Perceived barriers and facilitators to workplace exercise participation.

Structured Abstract:

Purpose: Workplace exercise programs have been shown to increase employee participation in physical activities and improve health and fitness in the short-term. However, limited breadth of employee engagement across organisations combined with declining exercise adherence within individual studies indicates a need for better-informed programs. This study investigated relationships between employee moderate-vigorous physical activity (exercise) participation and their perceived barriers and facilitators to engagement in onsite exercise, to inform the design and implementation of future workplace exercise interventions.

Design/methodology/approach: An online survey identified employee demographics, exercise (International Physical Activity Questionnaire), perceived barriers (Corporate Exercise Barriers Scale) and facilitators to exercise at an Australian university.

Findings: Of the 252 full-time employees who responded, most reported meeting (43.7%) or exceeding (42.9%) exercise guidelines over the previous week. A lack of time or reduced motivation (p<0.001), exercise attitude (p<0.05), internal (p<0.01) and external (p<0.01) barriers towards workplace exercise participation were all associated with failure to attain government-recommended volumes of weekly exercise. Personal training (particularly for insufficiently active employees) and group exercise classes were identified as potential exercise facilitators. Walking, gym (fitness centre), swimming and cycling were identified as the preferred modes of exercise training.

Practical implications: Employees not meeting recommended volumes of exercise might require additional support such as individualised gym and cycling programmes with personal supervision to overcome reported exercise barriers to improve exercise participation, health and fitness.

Originality/value: This study identifies specific barriers and facilitators to workplace exercise participation perceived by university employees. These findings can be used to inform the design and

implementation of workplace exercise programs aiming to achieve wider workplace engagement and greater exercise adherence, particularly of less active employees.

Introduction

The importance of being physically active (Caspersen, Powell & Christenson 1985) to reduce the risk of non-communicable diseases is well established (Ezzati et al. 2002). Regular exercise (i.e. planned, structured and repetitive physical activity) (Caspersen, Powell & Christenson 1985) improves cardiorespiratory and muscular fitness, reducing all-cause and cardiovascular mortality risk (Barry et al. 2013; Blair et al. 1989; Gupta et al. 2011; Lee & Skerrett 2001; Newman et al. 2006). Globally, physical inactivity (i.e. not meeting moderate-vigorous exercise recommendations) is estimated to cause 10% of the breast and colon cancer burden, 7% of type 2 diabetes, 6% of ischaemic heart disease, and 9% of overall premature mortality using conservative population attributable fractions (Lee et al. 2012). Furthermore, prolonged sedentary behaviour (i.e. sitting for more than eight hours per day) has been identified as an independent cardiometabolic (Owen et al. 2014; Staiano et al. 2014) and all-cause mortality risk factor (Chau et al. 2013; Van der Ploeg et al. 2012) even when accounting for volume of moderate-vigorous exercise performed. Despite the respective negative and positive health consequences of sedentary behaviour and exercise, 41% of men and 48% of women living in developed countries do not engage in sufficient (at least 150 minutes per week) moderate-intensity exercise to attain health benefits (World Health Organisation 2010).

The workplace presents a viable setting in which to promote the benefits of being physically active (World Health Organisation 2008) and to minimise the commonly reported barriers to exercise; a lack of time and access to facilities (Trost et al. 2002). Employees have reported workplace fitness centres as their most preferred workplace health promotion service, and would make use of onsite fitness facilities if they were provided (Kruger et al. 2007). In a systematic review and meta-analysis, Conn et al. (2009) concluded that workplace physical activity interventions (27% of which included supervised exercise sessions, and 80% of which included motivational or educational sessions) can

improve employee health and health-related outcomes, although effects were heterogeneous across outcomes. As a workplace, universities present suitable settings for the delivery of onsite exercise programs in particular, for several reasons. Firstly, large numbers of employees allow for economies of scale in program development and implementation. Secondly, universities often possess the infrastructure, resources and expertise required to deliver, monitor and assess the effectiveness of exercise programs (Seifer 2000). Thirdly, many job roles within universities involve prolonged sedentary behaviour throughout the working day (Alkhatib 2013), creating a significant opportunity for change (Buckley et al. 2015). This final point may in part explain the recent finding that employees who enrolled into a university workplace exercise program were mostly overweight with poor cardiorespiratory fitness (Hunter et al. 2018).

While onsite fitness centres may facilitate exercise engagement by offering convenience and reduced employee membership costs (Brown et al. 2014), studies involving US (Leininger, Adams & DeBeliso 2015) and Canadian (Pérusse-Lachance, Tremblay & Drapeau 2010) university employees report large variations in the proportion of employees meeting exercise guidelines (62% and 35% respectively, based on self-report data). Furthermore, the effectiveness of university-specific workplace interventions to improve long-term employee exercise participation and health is unknown. Specifically, a review of university and college physical activity (predominantly walking), diet and weight loss interventions found that nine of ten studies investigating changes in staff exercise participation or fitness reported improvements in daily step counts, leisure-time physical activity, cardiorespiratory fitness, muscular strength, flexibility and/or reduced daily sitting time (Plotnikoff et al. 2015). However, most interventions were of short duration (5-12 weeks) without long-term follow-up, with low overall participation rates acknowledged as a limiting factor to the wider positive impact on employee health and fitness. Since this review, a university-based randomised controlled trial reported a significant decrease in weekly onsite exercise training session attendance by employees over eight weeks (from a mean 1.9 to 1.4 sessions per week), regardless of whether they received 1:1 exercise supervision in addition to onsite facility access or not (Hunter et al. 2018). Collectively, these

data suggest that workplace exercise programs are efficacious for improving health, fitness and exercise participation in the short term, but these programs require refinement to increase engagement and adherence.

