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Association between Psychosocial and Organizational Factors and Objectively Measured Sedentary Behavior in Desk-Dependent Office Workers

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Abstract

Cross-sectional analysis of data from the Recharge@Work study was used to assess individual, interpersonal and organizational correlates of objectively- measured sedentary time, in desk-dependent office workers at two U.S. hospitals. Analysis included 65 participants (62 females and ~49.2 years old). Sedentary time was assessed by accelerometry across five consecutive days and expressed as prolonged sedentary bouts (60min ≤ 150 cpm). Correlates measured a baseline included: age, BMI, active break enjoyment, active break outcome expectancy, active break self-efficacy, active break social support, direct supervisor support of active breaks and senior manager support of active breaks. As expected, we found that the more individuals perceived their supervisor as supportive of active breaks and the more they enjoyed active breaks, the more likely they were to actually take active breaks (i.e., to experience less sedentary time, OR=2.8, CI=1.1-7.1; OR=5.2, CI=1.4-19.2 respectively). However, contrary to our expectations, the more employees perceived their senior managers as supportive of active breaks, the less likely they were to take these breaks (OR=0.29, CI=0.09-0.93). No significant associations were found between age, gender, BMI, outcome expectancy, or self-efficacy and active breaks from sedentary behavior.

Keywords: occupational, sedentary, office workers, determinants, active breaks

Introduction

Sedentary behavior has emerged as a focus in public health as an independent risk factor for poor health and mortality (Bauman et al., 2011). High volumes of sitting and sedentary behavior have been established as independent risk factors for conditions such as type II diabetes and obesity (Katzmarzyk, Church, Craig, & Bouchard, 2009; Patel et al., 2010). Even in individuals who accumulate recommended levels of moderate-vigorous physical activity (MVPA), prolonged sedentary behavior is associated with negative health outcomes (Owen, Sparling, Healy, Dunstan, & Matthews, 2010). When measured objectively (accelerometers), sedentary behavior is more closely associated with negative vascular and metabolic risk factors (ie, glucose, HDL, LDL, triglycerides) than MVPA (Celis-Morales et al., 2012). Despite established risks associated with sedentary behavior, our knowledge of the psychosocial and environmental determinants of sedentary behavior is relatively sparse.

The majority of studies on sedentary behavior have primarily focused on determinants of leisure time and TV viewing sedentary behavior. However, desk-dependent workers have been shown to spend approximately 81% of their workday in sedentary behavior (Parry & Straker, 2013), contributing to a large proportion of total sedentary time each day (Plotnikoff & Karunamuni, 2012). The workplace remains a setting where many individuals accumulate the majority of their daily sedentary time. Of particular concern are prolonged bouts of sedentary behavior greater than 60min, which have been associated with all-cause mortality independent of total sedentary time and MVPA (Van der Ploeg, Chey, Korda, Banks, & Bauman, 2012). Current occupational health recommendations include breaking up prolonged sedentary bouts with short activity breaks (Coenen, Gilson, Healy, Dunstan, & Straker, 2017). Active breaks from prolonged sedentary behavior generally include at least 2 minutes of light body movement while standing, stretching, or taking short walks around the office (Plotnikoff & Karunamuni, 2012).

Understanding the correlates of sedentary behavior in specific settings and populations is an important step to developing effective interventions.

Current theoretical frameworks, such as the socio-ecological model, hypothesize that a complex relationship between personal, environmental and social factors determine sedentary behavior (Chastin, Fitzpatrick, Andrews, & DiCroce, 2014). Research on the determinants of physical activity has shown that factors at multiple levels (e.g., individual, social, environmental, and policy) are important in behavior change and long-term maintenance (Owen, Leslie, Salmon, & Fotheringham, 2000). Whether the same levels of influence are important in short activity breaks that break up prolonged sedentary periods is unknown. In addition, our understanding of determinants of physical activity has shown that determinants may be population specific and shaped by the attributes of the settings in which they occur, and the social context within those settings (Owen et al., 2011).

