UNDERSTANDING DESK-BASED EMPLOYEES’ AND MANAGERS’ WORKPLACE SITTING AND SITTING-BREAKS

by

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October, 2014
I am the author of the thesis entitled:

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ABSTRACT

There is ample evidence to suggest that regular moderate-to-vigorous physical activity (MVPA) plays an integral role in the prevention and management of numerous chronic diseases. There is emerging evidence that sedentary behaviour, typically in the form of sitting, is an independent risk factor for premature mortality, cardiovascular disease (CVD), type-2 diabetes, and cancer. This is problematic considering the ubiquitous nature of sedentary behaviour in most developed countries, particularly within the workplace. Thus, the need to address sedentary behaviour in the workplace is imperative. However, the current research literature is limited in several respects. To address a number of these important research gaps, the design of two research studies was guided by the behavioural epidemiology framework, which outlines a series of systematic research phases for understanding and promoting population health. Two studies were conducted that addressed four of these research phases (measurement, prevalence, correlates, and feasibility of strategies to effect behaviour change). The overarching aims of both studies were to examine the psychometric properties of a self-report measure of workplace sitting and sitting-breaks, and to improve understanding of the social ecological factors associated with accumulated sitting and taking sitting-breaks in the desk-based workplace.

In the first study, a modified self-report measure of workplace sitting and sitting-breaks was validated and reliability tested. Over a one-week period desk-based employees (N=56) with a mean age of 32.20 years (SD= 9.77) completed the self-report measure of workplace sitting and sitting-breaks while wearing the ActiGraph accelerometer. The time spent sitting in the workplace on a weekday measure demonstrated acceptable test-retest reliability (ICC=.87, 95% CI 0.77, 0.93) and was fairly and significantly associated with accelerometer-derived sedentary time (<100
counts per minute), Spearman rank-order correlation coefficient ($\rho$) = .33, $p < .05$. The reliability of the frequency of sitting-breaks per work hour measure was not as high (ICC = .60, 95% CI .30, .76), nor was the criterion validity ($\rho$ = .27).

The second study (examining workplace sedentary), involved an online survey of desk-based employees ($n$ = 221; mean age 35 years [$SD$ = 11.93]) and desk-based managers ($n$ = 122; mean age 39 years [$SD$ = 12.12]).

The study examined the social ecological correlates (intrapersonal, interpersonal, environmental and policy level) of desk-based employees’ workplace sitting and sitting-breaks, and the feasibility of strategies to reduce and break-up sitting in the workplace. The data from the workplace sedentary study were examined from several different perspectives. The social ecological, intrapersonal, interpersonal factors were examined, as were the perceived outcomes of reducing workplace sedentary behavior, the healthiness of various physical activity intensities and the feasibility of reducing sedentary in increasing LPA. The results indicated that, in the final multivariate regression model in which the significant bivariate correlates from the linear regression models were combined, none of the social ecological correlates remained significant. However, sitting habit and limited physical opportunities for sitting-breaks approached significance in predicting an increase in workplace sitting time. Overall, the multivariate model explained 10% of the variance in workplace sitting. For workplace sitting-breaks, perceiving that workplace sitting is not bad for health and the habitualness of sitting-breaks were significant correlates of increased sitting-breaks in the multivariate model. The combined ecological correlates explained 25% of the variance in sitting-breaks.

The intrapersonal correlates of workplace sitting and sitting-breaks were examined from a dual-process perspective. Specifically, the relationship and
interactions between controlled (e.g., self-efficacy and barriers) and automatic (e.g., habit) psychological processes were examined with workplace sitting and sitting-breaks. Results indicated that increased self-efficacy and decreased barriers towards taking sitting-breaks were related with a higher frequency of sitting-breaks via increasing the habitualness of taking sitting-breaks. Furthermore, perceiving increased barriers towards taking sitting-breaks appeared to be particularly detrimental to this behaviour among desk-based employees who habitually sit.

To further examine workplace sitting and sitting-breaks from an interpersonal perceptive, desk-based managers’ beliefs concerning desk-based employees’ ability to take sitting-breaks were compared to those of the employees’. Employees and managers were found to spend similar amounts of the workday sitting, and reported taking few sitting-breaks per working hour. Interestingly, managers perceived their employees to have greater barriers and lower levels of self-efficacy towards taking sitting-breaks, than what the employees perceived for themselves.

The perceived outcomes of reducing accumulated sedentary behaviour and the healthiness of various physical activity intensities and sedentary behaviour were also examined among the employees and managers. While lower amounts of workplace sitting were predominantly considered to have positive outcomes for the desk-based worker and workplace, the level of awareness of the chronic health effects associated with sedentary behaviour was limited, particularly among the employees. Managers and employees perceived sitting to be unhealthy; however, there appeared to be the perception that sedentary behaviours and various physical activity intensities accumulated while at work were not as important for health as those same activities when accumulated during leisure-time. The presence or absence of leisure-time MVPA was perceived to be particularly important for determining overall health, to
the extent that the negative health effects of sitting all day at work were perceived to be mitigated if a person engaged in sufficient leisure-time MVPA.

In terms of the feasibility of strategies to reduce sitting and promote LPA in the workplace, the majority of managers and employees were supportive of strategies to reduce workplace sitting. However, concerns were raised in relation to productivity, workplace culture, the physical environment, and the manner of implementation of LPA strategies. Furthermore, managers and employees indicated they would prefer ‘typical’ LPA workplace activities, such as walking to the printer/scanner and standing and working for intervals, rather than engaging in standing or walking meetings.

Future research may benefit from the further development of a workplace measure that considers various occupations with diverse levels of workplace sitting time, including objective measures of postural allocation. The workplace sedentary study confirmed that simply encouraging desk-based employees to increase their sitting-breaks may not be sufficient, not only because sitting-breaks behaviours appear unrelated to workplace sitting time, they may not be easily increased and may even compromise work productivity. Research may benefit from further exploring the relationship between both controlled and automatic or habitual processes relevant to both reducing workplace sitting and promoting workplace LPA. It is important that management fully understands the perceived challenges for employees in taking sitting-breaks, and their role in encouraging and promoting workplace change. Research may also benefit from further understanding how management support may influence employees’ workplace behaviours, how to align managers’ and employees’ perceptions, and how favourable interpersonal environments for reducing workplace sitting and increasing sitting-breaks can be best created. Overall, these findings indicate that for interventions targeting workplace sedentary to be successful,
environmental-level factors must be considered in conjunction with intrapersonal and interpersonal level factors.
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1.1 Introduction

Emerging evidence suggests sedentary behaviour is an independent risk factor for chronic diseases (World Health Organization [WHO], 2011). Accumulated sedentary behaviour, typically in the form of sitting, is ubiquitous in modern society, particularly within the desk-based workplace (McCready & Levine, 2009; Plotnikoff & Karunamuni, 2012). The need to develop and implement effective interventions to reduce and break-up workplace sedentary behaviour is imperative (Plotnikoff & Karunamuni, 2012; Thorp et al., 2012). However, and in line with the socioecological model, limited research has included strategies or considered the influence of factors operating beyond the environmental level in relation to workplace sedentary and light intensity physical activity (LPA) behaviour (Clark et al., 2011; Bennie et al., 2011; Chau, van Der Ploeg, Dunn, Kurko, & Bauman, 2012; Plotnikoff & Karunamuni, 2012). Within the current thesis, it is argued that to better inform workplace sedentary interventions, research needs to extend understanding to examine the factors of relevance operating on the intrapersonal and interpersonal level (Sallis et al, 2006). In addition to this, the thesis highlights the limited research pertaining to the measurement of workplace sedentary behaviour, particularly in regard to capturing the manner in which workplace sedentary behaviour is accumulated (Clark et al., 2011; Bennie et al., 2011; Chau, van Der Ploeg, Dunn, Kurko, & Bauman, 2012; Plotnikoff & Karunamuni, 2012). These research gaps are consistent with systematic phases of the behavioural epidemiological framework designed to understand and inform the development of successful interventions and health promotion attempts of population
Chapter One: Thesis introduction

level behaviour (Owen, Healy, Matthews, & Dunstan, 2010; Sallis et al., 2006). The thesis aimed to explore these important research questions through the design of two research studies, specifically the first study, a reliability and validation study, examined the psychometric proprieties of a self-report measure of workplace sitting and sitting-breaks; and the second study, the workplace sedentary study, examined the various ecological, specifically the intrapersonal and interpersonal factors relevant to workplace sitting and sitting-breaks (Clark et al., 2011; Bennie et al., 2011; Chau et al., 2012; Owen et al., 2011; Plotnikoff & Karunamuni, 2012).

1.2 Overview of thesis chapters

In Chapter Two a review of the field of sedentary behaviour epidemiology, in addition to the recent population based recommendations pertaining to sedentary behaviour is presented (Australian Government Department of Health [DoHA], 2014; Department of Health, Social Science and Public Safety [DHSSPS], 2011; Tremblay, Colley, Saunders, Healy, & Owen, 2010; WHO, 2010). A broad overview of both the objective and subjective measures of sedentary behaviour is provided, and sedentary behaviour accumulated in the workplace is highlighted as an important setting in need of further research (Atkin et al., 2012; Clark et al., 2009; Troiano et al., 2012). In line with the ecological model, the literature review presents a rationale for further understanding the intrapersonal and interpersonal factors relevant to workplace sitting and sitting-breaks (Sallis et al., 2006). In order to guide understanding the review draws on a number of theories of heath behaviour change (Owen et al., 2011). In addition, a dual-process approach to understanding human behavior is introduced, which includes both automatic and controlled processes as the cognitive determinants of behaviour (Evans, 2003). Finally, the literature review presents a review of the extant literature pertaining to the various ecological factors relevant to workplace sitting and sitting-breaks (Bennie, Timperio, Crawford, Dunstan, & Salmon, 2011; Biddle & Fuchs, 2009;
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Evans et al., 2012; Healy et al., 2013; Owen et al., 2010, 2011). The review concludes with the broad thesis aims.

The results of a validation study examining the psychometric proprieties of a self-administered measure of workplace sitting and sitting-breaks are described in Chapter Three. The study utilised a one-week validation period to examine the test-retest reliability and criterion validity (compared with ActiGraph accelerometry) of the self-report measure.

The methods used in the cross-sectional workplace sedentary study (Study Two) are presented in Chapter Four, and these methods underpin the analyses and results interpreted in Chapters Five, Six, Seven, Eight, and Nine. In Chapter Five, the results of the workplace sedentary study examining the associations between the social ecological factors with desk-based employees’ workplace sitting and sitting-breaks are described.

In Chapter Six, a further focus on understanding the intrapersonal correlates relevant to workplace sitting and sitting-breaks was taken. Specifically, a dual-process approach, examining both the interaction and relationship with automatic (e.g., habit) and controlled (e.g., barriers and self-efficacy) processes with sitting and sitting-breaks was undertaken.

In Chapter Seven, an interpersonal focus examining managers’ beliefs concerning desk-based employees’ barriers and self-efficacy towards taking sitting-breaks was taken. This provided a unique opportunity to compare and contrast managers’ perceptions to those of the desk-based employees’ own beliefs about taking sitting-breaks.

For both the employees and managers, the perceived effect of reducing workplace sitting and the health rating of various physical activity intensities and sedentary behaviour is examined in Chapter Eight. A consideration is also placed on the
perceived healthiness of physical activity intensities and sedentary behaviour when accumulated in the work and leisure-time domains.

In Chapter Nine the respective support and willingness of employees and managers to implement strategies to reduce workplace sitting was examined. Employees’ and managers’ receptiveness to engage in various LPA strategies, was also examined.

In Chapter Ten, the final chapter, a synthesis of the results from the two research studies are described, and the implications of these results are discussed.
2.1 Introduction
Cardiovascular disease (CVD), type 2 diabetes, cancer and obesity are the leading causes of global death (WHO, 2011). There is ample research to suggest that these chronic health conditions are to some extent preventable through lifestyle modifications, primarily relating to improving diet and increasing moderate-to-vigorous physical activity (MVPA; Australian Institute of Health and Welfare [AIHW], 2013; United States Department of Health and Human Services [U.S.DHHS], 1996, 1998; Warburton, Nicol, & Bredin, 2006; WHO, 2011). Furthermore, emerging research suggests that accumulated periods of sedentary behaviour are also a risk factor, independent of MVPA, for chronic health conditions (Owen et al., 2010; Thorp, Owen, Neuhaus, & Dunstan, 2011; Veerman et al., 2011; Wilmot et al., 2012). Sedentary behaviour, typically in the form of sitting, is ubiquitous in modern society, particularly within the desk-based workplace (McCraday & Levine, 2009; Plotnikoff & Karunamuni, 2012). The desk-based workplace represents a key setting for the delivery of strategies aimed at reducing and breaking-up workplace sitting (Plotnikoff & Karunamuni, 2012; Owen et al., 2011; Thorp et al., 2012). However, this evidence base is limited in several respects. In order to guide further research and understanding, the thesis adopts a behavioural epidemiology framework.

The behavioural epidemiology framework posits a number of systematic research phases to help guide population health understanding, intervention and health promotion. The framework was developed by Sallis, Owen and Fotheringham (2000) in recognition of the need to effectively address the rising prevalence of chronic...
diseases. The framework focuses on understanding and influencing health behaviours to create population level interventions to promote health and prevent diseases. Owen et al. (2010) applied this framework to research on sedentary behaviour, and as a means to guide future research. The various systematic phases and current research related to sedentary behaviour is presented in Figure 2.1.

**Figure 2.1 Behavioural epidemiological framework and sedentary behaviour**

1) Establishing relationships between sedentary behaviour and health
2) Developing measures of sedentary behaviour
3) Characterising prevalence and variations in sedentary behaviour
4) Identifying determinants of sedentary behaviour
5) Developing and testing sedentary interventions
6) Using evidence to inform public health guidelines and policy

In accordance with this framework the current thesis will focus on phase two (the development of valid measures of sedentary behaviour), phase three (characterise prevalence of sedentary behaviour), phase four (understanding the determinants of
Chapter Two: Literature Review

sedentary behaviour), and phase five (understanding the feasibility of interventions to reduce sedentary behaviour; Owen et al., 2010)

When determining which factors influence a particular health behaviour, it is important to first consider the research methods used to capture behaviour and infer associations. In regard to measuring workplace sedentary behaviour, research is limited, particularly in relation to capturing the manner in which sedentary time and LPA is accumulated (i.e., frequency of breaks from sitting; Clark et al., 2011; Bennie et al., 2011; Chau et al., 2012). The development of a valid and reliable measure of workplace sitting and sitting-breaks was also deemed important to further understand the determinants of sedentary behaviour. (Bauman, Sallis, Dzewaltowski, Owbe, 2002). Understanding the factors related to reducing and taking sitting-breaks can provide valuable insights into the modifiable targets for interventions and health promotion attempts to promote behaviour change (Dishman, Heath, & Lee, 2012). Of particular interest to the current thesis are the ‘correlates’ of sedentary behaviour. A correlate is a term used to describe statistical associations between measured variables and behavior at one point in time, and such understanding is typically inferred from cross-sectional research. Correlates of behaviour can be used to critique existing health behaviour theories and can inform intervention development that can draw potential causal inferences (Bauman et al., 2002). The current thesis will specifically focus on understanding the correlates of workplace sitting and sitting-breaks (Bauman et al., 2002; Healy et al., 2013).

The present thesis will argue that future interventions aimed at reducing workplace sitting and taking sitting-breaks need to be better informed. Specifically, valid and reliable measures of workplace sitting and sitting-breaks are needed. The various factors related to reducing workplace sitting and taking sitting-breaks, as well as receptiveness to interventions designed to reduce workplace sitting and take sitting-
breaks (i.e., LPA strategies) needs to be better understood (Biddle, 2011; Clark et al., 2012; Healy et al., 2013; Plotnikoff & Karunamuni, 2012; Straker, Abbott, Heiden, Mathiassen, & Toomingas, 2013).

This chapter first introduces the extant literature pertaining to LPA, sedentary behaviour, and various chronic health outcomes. The prevalence of sedentary behaviour, particularly within the desk-based workplace will be reviewed, then the literature relating to the measurement of sedentary behaviour and LPA (i.e., total workplace LPA, breaks in sedentary/sitting time; Atkin et al., 2012) will be summarised. This chapter will conclude with a review of research exploring the various ecological factors related to sedentary behaviour and LPA in the workplace, and the overall thesis aims (Bennie et al., 2011; Gilson, Burton, van Uffelen, & Brown, 2011; Gilson, Straker, & Parry, 2012a).

2.2 Physical activity and sedentary behaviour

2.2.1 Physical activity

Physical activity can be defined as “any bodily movement produced by the skeletal muscles that results in energy expenditure” (Caspersen, Powell, & Christenson, 1985, p.2). There are various types of physical activity; exercise, which is structured, planned and repetitive; sport, which is organised and competitive; and incidental which is unstructured with no primary goal or purpose (Caspersen et al., 1985). Physical activity can be further quantified based on duration; the amount of time spent in physical activity; frequency; the number of physical activity sessions in a given amount of time; and intensity; the level of physical activity exertion (Caspersen et al., 1985). The intensity of physical activity is deemed important light in of the different associated physiological adaptations. Physical activity intensity can be quantified based on the metabolic cost of activity, which is made in comparison to resting
metabolic rate, generally referred to as a metabolic equivalent (MET) or 1MET which is equal to 3.5mL O2/kg/min (Ainsworth et al., 1993; Montoye, Kemper, Saris, & Washburn, 1996; Norton, Norton, & Sadgrove, 2009; Sallis & Owen, 2003). Most of the recognised and established benefits of physical activity have been associated with MVPA (6 ≥ 9 METs; Norton, Norton, & Sadgrove, 2009; WHO, 2010).

2.2.2 Health benefits of MVPA

Participation in regular MVPA, irrespective of age, has been shown to provide numerous physical and mental health benefits (AIHW, 2013; U.S.DHHS, 1996, 1998; Warburton et al., 2006; WHO, 2011). Regular MVPA has been shown to reduce the risk, manage the prognosis, and reduce the risk of premature mortality associated with various chronic conditions, such as cancer, CVD, and type 2 diabetes (AIHW, 2013; WHO, 2011; Friedenreich, Neilson, & Lynch, 2010; Janssen & LeBlanc, 2010; Penedo & Dahn, 2005). Regular MVPA has also been shown to reduce the effects of depression and anxiety, and improve physical and cognitive functioning (Andel et al., 2008; Barbour, Edenfield, & Blumenthal, 2007). Consequently, regular MVPA is a commonly recommended lifestyle modification by the WHO and various nations, including Australia (Australian Government Department of Health [DoHA], 2014; Department of Health, Social Science and Public Safety [DHSSPS], 2011; Tremblay, et al., 2010; WHO, 2010). While most of the physical activity recommendations have focused on emphasising physical activity of a moderate-to-vigorous intensity, the most appropriate physical activity intensity for health outcomes has been a topic of interest and a particular focus of the current literature review (DoHA, 2014; DHSSPS, 2011). Research is also beginning to associate lower levels of physical activity intensity with independent health benefits (Tremblay, Esliger, Tremblay, & Colley, 2007; Healy et al., 2008).
2.2.3 LPA

LPA is a term used to describe activity that is very light in nature and involves low levels of energy expenditure; 1.5-3 METS (Pate, O’Neill, & Lobelo, 2008). LPA can be structured and/or purposeful (e.g., going for a walk), or incidental and preferred in order to attain a secondary goal (e.g., walking up stairs to get somewhere). Less research on LPA as an independent physical activity intensity has been performed, which is in part due to measurement difficulties and the strong focus on MVPA (Powell, Paluch, & Blair, 2011). Fortunately, the use of operational definitions (i.e., activity between 1.5-3 METs) and accelerometers has contributed to further understanding LPA and disease associations (Tremblay et al., 2007). Research is now suggesting that LPA is a distinct activity component, with independent health benefits from MVPA (Healy et al., 2008; Pate et al., 2008).

2.2.4 Health benefits of LPA

LPA has been shown to have beneficial effects on metabolic risk factors, such as: elevated glucose levels, triglyceride uptake, and HDL cholesterol production independent of MVPA and sedentary time (Dunstan et al., 2007; 2010; Hamilton, Hamilton, & Zderic, 2007; Healy et al., 2007, 2008). The beneficial effects of LPA have also been associated with improved chronic disease outcomes, such as: obesity, type 2 diabetes, and coronary artery disease (Healy et al., 2007, 2008). LPA has also been associated with an increased metabolic rate, increased energy expenditure, and an improvement in cardiovascular fitness (McGuire & Ross, 2011; Swartz, Squires, & Strath, 2012). Although the energy expended from LPA may be small and discrete, the accumulative effects of LPA throughout the day can make a significant and variable contribution to total-daily energy-expenditure (TDEE). For example, an ‘active’ individual who engages in 30 minutes of MVPA per day is left with approximately 15.5 waking hours, in which the proportion of time spent in sedentary
versus LPA activities (i.e., sitting versus standing or in light-intensity ambulatory activities) can substantially vary (Healy et al., 2007; Hamilton, Healy, Dunstan, Zderic, & Owen, 2008; Levine, 2003; Levine, vander Weg, Hill, & Klesges, 2006; Tremblay et al., 2010).

Traditionally, those who did not meet the MVPA guidelines were simultaneously described as ‘physically (in) active’ and or ‘sedentary’ (Pate et al., 2008). Specifically, the health risks associated with physical inactivity and sedentary behaviour were thought to be the result of too little MVPA, leading to the assumption that physical activity and sedentary behaviour are the opposite ends of an activity continuum (Marshall & Gyi, 2010). However, this definition is inaccurate as it not only neglects the various intensities of physical activity, it fails to distinguish and consider that physical activity and sedentary behaviour may be independent behaviours (Owen et al., 2010). Research is now suggesting that ‘physical (in) activity’ and ‘sedentary behaviour’ are distinct behaviours with independent health risks; sedentary behaviour is it not merely the bottom end of a physical activity continuum or the absence of sufficient MVPA (Hamilton et al., 2007; Owen et al., 2010; Tremblay et al., 2010). Furthermore, from a physiological perspective, animal research indicates the underlying physiological and metabolic mechanisms of sedentary behaviour are distinct from that of physical activity/ inactivity (Hamilton, Hamilton, & Zderic, 2004; Hamilton et al., 2007; Zderic & Hamilton, 2006; O'Keefe & Bell, 2007). Which also supports the independence of physical activity / inactivity and sedentary behaviour (Hamilton et al. 2004, 2007; Tremblay et al., 2010).

2.3 Sedentary behaviour

Sedentary behaviour can be defined as any waking behaviour involving little or no energy expenditure while in a sitting or reclining posture; 1-1.5METs (Sedentary Behaviour Research Network [SBRN], 2012; Tremblay, 2012). Sedentary behaviour
is distinct from ‘physical (in) activity’, in that it refers to too much sedentary time as opposed to not meeting the MVPA guidelines (Tremblay, 2012). Sedentary behaviour can be further distinguished based upon the manner in which it is engaged in; specifically in a discretionary (i.e., involving the choice to be sedentary, such as watching TV) or non-discretionary manner (i.e., influenced by environmental constraints, such as sitting to complete computer based work). Discretionary sedentary behaviours can include: sitting, media use, and other non-occupational/ school computer related activities. Such types of sedentary behaviour are more amendable to targeted behavioural interventions. Whereas non-discretionary sedentary behaviours, such as that accumulated while at work, sleeping, and during transportation, are more likely to be influence by regulations and environmental factors (Clark, Sugiyama, Healy, Salmon, Dunstan, & Owen, 2009; Gabriel, Morrow, & Woolsey, 2012).

Understanding and treating sedentary behaviour as an independent health risk factor is a relatively new research focus (Brown, Bauman, & Owen, 2009). However, it can be argued that the pioneering research in the physical activity context (that set the stage for over half the next century’s research focus on MVPA) more closely pertained to workplace sitting (Morris, Heady, Raffle, Roberts, & Park, 1953; Pronk, 2010). This pioneering research precipitated 60 years of investigation into the effect of MVPA, in which the focus and distinction between LPA and sedentary time was overlooked. There is a rapidly growing research body indicating that accumulated sedentary behaviour is associated with increased health risks, all of which may be independent of MVPA (Brown et al., 2009; Ekelund, Brage, Besson, Sharp, & Wareham, 2008; Healy et al., 2008; Thorp et al., 2011; Wilmot et al., 2012).

2.4 Sedentary behaviour and health

Recently, a number of reviews have attempted to summarise and interpret the available literature pertaining to sedentary behaviour and associated health outcomes. Reviews
have focused on cross-sectional (Foster, Gore, & West, 2006), prospective (Proper, Singh, van Mechelen, & Chinapaw, 2011; Thorp et al., 2011) or combined types of research methodologies (van Uffelen et al., 2010; Williams, Raynor, & Ciccolo, 2008; Wilmot et al., 2012).

Prospective research has consistently found a positive relationship between sedentary behaviour and premature mortality, specifically all-cause and CVD related mortality, which appear to be independent of body mass index (BMI) and MVPA level (Thorp et al., 2011). In a systematic review of the health effects of workplace sitting, four prospective studies found a positive relationship between workplace sitting and increased mortality risk, one found no association, and another found an inverse association (van Uffelen et al., 2010). In another systematic review, that included three prospective studies, strong evidence for a relationship between sedentary behaviour and all-cause and CVD related mortality was found, but not with cancer related mortality (Proper et al., 2011). A recent systematic review and meta-analysis including 16 prospective studies and two cross-sectional studies, found that those with the greatest sedentary time when compared to the lowest, were associated with a 90% increased risk of CVD mortality and a 49% increase in all-cause mortality (Wilmot et al., 2012). However, the review did not quantify a specific amount of sedentary time to reflect the ‘highest’ and ‘lowest’ sedentary categories, which limits conclusions relating to the dose-response relationship between sedentary time and mortality outcomes (Wilmot et al., 2012).

A recent large (N=50,817) three year prospective study associated higher total sitting time (i.e., ≥ 10h/day) with all cause and cardiometabolic disease-related mortality in the short term. However, accumulated sitting while watching television and sitting while at work did not appear to significantly impact health in the same time frame. Possible explanations behind the different results were in part attributed to total
sitting time which consists of sitting in different contexts, may have a cumulative effect that is more evident in the short term (Chau et al., 2013). Furthermore, preliminary life modeling research suggests that the years of life lost associated with sedentary behaviour may be comparable to chronic diseases, ‘physical (in) activity’ and obesity (Veerman et al., 2011).

Prospective research is supportive of a relationship between sedentary behaviour and an increased risk of site-specific cancers, including: endometrial (Gierach et al., 2009; Proper et al., 2011) ovarian, and colon cancer (Patel, Rodrigues, Pavluck, Thun, & Calle, 2006). In a systematic review of workplace sitting, only five of the 17 included studies found a relationship between workplace sitting and an increase in the incidence of various cancers (van Uffelen et al., 2010). Ten prospective studies found no relationship, and two associated more active workers with increased lung cancer risk (van Uffelen et al., 2010). Although some of the included studies made limited distinctions between sedentary behaviour and physical activity/inactivity, which limits conclusions pertaining to the independent effects of sedentary behaviour (van Uffelen et al., 2010). In a recent meta-analysis of cohort and case-control studies, sedentary behaviour was associated with an increased risk of colon cancer, and sub-group analyses indicated a positive relationship between sedentary behaviour and rectal cancer (Cong et al., 2014).

Prospective research generally indicates a longitudinal relationship between type 2 diabetes and sedentary behaviour (Proper et al., 2011; van Uffelen 2010; Wilmot et al., 2012). In a systematic review and meta-analysis of prospective and cross-sectional research, those with the highest sedentary time compared to the lowest, were associated with a 112% relative risk increase of diabetes, which was largely independent of MVPA level (Wilmot et al., 2012()). Although a systematic review of prospective research indicated that the extent to which BMI and physical activity may
mediate such a relationship between sedentary behaviour and type 2 diabetes is unknown (Thorp et al., 2011).

Limited research has explored the relationship between sedentary behaviour and CVD incidence. Mixed results have been reported regarding the relationship between CVD outcomes and workplace sitting (van Uffelen et al., 2010); another systematic study reported insufficient evidence for a relationship (Proper et al., 2011); and those with the highest sedentary time have been associated with 147% increased risk of cardiovascular events when compared to those with the lowest sedentary time (Wilmot et al., 2012).

The association between sedentary behaviour and weight gain/overweight/obesity among adults has been inconsistent, and the question of directionality is unknown (Foster et al., 2006; Proper et al., 2010; Thorp et al., 2011; van Uffelen et al., 2010). Further, gender-specific associations have been found, and the mediating role of baseline BMI is unknown (Thorp et al., 2011; van Uffelen et al., 2010). It has also been proposed that sedentary behaviour may potentially induce poor health outcomes through a moderating influence on weight status and energy expenditure; occurring through the displacement of forms of physical activity with sedentary behaviour, which is associated with lower energy demands (Healy et al., 2008; Williams et al., 2007). Furthermore, sedentary behaviour may also influence weight status through its association with increased overall energy intake and snacking behaviours (Bowman, 2006).

Emerging research is also beginning to explore the relationship between sitting time and mental health outcomes (Kilpatrick, Sanderson, Bilzzard, Teale, & Venn, 2013; Teychenne, Ball, & Salmon, 2010; Teychenne & York, 2013). A systematic review which included seven observational and four prospective studies, examined the relationship between sedentary behaviour and depression among adults. Observational
results found positive associations, while the prospective research found inconsistent results (Teychenne et al., 2010). Further cross-sectional research has reported associations between total sedentary time and symptoms of postnatal depression (Techenne & York, 2013); and workplace sitting (>6hrs per day) with increased moderate-to-high symptoms of psychological distress (Kilpatrick et al., 2013). A recent prospective study among adults associated baseline television viewing time (≥ 6hrs/d versus <2 hrs/day) with higher depressive symptoms and poorer global cognitive function (Hamer & Stamatakis, 2013). Conversely, higher Internet use was inversely associated with depressive symptoms and higher global cognitive function. Over the two-year research period, no significant changes in sedentary behaviour related to mental health outcomes. These results highlighted the need to also consider and differentiate the context and type of sedentary behaviours under investigation (Hamer & Stamatakis, 2013). Another recent four-year prospective study found symptoms of depression predicted computer use but not television use among men only (Brunet et al., 2014).

In addition to research exploring the relationship between accumulated sedentary time and health outcomes, emerging research is also indicating that the manner in which sedentary time is accumulated may have health implications (Hamilton et al., 2004, 2007; Healy et al., 2008).

2.4.1 Effects of accumulated and interrupted sedentary behaviour

As part of the Australian Diabetes, Obesity and lifestyle study (AusDiab), Healy et al. (2008) objectively measured total daily sedentary time and breaks in sedentary time among a sample of adults (n=168). Independent of total sedentary and MVPA time, breaks in sedentary time (defined as accelerometer counts/minutes ≥ 100) were cross-sectionally and beneficially associated with: waist circumference, BMI, triglycerides, and 2-h plasma glucose. Specifically, sustained sedentary bouts were associated with
undesirable outcomes when compared to shorter sedentary bouts. Beneficial breaks were found to be short in duration (i.e., for as little as one minute) and light in intensity, for example standing for a few minutes or taking a brief walk (Tremblay et al., 2010; Hamilton et al., 2007). These preliminary results suggest that not only is the amount of sedentary time important, the manner in which it is accumulated may have important health implications (Hamilton et al., 2004, 2007; Healy et al., 2008).

2.4.2 Summary of health associations

Research examining the independent health effects of the various physical activity intensities, and of sedentary behaviour, further adds to the complexity of what influences metabolic health, and the rising prevalence of non-communicable diseases (Healy et al., 2008; Tremblay et al., 2007; WHO, 2011). Furthermore, this research indicates that even if adults meet the MVPA guidelines, their metabolic health may still be compromised if they are sedentary for accumulated periods (this has been termed the ‘Active Coach Potato’ phenomena; Owen et al., 2010; Proper et al., 2011; Tremblay et al., 2010). Indicating that simply promoting MVPA may not be suffice; a dual focus on sedentary time and the various physical activity intensities (i.e., reducing and breaking up accumulated sedentary time, in addition to increasing LPA and MVPA) may be required (Hamilton et al., 2008; Pate, O’Neil, & Blair, 2008; Tremblay et al., 2010).

2.5 Public health recommendations for sedentary behaviour

In light of the detrimental health outcomes associated with accumulated sedentary behaviour, nations are starting to recommend reducing and breaking up accumulated sedentary behaviour (DoHA, 2014; DHSSPS, 2011; Haskell et al., 2007). At a population level, the United Kingdom and Australia recommend that adults should minimise the amount of time spent being sedentary and to break-up periods of
accumulated sedentary time (DoHA, 2014; DHSSPS, 2011). Although specific reduction targets have not yet been given, which is due to the lack of dose-response evidence, recommendations about how this may be achieved are provided, such as reducing time spent watching television, swapping a long car journey with walking some of the way, taking regular breaks at work, setting a reminder to take regular breaks etc. (DoHA, 2014; DHSSPS, 2011; Owen et al., 2011). Given the associated health outcomes and the emergence of new public health recommendations for reducing and breaking-up sedentary behaviour, it is important to be able to accurately survey and monitor sedentary behaviour on a population level.

2.6 Measuring sedentary behaviour and LPA

The development of valid and reliable measures of sedentary behaviour are essential to further understand the associated health effects; assess intervention outcomes; identify the individual, social, and environmental-policy determinants/correlates of behaviour that may be amendable to intervention; and to monitor and survey sedentary behaviour among populations (Atkin et al., 2012; Hutcheon, Chiolero, & Hanley, 2010; Lagerros & Lagiou, 2007; Troiano, Gabriel, Welk, Owen, Sternfeld, 2012). A measure with adequate psychometric proprieties provides researchers with a degree of confidence that the behaviour under investigation is captured in an acceptable, accurate and consistent manner (Atkin et al., 2012). Sedentary behaviour is commonly measured via subjective (e.g., self-report measures) and objective measures (e.g., accelerometers), both with advantages and disadvantages (Troiano et al., 2012).

2.6.1 Subjective measures of sedentary behaviour

Subjective methods measure sedentary behaviour through proxy- or self-reports, such as recall questionnaires, diaries, and logbooks (Atkin et al., 2012). Such methods are advantageous as they can be implemented on a large scale, are cost-effective, readily
accessible, have a relatively low participant burden and do not alter the behaviour under investigation (Atkin et al., 2012; Clark et al., 2009; Sallis & Saelens, 2000; Troiano et al., 2012). Self-report measures, in the form of behavioural logs, capture behaviour in real time, and can provide information on the multi-faceted nature of sedentary behaviour (e.g., sitting at a desk, watching television etc.). However, as subjective measures rely on self-reports, they are subject to inherent limitations, such as random and systematic reporting errors, issues related to cognitive ability, and the influence of cultural norms and social desirability (Adams, Ebbeling, Cunningham, Fulton, & 2005; Baranowski, 1988; Durante & Ainsworth, 1996; Matthews & Welk, 2002; Sallis & Saelens, 2000).

To date, the majority of sedentary behaviour measurement research has focused on measuring daily television time as a proxy marker for overall sedentary time, particularly among children and adolescents (Bryant, Lucove, Evenson, & Marshall, 2007; Clark et al., 2009; Lubans et al., 2011; Marshall & Ramirez, 2011). Of the limited reliability and validity research measuring adult sedentary behaviour, most has focused on television viewing (Clark et al., 2009; Marshall & Ramirez, 2011), or total sedentary time (Rosenberg, Bull, Marshall, Sallis, Bauman, 2008). Limited data exist on the psychometric properties of a self-report measure of sedentary time and the manner in which it is accumulated/ broken-up (i.e., LPA and breaks from sedentary behaviour) in the workplace (Chau et al., 2012; Clark et al., 2011; Marshall, Miller, Burton, & Brown, 2010; McCormack, Corti, Milligan, 2003; Miller & Brown, 2004; Rosenberg et al., 2010). Further research is needed to address this gap by investigating the validity of a self-report measure of workplace sitting and sitting-breaks (Chau et al., 2012; Clark et al., 2011; Marshall, Miller, Burton, & Brown, 2010; McCormack, Corti, Milligan, 2003; Miller & Brown, 2004; Rosenberg et al., 2010). The development of a valid and reliable measure is deemed important in light of the adverse
health effects associated with accumulated sedentary behaviour, and the increasing prevalence of sedentary behaviour in the modern world, particularly within the desk-based workplace (Atkin et al., 2012; Proper, et al., 2011; Thorp et al., 2012). In addition, a reliable and valid measure that captures sitting breaks was desired, this is light of emerging research indicating that breaks in sedentary time may also be associated with health outcomes (Atkin et al., 2012; Dunstan et al., 2012).

2.6.2 Objective measures of sedentary behaviour

Objective measures typically involve the application of technology to record human movement. The hip-mounted ActiGraph accelerometer, which provides information on the frequency and amplitude of acceleration, is commonly used in sedentary measurement research (Sternfeld & Goldmna-Roasa, 2012). The ActiGraph also provides information about the manner in which sedentary time is accumulated, by capturing periods of time when movement exceeded specified sedentary thresholds (Chen & Bassett, 2005). Further, the collected information is stamped with real time, which allows for the extraction of specific times (e.g., sedentary time during working hours; Chen & Bassett, 2005). However, objective measures are not without their own limitations.

