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UK university staff experience high levels of sedentary behaviour during work and leisure time

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Objective. Reducing sedentary behaviours at work is imperative. Before effective strategies can be developed there is a need to understand profiles of activity within particular roles and organizations. This study aimed to determine activity profiles of staff by job title at a UK university. *Methods.* Three-hundred and seventeen participants completed the international physical activity questionnaire – short form to determine physical activity profiles. Fifty-one participants also wore a wrist-worn GENEActiv accelerometer for 7 days and completed a self-report diary denoting work and leisure hours. *Results.* Twenty-one per cent of respondents were categorized as inactive and achieved 298 ± 178 metabolic equivalent minutes (MET-min)/week. Those in administrative roles were most sedentary (501 ± 161 min/day). Accelerometer data highlighted that sedentary time was identical between job roles (pooled mean 8746 ± 823 counts) and equated to 84 ± 9% of total time. During working hours, management, professional and specialist job roles had the highest level of sedentary time (2066 ± 416 counts). *Conclusion.* Time spent undertaking sedentary activities during working hours contributes to reduced overall activity and can impede productivity, performance and health. Interventions encouraging regular movement and preventing sedentary behaviours at work are therefore required.

Keywords: physical activity; job role; sedentary behaviour; accelerometry

1. Introduction

Despite a substantial evidence base advocating active lifestyles, sedentary and inactive behaviours continue to rise at an alarming rate [1,2]. Large proportions of the global population (20% of males and 27% of female adults, aged 18–64 years) are not meeting the World Health Organisation guidelines of at least 150 min of moderate-intensity physical activity throughout the week or at least 75 min of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate-intensity and vigorous-intensity activity [3]. This has resulted in physical inactivity being acknowledged as a major risk factor for morbidity and premature mortality [4], presenting arguably the most important public health issue of the 21st century [5]. Although the primary consequences of sedentary and inactive lifestyles are directly related to an individual's health and well-being [6], with an estimated cost to the global economy of USD 67.5 billion per annum [7] and a cost of GBP 1.5 billion in the UK there are increasing pressures on health service providers, resulting in physical inactivity being acknowledged as a national and international priority [4,8].

Recent observations implicate that a reduction in total physical activity could be the result of reduced active job roles [9], and increased technological innovation and remote working have led to a rise in desk-based activities that influence total physical activity achieved during the working day [10]. Landmark research conducted by Morris and Crawford [11] observed that bus drivers were more likely to develop coronary heart disease than the conductors of buses, due to the sedentary nature of being a bus driver. Since this initial and important work, the employment landscape has changed significantly, leading to an overall reduction in the number of jobs that can be considered as an active job role. This is partly caused by significant advancements in technology and rapid manufacturing that have led to increased time being inactive and sedentary during the working day [12]. More recently, the Office for National Statistics [13] reported a decline in active jobs available as recently as March 2014. Job roles in agriculture, fishing and forestry (−5.6%) and in mining and quarrying (−11.7%) have decreased, with a rise in inactive job roles, such as transport and storage (+11%), information and communications (+5%) and administrative and support service activities (+9.7%), thus resulting in an increasingly inactive workforce. McCrady and Levine [14] support this claim and suggest that employees are spending more time sitting at work (average 597 ± 112 min/day) than in their leisure time (484 ± 83 min/day). This finding is consistent with that from Jans et al. [15], who observed that Dutch workers spend approximately 7 h per day conducting sedentary activities. More recent figures estimate

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that 59% of males and 54% of females spend a combined time of 5 h or more per day standing and sitting during their working day in the UK [16].