Recent survey (Brown et al. 2014; Leininger, Adams & DeBeliso 2015) and focus group (Das, Rinaldi-Miles & Evans 2013; Hill-Mey et al. 2013) studies cite time constraints and work schedule conflicts as the most commonly reported barriers to health and exercise program participation by university employees, however associations between volume of exercise completed and workplace exercise-specific barriers and facilitators are unknown. Therefore, it is important to gather detailed information regarding specific barriers and facilitators of workplace exercise participation in order to make informed decisions regarding the design and implementation of such programs to have the widest reach and greatest effectiveness on employee engagement and improved health and fitness. Specifically, the magnitude of perceived time, motivation, attitude, internal and external barriers to onsite exercise participation should be established, along with potential facilitators such as preferred mode of exercise and exercise assistance (supervision). Information regarding barriers and facilitators to exercise will assist the development of targeted workplace exercise programs that promote engagement and adherence to improve the long-term exercise behaviour, health and fitness of employees. A targeted exercise program might be effective at reducing employee absenteeism (Losina et al. 2017) and presenteeism (Walker et al. 2017), contributing to greater overall worker productivity, which has been identified as an area in need of improvement in academic settings (Kinman & Wray 2018). This study investigated: i) the current exercise participation of university employees; ii) the perceived barriers and facilitators (i.e. preferred mode of exercise and type of exercise assistance) to workplace exercise participation; and iii) the associations between perceived exercise barriers and facilitators and exercise participation.

Methods

Participants and procedures

After approval of the research protocol by the university human research ethics committee, employees of an Australian university's national (Melbourne (City and Bundoora)) and international (Vietnam) campuses were invited to participate in an online survey. The Vietnam campus provides similar study options to those available at the Melbourne campus in the fields of design and social context; science, engineering and health; and business. Therefore, apart from cultural differences, the knowledge and qualifications of individuals responding from different locations can be assumed to be similar. The survey was advertised in the university's weekly employee newsletter and on the research page of the university website during January to April 2015, and had the potential to reach 3,104 full-time employees. These means of advertising were chosen in order to generate maximum exposure for the study while adhering to the university policy, which restricts any direct email communication. The inability to directly contact staff is likely to have limited the overall response rate. The survey was conducted online using Qualtrics (Qualtrics Development Company, vers. 0206475, Provo, UT, USA) to ensure accessibility and minimise misplacement of paper surveys or failure of surveys to be returned. Only current full-time university staff were eligible to participate in the survey, and there were no other exclusion criteria. Participants could be any age and either blue- or white-collar employees, the details of which are provided in Table 1. Completion of the survey, after reading the information statement on the first page, was interpreted as providing informed consent. If employees did not consent, they were automatically redirected to the final 'thank you for your time' screen.

Measures

Demographics. Data on campus location, sex, age, ethnicity, education level, employment type (academic, professional or trades and services) and employment status (full-time or part-time) were collected. To specifically investigate the barriers and facilitators to workplace exercise of employees with limited time for leisure activities (including exercise), only full-time employees were included in analyses as part-time staff are likely to have other opportunities to be active.

Stage of behaviour change. The four-item physical activity stage of behaviour change questionnaire (Marcus & Forsyth 2009) classified employees into one of five categories in relation to regular exercise participation: pre-contemplation, contemplation, preparation, action and maintenance.

Exercise participation. The short-form International Physical Activity Questionnaire (IPAQ) (International Physical Activity Questionnaire Group 2014) was used to assess sedentary behaviour (weekday sitting time) and exercise participation. The IPAQ is an open access, self-report measurement tool that quantifies exercise (≥10 min bouts) into three categories; 1) walking; 2) moderate-intensity; and 3) vigorous-intensity exercise. The frequency and duration of activity reported in each of the categories was used to calculate MET-minutes (MET·min) of energy expenditure per week (International Physical Activity Questionnaire Group 2014). The IPAQ has acceptable reliability (test-retest; Spearman's ρ = 0.81) and validity (criterion-referenced; median ρ = 0.3) in adults across 12 countries, including Australia (Craig et al. 2003). The IPAQ data were used to classify participants as having a low (not meeting exercise guidelines); moderate (meeting exercise guidelines i.e. ≥30 minutes of moderate-intensity exercise on most days or ≥25 minutes of vigorous-intensity exercise on at least three days per week); or high (exceeding exercise guidelines i.e. ≥1500 MET·min per week of vigorous-intensity exercise or ≥3000 MET·min per week of a combination of moderate- and vigorous-intensity exercise) category of exercise participation (International Physical Activity Questionnaire Group 2014).

Perceived barriers to exercise. The 17-item Corporate Exercise Barriers Scale (C-EBS) using a 5-point Likert scale (*strongly disagree to strongly agree*) was used to assess perceived barriers to exercise participation and onsite fitness centre use (Schwetschenau et al. 2008). The C-EBS is a reliable measure (Cronbach's alpha 0.62-0.87) of barriers to workplace exercise participation (Schwetschenau et al. 2008) that contains four barrier dimensions: (a) time/motivation barriers (e.g., job demands don't allow time), (b) exercise attitudes barriers (e.g., I don't like the way exercise makes me feel), (c) internal barriers (e.g., I am embarrassed to exercise around my co-workers), and (d) external barriers (e.g., membership costs are too high).

Preferred types of exercise. Participants were asked what types of exercise they would most like to do if they were to exercise more or to take up exercise. Based on previous research involving Australian adults, a list of nine activities (walking, swimming, team sports, racquet sports, jogging, fitness centre, aerobics, cycling, and other) that have been found to account for most leisure-time exercise (Booth et al. 1997) were available for participants to choose all that applied.

Preferred types of exercise assistance. Participants were asked what type of assistance they would prefer if they were to exercise more or to take up exercise (Booth et al. 1997). Ten alternate responses were offered: (i) advice from a doctor or other health professional; (ii) a group of other people to exercise with; (iii) a personal trainer for each exercise session; (iv) advice over the telephone; (v) a video on how to exercise; (vi) a book on how to exercise; (vii) an exercise 'kit' containing pamphlets and practical tips; (viii) a course sent through the mail; (ix) no form of assistance; (x) other (Booth et al. 1997).