A few studies have explored correlates of sedentary behavior in specific populations. In a small sample (31) of cancer patients, instrumental attitude (i.e., perceived benefits) of physical activity and affective attitude (i.e., perceived enjoyment) of physical activity were negatively correlated with median time spent sitting (Lowe et al., 2014). Other studies have indicated sedentary behavior is negatively associated with self-efficacy for breaking up sedentary behavior and locus of control (perceived control) in older adults (Chastin et al., 2014) and access to digital media and socio-economic characteristics in children (Uijtdewilligen et al., 2011). In a sample of 801 office workers in Australia, the barriers associated with frequency of active breaks at work for men were perception of lack of time to take breaks at work and for women were lack of information regarding taking short breaks at work (Bennie, Timperio, Crawford, Dunstan, & Salmon, 2011). Another study indicated that a lack of control to sit less was associated with higher occupational sitting in part-time and full-time white-collar and professional workers in Australia (De Cocker, Duncan, Short, Van Uffelen, & Vandelanotte, 2014).

With a large number of adults employed in desk-dependent occupations, very little is known about the determinants of sedentary patterns at the workplace. Establishing correlates of sedentary behavior in the workplace is needed in order to

develop effective, evidence-based interventions that target appropriate mediating variables. This would provide important insight into whether strategies should target individual-level factors, social-level factors, organizational-level factors (e.g., policy and cultural change) or multiple levels of influence. The aim of this study was to investigate associations between objectively measured sedentary behavior and psychosocial and organizational factors of desk-dependent hospital workers prior to the implementation of the Recharge@Work program.

Theoretical framework

The socio-ecological model was used as a framework in which to examine whether workplace specific factors were associated with objectively measured occupational sedentary behavior. Based on established research on physical activity and sedentary determinants, it was hypothesized that individual level factors (enjoyment, outcome expectancy, self-efficacy), interpersonal level factors (social support) and organizational level factors (direct supervisor support, senior manager support) would be important correlates of occupational sedentary behavior in this study. More specifically, it was hypothesized that higher reported levels of active break enjoyment, active break self-efficacy, higher outcome expectancies around taking active breaks, higher perceived coworker social support for taking active breaks, higher perceived direct manager support of active breaks and higher perceived senior manager support of active breaks would be associated with lower levels of sedentary behavior in the workplace. These hypothesized correlates of sedentary behavior in the workplace are represented in multiple theories and models, including Social Cognitive Theory (e.g., self-efficacy, outcome expectancies), [Bandura, 2001] and Organizational Development Theory (direct supervisor and senior manager support) [Glanz & Rimer, 1995]. Self-efficacy, defined as "beliefs about personal ability to perform behaviors that bring desired

outcomes," is associated with both physical activity and sedentary behavior (Bandura, 2001) (Owen et al., 2011). Outcome expectancy includes "beliefs about the likelihood and value of the consequences of behavioral choices" and is positively associated with higher levels of physical activity and sedentary behavior (Deci & Ryan, 2010; Koeneman, Verheijden, Chinapaw, & Hopman-Rock, 2011). From the perspective of Social Cognitive Theory, "perceived enjoyment and social support contribute to the self-regulation of exercise behavior" (Koeneman et al., 2011). The role of both enjoyment and social support have been well established in predicting physical activity behavior (Bauman et al., 2012; Koeneman et al., 2011), however their role in sedentary behavior has not been established. Organizational climate is defined as the mood or unique "personality" of an organization (Tagiuri, 1968). Organizational climate characteristics such as leader support, participative management and openness of communication are positively related to employee satisfaction and implementation of action plans (Schneider, 1985). The role of organizational climate characteristics has yet to be explored in occupational sedentary behavior.