Tackling inactivity at work has been recognized as an important area of opportunity due to prolonged periods of sedentary behaviours [2], resulting in several initiatives and interventions developed specifically to increase overall activity levels at work. Macniven et al. [17] found that self-monitoring of reaching 10,000 steps per day increased the step count by employees ($n = 587$). However, 92% of the population were already meeting the physical activity recommendations, with the intervention lasting only 16 weeks and step count being the only measurable outcome. Similar to this, Thøgersen-Ntoumani et al. [18] found that participating in 5×30 min of walking per week (three walks at lunch during the working week and two at the weekend) for 16 weeks improved the step count and managed to obtain an adherence of 73% of the recommended physical activity guidelines. Surprisingly, although workplace interventions to increase physical activity or reduce sedentary behaviour have been trialled, the majority of these do not use theoretical frameworks that include key ecological environmental constructs to guide their research [19], and without considering social, organizational, policy, community and physical environment variables, attempts to increase health-related behaviours in workplace settings are less likely to be successful [20]. This study used organizational cultural theory and evidenced that the importance of considering the inter-related aspects of values/beliefs, strategy, structure, organizational operations and external environment is key in understanding patterns of physical activity and sedentary behaviour in the workplace. Despite this, there is a paucity of research which examines variation in physical activity habits according to different job roles within organizations. Organization cultural theory would posit that behaviours may differ due to strategy differences, i.e., different job roles will have different preset job-related objectives, and structures, i.e., different job roles may be subject to different rules in terms of work-related movement, such as being solely desk-based. This would manifest itself in changes in organizational operations, which are then mediated by each employee's values and beliefs, the organization's values and beliefs and external environmental influences [20] University settings offer a unique opportunity to determine the within-organization and between-role differences in physical activity levels due to the volume of staff who are categorized into specific and clearly defined roles, which is reflective of broader occupational settings and differences in the strategy and structure components of organizational cultural theory. Previous research attempting to reduce sedentary activity during working hours has adopted broad approaches that do not consider differences within organizations and associated job titles, leading to limited application and varying success. This highlights a need to better understand the profiles/characteristics of particular job titles and their activity levels within and outside the work environment. Accordingly, this study aimed to assess the physical activity duration and intensity achieved during work and leisure time, to determine differences between job titles in university staff in the UK.

2. Methods

2.1. Participants and procedures

Following ethics approval from the host university and informed consent, 317 participants (61% female), with a mean age of 42 ± 11 years, completed the international physical activity questionnaire – short form (IPAQ-SF) to determine staff physical activity profiles between October 2017 and October 2018. The survey was made available for completion through an online survey host (SurveyMonkey^{TM}) and participation was achieved via advertised targeted digital communications (e-mail and newsletters) and face to face approaches. The total sample represents an 11% response rate of all listed staff employed by that organization during the time of collection. Responses were categorized according to the titles allocated by the university human resources department and consisted of 'administrative support' (e.g., personal assistant, college advisor and administrative assistant), 'management, professional and specialist' (e.g., health and safety advisor, college registrar and corporate communications), 'operations support' (e.g., support worker, cleaner and kitchen assistant) and 'teaching and research' (e.g., lecturing staff and research fellow).

Subsequent to the questionnaire, all participants who completed the survey were invited to wear a wrist-worn GENEActiv accelerometer (ActivInsights Ltd, UK) on their non-dominant hand for 7 days, similar to the protocol of Dillon et al. [21]. These methods have been used extensively in the literature and provide an objective understanding of the frequency and intensity of activities that are completed, which are not captured with questionnaire approaches. During this study, all participants ($N = 51$) were instructed to maintain their habitual activities and to wear the device continuously during data collection. The GENEActiv is a lightweight triaxial accelerometer which provides raw acceleration data and has previously been described in detail [22]. It has high intra-instrument and inter-instrument reliability (coefficient of variation = 1.8 and 2.4%, respectively) and good criterion-referenced validity ($r = 0.97$) when compared to a multi-axis shaking table, and also a high concurrent validity with the Actigraph GT1M accelerometer [22]. Participants also provided a diary that captured information around their working schedule (days and hours per week) during the time of sampling, to allow comparisons to be made between overall activity, time being active at work and leisure time. Seven participants were excluded from

this part due to injury and were unable to achieve their usual activities.