Statistical Analysis

Survey response data were exported from Qualtrics into the Statistical Package for Social Sciences (SPSS for Windows, vers. 24.0, SPSS Inc., Chicago, IL, USA) for analysis. An alpha level of 0.05 was set as significant for all statistical testing. Descriptive statistics (frequencies and percentages, means and standard deviations, medians and interquartile ranges) were used to describe participant characteristics and their responses to the survey. Data were inspected visually and statistically (Kolmogorov-Smirnov statistic) for normality prior to analysis, and where data were not normally distributed and log transformation did not achieve normality, non-parametric analyses were conducted. Chi-Square were used to investigate associations between demographic characteristics and exercise participation as defined by the IPAQ (i.e. low, moderate or high). To compare exercise participation and perceived exercise barriers, mean sub-scores were calculated for each barrier dimension (i.e. time/motivation, exercise attitudes, internal and external barriers) and also summed to calculate a total barrier score. The questions pertaining to each barrier dimension were determined from a previous study using factor analysis (Schwetschenau et al. 2008). A one-way ANOVA was used

to compare barrier dimension sub-scores between those reporting low, moderate and high exercise participation. If results of the ANOVA were significant, a post-hoc comparison using the Tukey HSD test was undertaken. Chi-square were used to investigate differences in preferred exercise modes and types of assistance between employees not meeting and meeting or exceeding exercise guidelines.

Results

Demographics, stage of behaviour change and exercise participation

Two-hundred and fifty-two full-time employees (95% white-collar; 60% female; 79.4% aged 30-59 years; 57% professional and 38% academic) responded to the survey (response rate = 8.1%). Based on self-reports for the prior week, 42.9% of respondents were classified as exceeding exercise guidelines (i.e. high activity level), 43.7% as meeting exercise guidelines (i.e. moderate activity level) and 13.5% as not meeting exercise guidelines (i.e. low activity level). Chi-square analyses revealed no differences in 7-day exercise participation between participant demographics (Table 1). Reported weekly walking, moderate-intensity, vigorous-intensity and total exercise-related energy expenditure was a median (IQ range) 693 (347-1386) MET·min, 360 (0-720) MET·min, 600 (0-1440) MET·min and 1884 (1115-3265) MET·min respectively. Self-report exercise behaviour for the previous six months indicated 64.7% of employees were in maintenance, 8.3% were in action, 10.9% were in preparation, 12.4% were in contemplation and 3.8% were in the pre-contemplation stage of change.

INSERT TABLE 1 HERE

Associations between perceived barriers to exercise and exercise participation

Response frequencies and percentages for each perceived exercise barrier within the corporate exercise barriers scale are provided in Supplementary Table 1. One-way between-group ANOVA found significant associations between each barrier dimension (p<0.01) and exercise participation (i.e. low, moderate and high; Table 2). Large effect sizes (partial eta squared) for total barrier score and time

and motivation barriers, moderate effects for internal and external barriers, and a small effect size for exercise attitude barriers were observed (Table 2). Both total barrier score and time and motivation barriers were higher for employees who reported low (p<0.001) and moderate (p<0.001) compared to high exercise participation (Table 2). Time and motivation barriers were also higher in those reporting low (p<0.01) compared to moderate exercise participation (Table 2). Exercise attitude barriers were higher in employees who reported low (p<0.05) and moderate (p<0.05) exercise participation compared to those reporting high participation (Table 2). Internal barriers were higher in employees who reported low (p<0.01) and moderate (p<0.001) exercise participation compared to those reporting high participation (Table 2). Similarly, external barriers were higher in employees who reported low (p<0.01) and moderate (p<0.01) exercise participation compared to those reporting high participation (Table 2).

INSERT TABLE 2 HERE

Preferred Modes of Exercise and Types of Exercise Assistance

For employees meeting or exceeding vs. not meeting exercise guidelines, the most preferred types of exercise they would like to do if they were to take up exercise or exercise more frequently were walking (62% vs. 77%; p=0.13), swimming (43% vs. 56%; p=0.21), gym/fitness centre (48% vs. 47%; p=1.00), cycling (45% vs. 44%; p=1.00) and exercise classes (33% vs. 41%; p=0.43) (Figure 1). For employees meeting or exceeding vs. not meeting exercise guidelines, having a personal trainer (27% vs. 38%; p=0.26), receiving no form of assistance (26% vs. 21%; p=0.63) or exercising in a group (25% vs. 15%; p=0.28) were the most preferred types of exercise assistance (or non-assistance) (Figure 2).

INSERT FIGURE 1 HERE

INSERT FIGURE 2 HERE

Discussion

This study investigated the exercise participation, perceived barriers to workplace exercise participation and preferred modes of exercise and exercise assistance of full-time (predominantly white-collar) employees across an Australian university's national and international campuses. The number of survey respondents (n=252; response rate 8.1%) is comparable to another recent health-related university survey study (n=308; response rate 8.5%) (Leininger, Adams & DeBeliso 2015). Eighty-seven per cent of participants reported being sufficiently physically active for the previous week, and thus meeting the minimum recommended volume of exercise to attain health benefits (Garber et al. 2011). However, self-report measures of physical activity behaviour are prone to measurement error (Kahn et al. 2002). Specifically, adults have been shown to over-report walking, moderate- and vigorous-intensity physical activities using the IPAQ (Rzewnicki, Auweele & De Bourdeaudhuij 2003). Furthermore, while 87% of participants reported meeting exercise guidelines for the previous week (IPAQ), only two-thirds reported maintaining regular exercise for the previous six months (stage of change questionnaire), a similar rate to that observed in US university employees (Leininger, Adams & DeBeliso 2015). This is still considerably higher compared to data from the Australian National Health Survey (NHS), in which only 41% of adults reported meeting exercise guidelines (Chau et al. 2017). Selection bias may partly explain this difference, whereby employees with a stronger affinity towards exercise may have been more likely to participate in the university survey compared to the random sampling method used by the NHS. It is also possible that the university employees in this study were more educated on the health benefits of exercise and were a more active population. Despite the majority of survey respondents reporting moderate or high exercise participation in the past week, there were significant differences between low, moderate and high exercise participation in all perceived exercise barrier dimensions. Therefore, the barriers that are perceived to be limiting exercise participation in both active and insufficiently active employees can be identified.