Key issues related to the use of the ActiGraph accelerometer include the lack of consensus regarding the most appropriate data-processing protocol (e.g., the optimal epoch length, corresponding activity counts and definitions of non-wear time). When using the ActiGraph, <100 count per minute (cpm) is commonly used to define sedentary time in adults (Healy et al., 2008; Matthews et al., 2008). However, this cut point was not empirically derived and limited research has reported the validity of this cut point as a marker of sedentary time (Kozey-Keadle, Libertine, Lyden, Staudenmayer, & Freedson, 2011; Matthews et al., 2008). Sedentary time measured
by the ActiGraph has been validated against other objective measures of behaviour, such as the Intelligent Device for Energy Expenditure and Activity (IDEEA) monitor (Zhang, Pi-Sunyer, & Boozer, 2004) and the activPAL activity monitor and inclinometer (Grant, Ryan, Tigbe, & Granat, 2006). On average, recorded sedentary time has been reported to be lower for the ActiGraph monitor (8.7 (SD=16) hours/day or 60.9%) than for the activPAL (9.0 (SD=1.8) hours/days or 63.4%, p=0.01), although the correlation between the two measures is high (r=0.76, p<0.01). Furthermore, the Bland-Altman plot showed a small mean difference (-0.34 hours) with wide limits of agreement between the measures (95% confidence intervals 2.11 to -2.79 hours). Indicating that the ActiGraph has minimal bias overall, but can both substantially over- and under-estimate sedentary time when compared to the activPAL (Grant et al., 2006; Zhang et al., 2004).

A further limitation of the intensity-based accelerometer is the limited ability to distinguish between types of sedentary behaviours and postures, such as sitting and lying or standing still. Consequently, periods of standing stationary may be misclassified as sedentary time and vice versa. Which is of concern considering preliminary research suggesting postural changes may mitigate against the metabolic effects associated with accumulated sedentary behaviour, and consequently should be classified as LPA (Hamilton et al., 2007, 2008). Further, accelerometers do not indicate and record the context within which the sedentary behaviour occurs (Sternfeld & Goldman-Rosas, 2012).

**2.6.3 Summary of sedentary behaviour measurements**

Subjective and objective measures of sedentary behaviour each provide unique information about sedentary behaviour, and neither method alone provides a complete picture (Sternfeld & Goldman-Rosas, 2012; Troiano et al., 2012). While objective measures of sedentary behaviour are recommended, this approach is still in
development. Where possible, a concurrent measurement approach is recommended (Troiano et al., 2012); however, at the least, objective measures should be used to determine the validity of self-report measures (Sternfeld & Goldman-Rosas, 2012).

2.7 Workplace sedentary behaviour and LPA

Over time, workplace related physical activity has decreased, and currently most adults in developed nations are in occupations that require accumulated sitting (Straker & Mathiassen, 2009; van Uffelen et al., 2010). Many occupations are now computer-based and require workers to spend a large proportion of their workday sitting (McCrady & Levine, 2009; Plotnikoff & Karunamuni, 2012; Pronk, 2010). Prevalence data suggests that in Australia, 83% of adults are in full-time work, and can spend between half-to-77% of their working day sitting (Australian Bureau of Statistics, [ABS], 2012; Thorp et al., 2012). There is also evidence that working adults with higher workplace related sitting time do not necessarily compensate for this by spending less leisure-time in sedentary pursuits (Jans, Propper, & Hidebrandt, 2007; McCrady & Levine, 2009), and also report sitting for longer periods outside of work (Clemes, Patel, Mahon, & Griffiths, 2014).

Research has also shown that most office-based workers (51%) accumulate sedentary time in a accumulated and uninterrupted manner (i.e., in periods lasting longer than 30 minutes at a time; Ryan, Grant, Dall, & Granat, 2011; Thorp et al., 2012). Consequently workplace sedentary behaviour has become of particular interest within the context of workplace health (Carnethon et al., 2009; National Preventative Health Taskforce, 2009). The development and implementation of effective workplace sedentary interventions has become a priority (Hamilton et al., 2008; McCrady & Levine, 2009; Plotnikoff & Karunamuni, 2012). However, in order to further inform effective workplace sedentary interventions, research is needed to further elucidate what factors within the workplace may be of particular relevance to target in attempt
to reduce and encourage regular breaks from sitting in the workplace. The factors that influence behaviour can be extensive and complex, this is where the use of models and theories can be useful to guide understanding (Owen et al., 2011). One such model which is gaining interest and support in research on sedentary behaviour is the social ecological model (Sallis et al., 2006).

2.8 The social ecological model

The social ecological model provides a framework for understanding and conceptualising the various factors that influence behaviour (Sallis et al., 2006). This model proposes that the influences on behaviour are likely to be context specific, multiple, interacting, and operate from various levels. Specifically, from an intrapersonal (i.e., demographic, biological and psychological), interpersonal (i.e., social), environmental (i.e., rural and built), and policy (i.e., organisational regulations norms etc.) level (Bronfenbrenner, 1979; Stokols, 1992). Intrapersonal level factors can influence the decision to engage in behaviour; interpersonal, or social factors can play an important role in the initiation, maintenance, and reinforcement of specific behaviour; and environmental, policy and organisational level factors can influence behaviour directly or indirectly, via providing cues which influence the ease in which behaviour can occur (Hammond, Leonard, & Fridinger, 2000; Sallis et al., 2006; LaMontagne, 2004). The social ecological model acknowledges the complexity of factors that influence health behaviour, in which the policy and environmental context of behaviour, in addition to the intrapersonal and interpersonal level influences of behaviour, are all emphasised (Sallis et al., 2006).

The social ecological model can be useful to gain a more comprehensive understanding of the different factors that may influence behaviour. Furthermore, intervention success is likely to be enhanced if the multiple and interacting factors operating on the various levels can be identified and targeted (Owen et al., 2011; Sallis...
et al., 2006). Behaviour change is expected to be optimal when environmental and policy factors support healthy choices; when there are positive social norms and social supports for behaviour change; and when individuals are motivated and educated to make healthy choices (Owen et al., 2011; Sallis et al., 2006). The social ecological model has shown success in the physical activity intervention literature (Glanz, Rimer, & Viswanath, 2008; McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006; Sallis et al., 2006), and is beginning to guide sedentary interventions, particularly in regard to television viewing among children and adolescents (Salmon, Tremblay, Marshall, & Hume, 2011). However, from a social ecological approach there is a dearth of research targeting workplace sedentary behaviour (Healy et al., 2013; Evans, Fawole, Sheriff, Dall, Grant, & Ryan, 2012; Owen et al., 2011; Salmon, et al., 2011).

Interventions targeting workplace sedentary behaviour have predominantly employed environmental strategies to influence the manner in which work tasks can be completed (e.g., via implementing walking-work stations, sit-stand desks etc.; Alkhajah, Reeves, Eakin, Winkler, Owen, & Healy, 2012; Beers, Roemmich, Epstien, & Horvath, 2008; Gilson, Suppini, Ryde, Brown, & Burton, 2012b; John, Thompson, Raynor, Bielak, Rider, & Bassee, 2011; McAlpine, Manohar, McCrady, Hensrud, & Levine, 2007; Parry, Straker, Gilson, & Smith, 2014; Pronk, Katz, Lowry, & Payfer, 2012; Thompson, Foster, Elde, & Levine, 2007). The limited inclusion of strategies operating on the intrapersonal and interpersonal level suggests that more research is needed to better understand what and how these factors relate to sitting and taking breaks from sitting in the workplace. It is likely that intrapersonal differences, along with interpersonal factors, may also account for variance in the success of sedentary behaviour interventions (Gilson et al., 2012b; Plotnikoff & Karunamuni, 2012; Starker et al., 2013). As the correlates/determinates operating on the intrapersonal and interpersonal level can be diverse and complex, understanding the
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factors of particular relevance can be difficult (Biddle & Fuchs, 2009). As a broad framework, the social ecological model proposes that intrapersonal, interpersonal and policy-environmental level factors may influence behaviour, however, it does not specifically identify potential constructs. The potential list of constructs is long, and worth identifying on the basis of theoretical relevance. This is where the use of health behaviour theories can further guide understanding and complement the social ecological model, in an attempt to further understand workplace sedentary behaviour (Biddle & Fuchs, 2009; Owen et al., 2011).

2.9 Theories of health behaviour

Theories of health behaviour offer a more specific understanding of the processes through which health behaviour can change and occur (Kinzie, 2005; Sallis & Owen, 2003). In contrast to the social ecological model’s broad perspective upon the influences on behaviour, health behaviour theories generally specify the variables and mechanisms by which variables are expected to determine behaviour (Glanz et al., 2008). A number of health behaviour theories have been successfully applied to the understanding of various health behaviours, including physical activity (Biddle & Fuchs, 2009; Glanz et al., 2008). Such theories generally acknowledge the importance of the psychological and social environments upon behaviour, and some also acknowledge the environmental influences upon behaviour (Glanz et al., 2008). Theories vary in the emphasis placed on various factors and there is often an overlap in theoretical constructs used to understand behaviour (Glanz et al., 2008). The application of health behaviour theories upon sedentary behaviour is in the early stages, particularly in relation to workplace sedentary behaviour (Owen et al., 2011). Research based on elements of behavioural choice theory (Rachlin, 1989) and social cognitive theory (Bandura, 1997) have been used to better understand PA, and are beginning to be applied to sedentary behaviour patterns in children, adolescences,
adults, and older adults (Gardiner, Eakin, Healy, & Owen, 2012; Healy et al., 2013; Owen et al., 2011; Salmon, Owen, Crawford, Bauman, & Sallis, 2003). Consideration of some of these theories, in addition to the health belief model, will be addressed in the following sub-sections (Rosenstocks, 1974).

2.9.1 Behavioural choice theory

Behavioural choice theory is a decision-making theory that involves understanding the external (i.e., properties of the environment) and internal (i.e., reinforcement value of alternatives) processes that influence the choice between behavioural alternatives (Owen et al., 2000; Rachlin, 1989). Behavioural choice theory proposes that individuals have a choice between behaviours, and that this choice is influenced by: environmental barriers, preferences for behaviour, and determinants of reinforcement value (Vuchinich & Tucker, 1988). Specifically, fewer environmental barriers, and a higher preference and reinforcing value of a certain behaviour are likely to influence the choice to engage in that behaviour (Vuchinich & Tucker, 1988). In the context of sedentary behaviour, behavioural choice theory has been predominantly applied to the conceptualisation of children’s choices between physical activity and sedentary behaviour (Epstein & Roemmich, 2001; Salmon, Ball, Hume, Booth, & Crawford, 2008). Limited research has been applied to conceptualisation of adult sedentary behaviour. In a large cross-sectional sample of Australian adults (N= 1,332) barriers, enjoyment and preferences were found to be significantly related to self-reported physical activity and sedentary behaviour time (Salmon et al., 2003).

Behavioural choice theory has the potential to guide research attempting to understand workplace sitting and sitting-breaks sitting. Particularly considering with the introduction of workplace LPA strategies, desk-based workers will be presented with the choice to complete work based tasks in a sedentary (i.e., work while sitting) and non-sedentary manner (i.e., stand or move while completing work based tasks).
For example, understanding the barriers towards taking sitting-breaks and preferences for completing various work-based tasks in a sedentary or LPA manner, may enhance understanding of the factors related to workplace sitting and sitting-breaks, that could present as key intervention targets (Bennie et al., 2011; Owen et al., 2011; Salmon et al., 2003).

2.9.2 Social cognitive theory

Social cognitive theory proposes that behaviour change is reciprocally influenced by interactions between the environment, personal factors, and behaviour itself - ‘reciprocal determinism’- and that behaviour is determined by both self-efficacy and outcome expectancies (Bandura, 1997). Self-efficacy is defined as one’s belief in their capability to exercise control over a particular or specified event. Outcome expectancies refers to the belief that one would benefit from behaviour engagement. Social cognitive theory proposes that several social and personal factors influence self-efficacy and outcome expectations. These include: 1) past experience of success or failure doing a behaviour (i.e., mastery experience); 2) secondary experience such a modeling by others; 3) verbal persuasion by credible others; and 4) psychological states such as emotions and sensations related to performing the behaviour (Bandura, 1997; Trost, Owen, Bauman, Sallis, & Brown, 2002). Social cognitive theory is a comprehensive and well supported conceptual framework that has provided interventions with significant practical guidance (Elder, Ayala, and Harris, 1999). However, social cognitive theory has rarely been tested in its entirety because of the difficulty in capturing the dynamic interplay between various constructs.

Owen et al. (2011) proposed that from a social cognitive theory perspective the use of self-monitoring, realistic goal setting and the outcome expectancies construct may help guide sedentary behaviour understanding and change. Two sedentary interventions one specific to the workplace (Healy et al., 2013) and the other to the
home setting (Gardiner et al., 2012) have included the notion of goal setting, which can be related to building self-efficacy. However, specific self-efficacy outcome measures were not included. This limits the ability to determine the relative influence of self-efficacy changes upon relevant outcomes.

Social cognitive theory is a potentially useful theory for conceptualising and understanding workplace sitting and sitting-breaks. For example, self-efficacy beliefs may play a role in a person’s successful ability to take breaks from workplace sitting. Furthermore, social level factors, such as role modeling and verbal persuasion given by important others may be relevant to success of taking sitting-breaks. Specifically support from management and policy makers is also likely to be a key social influence in the successful implementation and promotion of workplace health behaviour change (Bandura, 1997; Gilson et al., 2011, 2012a; Owen et al., 2011).

2.9.3 Health belief model

The health belief model attempts to explain actions to prevent, screen for, or control illness conditions (Rosenstocks, 1974). The health belief model aims to explain and predict health behaviours on the basis of an individual’s perceived susceptibility to an illness; the perceived seriousness of the illness or its consequences; the perceived benefits of the proposed behaviour change; the barriers to engaging in this behaviour in relation to its tangible and psychological costs; and the availability of strategies to activate this behaviour (i.e., cues to action) as well as their confidence in being able to take this action (Rosenstocks, 1974). Systematic reviews and meta-analyses support the model and provide empirical support for its predictive utility, particularly for retrospective behaviour (Carpenter, 2010; Janz and Becker, 1984; Harrison, Mullen, & Green, 1992). However, the model has been found to have a weak predictive utility, particularly in comparison to social cognitive theory and the theory of planned behaviour (Zimmerman & Vernberg, 1994).
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Although, the model was initially designed to predict the adoption of preventative health behaviours (i.e., screening), a number of constructs were deemed potentially useful to guide understanding of workplace sedentary behaviour (Rosenstocks, 1974). Specifically, the health belief model was deemed potentially useful for further understanding the perceived consequences and health effects of reducing and breaking-up workplace sitting.

This section highlights a number of health behaviour theories that may guide understanding of workplace sitting and sitting-breaks. However, use of traditional theories of health behaviour alone may be limited (Custers & Aarts, 2010; Evans, 2003). Traditional theories of health behaviour assume that human behaviour is governed by conscious and controlled reflection processes, and that pursuing a health behaviour goal is precipitated by conscious intent (Custers & Aarts, 2010; Evans, 2003). However, this assumption ignores the fundamental issue that although individuals may be consciously aware of their behaviour, conscious awareness of what exactly drives individuals to attain goals, such as health behaviour goals, is often limited (Bargh, 2006; Bargh & Morsella, 2008; Custers & Aarts, 2010; Evans, 2003). Furthermore, traditional theories of health behaviour are limited in that they neglect the influence of past behaviour on subsequent behaviour (Wong & Mullan, 2009). When a behaviour has a history of repetition, future performance of that behaviour is expected to be less influenced by controlled and conscious processes; that is, they happen automatically and habitually (Aarts, Verplanken, & Knippenberg, 1998; Bargh & Morsella, 2008; Custers & Aarts, 2010; Evans, 2003; Orbell & Verplanken, 2010).

2.10 Behaviour habits

Habits can be defined as “learned sequences of acts that have become automatic responses to specific cues, and are functional in obtaining certain goals or end-states” (Verplanken & Aarts, 1999, p.104). Habits are created by frequent and satisfactorily
paring the execution of an act in response to a specific cue, which forms a mental representation of an association between the cue and behaviour (Hull, 1943). Environmental and social cues can become unconsciously associated with health behaviours, through: direct practice, social norms and/or communication with important others (Custers & Aarts, 2010; Fitzsimons & Bargh, 2003). If the context remains stable and the response remains satisfactory, behaviour enactment acquires a degree of automaticity and becomes habitual, and controlled/reflective processes play a limited role in determining behavior (Orbell & Verplanken, 2010; Verplanken & Aarts, 1999).

Habits have been hypothesised to have two related functions in determining action. First, habit strength will positively correlate with behaviour; second, habits will interact with conscious cognitive processes (i.e., intentions) in determining behaviour (Triandis, 1977). Specifically, in novel contexts behaviour is regulated by cognitive processes, but in familiar and unvarying settings, behaviour is guided by habit. Habitual behaviour is triggered by environmental and social cues, and cognitive processes will have little or no impact (Triandis, 1977).

In light of this, cognitive researchers have proposed two distinct systems underlying human behaviour and motivation (Evans, 2003). This dual-process approach distinguishes between automatic (i.e., impulsive) and controlled (i.e., reflective) motivational processes. Automatic motivation processes are unconscious, effortless, fast, and unintended, whereas, controlled motivational processes are conscious, effortful, slow and volitional (Evans, 2003). Both processes have been proposed to exert a unique influence on sedentary behaviour (Conroy et al., 2013; Warner & Biddle, 2011).

With consideration of the ubiquitous and environmentally determined nature of workplace sitting, it is likely that individuals may sit for long periods out of habit,
expectations and necessity in regard to their workplace role (i.e., computer work) rather than conscious intentions. Consequently the role of controlled and conscious psychological processes in relation to sedentary behaviour has been questioned and debated (Biddle, 2011; Conroy, Maher, Elavsky, Hyde, & Shawna, 2013). This presents as an important consideration when attempting to understand workplace sitting from the perspective of traditional theories of health behaviour (Evans, 2003; Triandis, 1977). When attempting to understand and address workplace sitting, focusing on the role of automatic processes and environmental cues to prompt behaviour could be prove useful. However, with consideration that taking sitting-breaks is a relatively new endeavour in the workplace, understanding the role of controlled cognitive processes on behaviour should not be exempt (Biddle, 2011; Conroy et al., 2013; Triandis, 1977). Further research is required to better understand workplace sitting and sitting-breaks using the dual-process framework (Conroy et al., 2013; Evans, 2003; Triandis, 1977; Warner & Biddle, 2011).

2.10.1 Summary of theories of health behaviour

The previous sections described several health behaviour theories and a dual-process theory, including the notion of behavioural habitualness that may be usefully applied to the study of workplace sedentary behaviour. The following section will adopt a social ecological framework to reviewing the correlates and determinants of workplace sitting time and frequency of taking sitting-breaks (Owen et al., 2011).

2.11 Factors related to workplace sitting and sitting-breaks in the workplace

In an attempt to further understand the factors related to workplace sitting and sitting-breaks, the following section will review intervention research, cross-sectional research and qualitative research specific to workplace sitting and LPA. The following review will draw on the ecological model, with a specific focus on the various levels
of influencing factors that may be relevant to sitting and taking sitting-breaks in the workplace.

2.11.1 Intrapersonal factors relevant to workplace sitting and sitting-breaks

Intrapersonal correlates of behaviour can be complex and varied (Biddle & Fuchs, 2009). Based upon Owen et al.’s. (2011) ecological model of sedentary behaviour and previous research on determinants, intrapersonal factors of interest can be organised into demographic (including biological factors) and psychological / cognitive factors (Dishman, et al., 2012). Although demographic factors are less-modifiable and generally not directly targeted by interventions, they are important considerations and may moderate intervention effectiveness (Dishman et al., 2012). Understanding the influence of various demographic characteristics on workplace sitting and break taking may also help identify groups that may be particularly prone to accumulated workplace sitting and in need of specific and targeted intervention. Understanding the relevant psychological factors is also important as such factors may mediate workplace sitting and sitting-breaks, and can offer key intervention targets (Dishman et al., 2012). The following sections will first explore the socio-demographic factors associated with workplace sitting followed by the psychological factors of relevance.

2.11.1.1 Socio-demographic factors relevant to workplace sitting and sitting-breaks

To the candidate’s knowledge, research has not been published on the relationship between various socio-demographic characteristics specific to workplace sitting. However, insights can be drawn from research exploring the socio-demographic correlates of computer-related sedentary time, as sedentary time in the workplace is characterised by computer-related sitting time, and overall sedentary time (Thorp et al., 2012).
Research exploring the relationship between age and total sitting time is mixed (Bauman et al., 2011; Wallmann-Sperlich, Buechs, Hansen, Schantz, & Froboese, 2013; Healy et al., 2011; Matthews et al., 2008; Peters et al., 2010). In relation to adult computer related sitting time, computer use has been inversely associated with age (Burton, Haynes, van Uffelen, Brown, & Turrell, 2012; Healy et al., 2011). Possible explanations were related to the importance of computers for work among young adults, and retirement is associated with a decreased need to use computers among older adults (Burton et al., 2012; Healy et al., 2011).

The relationship between overall daily and leisure-time sitting with gender has been mixed (Healy et al., 2011; Burton et al., 2012; Wallmann-Sperlich et al., 2013; Salmon et al., 2003; Proper, Cerin, Brown, & Owen, 2007), with some research indicating a potential age-gender interaction on sitting time (Matthews et al., 2008). In relation to computer-related sitting time, two cross-sectional studies have associated men with higher levels of computer related sitting time (Healy et al., 2011; Burton et al., 2012).

The relationship between sedentary time and weight status is inconclusive. Some cross-sectional research (Peters et al., 2010), and a large prospective research study (Hu, Li, Colditz, Willett, & Manson, 2003), found positive associations between total sedentary time, home television viewing, and computer use (Burton et al., 2012) with weight status. However, a large cross-sectional study (Wallmann-Sperlich et al., 2013) and a recent systematic review of longitudinal research (Thorpe et al., 2011), did not find significant associations. Further, research is mixed in regard to the confounding role of physical activity, socio-economic status, gender and age (Mummery, Scholfield, Steele, Eakin, & Brown, 2005; Salmon et al., 2003; Brown et al., 2003). Overall the relationship between sedentary time and weight status, and other confounders is inconclusive. The issue of directionality, and the inability to infer this
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from cross-sectional research, also presents with limitations when understanding the relationship between sedentary time and weight status (Thorp et al., 2011).

Limited research has found a mixed relationship between sedentary behaviour and income. Income has been inversely associated with leisure sitting time (Proper et al., 2007). However, higher home computer sitting time has been associated with those in the middle-income group when compared to those in low-income groups (Burton et al., 2012). This limited and inconclusive research precludes conclusions around the relationship between sitting time and income.

Research has generally found a positive relationship between level of education and sitting time (Bauman et al., 2011; Proper et al., 2007; Wallmann-Sperlich et al., 2013). This has been related to the fact that people with higher levels of education are more likely to: be from developed countries, occupy sedentary jobs, have cars, have more electronic and labor saving devices (Burton et al., 2012). Although some results have been mixed depending on the measures of sedentary behaviour (i.e., self-reported versus device based; Peters et al., 2010), and the type of sedentary behaviour under question (Burton et al., 2012). For example, Burton et al. (2012) found a positive relationship between home computer use and a negative relationship between home television use and educational attainment. The positive relationship between educational attainment and home computer use may reflect a greater use and importance of computers within this group (Burton et al., 2012). Preliminary research indicates a positive relationship between overall sitting time and home computer use, and level of educational attainment.

An inverse relationship between measures of sedentary behaviour, such as overall sitting time (Bauman et al., 2011; Proper et al., 2007; Wallmann-Sperlich et al., 2013) and home television and computer use (Burton et al., 2012), with measures of physical activity, has been reported. When considering the relationship between
physical activity and overall/all contexts of sitting time, the inverse relationship is not surprising considering time availability (Wallmann-Sperlich et al., 2013). However, when taking a more sedentary ‘behaviour’ specific approach, some results have indicated that it might be more complicated (Sjostrom, Hagstromer, Smith, & Bauman, 2006; van Uffelen et al., 2011). Preliminary research generally reflects an inverse relationship between physical activity time and sitting time.

Overall, research exploring the relationship between various socio-demographic characteristics is in the early stages, and generally limited to total sitting time. While some inferences can be drawn from this research, in particular research exploring the socio-demographic characteristics of computer related sitting time, further research is needed specific to the workplace context (Owen et al., 2011).

In relation to the socio-demographic characteristics relevant to break-taking, to the researcher’s knowledge, two studies have explored this in relation to workplace sitting-breaks. Bennie et al. (2011) found variations in the frequency of breaks from workplace sitting with sex and physical activity level. Specifically, men and those meeting the MVPA guidelines were found to take significantly more workplace sitting-breaks per working hour. It was concluded that those who are more active outside of working hours, may be inclined to be more active at work (Bennie et al., 2011). Age, education, BMI and workplace status (blue versus white collar) were not significantly related to variations in sitting-breaks. Conversely, and in relation to gender, a cross-sectional study exploring the use of sit-stand desks found females were significantly associated with more frequent use of sit-stand desks (Straker et al., 2013). However, frequency of breaks was not directly measured. Straker et al. suggested that females may be more conditioned to standing, fatigue less during standing (related to higher levels of light intensity household activity), and therefore choose to spend more time standing at work (Straker et al., 2013).
Overall, higher home and total daily computer use has been associated with males, younger adults (i.e., 40-44 years old versus 55-65 years old; Burton et al., 2012; Healy et al., 2011), educational attainment, those in the mid-income group (versus the low income group), and with a BMI $\geq 30$ (Burton et al., 2012). Furthermore, males and those meeting the MVPA guidelines have been associated with increased short physical activity breaks from sitting per working hour (Bennie et al., 2011). Conversely, females have been associated with more frequent use of sit-stand desks (Straker et al., 2013).

### 2.11.1.2 Intrapersonal factors relevant to workplace sitting and sitting-breaks

Currently there is a dearth of research exploring the intrapersonal factors, specifically the psychological / cognitive factors relevant to workplace sitting and taking sitting-breaks (Biddle, 2011; Conroy et al., 2013). Some insights around relevant factors may be gained from cross-sectional, qualitative research and from some preliminary pilot sedentary interventions.

In regard to knowledge, a Gilson et al.’s. (2011) qualitative study among a sample of employees and middle managers (N= 24) participants appeared well aware that sitting was bad for health and that these effects were independent of physical activity level. However, ill health effects were predominantly related to musculoskeletal concerns, and awareness of the chronic health effects was limited (Gilson et al., 2011). Similar results were found among a sample of OH&S practitioners (N= 34). However, unlike the employees and middle managers, the OH&S practitioners appeared more aware of the emerging research on independent associations with chronic diseases, although this sample in terms of knowledge and exposure (i.e., recruited at a national conference) may not be reflective of the ‘typical’ desk-based worker (Gilson et al., 2012a). These results suggest that there is a general
level of awareness that sedentary behaviour is bad for health, however, limited in relation to knowledge about associated chronic health implications (Gilson et al., 2011, 2012a). Further, based on these results, it is unknown how such knowledge may predict workplace sitting and sitting-breaks. Within the ergonomic literature, Starker et al. (2013) examined the cross-sectional relationship between ergonomic awareness associated with accumulated sitting and use of sit-stand desks. Ergonomic awareness was not significantly associated with sedentary related outcomes (e.g., sedentary time and use of sit-stand workstations). This result was unexpected in light of past research indicating that the provision of sit-stand workstations, along with awareness and training, has the potential to enable changes in workplace sitting (Laestadius et al., 2009; Robertson, Ciriello, & Garabet, 2013; Toomingas, Forsman, Mathiassen, Heiden, & Nilsson, 2012). It was noted that enhancing awareness, such as that related to the chronic health effects of accumulated sitting may more readily influence behaviour change (Straker et al., 2013).

In regard to motivation, Gilson et al. (2011) found that among the employees and middle managers, regardless of their workplace role, sitting time was somewhat at the discretion of the individual, and for effective intervention implementation, individual commitment and engagement was seen as important (Gilson et al., 2011). Further, among the sample of OH&S practitioners, choice and ownerships of the various strategies was identified as important when considering employee adoption of the various strategies (Gilson et al., 2012a). Conversely, a few OH&S practitioners stated that the overreliance on optional programs would only be associated with short term but not long-term change. The use of ergonomic principles to enforce change was identified as the most important factor in fostering long-term change (Gilson et al., 2012a).
In regard to habit, two research studies have examined the influence of habit, one specific to the workplace (Warner & Biddle, 2011) and another to adult daily sedentary behaviour (Conroy et al., 2013). Among working adults (N=101) and over three days, Warner and Biddle (2011) explored the predicative utility of the theory of planned behaviour and the habit strength of sedentary behaviour. Attitude, subjective norm and perceived behavioural control significantly predicted self-reported workplace sedentary behaviour, however, intention did not. When sedentary habit was included, an additional 34% of the variance in workplace sedentary behaviour was explained (Warner & Biddle, 2011).

Conroy et al. (2013) explored the role of habit and intentions in daily sedentary behaviour among college students using a 14-day ecological momentary assessment. Results indicated that participants with stronger sedentary habits reported on average more sedentary time, and those with stronger intentions to reduce sedentary behaviour reported on average less sedentary time. Conroy et al. (2013) concluded that sedentary behaviour was regulated by both automatic and controlled motivation processes, and that the results support the application of a dual-process theory in understanding sedentary behaviour (Hofmann, Friese, & Wiers, 2008). It was also emphasised that future research may benefit from distinguishing between different sedentary contexts (as the connection between environment and habit is fundamental) and by including additional conscious psychological processes (i.e., self-efficacy).

In regard to breaking up workplace sitting time, Bennie et al., (2011) found that most of the intrapersonal level items were bivariably associated with frequency of short breaks. However, when controlling for the socio-demographic characteristics associated with sitting-breaks, such as gender and meeting the MVPA guidelines, most bivariate relationships attenuated. For males, ‘lack of time’ and for females ‘not enough information’ were the only items significantly and inversely associated with
sitting-breaks. The fact that these two significant and unique intrapersonal correlates are potentially modifiable barriers\(^1\) has important implications for research and intervention. These results also highlight the importance of considering the influence of other potentially confounding factors (e.g., MVPA level; Bennie et al., 2011).

Further insight may be gained from some preliminary sedentary interventions.

Two workplace sedentary interventions (Healy et al., 2013; Evans et al., 2012), and one intervention targeting sitting among older adults (Gardiner et al., 2012) have implemented strategies on an intrapersonal level (e.g., health coaching, goal setting and an education component).

Healy et al. (2013) examined the efficacy of a multicomponent sedentary intervention in a two arm non-randomised controlled trial, among Melbourne based office workers (N=43). Healy et al. not only targeted workplace sitting from an environmental level (e.g., by implementing sit-stand workstations) they also included strategies on an organisational (e.g., organisational liaison and health promoter) and individual level (e.g., health coaching). The health coaching sessions took a motivational interviewing approach and emphasised behaviour change strategies, such as goal-setting, self-monitoring, use of prompts, and problem solving (Abraham & Michie, 2008). The intervention yielded favourable sedentary outcomes, and it was concluded that outcomes were likely attributable to both the environmental and intrapersonal level strategies. However, no outcomes measures relevant to potential mediating psychological factors were included (i.e., no measure of self-efficacy were included). Furthermore, no comparisons made between the effects of the different level intervention strategies on the sitting outcomes were made (i.e., no comparisons were made).

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\(^1\) As a way of encouraging short physical activity breaks, workplaces can provide height-adjustable work stations that allow employees the opportunities to stand for part of the day whilst continuing to work at computers (Beer et al., 2008). Consequently ‘not having enough time’ is a potentially modifiable factor.
made between the intrapersonal level strategies and the environmental level strategies; Healy et al., 2013).

In a two-armed randomised controlled trial, Evans et al. (2012) examined the efficacy of education (which aimed to increase awareness of the chronic health effects associated with accumulated sitting and benefits of sitting-breaks workplace sitting) and education in conjunction with break-promoting software among office workers (N=28) in Glasgow. While neither intervention strategy produced favourable sitting outcomes, education combined with the break-promoting software produced a favourable outcome pertaining to the number and duration of accumulated sitting events (Evans et al., 2012).

An intervention among older adults, not in paid employment, targeted reducing sitting, sitting-breaks, and total daily sedentary behaviour via a goal-setting intervention. The goal setting intervention based on psychological constructs grounded in social cognitive theory and behavioural choice theory (Gardiner et al., 2012). Results indicated favourable outcomes in terms of decreased total sedentary time, increased breaks in sedentary time, and total LPA time. The participants also reported high satisfaction with the program, indicating the intervention was received well. Unfortunately, outcomes pertaining to the targeted psychological constructs were not directly measured (Gardiner et al., 2012). While Healy et al. (2013) and Gardiner et al’s. (2012) interventions indicate that addressing various psychological constructs may be beneficial when targeting sedentary behaviour, due to the limited inclusion of relevant psychological related outcomes, it is not clear which psychological factors, if any, may have been responsible for the observed favourable behavioural changes (Gardiner et al., 2012; Healy et al., 2013).

Overall, past research has found a non-existent relationship between ergonomic (Straker et al., 2013) and chronic health awareness (Evans et al., 2012) and
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workplace sedentary and LPA. Lack of time and limited information pertaining to taking short physical activity breaks, has been inversely associated with short physical activity breaks (Bennie et al., 2011). Psychological processes influenced by health coaching sessions, such as self-efficacy, have been suggested to be potentially important for reducing and breaking-up workplace and daily sedentary behaviour (Gardiner et al., 2012; Healy et al., 2013). Furthermore, automatic psychological processes, such as habit have explained additional variance in workplace sedentary behaviour (Warner & Biddle, 2011), and are suggested as important considerations when attempting to further understanding sedentary behaviour (Conroy et al., 2013).

2.11.2 Interpersonal factors relevant to workplace sitting and sitting-breaks

Interpersonal factors are the social processes within a given context, specific to the workplace this can include the influence of managers and co-workers (Sallis et al., 2006). Qualitative research among desk-based employees and middle managers identified that employees’ perceive that managers and organisations need to take joint responsibility for workplace sedentary change. The role of managers in influencing employees’ negative perceptions regarding reducing sitting at work was also regarded as important, such as by addressing the synonymous relationship between work-productivity and sitting at a desk (Gilson et al., 2011). Furthermore, qualitative research among OH&S practitioners indicated that key personnel acting as role models to propagate knowledge are important for the adoption of new office behaviours. It was also highlighted that for sustained workplace change, management support is critical (Gilson et al., 2012a).

In regard to taking short physical activity breaks in the workplace, Bennie et al. (2011) found significant positive associations for females with: most work colleagues taking breaks, seeing work colleagues taking-breaks, and having
management support. However, after controlling for meeting the MVPA guidelines, the associations became non-significant.

Preliminary research in workplace sitting indicates that social factors such as managerial support and work-colleagues’ behaviour may play an integral role in workplace behaviour change. While research indicates that these factors are likely to influence workplace sedentary behaviour, further studies are needed to explore this, particularly in relation to workplace sitting and sitting-breaks (Bennie et al., 2011).

### 2.11.3 Environmental level factors relevant to workplace sitting and sitting-breaks

Environmental factors relate to the physical workplace environment that may sustain workplace sitting or promote sitting-breaks (Sallis et al., 2006). A qualitative research study among desk-based employees and middle managers (N=22) found participants believed that their traditional workplace provided opportunities to ‘sit less and move more’ (Gilson et al., 2011). However, a cross-sectional study with desk-based employees found non-significant associations between the perceived workplace environment and frequency of short physical activity breaks (Bennie et al., 2011).

An emerging body of intervention research has investigated the effectiveness of various environmental level interventions on workplace sitting and sitting-breaks. **Sit-stand-desks** have been associated with reduced work sitting time (Alkhajak et al., 2012; Pronk et al., 2012; Healy et al., 2013; Straker et al., 2013) and increases in workplace standing (Healy et al., 2013), sit-stand transitions and steps (Alkhajak et al., 2012). However, some interventions have reported non-significant results with shared sit-stand desks in relation to mean sedentary, light and moderate-intensity physical activity time (Gilson et al., 2012b). In regard to individual sit-stand desks, one intervention trial reported non-significant results with stepping time and number of
steps (Healy et al., 2013), and a cross-sectional study reported non-significant differences in length of sitting bouts or number of switches between sitting/standing per working hour (Straker et al., 2013). Furthermore, research from both the workplace sedentary and ergonomic literature has also found substantial variations in the use of sit-stand desks, with underlying reasons speculated to be related to motivation (Wilks, Mortimer, & Nylen, 2006) and issues around sharing sit-stand desks (Gilson et al., 2012b). Walking work-stations have been associated with increased steps and standing time (Thompson et al., 2007) and decreased workplace sitting time (John et al., 2011). Desk-based stepping devices have been associated with increased daily energy expenditure (McAlpine et al., 2007). Walking in the workplace/walking work tasks have been associated with increased daily steps (Gilson, Mckenna, Cooke, & Brown, 2007). Further, Sitting on a therapy ball at work has been associated with significant increases in energy expenditure (Beers et al., 2008).

Preliminary intervention research indicates that providing the physical means to reduce and break-up workplace sitting may have favourable effects on workplace sitting (i.e., Alkhajak et al., 2012; Healy et al., 2013; Pronk et al., 2012; Straker et al., 2013). However, not all interventions have consistently found favourable outcomes, and there appears to be variance in the uptake of environmental level strategies, and few studies have examined the associations with environmental level factors and both workplace sitting and sitting-breaks (Gilson et al., 2011, 2012b; Healy et al., 2013; Straker et al., 2013). Further research is needed to explore the relationship between the workplace physical environment and both workplace sitting and sitting-breaks.

2.11.4 Policy level factors relevant to workplace sitting and sitting-breaks

Sallis et al. (2006) proposed that factors operating on a policy level relevant to the workplace may include: media regulations, health sector policies (i.e., sitting policies),
business practices, advocacy by individuals (i.e., Occupational Health and Safety [OH&S] personnel) and organisations.