Methods

Participants

Participants were recruited from two hospitals located within the Portland-Vancouver metropolitan area in the northwest region of the United States. The two hospitals were chosen for similar characteristics (size, location, departments) and were part of a large health system made up of six hospitals in northwest Oregon and southwest Washington. The two hospital settings were separated by 12 miles, but

are part of a continuous metropolitan area that spans the border between the states of Oregon and Washington. Participant recruitment was conducted hospital-wide through an email advertisement sent to department managers and forwarded to their respective employees. Inclusion criteria included individuals classified as hospital administrative staff that self-reported spending ≥ 75% of the workday sitting at a desk. This cut off was used in order to capture the most sedentary hospital employees and is in line with estimated sedentary behavior from large epidemiological studies in office workers (Owen et al., 2011). Exclusion criteria included known medical conditions or physical problems requiring special attention. Informed consent was provided by all participants and the study protocol was approved by the Institutional Review Boards of the primary author's university and the health care organization. The final sample included 26 participants from one hospital setting and 39 participants from the second hospital setting. The total sample of 65 participants (62 female) averaged 49.2 ± 9.3 years of age and included 60 White, 3 Asian American, and 2 Hispanic participants. Overall characteristics of the hospital employee population are as follows: average age of 44 years, 78% female, and 82% White.

Outcome measure

Sedentary time

ActiGraph Model GT3X+ accelerometers (ActiGraph LLC, Fort Walton Beach, FL) were used to objectively assess sedentary behavior in the participants. Participants were asked to wear the accelerometers for 24hr a day on a belt positioned over the right hip for five consecutive working days. Only work hours were analyzed for this study, with work hours defined as self-recorded time in and time out each day. Valid days included wearing the accelerometer for ≥ 75 % of the time at the workplace (Healy et al., 2013), with a minimum of 3 valid days per subject required. Non-wear time was filtered as a period of ≥120min of consecutive zero counts, allowing for up to two consecutive, one-minute interruptions (count values between 1-99 cpm) per non-wear period (Winkler et al., 2012). A cut-point of ≤ 150 cpm from the vector magnitude was used to define sedentary time. Recent

studies have indicated that different cut-points should be used for the vertical axis and vector magnitude (Sasaki, John & Freedson, 2011) and a cut-point of ≤ 150 cpm provides the highest accuracy (area under curve) for determining sedentary behavior in adults (Aguilar-Farías, Brown, & Peeters, 2013). Prolonged sedentary bouts were defined as a period of ≥60 min of consecutive counts between 1 and 150 cpm. For this study, "activity breaks" were operationalized as consisting of at least 2 minutes of light body movement while standing, stretching, or taking short walks around the office. This type of movement for two minutes or more would record accelerometer counts above 150 cpm and reset any cumulative prolonged sedentary time occurring. Sedentary outcomes were converted to percentage of workday to standardize for different work schedules and accelerometer wear time.

Correlates

Hypothesized correlates were assessed using six validated scales that were modified for use in this study. Perceived social support for active breaks was measured with the widely used 12-item Social Support and Exercise Scale (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). The scale was modified to measure perceived social support of co-workers instead of friends and loved ones. Self-efficacy for active breaks was determined with a modified 7-item scale designed to assess confidence in overcoming common barriers to exercise such as negative affect, excuse making, resistance from others, inconvenience and bad weather (McAuley, Lox, & Duncan, 1993). Enjoyment for active breaks was measured using a modified version of the short form-Physical Activity Enjoyment Scale (S-PACES) (Paxton et al., 2008). Employee outcome expectations for active breaks were assessed using a modified version of the multidimensional outcome expectations for exercise scale (MOEES) (Wojcicki, White, & McAuley, 2009). Perceived direct supervisor support and perceived senior management support for active breaks were measured using a worksite health and culture audit adapted for this study from previously used instruments (Dishman, DeJoy, Wilson, & Vandenberg, 2009). Details of the measures used to assess the individual, social and organizational

248 mediators are provided in Table 1, along with internal consistency coefficients
249 (Cronbach's alpha).
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253 Table 1 – Measures used to assess individual, social and organizational factors