2.2. Measures

Physical activity was assessed using the IPAQ-SF. The IPAQ-SF is a nine-item questionnaire that allows participants to quantify their engagement in physical activity over 7 days. Physical activity is categorized by the intensity and includes time spent walking and sitting and being moderately and vigorously active, the sum of which is used to provide total physical activity time. Subsequently, this is converted respectively into metabolic equivalents (METs), which represents the energy expenditure of physical activity as a multiple of the resting metabolic rate [23]. Weekly minutes of walking is multiplied by 3.3, moderate physical activity is multiplied by 4.0 and vigorous physical activity is multiplied by 8.0 as denoted by the IPAQ guidance [24]. In addition to physical activity, the IPAQ-SF also provides information on total daily minutes of sitting time. From the information collected on the duration and intensity of physical activity undertaken, participants were individually classified according to the IPAQ physical activity classification. The IPAQ-SF categorizes physical activity habits into three categories: low (physically inactive), moderate and vigorous. Moderate physical activity is defined as achieving at least 600 MET-min/week through a combination of vigorous physical activity, moderate physical activity or walking, 30 min of moderate physical activity on at least 5 days per week or 20 min of vigorous activity on 3 days. High physical activity is defined as either: vigorous physical activity on at least 3 days, achieving more than 1500 MET-min/week; or being active on 5 days or more, expending at least 3000 MET-min/week. Low physical activity is defined as an individual failing to meet the minimum criteria set for moderate physical activity [24].

Accelerometer data were sampled at 100 Hz at a time interval (epoch) of 60 s and were reported as counts per minute (CPM). Counts were estimated using GENEActiv version 3.1 post-processing software. Following the return of the accelerometer, data were analysed from the three planes of motion and collapsed using the sum of vector magnitude equation: SVMgs $= \sum\sqrt{(x^2+y^2+z^2)}-g$. Each period was categorized based on the value of SVMgs with specific cut-off points, derived from previous work in this area [21] and used to determine the intensity of the physical activity achieved. Non-dominant cut-off values were <158.5 SVMgs (sedentary), <261.8 SVMgs (light), <465 SVMgs (moderate) and ≥465 SVMgs (vigorous), as detailed previously [21,25]. Participants were classified as either meeting (sufficiently active) or not meeting (insufficiently active) the physical activity guidelines.

2.3. Statistical analysis

Raw data were filtered, and 13 data sets were excluded due to forms being incomplete, inaccurate or containing anomalous data. Pairwise comparisons were used to exclude missing values before statistical analysis. All data were analysed using SPSS version 24.0. Survey responses and accelerometer data were analysed using a one-way analysis of variance (ANOVA) to determine differences between job titles, level of physical activity achieved and daily sitting time. All data are presented as mean ± standard deviation with an α level of <0.05 used to denote statistically significant differences.

3. Results

3.1. Survey

The findings show that 21% ($n = 64$; mean 298 ± 178 MET-min/week, range 0–594 MET-min/week) of participants are currently classed as undertaking low levels of physical activity and 34% ($n = 115$; mean 1459 ± 665 MET-min/week, range 600–2994 MET-min/week) and 45% ($n = 144$; mean 3921 ± 1348 MET-min/week, range 2060–8586 MET-min/week) undertook moderate and high levels of physical activity, respectively. The average MET-min/week across the sample was 2447 ± 2417 min per day and the average sitting time was 448 ± 189 min per day (Table 1). Interestingly, once the data were aggregated for job role, individuals employed as part of administrative support demonstrated reduced physical activity levels, when compared to individuals employed as part of operations support, management, professional, or specialist and teaching and research, respectively.

3.1.1. Total physical activity

The highest levels of total physical activity were reported by those in operations support, equating to 3741 ± 4952 MET-min/week, which was not significantly different to management, professional or specialist (2470 ± 1245 MET-min/week, $p > 0.05$). In contrast, when administrative support (1954 ± 1814 MET-min/week) and teaching and research (2661 ± 1565 MET-min/week) were compared to operations support, the differences were statistically different ($p < 0.05$).

3.1.2. Vigorous physical activity

Individuals employed as part of administrative support reported the lowest levels of vigorous activity per week (910 ± 1337 MET-min/week), but this was similar ($p > 0.05$) to all other job categories (Table 1). The role that reported the highest level of vigorous activity was management, professional and specialist (1170 ± 1254 MET-min/week), and this was similar to all other job categories (Table 1, $p > 0.05$).

Table 1. IPAQ-SF responses obtained from staff.