Lower weekly exercise participation was associated with higher perceived barriers to exercise. Of the four barrier dimensions, a lack of time and motivation had the largest effect size with over half of all participants somewhat or strongly agreeing that their job demands do not allow them to take the time to use the onsite fitness centre. Furthermore, almost one-third of participants cited not having time to exercise due to family, and a quarter cited not feeling motivated enough or feeling too tired to exercise. Despite the substantial proportion of respondents indicating a lack of time and motivation as barriers to exercise, up to 87% reported meeting exercise guidelines for the previous week. Either participants overcame these barriers (e.g. exercised outside of working hours or exercised with family), inflated their actual quantity of exercise participation, or were a highly exercise literate group who distinguished and reported physical activity participation as separate from moderate-vigorous exercise participation. Based on previous literature it is likely that respondents to the survey were more active individuals (Spittaels et al. 2007). However, respondents may not have been completing as much exercise as they indicated, as inflation of weekly exercise participation has been shown to occur using the IPAQ (Rzewnicki, Auweele & De Bourdeaudhuij 2003).

Similar to the barriers reported in this study, other studies involving university employees have found time constraints and work schedule conflicts to be commonly reported barriers to the use of onsite fitness facilities (Brown et al. 2014; Das, Rinaldi-Miles & Evans 2013) or participation in workplace health promotion programs (Hill-Mey et al. 2013; Kilpatrick et al. 2017; Leininger, Adams & DeBeliso 2015). To address the significant time constraints due to work and family commitments reported by employees, workplaces should consider offering extended onsite fitness centre opening hours (or access) and a greater number and variety of group exercise classes to provide time-restricted employees with more opportunities to exercise, as was suggested by US university employees surveyed in another study (Brown et al. 2014). This is supported by a survey study of 588 employees across England, which found that the presence of onsite exercise facilities and classes (although rarely evident in the workplaces) was associated with being less sedentary and more active at work, and with meeting exercise guidelines (Knox, Musson & Adams 2017). Survey respondents to the Brown et al.

(2014) study who were not current users of onsite exercise facilities also stated that they would be more likely to use the facilities if they were allowed time during working hours, for example using flex time to attend the fitness centre. Whether this increases employee exercise session attendance is yet to be investigated, however, performing aerobic and resistance exercise is associated with fewer health-related work limitations (i.e. presenteeism) amongst university employees (Walker et al. 2017), providing incentive for employers to consider this option. This is an important factor to consider, as evidence suggests high rates of presenteeism may exist amongst university staff. One study found that 88% of a sample of 6,874 UK academics stated they worked while sick at least sometimes, with 28% of these reporting often and 28% reporting always (Kinman & Wray 2018). Furthermore, another university-based study that implemented a 24-week walking intervention found that unplanned absenteeism was negatively associated with volume of exercise participation, suggesting illness-related leave benefits by providing access to an onsite exercise program (Losina et al. 2017).

A US study involving 88 corporate employees that also used the C-EBS found that internal barriers (e.g., I am embarrassed to exercise around my co-workers) but not external barriers (e.g., membership costs are too high) were related to the frequency of onsite fitness centre visits (Schwetschenau et al. 2008). However, external barriers but not internal barriers were related to exercise session duration, with participants who perceived the facility to be inadequate (i.e. not nice enough) exercising approximately 15 fewer minutes per session than those who did not report this barrier (Schwetschenau et al. 2008). Along with a lack of time and job strain barriers, UK call centre employees cited internal barriers to onsite exercise participation, including low exercise confidence (i.e. not knowing how to use the gym equipment correctly) and social physique anxiety (particularly female employees) (Edmunds, Hurst & Harvey 2013). Internal and external barriers were higher in employees reporting low or moderate (versus high) exercise participation in the current study. Approximately one-third of participants agreed or strongly agreed that they are embarrassed to exercise around co-workers, that fitness centre membership costs are too high, or that travelling prevents them from using sport or exercise facilities. Similar to the finding that internal barriers were

negatively associated with exercise participation, feeling self-conscious about exercising and perceiving weight and health problems as preventing exercise engagement have previously been reported in US (Fletcher, Behrens & Domina 2008) and Australian (Ball, Crawford & Owen 2000) blue- and white-collar workplace populations. These barriers were also reported by US university employees who were not using onsite fitness facilities, as opposed to their colleagues who cited convenience, low cost and social support as reasons for their use of the onsite fitness centre (Brown et al. 2014). Workplace programs that help to overcome internal and external exercise barriers may increase employee exercise participation. For example, reduced employee membership costs, the option of private exercise training sessions with an instructor, and individually-tailored exercise programming that takes into account personal goals and current health and fitness status may encourage onsite employee exercise participation and adherence and therefore the effectiveness of these strategies warrants investigation.

Attitudes towards exercise had minimal effect on exercise participation with fewer than five percent not liking how exercise made them feel, fewer than two percent not wanting to improve their health or fitness and fewer than three percent not understanding the benefits associated with exercise. These findings are similar to previous research investigating personal, social, and environmental factors associated with physical activity in adults which did not find any evidence that attitudes towards exercise were related to physical activity participation (Trost et al. 2002), nor were attitudes a correlate or determinant of adults' physical activity (Bauman et al. 2012). Exercise attitudes were also not related to membership, frequency or duration of visits to an onsite fitness centre amongst US corporate employees (Schwetschenau et al. 2008). Therefore, workplaces should focus on addressing time, motivation, internal and external barriers in the design of future onsite exercise programs. Strategies to address these barriers include offering greater opportunities for exercise such as longer facility opening hours throughout the workday, individual-level exercise guidance and support, social exercise environments such as frequent group exercise classes or walking groups,

subsidised membership costs and organisational support whereby employees may be permitted to exercise at a convenient time for them during the workday.

Apart from swimming, each of the most frequently preferred types of exercise (walking, fitness centre, cycling and exercise classes) can be performed using onsite facilities at each campus involved in this study. Furthermore, swimming pools are located within short walking distances of the Melbourne City and Vietnam campuses, and within three kilometers of the Melbourne Bundoora campus. Therefore, opportunities exist within and close to the university campuses for employees to access their most preferred types of exercise, although these facilities do not necessarily provide employees with their preferred types of exercise support. Despite the close proximity of access to facilities for these employees, almost a third of participants cited travel as an external exercise barrier, and external barriers were significantly higher in participants reporting low or moderate vs. high exercise participation. It is unclear why these participants cited travel to the on-site fitness facilities as an exercise barrier and is something that warrants further research to fully understand this barrier to enable the appropriate tailoring of any intervention. Similar to a previous survey involving Australian adults (Booth et al. 1997), having a personal trainer (particularly for the less-active employees), exercising in a group, and receiving no form of assistance were the three most preferred types of exercise assistance (or non-assistance). Offering exercise supervision and instruction in the workplace may help to improve employee exercise motivation (Brown et al. 2014), increase cardiorespiratory fitness (Alkhatib 2015), increase muscular strength and endurance (Dalager et al. 2015), and improve body composition (Vilela et al. 2015), and should be considered in the design of future workplace exercise interventions, especially those targeting less-active employees.

