'no risk' category in 2011 (Bridger, Brasher, and Bennett 2013). In a recent survey of office workers in Northern Ireland, higher sitting times were reported by obese individuals on both work and non-work days (Clemes et al. 2016). Ryan et al. (2011) measured the sitting patterns of office workers and found that 66% of the working day was spent sitting. None of the participants ($n = 83$) met the guideline of interrupting sitting every 20–30 minutes and only 8% interrupted sitting every hour. These authors concluded that office workers spend substantial periods of the working day in uninterrupted sitting.

Given its large contribution to sedentary behaviour, the workplace has been highlighted as a key setting for interventions designed to reduce sedentary behaviour. Straker and Mathiassen (2009) have noted that lack of physical activity is now a major health threat for workers. These authors argue that the traditional physical ergonomics paradigm of reducing risk by reducing physical workloads 'less is best' is no longer appropriate for many modern occupations. They propose that a new paradigm is needed where 'more can be better' in that work can be designed to instigate physical load and exercise to protect workers' health.

Walking Works Wonders is an intervention designed to increase physical activity and reduce sedentary behaviour at work. The development and initial evaluation of the intervention is described by Kazi (2013). This article presents the baseline data on the total sample of 1120 employees recruited from 10 worksites across the UK who participated in an evaluation study of Walking Works Wonders. This study investigated physical activity and sedentary behaviour across different domains on a work day and non-work day. The study also examined gender, geographical, job type and industrial sector differences as well as physical and psychological health measures.

Methods

Walking Works Wonders was developed as part of the Working Late research programme completed at Loughborough University, UK. The intervention was evaluated using a quasi-experimental design with five measurement time points over two years. Individual work sites were allocated to intervention or control conditions following baseline measurements. This paper reports the cross-sectional data collected from the whole sample at baseline.

Ten different work sites across the UK participated in the study. A large private sector telecommunications organisation 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. Posters were also placed on noticeboards around work sites, and announcements were made via newsletters. Employees were encouraged to participate with the offer of a free pedometer and feedback from an independent health assessment. Participants completed a questionnaire and undertook physiological and psychological measurements as part of the baseline measurements.

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

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; (c) heavy labour. 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.

Work ability was assessed using the WAI which comprises a series of questions regarding the demands of work, employees' health status and any additional resources. Total WAI scores have a range of

7–49 and high scores indicate high work ability. GHQ-12 is a 12-item self-report questionnaire that serves as an indicator of psychological distress or potential psychiatric morbidity and has robust psychometric properties. The GHQ-12 asks respondents to report how they felt recently on a range of variables using a 4-point Likert scale. There are several ways of scoring the GHQ-12. The Likert scoring (0–1–2–3), the method was used which gives a possible score range of 0–36. Higher scores on the GHQ-12 indicate greater levels of general psychiatric distress. The GHQ has good reliability (Cronbach's alpha = 0.92).

The organisational commitment (OC) scale is a 9-item scale in which asks respondents to rate each item using a 7-point Likert scale (1 = strongly disagree and 7 = strongly agree; Cronbach's alpha = 0.82). Intrinsic job motivation (JM) was measured using a 6-item scale designed to assess the degree to which a person wants to work well in their job in order to achieve satisfaction. Responses are given to each statement using a 7-point Likert scale (1 = strongly disagree and 7 = strongly agree). Responses were summed to produce a score, with a possible range of 6–42, with high scores equating to high intrinsic job motivation (Cronbach's alpha =0.78).

Job satisfaction (JS) was measured using a 3-item scale taken from the Michigan Organizational Assessment Questionnaire. Participants were asked to respond on a 7-point Likert scale (1 = strongly disagree and 7 = strongly agree). The scale was scored by averaging the responses, with a possible range of 1–7, with high scores indicating high levels of job satisfaction (Cronbach's alpha = 0.84). ITQ was measured using another scale from the Michigan Organizational Assessment Questionnaire. The measure was scored by calculating the average response, with a possible range of 1–7, with high scores indicating a strong intention to leave the job (Cronbach's alpha = 0.86).

The physiological measurements included: height; weight and body composition (measured using bio-impedance analysis, Tanita BC-418 MA, BMI was calculated at kg/m^2); waist circumference (WC); blood pressure (systolic blood pressure: SBP; diastolic blood pressure: DBP) and resting heart rate (HR) (measured using the Omron 705-IT automated blood pressure monitor). 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.