Variable	Items used to assess variable	Scale/response options	Mean (SD)	Internal reliability (α)
Individual factors				
Self-efficacy (7-item)	I believe that I could take regular standing breaks if work was very busy	10 point: 1=not very confident, 10=confident	5.3 (3.3)	0.83
Outcome expectancy (14-item)	Breaks from sitting will improve my ability to perform daily activities	5 point: 1=strongly agree, 5=strongly disagree	2.8 (1.1)	0.91
Enjoyment (16-item)	When I am taking breaks from sitting it feels good	5 point: 1=strongly agree, 5=strongly disagree	2.2 (0.98)	0.92
Social factors				
Co-worker social support (12-item)	My coworkers recently took breaks from sitting with me	5 point: 1=strongly agree, 5=strongly disagree	1.6 (1.1)	0.93
Direct supervisor support (5-item)	My direct supervisor support makes it easy for me to take breaks from sitting on a regular basis	5 point: 1=strongly agree, 5=strongly disagree	3.4 (0.98)	0.93
Organizational factors				

Senior management support (5-item)	Our senior management support makes it easy for me to take breaks from sitting on a regular basis	5 point: 1=strongly agree, 5=strongly disagree	3.6 (0.85)	0.89

Statistical analyses

Prior to running any models, statistical tests were performed to identify outliers, test for normality, and variance inflation factors were used to check for multicollinearity. No serious multicollinearity problems existed in the independent variables. Outliers were present in the main sedentary behavior outcome of workday prolonged sedentary behavior (bouts >60min). In addition, the same outcome of interest showed a non-normal distribution with significant negative skewness and positive kurtosis present. As a result, prolonged sedentary behavior was converted to a dichotomous variable. Creating a dichotomous outcome variable made sense in the context of this study since the main focus was to determine correlates of individuals that were more sedentary at work compared to their less sedentary counterparts.

To obtain the dichotomous outcome variable, high and low sedentary groups were created using the median of percent of workday spent in sedentary bouts of greater than 60 minutes for the sample. Participants were divided into the two categories based on whether they fell above or below the sample median of 70 percent of workday spent in sedentary time. Dichotomizing the population sample around the median of 70 percent of workday spent in sedentary time is also in line with previous studies which showed similar sedentary averages in similar populations in occupational settings (Thorp et al., 2012).

Initial exploratory analyses included bivariate analyses of each independent variable with the dichotomous prolonged sedentary outcome variable to determine unadjusted odds ratios. Next, logistic-regression models were built and estimated in

several steps. The first block of variables included in the model were demographic variables including age, BMI, and hospital site. The second step included addition of predictor variables with entry criteria set at $P \leq .30$. Final model selection was based on comparison of Akaike Information Criterion (AIC).

Results

Descriptive analyses

Participant characteristics and sedentary behavior variables are listed in Table 2. Approximately 97% of the overall sample was female with an average age of 49.2 years and BMI of 29.1. Compared to the less sedentary group, individuals that spent over 70% of their workday in prolonged bouts (>60min) of sedentary behavior spent a lower percent of their workday in light activity (12.8% vs 22.5%). Age and BMI were not significantly different between the two sedentary groups.

Table 2 – Initial baseline and demographic information

	Percent of Workday Spent in Prolonged Sedentary Bouts (bouts >60min)	
	Over 70% of Workday n=33	Under 70% of Workday n=32
Variables	Mean (SD)	Mean (SD)
Age	49.1 (10.1)	49.4 (8.0)
BMI	28.5 (6.6)	29.9 (5.6)
% of workday sedentary activity	84.0 (3.6)	72.8 (5.5)

% of workday light activity	12.8 (3.1)	22.5 (5.2)
% of workday moderate-vigorous activity	3.5 (2.2)	4.6 (2.5)

Sedentary **(**<1.5 METs); Light (1.5-2.9 METs); Moderate-vigorous (≥ 3.0 METs)

Unadjusted relationships

Bivariate analyses resulted in higher reported scores on enjoyment of breaks from sedentary behavior as the only statistically significant variable associated with lower prolonged sedentary behavior (Table 3). Outcome expectancy, perceived direct manager support and perceived senior manager support were related but not statistically significantly associated with prolonged sedentary behavior.