Variable	Total physical activity[a] (MET-min/week)	Vigorous physical activity (MET-min/week)	Moderate physical activity (MET-min/week)	Walking (MET-min/week)	Sitting time[b] (min/day)	IPAQ category[c]
Total ($N = 317$)	2447 ± 2417	1060 ± 111	500 ± 176	1100 ± 440	448 ± 189	2.25 ± 0.77
Administrative support ($N = 83$)	1954 ± 1814	910 ± 1337	281 ± 507	762 ± 776	501 ± 161	2.05 ± 0.76
Management, professional and specialist ($N = 89$)	2470 ± 1245	1170 ± 1254	465 ± 656	919 ± 825	444 ± 187	2.33 ± 0.74
Operations support ($N = 28$)	3741 ± 4952	1141 ± 1592	730 ± 1582	1870 ± 2617	412 ± 201	2.36 ± 0.83
Teaching and research ($N = 117$)	2406 ± 2007	1022 ± 1127	429 ± 644	954 ± 1163	419 ± 205	2.27 ± 0.77

[a]Total METs derived from the IPAQ-SF in terms of combined time spent at vigorous intensity, moderate intensity and walking.
[b]Average self-reported daily sitting time from the IPAQ-SF.
[c]Category derived from the IPAQ-SF scores to quantify level of physical activity.
Note: Data reported as mean ± standard deviation relative to categorization of the job role. IPAQ-SF = international physical activity questionnaire – short form; METS = metabolic equivalents.

3.1.3. *Moderate physical activity*

Following the trends observed for vigorous physical activity, individuals employed as part of administrative support demonstrated the lowest amount of moderate physical activity (281 ± 507 MET-min/week), and this was significantly lower than the values reported for operations support (730 ± 1582 MET-min/week, $p < 0.05$) but was similar to all other job categories (Table 1, $p > 0.05$).

3.1.4. *Walking*

Self-reported walking was highest in operational support (1870 ± 2617 MET-min/week), which was significantly higher than administrative support (762 ± 776 MET-min/week, $p < 0.05$) but was similar to all other groups (Table 1, $p > 0.05$).

3.1.5. *Sitting time*

Those reporting the highest levels of sitting time were those representing administrative support (501 ± 161 min); however, the time spent seated was not different when comparisons were made against each job role (Table 1, $p > 0.05$).

3.2. *Accelerometer data*

Mean working hours of the participants was 28.3 ± 4.7 h and was similar between each job title ($p > 0.05$). Average counts recorded were $10{,}408 \pm 322$ across the sample, with no between-group differences once separated for job role (see Table 2, $P > 0.05$). Those in administrative job roles recorded the highest level of total physical activity (2036 ± 881 counts), which was similar to all other job roles (Table 2, $p > 0.05$). When the data were broken down by the intensity of physical activity achieved, neither vigorous or moderate activity was different between job roles ($p > 0.05$); however, administrative staff reported a higher level of light activity (1452 ± 837 counts) when compared to those employed in teaching and research (1028 ± 1155 counts, $p < 0.05$) and management and professional services (999 ± 450 counts, $p < 0.05$).

Total physical activity levels were higher during leisure time in all groups when compared to the data obtained during working hours (pooled average work 337 ± 207 counts, leisure 1324 ± 816 counts, $p < 0.05$), with administrative staff reporting the highest within-group difference (work 263 ± 226 counts compared with leisure 1772 ± 739 counts, mean difference 1376 ± 690 counts, $p < 0.05$).

Sedentary time was high in all group counts but was not different between groups (see Table 2; pooled average 8746 ± 823 counts, $p > 0.05$). When the data are expressed relative to activity versus sedentary time, $84 \pm 9\%$ of the time was spent being sedentary with no between-group differences (Table 2, $p > 0.05$). During working hours, sedentary time was highest in management, professional and specialist roles (2066 ± 416 counts), but this was similar when compared to all groups.

4. Discussion

The key findings of this study highlight that a significant proportion (21%) of staff in a university setting are not achieving the recommended levels of daily physical activity, findings which are not biased towards particular roles

Table 2. Accelerometer outputs recorded over a 7-day period, reported by job titles and the level of activity achieved during work time and leisure time ($n = 51$).