The study was approved by the Loughborough University Ethical Advisory Committee. All participants provided informed consent and completed a health screening questionnaire before being recruited into the study.

Analyses were conducted using SPSS (19.0). The data were tested for normality using the Kolmogorov–Smirnov test, which revealed that all physiological, psychological, sitting time and metabolic equivalent energy expenditure data (METs – calculated from the IPAQ) were not normally distributed. Non-parametric tests are most useful for small studies and using non-parametric tests in large studies (e.g. >500 participants) may provide answers to the wrong questions (Hill and Lewicki 2005). Graphical outputs (Q-Q plots) were consulted along with the skewness and kurtosis values, which indicated the distributions did not deviate from the normal distribution to a range that justified transforming the data or using non-parametric analyses. With large sample sizes, '*t-tests and their corresponding confidence intervals can and should be used even for heavily skewed data*' (Fagerland 2012, 1). Due to the sample size involved (i.e. >1000 participants), parametric tests were conducted. Independent *t*-tests were used to identify gender differences and also public/private sector differences in physiological measures, psychological outcomes, and physical activity. For sitting times, a paired *t*-test examined differences in domain-specific sitting times between work days and non-work days. One-way analyses of variances (ANOVA) were used to explore geographical and ONS job category differences in physiological measures, psychological outcomes, and physical activity (MET-minutes) scores between participants.

Results

A total of 1120 employees were recruited into the study, 54% were male and 46% were female. In terms of geographical location, 47% were from South East England, 24% from Northern England and 29% from Scotland. Table 1 displays the demographic characteristics, physiological measures, psychological outcomes and physical activity (MET-minutes) scores, self-reported sitting times across each domain along with total sitting time on work days and non-work days, including results from *t*-tests assessing gender differences in these behaviours.

Blood pressure (SBP and DBP), weekly hours worked and monthly hours worked were significantly greater for males in comparison to females. Males also reported significantly higher MET-minutes per week in moderate and vigorous physical activity, which also meant the combined total physical activity MET-minutes per week were significantly higher for males than females.

Table 1. Gender differences between demographic characteristics, physiological measures, psychological outcomes, physical activity (MET-minutes) scores, and self-reported sitting times.

		Total sample	Male	Female	p value t-tests
Demographics	Age (years)	42.2 ± 10.3	42.3 ± 10.4	41.6 ± 10.4	.262 NS
	Weekly hours	36.4 ± 5.7	37.6 ± 4.6	35.0 ± 6.3	.001
	Monthly hours	147.1 ± 40.2	154.7 ± 36.8	139.1 ± 40.8	.001
Physiological measures	Height (cm)	170.7 ± 9.8	177.3 ± 7.2	163.2 ± 6.6	.001
	Weight (kg)	78.3 ± 16.3	84.7 ± 14.6	70.9 ± 15.1	.001
	BMI (kg/m^2)	26.8 ± 4.8	26.9 ± 4.1	26.6 ± 5.5	.215 NS
	Fat %	28.9 ± 9.1	23.2 ± 5.8	35.5 ± 7.5	.001
	WC (cm)	90.7 ± 13.5	95.1 ± 11.7	85.5 ± 13.3	.001
	SBP	129.9 ± 16.3	135.9 ± 15.0	125.0 ± 16.6	.001
	DBP	78.3 ± 10.3	80.7 ± 10.1	76.6 ± 10.3	.001
	HR	67.3 ± 11.2	65.9 ± 11.7	68.9 ± 10.6	.001
Psychological outcomes	WAI	42.2 ± 4.5	42.4 ± 4.5	41.9 ± 4.6	.049
	GHQ	11.1 ± 5.0	10.7 ± 4.9	11.4 ± 5.1	.019
	JS	5.3 ± 1.3	5.2 ± 1.3	5.3 ± 1.3	.297 NS
	OC	45.9 ± 8.2	45.9 ± 8.2	45.9 ± 8.2	.998 NS
	JM	34.8 ± 3.9	34.5 ± 3.9	35.0 ± 3.9	.037
	ITQ	2.9 ± 1.6	2.9 ± 1.7	2.9 ± 1.6	.931
IPAQ	Walking	819 ± 866	805 ± 829	834 ± 907	.297 NS
	Moderate PA	296 ± 618	362 ± 693	219 ± 508	.001
	Vigorous PA	712 ± 1118	891 ± 1239	504 ± 916	.001
	Total	1826 ± 1746	2058 ± 1868	1557 ± 1550	.001
Work day sitting	Transport	56 ± 51	56 ± 51	53 ± 48	.330 NS
	Work	375 ± 122	383 ± 116	368 ± 124	.019
	TV	94 ± 68	96 ± 65	95 ± 69	.466 NS
	PC at home	57 ± 90	67 ± 87	45 ± 90	.001
	Other leisure	44 ± 59	41 ± 55	48 ± 63	.035
	Total	624 ± 185	640 ± 170	604 ± 190	.002
Non-work day sitting	Transport	47 ± 53	48 ± 57	44 ± 48	.304 NS
	Work	42 ± 104	48 ± 114	34 ± 91	.011
	TV	158 ± 106	167 ± 100	154 ± 111	.013
	PC at home	86 ± 95	106 ± 102	66 ± 81	.001
	Other leisure	115 ± 104	117 ± 98	120 ± 108	.778 NS
	Total	458 ± 225	479 ± 225	431 ± 222	.001