Table 3 – Unadjusted odds ratios between lower sedentary behavior and independent variables

Variable	Odds ratio	95% CI
Age	1.0	0.95, 1.06
BMI	1.03	0.95, 1.12
Enjoyment	3.62	1.15, 11.36
Self-efficacy	0.99	0.97, 1.02
Outcome expectancy	1.43	0.57, 3.64

Perceived social support	0.81	0.38, 1.7
Perceived direct manager support	1.30	0.68, 2.48
Perceived senior manager support	0.64	0.27, 1.50

Final Model

Final model selection, as further described earlier, was based on comparison of Akaike Information Criterion (AIC). The final multivariate logistic regression model included active break enjoyment, perceived direct supervisor support of active breaks and perceived senior manager support of active breaks as significant correlates of prolonged sedentary bouts (Table 4). Higher levels of enjoyment of breaks from sedentary behavior, and higher perceived direct supervisor support of active breaks were associated with lower levels of percent of workday spent in prolonged sedentary bouts. Conversely, lower levels of perceived senior manager support were associated with lower levels of percent of workday spent in prolonged sedentary bouts. The final model was adjusted for hospital site.

Table 4 – Final adjusted multivariate logistic regression model between lower sedentary behavior and independent variables

Variable	Odds ratio	95% CI	
Enjoyment	5.2	1.4, 19.2	(p=.01)
Perceived direct supervisor support	2.8	1.1, 7.1	(p=.03)

Perceived senior manager support	0.29	0.09, 0.93	(p=.04)

*adjusted for hospital site

Discussion

In the current study, employees spent approximately 80% of their workday in sedentary time, comparable to rates found in larger cross-sectional studies (Parry & Straker, 2013). Enjoyment of breaks from sedentary behavior was the strongest correlate in all of the partial and full models. The role of enjoyment in predicting physical activity behavior has been well established (Salmon, Owen, Crawford, Bauman, & Sallis, 2003), and the results of this study suggest that enjoyment of active breaks from sedentary behavior has a similarly important role in lower levels of prolonged sedentary behavior. Research from physical activity interventions indicate that teaching or offering multiple forms of exercise types and modalities lead to the highest adoption and adherence rates (Lewis, Napolitano, Buman, Williams, & Nigg, 2017). This study supports these findings for occupational sedentary behavior and suggests that individuals that find enjoyable activities which they can perform in the office space may be more likely to take active breaks. Having a variety of portable equipment such as therapy bands, exercise balls, or simple walking routes around the office may prove to be an important strategy for increasing active breaks in the workplace.

The negative relationship between perceived senior management support and prolonged sedentary behavior (OR=0.29) was contrary to our hypothesized relationship. The results suggest that those with low perceived senior management support are less sedentary. The reason for this relationship is unknown but may indicate that enjoyment and perceived direct supervisor support are more

important variables in predicting sedentary behavior, even in the presence of perceived low senior management support. Large organizations such as hospitals often include multiple levels of senior management. Employees may interpret "senior management" to apply to different individuals even in the same hospital which may further complicate the interpretation of these results. More clear and specific measures that indicate specific levels of senior management and policy structures is needed to investigate these findings further. Most likely, in large organizations with complex departmental structuring, perceived supervisor support from a direct, or immediate, supervisor may be a more important factor in facilitating behavior changes. The final model supports the potential importance of direct supervisor support of active breaks and lower levels of prolonged sedentary behavior (OR=2.8). Since direct supervisors have more interaction with employees on a daily basis, the support, positive feedback, and social support they provide may be a more salient and meaningful determinant of whether employees take active breaks. This is supported by previous research that showed positive associations between direct supervisor support and occupational light physical activity in employees (Dishman et al., 2009). The results suggest that even in an unsupportive organizational climate (e.g., lack of organizational policy on supporting active breaks), direct supervisor support may still be effective in promoting active breaks. Further research is needed to understand the role and influence that multiple levels of administrators have in workplace sedentary behavior.

Employee health at the workplace, particularly in large organizations, may have complex interactions and determinants. Perhaps occupational public health research could improve our understanding of occupational sedentary behavior by using frameworks and models from the fields of performance management and organizational behavior management. Behavioral systems analysis (Hayes, Dubuque, Frying, & Pritchard, 2009; Diener, McGee, & Miguel, 2009; Brethower, 2000) and the Behavioral Engineering Model (Gilberts, 1978) may prove to be appropriate models to narrow down our more broad public health frameworks such as the socio-ecological model.