Bennie et al. (2011) explored the cross-sectional relationship between potential correlates operating on a policy level, and self-reported short physical activity breaks during working hours among a sample of blue and white-collar employees (N=801). Results indicated that among females, the recommendation to take short physical activity break from OH&S was significantly positively associated with short physical activity breaks. However, after controlling for meeting the physical activity guidelines, these correlations became non-significant (Bennie et al., 2011).

As part of the organisational level intervention, Healy et al., (2013) appointed a liaison person, who acted as an interface between the organisation and researchers in order to provide reinforcement and ‘standing tips of the week’ to employees. Although, the study did measure outcomes related to the different intervention components, it was noted that organisation change, including workplace social norms and workplace culture, is essential for workplace sedentary change. However, with consideration of the short intervention period (four-weeks) it was unlikely that such a policy-level intervention related to the observed favourable sedentary outcomes, as such a strategy is likely to take more time to influence behaviour (Healy et al., 2013).

These preliminary results indicate that organisational advocates, such as OH&S personnel recommending breaks, may have favourable effects of workplace sedentary behaviour (Bennie et al., 2011; Healy et al., 2013). However, further research is needed, specifically pertaining to the relationship between policy level correlates and workplace sitting and sitting-breaks.

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2 Short physical activity breaks were defined as ‘any interruption in sitting time during a typical work hour’ (Bennie et al., 2011).
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2.11.5 Summary of ecological factors of relevance

The section highlighted a number of research gaps pertaining to understanding the social ecological factors relevant to workplace sitting and sitting-breaks. To date, workplace interventions have predominantly targeted sedentary behaviour through influencing the workplace environment. Few workplace interventions have incorporated intrapersonal and interpersonal level strategies (i.e., Alkhajak et al., 2012; Pronk et al., 2012). Furthermore, limited research has even examined the relationship between various intrapersonal and interpersonal level factors with workplace sitting and LPA, such understanding precludes the inclusion of relevant and effective strategies operating on these levels within workplace interventions (Biddle & Fuchs, 2009; Evans et al., 2012; Healy et al., 2013; Owen et al., 2010). Not only is further research needed to examine the various social ecological factors relevant to workplace sitting and LPA, research also needs to consider how these multiple social ecological factors may interact to influence behaviour (Sallis et al., 2006).

While two workplace sedentary interventions have incorporated multilevel intervention strategies, as detailed in section 2.9.1, neither intervention examined the interaction between such multilevel strategies nor the effect of singular level interventions on sedentary outcomes (Evans et al., 2012; Healy et al., 2013). Although, Evans et al. (2012) did find that education (intrapersonal level strategies) was only effective when combined with the break-prompting software (policy-environmental level strategy). Furthermore, Bennie et al. (2011) not only examined the individual relationship between various ecological factors with workplace LPA, the various bivariate predictors were combined and examined in an overall multivariate model. While a number of ecological factors were bivariably associated with workplace LPA, particularly for females, in the final multivariate model, only intrapersonal level correlates for both males (‘not enough time’) and females (‘not enough information’).
uniquely predicted workplace LPA. This preliminary research highlights the need for future research to not only consider factors of importance on each level but to also consider how ecological factors of relevance may interact, and which ecological factors may present as key intervention targets (Dishman et al., 2012; Sallis et al., 2006). Given this, it could be argued that a more comprehensive understanding of the determinants, or at least correlates, of workplace sitting and sitting-breaks is needed from a social ecological perspective (Conroy et al., 2013; Owen et al., 2011; Starker et al., 2013).

2.12 Chapter summary

The present literature review examined emerging evidence that sedentary behaviour, most notably uninterrupted time spent sitting, constitutes a significant independent health risk factor (Hamilton et al., 2007; Thorp et al., 2011). In light of this emerging body of research, and given current societal trends towards ever-increasing sedentary time, particularly within the workplace, it is imperative to further understand and address this pertinent health behaviour (Ryan et al., 2011). Preliminary research has begun to explore the effectiveness of various strategies, particularly environmental level strategies, on reducing and sitting-breaks accumulated workplace sitting (i.e., Pronk et al., 2012). This literature review identified a need to examine the multiple level of influence on sedentary behaviour in the workplace. Such evidence may provide a more comprehensive understanding of the factors of relevance, potentially informing and improving attempts to reduce and break-up workplace sitting (Owen et al., 2011). This literature review also identified a need for accurate and consistent measures of workplace sitting and sitting-breaks. This is important not only to gauge the prevalence of occupation sitting and sitting-breaks, but to also explore the various
intrapersonal, interpersonal, environmental and policy level factors that may relate to variations in such workplace behaviours (Atkin et al., 2012).

2.13 Thesis aims

The research thesis will address the following aims:

I. To modify and examine the psychometric properties of a self-report measure of workplace sitting and sitting-breaks (Chapter Three).

II. To examine the cross-sectional associations between and relative influence of intrapersonal, interpersonal, and policy-physical environment factors with workplace sitting and sitting-breaks (Chapter Five).

III. To examine the interaction and influence of automatic and controlled intrapersonal factors with workplace sitting and frequency of sitting-breaks per working hour (Chapter Six).

IV. To examine managers’ workplace behaviours and their beliefs concerning employees’ ability to take sitting-breaks (Chapter Seven).

V. To examine the perceptions of reducing workplace sitting and perceived effects of engaging in sedentary behaviour and various physical activity intensities (Chapter Eight).

VI. To examine the feasibility of strategies to reduce sitting and promote LPA in the workplace among desk-based employees and managers (Chapter Nine).
CHAPTER THREE

DEVELOPMENT OF A WORKPLACE SITTING AND SITTING-BREAKS MEASURE

3.1 Introduction

Reliable, valid and practical measures of sedentary behaviour are necessary for examining the relationship between sedentary time and health, changes in sedentary behaviour over time, and the effects of interventions to reduce sitting time in the workplace (cf. the behavioural epidemiological framework; Hutcheon et al., 2010; Lagerros & Lagiou, 2007; Owen et al., 2010; Troiano et al., 2012). Sedentary measurement research has typically used daily television time as a proxy for sedentary time, particularly among children and adolescents (Bryant et al., 2007; Clark et al., 2009; Marshall & Ramirez, 2011). However, emerging research is exploring the psychometric properties of self-report measures of sedentary and LPA behaviour specific to the workplace (Chau et al., 2012; Clark et al., 2011; Marshall et al., 2010; McCormack et al., 2003; Miller & Brown, 2004; Rosenberg et al., 2010). These measures are summarised in Table 3.1.
<table>
<thead>
<tr>
<th>Test-rest reliability</th>
<th>Sedentary criterion measure</th>
<th>Criterion validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR (SR) sedentary measure</td>
<td>Interclass correlation coefficients (95% CI)(^3)</td>
<td>Sedentary criterion measure</td>
</tr>
<tr>
<td>McCormack et al. (2003) * Weekday work computer or TV use</td>
<td>Workplace computer or TV use</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- 0.93 (0.86-0.96)</td>
<td></td>
</tr>
<tr>
<td>Miller &amp; Brown (2004) * Work sitting time</td>
<td>Work sitting time</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- 0.76 (0.76-0.94)</td>
<td>-</td>
</tr>
<tr>
<td>Rosenberg et al. (2010) * Office-paper work during working hours</td>
<td>Work office-paper work</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Weekday: 0.77 (0.63-0.87)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Weekend: = 0.64 (0.44- 0.61)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Marshall et al. (2010) * Sitting while at work</td>
<td>Work sitting</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Males: weekday = 0.86 (0.79 to 0.90); weekend (r_s) = 0.23</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Females; weekday= 0.79 (0.73 to 0.84); weekend (r_s) = 0.53</td>
<td>-</td>
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</tbody>
</table>

\(^3\) Test-retest reliability was assessed using ICC’s unless otherwise specified.

\(^4\) Validity correlations were calculated using partial correlations and were adjusted for age, ethnicity, education, marital status, and number of children (Rosenberg et al., 2010).

\(^5\) The validity, specifically the level of agreement between total self-reported sitting time with total daily accelerometer sedentary time was assessed using Bland-Altman plots (Marshall et al., 2010). Clark et al., (2011) and Chau et al., (2012) also used this method to assess the level of agreement between SR workplace sitting and accelerometer-derived workplace sedentary time.
### Clark et al. (2011)

- Workplace sitting
- Breaks in sitting per work sitting hour

<table>
<thead>
<tr>
<th>Workplace sitting</th>
<th>Workplace accelerometer sedentary time, Breaks in work accelerometer sedentary time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workplace sitting</td>
<td>Workplace sitting</td>
</tr>
<tr>
<td>- OSPAQ = 0.89 (0.83-0.92)</td>
<td>- MOSPA-Q = 0.54 (0.36-0.68)</td>
</tr>
<tr>
<td>Workplace standing</td>
<td>Workplace standing</td>
</tr>
<tr>
<td>- OSPAQ = 0.90 (0.85-0.93)</td>
<td>- MOSPA-Q = 0.64 (0.48-0.75)</td>
</tr>
</tbody>
</table>

**Workplace sedentary/ work sitting time**

- Total: \( r_p = 0.39 \) (0.22-0.53); \( r_s = 0.29 \) (0.11-0.44); mean difference \(-2.75 \) h + 0.4 x average sitting/sedentary time, \( p<.001 \).
- Office-based: \( r_p = 0.44 \) (0.24-0.60); \( r_s = 0.34 \) (0.13-0.52)
- Call setting: \( r_p = 0.27 \) (-0.15 -0.61); \( r_s = 0.13(-0.29-0.51) \)
- Customer service: n.s.

**Breaks in workplace sedentary / breaks in work sitting**

- Total: \( r_s = 0.26 \) (0.11-0.44)
- Office-based: \( r_s = 0.23 \) (0.02-0.43)
- Call-setting: \( r_s = 0.43 \) (0.04-0.71)
- Customer service: n.s.

**Workplace sedentary time/ work sitting time**

- OSPAQ: \( r_s = 0.65^*; \) mean difference = 22 min, 95% CI =3-41 min.
- MOSPA-Q: \( r_s = 0.52^* \)

**Workplace light intensity PA/ work standing time**

- OSPAQ: \( r_s = 0.49^* \)
- MOSPA-Q: \( r_s = 0.49^* \)

**Workplace moderate intensity PA/ work walking time**

- OSPAQ: \( r_s = 0.29^{**} \)
- MOSPA-Q: \( r_s = 0.27^{**} \)

---

### Chau et al. (2012)

- Workplace sitting
- Workplace total standing
- Workplace total walking

<table>
<thead>
<tr>
<th>Workplace sitting</th>
<th>Workplace accelerometer sedentary time, Workplace accelerometer light intensity PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workplace sitting</td>
<td>Workplace sitting</td>
</tr>
<tr>
<td>- OSPAQ = 0.89 (0.83-0.92)</td>
<td>- MOSPA-Q = 0.54 (0.36-0.68)</td>
</tr>
<tr>
<td>Workplace standing</td>
<td>Workplace standing</td>
</tr>
<tr>
<td>- OSPAQ = 0.90 (0.85-0.93)</td>
<td>- MOSPA-Q = 0.64 (0.48-0.75)</td>
</tr>
<tr>
<td>Workplace walking</td>
<td>Workplace walking</td>
</tr>
<tr>
<td>- OSPAQ = 0.73 (0.62-0.82)</td>
<td>- MOSPA-Q = 0.89 (0.84-0.93)</td>
</tr>
</tbody>
</table>

**Workplace sedentary/ work sitting time**

- Total: \( r_p = 0.39 \) (0.22-0.53); \( r_s = 0.29 \) (0.11-0.44); mean difference \(-2.75 \) h + 0.4 x average sitting/sedentary time, \( p<.001 \).
- Office-based: \( r_p = 0.44 \) (0.24-0.60); \( r_s = 0.34 \) (0.13-0.52)
- Call setting: \( r_p = 0.27 \) (-0.15 -0.61); \( r_s = 0.13(-0.29-0.51) \)
- Customer service: n.s.

**Workplace sedentary time/ work sitting time**

- OSPAQ: \( r_s = 0.65^*; \) mean difference = 22 min, 95% CI =3-41 min.
- MOSPA-Q: \( r_s = 0.52^* \)

**Workplace light intensity PA/ work standing time**

- OSPAQ: \( r_s = 0.49^* \)
- MOSPA-Q: \( r_s = 0.49^* \)

**Workplace moderate intensity PA/ work walking time**

- OSPAQ: \( r_s = 0.29^{**} \)
- MOSPA-Q: \( r_s = 0.27^{**} \)

---

6 Two SR measures were used: the Occupational Sitting and Physical Activity Questionnaire (OSPAQ; \( n=84 \)); and the Modified version of the MONICA Optional Study on Physical Activity Questionnaire (modified MOSPA-Q; \( n=75 \)).
Table 3.1 shows that a number of research studies have explored the test-retest reliability of self-reported workplace sitting (Chau et al., 2012; Marshall et al., 2010; McCormack et al., 2003; Miller & Brown, 2004; Rosenberg et al., 2010) and the criterion validity of self-reported workplace sitting against accelerometer-derived sedentary time, pedometers, log books, and total daily sitting (Chau et al., 2012; Clark et al., 2011; Marshall et al., 2010; Miller & Brown, 2004; Rosenberg et al., 2010). A dearth of research has examined the psychometric properties of self-report measures of workplace LPA (Chau et al., 2012; Clark et al., 2011).

Overall, self-report measures of workplace sitting show acceptable test-retest reliability estimates (Landis & Koch, 1977). Limited research has validated self-report workplace sitting with objective sedentary criteria, particularly that derived within the workplace; with two studies indicating acceptable validity estimates, however, large limits of agreement have been found (Chau et al., 2012; Clark et al., 2011). In regard to self-report measures of workplace LPA, Chau et al., (2012) found acceptable test-rest reliability estimates for total self-report workplace standing and walking; while, Clark et al., (2011) did not examine the test-retest reliability of self-reported breaks from workplace sitting. Chau et al. indicated acceptable validity estimates for workplace standing and walking when assessed against accelerometer-derived workplace LPA and moderate intensity PA, respectively. Clark et al. also indicated acceptable validity estimates for self-report breaks in workplace sitting when compared to accelerometer-derived breaks in sedentary time, particularly for workers employed in customer service than office-based occupations. While these preliminary studies support the use various self-report measures to adequately capture workplace sitting and LPA, there are a number of research gaps in need of further attention.
Chapter Three: Development of a workplace sitting and sitting-breaks measure

3.2 Research limitations and gaps

Few research studies have validated self-report workplace sitting with accelerometer-derived workplace sedentary time, and further limitations pertain to statistical methods used to estimate validity (Chau et al., 2012; Clark et al., 2011). Specifically, the correlation coefficient measures the strength of a relation between two variables, not the level of agreement, which is more appropriate when comparing one type of measurement to another criterion measurement method (Bland & Altman, 1986). While Chau et al., (2012) and Clark et al., (2011) acknowledged this, and in addition conducted Bland-Altman plots to assess level of agreement, this method is not without limitations. When the scales of measurement differ, such as when comparing self-report sitting with accelerometer-derived sedentary time, this method is limited (Bland & Altman, 1989).

In regard to research examining the psychometric properties of self-report measures of workplace LPA, there a further number of research gaps and limitations. Chau et al., (2012) found acceptable test-retest reliability estimates for self-report workplace standing and walking, although this measure pertained to total workplace activity, and is limited in relation to capturing the manner in which workplace sitting may have been accumulated. While assessing the total amount of these intensities of physical activity is important (Healy et al., 2007; Hamilton et al, 2008; Tremblay et al., 2010), in light of research indicating that sedentary time accumulated in an accumulated and uninterrupted manner may be detrimental, this measure is limited (Healy et al., 2008). Clark et al., (2011) used a self-report measure that has the potential to capture this information, as they assessed breaks from sitting per hour. Although, low but acceptable validity estimates were found, the results were not without limitations. Firstly, while the measure was self-report, the question was administered by an interviewer, which limits generalisability for use as a self-administered self-
Chapter Three: Development of a workplace sitting and sitting-breaks measure report measure of workplace sitting-breaks. Also the scale used to assess sitting breaks was capped, and in light of the large variance observed in sitting-breaks, particularly based on the accelerometer data, this may present with limitations. Finally, Clark et al., (2011) did not assess that test-rest validity of the self-report measure of breaks from workplace sitting.

In light of limited research validating a self-report measure of workplace sitting against accelerometer-derived workplace sedentary time, and the limited and non-existent research pertaining to the psychometric properties of a self-report measure of breaks from workplace sitting, the present study aimed to address these research gaps. As a psychometrically sound measure of workplace sitting and sitting-breaks was deemed important to further develop.

3.3 Aims

This research study aims to assess:

1. The test-retest reliability if a self-report measure of workplace sitting
2. The test-retest reliability of a self-report measure of taking sitting-breaks from workplace sitting
3. The criterion validity of a self-report measure of workplace sitting
4. The criterion validity of a self-report measure of taking sitting-breaks from workplace sitting

3.4 Methods

3.4.1 Design

This was a one-week validation study. Participants completed a self-report questionnaire at the start-and-end of a one-week period, and wore an ActiGraph accelerometer and completed a behavioural activity log during this period. Ethical
Chapter Three: Development of a workplace sitting and sitting-breaks measure approval for the research study was granted by Deakin University Human Ethics Advisory Group – Health (refer to Appendix A: HEAG-H 62_2012).

3.4.2 Sample, and survey and device administration

A total of 56 participants were recruited from metropolitan Melbourne for the study, through convenience and snowballing techniques. Advertisements for the study were placed around Deakin University and Facebook, and eligible participants known to the researcher, were contacted. Upon initial contact, potential participants were given a brief overview of the study aims and participation requirements. If an expression of interest was indicated, and if the potential participant met the eligibility criteria (18 years of age, and working in a desk-job where they spend most of their time sitting down), a startup interview with the participant and one of the student researchers was organised. During this meeting, participants were provided with the Plain Language Statement and consent form (refer to Appendix B).

After signing the consent form, participants were required to fill in the first version of the self-report questionnaire (refer to Appendix C). Participants were shown how to fit the devices, and given relevant information about the ActiGraph (refer to Appendix D). Participants were instructed to wear accelerometer on the midaxillary line of either hip, for the seven-day measurement period. Participants were instructed to remove the devices only if engaging in water based activities (i.e., swimming, showering) or any contact sports (i.e., Australian Rules football). Participants were shown how to use the behavioural activity log (refer to Appendix E), including recording the type and duration of any non-wear period, and the time they started and finished work. After the start-up meeting, a time was made a week later to follow-up with participants. Within 2-3 days of wearing the ActiGraph, a student researcher contacted the participants by telephone to encourage compliance and troubleshoot any problems. At follow-up the student researcher collected the devices and ensured the
Chapter Three: Development of a workplace sitting and sitting-breaks measure activity log was filled out, and gave the participant the self-report questionnaire to fill out for the second time (refer to Appendix C). Upon collecting the ActiGraph participants were given the $20 dollar Coles-Myer voucher to thank them for their participation. To ensure anonymity, each participant was given an alphanumeric code, this was used to link responses to the questionnaires, activity logs and objective device feedback. During this process, six graduate diploma of Psychology students assisted with data collection, and in attempt to attain data collection consistency, each student was given a step-by-step data collection protocol to follow (refer to Appendix F).

3.5 Measures

3.5.1 Socio-demographic characteristics
Participants were asked to self-report the following socio-demographic characteristics: sex, age, weight, height, highest level of education, and work status. Height and weight were used to calculate body mass index (BMI; weight (kg)/height (m)²; Healthy (<25kg/m²); Overweight or obese (>= 25kg/m² ; WHO, 2000), highest level of education was collapsed into three categories: <12 years, 12 years and university, and work status was dichotomised into full-time or part-time workers.

3.5.2 Leisure time MVPA
The Active Australia Survey (AAS; Armstrong, Bauman and Davies, 2000) was used to assess the proportion of participants meeting public health recommendations of 150 min/week in MVPA. Time spent in vigorous physical activity was doubled in recognition of additional health benefits, and all physical activity items were summed to create a total leisure-time and transport-based physical activity estimate (Armstrong et al., 2000). Reliability studies have found the questionnaire items to have excellent reliability (Cronbach’s α = 0.71-0.86) and acceptable validity (Cronbach’s α = -.86; Brown, Bauman, Timperio, Salmon & Trost, 2002).
Chapter Three: Development of a workplace sitting and sitting-breaks measure

3.5.3 Workplace sitting
Workplace sitting during the weekday and on the weekend was assessed using the self-report measure adapted by Marshall et al., (2010). Participants were asked to reflect upon their workplace sitting over the past seven days. As detailed in Table 3.1, this measure has demonstrated adequate test-retest reliability, and criterion validity properties when compared to total daily accelerometer sedentary time (Marshall et al., 2010).

3.5.4 Workplace sitting-breaks
Workplace sitting-breaks was obtained by asking participants to indicate their average breaks from sitting per working hour. This was deemed important in light of research suggesting desk based workers spend most of their work day sedentary, and breaks in sedentary time have been associated with beneficial metabolic biomarkers (Dunstan et al., 2012; Parry & Straker, 2013). Participants were instructed that these breaks could include standing, stretching, taking a short walk etc., and were asked to exclude lunch and tea breaks. This newly designed item was adapted from a Bennie et al.’s. (2011) item pertaining to ‘short physical activity breaks per typical work hour’ and the interview-administered item used by Clark et al. (2011) to reflect breaks per working hour rather than per work hour spent sitting. In addition, this item was modified from a capped scale used by Bennie et al. and Clark et al. to a continuous scale.

3.6 Criterion validity measures

3.6.1 ActiGraph accelerometer
Work time spent in sedentary activity and breaks in sedentary time was objectively assessed using the ActiGraph GT3X accelerometer. Activity counts were recorded in 15-s intervals and aggregated into 1-min epochs, which were then used to calculate time spent in sedentary behaviour (<100 counts-per-minute (cpm)) and breaks in
Chapter Three: Development of a workplace sitting and sitting-breaks measure
sedentary time, as defined as any period that the accelerometer-recorded activity
transitioned from sedentary (<100cpm) to active (≥ 100 cpm), for a minimum of one
minute (Freedson et al., 1998; Healy et al., 2008; Pate et al., 2008). Periods of
consecutive strings of zero-counts epoch lasting ≥ 60 minutes were considered non-
wear time (Evenson & Terry, 2009).

3.6.2 Activity behaviour log
Participants were given a seven-day activity log to complete while wearing the
ActiGraph. Participants were asked to record the date when they commenced wearing
the ActiGraph, and the time they started and finished work (excluding travel time).
Participants were also asked to record any non-wear periods, and record the activity
and duration of the non-wear period. The logbook was used to help identify working
hours (the time between work start and finish times), and work and non-work days (as
indicated by the absence of a work start and finish time). The logbook enabled the
comparison of self-report workplace sitting and sitting-breaks with accelerometer-
derived activity accumulated during working hours (Freedson et al., 1998; Pate et al.,
2008).

3.7 Statistical analyses
Data was managed and analysed using Statistical Package for the Social Sciences
(SPSS) PWSA (version 21; IBM Corp, 2012) and STATA Data Analysis and
Statistical Software (version 12; StataCorp LP, 2012).

3.7.1 Self-report data preparation and variable creation
Workplace weekday and weekend sitting time and sitting-breaks were based on
participant responses to items, and MVPA was calculated in accordance with the ASS
analysis and reporting guide (AIHW, 2003). For descriptive purposes, participants
were dichotomised as sufficiently active for health (≥ 150 mins/wk) or insufficiently
Chapter Three: Development of a workplace sitting and sitting-breaks measure active (<150 mins/wk; Armstrong et al., 2000). Average daily working hours for each participant were attained from the participant’s behaviour log. Missing values for MVPA time, and frequency of sitting-breaks were assumed to equal zero behaviour levels. No participants were missing workplace sitting time data.

For workplace sitting, scores were deemed admissible if (i) time did not exceed the time participants reported working (as indicating from the participants logbook work start and finish times); and (ii) if work sitting time was at least half the amount of time participants reported working (this was to ensure compliance with the primary selection criterion for the study: spending most of one’s time sitting while at work). All reported times, bar one, were deemed possible scores and retained in the data. All data for weekend workplace sitting time and sitting-breaks was deemed admissible and retained. Resultant behaviour variables were assessed for normality, outliers and reliability.

The variables were screened of univariate outliers and no outliers were identified. On inspection of the distribution of the data, it was evident that frequency of sitting-breaks (at both measurement points; skew =3.36; skew =2.45 respectively), and weekend workplace sitting time (at the start of the validation week; skew =2.56), were not normally distributed. As the observed skew of the variables was reasoned to reflect an inherent naturally occurring underlying skew, a decision was made to truncate the data. After truncating data (±1.5SD), normality was attained.

3.7.2 Accelerometer data preparation and variable preparation

After coding for workdays and non-workdays, criteria for a valid workday included wearing the device for 75% of the total time the participant reported working (e.g.,

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7 These definitions were based on the adults MVPA guidelines, specifically 30 minutes of MVPA should be accumulated on at least least five days of the week for health benefits (i.e., 150 minutes per week). Sufficient MVPA time was defined as exercising for 150 minutes per week, and insufficient MVPA time was defined as exercising for less than 150 minutes per week (DoHA, 2014; National Health Survey [NHS], 2011-12, as cited in AIHW, 2013).
Chapter Three: Development of a workplace sitting and sitting-breaks measure 75% of the time between their average self-reported work start and finish time). Full-time workers required at least three valid workdays and part-time workers required two. This amount of accelerometer data is sufficient for determining reliable estimates among adults in field research (Trost, Mciver, & Pate, 2005). Overall, accelerometer compliance rate was high, 51 of the 56 participants (91.07%) wore the accelerometers for a sufficient number of valid workdays for their results to be included in analyses. On inspection of the data, all the accelerometer data that met the validity criteria, occurred during a weekday. Consequently, only self-reported weekday work sitting time was used in the validity component of the research study.

Analysis and interpretation of accelerometer data was based on the average of data from the valid workdays (Chau et al., 2012; Clark et al., 2011). Sedentary time was expressed as the average proportion of time during working hours (as determined from the behavioural logbook) spent in sedentary behaviour (<100cpm). Sedentary breaks were expressed as breaks per working hour, calculated as total breaks/total work-wear time (Healy et al., 2008).

3.7.3 Statistical analyses

Descriptive statistics (e.g., percentages, means and standard deviations) were used to portray the demographic profile of the participants, their leisure time MVPA, and workplace sitting and sitting breaks. To examine the test-rest reliability of self-report workplace sitting and sitting-breaks over the validation week, interclass correlation coefficients (ICC’s) were calculated. ICC’s were calculated using a two-way mixed model based on absolute agreement. To examine the criterion validity of self-report workplace sitting, Spearman rank-order correlations ($r_s$) and box-and-whisker plots were conducted. A box-and-whisker plot was used in recognition of the limitations of using correlation coefficient to interpret level the of agreement between two measures, and was used rather than a Bland-Altman plot in recognition of the different
Chapter Three: Development of a workplace sitting and sitting-breaks measure
measurement techniques used (Bland & Altman, 1986). The criterion validity of self-report sitting-breaks was examined using \( r_s \) only. Reliability and validity estimates were interpreted in relation to Landis and Koch’s (1977) benchmarks: \(<0.00 = \text{poor}, 0.00-0.20 = \text{slight}, 0.21 - 0.40 = \text{fair}, 0.41 - 0.60 = \text{moderate}, 0.61 - 0.80 = \text{substantial}, \text{and } 0.81-1 = \text{almost perfect.}\)

3.8 Results

3.8.1 Quantifying workplace sitting and sitting-breaks

The final sample included 21 men with a mean age of 31.67 years (\( SD = 9.25, \) range 22 to 56 years) and 30 females with a mean age of 32.73 years (\( SD = 10.28, \) range 21 to 58 years). Further socio-demographic characteristics of the sample are presented in Table 3.2, and the levels of self-report and accelerometer-derived workplace sitting and sitting-breaks are displayed in Table 3.2. Table 3.2 shows that the majority of the participants’ were: female, between the ages of 18-39 years had a university level qualification, of a healthy BMI and were meeting the MVPA guidelines.

### Table 3.2 Socio-demographic characteristics of the sample

<table>
<thead>
<tr>
<th>Socio-demographic characteristics</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample</td>
<td>51 (100)</td>
</tr>
<tr>
<td>Sex: Females</td>
<td>30 (59)</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
</tr>
<tr>
<td>18-39 years</td>
<td>39 (77)</td>
</tr>
<tr>
<td>40-54 years</td>
<td>9 (18)</td>
</tr>
<tr>
<td>55+ years</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>&lt;12 years</td>
<td>9 (18)</td>
</tr>
<tr>
<td>12 years</td>
<td>8 (16)</td>
</tr>
<tr>
<td>University</td>
<td>34 (67)</td>
</tr>
<tr>
<td>PA guidelines</td>
<td></td>
</tr>
<tr>
<td>Insufficiently active (&lt; 150 mins/week)</td>
<td>8 (16)</td>
</tr>
<tr>
<td>Sufficiently active (≥150 mins/week)</td>
<td>43 (84)</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td></td>
</tr>
<tr>
<td>Healthy (≤25kg/m²)</td>
<td>29 (57)</td>
</tr>
<tr>
<td>Overweight or obese (≥ 25kg/m²)</td>
<td>21 (42.2)</td>
</tr>
</tbody>
</table>
Chapter Three: Development of a workplace sitting and sitting-breaks measure

Table 3.3 indicates that on average participants self-report sitting at work on a
weekday justs over 6 and a-half hours, and based on the accelerometer data were
sedentary at work about seven hours. On average participant self-report taking two
breaks from sitting per work hour, and the accelerometer data indicated participants
took more sitting-breaks per working hour.

Table 3.3 Mean workplace sitting/sedentary time and sitting/sedentary breaks

<table>
<thead>
<tr>
<th>Workplace behaviour</th>
<th>Self-report data(^8)</th>
<th>Accelerometer data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Workplace sitting/sedentary time(^9)</td>
<td>6.55</td>
<td>(1.54)</td>
</tr>
<tr>
<td>Workplace sitting/sedentary-breaks</td>
<td>2.05</td>
<td>(1.89)</td>
</tr>
</tbody>
</table>

3.8.2 Reliability and validity of self-report workplace sitting

To examine the test-retest reliability and criterion validity of the self-report measure
of workplace sitting, ICCs and Spearman-rank order correlations were respectively
conducted, these results are presented in Table 3.4. Table 3.4 shows a significant and
almost perfect test-retest reliability ICC for weekday work sitting time, and significant
moderate test-retest reliability ICC for weekend day work sitting time. Table 3.4 also
shows a significant fair Spearman-rank order validity correlation between self-report
workplace sitting and workplace sedentary time (Landis & Koch, 1977).

Table 3.4 Test-retest reliability and criterion validity of workplace sitting

<table>
<thead>
<tr>
<th>Workplace behaviour</th>
<th>Test-retest reliability (ICC’s; 95% CI)</th>
<th>Criterion validity ((r_s))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekday workplace sitting/sedentary time</td>
<td>.87** (0.77-0.93)</td>
<td>.33*</td>
</tr>
<tr>
<td>Weekend day workplace sitting/sedentary</td>
<td>.64** (0.38-0.79)</td>
<td>-</td>
</tr>
<tr>
<td>sitting time</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. *Correlation is significant at the 0.05 level (2-tailed).
b. ** Correlation is significant at the 0.01 level (2-tailed).

\(^8\) SR data is from the end of the one-week validation period (T2).
\(^9\) Weekday data only.
To further examine the level of agreement between self-report sitting and accelerometer-derived workplace sitting, a box-and-whisker plot was generated. Figure 3.1 displays this plot. The box-and-whisker plot displayed in figure 3.1 illustrates the error range for the duration (minutes per working day) for workplace sitting/sedentary time. The boxes represent the interquartile range (50% of error values), and the dark line in the boxes represents the median. The lines that extend from the box (whiskers) represent the highest and lowest values, excluding outliers (no outliers in the data). As observed in Figure 3.1, the position of the median line close to zero indicates minimal bias for the self-report measure when compared to accelerometer-derived work sedentary time. However, the length of the whiskers indicates comparatively large variance at both the lower and upper ranges of sitting/sedentary time, suggesting substantial individual-level randomability.
Chapter Three: Development of a workplace sitting and sitting-breaks measure

Figure 3.1 Box-and-whisker plots of the error (self-report – accelerometer, min/day) for workplace sitting/sedentary time

The research study also included a self-report measure pertaining to the proportion of work time spent sitting, the validity of this self-report measure was examined in Appendix K. Results indicate that the self-report measure pertaining to the proportion of work time spent sitting, is also an valid way to capture desk-based employees’ workplace sitting time.

3.8.3 Reliability and validity of self-report workplace sitting-breaks

To examine the test-retest reliability and criterion validity of the self-report measure of workplace sitting-breaks, ICCs and Spearman-rank order correlations were respectively conducted, these results are presented in Table 3.5. Table 3.5 shows a
Chapter Three: Development of a workplace sitting and sitting-breaks measure non-significant, albeit fair, Spearman correlation between self-reported sitting-breaks and accelerometer-derived sedentary-breaks (Landis & Koch, 1977).

Table 3.5 Test-retest reliability and criterion validity of workplace sitting-breaks

<table>
<thead>
<tr>
<th>Workplace sitting/sedentary breaks</th>
<th>Test-retest reliability (ICC’s)</th>
<th>Criterion validity (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.60** (.30-.76)</td>
<td>.27</td>
</tr>
</tbody>
</table>

a. *Correlation is significant at the 0.05 level (2-tailed).

b. ** Correlation is significant at the 0.01 level (2-tailed).

3.9 Discussion

This study explored the psychometric properties of a self-report measure of workplace sitting and breaks from workplace sitting (Chau et al., 2012; Marshall et al., 2010). Specifically, the aims were to explore the test-retest reliability and criterion validity properties of a self-report measure of workplace sitting and sitting-breaks. Criterion validity was assessed by comparing self-reported workplace sitting time and sitting-breaks with accelerometer-derived workplace sedentary time and sedentary-breaks. Reliable, valid and practical measures of sedentary behaviour in the workplace are needed (Owen et al., 2010). Good-quality measurement tools are essential to further understand the relationship with associated health outcomes, measure patterns and changes over time, and to further explore the factors that may be related to behaviour (Atkin et al., 2012).

Previous research has demonstrated acceptable test-retest reliability and criterion validity for workplace sitting measures (Chau et al., 2012; Marshall et al., 2010). However, validity estimates have been variable and infrequently assessed against accelerometer-derived workplace sedentary measures (Chau et al., 2012; Clark et al., 2011). Research exploring the reliability and validity of self-report measures of workplace sitting and LP, particularly one that captures the manner in which
Chapter Three: Development of a workplace sitting and sitting-breaks measure

Workplace sitting may be accumulated (i.e., frequency of breaks in sedentary time), is
limited (Clark et al., 2011). Overall, results indicate that both the self-report measure
of workplace sitting and sitting-breaks demonstrated acceptable test-retest reliability
and criterion validity. The following section will discuss and interpret these research
findings in further detail.

3.9.1 Quantifying workplace sitting and sitting-breaks

The participants spent most of their work time sitting, and took limited breaks from
sitting per work hour. This confirmed that the selection criterion for workplace sitting
time was attained. Participants’ self-reported workplace sitting time and
accelerometer-derived work sedentary time was similar to past research (Clark et al.,
2011). In regard to frequency of sitting breaks per working hour, participants self-}
reported taking few breaks per work hour, which is consistent with past research
(Bennie et al., 2011), particularly among office-based and call-settings workers (Clark
et al., 2011). Comparisons to Clark et al. research is limited as their item asked about
breaks per hour of sitting and the measure used in the current study pertained to
average breaks per working hour.

3.9.2 Reliability and validity of self-report workplace sitting

The study indicates that the self-report measure of workplace sitting demonstrated
acceptable test-retest reliability and criterion validity properties. The substantial-to-
moderate test-retest reliability observed for workplace sitting is consistent with past
research examining the test-retest reliability properties of self-report measures of
workplace sitting (Chau et al., 2012; Clark et al., 2011; Marshall et al., 2010) and
office/paper work (Rosenberg et al., 2010). Further, and consistent with past research,
reliability was higher for weekday than weekend work sitting (Rosenberg et al., 2010;
Marshall et al., 2010). This has been attributed to the greater variability in weekend
Chapter Three: Development of a workplace sitting and sitting-breaks measure behaviour patterns and that structure and routine which tends to characterise weekday activities, can make recall easier and enhance the measure’s psychometric properties (Atkin et al., 2012; Clemes et al., 2012).

The self-report measure of workplace sitting demonstrated a fair relationship with accelerometer-derived work sedentary time, and the box-and-whisker plot demonstrated an acceptable level of agreement, particularly around average sitting/sedentary time. This is similar to what Clark et al. (2011) observed among office-based workers, and slightly lower than what Chau et al. (2012) found. Furthermore, the consistency in agreement between self-report sitting and sedentary time around the mean, but the high level of variability between the measures at higher and lower level of sitting/sedentary time as shown in the box-and-whisker plot, is consistent with past research using Bland-Altman plots (Chau et al., 2012; Clark et al., 2012). Indicating that the self-report measure may be acceptable for use on a population level. However, when interpreting behaviour at the individual level, such as after an intervention, caution is warranted (Chau et al., 2012; Clark et al., 2011). The fair relationship between self-reported and accelerometer-derived proportion of work time spent sitting, indicated that this self-report question is also a valid way of capturing workplace sitting time (refer to Appendix K). This has desirable implication for assessing workplace sitting-time when considering participant burden and demand (Atkin et al., 2012; Clemes et al., 2012).