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: organisational commitment; PA: physical activity; SBP: systolic blood pressure; WAI: Work Ability Index; WC: waist circumference.

More time was reported sitting at work than any other domain, accounting for more than half of the total daily sitting time accumulated on a work day (60%). On work days, sitting time at work and while using a PC at home was higher for males in comparison to females. Sitting time during leisure activities was significantly higher for females than males. There were no significant gender differences for sitting time during transport and while watching TV on work days. On non-work days, sitting time whilst working, watching TV and using a computer at home were higher for males in comparison to females. Total daily sitting times were significantly higher in males than females on both work days and non-work days.

A paired-samples t-test indicated significantly higher sitting times on non-work days for the domains of TV [$t = -21.52$, $p < .001$], PC at home [$t = -9.53$, $p < .001$] and other leisure activities [$t = -24.43$, $p < .001$] in comparison to work days. Participants reported significantly higher sitting times on work days for the domains of transport [$t = -4.63$, $p < .001$] and at work [$t = -70.72$, $p < .001$] in comparison to non-work days.

Independent t-tests demonstrated some significant sectorial differences between the outcomes (Table 2). Average weekly and monthly hours worked were significantly greater ($p < .05$) in the private sector in comparison to the public sector. BMI and WC were also significantly higher ($p < .05$) for workers in the private sector than the public sector. However, there were no significant differences for age, Fat %, SBP, DBP and HR. The only psychological outcome that demonstrated a difference was JM, which was significantly greater ($p < .05$) in the public sector than the private sector. There were no statistically significant differences between the sectors in terms of the time participants reported spending in the different physical activity intensities.

There were also significant sector differences between the sitting times for some domains on work days and non-work days (Table 3). On work days, sitting time at work for private sector employees was significantly higher ($p < 0.001$) in comparison to public sector workers. This also resulted in total sitting time being significantly higher ($p < 0.001$) for those working in the private sector compared to those working in

Table 2. Public/private sector differences between demographic characteristics, physiological measures, psychological outcomes and physical activity (IPAQ) scores.

		Private sector	Public sector	*p* Value *t*-tests
	Age (years)	41.8 ± 10.3	43.5 ± 10.9	.063 NS
Physiological measures	Height (cm)	170.8 ± 9.9	170.6 ± 8.8	.907 NS
	Weight (kg)	78.6 ± 16.5	75.8 ± 16.6	.055 NS
	BMI (kg/m^2)	26.9 ± 4.8	25.9 ± 4.5	.037
	Fat %	28.9 ± 9.2	28.3 ± 8.3	.396 NS
	WC (cm)	91.0 ± 13.6	88.4 ± 12.6	.030
	SBP	129.9 ± 16.4	129.1 ± 16.2	.533 NS
	DBP	78.3 ± 10.3	77.8 ± 10.0	.535 NS
	HR	67.3 ± 11.2	67.2 ± 11.2	.922 NS
Hours worked	Weekly hours	36.7 ± 5.6	34.4 ± 6.4	.001
	Monthly hours	148.4 ± 40.3	137.9 ± 38.4	.004
Psychological outcomes	WAI	42.1 ± 4.6	42.7 ± 4.2	.224 NS
	GHQ	10.9 ± 5.1	11.4 ± 4.7	.330 NS
	JS	5.3 ± 1.3	5.5 ± 1.3	.068 NS
	OC	45.9 ± 8.2	46.3 ± 8.1	.540 NS
	JM	34.7 ± 4.0	35.4 ± 3.3	.013
	ITQ	2.9 ± 1.6	2.9 ± 1.6	.885 NS
IPAQ (PA)	Walking	808 ± 844	888 ± 1001	.301 NS
	Moderate	285 ± 586	364 ± 797	.249 NS
	Vigorous	694 ± 1099	828 ± 1229	.179 NS
	Total	1788 ± 1707	2081 ± 1972	.059 NS

Table 3. Public/private sector differences between sitting times across each domain on a work day and non-work day.