Job title	Total physical activity			Vigorous physical activity			Moderate physical activity			Light physical activity			Sedentary time		
	Overall (G-forces (g))	Work (G-forces (g))	Leisure (G-forces (g))	Overall (G-forces (g))	Work (G-forces (g))	Leisure (G-forces (g))	Overall (G-forces (g))	Work (G-forces (g))	Leisure (G-forces (g))	Overall (G-forces (g))	Work (G-forces (g))	Leisure (G-forces (g))	Overall (G-forces (g))	Work (G-forces (g))	Leisure (G-forces (g))
Administrative support ($N = 13$)	2036 ± 881	263 ± 226	1773 ± 739	72 ± 104	16 ± 31	56 ± 86	510 ± 188	103 ± 87	407 ± 135	1452 ± 837	144 ± 147	1308 ± 731	8598 ± 550	1795 ± 505	6803 ± 932
Management, professional and specialist ($N = 19$)	1523 ± 609	294 ± 126	1229 ± 529	131 ± 137	22 ± 30	108 ± 125	409 ± 196	115 ± 48	294 ± 167	999 ± 450	155 ± 69	844 ± 407	8914 ± 467	2066 ± 416	6847 ± 453
Operations support ($N = 4$)	1796 ± 230	305 ± 71	1491 ± 224	46 ± 50	4 ± 6	42 ± 43	374 ± 93	75 ± 38	298 ± 71	1375 ± 108	225 ± 47	1150 ± 141	8872 ± 174	1505 ± 443	7367 ± 563
Teaching and research ($N = 19$)	1510 ± 1263	441 ± 252	1069 ± 1071	53 ± 47	11 ± 20	41 ± 39	445 ± 197	138 ± 64	307 ± 177	1028 ± 1155	291 ± 225	737 ± 955	8642 ± 1268	1949 ± 734	6692 ± 1151

Note: All data reported as mean ± standard deviation.

within the organization. Secondly, there is a high prevalence of sedentary behaviour recorded by all respondents during working hours. The findings here are consistent with previous work in this area, which demonstrates that universities, despite their unique setting and facilities and policies that support physical activity, are not immune to the high periods of inactivity during a working day. Cooper and Barton [26] demonstrated that of the 502 respondents, 42% ($n = 242$) of their sample reported low levels of physical activity below the recommended guidelines. Interestingly, the authors here provide little detail and/or comparison of the job titles of the sample, which is limited to academic versus non-academic colleagues, therefore it is unclear how the differing job roles and associated responsibilities influence total physical activity. Similarly, high proportions (59%) of staff and students were reported as inactive by Rissel, Mulley and Ding [27] when they investigated the physical activity and the importance of active transport at Sydney University. The results of these two previous studies provide findings that are notably higher than those reported in this study. An interesting comparison with these previous studies is that the data collected as part of this study is expressed in line with the most recently published guidelines from the Chief Medical Officer [28]. The guidelines have been reconfigured to incorporate a greater level of flexibility by adopting a cumulative approach rather than achieving the previously reported 30-min exercise blocks. Within the new guidelines, it is stated that any activity is better than no activity, but more is better still. Despite a more flexible approach, a significant number of staff are still not achieving the required levels of activity, which is primarily the result of prolonged periods spent conducting sedentary tasks whilst at work.

Whilst the evidence available to make informed conclusions of all academic institutions is limited, the literature demonstrating prolonged sedentary behaviours/inactivity across the broader employment sector is more established and demonstrates that the findings here are not isolated to academic settings or job roles. Parry and Straker [6] observed that sedentary behaviours accounted for 82% of total work hours, with only 3% of total work time spent achieving levels of moderate and vigorous physical activity, and concluded by stating that office-based employment is highly characterized by sustained periods of inactivity and sedentary behaviours. Interestingly, the authors observed a noticeable difference between the levels of sedentary behaviour that was achieved at work compared with leisure time (82% vs 69%, $p < 0.001$). The data here indicate that sedentary time was significantly greater than physical activity levels across all groups (as shown in Table 2), a finding that was consistent during work and leisure time. Interestingly, the accelerometer data confirmed low periods of activity during work time for each intensity and this was significantly different for both light and moderate intensity counts when compared to leisure