Potential discrepancies between the two measures of workplace sitting/sedentary time may relate to the ActiGraph’s limited ability to determine posture, and is therefore an indirect measure of sitting time. While the research study employed a commonly used cut-point for assessing sedentary time, this cut-point has not been empirically derived or uniformly agreed upon, and it has only been validated in limited population groups, such as among children (Ridgers, Salmon, Ridley, O’Connell, Arundell, &
Chapter Three: Development of a workplace sitting and sitting-breaks measure Timperio, 2012). Furthermore, it has been found to both over-and-underestimate sedentary time through misclassifying standing light-to-moderate activities as sedentary (Kozey-Keadle et al., 2011; Trost, Loprinzi, Moore, Pfeiffer, 2011; Rowlands, 2007). In comparison to other objective measures of sedentary behaviour, while the ActiGraph has been found to have minimal overall bias, large variability at both the extremes of sedentary time have been reported (Grant, et al., 2006; Hart, Ainsworth, & Tudor-Ocke, 2011; Healy et al. 2008; Kozey-Keadle et al., 2011; Zhang et al., 2004; Ridges et al., 2012).

Overall, the self-report measure of weekday workplace sitting demonstrated adequate psychometrical properties, particular for use on a population level.

3.9.3 Reliability and validity of self-report workplace sitting-breaks

The study revealed that the self-report measure of sitting-breaks workplace sitting demonstrated acceptable test-retest reliability and criterion validity properties.

The test-retest reliability of a measure of workplace sitting-breaks has not been previously explored (Clark et al., 2011). Although, the observed acceptable test-retest reliability properties is consistent with past research examining the test-retest reliability of total workplace LPA , and indicates that self-report sitting-breaks can be reliability measured.

The self-report sitting-breaks measure demonstrated lower, albeit acceptable criterion validity properties. However, when assessing validity with consideration of the measure’s potential skew, the validity estimate was non-significant, indicating accelerometer-derived sedentary breaks were skewed. While Clark at al. (2011) found validity estimates of a similar magnitude, significant correlations were observed among all employee groups, except those in customer service. Clark et al. used a categorical scale to measure sitting-breaks, which limits direct comparability to the current research study, wherein a continuous scale was used to measure sitting-breaks.
Chapter Three: Development of a workplace sitting and sitting-breaks measure

Overall, the self-report sitting-breaks measure demonstrated acceptable test-rest reliability and criterion validity properties.

3.9.4 Research limitations and strengths

Limitations pertaining to the use of the accelerometer as the criterion ‘gold-standard’ against which the self-report measures validity was assessed, warrants attention. In regard to the cut point used to define a break from sedentary time (≥100 cpm), there is likely to be individual variance in activities that will reach such a threshold. The ActiGraph is also limited in measuring postural changes and is limited in distinguish sitting from standing with minimal movement (Kozey-Keadle et al., 2011). This is problematic as postural changes have been associated with independent health benefits and may mitigate the adverse metabolic effects of accumulated sedentary time (Healy et al., 2008). Furthermore, in the current study the definition of a sitting-break in the self-report measures included ‘standing’. These considerations could have potentially confounded the results, and warrant caution when interpreting the self-reported sitting-breaks validity against the accelerometer. It has been recommend that research attempting to capture sitting and standing, should also include objective measures with inclinometers that can more accurately measure postural changes (Kozey-Keadle et al., 2011; Lyden, Kozey-Keadle, Staudenmayer, & Freedson, 2012).

Another limitation concerns the ability to self-report sitting-breaks, considering the limited structure and salience of behaviours done to break-up workplace sitting, sitting-breaks may be harder to recall and thus influence the psychometric properties of self-report measures trying to capture such behaviours (Clark et al., 2011). This is an inherent limitation of self-report methods of measurement. These considerations all have the potential to confound the results and lead to over-or-underestimates of both the accelerometer-derived sedentary-breaks and self-reported sitting-breaks.
Limitations also relate to the use of a self-report measure, particularly when considering the non-discretional and habitual nature of workplace sitting and sitting-breaks which can also create difficulties in recalling behaviour (Clark et al., 2011). A convenience sample was used to validate the self-report measures and may not be representative of the larger ‘desk-based’ population. With consideration of the socio-demographic characteristic of the sample, the sample appears to have lower rates of overweight/obesity, higher levels of education, a higher representation of younger adults, and a larger proportion who report meeting the MVPA guidelines (ABS, 2012; AIHW, 2012, 2013)\(^\text{10}\). All of which may restrict the generalisability of the results to the working population.

The research study did not distinguish between different occupational roles. Previous research has indicated that this may be important when attempting to understand workplace sedentary behaviour (Clark et al., 2011). In line with the eligibility criteria and observed results, these results may be applied to ‘desk-based’ workers who spend ‘most of their time at work sitting’. When calculating accelerometer-derived work sedentary time and sedentary breaks, the research study did not consider the influence of structured work breaks. This may have led to overestimates in accelerometer-derived sedentary-breaks, particularly considering the self-report measure asked participants to exclude lunch or tea breaks when calculating breaks. Another limitation of the research study was that there was not sufficient data to validate weekend workplace sitting time, consequently these results can only be applied to workplace sitting time during the \textit{weekday}. A limitation when interpreting reliability through test-retest correlations is the inherent assumption that the behaviour

\(^{10}\) In 2011-12, 63% of Australian adults were found to be overweight or obese (The Australian Health Survey, 2012); in 2012, 27% of Australians had an education level of year 11 or below, 20% had year 12 and 18% had a bachelor degree (ABS, 2012). In regard to MVPA levels, the National Health Survey in 2011-12 found that only 43% of Australian adults were “sufficiently active”, the remainder were classed as insufficiently active (36%) or inactive (20%; AIHW, 2013).
Chapter Three: Development of a workplace sitting and sitting-breaks measure under investigation is predictable and constant (i.e., differences in test-retest are not assumed to reflect actual behavioural differences, but rather instability in the measurement tool; Atkin et al., 2012; Clemes et al., 2012). Therefore, ensuring overlap of days in the recall period is important for testing the reliability of behaviour measures, the current research study did not do this. These limitations need to be taken into consideration when generalising the results and using the workplace self-report measure.

Research strengths include the validation of a self-reported measure against accelerometer derived workplace sedentary time and breaks in sedentary time. Furthermore, the fact that participants were not recruited from a single workplace, or just from a university is also a strength of the convenience sample used to validate the self-report measures (Chau et al., 2012).

3.10 Chapter summary

Overall, the research study demonstrated that the self-report measure of workplace sitting and sitting-breaks had adequate psychometric properties, particularly for use on a population level. This research study supports the use of these self-report measures in the following chapters to quantify workplace sitting and sitting-breaks among a population-based sample of desk-based workers. Specifically, to quantify and explore the various ecological variables that may relate to variance in workplace sitting and sitting-breaks. The next chapter will detail the methods used in the second research study to further understand the determinants of workplace sitting and sitting-breaks, the methods described in this chapter will underline the remaining research chapters, specifically Chapter Five to Nine.
CHAPTER FOUR

WORKPLACE STUDY METHODS

The present chapter describes the methods used in the workplace sedentary study. These methods underpin results in Chapter Five, Six, Seven, Eight, and Nine.

4.1 Methods

4.1.1 Design

The study was a cross-sectional design in the form of an online questionnaire designed to examine the relationship between various ecological factors and workplace sitting and sitting-breaks, and the feasibility of targeting workplace sitting among desk-based workers. Ethical approval was granted by the Deakin University Human Ethics Advisory Group – Health (refer to Appendix G: HEAG-H 24_2012).

4.1.2 Sample and survey administration

A total of 343 desk-based workers, specifically 221 desk-based employees and 122 desk-based managers were recruited and completed the online questionnaire. Participants were recruited via an online database of businesses in metropolitan Melbourne, accessed through the University Library. The businesses were initially contacted via telephone where the purpose of the call was briefly explained and the most appropriate contact person was identified (e.g., human resources, OH&S). If an expression of interest was received, the contact person was sent an email that briefly described the study and provided a URL link to the individual Plain Language Statement (refer to Appendix H). The contact person was asked to distribute the link to the Plain Language Statement to any desk-based workers within their organisation.
Chapter Four: Workplace sedentary study methods

that meet the inclusion criteria.

Once participants read the Plain Language Statement and consented to the study, they were directed to the online questionnaire. After completing the socio-demographic section, participants were directed to the employee version of the questionnaire (refer to Appendix I), or the manager version if they indicated they manage other employees and have either a direct or indirect influence over the workplace environment (refer to Appendix J).

Telephone contact was initially made with human resources representatives of 260 different Melbourne-based organisations. To maintain confidentiality, participants were not asked to name their employer. Therefore, it is not known how many different organisations were represented in the results. Thirty-eight of the 260 organisations formally declined upon initial contact (with common reasons given including “survey fatigue” and being “too busy”), indicating a response rate for receiving further information about the study of 85.38%.

4.2 Measures

The online questionnaire contained the following measures, with slight variations in measures presented to desk-based employees (see Appendix I) and managers (see Appendix J). These differences are highlighted in the following sections.

4.2.1 Quantifying and describing workplace sitting and sitting-breaks

4.2.1.1 Workplace sitting

Participants completed the same workplace sitting measure as described in Chapter Three (Marshall et al., 2010). Workplace sitting was described as the usual amount of time, in minutes per day, spent sitting at work on a weekday over the past seven days.
4.2.1.2 Workplace sitting-breaks

For workplace sitting-breaks, participants completed the measure described in Chapter Three, although with slight variations. Specifically, the measure validated in Chapter Three asked about sitting-breaks over the ‘past seven days’. In the present cross-sectional study, all participants were asked about sitting–breaks on a ‘typical workday’. Although in the workplace sedentary study, 128 desk-based workers (37.64%) completed both items (i.e., sitting breaks (i) over past ‘seven days’ and (ii) sitting-breaks on a ‘typical workday’). A Spearman’s rank order correlation between the two items revealed a significant substantial positive correlation ($r_s = .62, p = 0.00$), indicating reasonable agreement between the two items (Landis & Koch, 1977). Sitting-breaks were expressed as the typical frequency of breaks from workplace sitting per working hour.

4.2.1.3 Workplace sitting-break behaviours

To further describe desk-based workers’ sitting-breaks, a series of nine items were used to capture the type of workplace behaviours that they engaged in during their sitting-break. This scale was adapted and modified from Bennie’s (2010) workplace sedentary study. Participants were asked to report the frequency in which they engaged in the various behaviours to break-up workplace sitting, based on a six-point Likert scale (ranging from 1) never, 2) rarely, 3) sometimes, 4) often, 5) always, and 6) not applicable). For example, ‘standing-up/ walking a short distance from my desk/workstation to get a drink or something to eat’, ‘stand-up and walk to the printer’, and ‘stand up at my workstation’ etc. (Bennie et al., 2010). For analysis purposes, ‘not applicable’ was recoded to ‘never’, and item means were calculated, with a higher mean reflecting a more common break-taking behaviour.
4.2.2 Intrapersonal level factors

4.2.2.1 Sociodemographic and biological factors

Information pertaining to participants’ sex, age, weight, height, highest level of education, level of leisure-time MVPA and average gross weekly income was collected. For descriptive and analysis purposes, meaningful categories were created for age, weight, education and income. Age was collapsed into various three age groups (e.g., 18-39, 40-54, and 55+ years). Weight and height were used to calculate BMI and categorise weight status (e.g., weight (kg)/height (m)²; healthy (<25kg/m²); overweight or obese (>= 25kg/m²; WHO, 2000). Education attainment was collapsed into three categories (i.e., < 12 years, 12 years, and university). Income was collapsed into three categories (<$999 p/week, $1,000-1,499 p/week, and > $1,500 p/week). Information pertaining to leisure-time MVPA used the same method of data management described in Chapter Three (i.e., the Active Australia Survey; Armstrong et al., 2000).

4.2.2.1 Preferences for completing work-based tasks

Employees were asked to indicate how they would prefer to do four work-based tasks, specifically, while sitting, standing or moving. Items were developed by the research candidate, and an example item included “When at work and you need to talk to a co-worker in your building, would you prefer to: (i) email/telephone the co-worker while sitting at your desk (ii) email/telephone the co-worker while standing at your desk, (iii) walk over and talk to your co-worker?”. For analysis purposes these items were dichotomised into a preference score for either sedentary (i.e., sitting) or LPA (i.e., combined standing and moving) response items.
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4.2.2.3 Intrapersonal level barriers towards taking workplace sitting-breaks

Employees were asked to indicate the extent to which they believed six intrapersonal level barriers would affect their ability to take sitting-breaks while at work. These items were adapted from Bennie et al.’s, (2011) study examining the cross-sectional relationship between various ecological factors and short physical activity breaks in the workplace. Employees were asked to rate the extent to which the factor would influence their ability take sitting-breaks, on a six point Likert scale (ranging from 1) strongly disagree, (2) disagree, (3) neither agree nor disagree, (4) agree, (5) strongly agree, to (6) not applicable. For analysis purposes, each item response score was subtracted by three, so ‘neither agree nor disagree’ reflected a zero; a score below zero indicated that the participants’ disagreed that the item was important for taking sitting-breaks; a score above zero indicated that the participants agreed that the item was important for sitting-breaks. Example items included: “I do not have enough free time throughout the working day to take breaks from sitting” and “Taking breaks from sitting is a low priority for me” etc.

Using the same items, scale, and method for interpretation, managers were asked to rate the extent to which the perceived the various intrapersonal level factors would affect their employees’ ability to take sitting-breaks.

4.2.2.4 Self-efficacy for taking sitting-breaks

Employees were asked to rate their level of confidence to overcome various ecological factors that may impede their ability to take breaks from workplace sitting. The 11 items were adapted and modified from the Exercise Self-Efficacy Scale (Marcus, Rossi, Selby, Niaura, & Abrams, 1992; Resnick & Jenkins, 2000) and Bennie et al.’s, (2011) ecological correlates of sitting-breaks. Participants were asked to rate their level of confidence on a 5-point Likert scale (ranging from 1) not at all confident to 5)
extremely confident) towards taking sitting-breaks. Example items included, “I could take sitting-breaks even if…”: “I did not have support from management”, “I felt mentally tired”, and “OH&S did not recommend it” etc. For analysis purposes the various items were combined to reflect an overall self-efficacy variable for the employees. Reliability analyses on the current items revealed that the items together had acceptable reliability for the employees (Cronbach's $\alpha = .91$).

Using the same items and scales, managers were asked to rate their employees’ self-efficacy towards taking breaks from workplace sitting.

4.2.2.5 Health ratings of physical activity intensities and sedentary behaviour

The managers and employees were asked to rate how healthy they perceived six different activities (i.e., sitting, LPA and MVPA) accumulated in both the work and leisure contexts. Employees were asked to rate the healthiness of the activities on a 10-point Likert scale (accorded at 0) extremely unhealthy; 10) extremely healthy). Items were developed by the research candidate, and example items included: “Sitting all day at work and rarely getting up to move around”, “Standing for extending periods of time at work and often getting up to move around”, and “In leisure-time doing vigorous physical activities such as playing support” etc. To control for ordering effects, the order in which participants were presented with these activities in the online survey varied.

4.2.2.6 Habitualness of workplace sitting and sitting-breaks

The Self-Report Habit Index (SRHI) was used and adapted to assess the habitualness of employees’ workplace sitting and sitting-breaks (Verplanken & Orbell, 2003). Employees were required to rate their level of agreement with 12 items relating to both workplace sitting and sitting-breaks. Item responses were based on a five-point Likert scale (1) strongly agree; 5) strongly disagree). Example items included, sitting at
work/breaking-up workplace sitting is something: “I do often”, “I do without having to remember to do so”, and “I would find hard not to do” etc.

For descriptive and analysis purposes, the scales were reversed so that a higher scored reflected a greater level of behaviour habit. Resultant percentages were then calculated and reflected the extent to which the employees agreed with the 12 statements portraying sitting and sitting-breaks as habitual. Researchers in the field recommend interpreting scores above the midpoint as indicating the presence of habit (Lally, van Jaarsveld, Potts, & Wardle, 2010).

Previous research has found the scale has adequate test-rest reliability properties, and criterion validity properties when assessed against past behaviour frequency (Gardner et al., 2011; Verplanken & Orbell, 2003). Internal reliability estimates further supported the reliability properties of the scales; workplace sitting Cronbach's $\alpha = .93$; sitting-breaks Cronbach's $\alpha = .96$.

### 4.2.3 Interpersonal level factors

#### 4.2.3.1 Interpersonal level barriers towards taking workplace sitting-breaks

Participants were asked to indicate to what extent they believed two interpersonal barriers would affect their ability to take sitting-breaks while at work. The various social level items included: “Seeing most of my work colleagues also take breaks from sitting would encourage me to do so” and “It would be helpful if management supported my attempts to reduce sitting”.

These items, as described in section 4.4.2.2, were also adapted from Bennie et al. (2011), presented on the same Likert scale, and interpreted in the same manner. Using the same items, scale, and method for interpretation, managers were asked to rate how much they believed the various interpersonal level barriers would affect their employees’ ability to take sitting-breaks.
4.2.4 Policy-environmental level factors

4.2.4.1 Workplace policies to reduce and break-up workplace sitting
Participants were asked if their workplace had any policies/incentives to reduce sitting time (e.g., regular breaks involving standing or walking, standing desks?). Participants were asked to indicate as ‘yes’ or ‘no’.

4.2.4.2 Policy and physical environmental level barriers
Participants were asked to indicate to what extent they believed three environmental level factors would affect their ability to take sitting-breaks while at work. The various policy and environmental items included: “It would be helpful if OH&S supported workers taking breaks from sitting at work”, “My workplace should provide me with information about appropriate ways that I can take breaks from sitting”, and “My workplace has limited physical opportunities for me to take breaks from sitting (e.g., insufficient space to walk around)”.

These items, as described in section 4.4.2.2, were also adapted from Bennie et al. (2011), presented on the same Likert scale, and interpreted in the same manner. Using the same items, scale, and method for interpretation, managers were asked to rate how much they believed the various policy and environmental level barriers would affect their employees’ ability to take sitting-breaks.

4.2.5 Feasibility and health effects of reducing workplace sitting

4.2.5.1 Consequences of reduced workplace sitting
Participants were provided with open-ended questions asking what they perceived the negative and positive (i.e., benefits) consequences would be (if any), if workplace sitting could be reduced for (i) the individual desk-based worker and (ii) the workplace. For interpretation purposes employees’ and managers’ responses were separated.
4.2.5.2 Strategies to promote workplace LPA

Employees were asked if they would support the introduction of workplace sitting-breaks strategies; and managers were asked if they would be willing to implement workplace strategies to reduce sedentary time. Participants were asked to indicate a: (1) yes, (2) maybe, or (3) no, to reflect their support/willingness to implement strategies. An open-ended question was also provided inviting participants to further elaborate on their support/willingness to implement strategies to reduce workplace sitting. Participants were presented with five different workplace sedentary strategies, for example: “Having standing meetings” and “Standing and working for short intervals throughout the day” etc. Participants were then asked specifically what workplace sedentary strategies they would be most willing to engage in (i.e., ‘yes’, ‘maybe, and ‘no’).

4.2.5.3 Health ratings of lifestyles

Participants were asked to rate how healthy they perceived twelve hypothetical lifestyles, which described people with different levels of physical activity. The lifestyles consisted of various combinations of sedentary, LPA and MVPA time, accumulated in both the work and leisure contexts. Participants were required to rate how physically healthy they believed each person was on a 10-point Likert scale (0) extremely unhealthy; 10) extremely healthy). For example, participants were asked, “Below you will find descriptions of various people’s physical activity levels throughout the day. Please read each description carefully and rate each persona out of 10 for how physically healthy you think they are”. Some example people/lifestyles included: “This person has a desk job in which they sit all day and rarely get up and move around. They spend much of their free time sitting watching television or surfing the Internet”, “This person works in a physically demanding job in which they rarely get to rest or sit down. They spend much of their free time doing light physical
activities, such as gardening and going for leisurely walks”. To control for ordering effects, the order in which participants were presented with the various lifestyles varied.

4.3 Data preparation and variable creation

Data was managed and analysed using Statistical Package for the Social Sciences (SPSS) PWSA and AMOS™ (version 21; IBM Corp, 2012).

Workplace sitting was based on sitting time accumulated during work hours on a weekday, as few participants reported working on a weekend day. Nine employees and three managers were excluded for not meeting the selection criteria of spending at least half their time sitting while at work. Missing values for MVPA time, and sitting-breaks were assumed to equal zero behaviour levels; this was the case for 36 participants (10.6%) for frequency of sitting-breaks, and seven participants (2.1%) for MVPA time. A missing values analysis revealed that none of the independent or dependent variables were missing more than 5% data. For the purposes of the structural equation modeling only, a further two employees’ cases were excluded as they failed to respond to one or more independent variables (i.e., barriers, self-efficacy, sitting habit or sitting-breaks habit).

All independent and dependent variables were assessed for normality, outliers and reliability, and one case was excluded due to the presence of extreme outliers. On inspection of the workplace sitting time variable, it was evident that there were a number of outliers (i.e., exceeded the ‘typical’ eight hour workday). Consequently, workplace sitting was capped at eight hours to reflect the typical working day. On inspection of normality it was evident that all variables, except workplace sitting-breaks\(^{11}\) (skew =2.22) and sitting habit (skew=-2.347), were normally distributed. As

\(^{11}\) Sitting-breaks over ‘the past seven days’ was also skewed, and normality was attained after capping at 1.5\(SD\) above and below the mean.
the observed skew of two variables was reasoned to reflect inherent natural underlying skew, a decision was made to truncate, rather than transform the data. After truncating data for workplace sitting-breaks and workplace sitting habit ($\pm 1.5SD$), normality was attained.

The statistical analyses used to examine the research aims are described in the methods section of each chapter.
CHAPTER FIVE

ECOLOGICAL CORRELATES OF DESK-BASED EMPLOYEES’ WORKPLACE SITTING AND SITTING-BREAKS

5.1 Introduction

Understanding the ecological factors relevant to reducing and breaking-up workplace sitting is important for informing the development and implementation of effective workplace LPA (cf. the behavioural epidemiological framework; Owen et al., 2010; Plotnikoff & Karunamuni, 2012; Sallis et al., 2006). To date, interventions targeting workplace sedentary behaviour have predominantly focused on influencing the physical manner in which work tasks can be completed, or have encouraged participation in structured physical activity programs (Chau et al., 2010; Healy et al., 2012). Few studies have examined the intrapersonal and interpersonal, and combined social ecological (i.e., the intrapersonal, interpersonal, and policy-environmental level) factors relevant to workplace sedentary behaviour and LPA (Evans et al., 2012; Healy et al., 2013). A more comprehensive understanding of the multiple and interacting factors relevant to workplace sitting and sitting-breaks is likely to inform the development of more successful interventions (Owen et al., 2011; Sails et al., 2006). In light of emerging research associating accumulated sedentary time with chronic health outcomes, and the high prevalence of accumulated sitting in the workplace, the need to develop effective interventions to reduce and break-up workplace sitting is imperative (Biddle & Fuchs, 2009; Hamilton et al., 2007; Linnan, Fisher, & Hood, 2013; Plotnikoff & Karunamuni, 2012; Thorp et al., 2011, 2012).
Chapter Five: Ecological correlates

From a policy and physical-environmental level, preliminary research indicates that organisational advocates and support from OH&S may be important (Bennie et al., 2011; Gilson et al., 2011, 2012a; Healy et al., 2013). Intervention research has demonstrated that providing the physical means to reduce and break-up sitting may have favourable effects on workplace sitting and LPA (i.e., Alkhajak et al., 2012; Healy et al., 2013; Pronk et al., 2012; Parry et al., 2014; Straker et al., 2013). However, not all interventions have produced consistent and favourable outcomes, and some research has even found substantial variance in the engagement in environmental level strategies (Gilson et al., 2011, 2012b; Healy et al., 2013; Straker et al., 2013). In regard to interpersonal factors of relevance, preliminary research indicates that management support may be important, and that management and work colleagues’ behaviours may be important for workplace LPA (Bennie et al., 2011; Gilson et al., 2011, 2012a; Healy et al., 2013).

Further research is needed to better understand what specific variables, operating on multiple levels of influence relate to workplace sitting and sitting-breaks. Understanding the relationship between relevant policy and physical-environmental factors, and interpersonal and intrapersonal factors will inform the development of potentially more effective strategies to reduce sitting time in the workplace and promote a greater frequency of sitting breaks (Biddle & Fuchs, 2009; Linnan et al., 2013; Plotnikoff & Karunamuni, 2012; Sallis et al., 2006; Starker et al., 2013). In light of these research gaps, the current chapter will address the following aims.

5.2 Aims

The overall aims of Chapter Five were to examine the cross-sectional associations between and relative influence of intrapersonal, interpersonal, and policy-physical environment factors with workplace sitting and sitting-breaks.

The specific aims were:
1. To describe the prevalence of workplace sitting and sitting-breaks, and the specific types of workplace behaviours in which employees engage to break-up workplace sitting, and to examine the relationship between these specific types of behaviours and workplace sitting and sitting-breaks.

2. To examine the relationship between intrapersonal level factors and workplace sitting and sitting-breaks.

3. To examine the relationship between interpersonal level factors and workplace sitting and sitting-breaks.

4. To examine the relationship between policy and physical environmental factors and workplace sitting and sitting-breaks.

5. To examine the overall and independent contributions of the various ecological correlates with workplace sitting and sitting-breaks.

5.3 Methods

A detailed description of the procedure and methods used in this study were provided in Chapter Four (Sections 4.1 and 4.2). Briefly, 221 desk-based employees were recruited via an online database of businesses in metropolitan Melbourne, and completed the online questionnaire. The survey items were developed to reflect the various levels of influence based on a social ecological framework. A detailed description of how the data were managed and cleaned was provided in Chapter Four, section 4.3.

5.3.1 Analysis of workplace behavior and ecological correlates

Percentages were calculated to describe the socio-demographic profile of the sample, these results are presented in Table 5.1. Means and standard deviations were calculated to quantify workplace sitting and sitting-breaks are presented in Table 5.2. The extent to which various break-taking behaviours were engaged in are presented in Table 5.3.
Pearson correlations were conducted to examine the relationship between break-taking behaviours and workplace sitting and sitting-breaks are presented in Table 5.4.

To examine the relationship between the various social ecological independent variables and workplace sitting and sitting-breaks, a series of bivariate linear regression analyses were conducted. To examine the unique and combined influence of the various ecological factors of workplace sitting and sitting-breaks, two multivariate regression analyses, one for workplace sitting time and for frequency of sitting breaks were conducted. Independent variables that were significantly associated with workplace sitting and sitting-breaks at the $p < .1$ level, were incorporated in the multivariate models. Specifically for workplace sitting this included eight predictors (Table 5.7) and for sitting-breaks included 14 predictors (Table 5.8). Before being included in the multivariate model, the significant bivariate independent variables were assessed for collinearity. A bivariate correlation of $< .7$ between independent variables was used to indicate collinearity. None of the independent variables demonstrated collinearity (Pallant, 2013; Tabachnick & Fidell, 2012). For interpretive purposes the unstandardised regression estimates, 95% confidence intervals (CI’s), and corresponding alpha levels, for both the bivariate and multivariate models, are presented in tables in the present chapter. In keeping with the ecological model, independent variables were grouped according to their level of influence, that is, intrapersonal (Table 5.4), interpersonal (5.5), and policy and physical-environmental (Table 5.6).

5.4 Results
The employee sample included 59 men with a mean age of 35 years ($SD = 12.45$, range 19 to 72 years) and 162 females with a mean age of 35 years ($SD = 11.41$, range 19 to 66 years). Further socio-demographic characteristics of the sample are presented in Table 5.1. The majority of the participants were female, between the ages of 18-39.
years, had a university education, earned between $1,000-$1,499 per/week or more, were within the healthy BMI range, and met the MVPA guidelines.

Table 5.1 Socio-demographic characteristics of the desk-based employees

<table>
<thead>
<tr>
<th>Socio-demographic characteristic</th>
<th>% (n=221)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>27</td>
</tr>
<tr>
<td>Females</td>
<td>73</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>18-39 years</td>
<td>71</td>
</tr>
<tr>
<td>40-54 years</td>
<td>20</td>
</tr>
<tr>
<td>55+ years</td>
<td>8</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>&lt;12 years</td>
<td>8</td>
</tr>
<tr>
<td>12 years</td>
<td>20</td>
</tr>
<tr>
<td>University</td>
<td>71</td>
</tr>
<tr>
<td>Income</td>
<td></td>
</tr>
<tr>
<td>&lt;$999 p/week</td>
<td>28</td>
</tr>
<tr>
<td>$1,000-$1,499 p/week</td>
<td>41</td>
</tr>
<tr>
<td>&gt; $1,500 p/week</td>
<td>21</td>
</tr>
<tr>
<td>BMI&lt;sup&gt;12&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>61</td>
</tr>
<tr>
<td>Overweight/obese</td>
<td>37</td>
</tr>
<tr>
<td>Meet MVPA guidelines&lt;sup&gt;13&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Insufficiently active</td>
<td>17</td>
</tr>
<tr>
<td>Sufficiently active</td>
<td>83</td>
</tr>
</tbody>
</table>

5.4.1 Quantifying and describing workplace sitting and sitting-breaks

The following section presents the level of self-reported workplace sitting, frequency of sitting-breaks, and the specific types of behaviours performed while breaking-up workplace sitting among the desk-based employees. Table 5.2 indicates employees

<sup>12</sup> Healthy (<25kg/m²); overweight/obese (>= 25kg/m²; WHO, 2000).
<sup>13</sup> Insufficiently active (< 150 mins/week); sufficiently active (<= 150 mins/week; DoHA, 2014).
reported sitting at work during a weekday for approximately seven hours and taking around one-and-a–half breaks from sitting per working hour.

Table 5.2 Quantifying workplace sitting (hours per day) and sitting-breaks (frequency per work hour) among desk-based employees

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workplace sitting</td>
<td>6.93</td>
<td>(1.04)</td>
</tr>
<tr>
<td>Workplace sitting-breaks</td>
<td>1.61</td>
<td>(1.24)</td>
</tr>
</tbody>
</table>

Table 5.3 displays the mean frequency of specific types of sedentary break behaviours that employees reported engaging in when they took a break from sitting at work. The most frequently reported behaviours included getting a drink/something to eat, standing/moving during workplace tasks, going to the bathroom, using a printer/scanner, and talking with a co-worker. Table 5.3 shows three significant negative correlations between the less frequently performed break-taking behaviours (e.g., standing while using a workstation, standing while using the telephone, and doing workplace tasks while moving) and workplace sitting. Table 5.3 indicates that most of break-taking behaviours were positively associated with sitting-breaks.
Table 5.3 Mean frequency\(^a\) of engaging in break-taking behaviours and associations\(^b\) with sitting time (hours per day) and sitting-breaks (frequency per work hour)

<table>
<thead>
<tr>
<th>Break-taking behaviours</th>
<th>Mean (SD)</th>
<th>Sitting time</th>
<th>Sitting-breaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drink/eat</td>
<td>3.59 (0.84)</td>
<td>-.10</td>
<td>.27**</td>
</tr>
<tr>
<td>Standing/moving during structured work breaks</td>
<td>3.54 (1.17)</td>
<td>-.08</td>
<td>.18**</td>
</tr>
<tr>
<td>Bathroom</td>
<td>3.51 (0.74)</td>
<td>-.04</td>
<td>.03</td>
</tr>
<tr>
<td>Printer/scanner</td>
<td>3.42 (0.93)</td>
<td>-.06</td>
<td>.24**</td>
</tr>
<tr>
<td>Chat to co-worker</td>
<td>3.03 (0.89)</td>
<td>-.10</td>
<td>.23**</td>
</tr>
<tr>
<td>Work tasks while moving/standing (i.e., walking meeting)</td>
<td>2.41 (1.01)</td>
<td>-.15*</td>
<td>.20**</td>
</tr>
<tr>
<td>Standing workstation</td>
<td>2.10 (0.92)</td>
<td>-.15*</td>
<td>.24**</td>
</tr>
<tr>
<td>Stand while using telephone</td>
<td>1.82 (0.94)</td>
<td>-.20**</td>
<td>.18**</td>
</tr>
</tbody>
</table>

Note: \(^a\) Frequency of engagement based on a five-point Likert scale ranging from never (1) to always (5); \(^b\) Pearson’s correlations; * Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

### 5.4.2 Intrapersonal correlates of workplace sitting and sitting-breaks

The following section presents the cross-sectional bivariable relationships between the various intrapersonal factors and workplace sitting and sitting-breaks. Table 5.4 displays the distribution of the independent variables (means and mean percentages) and results of the bivariate linear regression analyses. None of the socio-demographic characteristics were associated with workplace sitting. However, sex, age and education were associated with self-reported sitting-breaks. Specifically, females, younger employees, and those with higher levels of education reported fewer sitting-breaks.

In regard to the various intrapersonal level barriers to workplace sitting, Table 5.4 indicates that high work demands alone were associated with increased workplace sitting time. Every unit increase in perceived work demands to take sitting breaks was associated with 10 minutes more sitting time per day at work. A number of items were
Chapter Five: Ecological correlates

inversely associated with frequency of sitting-breaks. Specifically, limited free time, high work demands, low priority, and not having enough energy for sitting-breaks were inversely associated with the frequency of breaks per work hour. Every unit increase in perceived limited free time, high work demands, low priority, and not having enough energy for sitting-breaks at work was associated with between .18 to .30 less sitting-breaks per working hour.

Self-efficacy for taking sitting-breaks was inversely associated with workplace sitting time and positively associated with the frequency of sitting-breaks. Every unit of increase in self-efficacy for taking sitting-breaks was associated with one-minute less workplace sitting time and .03 more sitting-breaks per working hour.

Preference for using a printer/scanner in a LPA manner rather than in a more sedentary manner was the only variable associated (positively) with the frequency of sitting-breaks. Every unit of increase in the preference to use a printer/scanner in a LPA was associated with .93 more sitting-breaks per working hour.

Counterintuitively, the health rating of workplace sitting was positively associated with the frequency of sitting-breaks. However, every unit of increase in the perceived healthiness of workplace sitting was only associated with .10 sitting-break per working hour. The relationship between the health ratings and behaviour was further examined and presented in Appendix M. Interestingly, employees’ who perceive leisure-time physical activity (i.e., LPA and MVPA) as healthy, took fewer breaks from sitting while at work, while employees who did not perceive sitting (both at work and during leisure) to not be as detrimental to health, took more workplace sitting-breaks. There did not appear to be a relationship between MVPA health beliefs and MVPA time, nor sitting health beliefs and sitting time.