		Private sector	Public sector	*p* Value *t*-tests
Work day	Transport	56 ± 53	55 ± 45	.949 NS
	Work	384 ± 120	319 ± 116	.001
	TV	95 ± 68	92 ± 67	.593 NS
	PC at home	59 ± 92	46 ± 75	.123 NS
	Other leisure	45 ± 61	41 ± 51	.469 NS
	Total	635 ± 183	552 ± 183	.001
Non-work day	Transport	46 ± 56	50 ± 45	.397 NS
	Work	44 ± 108	27 ± 74	.019
	TV	158 ± 108	156 ± 93	.829 NS
	PC at home	89 ± 98	69 ± 69	.003
	Other leisure	116 ± 105	111 ± 97	.666 NS
	Total	463 ± 226	420 ± 216	.033

the public sector. There were no significant sectorial differences for sitting time during transport, while watching TV, using a PC at home or leisure activities on work days. On non-work days, sitting time whilst working and using a computer at home were significantly higher ($p < .05$) for private sector workers compared to public sector workers. There were no significant sectorial differences for sitting time during transport while watching TV or leisure activities on non-work days.

Table 4 shows the participants' demographic characteristics, physiological measures, psychological outcomes and physical activity (IPAQ) scores, self-reported domain-specific sitting times according to geographical location. A series of one-way ANOVAs revealed significant differences in sitting times on a work day between the geographical groups and the domains of work and TV.

Post-hoc Tukey HSD comparisons indicated mean BMI, Fat % and HR measurements for participants in South East England were significantly lower than participants in Northern England (all $p < .01$) and Scotland (all $p < .05$). WC measurements for participants in South East England were significantly lower than participants in Scotland ($p < .05$). Weekly and monthly hours reported working were significantly higher in South East England compared to Northern England ($p < .01$) and Scotland ($p < .05$).

Post-hoc Tukey HSD comparisons indicated mean JS, OC and JM scores for participants in South East England were significantly higher than participants in Northern England (all $p < .05$) and Scotland (all $p < .001$). Participants in South East England also reported significantly higher WAI scores than those in Scotland ($p < .01$) and lower psychological distress on the GHQ scale compared to those in Northern England ($p < .01$). ITQ was significantly higher in participants from Northern England compared to those in South East England ($p < .001$) and Scotland ($p < .01$).

Post-hoc Tukey HSD comparisons indicated that mean sitting times for participants in South East England were significantly higher at work ($p < .05$) and significantly lower whilst watching TV ($p < .001$) compared to participants in Scotland. Table 4 also demonstrates significant differences on a non-work day between the groups and the domains of work, PC at home and total non-work day sitting. *Post-hoc* comparisons indicated that mean sitting times at work for participants in South East England were significantly lower compared to those in Northern England ($p < .001$) and Scotland ($p < .01$). Sitting times whilst using a PC at home for participants in Northern England were significantly higher than those in South East England ($p < .05$) or Scotland ($p < .001$). Finally, total sitting times on a non-work day for participants

Table 4. Geographical differences between demographic characteristics, physiological measures, psychological outcomes, physical activity (IPAQ) scores and self-reported sitting times.