A limitation of this study was the use of a self-report physical activities tool (IPAQ), a common measurement tool in this context, rather than the use of an objective measure of physical activities such as pedometers or accelerometers. The survey population reported higher exercise participation than average global figures for developed countries (World Health Organisation 2010), possibly due to i) selection bias (Spittaels et al. 2007), as employees who were already physically active or had more

positive attitudes towards exercise could have been more likely to respond to the survey; ii) over-reporting of exercise (Rzewnicki, Auweele & De Bourdeaudhuij 2003); or iii) being a more physically active population. Therefore, it is acknowledged that the sample may not accurately represent the university workplace population as a whole, and based on previous research the average exercise participation of university employees is probably lower than that reported in this study. However, it is a validated questionnaire that enabled us to differentiate between those that completed different volumes of exercise to investigate relationships with exercise barriers and facilitators.

Other limitations to this study include the low response rate to the survey (8.1%) and only 9 participants from Vietnam, and the cross-sectional nature of the study, which limits any inference of causality. The Melbourne campus response rate is however, similar to another study using the IPAQ to measure exercise in a university setting enabling us to make comparisons (Leininger, Adams & DeBeliso 2015). The lack of survey engagement in Vietnam may indicate that this is a location/population in need of education around the benefits of exercise and physical activity or it may be an indication of how employees engage with university communication differently in the different campuses, which was beyond the scope of this study. Nevertheless, the barriers and facilitators to workplace exercise reported by employees were compared between those completing sufficient and insufficient exercise and therefore provides guidance for the design and implementation of future workplace exercise initiatives aimed at engaging both active and inactive employee populations.

Complete biopsychosocial aspects influencing employees' perceived barriers and facilitators to workplace exercise participation are yet to be investigated in a university setting, and future research should investigate these along with the effects on employee exercise engagement in interventions that address the barriers and facilitators identified in this study.

Conclusions

Workplace exercise programs should address the unique time, motivation, internal and external perceived barriers to exercise participation reported by full-time (predominantly white-collar) university employees. Time, motivation, internal and external barrier dimensions were negatively associated with reported exercise participation. The preferred exercise modes and types of assistance should also be considered in the design of workplace exercise programs aiming to increase full-time university employee exercise participation, improve health and fitness outcomes and reduce chronic disease risk. Individual biopsychosocial factors should be considered when making recommendations for workplace interventions, however, to facilitate exercise participation, full-time university employees should be provided with access to individually prescribed exercise programs including walking, fitness centre and group exercise classes that could be completed individually, with a personal trainer or in a trainer-led group. Permitting these employees to exercise during working hours may also facilitate participation and potentially provide employer-benefits including reduced employee health-related work limitations.

References

Alkhatib, A. (2013), "Sedentary risk factors across genders and job roles within a university campus workplace: preliminary study", *Journal of Occupational Health*, Vol. 55, No. 3, pp. 218-24.

Alkhatib, A. (2015), "High prevalence of sedentary risk factors amongst university employees and potential health benefits of campus workplace exercise intervention", *Work*, Vol. 52, No. 3, pp. 589-95.

Ball, K., Crawford, D. & Owen, N. (2000), "Obesity as a barrier to physical activity", *Australian and New Zealand Journal of Public Health*, Vol. 24, No. 3, pp. 331-3.

Barry, V.W., Baruth, M., Beets, M.W., Durstine, J.L., Liu, J. & Blair, S.N. (2013), "Fitness vs. fatness on all-cause mortality: a meta-analysis", *Progress in Cardiovascular Diseases*, Vol. 56, No. 4, pp. 382-90.

Bauman, A.E., Reis, R.S., Sallis, J.F., Wells, J.C., Loos, R.J. & Martin, B.W. (2012), "Correlates of physical activity: why are some people physically active and others not?", *The Lancet*, Vol. 380, No. 9838, pp. 258-71.

Blair, S.N., Kohl, H.W., Paffenbarger, R.S., Clark, D.G., Cooper, K.H. & Gibbons, L.W. (1989), "Physical fitness and all-cause mortality: a prospective study of healthy men and women", *Journal of the American Medical Association*, Vol. 262, No. 17, pp. 2395-401.

Booth, M.L., Bauman, A., Owen, N. & Gore, C.J. (1997), "Physical activity preferences, preferred sources of assistance, and perceived barriers to increased activity among physically inactive Australians", *Preventive Medicine*, Vol. 26, No. 1, pp. 131-7.

Brown, T.C., Volberding, J., Baghurst, T. & Sellers, J. (2014), "Faculty/staff perceptions of a free campus fitness facility", *International Journal of Workplace Health Management*, Vol. 7, No. 3, pp. 156-70.

Buckley, J.P., Hedge, A., Yates, T., Copeland, R.J., Loosemore, M., Hamer, M., Bradley, G. & Dunstan, D.W. (2015), "The sedentary office: an expert statement on the growing case for change towards better health and productivity", *British Journal of Sports Medicine*, Vol. 49, No. 21, pp. 1357-62.

Caspersen, C.J., Powell, K.E. & Christenson, G.M. (1985), "Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research", *Public Health Reports*, Vol. 100, No. 2, pp. 126-31.

Chau, J., Chey, T., Burks-Young, S., Engelen, L. & Bauman, A. (2017), "Trends in prevalence of leisure time physical activity and inactivity: results from Australian National Health Surveys 1989 to 2011", *Australian and New Zealand Journal of Public Health*, Vol. 41, No. 6, pp. 617-24.