Habitual sitting was positively associated with workplace sitting time, specifically every unit increase in the habitualness of workplace sitting was associated
with an increase of 16.73 minutes in workplace sitting time per day at work. Habitual sitting-breaks were inversely associated with workplace sitting and positively related to frequency of sitting-breaks. Every unit increase in the habitualness of sitting-breaks was associated with 9.34 fewer minutes of workplace sitting per day at work and .40 more sitting-breaks per working hour. Mean percentages indicate that workplace sitting is highly habitual, and sitting-breaks are only slightly habitual with a large standard deviation for sitting-breaks habit reflecting a high level of variances in the habitualness of sitting-breaks (Kremers & Brug, 2008).
Table 5.4 Bivariate linear regression models examining associations between intrapersonal level factors and workplace sitting (hours per day) and sitting-breaks (frequency per work hour)

<table>
<thead>
<tr>
<th>Item descriptive statistics</th>
<th>Workplace sitting Unadjusted unstandardised $B$ (95% CIs)</th>
<th>p-value</th>
<th>Sitting-breaks Unadjusted unstandardised $B$ (95% CIs)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Socio-demographic characteristics</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sex</td>
<td>.40 (-18.60, 19.41)</td>
<td>.967</td>
<td>-.56 (-.90, -.17)</td>
<td>.004</td>
</tr>
<tr>
<td>Age</td>
<td>-11.62 (-24.92, 1.68)</td>
<td>.086</td>
<td>.39 (.13, .65)</td>
<td>.003</td>
</tr>
<tr>
<td>Education</td>
<td>-.31 (-16.59, 15.97)</td>
<td>.970</td>
<td>-.31 (-.61, -.01)</td>
<td>.041</td>
</tr>
<tr>
<td>Income</td>
<td>3.39 (-8.77, 15.55)</td>
<td>.583</td>
<td>.11 (-.13, .34)</td>
<td>.383</td>
</tr>
<tr>
<td>BMI</td>
<td>-11.65 (-29.20, 6.00)</td>
<td>.192</td>
<td>.21 (-.14, .55)</td>
<td>.239</td>
</tr>
<tr>
<td>Meeting the MVPA guidelines</td>
<td>-12.92 (-35.14, 9.30)</td>
<td>.253</td>
<td>.14 (-.30, .58)</td>
<td>.519</td>
</tr>
<tr>
<td><strong>Barriers</strong></td>
<td>Mean</td>
<td>(SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work stress</td>
<td>0.56</td>
<td>(1.08)</td>
<td>3.46 (-4.37, 11.30)</td>
<td>.385</td>
</tr>
<tr>
<td>Limited free time</td>
<td>0.02</td>
<td>(1.20)</td>
<td>2.15 (-4.86, 9.16)</td>
<td>.546</td>
</tr>
<tr>
<td>High work demands</td>
<td>-0.15</td>
<td>(1.09)</td>
<td>10.87 (3.28, 18.47)</td>
<td>.005</td>
</tr>
<tr>
<td>Low priority</td>
<td>-.37</td>
<td>(1.11)</td>
<td>1.51 (-6.08, 9.10)</td>
<td>.695</td>
</tr>
<tr>
<td>Not motivated</td>
<td>-0.79</td>
<td>(0.93)</td>
<td>5.49 (-3.54, 14.53)</td>
<td>.232</td>
</tr>
<tr>
<td>Not enough energy</td>
<td>-1.17</td>
<td>(0.79)</td>
<td>9.69 (-9.3, 20.32)</td>
<td>.074</td>
</tr>
<tr>
<td><strong>Self-efficacy for sitting-breaks</strong></td>
<td>-</td>
<td>-</td>
<td>-1.00 (-1.94, -.06)</td>
<td>.038</td>
</tr>
<tr>
<td><strong>Preferences</strong></td>
<td>%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using a printer/scanner</td>
<td>95</td>
<td></td>
<td>7.96 (-30.74, 46.65)</td>
<td>.686</td>
</tr>
</tbody>
</table>

91
### Structured work breaks
- Mean: 85
- 92.2 (9.21, 9.48)
- 62 (9.62)

### Talking to a co-worker
- Mean: 80
- 17.25 (-17.25, 17.25)
- 10.6 (10.6)

### Computer-based tasks
- Mean: 48
- 15.12 (-15.12, 15.12)
- 7.5 (7.5)

### During a meeting
- Mean: 48
- 12.24 (-12.24, 12.24)
- 151 (151)

### Health ratings

<table>
<thead>
<tr>
<th>Activity</th>
<th>Mean</th>
<th>(SD)</th>
<th>T-statistic</th>
<th>P-value</th>
<th>Mean</th>
<th>(SD)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting at work</td>
<td>1.92</td>
<td>1.62</td>
<td>-0.91 (-6.13, 4.31)</td>
<td>0.31</td>
<td>.10</td>
<td>(0.00, 0.21)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>LPA at work</td>
<td>2.11</td>
<td>1.69</td>
<td>-1.00 (-6.29, 4.29)</td>
<td>0.31</td>
<td>.05</td>
<td>(-0.15, 0.05)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

### Habit

<table>
<thead>
<tr>
<th>Habit</th>
<th>Mean %</th>
<th>(SD)</th>
<th>T-statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting habit</td>
<td>97 (13)</td>
<td>16.73 (28, 33.19)</td>
<td>.046</td>
<td>.21</td>
</tr>
<tr>
<td>Sitting-breaks habit</td>
<td>54 (25)</td>
<td>-9.34 (-17.57, -1.10)</td>
<td>.027</td>
<td>.40</td>
</tr>
</tbody>
</table>

**Note**: bolded numbers indicate statistical significance; a Barrier items means range from -3 to 3, with a mean less than zero reflecting ‘disagreement’ and a mean above zero reflecting ‘agreement’ that the item is important for sitting-breaks; b Health ratings ranged from zero ‘extremely unhealthy’ to ten ‘extremely healthy’; c Habit mean percent < 50 reflects the absence of habit, and >50 fifty reflects the presence of habitual behaviour.
5.4.3 Interpersonal correlates of workplace sitting and sitting-breaks

The following section presents the relationships between interpersonal factors and workplace sitting and sitting-breaks. Item means and results of the bivariate linear regression analyses are presented in Table 5.5. Neither of the interpersonal factors were significantly associated with workplace sitting time or frequency of sitting-breaks. The extent to which the employees’ perceived the various ecological factors as barriers towards sitting-breaks was further examined (results presented in Appendix L). These results revealed that employees’ rated colleagues taking breaks, management support, and OH&S support as the most important factors for taking sitting-breaks. While the interpersonal factors were not significantly related to variance in workplace sitting or sitting-breaks, they were endorsed as the most important factors for taking workplace sitting-breaks.
Table 5.5 Bivariate linear regression models examining associations between interpersonal level factors and workplace sitting (hours per day) and sitting-breaks (frequency per work hour)

<table>
<thead>
<tr>
<th>Item descriptive statistics</th>
<th>Workplace sitting</th>
<th>Sitting-breaks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted</td>
<td>p-value</td>
</tr>
<tr>
<td></td>
<td>unstandardised B (95% CIs)</td>
<td></td>
</tr>
<tr>
<td>Barriersa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work colleagues taking breaks</td>
<td>0.97 (0.89)</td>
<td>-0.67 (-10.21, 8.86)</td>
</tr>
<tr>
<td>Management support</td>
<td>0.93 (0.84)</td>
<td>4.01 (-6.09, 14.11)</td>
</tr>
</tbody>
</table>

Note: bolded numbers indicate statistical significance; a Barrier items means range from -3 to 3, with a mean less than zero reflecting 'disagreement' and a mean above zero reflecting 'agreement' that the item is important for sitting-breaks.
5.4.4 Policy-physical correlates of workplace sitting and sitting-breaks

Table 5.6 displays the mean/mean percentages and results from the bivariate linear regression analyses. The perceived presence of opportunities to reduce and break-up workplace sitting was not significantly associated with workplace sitting behaviour. Percentages indicate that just one-fifth of the employees reported having opportunities to reduce workplace sitting. Every unit increase in perceived limited physical opportunities to take sitting-breaks at work was associated with 10 minutes more sitting time per day at work. The more helpful OH&S support to take sitting-breaks was perceived to be, the fewer actual sitting-breaks the employees took. Every unit increase in the perceived importance of OH&S support for taking sitting-breaks was inversely associated with .26 fewer sitting-breaks per working hour.
Table 5.6 Bivariate linear regression models examining associations between policy-physical environmental level factors and workplace sitting (hours per day) and sitting-breaks (frequency per work hour)

<table>
<thead>
<tr>
<th>Current opportunities</th>
<th>Workplace sitting</th>
<th>Sitting-breaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Yes</td>
<td>Bivariate linear regression</td>
<td>Bivariate linear regression</td>
</tr>
<tr>
<td></td>
<td>Unadjusted unstandardised $B$ (95% CIs)</td>
<td>$p$-value</td>
</tr>
<tr>
<td>Opportunities to reduce workplace sitting/ take sitting-breaks</td>
<td>19.8</td>
<td>9.95 (-11.13, 31.03)</td>
</tr>
<tr>
<td>Barriers *</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>OH&amp;S support would be helpful</td>
<td>0.91 (0.90)</td>
<td>-1.28 (-10.82, 8.25)</td>
</tr>
<tr>
<td>Workplace information</td>
<td>0.65 (0.92)</td>
<td>-2.55 (-11.77, 6.67)</td>
</tr>
<tr>
<td>Limited physical opportunities</td>
<td>-0.60 (1.10)</td>
<td>10.95 (3.42, 18.47)</td>
</tr>
</tbody>
</table>

*Note: bolded numbers indicate statistical significance; * Barrier items means range from -3 to 3, with a mean less than zero reflecting ‘disagreement’ and a mean above zero reflecting ‘agreement’ that the item is important for sitting-breaks.
5.4.5 Ecological correlates of workplace sitting and sitting-breaks

The following section presents the combined and unique contributions of the significant bivariately related correlates of workplace sitting and sitting-breaks. Table 5.7 shows the results for the multivariate model for workplace sitting. None of the bivariately associated factors uniquely predicted variance in workplace sitting in the multivariate model, although sitting habit and limited physical opportunities for sitting-breaks approached significance. Overall, the multivariate model explained 10% of the variance in workplace sitting ($R^2=0.09$, $F[8, 206] = 2.84$, $p=.005$).

Table 5.7 Multivariate linear regression model examining associations between ecological factors and workplace sitting (hours per day)

<table>
<thead>
<tr>
<th>Multivariate linear regression</th>
<th>Adjusted unstandardised $B$ (95% CIs)</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intrapersonal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-5.06 (-18.32, 8.20)</td>
<td>.453</td>
</tr>
<tr>
<td>Preference to complete computer task</td>
<td>-14.79 (-31.65, 2.10)</td>
<td>.085</td>
</tr>
<tr>
<td>Barrier: not enough energy</td>
<td>-.07 (-11.57, 11.43)</td>
<td>.990</td>
</tr>
<tr>
<td>Barrier: high work demands</td>
<td>5.0 (-3.61, 13.59)</td>
<td>.254</td>
</tr>
<tr>
<td>Self-efficacy for sitting-breaks</td>
<td>-.46 (-1.46, .53)</td>
<td>.361</td>
</tr>
<tr>
<td>Sitting habit</td>
<td>15.0 (-1.68, 31.68)</td>
<td>.078</td>
</tr>
<tr>
<td>Sitting-breaks habit</td>
<td>-4.07 (-13.00, 4.90)</td>
<td>.371</td>
</tr>
<tr>
<td><strong>Policy-physical environmental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barrier: limited physical opportunities</td>
<td>7.59 (-.50, 15.67)</td>
<td>.066</td>
</tr>
</tbody>
</table>

*Note:* bolded numbers indicate statistical significance

Table 5.8 shows the results of the multivariate model for sitting-breaks. Sitting-breaks habit and the perceptions that workplace sitting is not as detrimental to health are unique predictors of increased workplace sitting-breaks. Overall, the multivariate model explained 26% of the variance in sitting-breaks ($R^2=0.256$, $F[14, 150] = 3.684$, $p=.000$).
Table 5.8 Multivariate linear regression model examining associations between ecological factors and sitting-breaks (frequency per work hour)

<table>
<thead>
<tr>
<th>Multivariate linear regression</th>
<th>Adjusted unstandardised B (95% CIs)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intrapersonal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>-.05 (-.46, .36)</td>
<td>.822</td>
</tr>
<tr>
<td>Age</td>
<td>.07 (-.22, .36)</td>
<td>.638</td>
</tr>
<tr>
<td>Education</td>
<td>-.09 (-.40, .215)</td>
<td>.554</td>
</tr>
<tr>
<td>Preference to use the printer/scanner</td>
<td>.43 (-.33, 1.18)</td>
<td>.266</td>
</tr>
<tr>
<td><strong>Barrier: not enough energy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-.06 (-.30, .17)</td>
<td>.597</td>
</tr>
<tr>
<td><strong>Barrier: high work demands</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.07 (-.15, .28)</td>
<td>.554</td>
</tr>
<tr>
<td><strong>Barrier: low priority</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-.14 (-.32, .03)</td>
<td>.098</td>
</tr>
<tr>
<td><strong>Barrier: limited free time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-.09 (-.27, .10)</td>
<td>.351</td>
</tr>
<tr>
<td><strong>Barriers: work stress</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-.14 (-.31, .04)</td>
<td>.125</td>
</tr>
<tr>
<td><strong>Health rating: sitting at work</strong></td>
<td>.15 (.05, .26)</td>
<td>.006</td>
</tr>
<tr>
<td>Self-efficacy for sitting-breaks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.01 (-.01, .03)</td>
<td>.379</td>
</tr>
<tr>
<td>Sitting-breaks habit</td>
<td>.20 (.01, .40)</td>
<td>.040</td>
</tr>
<tr>
<td><strong>Policy-physical environmental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Barrier: OH&amp;S support would be helpful</strong></td>
<td>-.15 (-.36, .06)</td>
<td>.152</td>
</tr>
<tr>
<td><strong>Barrier: limited physical opportunities</strong></td>
<td>-.34 (-.31, .03)</td>
<td>.108</td>
</tr>
</tbody>
</table>

Note: bolded numbers indicate statistical significance

5.5 Discussion

This chapter explored the cross-sectional associations between various ecological factors with workplace sitting time and frequency of sitting-breaks among a sample of desk-based employees. The aims of the chapter were to quantify the amount of time spent sitting at work and the frequency of sitting-breaks, and to examine associations between various intrapersonal, interpersonal and policy-physical environmental level factors with workplace sitting and sitting-breaks. Understanding the ecological correlates relevant to workplace sitting and sitting-breaks is important for informing the development and implementation of strategies targeting reductions and breaks in
workplace sitting (Biddle, 2011; Healy et al., 2013; Plotnikoff & Karunamuni, 2012; Straker et al., 2013). The chapter found that a number of ecological correlates, particularly on an intrapersonal level were related to workplace sitting and sitting-breaks. The following section will compare these findings with the published literature and discuss and interpret the implications in further detail.

5.5.1 Quantifying and describing workplace sitting and sitting-breaks

The desk-based employees reported spending most of their workday sitting and taking few breaks from sitting per working hour. These estimates provide confirmation that the sample was indeed composed primarily of desk-based workers who spend most of their workday sitting, and that the targeted research sample was attained. This encourages confidence in the ecological validity of the study findings (Clemes et al., 2014; Thorp et al., 2012). The high prevalence of sitting in the current sample is consistent with past research indicating that working adults can spend half to most of their workday sitting (Clemes et al., 2014; Evans, 2012; ABS, 2009; Thorp et al., 2012). The few breaks from sitting per work hour was slightly lower than what was reported in the methodological study reported in Chapter Three and what has been previously reported (Bennie et al., 2011). However, Bennie et al.’s (2011) sample of adult workers included both blue and white-collar workers, which could have led to higher sitting-break estimates due to the more active nature of blue-collar workers compared to the current sample of desk-based employees (Miller & Brown, 2004; Trost et al., 2002).

The employees in the present study reported commonly breaking-up their sitting whilst performing naturally occurring workplace behaviours, rather than sitting-breaks behaviours typified by LPA strategies, such as breaking-up workplace sitting by doing work tasks while standing/ moving, using a standing workstation, and standing while talking on the telephone. This is not surprising considering the typical workplace
environment promotes sitting and strategies designed to promote increased workplace LPA are not commonplace (Chau et al., 2010; Healy et al., 2012). While most break-taking behaviours were associated with increased sitting-breaks, only the less common break-taking behaviours, typically endorsed by LPA strategies (i.e., using sit-stand desk, walking/standing meetings) were associated with less workplace sitting time (Chau et al., 2010; Evans et al., 2012; Gilson et al., 2012b; Healy et al., 2013; Parry et al., 2014). This confirms that the introduction of current LPA strategies within the workplace (Chau et al., 2010; Healy et al., 2012).

5.5.2 Ecological correlates of workplace sitting

The investigation of the potential ecological correlates of workplace sitting and sitting-breaks produced few significant results in the final multivariate models. Several intrapersonal and policy-environmental factors were significant in the bivariate analyses, particularly in relation to sitting-breaks. However, when combined into the multivariate models, two factors, sitting-breaks habit and health rating of workplace sitting, remained significant for workplace sitting-breaks. No independent variables remained significantly related to workplace sitting, although sitting habit and limited physical opportunities for sitting-breaks approached significance.

In regard to workplace sitting, the limited influence of the combined various ecological correlates with sitting could be explained with reference to the non-discretional nature of workplace sitting (Clark et al., 2009; Gabriel et al., 2012). Workplace sitting among desk-based employees is likely to be largely constrained by the physical and policy environment of the workplace (i.e., desk-based workers are obligated to sit while they work). Thus it is plausible that the non-discretional nature of workplace sitting may attenuate the influence of interpersonal and intrapersonal factors (Custer & Aarts, 2010; Biddle, 2010). However, few policy and physical
environmental level factors were bivariably associated with workplace sitting. Although in the final multivariate model, the physical-environmental factor, limited physical opportunities for sitting-breaks approached significance. Specifically, limited physical opportunity was associated with increased workplace sitting, which is consistent with non-discretionary and environmentally determined nature of workplace sitting (Custer & Aarts, 2010; Biddle, 2010; Owen et al., 2010).

A novel construct examined in the current study was habit (Conroy et al., 2013). Workplace sitting was found to be highly habitual, and sitting habit predicted increased workplace sitting time. The high habitualness of sitting is not surprising considering the workplace environment constrains sitting, and the importance of stable environmental cues for habit formation (Bargh & Chartrand, 1999; Custere & Aarts, 2010; Verplanken & Aarts, 1999). The relationship between increased behaviour habitualness and behaviour engagement is consistent with past research (Conroy et al., 2013; Gardner et al., 2011; Verplanken & Orbell, 2003). Specifically, Warner and Biddle (2011) found sedentary habit significantly contributed to a large proportion of the variance, specifically 34% of additional variance, in workplace sedentary behaviour (N=101; Warner & Biddle, 2011) Similarly, in the physical activity and nutrition literature, a recent systematic review and meta-analysis found habit explained around 20% of the variance in physical activity and nutrition behaviours (Gardner et al., 2011). The notion that habitual behaviour is largely influenced by environmental cues, specifically stable environmental cues, is consistent with the non-discretionary and environmental influences upon workplace sitting (Clark et al., 2009; Gabriel et al., 2012). Furthermore, as habitual behaviour largely occurs automatically in response to social and environmental cues, it is logical that the controlled intrapersonal factors had a limited influence on workplace sitting, particularly considering the high habitualness
of workplace sitting (Custer & Aarts, 2010; Orbell & Verplanken, 2010; Verplanken & Aarts, 1999).

The limited influence of various intrapersonal and intrapersonal factors, and the near significant influence of limited opportunities to take workplace sitting-breaks and sitting habit, indicates workplace sitting is in large influenced by the physical environment of the workplace and non-discretional (i.e., occurs automatically in response to the workplace environment; Custer & Aarts, 2010; Biddle et al., 2010; Orbell & Verplanken, 2010; Verplanken & Aarts, 1999). This notion is consistent with propositions that given the ease and ubiquitous nature, sedentary behaviours may require little or no conscious decision making for behaviour engagement (Biddle, 2010). Furthermore, past research indicates that habit may play a large role in determining sedentary behaviour (Conroy et al., 2013; Warner & Biddle, 2011). These results, in conjunction with emerging past research, highlight the importance of the physical-environment when determining what influences workplace sitting (Owen et al., 2010). These results have implications for interventions that assume a level of deliberate planned behaviour, when a focus should rather be, at least initially, on addressing the environmental cues underpinning the habitual nature of workplace sitting, as sitting largely occurs automatically in response to these cues. The limited influence of various policy- environmental factors may also pertain to measurement limitations (Giles-Corti & Donovan, 2002).

It is possible that the items used to capture the environmental-level influences of workplace sitting were not sufficient and or varied enough to truly capture the underlying environmental influences of workplace sitting (Giles-Corti & Donovan, 2002). In fact, past research has highlighted that a challenge of using the ecological model pertains to the limited variation in units of measurement on some ecological levels (Giles-Corti & Donovan, 2002). Lack of variation and comprehensiveness of
units of measurement can lead to underestimation of effect sizes and the ability to test corresponding hypotheses (Sallis, Owen, & Fisher, 2008).

5.5.3 Ecological correlates of workplace sitting-breaks

In regard to workplace sitting-breaks, two intrapersonal level factors uniquely predicted variance in sitting-breaks, specifically sitting-breaks habit and health rating of workplace sitting. In relation to past research, a similar cross-sectional Australian workplace study examining the ecological correlates of short physical activity breaks in the workplace, found intrapersonal factors, such as men’s perception of limited time for short breaks, and for women, having limited information, were inversely associated with breaks (Bennie et al., 2011). While the current study did not find these variables to be associated with sitting-breaks, in the bivariate analyses the perception of ‘limited free time’ was related to fewer sitting-breaks. This perception could in part reflect a limited understanding that strategies designed to increased workplace LPA can in fact be done while maintaining work-productivity (i.e., standing while completing computer based task at a height-adjustable desk). Furthermore, such a perception may reflect a misunderstanding of workplace attempts to increase structured MVPA, rather than reducing sitting and increasing LPA (Owen et al., 2010; van Uffelen et la., 2010).

Encouragingly, the perception of limited free time, is a modifiable factor, in which interventions could potentially involve clarifying misperceptions and providing education about workplace LPA strategies in relation to work-productivity (Gilson et al., 2011, 2012a). Although in comparison to Bennie et al. (2011), the current study examined a larger number of ecological correlates, particularly upon the intrapersonal-level, which makes it difficult to compare findings. Furthermore, Bennie et al. (2011) examined ‘short physical activity breaks in the workplace’ which could be argued to be
a slightly different behavioural concept than the current study’s focus on ‘sitting-breaks’; thus the two behaviours may have different determinants.

In the current study, habitual sitting-breaks uniquely predicted an increase in sitting-breaks. Taking sitting-breaks demonstrated slight habitualness, however, there was a large level of disparity between the habitualness of sitting-breaks among the employees. The slight presence of habitualness may be explained with references to earlier observed results pertaining to common behaviours done to break-up workplace sitting. The employees indicated that they commonly broke sitting in relation to naturally occurring workplace behaviours (see Chapter Five, Table 5.3). These common everyday work behaviours are influenced by the work environment (i.e., the workplace encourages having a lunch break, going to the bathroom involves break-up sitting etc.). Therefore they may contribute to the slight habitualness of regular sitting-breaks. Conversely, the fact that the modern workplace environment favours sitting, not sitting-breaks, may potentially undermine the habitualness of sitting-breaks (Warner & Biddle, 2011; Conroy et al., 2013; Verplanken & Aarts, 1999).

The unique influence of habitual sitting-breaks may reflect the role unconscious processes have on taking breaks from workplace sitting. This is logical considering breaking-up workplace sitting has the potential to involve behaviours that involve minimal effort and cognitive processing, and may be done in response to environmental cues, thus are automatic and habitual behaviours (Custers & Aarts, 2010; Fitzsimons & Bargh, 2003). For example, breaking-up sitting in response to collecting printing from a printer, or standing up at desk to reach a filling cabinet involve minimal cognitive effort and occur rather in response to a secondary goal, such as completing a work task. The unique influence of sitting-habit on sitting-breaks may also in part reflect the uniqueness of this independent variable from the other ecological correlates, specifically the intrapersonal factors, as these are based on the assumption that human
behaviour is governed by conscious rational thought (Bargh, 2006; Bargh & Morsella, 2008; Custers & Aarts, 2010; Evans, 2003). The unique predictive utility of habit reported in this chapter, supports emerging research that the inclusion of automatic process, specifically habit, can further enhance understanding of health behavior, particularly sedentary behaviour (Conroy et al., 2013; Gardner et al., 2011; Warner & Biddle, 2011).

Interestingly, those who do not perceive sitting at work (and during leisure; Appendix M) to be as detrimental towards health, took more workplace sitting-breaks. It is possible that as sitting-breaks can occur involuntarily (i.e., automatically and habitual) as part of work. Therefore sitting-breaks may be unrelated to how important workplace sitting is perceived to be for health (Evans, 2003). This proposition is also consistent with the unique predicted increase in sitting-breaks explained by the habitualness of workplace sitting-breaks. These results suggest that sitting-breaks largely occur automatically and habitually at work, rather than in response to how healthy you perceive workplace sitting.

The lack of a relationship between activity health beliefs and corresponding behaviour levels is consistent with past research in the physical activity literature, specifically that physical activity knowledge is unrelated to MVPA time (Trost et al., 2002). The relationship between sitting-knowledge and sitting time may be similar to that consistently observed in the physical activity literature. Straker et al. (2013) reported that ergonomic awareness of accumulated sitting was unrelated to variations in sedentary patterns among those with sit-stand desks. Also, a randomised controlled trial (N=28) with office workers found education concerning the chronic health effects of sedentary time was unrelated to sitting time, number of sitting events, number of accumulated sitting events, and duration of accumulated sitting events over the five-work day intervention period (Evans et al., 2012). Thus it is possible, that consistent
with the physical activity literature (Trost et al., 2002), there may not be a relationship, or in a manner consistent with theoretical understanding (Rosenstocks, 1974), between sedentary behaviour knowledge and participation in sedentary behaviour (Evans et al., 2012; Straker et al., 2013).

The small correlations between the perceived health effects of leisure time physical activity (i.e., MVPA and LPA; refer to Appendix M) and fewer sitting-breaks, could reflect the ‘physical activity believers’. Specifically, those who believe MVPA time is very important for health may not deem sedentary time, or what occurs at work, as important to health. This perception could also reflect the ‘active couch potato phenomena’ specifically which refers to when sufficient MVPA time is accumulated, the level of sedentary time or need to reduce/ break up sitting is deemed irrelevant (Owen et al., 2010; Proper et al., 2011; Tremblay et al., 2010). However, results reported in Appendix M, Table 1 indicate the perceived healthiness of MVPA is unrelated to sitting time. As discussed in the previous paragraph, this may be influenced by the lack of a relationship between health perceptions of behavior and actual behaviour (Evans et al., 2012; Starker et al., 2013; Trost et al., 2002). Thus, it may be unrealistic to expect a relationship between health perceptions of one behaviour (i.e., MVPA health rating) to lead to engagement in another behaviour (i.e., sedentary time). These results indicate that the relationship between the perceived healthiness of various physical activity intensities and sitting, and actual behaviour is complicated, and that knowledge about the relevance of sedentary behaviour to health may not relate to actual behaviour, or in the anticipated manner (Evans et al., 2012; Starker et al., 2013; Trost et al., 2002).
5.5.4 Research limitations and strengths

A number of limitations of the research study relate to generalisability of the sample characteristics of the desk-based employees. The sample of desk-based employees reported a similar weekly income to that of the general Australian population (41% of the employees’ reported earning between %1,000-1,499 per week compared to the average weekly income for Australians in 2012 was $1,352 per week; ABS, 2012; AIHW, 2012; 2013). However, the sample of desk-based employees included a high proportion of females (73%) and younger adults (71 of the sample were between the age of 18-39 years). In comparison to the Australian population where 18% of the population had a bachelor degree, a larger proportion of the desk-based employees (71%) reported having university level qualifications (ABS, 2012). Furthermore, in comparison to the Australian population where 63% of adults are overweight or obese and 43% meet physical activity guidelines (ABS, 2012; The Australian Health Survey, 2012, 2013), the desk-based employees appeared to be have lower rates of overweight/obesity (37%) and a larger proportion who reported meeting the MVPA guidelines (83%). While these characteristics of the employees need to be considered when generalising results, past literature describing the ‘healthy worker effect’, highlight that for an individual to be employable they must be relativity healthy, and consequently both rates of morbidity and mortality tend to be lower among working populations than that of the general population. Thus, comparing individuals within the occupational context to that of the general population is biased, and should be interpreted with caution (Li & Sung, 1999). It is also possible that the employees who participated in this study had a specific interest in workplace health, and thus may not be representative of the typical desk-based population (ABS, 2012; The Australian Health Survey, 2012, 2013; Li & Sung, 1999).
Chapter Five: Ecological correlates

The present sample only included desk-based employees who indicated they sat for most of their work time. Thus, it is unknown how the results may apply to desk-based workers with lower and more variable levels of workplace sitting. While the participants were recruited through an online business database, due to confidentiality it is unknown how many different workplaces participated in the research study, and information was not collected about the type of job or workplace. Future research may benefit from extending the focus to desk-based workers with more variable levels of workplace sitting and considering the type of job employees may have (i.e., call center workers, technicians etc; Bennie et al., 2011; Clark et al., 2011).

A number of limitations also apply to the self-report measures used to capture workplace sitting and sitting-breaks. There is the potential for recall difficulties when assessing workplace sitting and sitting-breaks, especially considering the ubiquitous and habitual nature of workplace sitting and sitting-breaks (Chau et al., 2012; Clark et al., 2011; Conroy et al., 2013). Future studies would ideally use an objective measure of sitting, such as an activPAL inclinometer, or of sedentary time, such as an ActiGraph accelerometer (Healy et al., 2011). With regard to the measurement of sitting-breaks, the current study used a slightly modified measure validate in the study described in Chapter Three. In this study, validation of a sitting-breaks measure pertaining to breaks from sitting per work hour over the past ‘seven days’, and the current study used a measure that assessed the number of sitting breaks per work hour on a ‘typical workday’ was undertaken. As reported in Chapter Four, section 4.2, one-third of the sample were given both questions, and results revealed a moderate to substantial positive association between the two sitting-break items ($r = .62, p = .00$), indicating a reasonable level of agreement (Landis & Koch, 1977). Furthermore, past research in the non-workplace context and for overall levels of sedentary time have found non-significant differences between measures asking participants to reflect on a ‘typical’ pattern versus ‘the past
seven days’ (Craig et al., 2003; Clark et al., 2009). While the questions were slightly different, it is reasonable to assume that it closely approximates the validated measure in Chapter Four.

In comparison to the number of significant correlates in the bivariate models (eight in the sitting time model and 14 in the sitting-breaks model), the lack of associations in the multivariate models may have been due to a loss of power. In addition, as previously mentioned, the lack of significant associations between various policy and physical environmental, and interpersonal level factors with sitting time and sitting-breaks may be attributable to the limited number of measures in these contexts used in the current study (Pallant, 2013; Tabachnick & Fidell, 2012). In addition, the measures used to assess the interpersonal and environmental-policy level factors may not have been the most relevant. Lack of variation and comprehensiveness of units of measurement can lead to underestimations of effects and reduce the ability to test corresponding hypotheses (Giles-Corti & Donovan, 2002; Sallis et al., 2008). For example, the question relating to ‘opportunities’ to reduce workplace sitting in the current study (e.g., regular breaks involving standing or walking, or standing desk) may not have been entirely clear to respondents. Specifically, the term ‘regular’ was undefined and most workplaces would offer some form or regular/scheduled work-breaks (i.e., morning and afternoon tea, lunch breaks, etc.). Thus, this question may not have been able to identify sufficient heterogeneity in opportunities to reduce workplace sitting across organisations, which would consequently limit the ability to detect associations with workplace sitting or sitting-breaks (Giles-Corti & Donovan, 2002; Sallis et al., 2008). Future studies should aim to develop items that are able to capture a greater diversity in workplace environments and policies, and interpersonal factors of relevance.

Finally, the cross-sectional design of the study precluded the drawing of causal
interferences and changes in variables over time. However, as previously discussed in Chapter Two, very few studies have comprehensively examined associations between ecological factors and workplace sitting and sitting-breaks, which is a strength of the present study (Bennie et al., 2011; Evans et al., 2012; Healy et al., 2013). Therefore, cross-sectional research can provide initial valuable insights for informing the development of hypotheses in relation to potential causal pathways of behavior change which can be tested with longitudinal and experimental research designs (Bauman et al., 2002). Overall, this study provides preliminarily insights that may warrant further investigation in research that has the potential to infer such relationships (Bauman et al., 2002; Bennie et al., 2011; Biddle, 2010; Biddle & Fuchs, 2009).

5.6 Chapter summary

The findings from this study highlight the importance of considering multiple levels of influence relevant to workplace sitting and sitting-breaks. However, in terms of determining the most important correlates, research at this stage is unclear (Bennie et al., 2011; Healy et al., 2013). The ecological correlates explained a reasonable proportion of the variance in workplace sitting-breaks ($R^2=0.256$) and some of the variance in workplace sitting ($R^2=0.099$). Further research is now needed to better understand the various social ecological correlates of workplace sitting-breaks and sitting (Bennie et al., 2011; Owen et al., 2010; Plotnikoff & Karunamuni, 2012). Furthermore, habitual sitting and sitting-breaks were the strongest correlates of these respective behaviours in the workplace. In recognition of emerging research indicating this behaviour can be governed by both controlled and automatic cognitive processes (Evans, 2003), the following chapter aims to further examine this in attempt to understand the interaction and influence of such intrapersonal factors with workplace sitting and sitting-breaks. Understanding the relationship & inter-relationships between
automatic (i.e., habit) and controlled (i.e., barriers and self-efficacy) intrapersonal correlates of workplace sitting and sitting-breaks is important for informing the development of strategies to reduce unhealthy habitual behaviours, such as sitting, and promoting habits in desirable behaviours, such as taking sitting-breaks (Evan, 2003; Verplanken & Wood, 2006).
6.1 Introduction

Cognitive researchers propose two distinct systems underlying human reason and motivation (Evans, 2003). This dual-process approach distinguishes between automatic (i.e., impulsive, habitual) and controlled (i.e., reflective, conscious) cognitive processes, both of which have been proposed to influence and interact when determining behaviour (Evans, 2003; Triandis, 1977). The extent to which automatic and controlled cognitive processes influence and interact is largely determined by the physical and social context in which behaviour occurs (Custers & Aarts, 2010; Fitzsimons & Bargh, 2003). Specifically, in novel contexts automatic process (i.e., habit) will interact with controlled cognitive processes to determine behaviour, and in familiar and unvarying settings, behaviour will be guided by automatic process, and cognitive processes will have little or no impact (Evans, 2003; Triandis, 1977). Both processes have been proposed to exert a unique influence on sedentary behaviour (Conroy et al., 2013), however, limited research has examined this specific to workplace sitting and sitting-breaks (Warner & Biddle, 2011).

In regard to reducing and breaking-up workplace sitting, controlled and automatic psychological process are likely to both exert an influence (Chau et al., 2010; Conroy et al., 2013; Evans, 2003; Triandis, 1977). Specifically, given that workplace sitting is a ubiquitous and environmental determined behaviour, it is likely to be
Chapter Six: Dual-process understanding

habitual, and given that breaking-up workplace sitting a relatively new health endeavor, it is likely to involve controlled psychological processes (Chau et al., 2010; Conroy et al., 2013; Evans, 2003; Triandis, 1977). Results from the findings described in the previous chapter support this proposition. Specifically, behaviour habit was found to uniquely predict sitting-breaks and approached significance for workplace sitting, and a number of controlled cognitive factors (i.e., barriers and self-efficacy) were bivariably associated with behaviour, particularly sitting-breaks. Consequently, in the present chapter, it was deemed important to take a dual-process approach to further examine the intrapersonal factors relevant to workplace sitting and sitting-breaks (Conroy et al., 2013; Evans, 2003; Triandis, 1977; Warner & Biddle, 2011).

6.2 Aims

The overall aims of the chapter were to examine the interaction and influence of automatic and controlled intrapersonal factors with workplace sitting and frequency of sitting-breaks per working hour. The chapter has the following specific aims:

1. To examine the mediating role of automatic processes (e.g., habit) in the relationship between controlled intrapersonal correlates (e.g., barriers and self-efficacy) and workplace sitting and frequency of sitting-breaks per work hour.

2. To examine the moderating effect of sitting-habit with self-efficacy and barriers towards sitting-breaks with frequency of sitting-breaks.

6.3 Methods

A detailed description of the procedures and methods used in this chapter were provided in Chapter Four (Sections 4.1 and 4.2). Briefly, 221 desk-based employees were
recruited via an online database of businesses in metropolitan Melbourne, and completed the online questionnaire. The survey items were developed to capture automatic (i.e., habit) and controlled intrapersonal (i.e., barriers and self-efficacy) correlates of workplace sitting and sitting-breaks. A detailed description of how the data was managed and cleaned is described in Chapter Four, section 4.3.

6.3.1 Analysis of dual-process correlates

To examine the interaction between controlled (i.e., self-efficacy and barriers) and automatic (i.e., habit) processes on workplace sitting-breaks, a path analysis and two moderation analyses via a hierarchical multiple regression were conducted. For the purpose of these analyses, self-efficacy and barrier variables were created based on item means. Reliability analyses revealed the variables had acceptable internal consistency proprieties (barriers Cronbach's $\alpha = .66$; self-efficacy Cronbach's $\alpha = .91$).

The path analyses were conducted via a bias-corrected bootstrap re-sampling method (Shrout & Bolger, 2002) within AMOS$^{\text{TM}}$ version 21 to test the significance of the indirect paths from self-efficacy and barriers via habit (both workplace sitting habit and sitting-breaks habit) for workplace sitting and sitting-breaks. The model is presented in Figure 6.1 for workplace sitting and in Figure 6.2 for sitting-breaks. These figures include the standardised beta weights for the direct and indirect paths, and the $R^2$ values corresponding to the proportion of total variance in sitting-breaks explained. Significant paths and explained variances, were denoted by asterisks (*$p<.05$; **$p<.01$). Pertaining to the final model (i.e., the model which contained only significant paths), model fit was evaluated using fit indices such as GFI, NFI, CFI, and RMS.

To examine the moderation effect of workplace sitting habit with self-efficacy and barriers on sitting-breaks, two hierarchical regression analyses were conducted.
First, a hierarchical regression was conducted in which sitting-breaks was regressed on sitting habitualness and (i) barriers and (ii) self-efficacy to sitting-breaks (the main effects) in step one, followed by the combined inclusion of the product of sitting-habitualness and barriers and self-efficacy in step two (the interaction effects). For the purpose of the moderation analysis, all independent variables were centred prior to their multiplication. A figure was used to display significant moderation effects, wherein high and low levels of the variables were plotted, these values were determined by the variables minimum and maximum values (i.e., ‘high’ sitting habit reflected the maximum sitting habit value, after centring). This plot is displayed in Figure 6.3.

6.4 Results

6.4.1 Interaction between automatic and controlled correlates

The following section explored the mediating role of automatic process (e.g., habit) in the relationship between controlled (e.g., barriers and self-efficacy) intrapersonal correlates, with both workplace sitting (Figure 6.1) and sitting-breaks (Figure 6.2).

Figure 6.1 shows that the controlled intrapersonal variables did not have a significant relationship with sitting habit or workplace sitting, nor did sitting habit have a significant relationship with workplace sitting. However, decreased barriers ($\beta = -.15, p < .05$) and increased self-efficacy ($\beta = -.20, p < .01$) significantly increased the habitualness of sitting-breaks habit. The model overall accounted for a significant, but small proportion of the variance in workplace sitting ($R^2 = .07, p < .01$), in which only the significant paths were retained, the model met most relevant fit criteria: GFI = .99 (i.e., >.90, Byrne, 1994); CFI = .97 (i.e., >.93; Byrne, 1994); RMS = .05 (i.e., <.05; Stieger, 1990), with the exception of NFI = .93 (i.e., >.95; Schumacker & Lomax, 2004). Interestingly, when the non-significant paths were removed to determine the relevant
Chapter Six: Dual-process understanding

fit indices, sitting-breaks habit related to significantly less workplace sitting ($\beta = -.15$, $p < .01$).

Figure 6.1 Structural model with standardised beta weights and $R^2$ values for automatic and controlled intrapersonal predictors with workplace sitting

![Diagram showing the structural model with beta weights and $R^2$ values for automatic and controlled intrapersonal predictors with workplace sitting.]  