		South East England	Northern England	Scotland	*p* Value ANOVA
Demographics	Age (years)	43.1 ± 10.2	39.8 ± 10.2	42.1 ± 10.6	.001
	Weekly hours	37.2 ± 5.9	35.3 ± 6.3	35.9 ± 4.7	.001
	Monthly hours	151.4 ± 40.8	141.3 ± 43.3	144.8 ± 35.5	.003
Physiological measures	Height (cm)	171.4 ± 9.3	170.2 ± 9.9	169.9 ± 10.6	.051 NS
	Weight (kg)	77.3 ± 16.5	79.5 ± 16.4	78.7 ± 16.4	.191 NS
	BMI (kg/m^2)	26.2 ± 4.5	27.4 ± 5.3	27.1 ± 4.8	.001
	Fat %	27.4 ± 8.3	29.8 ± 9.9	30.4 ± 9.3	.001
	WC (cm)	89.5 ± 13.5	91.8 ± 13.4	91.7 ± 13.3	.018
	SBP	130.0 ± 16.5	128.4 ± 15.1	130.8 ± 17.0	.202 NS
	DBP	78.9 ± 10.5	76.5 ± 9.7	78.7 ± 10.2	.005
	HR	65.6 ± 10.6	69.9 ± 11.9	67.9 ± 11.2	.000
Psychological outcomes	WAI	42.7 ± 4.0	42.2 ± 4.6	41.6 ± 5.1	.008
	GHQ	10.6 ± 4.5	11.6 ± 5.5	11.3 ± 5.4	.012
	JS	5.5 ± 1.2	5.2 ± 1.3	4.9 ± 1.4	.001
	OC	47.2 ± 7.4	44.8 ± 8.9	44.9 ± 8.5	.001
	JM	35.3 ± 3.5	34.3 ± 4.5	34.3 ± 4.1	.001
	ITQ	2.8 ± 1.5	3.3 ± 1.8	2.8 ± 1.6	.001
IPAQ	Walking	790 ± 801	856 ± 984	832 ± 860	.562 NS
	Moderate PA	337 ± 697	237 ± 558	278 ± 519	.078 NS
	Vigorous PA	760 ± 1114	706 ± 1218	639 ± 1033	.307 NS
	Total	1888 ± 1686	1800 ± 1943	1750 ± 1666	.509 NS
Workday sitting	Transport	56 ± 46	57 ± 66	54 ± 46	.637 NS
	Work	386 ± 121	368 ± 129	364 ± 117	.022
	TV	87 ± 65	98 ± 70	104 ± 70	.001
	PC at home	57 ± 92	61 ± 92	55 ± 86	.761 NS
	Other leisure	42 ± 51	41 ± 60	50 ± 71	.114 NS
	Total	623 ± 179	615 ± 184	627 ± 194	.582 NS
Non-workday sitting	Transport	46 ± 48	48 ± 70	46 ± 51	.890 NS
	Work	27 ± 75	61 ± 136	49 ± 110	.001
	TV	150 ± 97	165 ± 121	165 ± 107	.067
	PC at home	84 ± 83	106 ± 125	73 ± 81	.001
	Other leisure	117 ± 100	109 ± 111	117 ± 105	.529 NS
	Total	432 ± 211	496 ± 244	469 ± 228	.001

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: organisational commitment; PA: physical activity; SBP: systolic blood pressure; WAI: Work Ability Index; WC: waist circumference.

in Northern England were significantly higher than those in South East England ($p < .001$).

Table 5 shows the participants' demographic characteristics, physiological measures, psychological outcomes and physical activity (IPAQ) scores according to ONS job type.

Post-hoc Tukey HSD comparisons indicated that mean BMI for employees in sales and customer service was significantly higher than those in professional occupations ($p < .01$). Fat percentages for employees in sales and customer service and secretarial occupations were significantly higher than managers, directors and senior officials; professional occupations and associate and technical occupations (all $p < .001$). HR readings for employees in sales and customer service were significantly higher than managers, directors and senior officials; professional occupations and associate and technical occupations (all $p < .01$). WAI scores for employees in sales and customer service were significantly lower compared to managers, directors and senior officials ($p = .001$); professional occupations ($p < .05$) and associate and technical occupations ($p < .05$). GHQ scores for employees in sales and customer service were significantly higher (indicating greater psychological distress) compared to managers, directors and senior officials ($p < .05$); and professional occupations ($p < .01$).

JS scores for employees in sales and customer service were significantly lower compared to managers, directors and senior officials ($p < .001$); secretarial occupations ($p < .05$); and skilled trades persons ($p < 0.001$). JS scores for skilled trades persons were significantly higher compared to participants in professional occupations ($p < .001$); associate and technical occupations ($p = <.01$); and sales and customer service ($p < .001$). OC scores for employees in sales and customer service were significantly lower than managers, directors and senior officials ($p < .001$); professional occupations ($p < .001$); associate and technical occupations ($p < .001$) and secretarial occupations ($p < .01$). JM scores for employees in sales and customer service were significantly lower than managers, directors and senior officials ($p < .001$); professional occupations ($p < .001$); associate and technical occupations ($p < .01$); secretarial occupations ($p < .05$); and skilled trades persons ($p < .001$). In addition, JM scores for

Table 5. ONS job type differences between demographic characteristics, physiological measures, psychological outcomes and physical activity (IPAQ) scores.