Chau, J.Y., Grunseit, A.C., Chey, T., Stamatakis, E., Brown, W.J., Matthews, C.E., Bauman, A.E. & van der Ploeg, H.P. (2013), "Daily sitting time and all-cause mortality: a meta-analysis", *PLoS One*, Vol. 8, No. 11, pp. 1-14.

Conn, V.S., Hafdahl, A.R., Cooper, P.S., Brown, L.M. & Lusk, S.L. (2009), "Meta-analysis of workplace physical activity interventions", *American Journal of Preventive Medicine*, Vol. 37, No. 4, pp. 330-9.

Craig, C.L., Marshall, A.L., Sjostrom, M., Beauman, A.E., Booth, M.L., Ainsworth, B.E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J.F. & Oja, P. (2003), "International physical activity questionnaire: 12-country reliability and validity", *Medicine and Science in Sports and Exercise*, Vol. 35, No. 8, pp. 1381-95.

Dalager, T., Bredahl, T.G., Pedersen, M.T., Boyle, E., Andersen, L.L. & Sjøgaard, G. (2015), "Does training frequency and supervision affect compliance, performance and muscular health? A cluster randomized controlled trial", *Manual therapy*, Vol. 20, No. 5, pp. 657-65.

Das, B.M., Rinaldi-Miles, A.I. & Evans, E.M. (2013), "Exploring faculty and staff PA barriers at a large university", *Californian Journal of Health Promotion*, Vol. 11, No. 2, pp. 61-72.

Edmunds, S., Hurst, L. & Harvey, K. (2013), "Physical activity barriers in the workplace: An exploration of factors contributing to non-participation in a UK workplace physical activity

intervention", *International Journal of Workplace Health Management*, Vol. 6, No. 3, pp. 227-40.
Ezzati, M., Lopez, A.D., Rodgers, A., Vander Hoorn, S. & Murray, C.J. (2002), "Selected major risk factors and global and regional burden of disease", *The Lancet*, Vol. 360, No. 2, pp. 1347-60.
Fletcher, G.M., Behrens, T.K. & Domina, L. (2008), "Barriers and enabling factors for work-site physical activity programs: a qualitative examination", *Journal of Physical Activity & Health*, Vol. 5, No. 3, pp. 418-29.
Garber, C.E., Blissmer, B., Deschenes, M.R., Franklin, B., Lamonte, M.J., Lee, I.-M., Nieman, D.C. & Swain, D.P. (2011), "Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise", *Medicine and Science in Sports and Exercise*, Vol. 43, No. 7, pp. 1334-59.
Gupta, S., Rohatgi, A., Ayers, C.R., Willis, B.L., Haskell, W.L., Khera, A., Drazner, M.H., de Lemos, J.A. & Berry, J.D. (2011), "Cardiorespiratory fitness and classification of risk of cardiovascular disease mortality", *Circulation*, Vol. 123, No. 13, pp. 1377-83.
Hill-Mey, P.E., Merrill, R.M., Kumpfer, K.L., Reel, J. & Hyatt-Neville, B. (2013), "A focus group assessment to determine motivations, barriers and effectiveness of a university-based worksite wellness program", *Health Promotion Perspectives*, Vol. 3, No. 2, pp. 154-64.
Hunter, J.R., Gordon, B.A., Lythgo, N., Bird, S.R. & Benson, A.C. (2018), "Exercise at an onsite facility with or without direct exercise supervision improves health-related physical fitness and exercise participation: An 8-week randomised controlled trial with 15-month follow-up", *Health Promotion Journal of Australia*, Vol. 29, No. 1, pp. 84-92.
International Physical Activity Questionnaire Group (2014), "International physical activity questionnaire", viewed June 22 2015, <https://sites.google.com/site/theipaq/>.
Kahn, E.B., Ramsey, L.T., Brownson, R.C., Heath, G.W., Howze, E.H., Powell, K.E., Stone, E.J., Rajab, M.W. & Corso, P. (2002), "The effectiveness of interventions to increase physical activity: a systematic review", *American Journal of Preventive Medicine*, Vol. 22, No. 4, pp. 73-107.
Kilpatrick, M., Blizzard, L., Sanderson, K., Teale, B., Jose, K. & Venn, A. (2017), "Barriers and facilitators to participation in workplace health promotion (WHP) activities: results from a cross-sectional survey of public-sector employees in Tasmania, Australia", *Health Promotion Journal of Australia*, Vol. 28, No. 3, pp. 225-32.
Kinman, G. & Wray, S. (2018), "Presenteeism in academic employees—occupational and individual factors", *Occupational Medicine*, Vol. 68, No. 1, pp. 46-50.
Knox, E.C.L., Musson, H. & Adams, E.J. (2017), "Workplace policies and practices promoting physical activity across England: What is commonly used and what works?", *International Journal of Workplace Health Management*, Vol. 10, No. 5, pp. 391-403.
Kruger, J., Yore, M.M., Bauer, D.R. & Kohl III, H.W. (2007), "Selected barriers and incentives for worksite health promotion services and policies", *American Journal of Health Promotion*, Vol. 21, No. 5, pp. 439-47.
Lee, I.-M. & Skerrett, P.J. (2001), "Physical activity and all-cause mortality: what is the dose-response relation?", *Medicine and Science in Sports and Exercise*, Vol. 33, No. 6, pp. S459-71.
Lee, I.M., Shiroma, E.J., Lobelo, F., Puska, P., Blair, S.N. & Katzmarzyk, P.T. (2012), "Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy", *The Lancet*, Vol. 380, No. 9838, pp. 219-29.
Leininger, L.J., Adams, K.J. & DeBeliso, M. (2015), "Differences in health promotion program participation, barriers and physical activity among faculty, staff and administration at a university worksite", *International Journal of Workplace Health Management*, Vol. 8, No. 4, pp. 246-55.
Losina, E., Yang, H.Y., Deshpande, B.R., Katz, J.N. & Collins, J.E. (2017), "Physical activity and unplanned illness-related work absenteeism: Data from an employee wellness program", *PloS one*, Vol. 12, No. 5, p. e0176872.

Marcus, B. & Forsyth, L. (2009), *Motivating People to be Physically Active*, Human Kinetics, Champaign, IL.