Note: Indirect paths: $\beta_{\text{barriers} \rightarrow \text{breaks} \rightarrow \text{sitting}} = .02^*$, $\beta_{\text{self-efficacy} \rightarrow \text{breaks} \rightarrow \text{sitting}} = -.03^{**}$, $\beta_{\text{barriers} \rightarrow \text{sitting habit} \rightarrow \text{breaks}} = -.00$, $\beta_{\text{barriers} \rightarrow \text{sitting habit} \rightarrow \text{sitting breaks}} = -.00$; Fit indices: GFI = .99; NFI = .93; CFI = .97; RMS = .05. *$p < .05$; **$p < .01$.

Figure 6.2 displays the path analysis between the automatic and controlled predictors with workplace sitting-breaks. Figure 6.2 shows a significant positive relationship between sitting-breaks habit and sitting-breaks and significant indirect paths from barriers and self-efficacy, via sitting-breaks habit, to sitting-breaks. The standardised beta weight for barriers ($\beta = -.06$, $p < .05$) indicates that for every standard unit increase in barriers, sitting-breaks decreased by .06 units by way of decreased...
sitting-break habit. This indirect path, was also accompanied by a direct inverse path from barriers to sitting-breaks ($\beta = -.14, p < .05$). These results indicate that the perceived ecological barriers to sitting-breaks is both directly and indirectly, by way of decreasing the habitualness of sitting-breaks habit, associated with fewer sitting-breaks.

The standardised beta weight for the path from self-efficacy ($\beta = .07, p < .05$), indicates that for every standard unit increase in self-efficacy, sitting-breaks increased by .07 units by way of increased breaks habit. This indirect path was not accompanied by a significant direct path from self-efficacy to sitting-breaks ($\beta = .10, \text{n.s}$). These results indicate that self-efficacy is only indirectly associated with increased sitting-breaks, by way of increasing the habitualness of sitting-breaks.

Together, these results suggest that the controlled intrapersonal variables may relate to increased sitting-breaks, via influencing the habitualness of sitting-breaks. The model overall accounted for significant variance in sitting-breaks ($R^2 = .15, p < .05$), and on inspection of fit indices, confirmed that the final version of the model, in which only the significant paths were retained, met relevant fit criteria: GFI = .99 (i.e., >.90, Byrne, 1994); NFI=.97 (i.e., >.95; Schumacker & Lomax, 2004); CFI=.98 (i.e., >.93; Byrne, 1994); with the exception of RMS=.07, although it is still within acceptable limits (i.e., <.05; Stieger, 1990).
These results suggest that the controlled intrapersonal variables may relate to increased sitting-breaks and decreased workplace sitting, via influencing the habitualness of sitting-breaks.

6.4.2 Moderation effect of sitting-habit on controlled intrapersonal correlates

Results from the moderation analysis revealed that workplace sitting habit did not significantly moderate the effects of self-efficacy for taking sitting-breaks on the frequency of sitting breaks ($R^2_{change} = 0.00, F[1,217]=.12, p=.73$). There was a significant moderation effect of workplace sitting habit on the relationship between barriers to taking sitting-breaks and frequency of sitting-breaks ($R^2_{change} = 0.02, F[1,218]=5.52, p=.02$). This moderation effect is displayed in Figure 6.3 and indicates...
that workplace sitting habitualness is particularly challenging for employees who habitually sit and perceive more barriers towards taking sitting-breaks. Whereas, barriers are less of an issue for those who reported a low workplace sitting habit.

Figure 6.3 Moderation effect between sitting habit and barriers to sitting-breaks on frequency of sitting-breaks

Note: ‘Low’ reflects the variables minimum and ‘high’ reflects the variables maximum, after centering.

6.5 Discussion

In this chapter the interaction and influence of automatic and controlled cognitive processes with frequency of sitting-breaks per working hour was examined. Interactions between automatic and controlled intrapersonal processes were found and related to differences in frequency of sitting-breaks. Increased self-efficacy and
decreased barriers towards sitting-breaks was related to an increased habitualness of sitting-breaks, which in turn related to increased sitting-breaks.

6.5.1 Interaction between automatic and controlled intrapersonal correlates

To the candidate’s knowledge, past research has not examined the relationship between habit, barriers, and self-efficacy towards behaviour engagement. However, the results may be interpreted with reference to theoretical understanding of habitual behaviour and preliminary past research (Conroy et al., 2013; Evan, 2003; Triandis, 1977; Warner and Biddle, 2011).

The modern workplace favours and promotes sitting, thus it is not unsurprising that workplace sitting is highly habitual (as described in Chapter Five) and controlled cognitive processes have been found to be not relevant to workplace sitting (Clark et al., 2009; Custers & Aarts, 2010; Fitzsimons & Bargh, 2003; Gabriel et al., 2012). This is consistent with Trinadis (1997) proposition that when the environment is familiar and unvarying, behaviour will be guided by habit and cognitive processes will have little or no impact. This indicates that workplace sitting largely occurs automatically, in response to the physical and social context of the modern workplace (Custers & Aarts, 2010; Orbell & Verplanken, 2010). However, with regard to past research, Warner and Biddle (2011) found that among working adults, controlled cognitive processes (e.g., attitude, subjective norm, and perceived behavioural control; theory of planned behaviour) in addition to sedentary habit, predicted variance in occupational sedentary time. Furthermore, Conroy et al., (2013) found that intentions (controlled cognitive process) to limit daily sedentary behaviour significantly related to variations in daily sedentary behaviour. Specifically, stronger than usual intention to limit sedentary behaviour was associated with reduced sedentary behaviour. While Warner and Biddle (2011) did not find intention significantly related to occupational sedentary behaviour, this preliminary past research indicates that controlled cognitive processes
may be relevant to occupational sedentary behaviour. However, the authors of the studies did not report the strength of sedentary habit, thus it is unknown if the role of cognitive processes was more relevant, as the habit strengths of the sedentary time under examination was lower than observed in the current study (Chapter Five; Trinidis, 1977). The disparity between results of the current study with preliminary past research, specifically in relation to the influence of controlled cognitive process on sedentary behaviour/occupational sedentary behaviour could in part reflect limitations within the current study measures of controlled cognitive processes relevant to workplace sitting (Conroy et al., 2013; Warner and Biddle, 2011). In the present study, the controlled cognitive processes examined more closely pertained to taking sitting-breaks rather than reducing workplace sitting (i.e., barriers and self-efficacy towards taking sitting-breaks). Thus, it is possible that the measures may not be a accurate representation of controlled processes relevant to workplace sitting, consequently underestimating the influence of controlled cognitive processes with workplace sitting. However, considering the habitualness of workplace sitting, habit is likely to play a large role and if controlled cognitive processes do in fact have an influence, this is likely to be marginal, particularly in contexts where the social and physical environment is stable and favours sitting, such as within the modern workplace (Orbell & Verplanken, 2010; Triandis, 1977). This is consistent with theoretical reasoning, specifically, that in familiar and unvarying settings, behaviour will be guided by habit, and cognitive processes will have little or no impact (Evans, 2003; Triandis, 1977).

In regard to workplace sitting-breaks, the physical environment of the workplace is not conducive to frequently breaking-up workplace sitting. Consequently, behaviour enactment cannot simply occur in response to environmental cues. Controlled cognitive processes are required to determine behaviour. The results of the path analysis in Figure 6.3 are consistent with this theoretical reasoning. Specifically,
that controlled cognitive factors both influenced and interacted with behaviour habit to determining sitting-breaks (Evans, 2003; Triandis, 1977).

Furthermore, considering workplace sitting-breaks were found to be only slightly habitual, results from the current analysis indicate that in the early stages of habit formation, such as for behaviour initiation, controlled cognitive factors are likely to play role. Specifically, reducing barriers to taking sitting-breaks is likely to both increase the habitualness of sitting-breaks and in turn increase sitting-breaks, and directly increase workplace sitting-breaks. No past research could be located that has taken a dual-process approach to examining reducing and breaking-up workplace sitting. Although Conroy et al. (2013) did examine intentions to reduce daily sedentary behaviour, the study did not examine the potential interactions between automatic (i.e., sedentary habit) and controlled (i.e., intentions to reduced sedentary time) process with behaviour, focused only on the influence of these processes directly with total sedentary behaviour.

The relationship between reducing barriers and increased sitting-breaks is consistent with both the bivariate results observed in Chapter Five and past research findings (Bennie et al., 2011). Specifically, Bennie et al. (2011) found greater perceived barriers to short physical activity breaks were associated with fewer short physical activity breaks at work. Furthermore, in the physical activity context, research has repeatedly documented an inverse relationship between perceived barriers to physical activity and physical activity level (Trost et al., 2002). These results indicate that addressing barriers may directly and indirectly influence workplace sitting-breaks. This is particularly important considering the unique influence workplace sitting-breaks habit was found to have on sitting-breaks in the final multivariate model, described in Chapter Five.

In regard to self-efficacy, interestingly, there was no direct relationship with
sitting-breaks, only an indirect relationship via way of increasing the habitualness of sitting-breaks. The lack of a direct relationship between self-efficacy and sitting-breaks is in contrast to theoretical understanding and past research in the physical activity literature (Bandura, 1997; Bauman et al., 2002; Rosenstocks, 1974; Tierney et al., 2011; Trost et al., 2002). However, in the physical activity literature, self-efficacy beliefs have been proposed to be more important for physical activity behaviours that require more effort, such as with structured exercise programs or exercising when obese or significantly unfit (Biddle, 2012; Biddle, 2009; Trost et al., 2002). With consideration of the ease and unintentional manner of sitting-breaks, self-efficacy beliefs towards taking sitting-breaks may not be as relevant. However, the indirect relationship via way of increasing the habitualness of sitting-breaks suggests that while self-efficacy may not directly influence sitting-breaks, such beliefs may be relevant in the early stages of habit formation. The limited influence of self-efficacy beliefs is logical when considering taking sitting-breaks was only slightly habitual (Chapter Five), and that the physical environment of the modern workplace is not yet conducive to taking sitting-breaks, which is a predominant focus of workplace sedentary interventions (Chau et al., 2010; Verplanken & Wood, 2006). Furthermore, with consideration of the results described in Chapter Five, where employees were found to commonly take sitting-breaks in relation to natural and commonly occurring workplace behaviours (i.e., getting a drink; Table 5.3), it is possible that self-efficacy may also exert more of a direct influence on sitting-breaks when these are unfamiliar and require effort, such as with the introduction of workplace LPA strategies (Biddle, 2011; Biddle & Fuchs, 2009; Triandis, 1977; Trost et al., 2002). Overall, analyses indicate that reducing barriers and increasing self-efficacy towards taking sitting-breaks, may pave the way for the formation of healthy workplace LPA habits and ultimately increase workplace LPA.
6.5.2 Moderation effect of sitting-habit on controlled intrapersonal correlates

Interestingly, the habitualness of workplace sitting was found to moderate the effects of barriers to taking sitting-breaks on frequency of sitting-breaks. To the candidates knowledge, past research has not examined the influence of one behaviours habitualness (i.e., sitting) on the target behaviour (i.e., increasing sitting-breaks). The present results indicated that high sitting habit appeared to be particularly problematic towards taking sitting-breaks (i.e., fewer sitting-breaks) when combined with high barriers to sitting-breaks. Considering the high habitualness of workplace sitting and that habitual behavior entails a high level of automacity when engaging in behaviour, there is likely to be a reduced ability to address controlled cognitive process, such as perceived barriers to workplace sitting-breaks (Evans, 2003; Triandis, 1977). This is important considering results indicated barriers towards taking sitting-breaks can both directly and indirectly influence the frequency of sitting-breaks. Furthermore, the results described in Chapter Five indicated that the habitualness of sitting-breaks is also an important unique predictor of sitting-breaks. Results from the moderation analysis indicated that without first disrupting the environmental-cues that underpin the habitualness of workplace sitting, particularly among those who habitually sit at work, addressing barriers towards sitting-breaks may be difficult and have a limited effect on increasing sitting-breaks (Verplanken & Wood, 2006). This result support the application of the social ecological model, specifically examining the combined and interacting nature of various level factors upon workplace sitting and LPA (Owen et al., 2010).

6.5.3 Research strengths and limitations

A number of limitations, in addition to those discussed in Chapter Five warrant attention. The cross-sectional study modeled habit as a predictor of past behaviour.
However, this is limited when considering the temporal sequence between behaviour and habit, and that in the early stages of habit formation, repeated action will likely increase habit strength (Lally, van Jaarsveld, Potts, & Wardle 2010; Verplanken, Aarts, & Knippenberg, 1997). Furthermore, the validity of the SRHI scale in modeling the habit-behaviour relationship has been previously questioned. Some of the SRHI items relate to behaviour frequency and may inflate the habit-behaviour relationship. Research removing these items has found the habit-behaviour relationships reduces, and it has been recommended that future studies should consider removing these items for a more valid estimate of the cue-response association with behaviour (Webb & Sheeran, 2006).

Another limitation relating to habit relates to the validity of a self-report measure in capturing automatic cognitive processes (Webb & Sheeran, 2006). Furthermore, the current study only included a few controlled and automatic cognitive processes to evaluate the propositions of dual-process theory (Conroy et al., 2013; Evans, 2003). These may not generalise to all automatic and controlled motivation processes, and may further differ depending on if behaviour change or maintenance is of focus. As previously discussed, limitations pertaining to the controlled cognitive factors used to examine workplace sitting, may have lead underestimations of the potential influence controlled cognitive factors on workplace sitting (Conroy et al., 2013; Warner and Biddle, 2011). Furthermore, the inclusion of habit in attempt to further understand behaviour has been criticised as being atheoretical. Further research may benefit from the guidance of theories that postulate on the relationship between automatic and controlled processes in determining health behaviour. For example, one such theory that makes such propositions is temporal self-regulatory theory (Conroy et al., 2013; Hall & Fong, 2007; Rothman, Sheeran, Wood, 2009).

The present study filled a gap in the current body of research by including the
use of the dual-process approach to justify the inclusion of both controlled and automatic cognitive processes to further understand workplace sitting and sitting-breaks. Furthermore, the analysis conducted in this chapter not only examined the influence of these processes on behaviour, but also the nature of the interactions between controlled and automatic processes and actual behaviour (Evan, 2003; Conroy et al., 2013; Triandis, 1977).

6.6 Chapter summary

Overall, the findings from this chapter highlight the importance of taking a dual process approach, specifically, one that considers the influence and interaction between controlled and automatic correlates of workplace sitting and sitting-breaks (Evan, 2003; Conroy et al., 2013; Triandis, 1977). The results indicated that in terms of creating healthy workplace habits, specifically, increased workplace sitting-breaks, increasing self-efficacy and addressing barriers to taking sitting-breaks was important. Furthermore, while these change were important, the results indicate a need to address the habitualness of workplace sitting, as this may potentially undermine the promotion of frequent workplace sitting-breaks. Particularly when sitting habits are combined with controlled psychological process not conducive to promoting LPA change, such as perceiving high barriers towards taking sitting-breaks (Evan, 2003; Conroy et al., 2013; Triandis, 1977; Verplanken & Wood, 2006).

In the next chapter, a particular focus on further examining workplace sitting and sitting-breaks on an interpersonal level will be given (Sallis et al., 2006). Specifically, the analysis described in the next chapter will focus on understanding the beliefs of managers’ of desk-based employees concerning employees’ barriers and self-efficacy towards taking sitting-breaks, and compare to employees’ own self-ratings, as detailed in Chapter Five. This focus is taken in recognition of the relevance of these
controlled cognitive process towards employees ability to take sitting-breaks, the
importance employees placed on having managerial support for sitting-breaks, and the
integral role managers have in the promotion and enforcement of workplace health
promotion (Commission to Build a Healthier America, 2008; Gilson et al., 2011, 2012a;
Health and Productivity Institute Australia [HPIA], 2007; Linnan et al., 2013). It is
hoped that such a focus may lead to a greater understanding of the variables that may
influence workplace sitting and sitting-breaks, particularly on an interpersonal level
(Bandura, 1997; Plotnikoff & Karunamuni, 2012).
CHAPTER SEVEN

MANAGERS’ WORKPLACE BEHAVIOURS AND THEIR PERCEPTIONS REGARDING EMPLOYEES’ BARRIERS AND SELF-EFFICACY TOWARDS SITTING-BREAKS

7.1 Introduction

Managers play an integral role in influencing the workplace environment and are key to the implementation and success of workplace health promotion (Gilson, 2011, 2012a; HPIA, 2007; Linnan et al., 2013). Therefore, understanding managers’ workplace behaviours and beliefs concerning employees’ ability to take sitting-breaks is deemed important (Gilson et al., 2012a; Linnan et al., 2013; Marcus et al., 2006). It has been argued that managers play an important role in addressing barriers to workplace sitting-breaks, acting as role models, and propagating health-related knowledge regarding workplace sitting (Gilson et al., 2011, 2012a). The importance of perceived managerial and OH&S level support for employees’ workplace sitting-breaks with time spent sitting in the workplace and frequency of sitting-breaks per work hour was examined in Chapter Five. Although not significantly related to these behaviours, the employees rated management and OH&S support for taking sitting-breaks as two of three most important factors for taking sitting-breaks. It was concluded in Chapter Five that further research was needed to better understand the influence of interpersonal factors, specifically from the perspective of managers who have the ability to influence, either directly or indirectly, the workplace environment of co-workers.

Past research has highlighted the need to compare employees’ and managers’ workplace behaviours (Clark et al., 2011; Miller & Brown, 2004). However, few
studies have examined managers’ beliefs concerning employees’ ability to take sitting-breaks. This chapter will compare managers’ beliefs concerning employees’ barriers and self-efficacy towards taking sitting-breaks, to that of the employees’ own perceived barriers and self-efficacy for sitting-breaks. To the candidate’s knowledge, previous research has not considered the presence and implications of disparities between employees’ and managers’ beliefs in relation to taking sitting-breaks.

7.2 Aims

The overall aims of the chapter were to examine managers’ workplace sitting behaviours and their beliefs concerning employees’ ability to take sitting-breaks. Specifically, the following aims were addressed:

1. Describe the prevalence of managers’ workplace sitting and sitting-breaks, and the type of workplace behaviours managers engage in to break-up workplace sitting, and examine the relationship between these behaviours and workplace sitting and sitting-breaks.

2. Compare managers’ workplace sitting, sitting-breaks, and break-taking behaviours to those of the desk-based employees, described in Chapter Five.

3. Compare managers’ ratings of employees’ barriers and self-efficacy towards sitting-breaks to those of the employees’ self-ratings, as described in Chapter Five.

7.3 Methods

A detailed description of the procedures and methods used in this study were provided in Chapter Four (Sections 4.1 and 4.2). Briefly, a total of 122 desk-based managers were recruited via an online database of businesses in metropolitan Melbourne, and completed the online questionnaire. In the workplace sedentary study, a manager was defined as a desk-based worker who manages other people, and has either a direct or
Chapter Seven: Managers’ workplace behaviours and beliefs

indirect influence over the workplace environment of co-workers. The survey items were developed to reflect the various levels of influence based on an ecological framework. A detailed description of how the data were managed and cleaned is provided in Chapter Four, section 4.3.

7.3.1 Analysis of managers’ workplace behaviours and beliefs

Percentages were calculated to describe the socio-demographic profile of the desk-based managers. Means and standard deviations were calculated to quantify their usual workplace sitting time and sitting-breaks, and the extent to which the managers engaged in various break-taking behaviours. Pearson’s correlations were conducted to examine the relationship between break-taking behaviours and workplace sitting and sitting-breaks. To examine whether workplace sitting and sitting-breaks differed between the employees and managers, two independent t-tests were conducted.

To examine if managers and employees significantly differed in the mean ratings of the various barrier and self-efficacy items for employees’ sitting-breaks, two MANOVAs were conducted, one for the barriers and one for the self-efficacy items. These were conducted by way of respondent differences (i.e., manager and employee; independent variable) on each of the items (dependent variables). Wilks’ Lambda was used to interpret the multivariate effects. For interpretive purposes, item means and standard deviations, and the between-subject effects are presented in Tables 7.2 and 7.3. Differences in the extents to which the various barriers were endorsed as important by the managers for taking sitting-breaks were further examined (refer to Appendix L).

7.4 Results

The manager sample included 47 men with a mean age 38 years ($SD = 11.38$ years; range 23 to 62 years) and 71 women, mean age 40 years ($SD = 12.85$ years; range 23 to
Chapter Seven: Managers’ workplace behaviours and beliefs

70 years). Further socio-demographic characteristics of the managers are presented in Table 7.1. The majority of the managers had a university education, were earning over $1,500 per/week, were within the healthy BMI range (≤25 kg/m²; WHO, 2000), and meeting the MVPA guidelines (≥150 minutes per week; DoHA, 2014).

Table 7.1 Socio-demographic characteristics of the desk-based managers

<table>
<thead>
<tr>
<th>Socio-demographic characteristics</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n= 118)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>60</td>
</tr>
<tr>
<td>Males</td>
<td>40</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
</tr>
<tr>
<td>18-39 years</td>
<td>61</td>
</tr>
<tr>
<td>40-54 years</td>
<td>20</td>
</tr>
<tr>
<td>55+ years</td>
<td>19</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>&lt;12 years</td>
<td>7</td>
</tr>
<tr>
<td>12 years</td>
<td>4</td>
</tr>
<tr>
<td>University</td>
<td>79</td>
</tr>
<tr>
<td>Income</td>
<td></td>
</tr>
<tr>
<td>&lt;$999 p/week</td>
<td>14</td>
</tr>
<tr>
<td>$1,000-1,499 p/week</td>
<td>23</td>
</tr>
<tr>
<td>&gt;$1,500 p/week</td>
<td>55</td>
</tr>
<tr>
<td>BMI14</td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>51</td>
</tr>
<tr>
<td>Overweight/obese</td>
<td>48</td>
</tr>
<tr>
<td>Meet MVPA guidelines15</td>
<td></td>
</tr>
<tr>
<td>Insufficiently active</td>
<td>20</td>
</tr>
<tr>
<td>Sufficiently active</td>
<td>81</td>
</tr>
</tbody>
</table>

14 Healthy (<25kg/m²); overweight/obese (≤25 kg/m²; WHO, 2000).
15 Insufficiently active (< 150 mins/week); sufficiently active (≥150 mins/wk; DoHA, 2014).
Chapter Seven: Managers’ workplace behaviours and beliefs

7.4.1 Quantifying managers’ workplace sitting and sitting-breaks

The following section reports on the time spent in workplace sitting, the frequency of sitting-breaks, and the types of behaviours engaged in to break-up workplace sitting among the desk-based managers. Table 7.2 displays the managers’ average work sitting time and frequency of sitting-breaks. The managers reported sitting at work during a weekday for less than seven hours and taking around one-and-a-half breaks from sitting per working hour.

Table 7.2 Quantifying workplace sitting and sitting-breaks

<table>
<thead>
<tr>
<th>Workplace behaviour</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workplace sitting</td>
<td>6.77 (1.28)</td>
</tr>
<tr>
<td>Workplace sitting-breaks</td>
<td>1.64 (1.16)</td>
</tr>
</tbody>
</table>

Table 7.3 shows the modes of sitting-breaks that are commonly occurring workplace activities, such as getting a drink/food, using a printer scanner etc. Using a standing workstation, standing while using a telephone, talking to a co-worker, and moving/standing work tasks were weakly negatively correlated with workplace sitting time. Apart from visiting the bathroom, all of the sitting-break behaviours were positively correlated with the frequency of sitting-break per working hour.
Chapter Seven: Managers’ workplace behaviours and beliefs

Table 7.3 Mean frequency\(^a\) of managers’ engagement in break-taking behaviours and associations\(^b\) with sitting time (hours per day) and sitting-breaks (frequency of work breaks per hour)

<table>
<thead>
<tr>
<th>Sitting-breaks behaviours</th>
<th>Mean (SD)</th>
<th>Sitting time</th>
<th>Sitting-breaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drink/eat</td>
<td>3.63 (0.74)</td>
<td>-.07</td>
<td>.24**</td>
</tr>
<tr>
<td>Printer/scanner</td>
<td>3.53 (0.85)</td>
<td>-.04</td>
<td>.23**</td>
</tr>
<tr>
<td>Standing/moving during structured work breaks</td>
<td>3.40 (0.99)</td>
<td>-.06</td>
<td>.14**</td>
</tr>
<tr>
<td>Bathroom</td>
<td>3.40 (0.74)</td>
<td>-.07</td>
<td>.05</td>
</tr>
<tr>
<td>Talking to co-worker</td>
<td>3.27 (0.77)</td>
<td>-.13*</td>
<td>.20**</td>
</tr>
<tr>
<td>Work tasks while moving/standing (i.e., walking meeting)</td>
<td>2.60 (1.09)</td>
<td>-.19**</td>
<td>.21**</td>
</tr>
<tr>
<td>Standing workstation</td>
<td>2.26 (0.98)</td>
<td>-.19**</td>
<td>.20**</td>
</tr>
<tr>
<td>Stand while using telephone</td>
<td>2.05 (1.02)</td>
<td>-.22**</td>
<td>.17**</td>
</tr>
</tbody>
</table>

\(^a\)Frequency of engagement based on a five-point Likert scale ranging from never (1) to always (5); \(^b\)Pearson’s correlations; *Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

7.4.2 Comparing managers’ and employees’ workplace behaviours

In the following section, managers’ workplace sitting, sitting-breaks, and break-taking behaviour to that of the employees described in Chapter Five. Independent \(t\)-tests revealed that there were no significant differences in workplace sitting \((t[203.90] = -1.15, p=.25)\), or sitting-breaks, \((t[338] = .18, p=.86)\) between managers and employees. A MANOVA also revealed a non-significant difference in break-taking behaviours \((F[8, 225] = .36, p=.94, \eta_p^2 = .03)\) between employees and managers.

7.4.3 Managers’ beliefs regarding employees’ sitting-breaks

The following section compared managers’ ratings of employees’ barriers and self-efficacy towards taking sitting-breaks were compared to that of the employees (as described in Chapter Five). A MANOVA revealed a significant difference between
ratings of the various barriers items between the employees and managers (Wilks’ $\lambda = .76, F[11, 291] = 8.57, p=.000, \eta_p^2 = .25$). Table 7.4 indicates that the managers rated a number of items significantly higher than the employees. Specifically, having management support, workplace information, work stress, sitting-breaks being a low priority, low motivation, and low energy were scored higher by managers than employees. The managers’ ratings of perceived barriers for employees’ ability to take sitting-breaks were examined (results reported in Appendix L). These findings indicated that, as for the employees, managers’ perceived colleagues taking breaks, and management and OH&S support for sitting-breaks, as some of the most important factors for employees’ sitting-breaks.

Table 7.4 Comparison between employees’ self-rated barriers and managers’ perceived barriers for employees’ sitting-breaks

<table>
<thead>
<tr>
<th>Barriers to sitting-breaks</th>
<th>Employees Mean (SD)</th>
<th>Managers Mean (SD)</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colleagues taking breaks</td>
<td>0.97 (0.89)</td>
<td>1.02 (0.66)</td>
<td>.880</td>
</tr>
<tr>
<td>Management support</td>
<td>0.93 (0.84)</td>
<td>1.27 (0.78)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>OH&amp;S support</td>
<td>0.91 (0.90)</td>
<td>0.88 (0.86)</td>
<td>.668</td>
</tr>
<tr>
<td>Workplace information</td>
<td>0.65 (0.92)</td>
<td>1.09 (0.66)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Work stress</td>
<td>0.56 (1.08)</td>
<td>0.81 (1.09)</td>
<td>.025</td>
</tr>
<tr>
<td>Limited free time</td>
<td>0.02 (1.20)</td>
<td>-0.13 (1.28)</td>
<td>.666</td>
</tr>
<tr>
<td>Work demands</td>
<td>-0.15 (1.09)</td>
<td>0.06 (1.24)</td>
<td>.050</td>
</tr>
<tr>
<td>Low priority</td>
<td>-0.37 (1.11)</td>
<td>0.23 (0.86)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Limited physical opportunities</td>
<td>-0.60 (1.10)</td>
<td>-0.43 (1.16)</td>
<td>.287</td>
</tr>
<tr>
<td>Low motivation</td>
<td>-0.79 (0.93)</td>
<td>-0.19 (0.89)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Low energy</td>
<td>-1.17 (0.79)</td>
<td>-0.89 (0.87)</td>
<td>.004</td>
</tr>
</tbody>
</table>

*Note: bolded numbers indicate statistical significance; a Barrier items means range from -3 to 3, with a mean less than zero reflecting ‘disagreement’ and a mean above zero reflecting 'agreement' that the item is important for sitting-breaks.

MANOVA results also revealed significant differences in self-efficacy item ratings between the employees and managers (Wilks’ $\lambda = .91, F[11, 308] = 2.79, p<.00,$
Chapter Seven: Managers’ workplace behaviours and beliefs

$\eta_p^2 = .09)$. Table 7.5 displays the item means for both the employees and managers, and the corresponding $p$-values for the MANOVA between-subject effects. Managers rated employees’ self-efficacy towards sitting-breaks as significantly lower than what the employees rated for themselves. Specifically, managers reported significantly lower levels of self-efficacy in relation to taking sitting-breaks when mentally tired, not having the energy, not feeling motivated, and sitting-breaks being a low priority.

Table 7.5 Comparisons between employees’ self-rated self-efficacy and managers’ perceived self-efficacy for employees’ sitting-breaks

<table>
<thead>
<tr>
<th>Confident can take a break even when…</th>
<th>Employee Mean (SD)</th>
<th>Manager Mean (SD)</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mentally tired</td>
<td>3.47 (0.97)</td>
<td>3.14 (1.03)</td>
<td>.006</td>
</tr>
<tr>
<td>Stressed</td>
<td>3.08 (1.12)</td>
<td>2.96 (1.12)</td>
<td>.438</td>
</tr>
<tr>
<td>Work colleagues were not taking breaks</td>
<td>3.06 (1.10)</td>
<td>2.92 (1.06)</td>
<td>.235</td>
</tr>
<tr>
<td>No support from management</td>
<td>2.99 (1.19)</td>
<td>2.85 (1.09)</td>
<td>.259</td>
</tr>
<tr>
<td>OH&amp;S did not recommend it</td>
<td>2.95 (1.19)</td>
<td>2.81 (1.11)</td>
<td>.178</td>
</tr>
<tr>
<td>Limited physical space</td>
<td>2.77 (1.04)</td>
<td>2.64 (1.03)</td>
<td>.166</td>
</tr>
<tr>
<td>Not have the energy</td>
<td>2.73 (1.04)</td>
<td>2.46 (1.05)</td>
<td>.011</td>
</tr>
<tr>
<td>Not motivated</td>
<td>2.68 (1.13)</td>
<td>2.36 (1.09)</td>
<td>.012</td>
</tr>
<tr>
<td>Low priority</td>
<td>2.59 (1.09)</td>
<td>2.22 (1.15)</td>
<td>.006</td>
</tr>
<tr>
<td>High work demands</td>
<td>2.35 (1.07)</td>
<td>2.46 (1.16)</td>
<td>.522</td>
</tr>
<tr>
<td>Limited free time</td>
<td>2.35 (1.13)</td>
<td>2.44 (1.11)</td>
<td>.545</td>
</tr>
</tbody>
</table>

Note: bolded numbers indicate statistical significance; a higher self-efficacy mean reflects a higher level of confidence to take sitting-breaks.

7.5 Discussion

This chapter described desk-based managers’ self-reported workplace sitting time, their frequency of sitting-breaks per working hour, their participation in specific-break behaviours, and their beliefs concerning desk-based employees’ ability to take sitting-breaks. The chapter also compared managers’ workplace behaviours and beliefs concerning employees’ ability to take sitting-breaks, to those of desk-based employees.
Chapter Seven: Managers’ workplace behaviours and beliefs

Results indicated that managers’ workplace sitting, sitting-breaks, and break-taking behaviours were similar to those of the employees. While previous research has reported differences in workplace sitting between office-based workers and workers in different occupations, such as those employed in blue-collar versus customer service roles (Clark et al., 2011; Miller & Brown, 2004), the observed similarities between the employees and managers in desk-based occupations suggests that variations in workplace sitting and sitting-breaks may be influenced by occupational roles rather than by level of management. This result is also consistent with the non-discretionary nature of workplace sitting; that is, the workplace constrains sitting for employees and management alike (Clark et al., 2009; Gabriel et al., 2012).

7.5.1 Managers’ beliefs concerning employees’ sitting-breaks

In the absence of previous research examining employees’ and managers’ beliefs concerning employees’ ability to take sitting-breaks, explanations behind the observed results are speculative. The discrepancies between managers’ and employees’ beliefs concerning employees’ sitting-breaks are of interest. Consistent with past research, employees and managers perceived having management and OH&S support as important for sitting-breaks (Gilson et al., 2011, 2012a). Interestingly, managers were more likely than employees to report management support as important for taking sitting-breaks. Furthermore, managers perceived a number of factors (e.g., workplace information, work stress, and low priority, motivation, and energy for taking sitting-breaks) to be more important for employees’ sitting-breaks, than what the employees perceived for taking their own sitting-breaks.

The higher ratings among the managers indicates they perceive these factors as more important, and therefore potentially greater barriers towards sitting-breaks. This is of concern as barriers and self-efficacy were found in the previous analyses to be
important for employees’ sitting-breaks and the development of LPA workplace habits (Chapters Five and Six). Furthermore, managers play a key role in promoting and addressing barriers to workplace change, and managerial level support has been suggested as important for workplace sedentary change (Gilson, 2011, 2012a; HPIA, 2007; Linnan et al., 2013). In recognition of managers’ role in promoting and addressing barriers to workplace change, it is plausible that their less positive beliefs regarding employees’ sitting-breaks, may negatively influence workplace sedentary change. Specifically, managers may perceive workplace sedentary reductions as unfeasible, which may relate to a reduced ability or desire to address barriers for employees to take sitting-breaks. Furthermore, they may also be more reluctant to reduce and break-up their own workplace sedentary behaviour, which in addition to the risks associated to their own health, could potentially and adversely influence employees’ ability to reduce and break-up sitting through a role modeling effect (Bandura 1997; Trost et al., 2002).

Clearly from a mismatch perspective it is important that managers understand the challenges for desk-based employees in reducing their sitting time at work. Of course, the employees and managers in the present study were not necessarily from the same organisations, so these contrasts may simply reflect organisational differences. Nevertheless, an important potential strategy for consideration in the development of future workplace initiatives is that management fully understands the perceived challenges for employees in taking sitting-breaks, and their role in encouraging and promoting workplace change (HPIA, 2007; Linnan et al., 2013). It is also important to determine whether this is even a priority for managers, as previous research has shown this is a priority for managers (Gilson et al., 2011b; Gilson et al., 2012).
7.5.2 Research limitations and strengths

A number of limitations, in addition to those discussed previously, warrant attention. The study did not examine managers’ own barriers and self-efficacy towards taking sitting-breaks, nor the relationship between such beliefs and their workplace sitting and sitting-breaks. Thus, it is unknown if managers simply perceive more barriers and lower levels of self-efficacy towards taking sitting-breaks in general, or just in relation to their employees. Further, as previously mentioned, it is unknown if the mismatch between employees’ and managers’ beliefs reflects actual differences within a workplace, or organisational differences. It is also unknown what effect the managers’ beliefs may have on employees’ workplace behaviour, or in regard to their own ability to take sitting-breaks (Bandura, 1997).

Research strengths include collecting data from the manager’s perspective, and comparing this to the desk-based employees own beliefs. This is a unique research strength, as managers are not only responsible for resourcing and implementing workplace change, they are also important role models for workplace behaviour (Gilson et al., 2011, 2012a; HPIA, 2007; Linnan et al., 2013). In addition, as the present research has identified, as identified management and OH&S support were rated by management as highly important for sitting-breaks. This supports the usefulness of the social ecological model, specifically the interpersonal, policy and organisational levels if influence, which were a focus in this chapter (Owen et al., 2010; Sallis et al., 2006).

7.6 Chapter summary

This chapter presents results that indicated that both desk-based managers and employees spent most of their work time sitting, take few sitting-breaks, and engaged in fairly typical workplace behaviours to break-up their sitting time at work. This research also found contrasts in managers’ beliefs regarding factors associated with
employees’ sitting-breaks when compared to employees’ own beliefs. Further research on understanding these contrasts and whether this is something that needs to be addressed in the development of workplace interventions to reduce sitting time and increase the frequency of sitting-breaks is warranted (Gilson et al., 2011; 2012a).

The next chapter will specifically focus on understanding the perceived effects of reducing workplace sitting and increasing LPA on health, and compare and contrast this between the employees and managers.
CHAPTER EIGHT

THE PERCEIVED CONSEQUENCES OF REDUCING SITTING AND INCREASING PHYSICAL ACTIVITY AMONG EMPLOYEES AND MANAGERS

8.1 Introduction

Addressing extensive time spent sitting in the workplace is a recent health promotion endeavour, particularly from a chronic disease prevention perspective (Healy et al., 2012; Thorp et al., 2011). Therefore, it is important to understand what is currently known about potential health effects of workplace sitting among employees and managers, and how strategies to reduce sitting and increase LPA may be best conveyed (Gilson et al., 2012a). Qualitative research among OH&S personnel, desk-based employees, and middle managers, has predominately associated workplace sitting with musculoskeletal complaints (Gilson et al., 2011, 2012a). While, OH&S personnel appeared to have some understanding of the independent associations of accumulated sitting and chronic health outcomes, awareness of such implications was non-existent among the employees and middle managers in that sample (Gilson et al., 2012a). A study in a Swedish call centre found that awareness of the ergonomic effects of accumulated sitting (i.e., musculoskeletal complaints) was high among employees and middle managers, however, awareness of the chronic health effects of accumulated sitting was non-existent (Straker et al., 2013). Given the importance of informing desk-based workers and managers of the chronic health effects of accumulated sitting, and the benefits of increasing PA, even light in intensity, further research is needed to
determine perceptions among those working in primarily sedentary desk-based environments (Gilson et al., 2011, 2012a; Hamilton et al., 2008; Straker et al., 2013).