		Managers, Directors and Senior Officials ($n = 109$)	Professional occupations ($n = 394$)	Associate professionals and technical occupations ($n = 212$)	Secretarial and related occupations ($n = 115$)	Skilled trades ($n = 12$)	Sales and customer service ($n = 249$)	Process, plant and machine operatives ($n = 4$)	Elementary administration and service occupations ($n = 21$)	p Value ANOVA
	Age (years)	42.9 ± 8.7	42.6 ± 10.1	42.6 ± 10.2	44.6 ± 9.4	47.2 ± 10.2	38.6 ± 11.1	34.0 ± 11.5	38.8 ± 14.9	.001
Physiological measures	Height (cm)	173.1 ± 9.3	173.4 ± 9.2	171.1 ± 9.6	165.2 ± 8.6	173.5 ± 7.9	167.8 ± 10.3	170.3 ± 17.5	161.8 ± 4.5	.001
	Weight (kg)	79.6 ± 16.2	78.7 ± 15.3	77.8 ± 16.2	75.4 ± 17.9	88.6 ± 18.4	78.0 ± 17.1	72.3 ± 22.4	62.6 ± 4.8	.009
	BMI (kg/m^2)	26.5 ± 4.4	26.1 ± 4.1	26.5 ± 4.5	27.5 ± 5.8	29.3 ± 5.4	27.7 ± 5.6	24.4 ± 2.6	23.9 ± 1.9	.001
	Fat %	27.7 ± 7.5	25.9 ± 7.7	28.2 ± 8.9	34.4 ± 8.4	30.3 ± 9.1	32.0 ± 10.2	22.5 ± 5.4	27.9 ± 3.6	.001
	WC (cm)	90.1 ± 13.1	90.3 ± 12.7	90.6 ± 13.8	89.5 ± 14.2	98.2 ± 14.0	91.6 ± 13.8	84.0 ± 9.0	81.3 ± 9.2	.071 NS
	SBP	127.7 ± 15.0	130.7 ± 15.2	130.7 ± 17.3	131.6 ± 19.2	127.4 ± 15.2	134.5 ± 15.6	134.6 ± 29.4	111.4 ± 14.2	.014
	DBP	77.8 ± 10.7	79.1 ± 9.9	77.9 ± 10.5	79.4 ± 11.3	81.5 ± 10.1	76.9 ± 9.4	78.9 ± 18.0	65.3 ± 13.0	.016
	HR	66.0 ± 9.9	65.7 ± 11.1	66.9 ± 11.1	67.5 ± 12.1	69.6 ± 11.6	70.6 ± 11.1	64.4 ± 8.3	71.1 ± 12.6	.001
Psychological outcomes	WAI	43.3 ± 3.7	42.4 ± 4.2	42.3 ± 4.6	41.7 ± 4.7	42.6 ± 4.8	41.0 ± 5.1	42.2 ± 5.8	44.6 ± 3.3	.002
	GHQ	10.4 ± 4.3	10.5 ± 4.5	11.0 ± 5.1	10.8 ± 4.6	117 ± 4.9	12.3 ± 5.9	9.3 ± 1.5	10.0 ± 3.7	.006
	JS	5.6 ± 1.1	5.3 ± 1.3	5.3 ± 1.3	5.5 ± 1.2	6.0 ± 0.8	4.9 ± 1.5	5.4 ± 1.2	5.2 ± 1.7	.001
	OC	47.8 ± 6.5	46.5 ± 7.5	46.4 ± 8.3	46.6 ± 7.9	48.4 ± 7.4	43.3 ± 9.2	41.7 ± 8.5	40.0 ± 5.4	.001
	JM	36.5 ± 3.1	35.0 ± 3.5	34.8 ± 3.8	35.0 ± 3.8	36.4 ± 2.7	33.4 ± 4.8	33.5 ± 0.7	32.0 ± 1.4	.001
	ITQ	3.1 ± 1.5	2.9 ± 1.6	2.8 ± 1.6	2.5 ± 1.5	2.7 ± 1.3	3.2 ± 1.8	3.1 ± 1.9	2.2 ± 0.4	.008
IPAQ (PA)	Walking	780 ± 706	746 ± 793	803 ± 849	926 ± 858	1072 ± 1302	865 ± 939	88 ± 83	2500 ± 1966	.001
	Moderate	232 ± 416	317 ± 546	279 ± 546	380 ± 906	735 ± 1351	227 ± 569	80 ± 139	462 ± 924	.005
	Vigorous	740 ± 1008	796 ± 1176	715 ± 1149	609 ± 976	779 ± 999	611 ± 1105	640 ± 733	1320 ± 1634	.536 NS
	Total	1751 ± 1479	1858 ± 1789	1797 ± 1668	1914 ± 1613	2586 ± 2498	1703 ± 1819	808 ± 803	4282 ± 1793	.028