Newman, A.B., Kupelian, V., Visser, M., Simonsick, E.M., Goodpaster, B.H., Kritchevsky, S.B., Tylavsky, F.A., Rubin, S.M. & Harris, T.B. (2006), "Strength, but not muscle mass, is associated with mortality in the health, aging and body composition study cohort", *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, Vol. 61, No. 1, pp. 72-7.

Owen, N., Salmon, J., Koohsari, M.J., Turrell, G. & Giles-Corti, B. (2014), "Sedentary behaviour and health: mapping environmental and social contexts to underpin chronic disease prevention", *British Journal of Sports Medicine*, Vol. 48, No. 3, pp. 174-7.

Pérusse-Lachance, E., Tremblay, A. & Drapeau, V. (2010), "Lifestyle factors and other health measures in a Canadian university community", *Applied Physiology, Nutrition and Metabolism*, Vol. 35, No. 4, pp. 498-506.

Plotnikoff, R., Collins, C.E., Williams, R., Germov, J. & Callister, R. (2015), "Effectiveness of interventions targeting health behaviors in university and college staff: a systematic review", *American Journal of Health Promotion*, Vol. 29, No. 5, pp. 169-87.

Rzewnicki, R., Auweele, Y.V. & De Bourdeaudhuij, I. (2003), "Addressing overreporting on the international physical activity questionnaire (IPAQ) telephone survey with a population sample", *Public Health Nutrition*, Vol. 6, No. 3, pp. 299-305.

Schwetschenau, H.M., O'Brien, W.H., Cunningham, C.J.L. & Jex, S.M. (2008), "Barriers to physical activity in an on-site corporate fitness center", *Journal of Occupational Health Psychology*, Vol. 13, No. 4, pp. 371-80.

Seifer, S.D. (2000), "Engaging colleges and universities as partners in healthy communities initiatives", *Public Health Reports*, Vol. 115, No. 2-3, pp. 234-7.

Spittaels, H., De Bourdeaudhuij, I., Brug, J. & Vandelanotte, C. (2007), "Effectiveness of an online computer-tailored physical activity intervention in a real-life setting", *Health Education Research*, Vol. 22, No. 3, pp. 385-96.

Staiano, A.E., Harrington, D.M., Barreira, T.V. & Katzmarzyk, P.T. (2014), "Sitting time and cardiometabolic risk in US adults: associations by sex, race, socioeconomic status and activity level", *British Journal of Sports Medicine*, Vol. 48, No. 3, pp. 213-9.

Trost, S.G., Owen, N., Bauman, A.E., Sallis, J.F. & Brown, W. (2002), "Correlates of adults' participation in physical activity: review and update", *Medicine and Science in Sports and Exercise*, Vol. 34, No. 12, pp. 1996-2001.

Van der Ploeg, H.P., Chey, T., Korda, R.J., Banks, E. & Bauman, A. (2012), "Sitting time and all-cause mortality risk in 222 497 Australian adults", *Archives of Internal Medicine*, Vol. 172, No. 6, pp. 494-500.

Vilela, B.L., Silva, A.A.B., de Lira, C.A.B. & dos Santos Andrade, M. (2015), "Workplace exercise and educational program for improving fitness outcomes related to health in workers: a randomized controlled trial", *Journal of Occupational and Environmental Medicine*, Vol. 57, No. 3, pp. 235-40.

Walker, T.J., Tullar, J.M., Diamond, P.M., Kohl III, H.W. & Amick III, B.C. (2017), "The Relation of Combined Aerobic and Muscle-Strengthening Physical Activities With Presenteeism", *Journal of Physical Activity and Health*, Vol. 14, No. 11, pp. 893-8.

World Health Organisation (2008), "Preventing noncommunicable diseases in the workplace through diet and physical activity: WHO/world economic forum report of a joint event", WHO Press, Geneva, Switzerland.

World Health Organisation (2010), "Prevalence of insufficient physical activity", WHO Press, Geneva, Switzerland, viewed June 22 2015, <http://www.who.int/gho/ncd/risk_factors/physical_activity_text/en/#>.

Table 1: Physical characteristics of participants and their exercise behaviour.

			Exercise Participation Defined by IPAQ							
			Low		Moderate		High		Chi-square (*p*)	ES (*V*)
	Total N	%	N	%	N	%	N	%		
Campus									0.30	0.10
Melbourne City	173	68.6	18	10.4	77	44.5	78	45.1		
Melbourne Bundoora	70	27.8	14	20.0	30	42.9	26	37.1		
Vietnam	9	3.6	2	22.2	3	33.3	4	44.4		
Sex									0.10	0.13
Male	101	40.1	9	8.9	42	41.6	50	49.5		
Female	151	59.9	25	16.6	68	45.0	58	38.4		
Age (years)									0.25	0.14
<30	25	9.9	2	8.0	6	24.0	17	68.0		
30-39	68	27.0	12	17.6	26	38.2	30	44.1		
40-49	66	26.2	8	12.1	31	47.0	27	40.9		
50-59	66	26.2	8	12.1	34	51.5	24	36.4		
>60	27	10.7	4	14.8	13	48.1	10	37.0		
Ethnicity									0.97	0.05
Oceanian	63	25.0	10	15.9	27	42.9	26	41.3		
European	153	60.7	19	12.4	69	45.1	65	42.5		
African/Middle Eastern/Americas/Other	11	4.4	1	9.1	5	45.5	5	45.5		
Asian	25	9.9	4	16.0	9	36.0	12	48.0		
Highest Education Level									0.29	0.10
High School	9	3.6	1	11.1	3	33.3	5	55.6		
College Degree	61	24.2	9	14.8	20	32.8	32	52.5		
Postgraduate Degree/Diploma	182	72.2	24	13.2	87	47.8	71	39.0		
Employment Type									0.60	0.07
Academic	96	38.1	12	12.5	47	49.0	37	38.5		
Professional	144	57.1	21	14.6	59	41.0	64	44.4		
Trades and Services or Other	12	4.8	1	8.3	4	33.3	7	58.3		

Abbreviations. ES, effect size using Cramer's *V*; IPAQ, International Physical Activity Questionnaire. *p* values using Pearson Chi-Square. Exercise level was defined using the IPAQ as: low (not meeting exercise guidelines); moderate (meeting exercise guidelines); or high (exceeding exercise guidelines).