Further research is also needed to better understand the perceived importance of reducing workplace sitting and increasing the various intensities of physical activity in the context of overall lifestyles (i.e., within the context of what one does during work and leisure-time over a typical day). For example, one question is whether employees and managers who engage in high amounts of physical activity outside of work hours also perceive it as important to reduce their workplace sitting and increase their daily LPA? Or do they feel that if they are highly active during their leisure-time they do not need to be concerned about how much time they spend sitting at work? Such understanding is likely to offer valuable insights into the potential feasibility of strategies for reducing sitting and/or promoting LPA in the workplace.

8.2 Aims

The overall aim of the chapter is to examine the perceived effects of reducing workplace sitting and engaging in various physical activity intensities on health. This chapter has the following specific aims:

1. To qualitatively explore and contrast the perceived effects of reduced workplace sitting on health among desk-based employees and managers.
2. To examine and contrast the perceived health ratings of engagement in different combinations of sedentary time and various physical activity intensities between the employees and managers.
3. To examine and contrast the perceived health ratings of engagement in different combinations of sedentary time and various physical activity intensities across contexts (e.g., work, leisure) between the employees and managers.
Chapter 8: Perceptions of reducing workplace sitting and health ratings

8.3 Methods

A detailed description of the procedure and methods used in this study were provided in Chapter Four (Sections 4.1 and 4.2). Briefly, a total of 122 desk-based managers and 221 desk-based employees were recruited via an online database of businesses in metropolitan Melbourne, and completed the online questionnaire. The survey items were developed to reflect understanding of the perceived effects of reducing workplace sitting and health ratings of sedentary time and various physical activity intensities. A detailed description of how the data were managed and cleaned is described in Chapter Four, section 4.3.

8.3.1 Analysis of the perceived effects of workplace sitting and various physical activity intensities on health

8.3.1.1 Analysis of qualitative data

To explore the managers’ and employees’ perceived effects of reducing workplace sitting on health, a thematic analysis was conducted based on the responses to the open-ended question ‘What do you believe the consequences/benefits may be for both the employees and the workplace if sitting time could be reduced (if any)? a) Employee consequences (positive/negative)? b) Workplace consequences (positive/negative)? A thematic analysis was used to identify key emerging themes pertaining to the consequences (negative/positive) of reducing workplace sitting, on the individual worker’s health and the impact on the organisation as a whole. Themes were identified in relation to the research questions and past research (Gilson et al., 2011, 2012a), and represented a level of patterned response (Braun & Clarke, 2006). Where possible the themes were separated based on perceived positive/benefits and negative consequences of reduced workplace sitting, and any patterned response within the main themes were identified as sub-themes. Employees’ and managers’ data were analysed separately.
Data were organised and coded based on the method suggested by Braun and Clarke (2006). After reviewing the responses, a coding and theme identification process was developed. Quotes were selected to demonstrate themes and sub-themes (Braun & Clarke, 2006). For interpretive and comparative purposes (i.e., between the employees and managers), themes (in order of most to least commonly reported), sub-themes, and example quotes are presented in Tables 8.1 and 8.2.

8.3.1.2 Analysis of quantitative data
To examine whether ratings of the health effects of different combinations of sedentary time and physical activity intensities differed between the employees and managers, two Chi-square tests for independence were conducted. To examine the health ratings of sedentary time and different physical activity intensities in the leisure-time and occupational contexts, a 2 X 3 repeated measure ANOVA was conducted. Mauchly’s test indicated that the assumption of sphericity had been violated for the main effect of activity ($\chi^2 [2] = 43.49, p=.00$), and for the interaction between activity and context ($\chi^2 [2] = 30.57, p=.00$). Therefore degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity ($\epsilon = .89$ for the main effect of activity and $\epsilon = .92$ for the interaction of activity and context). For analysis purposes, the main and interaction effects were examined, and for interpretative purposes means and standard errors for these main effects were plotted and displayed for both the activity and health ratings in Figure 8.1.

To examine the impact of context-specific sedentary time and physical activity intensities on health ratings, a 4 x 3 repeated measures ANOVA was conducted. Mauchly’s test indicated that the assumption of sphericity had been violated for the main effect of work activity ($\chi^2 [5] = 70.00, p=.00$), leisure activity ($\chi^2 [2] = 26.17, p=.00$), and for the interaction between activity and context ($\chi^2 [20] = 84.33, p=.00$).
Chapter 8: Perceptions of reducing workplace sitting and health ratings

Therefore a Greenhouse-Geisser adjustment was used ($\varepsilon = .87$ for the main effect of occupational activity, $\varepsilon = .93$ for leisure-time activity, and $\varepsilon = .92$ for the interaction of activity and context).

For analysis purposes, the main and interaction effects were examined, and for interpretative purposes means and standard errors for these main effects were plotted and displayed for both the activity and health ratings in Figure 8.2.

To further examine the perceived ‘healthiness’ ratings of the various combinations of intensity, a conjoint analysis was conducted to quantify the relative importance of different activities accumulated in the leisure-time and occupational contexts. The conjoint analysis was performed with the employees’ data only. The occupational context was divided into four attributes: 1) sitting; 2) sitting with breaks; 3) standing; and 4) physically active at work. The leisure-time context was divided into three attributes: 1) sitting; 2) LPA; and 3) MVPA. Range scores were calculated (from unstandardised coefficients) to determine the relative influence of activity accumulated in the work versus leisure context.

8.4 Results

8.4.1 Perceived health effects of reducing workplace sitting among employees and managers

The following section reports example responses of the perceived effects of reducing workplace sitting on desk-based workers (Table 8.1) and on the overall workplace (Table 8.2) from the viewpoint of the employees and the managers. Themes and sub-themes are presented in order of most to least commonly occurring. For the perceived effects on desk-based workers, the most commonly cited benefits of reducing sitting in the workplace related to health benefits, specifically reduced musculoskeletal concerns. There appeared to be some awareness of the chronic health effects associated with
workplace sitting (e.g., life-expectancy, diabetes and CVD). Interestingly, this awareness appeared to be more commonly reported among the managers than employees. Improved psychosocial outcomes for the desk-based workers (e.g., mood and wellbeing, stress), also emerged as a theme among the employees and managers. The most commonly reported negative theme for the desk-based workers related to reduced work productivity (e.g., concentration and fatigue, time efficiency); although conversely, employees and managers also made reference to positive effects of reducing sitting in relation to work productivity (e.g., greater concentration levels, improved time efficiency, increased energy etc).
### Table 8.1 Effects of reducing workplace sitting on desk-based workers

<table>
<thead>
<tr>
<th>Theme</th>
<th>Example response</th>
<th>Example responses</th>
</tr>
</thead>
</table>
| **Health**  | **Benefit:**  
*Musculoskeletal effects:* “less physical injuries, back, neck, shoulder pain”  
*Fitness and energy levels:* “Health benefits associated with increased movement and energy expenditure”  
*Chronic health effects:* “Heart problems could be avoided” “Live longer”  
| **Employees** |                                                        | **Managers**                                                                      |
|             | **Benefit:**  
*Musculoskeletal effects:* “Reduced muscle and joint strain injuries”  
*Fitness and energy levels:* “Greater cardio fitness” “Burns calories”  
*Chronic health effects:* “Reduced sedentary risks factors for diabetes and heart disease” “Increased life expectancies”  
| **Work**  | **Benefit:**  
*Concentration & Fatigue:* “Greater concentration levels” “I wouldn’t get as tired during the day”  
*Motivation:* “More motivated”  
*Time efficiency:* “More productive time”  
| **Employees** |                                                        | **Managers**                                                                      |
|             | **Benefit:**  
*Concentration & Fatigue:* “Moving away from the desk can help you think more clearly” “More alert”  
*Time efficiency:* “Potential increase in efficiency”  
| **Negative consequence:**  
*Reduced time:* “Less work gets done in the same amount of time”  
*Distractions:* “Lose focus on workplace requirements”  
| **Psychosocial**  | **Benefit:**  
*Mood & wellbeing:* “Happier, better for mental health” “better overall wellbeing” “more sociable”  
*Stress:* “less stress and anxiety about being immobilised and confined to a computer”  
| **Employees** |                                                        | **Managers**                                                                      |
|             | **Benefit:**  
*Mood & wellbeing:* “Improved sense of wellbeing”  
*Stress:* “Possibly stress reductions from having a break”  
| **Negative consequence:**  
*Stress:* “Potentially more stress as need to compress workplace in shorter time frames”  
|
The perceived impact of reducing workplace sitting on the workplace are presented in Table 8.2. More benefits than negative consequences of reducing workplace sitting were identified for the workplace. Work productivity was the most prevalent theme, and again similar amounts of benefits (e.g., concentration, time benefits) and negative consequences (e.g., distractions, and reduced work output) were reported. A theme also emerged around an improved psychosocial environment (e.g., staff mood, social connectedness) and work attendance (e.g., improved attendance and less work cover claims). Among the employees, in relation to the psychosocial theme, a negative sub-theme emerged around the enforcement of workplace sedentary strategies (e.g., “…telling us how to act”). Workplace costs also emerged as a theme among the employees, although there appeared to be some ambivalence about the associated effects, particularly in regard to short- versus long-term costs, and how changes in work-productivity may interact with costs.

Managers and employees perceived similar potential effects of reductions in workplace sitting, including more benefits than negative consequences for both desk-based workers and the overall workplace.
## Table 8.2 Effects of reduced workplace sitting for the desk-based workplace

<table>
<thead>
<tr>
<th>Theme</th>
<th>Example response</th>
<th>Employees</th>
<th>Example responses</th>
<th>Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work-productivity</strong></td>
<td><strong>Benefit:</strong> <em>Time efficiency:</em> “more productive as time at desk is limited” <em>Alertness:</em> “More alert workforce”</td>
<td></td>
<td><strong>Benefit:</strong> <em>Concentration:</em> “Better focused employees”</td>
<td><strong>Negative consequence:</strong> <em>Distractions:</em> “Excess noise would be distracting”</td>
</tr>
<tr>
<td></td>
<td><strong>Negative consequence:</strong> <em>Distractions:</em> “Interruptions to workflow” “More easily sidetracked if not at desk” <em>Work output:</em> “Potentially less work achieved” “more wasted time”</td>
<td></td>
<td><strong>Implementation:</strong> “If not managed well, there is a risk of loss of productivity” “Unless done in a structured way, loss of productivity”</td>
<td></td>
</tr>
<tr>
<td><strong>Psychosocial Environment</strong></td>
<td><strong>Benefit:</strong> <em>Mood:</em> “Happier environments” <em>Social connectedness:</em> “Improved social interaction, friendlier workplace environment”</td>
<td></td>
<td><strong>Benefit:</strong> <em>Staff mood:</em> “Employees happier, better moral”</td>
<td><strong>Attitudes &amp; motivation towards work:</strong> “Positive attitudes, motivation increases”</td>
</tr>
<tr>
<td></td>
<td><strong>Negative consequence:</strong> <em>Enforcing strategies:</em> “Challenges about telling us how to act” “Some may resent certain strategies”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Work Attendance</strong></td>
<td><strong>Work attendance:</strong> “Improved attendance at work” “Higher employee retention rates through reducing medical issues” <em>Work Cover:</em> “Less work cover claims”</td>
<td></td>
<td><strong>Benefit:</strong> <em>Work attendance:</em> “Staff retention, less sick leave”</td>
<td><strong>Work Cover:</strong> “Decrease in work cover complaints”</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td><strong>Benefit:</strong> “Costs of standing desks would be offset by productivity” “Decreased costs in terms of long term staff health and improved quality of work”</td>
<td></td>
<td></td>
<td><strong>No theme identified</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Negative consequence:</strong> “Costs associated with initiatives to reduce sitting” “Potential costs of loss of time and productivity” “Costs unlikely to be supported in current economic climate”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8.4.2 Activity health ratings

The following section examines the health ratings of sedentary behaviour, LPA and MVPA, accumulated in both the work and leisure contexts. Results from the Chi-square tests revealed no significant differences between employees’ and managers’ health ratings in relation to physical activity and sitting time ($\chi^2 [32, n=333], p=.32, \phi=.33$). Consequently, their data were combined. In relation to the health ratings of the various activities, ANOVA results revealed a significant main effect for activity intensity ($F[1.77, 374.20] = 835.70, p<.001, \eta_p^2 = .80$), and context ($F[1, 212] = 245.53, p<.001, \eta_p^2 = .54$), and for the interaction between activity intensity and context ($F[1.76, 235.25] = 136.70, p<.001, \eta_p^2 = .39$).

Figure 8.1 displays the means and standard errors for these main and interaction effects. In the graph, each coloured line represents a different activity intensity within the work and leisure-time contexts, and the Y-axis represents the perceived health ratings. Figure 8.1 indicates that sitting in both the occupational and leisure contexts was rated as the unhealthiest, and MVPA was rated as the healthiest, but only in the leisure-time context. Although MVPA at work still appears to be perceived as healthy, LPA at work was rated as healthier. Furthermore, MVPA and LPA were rated as healthier when accumulated in leisure-time rather than in the work context, and the perceived healthiness of sitting was consistent regardless of context.
Chapter Eight: Consequences of reducing sitting and increasing physical activity

Figure 8.1 Health ratings of sedentary behaviour, light-intensity (LPA) and moderate-to-vigorous-intensity physical activity (MVPA) in the work and leisure contexts (±1 SE bars are included)

8.4.3 Interactions between leisure-time activity intensities and health ratings according to specific activities at work

The following section examines the interactions between sitting and various physical activity intensities during leisure-time with perceived health ratings of these activities by specific types of activities of varying intensities at work. Results from the Chi-square tests revealed no significant differences between employees’ and managers’ lifestyle health ratings ($\chi^2 [72, n=339], p = .47, \text{phi} = .46$), consequently, data were combined.
Chapter Eight: Consequences of reducing sitting and increasing physical activity

ANOVA results revealed a significant main effect for specific types of work activities \( (F[2.52, 508.88] = 173.05, \quad p < .00, \quad \eta^2 = .46) \), for different leisure-time activity intensities \( (F[1.84, 370.70] = 648.42, \quad p =< .00, \quad \eta^2 = .76) \), and an interaction between type of work activity intensity and leisure activity intensity \( (F[5.44, 1098.21] = 35.19, \quad p =< .00, \quad \eta^2 = .15) \).

Figure 8.2 displays the means and standard errors for these main and interaction effects. In the graph, the coloured lines represent different leisure-time activity intensities, the X-axis represents the specific work activities of different intensities, and the Y-axis represents the perceived health ratings. Figure 8.2 illustrates that lifestyles characterised by sitting while at work and during leisure-time are rated as the unhealthiest, and lifestyles characterised by leisure-time MVPA are rated as the healthiest. While sitting at work was perceived as unhealthy, it did not appear to be perceived as detrimental when determining what constitutes a healthy lifestyle as insufficient leisure-time MVPA. The perceived health benefits associated with breaking-up workplace sitting do not appear to be as substantial as the health benefits expected to follow increased leisure-time MVPA. Furthermore, there appears to be the perception that the presence of leisure-time MVPA may mitigate the effects of workplace sitting. This is evident when comparing the health rating of the person who is sedentary at work and active during leisure, particular in relation to MVPA, to that of the person who has a sedentary job and is sedentary during leisure.
A conjoint analysis was performed to further examine the relative influence of activity accumulated in the work versus leisure context. Results indicated that being active at work (e.g., taking regular breaks, standing or being physically active) explained 22.7% of the variance, and being active during leisure-time (e.g., engaging in LPA and/or MVPA activities) accounted for 77.3% of the variance in lifestyle healthiness ratings. Findings suggest that activities performed in the leisure-time context have higher perceived overall lifestyle healthiness ratings than when these same
Chapter Eight: Consequences of reducing sitting and increasing physical activity activities are accumulated in the work context. The following section will discuss the observed results in light of past research and theoretical understanding.

8.5 Discussion

The overall aim of the chapter was to examine the perceived effects of reducing workplace sitting and of engaging in sedentary behaviour and various physical activity intensities in work and leisure-time contexts. Research regarding knowledge or perceptions of the chronic health effects of sitting and engagement in lower intensities of physical activity is limited. Emerging evidence that increases in light-intensity physical activity confers independent health benefits, suggests this is an important research question (Hamilton et al., 2008; Thorp et al., 2011). This chapter also considered the context in which activities were accumulated. Some research has shown different associations between physical activity contexts and certain health outcomes (e.g., Teychenne et al., 2009), therefore it was of interest to also examine whether perceptions of health risk varied by activity context.

8.5.1 Perceptions of reduced workplace sitting

Employees and managers predominantly associated reductions in workplace sitting with favourable outcomes, specifically improved musculoskeletal outcomes. Encouragingly there was some (although not common) awareness regarding the chronic health effects of workplace sitting among both the employees and managers. This finding is consistent with past qualitative research among OH&S personnel (Gilson et al., 2012a), but contrasts with other research indicating that awareness of chronic health effects associated with workplace sitting is non-existent (Gilson et al. 2011; Starker et al., 2013). The high awareness of the musculoskeletal effects of workplace sitting is not unsurprising considering the history of ergonomic awareness and interventions within the workplace (Healy et al., 2012). The awareness of potential health effects of
accumulated sitting is encouraging. The awareness among employees, albeit limited, may reflect the increasing evidence base, media attention, and recent population guidelines recommending reducing sedentary behaviour (DoHA, 2014; DHSSPS, 2011; Owen et al., 2010).

The reported benefits of reducing sitting in creating a more positive psychosocial environment (e.g., happier environments, friendly workplace, better moral) is similar to past research among employees and middle managers. Specifically, in which accumulated sitting in the workplace was associated with fatigue, demotivation, stress, and social isolation (Gilson et al., 2011).

Negative consequences of reduced workplace sitting reported by the managers and employees, included reduced work-productivity, and associated costs and concerns around the enforcement of strategies.

In regard to work-productivity, the employees and managers opinions were mixed, which is similar to observed differences in past research. Past qualitative research has highlighted concerns around loss of work-productivity with LPA strategies (i.e., through loss of focus and concentration, feeling drained and sluggish, and as a strategy to avoid working; Gilson et al., 2011, 2012a). Furthermore, it is also possible that the reported negative effects with work-productivity, may relate to misunderstandings. Specifically, between LPA strategies and attempts to increase structured physical activity (which may displace working time, such as extra time for structured MVPA during working hours; van Uffelen et al., 2010). In the present study some of the desk-based participants highlighted “less work gets done in the same amount of time”, “more wasted time”, “more easily side tracked if not at desk” etc. as negatives to reducing sitting time. These responses indicate that the participants may not be aware that some LPA strategies are designed specifically so that work-productivity can be maintained while engaging in LPA. For example, continuing with
Chapter Eight: Consequences of reducing sitting and increasing physical activity computer-based work while standing at a height adjustable desk. Contradictory, intervention research has anecdotally associated LPA strategies with a positive or null effect on workplace productivity, however, the need for further research using validated and systematic measures is required (Alkhajak et al., 2012; Beers et al., 2007; Thompson et al., 2007; Pronk et al., 2007). Furthermore, qualitative research has highlighted the effects upon work-productivity as a preeminent factor influencing the adoption of workplace LPA strategies at an organisational and managerial level (Gilson et al., 2012).

In regard to concerns raised about the enforcement of strategies (e.g., “…challenges telling us how to act” “…some may resent certain strategies”), past qualitative research has found similar concerns (Gilson et al., 2011, 2012a). Specifically, the importance of fostering choice and ownership to promote engagement in LPA strategies has been highlighted (Gilson et al., 2012a). However, past qualitative research has also highlighted that without ergonomic principles to enforce change, sustained change in unlikely (Gilson et al., 2012a). The concerns raised among the employees and discrepancies in previous qualitative research, highlight the need for future research to examine the most effective way to introduce and promote engagement in LPA strategies. Particularly, in light of preliminary research indicating the use and uptake of LPA strategies can vary substantially, and the mere provision or strategies may not suffice for promoting actual behavior change (Gilson et al., 2012a, 2012b; Starker et al., 2013).

8.5.2 Sedentary behaviour and physical activity intensity health ratings

The rating of MVPA as the healthiest activity, is consistent with the well-established and recognised health benefits of MVPA, and the rating of sitting as the unhealthiest activity is consistent with past research indicating sitting is viewed as unhealthy (Gilson
Chapter Eight: Consequences of reducing sitting and increasing physical activity et al., 2011, 2012a; Straker et al., 2013; Tremblay et al., 2010). Interestingly, MVPA time accumulated in the leisure-time context was rated as healthier than that accumulated during work time.

The positive beliefs regarding leisure-time MVPA and health are not surprising given the emphasis placed on MVPA in this context historically (Tremblay et al., 2010). The perceived benefits of leisure-time MVPA may also reflect a greater range of associated health benefits (i.e., ‘staying in shape’ ‘becoming strong’; Tergerson & Keith, 2002). Engagement in occupational MVPA has rarely been promoted for health benefits; any health benefits achieved are typically by-products of working conditions. Therefore, MVPA accumulated at work may not be considered as relevant to health as that accumulated in leisure-time. Furthermore, workplace related MVPA is associated with more labor-intensive jobs, which have been associated with undesirable health and psychosocial outcomes (Commission to Build a Healthier America, 2008). It is also possible that the pervasive belief that exercise needs to be accumulated in longer bouts to accrue health benefits (i.e., in 30 minutes bouts alike recommendations propose), that if it is accumulated in shorted bouts (which may typically occur during work), it may not be associated with health benefits (Tergerson & Keith, 2002; Tremblay et al., 2012). These perceptions may confound the health ratings of the different activity intensities and sitting time in the workplace. With these considerations in mind and in line with the health belief model (Rosenstocks, 1974), MVPA accumulated in leisure-time may be associated with more ‘perceived benefits’, and MVPA accumulated at work may be associated with more negative perceptions, therefore influencing how physical activity is rated in regard to healthiness when accumulated in different contexts (Commission to Build a Healthier America, 2008: Rosenstocks, 1974; Tremblay et al., 2010). This is an important area in need of further research.
Chapter Eight: Consequences of reducing sitting and increasing physical activity

8.5.3 Health ratings of specific activities at work

With regard to the health ratings of specific activities at work, sitting at work was viewed as least healthy. However, in the context of high participation in leisure-time MVPA, sitting at work was not considered to be as detrimental to health. The presence of leisure-time MVPA appeared to attenuate the perceived negative health effects of sitting all day at work. Furthermore, the level of the specific workplace physical activity (i.e., sitting with regular breaks, standing or MVPA) appeared less important if the lifestyle included sufficient leisure-time MVPA.

This result is of concern as not only is sedentary time highly prevalent in the modern workplace, promoting LPA is more likely to be feasible in the workplace than increasing MVPA (Chau et al., 2010; Thorp et al., 2008). These results indicate that educational strategies regarding the benefits of reducing sitting and/or promoting LPA in the workplace are needed to shift employees’ and managers’ perceptions of the potential benefits of these activities while at work.

8.5.4 Research limitations and strengths

In addition to limitations discussed in earlier chapters, the sample characteristics and study design, some limitations warrant attention. The participants not directly ask about the health effects associated with accumulated sedentary time when one also accumulates sufficient leisure-time MVPA. This is also important to understand desk-based workers understanding of sedentary behaviour and physical activity. “It is also noted that LPA is a difficult behaviour define and recall (as it often occurs in response to a secondary goal, such as walking to the printer, potentially making it a less salient behaviour and consequently more difficult to recall), this could have led to an underestimation of potential perceived effects of behaviour upon health. Further research may benefit from defining this more specifically (Gilson et al., 2011, 2012).
Chapter Eight: Consequences of reducing sitting and increasing physical activity

Research strengths included the consideration of different perspectives from desk-based employees and managers, which previous research has shown may differ (Gilson et al., 2011, 2012a). Another strength of the analyses described in this chapter was the examination of the interactions between leisure-time sitting and different physical activity intensities with specific activities in the workplace. This novel approach provided the opportunity for unique insights into the relative importance of sitting and various activity intensities according to perceived health ratings. That is, from the employees’ and managers’ viewpoints it may not matter to their health how much they sit or engage in LPA or MVPA in the workplace provided they are highly active in their leisure-time.

8.6 Chapter summary

Overall, the chapter indicates desk-based workers predominantly associated reductions in workplace sitting with favourable outcomes, particularly musculoskeletal outcomes. Encouragingly, there was some, albeit limited, awareness of the chronic health effects associated with accumulated workplace sitting. While these results indicate that strategies to reduce workplace sitting may be well received, concerns were also raised in relation to the effects on work productivity. The desk-based workers perceived workplace sitting as unhealthy, however, when accumulated in the context of a lifestyle with sufficient leisure-time MVPA, it seemed that workplace sitting was considered not as detrimental to health. The chapter also indicated that physical activity accumulated during leisure-time, rather than at work, was a greater predictor of perceived health benefits.

In the following chapter, the feasibility of strategies to reduce workplace sitting and to promote workplace LPA will be examined. Given the observed differences between employees and managers described in Chapter Seven, the following chapter will expand
Chapter Eight: Consequences of reducing sitting and increasing physical activity

on this understanding by examining desk-based managers’ and employees’ attitudes
towards these strategies.
9.1 Introduction

The promotion of workplace LPA is a new health endeavor (Owen et al., 2010). Therefore, understanding the feasibility and receptiveness towards strategies designed to reduce and break-up workplace sitting is warranted (Straker et al., 2013). Qualitative research has found desk-based employees and middle managers perceive strategies to reduce workplace sitting as feasible (Gilson et al., 2011). However, opinions have been mixed as to whether structured versus unstructured LPA strategies would be optimal (Gilson et al., 2011, 2012a). Furthermore, reports from the employees in the previous chapter (Table 8.2), highlighted concerns around how strategies are enforced, which may undermine receptiveness.

Preliminary intervention research has found various workplace LPA strategies to be well received (e.g., sit-stand desks, walking and standing meetings, etc), although this research has predominantly only evaluated one type of LPA strategy, such as sit-stand desks (Chau et al., 2010; Healy et al., 2013; John et al., 2011; Parry et al., 2014; Pronk et al., 2012). An intervention evaluating different types of LPA strategies found clerical workers liked sitting on a therapy ball as much as sitting in a desk chair, and liked sitting on a therapy ball more than standing at a desk (Beers et al., 2008). Past research indicates that while desk-based workers may be receptive to the introduction
Chapter Nine: Feasibility of strategies to reduce and promote LPA

of workplace LPA strategies, there may be differences in the receptiveness of various workplace LPA strategies.

Further research is needed to examine desk-based employees’ willingness to engage in various LPA strategies and managers’ willingness to implement LPA strategies (Beers, et al., 2008; Healy et al., 2013; Pronk et al., 2012; etc). This is deemed important from the perspective of employees, who are likely to be the primary recipients of such strategies, and from the perspective of managers, who have the ultimate responsibility for implementing, managing and resourcing policies relevant to workplace sitting (Gilson et al., 2011, 2012a). In light of the different LPA strategies proposed, research also needs to understand what LPA strategies managers and employees may be more willing to engage in. This is important for informing the development of intervention strategies that are likely to lead to more successful promotion of workplace LPA and reductions in sitting.

9.2 Aims

Overall, the chapter aims to examine the feasibility of strategies to reduce sitting and promote LPA in the workplace among desk-based employees and managers. The chapter will address the following aims:

1. To examine employees’ willingness to engage, and managers’ willingness to implement strategies to reduce workplace sitting.

2. To examine and compare employees’ and managers’ willingness to engage in different workplace LPA strategies.

9.3 Methods

A detailed description of the procedures and methods used in this study were provided in Chapter Four (Sections 4.1 and 4.2). Briefly, a total of 122 desk-based managers and 221 desk-based employees were recruited via an online database of businesses in
Chapter Nine: Feasibility of strategies to reduce and promote LPA

metropolitan Melbourne, and completed the online questionnaire. The survey items
were developed to reflect understanding of the receptiveness of strategies to reduce
workplace sitting and various workplace LPA strategies. A detailed description of how
the data were managed and cleaned is provided in Chapter Four, section 4.3.

9.3.1 Analysis of perceived feasibility of workplace LPA strategies among
managers and employees

Percentages were calculated to describe the proportion of employees willing to engage
in strategies and the proportion of managers willing to implement strategies to reduce
workplace sitting. Percentages were also used to describe the proportion of employees
and managers willing to increase their LPA in the workplace. A thematic analysis of
qualitative data from the open-ended questions was conducted to identify common
themes among the employees and managers. Themes were captured in relation to the
research questions and past research (Gilson et al., 2011, 2012a), and which represented
a level of patterned response (Braun & Clarke, 2006). For interpretive purposes, theme
and example responses for both the employees and managers are presented in Table
9.1.

To examine whether willingness to engage in the different LPA strategies varied
between the employees and managers, a Chi-square test was conducted. For interpretive
purposes, the percentage of those willing to engage in the various strategies are
presented in Table 9.2. The managers and employees were provided with an
opportunity to further comment on the perceived feasibility of strategies to reduce
workplace sitting. However, due to the limited number of responses a thematic analysis
was not performed for this section; common responses were simply collated.
Chapter Nine: Feasibility of strategies to reduce and promote LPA

9.4 Results

9.4.1 Feasibility of strategies to reduce workplace sitting

Most employees (76%) reported that they would support the introduction of strategies to reduce workplace sitting, and more than half of the managers (60%) indicated they would be willing to implement strategies to reduce workplace sitting. Themes identified regarding employees’ willingness to engage in the strategies and managers’ willingness to implement the strategies to reduce workplace sitting, are presented in Table 9.1. Emergent themes from the employees’ responses included concerns with work productivity and the challenge of implementation of LPA strategies (i.e., not making engagement compulsory and fostering autonomy). The physical constraints of the workplace also emerged as theme that could undermine receptiveness of strategies. Among the managers, similar themes emerged regarding concerns about work productivity and the physical constraints of the workplace. A theme also emerged among the managers in relation to workplace culture (i.e., the perception that you need to be sitting to be working).
Table 9.1 Employees’ responses in relation to supporting, and managers’ responses in relation to implementing, strategies to reduce workplace sitting

<table>
<thead>
<tr>
<th>Theme</th>
<th>Employees willingness to support</th>
<th>Managers willingness to implement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work productivity</td>
<td>Benefit:</td>
<td>Benefit:</td>
</tr>
<tr>
<td></td>
<td>“As long as it does not interfere with work I am all for it”</td>
<td>“Yes if the efficiency of the workplace would not deteriorate”</td>
</tr>
<tr>
<td></td>
<td>Negative:</td>
<td>“As long as it was not a distraction”</td>
</tr>
<tr>
<td></td>
<td>“My job is too busy, breaks interrupt the work process”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“The nature of the work is to sit at a desk, your need to get your work done and walking around doesn’t get it done”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“I would love it but my job is too busy”</td>
<td></td>
</tr>
<tr>
<td>Workplace environmental constraints</td>
<td>Negative:</td>
<td>Negative:</td>
</tr>
<tr>
<td></td>
<td>“Nice idea but probably not physically practical”</td>
<td>“Not feasible as my work is done at a desk so I have to sit there”</td>
</tr>
<tr>
<td></td>
<td>“It’s part of my job to sit”</td>
<td>“Very difficult given the current office space”</td>
</tr>
<tr>
<td>Workplace culture</td>
<td>No responses.</td>
<td>No responses.</td>
</tr>
<tr>
<td></td>
<td>“There are culture issues around being perceived to not be at your desk”</td>
<td>“Our company does not support desk-breaks”</td>
</tr>
<tr>
<td>Implementation</td>
<td>“Strategies need to be implemented properly, there needs to be a balance of both sitting and moving, but the biggest issues is making sure it is applied consistently”</td>
<td>“Strategies should not be compulsory as different people have different habits”</td>
</tr>
<tr>
<td></td>
<td>“Scheduled breaks interrupt work processes and can result in errors that inevitably cause stress. Breaks taken at natural landmarks can act as rewards, these are far more appropriate than scheduled breaks”</td>
<td>“Scheduled breaks interrupt work processes and can result in errors that inevitably cause stress. Breaks taken at natural landmarks can act as rewards, these are far more appropriate than scheduled breaks”</td>
</tr>
</tbody>
</table>
9.4.2 Willingness to engage in workplace LPA strategies

Results from the Chi-square test for independence revealed a non-significant difference between employees’ and managers’ willingness to engage in the various LPA strategies ($\chi^2 [2, n=335], p =0.65, \phi = .85$), consequently, employees’ and managers’ data were combined. Table 9.2 displays the percentage of respondents willing to engage in the various workplace LPA strategies and shows that most respondents were willing to walk to the printer/scanner and to stand and work for short intervals throughout the day. Approximately one-quarter or less of the respondents indicated that they would be willing to use standing desks, and have walking and standing meetings.

Table 9.2 Percentage engagement in workplace LPA strategies

<table>
<thead>
<tr>
<th>LPA strategy</th>
<th>Yes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk to printers</td>
<td>77</td>
</tr>
<tr>
<td>Stand and work for intervals</td>
<td>63</td>
</tr>
<tr>
<td>Standing desks</td>
<td>25</td>
</tr>
<tr>
<td>Walking meetings</td>
<td>23</td>
</tr>
<tr>
<td>Standing meetings</td>
<td>21</td>
</tr>
</tbody>
</table>

9.5 Discussion

This chapter reported on the receptiveness of employees and management regarding supporting and implementing strategies to reduce workplace sitting and increase LPA. Few interventions have been developed to test the feasibility or efficacy of such strategies (Chau et al., 2010; Gilson et al., 2011, 2012a; Hamilton et al., 2008; Thorp et al., 2011). Furthermore, given employees are likely to be the primary beneficiaries of sitting and LPA strategies, and managers are responsible for implementing and
resourcing such strategies, it was considered important to incorporate these different perspectives.

9.5.1 Feasibility of strategies to reduce workplace sitting and promote LPA

Willingness to support and implement strategies to reduce workplace sitting was high, although, concerns were raised regarding the potential effects on work productivity and that the implementation of such strategies that could undermine autonomy. These concerns are consistent with previous qualitative research among employees, middle managers and OH&S personnel (Gilson et al., 2011, 2012a). The support for LPA strategies is also consistent with past qualitative research (Gilson et al., 2011, 2012a) and previous interventions have found LPA strategies, such walking treadmills, height-adjustable desks etc., are generally well received (Alkhajah et al., 2012; Pronk et al., 20102; Thompson et al., 2007).

Some LPA strategies were more favourably viewed than others, such as standing and working for intervals and walking to the printer in comparison to walking and standing meetings. This is consistent with one intervention trial which reported that some LPA strategies (i.e., sitting on a therapy ball) were preferred over others (i.e., standing; Beers et al., 2008). Beers et al. (2008) suggested that the preference for standing while doing clerical work may be low because it may be less comfortable and more fatiguing. In the present study, differences in the willingness to engage in some LPA strategies over others could also potentially reflect current work practices (e.g., moving away from the desk to use a printer/scanner). In comparison, using a sit-stand desk and engaging in walking/standing meetings may be a more novel and unfamiliar workplace behaviour, potentially creating apprehension about engaging in such LPA strategies (Owen et al., 2000). It is also possible organisational cultural factors, such as the synonymous relationship between sitting and work-productivity, and management related factors (i.e., support, role modeling) may influence the ability to
Chapter Nine: Feasibility of strategies to reduce and promote LPA engage in workplace LPA strategies (Gilson et al., 2011, 2012a). Future research would benefit from further examining the factors related to engagement in various workplace LPA strategies.

9.5.4 Research limitations and strengths

A number of limitations warrant attention. Firstly, the study only examined and compared a few workplace LPA strategies. Furthermore, the chapter assumed that the desk-based workers understood the various LPA strategies (i.e., that they can be engaged in LPA while maintaining work productivity). Future research may benefit from incorporating a greater variety of workplace LPA strategies and work-based tasks that could be completed in a LPA manner. Finally, future research may benefit from ensuring that participants understood what the various LPA strategies entail, and how work productivity may be maintained while engaging in the LPA strategies.

Research strengths includes the consideration and comparison of receptiveness to strategies to reduce workplace sitting and promote LPA from the perspective of both employees and managers, who are respectively the primary beneficiaries and drivers of implementing workplace LPA strategies.

9.6 Chapter summary

Overall, finding described in this chapter indicated that strategies to reduce workplace sitting and some LPA strategies may be well received by both employees and managers. Desk-based workers appear to have differences in their willingness to engage in various LPA strategies. A number of practical implications for reducing sedentary activity arise from these findings which will be discussed in the following chapter.
CHAPTER TEN

THESIS CONCLUSIONS

10.1 Overview of main findings

This thesis makes an original contribution to the body of knowledge relating to measurement and understanding of the factors relevant to workplace sitting and sitting-breaks (LPA). The premise of the research presented in this thesis was that valid and reliable measures of workplace sitting and sitting-breaks are needed for accurately and reliably capturing these behaviours at a population level. Furthermore, workplace interventions targeting reducing and breaking-up sitting and increasing LPA need to be informed by a better understanding of the key influences or correlates of these behaviours (Biddle, 2010; Owen et al., 2011; Plotnikoff & Karunamuni, 2012). There has been limited research investigating workplace sitting and sitting-breaks in such a comprehensive manner. Previous research on desk-based workers has largely focused on the measurement of workplace sitting, and the physical-environmental factors relevant to reducing and breaking-up workplace sitting. This prior research has largely failed to capture the manner in which workplace sitting is accumulated (e.g., sitting-breaks per working hour), and the intrapersonal and interpersonal factors of relevance, particularly while still acknowledging the contextual influences upon workplace behaviour (i.e., the physical-environmental level influences; Bennie et al., 2011; Clark et al., 2011; Healy et al., 2013; Owen et al., 2010). Given the research gaps identified in the literature, two research studies were designed. The first study examined the psychometric properties of a self-report measure of workplace sitting and sitting-breaks. The second examined the social ecological factors associated with
accumulated sitting and taking sitting-breaks in the desk-based workplace, and the feasibility of strategies to target workplace sitting.