managers, directors and senior officials were significantly higher compared to participants in professional occupations ($p < .01$); associate and technical occupations ($p < .001$). ITQ scores for employees in sales and customer service were significantly higher than participants in secretarial occupations ($p < .01$).

Table 6 shows the self-reported domain-specific sitting times for participants according to ONS job type. On a work day, sitting time reported by managers, directors and senior officials and those in professional occupations was significantly higher than participants in other job types (all $p < 0.01$). In addition, sitting time reported during transport was significant higher for managers, directors and senior officials compared to participants in sales and customer service ($p < .05$).

Discussion

This study incorporated a wide range of physiological and psychological measures and generated new data on physical activity, sedentary behaviour, and health among UK workers. The focus of the discussion is to explore the key findings that offer clear implications for workplace interventions.

Employees in sales and customer service had significantly higher BMIs than those in professional occupations. Fat percentage and HR readings for those in sales and customer service and secretarial occupations were significantly higher than other occupational groups. Employees in sales and customer service had significantly lower (poorer) WAI scores (though still in the 'good' category) and significantly higher GHQ scores (indicating greater psychological distress) compared to the other occupations. Job satisfaction, organisational commitment and job motivation were significantly lower for those in sales and customer service compared to the other occupations. ITQ was significantly higher among sales and customer service staff compared to participants in secretarial occupations. These findings highlight a need to focus interventions on employees in sales and customer services.

On a working day, managers, directors, senior officials and those in professional occupations spent significantly more time sitting than employees in associate and technical, secretarial, skilled trades, sales and customer service and elementary administration and service sectors. Moreover, sitting time reported during transport was significantly higher for managers, directors and senior officials compared to participants in sales and customer service. Interventions that encourage active commuting would seem especially beneficial with these senior managerial groups.

The findings suggest that private sector workers are particularly susceptible to high levels of sitting. On work days, their total sitting time and sitting time at work was significantly greater than public sector workers and even on non-work days their sitting time whilst working and using a PC at home was also significantly higher than public sector workers. Correspondingly, weekly and monthly hours worked, BMI and WC were significantly higher for workers in the private sector compared to the public sector. This

Table 6. ONS job type differences between sitting times

		Managers, Directors and Senior Officials	Professional occupations	Associate professionals and technical occupations	Secretarial and related occupations	Skilled trades	Sales and customer service	Process, plant and machine operatives	Elementary administration and service occupations	*p* Value ANOVA
Work day	Transport	68 ± 59	53 ± 42	60 ± 60	58 ± 40	48 ± 36	48 ± 53	103 ± 86	10 ± 20	.005
	Work	426 ± 111	405 ± 112	356 ± 116	356 ± 134	287 ± 120	360 ± 125	280 ± 92	125 ± 158	.001
	TV	82 ± 54	96 ± 66	96 ± 71	94 ± 70	82 ± 67	97 ± 72	120 ± 120	75 ± 90	.583 NS
	PC at home	64 ± 108	55 ± 77	57 ± 94	65 ± 116	37 ± 52	60 ± 87	20 ± 35	8 ± 15	.690 NS
	Other leisure	45 ± 46	44 ± 52	39 ± 53	42 ± 61	47 ± 68	52 ± 79	10 ± 17	75 ± 90	.283 NS
	Total	648 ± 151	653 ± 164	602 ± 179	617 ± 216	501 ± 177	614 ± 203	533 ± 148	293 ± 191	.001
Non-work day	Transport	47 ± 50	47 ± 47	49 ± 68	46 ± 43	55 ± 50	42 ± 50	40 ± 35	53 ± 86	.888 NS
	Work	35 ± 96	42 ± 105	45 ± 113	34 ± 86	35 ± 85	45 ± 107	0 ± 0	0 ± 0	.913 NS
	TV	131 ± 78	161 ± 101	161 ± 110	151 ± 110	154 ± 68	162 ± 122	240 ± 60	143 ± 96	.233 NS
	PC at home	76 ± 61	95 ± 93	87 ± 99	60 ± 76	65 ± 73	92 ± 112	60 ± 0	45 ± 90	.036
	Other leisure	117 ± 87	123 ± 100	110 ± 101	101 ± 105	114 ± 113	116 ± 119	100 ± 92	60 ± 85	.577 NS
	Total	414 ± 181	471 ± 217	457 ± 230	406 ± 233	440 ± 238	484 ± 242	440 ± 183	400 ± 171	.072