Table 2: Mean sub-scores and one-way ANOVA for each barrier domain by exercise level.

	Exercise Participation Defined by IPAQ							
	Low		Moderate		High		ANOVA	ES (η^2)
Barrier Dimension	Mean	SD	Mean	SD	Mean	SD	*(p)*	
Time and Motivation	10.7	4.0	8.0	4.6	4.3	3.8	<0.001	0.24
Exercise Attitudes	1.2	1.6	1.1	2.1	0.4	1.1	<0.01	0.04
Internal	4.5	3.6	4.6	4.2	2.3	2.6	<0.001	0.10
External	5.3	3.0	4.9	2.9	3.5	2.7	0.001	0.06
Total Barrier Score	21.7	8.6	18.6	10.6	10.5	7.5	<0.001	0.20

Abbreviations. ANOVA, analysis of variance; ES, effect size calculated as eta squared (η^2); IPAQ, International Physical Activity Questionnaire; SD, standard deviation. Exercise level was defined using the IPAQ as: low (not meeting exercise guidelines); moderate (meeting exercise guidelines); or high (exceeding exercise guidelines). Barrier scores were obtained using the Corporate Exercise Barriers Scale (C-EBS).

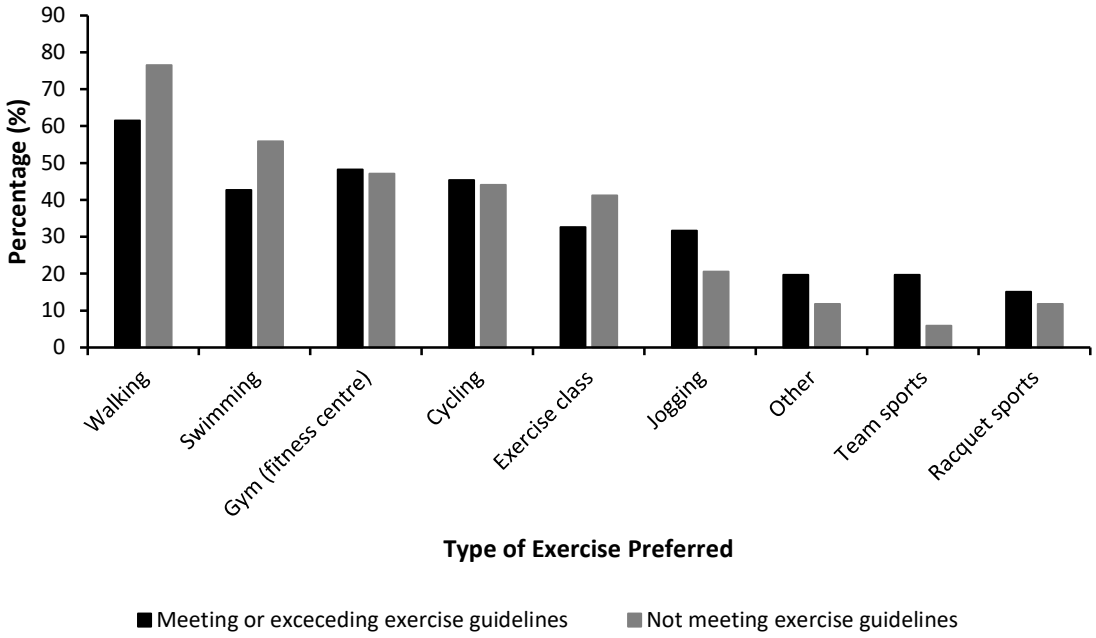

Figure 1: Preferred types of exercise reported by university employees meeting and not meeting exercise guidelines if they were to take up exercise or exercise more.

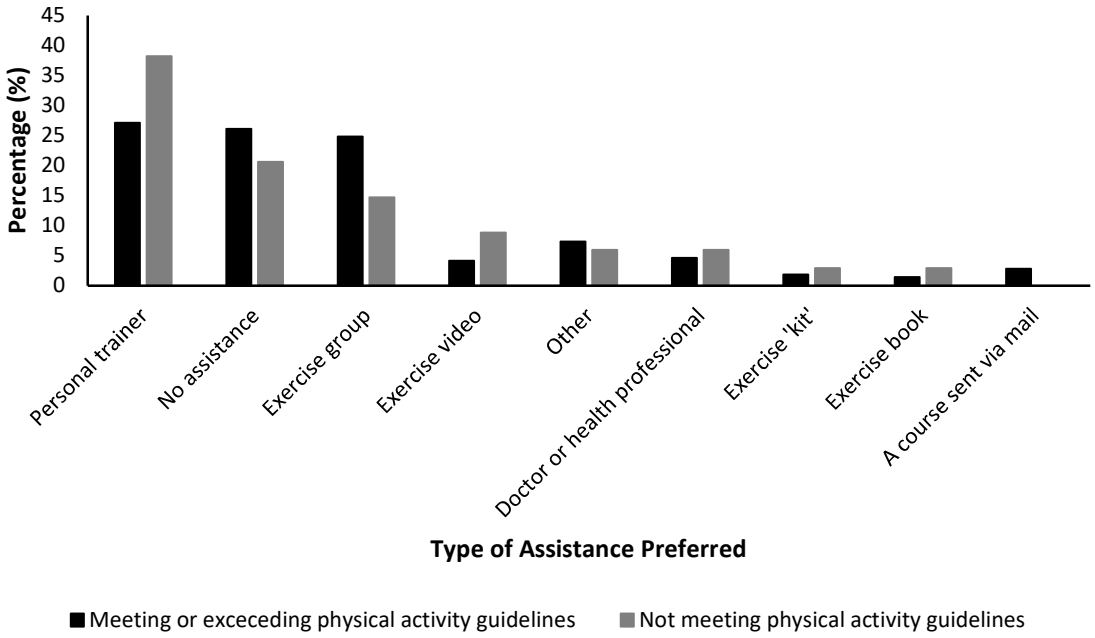

Figure 2: Preferred types of exercise assistance reported by university employees meeting and not meeting physical activity guidelines if they were to take up exercise or exercise more.