time, reinforcing the need to address prolonged periods spent being sedentary during working hours. A qualitative exploration of 547 office workers highlighted that the most common barrier to engaging with physical activity during the working day is the constraint of the role, which requires prolonged periods sitting and using a computer to fulfil the requirements of the role [29]. The body of literature demonstrating the implications of a sedentary workforce has stimulated a plethora of intervention studies that attempt to increase engagement with physical activity during the working day. A systematic review by Pereira et al. [30] highlighted large variation in the design and success of intervention studies, which are largely driven by productivity and performance metrics rather than increases in participants' health and well-being, which is a determinant of productivity and performance. Whilst there is inconsistent evidence that workplace intervention programmes are effective, the authors state there is a need to consider the design and approaches to developing interventions that specifically target those who are most sedentary and considered at risk, whilst also considering interventions that consider the intensity at which activity is conducted.

University settings offer a unique opportunity to promote increased physical activity levels due to the presence and access to superior facilities, resources, appropriately qualified staff (including health professionals) and supportive systems [31], but similar to the broader employment sector, those employed in these institutions are not immune to prolonged periods of sedentary behaviour whilst at work. Whilst we provide a clear need for research to develop efficacious interventions that increase physical activity within staff members, future approaches must consider those that perturb prolonged sedentary profiles which may include regular breaks to reduce sedentary time in order to realise prolonged health effects [32]. More flexible approaches, underpinned within the revised physical activity guidelines and considering the broader and interrelated determinants that are captured within contemporary theoretical models such as the Capability, Opportunity, Motivation, Behaviour (COM-B) model [33] and innovative and contemporary approaches to intervening [36], would be the most successful interventions.

This study provides an important insight into the levels of sedentary activity during working and leisure hours that is not biased to particular job titles within a university institution. In the context of organizational cultural theory, this might suggest that there was a similarity in aspects of the organization's value and belief system, strategy and structures which resulted in more homogeneous patterns of organizational activities in relation to sedentary behaviour. Further work in this area should include larger cohort observations and combine this with the use of objective and mixed-method approaches to better understand the broader determinants of engaging with physical activity whilst at work, from the perspectives of a range of stakeholders such as employees of different roles, managers and contractors [34]. The authors here acknowledge the low response rate to the survey component (317 responses, 11%) as a limitation to this study. Participants were categorized according to defined roles by the human resource department and the total responses were similar across each group, so we are confident that the sample is generalizable, allowing comparisons to be made between each group. Future work in this area may wish to consider the demographic profile within each defined job role category and consider the implications this might have upon total physical activity and/or sedentary time to better understand the impact upon performance indicators such as concentration, absenteeism, productivity, health, engagement and well-being. Whilst outside the scope of the current study, which sought to determine the prevalence of inactivity in university employees, it may be pertinent to also assess the multiple domains and interactions that occur as part of a complex system [35], to ascertain an increased depth of understanding the broader influences of work-based activity, leading to the development of more encompassing interventions which reflect holistic perspectives and the participant engagement of key stakeholders. Systems mapping literature [36] emphasizes the need to identify and study the whole system and dynamic interrelations, rather than singularly identifying individual elements in isolation, an approach being developed in the community as well as in National Health Service contexts [37]. Given that interventions impacting on physical activity and sedentary behaviour of university employees will occur across multiple systems (e.g., workplace, travel, healthcare), a real strength of the whole systems-based approach is that it considers the complete system across different settings and thus offers potential for promoting physical activity and reducing sedentary behaviour in higher education institutions.

5. Conclusion

The findings of this study provide a strong indication that university employees experience high levels of inactivity during their working day and also during their leisure time. This information confirms the documented prevalence of inactivity of university staff and provides key considerations for the expansion of knowledge in this area and that there is the requirement for the development of interventions to tackle this challenge, including those that adopt innovative approaches.

Disclosure statement

No potential conflict of interest was reported by the authors.

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