highlights the need to target private sector workers in interventions.

The findings showed some interesting geographical differences in that participants in the South East had better health measures (lower BMI, Fat% and HR) than those in Northern England and Scotland. WC measurements for participants in South East England were significantly lower than participants in Scotland. Job satisfaction, organisational commitment and motivation scores were significantly higher for participants in the South East of England compared to Northern England. Participants in South East England also reported significantly higher WAI and lower psychological distress on the GHQ scale compared to those in Northern England. ITQ was significantly higher in participants from Northern England compared to those in South East England. These more favourable health and psychological outcomes were evident even though participants in the South East of England worked longer hours than those in Northern England. Data on geographical differences in workforces can be important in terms of prioritising and targeting intervention initiatives.

This study also demonstrated some important gender differences. Males had significantly higher working hours than females. While males reported higher levels of physical activity per week than females, sitting times at work and while using a PC at home were higher for males in comparison to females. On non-work days, sitting time whilst working, watching TV and using a computer at home were higher for males compared to females. Total daily sitting times were significantly higher in males than females on both work days and non-work days. This suggests that workplace interventions designed to reduce sedentary behaviour should consider how to reach and influence male employees in particular and how the intervention may translate to sitting behaviour beyond the workplace.

This study provides new data on employee physical activity, sedentary behaviour and health outcomes and specifically offers new insights into gender, job role, industrial sector and geographical differences. The results are in line with previous research e.g. Kazi et al. (2014) in demonstrating that sitting at work and sitting during transport to work are major contributors to total sitting time across a wide range of job roles. The findings are consistent with previous studies, which suggest that the workplace is an ideal arena for interventions aimed at reducing sitting time (Chau et al. 2014; Kazi et al. 2014; Clemes et al. 2016). Sedentary behaviour is now a major threat to the health of workers and Straker and Mathiassen (2009) have argued for a new paradigm within ergonomics where work can be designed to instigate physical load and exercise to protect workers' health. In a recent study exploring what constitutes 'a good job' physical activity was a core feature which contributed to workers' perceptions of job quality (Jones, Haslam, and Haslam 2017). There is a pressing need for evidence-based interventions to increase physical activity and reduce sedentary behaviour in the workplace and to encourage active commuting.

The authors recognise the limitations of the study, which include the self-report nature of the psychological measures, domain-specific sitting time and physical activity data. Also, the findings reported are baseline (cross-sectional) data, which will be subsequently developed in the following article which presents the longitudinal data.

Participants in this study reported spending around 60% of their daily sitting time at work on a workday, providing strong evidence that the workplace is a

prime arena for introducing interventions to reduce sitting time and increase physical activity. The findings that males spend more time sitting on a work day and non-work day compared to females emphasises the need for workplace interventions to be inclusive and target harder to reach employees. Interventions need to be informed by user engagement to develop materials and techniques that are tailored to the workforce, and that will appeal to both male and female employees. Workplace interventions should also consider how the health information may translate to employees' home life activities. The results of this study showed that while employees in the South East had longer working hours they had better health outcomes and job attitudes. This would suggest that targeting workforces in Northern England and Scotland should be a priority. Finally, this research indicates that, when planning workplace interventions, it may be beneficial to target private sector organisations and focus on employees in sales and customer service industries. This is particularly important, given the continuing growth of service-related industries and the increased privatisation of the UK economy. Targeted interventions which take account of gender, job, sector and regional differences are likely to have the greatest impact on sedentary behaviour and health outcomes.

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