Behavioral Engineering Model (BEM) has traditionally been utilized in the performance technology field and provides a systematic and systemic way to identify person-related and environment-related barriers to individual performance and behavior (Gilberts, 1978). While previous research on sedentary behavior has yet to use the BEM, the model may provide an important perspective in which to understand the conditions of sedentary behavior. The six conditions of behavior in the BEM include data, instruments and incentives (i.e., supervisor and manager support) at the environment level and knowledge (i.e., self-efficacy), capacity and motives (i.e., outcome expectancy, enjoyment) at the individual level. The results of this study suggest that the BEM might be useful in identifying barriers to movement that increase occupational sedentary behavior. In addition, behavioral systems analysis (BSA) may provide further understanding of occupational sedentary behavior and the factors leading to productive performance as well as identifying process and system changes necessary for improved performance (McGee & Diener, 2010; Diener et al., 2009; Redmon & Wilk, 1991). Further research should consider using the BEM and incorporating BSA in order to further our understanding of the complex organizational factors that influence sedentary behavior at the workplace.

The results of the present study suggest that active break outcome expectancy, active break self-efficacy, and perceived social support for taking active breaks were not significantly associated with prolonged sedentary behavior in the study participants. The relatively small sample size may have contributed to the lack of significant findings for those variables. Additionally, the measures used to assess these variables were adapted from previously used instruments used in physical activity research. While the measures did show strong internal consistency in this study, whether these measures are appropriate to use when assessing behavior related to taking short active breaks is unknown. Alternatively, self-efficacy and perceived social support for taking active breaks may not be important in the context of taking short active breaks at the workplace like as they have been shown to be in planned MVPA (Koeneman et al., 2011).

Direct supervisor support, senior manager support, and enjoyment all provide realistic modifiable targets for programs and interventions aimed at reducing sedentary behavior at the workplace. Indeed, our knowledge of physical activity interventions suggests that the most effective interventions target multiple levels within the socio-ecological model (Marshall & Ramirez, 2011). Previous research has shown that sit-stand desks (Dutta, Koepp, Stovitz, Levine, & Pereira, 2014)) and point-of-choice prompts (Parry, Straker, Gilson, & Smith, 2013) may decrease sedentary behavior in office workers, however, the social environment has not been specifically investigated in the occupational sedentary behavior domain. In a public health policy context, this includes the need to decrease sedentary behavior not only through changes in individual-level variables but also through environmental and organizational influences (Salmon et al., 2003). From these findings, interventions could target multiple levels of influence to reduce sedentary behavior in desk-dependent office workers. First, direct supervisors frequently reminding employees of the importance of active breaks would provide a more salient support of employees taking short active breaks. Secondly, providing employees with multiple options of portable exercise equipment and walking routes around the office may improve enjoyment and self-efficacy of active breaks. In addition, the oversight of an employee wellness committee would help ensure that departmental managers and supervisors are adhering to organizational health policies and providing adequate resources and support for taking active breaks. Interventions aimed at enjoyment of active breaks (personal) and increasing direct manager support (interpersonal) and organizational climate (organizational) may have the greatest impact on changing sedentary behavior.

This study provides new insights into the correlates of sedentary behavior in office-workers, however, several limitations exist. A larger sample size could provide a stronger statistical analysis of the correlates. The choice of using 70% as the cut-off for percent of day spent sedentary could be further supported by additional research on specific thresholds of sedentary behavior related to negative health outcomes. Lastly, with the sample consisting of predominantly white,

middle-aged females, future studies should look at other populations to investigate generalizability.

Conclusions

The results of this study indicate that direct manager support and enjoyment of active breaks may be important determinants for breaking up prolonged sedentary behavior in the workplace. Future interventions should aim to improve direct manager support of active breaks, provide resources and equipment to increase the enjoyment of active breaks and develop widespread organizational policies supporting active breaks at the workplace. In addition, more studies within the behavioral epidemiological framework of sedentary behavior are needed to better understand both determinants of sedentary behavior and effective interventions to reduce sedentary behavior.

Conflict of Interest Statement:

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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