In Chapter Two, the behavioral epidemiological framework was presented as a conceptual framework for guiding the design of the two research studies in an attempt to understand sedentary behaviour in the workplace (Sallis et al., 2006). A particular focus was on the development of valid measures of sedentary behaviour, and on understanding the determinants of sedentary behaviour (Owen et al., 2010). Previous reviews have shown that valid and reliable self-report estimates of workplace sitting and sitting-breaks are required (Atkin et al., 2012; Clark et al., 2011). In order to gain a more comprehensive understanding of the determinants of workplace sedentary behaviour, a social ecological approach was taken, in which various constructs from health behaviour theories, such as behaviour barriers, self-efficacy, habit etc. were used to further guide understanding (Bronfenbrenner, 1979; Owen et al., 2011; Sallis et al., 2006).

The development of a self-report measure was described in Chapter Three. This measure was found to be a reliable measure of workplace sitting and sitting-breaks, particularly with a larger sample. This chapter confirmed the use of the measure in the subsequent research study (the workplace sedentary study), which aimed to further understand workplace sitting and sitting-breaks. In Chapter Four, the procedure and methods used in the workplace sedentary study examining the ecological correlates and feasibility of strategies designed to reduce and break-up workplace sitting was presented. The results of this study were subsequently described in Chapters Five, Six, Seven, Eight, and Nine.

From the analysis described in Chapter Five, it was found that various ecological factors explained a moderate amount of the variance in workplace sitting-
breaks. Furthermore, the habitualness of sitting-breaks and the perception that workplace sitting is not as detrimental towards health were found to be unique predictors of increased sitting-breaks. The ecological correlates explained limited variance in workplace sitting and no correlate uniquely predicted variance in this behaviour. However, having limited physical opportunities to take sitting-breaks and the habitual nature of workplace sitting approached significance in relation to predicting increased workplace sitting. This chapter indicated that considering various levels of influence, including intrapersonal and interpersonal level factors can enhance understanding workplace behaviour, particularly workplace sitting-breaks.

In Chapter Six, a further exploration of the results from the Chapter Five was undertaken using a dual process approach. Lower barriers and higher self-efficacy was positively associated with the habitualness of sitting-breaks, which in turn increased the frequency of sitting-breaks. The automatic (e.g., habit) and controlled (e.g., barriers and self-efficacy for sitting-breaks) intrapersonal factors did not explain variance in workplace sitting. However, higher habitualness of workplace sitting in combination with high barriers to taking sitting-breaks, was found to be particularly detrimental to taking workplace sitting-breaks. These results highlighted the importance of taking a dual-process approach to enhanced understanding of the psychological determinates of behaviour (Conroy et al., 2013; Evans, 2003; Triandis, 1977).

An interpersonal level focus was taken for the analysis in Chapter Seven to examine workplace sitting behaviours and beliefs concerning breaking up sitting from the perspective of desk-based managers. Managers perceived employees to have greater barriers and lower self-efficacy for taking sitting-breaks than what the employees themselves perceived. The results highlighted that intrapersonal factors relevant to employees’ ability to take sitting-breaks (e.g., barriers and self-efficacy),
needed to be considered from the perspective of important interpersonal influences. That is, from the perspective of desk-based managers. This is important evidence given the responsibility that managers would typically have for resourcing and promoting workplace health promotion for employees.

In Chapter Eight, it was found that managers and employees perceive reductions in workplace sitting favourably, specifically in relation to improved musculoskeletal outcomes. However, there was limited awareness of the health implications of accumulated sitting, particularly among the employees compared to the managers. Employees and managers similarly rated sitting as unhealthy, yet when asked in a more realistic manner, it was perceived that the presence of leisure-time MVPA appeared to reduce the effects of accumulated workplace sitting.

Finally, in Chapter Nine the feasibility of potential strategies designed to reduce sitting and increase LPA in the workplace was examined. While most employees and managers were willing to support and implement LPA strategies respectively, concerns were again raised by the study participants in relation to several negative effects. These included impacts to work-productivity, the physical constraints of the workplace, how to best implement and enforce strategies, and the workplace culture. From these findings it was evident that while LPA strategies may be well received and some LPA strategies are more preferred over others, associated concerns (e.g., work-productivity, workplace culture, the physical environment, and enforcement of strategies) may potentially undermine receptiveness to workplace changes to increase LPA and reduce sitting time.

10.2 Significance of thesis findings

The results of the two studies described in this thesis make a unique contribution to what is know about the measurement and understanding of factors related to workplace sitting and sitting-breaks among desk-based workers and
managers. Prior to these studies there was limited research exploring the psychometric properties of self-report measures of workplace sitting and sitting-breaks (Clark et al., 2011), and a limited understanding of potential influences on these behaviours, particularly those operating beyond the environmental level which may be related to workplace sitting and sitting-breaks (Bennie et al., 2011; Chau et al., 2010; Healy et al., 2013). The inclusion of both controlled and automatic processes provided support for a novel dual-process approach to enhancing understanding of workplace sitting and sitting-breaks (Conroy et al., 2013; Evans, 2003). From a theoretical perspective, the findings supported the use of the social ecological model and the incorporation of health behaviour theories, taking a dual-process approach to further understanding workplace sitting and sitting-breaks (Evans, 2003; Owen et al., 2011; Plotnikoff & Karunamuni, 2012; Sallis et al., 2006).

One of the interesting nuances of people’s engagement in extended sitting is when other lifestyle attributes are taken into account. Participation in leisure-time MVPA contributes to the perception that provided an individual is being highly active in their leisure-time, how much they sit at work will not affect their health (Owen et al., 2010; Tremblay et al., 2010). This interaction between sitting and different intensities in the work and leisure contexts and health ratings has not been previously examined; therefore, a further innovative aspect of this thesis was in filling this knowledge gap. Participants were asked to rate how healthy they perceived twelve hypothetical lifestyles, which described people who engaged in various combinations of sedentary, LPA and MVPA time, accumulated in both the work and leisure contexts. Not surprisingly, when leisure-time MVPA was high, this resulted in a high health rating no matter how much the individual sat at work or during leisure-time. The implications of this novel approach to understanding the perceived health effects of workplace sitting are discussed in Section 10.4 below.
The workplace sedentary study also provided a unique opportunity to compare and consider disparities in intrapersonal variables relevant to employees’ sitting-breaks (e.g., barriers and self-efficacy) from the perspective of managers and desk-based employees. Managers exert a direct and indirect influence over the workplace environment and employees’ behavior, yet few studies have sought the perspectives of this important group (Gilson et al., 2011, 2012a; HPIA, 2007; Linnan et al., 2013). Comparing the perceived feasibility of strategies to reduce sitting and promote LPA in the workplace according to employees and managers was also novel and provided insights into what workplace interventions might be possible to implement in the workplace (Gilson et al., 2011, 2012a; Sallis et al., 2006). No matter how appealing many of these strategies are for desk-based employees, they are unlikely to be successfully implemented without support from management.

10.3 Limitations of research

There are several limitations to the research that need mentioning. The generalisability of the results is limited to desk-based workers who spend most of their work time sitting. Furthermore, it is possible that desk-based workers who participated in the research may have more of an invested interest in health, and thus may not be representative of the larger desk-based worker population (Li & Sung, 1999). The two research studies also did not distinguish between different workplace jobs, which past research suggests may be associated with variation in workplace behaviours (Clark et al., 2011; Marshall & Brown, 2004). Specific to the validation study, the main limitations include the absence of an objective measure of postural allocation and not controlling for structured work-breaks (i.e., lunch breaks; Clark et al., 2011; Kozey-Keadle et al., 2011).
Chapter Ten: Thesis conclusions

In relation to the workplace sedentary study, the online database used to recruit desk-based workers may have been restrictive, it is unknown the number and type of organisations and desk-based workers who participated in the research study. Furthermore, the cross-sectional design of the workplace sedentary study limits the ability to infer causal relations between the ecological variables and workplace sitting and sitting-breaks. However, these results provide preliminary evidence for further exploring and developing hypotheses related to not only the contextual influences upon workplace behaviour. Specifically, to also focus on intrapersonal, both controlled and automatic, and interpersonal variables, such as support from managers, relevant to workplace sitting and sitting-breaks. Furthermore, the measures used to capture the physical environment, policy, and interpersonal factors of relevance were limited, and may have potentially underestimated the influence of factors operating at these levels (Giles-Corti & Donovan 2002; Sallis et al., 2008). Finally, the measures of workplace sitting and sitting-breaks were based on self-reports. Even though key questions were validated (e.g., workplace sitting and sitting-breaks) they were modestly correlated with objective measures.

10.3 Concluding remarks and implications for future workplace sedentary and LPA interventions and research

The first research study found that the validated self-report measure may be acceptable for assessing workplace sitting and sitting-breaks among desk-based workers. Specifically, the measure is valid at a population level, such as when monitoring and surveying workplace sitting and sitting-breaks, and when exploring the variables relevant to workplace sitting and sitting-breaks etc. (Atkin et al., 2012). The research study also indicated that desk-based workers’ sitting time can be accurately captured using a self-report questionnaire for assessing the proportion of
work time spent sitting (as described in Appendix C). The implications are promising when considering the importance of developing practical self-report questions that can minimise participant time and burden (Atkin et al., 2012; Clark et al., 2009; Sallis & Saelens, 2000).

Future research may benefit from further validating a workplace measure that considers various workplace jobs with diverse levels of workplace sitting time, including objective measures of postural allocation, and controlling for structured work-breaks (i.e., excluding lunch breaks; Clark et al., 2011; Kozey-Keadle et al., 2011). Furthermore, in light of research indicating that sedentary time accumulated in an accumulated uninterrupted manner may also have health implications, future research may benefit from developing a measure that can accurately capture this. For example, in addition to capturing the frequency of sitting-breaks, also capturing the length of sitting bouts during working time (Healy et al., 2008; Ryan et al., 2011).

The workplace sedentary study confirmed that desk-based employees and managers are in need of LPA interventions to reduce and break-up workplace sitting (Clemes et al., 2014; Healy et al., 2013; McCrady & Levine, 2009; Plotnikoff & Karunamuni, 2012; Ryan et al., 2011; Thorp et al., 2012). Furthermore, simply encouraging desk-based employees to increase their current sitting-breaks behaviours may not be sufficient, not only because such sitting-breaks behaviours appear unrelated to workplace sitting time, they may not be feasibly increased and may even compromise working time (i.e., encouraging increased drink/food breaks and bathroom visits may displace working time). Such insights confirm the importance of moving beyond educational strategies and that environmental strategies employed by workplace LPA interventions, such as sit-stand desks, may be more efficacious in changing workplace sitting time and LPA long term (Healy et al., 2013; Parry et al., 2014).
Chapter Ten: Thesis conclusions

Targeting workplace sitting appears particularly relevant to addressing the physical manner in which work-based tasks can be completed, this is consistent with the non-discretionary nature of workplace sitting and the environmental level focus of current workplace LPA interventions (Chau et al., 2010; Biddle, 2011; Pronk et al., 2012). Providing the physical environment that supports reductions in sitting time at work and setting the scene for the development of healthy workplace LPA habits appears to be an important and essential first step. Without these initial changes to the workplace physical-environment, promoting workplace LPA is likely to be unsuccessful, particularly considering the ubiquitous and habitual nature of workplace sitting (Verplanken & Wood, 2006). However, merely providing the physical means to promote LPA workplace behaviour change may not be sufficient (Straker et al., 2013). The present findings indicate that consideration is also warranted toward potential intrapersonal level factors of relevance, particularly in relation to creating healthy workplace habits. Specifically, via reducing and addressing perceived obstacles and increasing confidence towards sitting-breaks, which may promote the development of healthy LPA workplace habits and ultimately increase workplace LPA (Bennie et al., 2011; Sallis et al., 2006).

Future research may benefit from further exploring the relationship between both controlled and automatic processes relevant to both reducing workplace sitting (i.e., intention to reduce sitting-time; Conroy et al., 2013) and promoting workplace LPA. Particularly with research that has the ability to measure changes in potential variables of relevance over time, such as in workplace LPA interventions (Evans, 2003; Warner & Biddle, 2009). Such research may also benefit from further exploring the barriers particularly relevant to workplace LPA and the role of self-efficacy in the adoption and habit formation of novel sitting-breaks behaviours (Bandura, 1997; Bennie et al., 2011). Extending this research to also include other constructs and
Chapter Ten: Thesis conclusions

Theories of health behaviour change, such as the theory of planned behaviour, and including theories that postulate relations between controlled and automatic determinants of behaviour, such as temporal self-regulatory theory, may also prove successful (Conroy et al., 2013; Rothman et al., 2009; Zimmerman & Vernberg, 1994). This focus may also benefit from elucidating variables specific to both reducing workplace sitting and increasing workplace LPA. Such understanding may provide additional insights into potential intervention targets to promote reductions in sitting and increases in LPA in the workplace (Dishman et al., 2012).

The managers’ less favourable beliefs concerning their employees’ ability to break-up workplace sitting highlights the importance of considering variables relevant to workplace LPA behaviour from the perspective of important interpersonal influences. That is, from the perspective of managers of desk-based employees. While the current research study did not examine what influence this may have on employees’ behaviour, both the employees and managers highly rated management and policy-level support for sitting-breaks as important. It is possible that the managers’ attitudes may deem LPA change as unfeasible health promotion targets for employees (i.e., too many obstacle and limited confidence to take sitting-breaks). In turn this may negatively influence managers’ encouragement and support of LPA workplace behaviour, which has the potential to undermine LPA workplace behaviour among employees (Della et al., 2010; Engström, 2008; Gilson et al., 2012a). This indicates that addressing healthy workplaces from a top-down perspective, by way of gaining support from management, may constitute an important area of workplace change. Specifically, ensuring management fully understands the perceived challenges for employees to take sitting-breaks, and their role in encouraging and promoting workplace change, appear as an important potential strategy for future workplace initiatives. Future research may benefit from further understanding how management
support may influence employees’ workplace behaviours, how to align managers’ and employees’ perceptions, and how favourable interpersonal environments for LPA change can be best created. Such a research pursuit may be guided by social cognitive theory (Bandura, 1997; Linnan et al., 2013).

For workplace intervention to be well received and successful, awareness of the chronic health effects associated with accumulated sitting needs to be increased; particularly for those who engage in high amounts of leisure-time MVPA. As the findings indicated, there was a perception among participants that the level of workplace sedentary time may be deemed irrelevant for health if one attains sufficient leisure-time MVPA. While the provision of information about the chronic health effects of accumulated workplace sitting may be well received, this understanding may compete with and be undermined by pre-existing beliefs about leisure-time MVPA. It needs to be emphasised that the health benefits of regular leisure-time MVPA are possibly independent of the detrimental health effects of extensive workplace sitting (Tremblay et al., 2010). Furthermore, the workplace needs to be stressed as an important setting in which behaviours can detrimentally (i.e., accumulated sitting) and favourably influence health (i.e., increases in physical activity; Tremblay et al., 2010). While it appears unrealistic to assume that awareness alone may translate into behaviour change, knowledge provision is an essential component of intervention and health promotion attempts. Knowledge about the adverse health effects of behaviour provides a rationale for intervention and behaviour change, thus constitutes an important focus of further research (Straker et al., 2013; Trost et al., 2002; Rosenstocks, 1974).

While desk-based employees and managers appear receptive to the introduction of LPA strategies, concerns around work-productivity, workplace culture, the physical constraints of the workplace, and the enforcement of such strategies need
to be further examined. These concerns may potentially undermine receptiveness to LPA strategies. It is possible that workplace behaviour change may be more successful if attempts can build, at least initially on LPA strategies desk-based workers are more willing to engage in, such as via encouraging using a printer/scanner in a LPA manner, standing and working for intervals. Considering the typical workplace favours sitting and the employees indicated concerns around the enforcement of LPA strategies, if attempts to increase workplace LPA strategies can build on strategies that may be more receptive it may pave the way for LPA change and receptiveness to other LPA strategies, such as the use of sit-stand desks and participation in standing/walking meetings. Although, while enforcing participation in strategies may undermine workplace LPA, considering the high habitualness and physical-environmental factors that deem workplace sitting ubiquitous, without some form of environmental-ergonomic level change, LPA workplace behaviour change is likely to be unsuccessful if it is to be solely reliant on individual decision making (Gilson et al., 2012a; Verplanken & Wood, 2006). Further research is needed to examine the optimal manner in which workplace LPA strategies may be implemented. Specifically, from the perspective of promoting initial and sustained LPA engagement (Gilson et al., 2012a; Straker et al., 2013; Verplanken & Wood, 2006). Further research may also benefit from examining what may influence willingness to engage in some LPA strategies over others.

Concerns regarding the effects on work productivity and how they impact on acceptability of LPA strategies need to be further examined. As it is part of the managers’ role to consider workplace productivity and costs (“making the case for business”), it is possible that such concerns may undermine their receptiveness towards LPA workplace change (Della et al., 2010; Engström, 2008; Gilson et al., 2012a, p. 211). Considering the integral role managers play in implementing and
promoting workplace change and influencing employees, this is an important area in need of further research and clarification (Della et al., 2010; Engström, 2008; Gilson et al., 2012a; HPIA, 2007; Linnan et al., 2013; Pronk, 2010). Past intervention research also supports this research pursuit, particularly using standardised outcomes measures assessing both short- and long-term effects on work-productivity (Allkhaja et al., 2012; Brown et al., 2013; Thompson et al., 2007; Pronk et al., 2007).

The workplace sedentary study provided empirical evidence that further understanding the intrapersonal and interpersonal variables relevant to workplace sitting and sitting-breaks is likely to be an important and valid research pursuit for understanding and addressing workplace sedentary and LPA behaviour (Biddle, 2010; Plotnikoff & Karunamuni, 2012).

10.4 Thesis conclusion

In summary, this thesis presents a novel contribution to the literature in regard to the development of psychometrically sound measure of workplace sitting and sitting-breaks, and a rationale for further understanding ecological factors related to workplace sitting and sitting-breaks. It examined desk-based employees’ and managers’ perceptions of workplace sedentary behaviour and promoting increases in LPA. While altering the physical workplace environment appears important for supporting such changes, the results of the studies described in this thesis indicate that attention is warranted beyond solely providing the physical context conducive to change. Attention is also warranted at the intrapersonal level (creating healthy and sustained workplace habits by addressing relevant controlled and automatic processes for behaviour change); and at the interpersonal level (e.g., the managers who have a direct or indirect influence over the workplace environment of co-workers). It is hoped that future research will seek to further understand the relative influence and interactions between various social ecological predictors relevant to workplace sitting
and LPA with the ultimate aim of promoting healthy and sustained workplace habits (Straker et al., 2013). This is important in light of mounting evidence indicating that accumulated sedentary time is associated with adverse health outcomes, and desk-based workers spend a large portion of their day in uninterrupted sitting (Clemes et al., 2014; Hamilton et al., 2008; Thorp et al., 2011).
References


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APPENDIX A: Validation study (study 1) ethics

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Memorandum

To A/Prof Alexander Mussap & Prof Jo Salmon
School of Psychology & Exercise and Nutrition
Sciences

Date 29 May, 2012

From Secretary – HEAG-H
Faculty of Health

Subject HEAG-H 62_2012: Validation of a self-report secretary behaviour measure

Approval has been given for A/Prof Alexander Mussap & Prof Jo Salmon of the School of Psychology & ENS, to undertake this project for a period of 2 years from 29 May, 2012. The current end date for this project is 29 May, 2014.

The approval given by the Deakin University HEAG - H is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Secretary immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion
- Modifications that have been requested by other Human Research Ethics Committees

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

HEAG-H may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007). An Annual Project Report Form can be found at http://www.deakin.edu.au/hmibs/research/ethics/ethicssubmissionprocess.php which you will be required to complete in relation to this research. This should be completed and returned to the Administrative Officer to the HEAG-H, Pro-Vice Chancellor’s office, Faculty of Health, Burwood campus by Tuesday 20th November, 2012 and when the project is completed.

Good luck with the project!

Signature Redacted by Library

Steven Sawyer
Secretary
HEAG-H

cc Bronwyn Sudhalz, Eliza Hawkey, Ming Mei Tan Tim, Andera Laksana,
Jacqueline Tedinson, Katherine Beicos, Senaya Aden.
APPENDIX B: Validation study (study one) Plain Language Statement and consent form

Full Project Title: The psychosocial factors of sedentary behaviour

Principal Researchers: Associate Professor Alexander Mussap and Professor Jo Salmon

Student Researchers: Bronwyn Sudholz, Eliza Hawley, Ming Mei Tan Tan, Andrea Laksana, Jacqueline Tzefronis, Katherine Boicos and Senaya Aden.

Are you at least 18 years of age and currently working a job where you spend most of your time sitting down? If so, I would like to ask you to participate in our study. On completion of the study you will receive a $20 Cole-Myer gift voucher. Your participation would involve:

a) Organising a contact time and meeting place with a student researcher at the start and end of a one week period
b) Wearing two device based activity measures over a one week period. These are small devices that detect movement and motion; one is worn on your hip and the other around your thigh.
c) Recording when these devices are taken off and what time your start and finish work
d) Filling in a short 7 minute activity questionnaire at the start and end of this one week period. This questionnaire will ask you about your level of physical activity and sitting time. E.g., During the last 7 days, how much time did you usually spend sitting at work on a weekday

Research is suggesting there is a relationship between sedentary time (i.e., time spent sitting down) and negative physical health effects. This research study aims to understand the consistency and accuracy of different measures of sedentary behaviour. This understanding will influence what we know about sedentary behaviour and how we can measure sedentary behaviour in the future.

The research findings will be written up in the form of a thesis and will be submitted for publication in a research journal. Participation will be anonymous, this will be ensured by the use of a unique alphanumeric code linking your questionnaire answers and your device based activity results. Storage of the collected data will adhere to the University regulations and be kept on the research supervisor’s secure password-protected computer at Deakin University for a minimum of six years. There are no foreseeable risks associated with participation in this research project and you are free to withdraw from the research at any time simply by not completing the questionnaire.
This project will be carried out according to the National Statement on Ethical Conduct in Human Research (2007) produced by the National Health and Medical Research Council of Australia. This statement has been developed to protect the interests of people who agree to participate in human research studies. The ethics aspects of this research project have been approved by the Human Research Ethics Committee of Deakin University.

If you have any queries or would like to be informed of the aggregate research findings, please contact A/Prof Alexander Mussap (mussap@deakin.edu.au; phone: (03)92517103)

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact: The Manager, Deakin Research Integrity, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, Facsimile: 9244 6581; research-ethics@deakin.edu.au

Please quote project number HEAG-H62_2012.

<table>
<thead>
<tr>
<th>Consent Form</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>To:</strong></td>
</tr>
<tr>
<td>Date:</td>
</tr>
<tr>
<td><strong>Full Project Title:</strong> Validation of a self-report Physical Activity Measure</td>
</tr>
<tr>
<td><strong>Reference Number:</strong> HEAG-H 62_2012</td>
</tr>
<tr>
<td>I have read and I understand the attached Plain Language Statement.</td>
</tr>
<tr>
<td>I freely agree to participate in this project according to the conditions in the Plain Language Statement.</td>
</tr>
<tr>
<td>I have been given a copy of the Plain Language Statement and Consent Form to keep.</td>
</tr>
<tr>
<td>The researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.</td>
</tr>
</tbody>
</table>

Participant’s Name (printed)  
………………………………………………………………………………………………

Signature ………………………………… Date  
………………………………
APPENDIX C: Validation study (study one) self-report questionnaire

Date ____________

**DEMOGRAPHICS**
Could you please provide some information about you:

1. **Are you?** Please select one box

   - [ ] Male
   - [ ] Female

2. **How much do you weigh without clothes and shoes?** (If unsure please state best guess)

   _____ kg or _____ stone / pounds

3. **How tall are you without shoes?** (If unsure please state best guess)

   _____ cm or _____ feet / inches

4. **How old are you** (in years)

   ________

5. **Approximately how much time do you spend sitting down at work during a typical workday?** (Please circle the best option)

   - a. almost never
   - b. one fourth of the time
   - c. half of the time
   - d. three fourths of the time
   - e. almost all the time

6. **What is the HIGHEST qualification you have completed?** (Please circle one response)

   - a. No formal qualifications
   - b. Year 10 or equivalent (e.g., school certificate)
   - c. Year 12 or equivalent (e.g. Higher School Certificate, final year of secondary school)
   - d. Trade/apprenticeship (e.g. hairdresser, chef)
   - e. Certificate/diploma (e.g. childcare, technician)
   - f. University degree
   - g. Higher University degree (e.g. Graduate Diploma, Masters, PhD)

7. **Which of the following BEST describes your current MAIN DAILY activities and/or responsibilities?** (Please circle one response)

   - a. Working full-time
   - b. Working part-time
   - c. Unemployed or laid off
   - d. Keeping and/or raising children full-time
   - e. Studying full-time
f. Studying part-time

g. Retired

**PHYSICAL ACTIVITY**

- *This section was again completed at the end of the validation week.*

The following questions are about any physical activities that you may do in a typical week. Please answer the questions based on the past year.

8. In a typical week, how many times have you walked continuously for at least 10 minutes, for recreation, exercise or to get to or from places?

   
   □ times

9. What do you estimate was the total time that you spent walking in a continuous way during a typical week? *(in hours and/or minutes)*

   
   □ hours □ minutes

10. In a typical week, how many times did you do any vigorous household chores, gardening or heavy yardwork, which made you breathe harder or puff and pant?

    
    □ times

11. What do you estimate was the total time that you spent doing vigorous household chores, gardening or yardwork, in a typical week? *(in hours and/or minutes)*

    
    □ hours □ minutes

The next questions exclude household chores, gardening or yardwork:
12. In a typical week, how many times did you do any vigorous physical activity which made you breathe harder or puff and pant? (e.g. jogging, cycling, aerobics, competitive tennis)

[ ] times

13. What do you estimate was the total time that you spent doing this vigorous physical activity in a typical week? (in hours and/or minutes)

[ ] hours [ ] minutes

14. In a typical week, how many times did you do any other more moderate physical activities that you have not already mentioned? (e.g. gentle swimming, social tennis, golf)

[ ] times

What do you estimate was the total time that you spent doing these activities in a typical week? (in hours and/or minutes)

[ ] hours [ ] minutes

**SITTING TIME**

- *This section was again completed at the end of the validation week.*

The next questions are about the time you spend sitting at a) **work** or b) **during your leisure-time**. The first questions are about the time spent sitting at work. This may include time spent sitting at a desk or using a computer. Do not include any time spent sitting when travelling to work.

16. During the last 7 days, how much time did you usually spend sitting at work on a weekday? (if you did not work on a week day your answer would be 0 hours per day)

[ ] hours per day [ ] minutes per day
17. During the last 7 days, how much time did you usually spend sitting at work on a weekend day? (if you did not work on the weekend your answer would be 0 hours per day)

☐ hours per day ☐ minutes per day

The next questions are about the time spent sitting in your leisure-time. This may include visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting while travelling.

18. During the last 7 days, how much time did you usually spend sitting during your leisure-time on a weekday?

☐ hours per day ☐ minutes per day

19. During the last 7 days, how much time did you usually spend sitting during your leisure-time on a weekend day?

☐ hours per day ☐ minutes per day

WORKPLACE BREAKS FROM SITTING

- This section was again completed at the end of the validation week.

An area we wish to explore is whether you take breaks from sitting while at work, in a typical week and over the last 7 days. Specifically, we are interested in sitting breaks that include standing or involve being on your feet as opposed to just sitting down. For example, standing up, moving around your workstation to perhaps to get a drink, have a bathroom break or even continuing a work task while standing.

a. In the last 7 days, how many breaks from sitting did you take per hour while at work? This could include standing, stretching, taking a short walk etc. Please do not count lunch breaks or tea breaks.

☐ breaks per hour

b. In the last 7 days, when you took a break from sitting at work, how long did the break usually last?

☐ mins and ☐ secs
APPENDIX D: ActiGraph information

Activity Monitor Protocol

**ActiGraphs:** Are a small plastic box (approximately the size of matchbox) that is worn on an elastic belt around the waist during waking hours for one week, including on the weekend (it can be worn under clothes). The ActiGraph utilises a motion sensor known as an “accelerometer” to measure the magnitude of movement and amount of movement. The activity monitor has been used for the last ten years in Scientific Research as an objective way to an individual’s activity level (or lack of activity). The activity monitor is no more harmful than wearing a watch. The activity monitor contains a small battery and is set to record the physical activity of the participant during the week that it is being worn. This data is downloaded at the end of the week back at the research centre. These devices are designed to detect vertical acceleration ranging in magnitude from 0.05 to 2.00 G with frequency response of 0.25 to 2.50 Hz. These parameters allow for the detection of normal human motion and will reject high frequency vibrations encountered in activities such as operation of a lawn mower. The filtered acceleration signal is digitised and the magnitude is summed over a user-specified time interval usually one minute.

**Fitting the activity monitor**

1. Explain to the participant:
   - the monitor is attached to the elastic belt and is to be worn on the right hip
   - the monitor can not be worn in water and must be removed for bathing or swimming
   - the monitor is to be worn from waking until bed time at night
   - that they need to record any activities they perform while not wearing it (eg swimming) on the monitor sheet

2. Show the participant how the monitor is to be worn (smile facing up)

3. Give the monitor and belt to the participant to fasten around their waist, assist them if required.
APPENDIX E: Validation study (study one) behaviour activity log

Monitor log

If you remove your monitor during the day for any reason, please record why and your activity. Please also indicate when you started and finished work, if you did not work please put NA.

<table>
<thead>
<tr>
<th>Date</th>
<th>What were you doing?</th>
<th>Time started</th>
<th>Duration (min)</th>
<th>What time did you start and finish work (do NOT include travel time to and from work)</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g., 28/9 Monday</td>
<td>Swimming</td>
<td>4:30 pm</td>
<td>45 minutes</td>
<td>Start: 4:30 pm Finish: 5:15 pm</td>
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<tr>
<td>Monday</td>
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<td>Start:</td>
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<td></td>
<td>Finish:</td>
</tr>
</tbody>
</table>
APPENDIX F: Validation study (study one) data collection protocol

Initial contact

☐ Organise a time and place to meet the participant. The participant needs to wear the two devices for one week e.g., give them the device Monday night, they start wearing it Tuesday morning and collect it again (at the earliest) the following Monday night.

☐ Get envelope. On Google docs and spreadsheet make sure ID numbers (on all sheets) correspond to device model numbers. You will need to put the ID numbers on all the sheets in the envelopes you get from Alex’s office.

☐ Envelope should contain
  - Start of week questionnaire
  - End of week questionnaire
  - Monitor form
  - Research consent form
  - Plain language statement
  - Voucher
  - Voucher consent form

☐ Take out this check list, the $20 dollar voucher AND the “end of week questionnaire”

☐ Provide participant with envelope. Get them to read the plain language statement (they keep this) then sign the consent form. Answer any questions, make sure they have:
  a) Signed the consent form (and the ID is on it)
  b) Filled out the “start of week questionnaire”- make sure it is dated
     - **You need to collect these two items from the participant!**

☐ Explain the device based measures, when to wear them (during waking hours) and when not to wear them (when sleeping, showering or swimming). Demonstrate how to wear the device and assist the participant to put them on if need. Provide extra info if needed –see handouts.

☐ Show the participant the monitor log. Explain how to use it (e.g., record when you start and finish work- this does not include travel time to and from work, and to note when and for how long the device was taken off during waking hours).

☐ Organise a meeting time for the following week, provide an email contact should any problems arise during the one week period. Make sure they have worn the devices for a one week period i.e., if you give it to them Monday night to wear starting Tuesday you need to collect it at the earliest- the following Tuesday.

Follow up contact:

☐ Confirm follow up time mid week and see how the participant is going (best to give a call). This is very important and will help with compliance.
Collect the two device based measures. You must be persistent in collecting the devices- as they are expensive!

Get the participant to fill out the “end of week questionnaire”. Ensure it is dated and has the correct ID number

Ensure they have completed the monitor log- especially when they started and finished work each day

Once everything has been collected and completed? Give the participant the $20 dollar Coles-Myer voucher

Get to them sign the sheet confirming the have received the $20 dollar voucher

**Picking up/ dropping off the devices**

- If you have organised to do this on a Monday (preferable) I will bring the devices to our meeting
- If you are picking them up on a Tuesday or Thursday (based on when Sharon works) you will need to first collect an envelope and then go to Sharon’s office J3.49. Double check that the ID # and Monitor numbers correspond! (Sharon has a box for us on the bookcase just behind the computer screen on the top shelf in her office- there is a spreadsheet in this to confirm ID and monitor numbers)
- The participant needs to have the device for one whole week (they may accidentally miss one day- this is ok) so if you give it to them on Monday night and they start wearing it Tuesday you can pick it up earliest Monday night (has to be at the end of the day). Try to pick the device up as soon as possible so we can keep collecting data (there is only a certain number of devices!).
- It may help with compliance to tell them that we can tell when they take it off and that we would really appreciate if they could wear it every day as the data will be better quality.
- Return device to Sharon’s office (J3.49) again put it in the box. Record on Google docs when you returned it- this is important in case devices go missing.

**What to do with the envelope and reaming documents?**

You should have in the envelope

- A completed “start of week questionnaire”
- A completed “end of week questionnaire”
- A filled in monitor log
- Research consent form- signed!
- Voucher Consent form- signed!

Keep these things in the envelope and give them to Alex or hand them to me in the next meeting.
APPENDIX G: Workplace sedentary study (study two) ethics approval

DEAKIN UNIVERSITY

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Memorandum

To
Associate Professor Alexander Mussap
School of Psychology

From
Secretary – HEAG-H
Faculty of Health

Date
26 April, 2012

Subject
HEAG-H 24/2012: The psychosocial factors of sedentary behavior.

Approval has been given for Associate Professor Alexander Mussap, School of Psychology, to undertake this project for a period of 3 years from 26 April, 2012. The current end date for this project is 26 April 2015.

The approval given by the Deakin University HEAG – H is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Secretary immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion
- Modifications that have been requested by other Human Research Ethics Committees

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

HEAG-H may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007). An Annual Project Report Form can be found at http://www.deakin.edu.au/hmbhs/research/ethics/ethicssubmissionprocess.php which you will be required to complete in relation to this research. This should be completed and returned to the Administrative Officer to the HEAG-H, Pro-Vice Chancellor’s Office, Faculty of Health, Burwood campus by Tuesday 20th November, 2012 and when the project is completed.

Good luck with the project!

Signature Redacted by Library

Steven Sawyer
Secretary
Full Project Title: The psychosocial factors of sedentary behaviour and light intensity physical activity in the workplace context

Principal Researchers: Associate Professor Alexander Mussap and Professor Jo Salmon

Student Researcher: Bronwyn Sudholz

Are you at least 18 years of age and currently work in a job where you spend time sitting down? If so, I would like to ask you about your attitudes to sitting down at work and about the benefits of breaking up your sitting time, such as standing and being on your feet at work. The online questionnaire will take approximately 15-20 minutes to complete.

The research study aims to understand what factors influence ones engagement in sedentary behaviour (defined as sitting time) and taking breaks from sitting while at work. The research results are expected to inform the development of work based interventions aiming to reduce workplace sedentary behaviour.

If you agree to complete the online questionnaire you will asked various questions about your level of physical activity and sedentary behaviour, there are also questions exploring your knowledge, barriers and sedentary behaviour habit. Examples of questions include:

- During the last 7 days, how much time did you usually spend sitting at work on a weekday
- Reducing or breaking up my sitting time at work is something I often do

The research findings will be written up in the form of a thesis and will be submitted for publication in a research journal. Participation is completely anonymous and none
of the information you provide will reveal your identity. Storage of the collected data will adhere to the University regulations and be kept on the research supervisor’s secure password-protected computer at Deakin University for a minimum of six years. There are no foreseeable risks associated with participation in this research project and you are free to withdraw from the research at any time simply by not completing the questionnaire.

This project will be carried out according to the National Statement on Ethical Conduct in Human Research (2007) produced by the National Health and Medical Research Council of Australia. This statement has been developed to protect the interests of people who agree to participate in human research studies. The ethics aspects of this research project have been approved by the Human Research Ethics Committee of Deakin University.

If you have any queries or would like to be informed of the aggregate research findings, please contact A/Prof Alexander Mussap (mussap@deakin.edu.au; phone: (03)92517103)

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact: The Manager, Deakin Research Integrity, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, Facsimile: 9244 6581; research-ethics@deakin.edu.au

Please quote project number **HEAG-H 24_2012**

Please indicate that you have read and understood the information provided here and that you agree to participate in this study by clicking the “I agree” button below.
APPENDIX I: Workplace sedentary study (study two) employee questionnaire

SECTIONS 1: Demographics
Instructions:
Could you please provide some information about you:

Item:
Are you?

Scale:
____ Male
____ Female

Item:
How much do you weigh without clothes and shoes? (if unsure please state best guess)

Scale:
______________ kg  or  ______________ stone / pounds

Item:
How tall are you without shoes? (If unsure please state best guess)

Scale:
______________ cm  or  __________ feet / inches

Item:
What is your date of birth? (Please write on the line)

Scale:
______/______/19____ (dd/mm/19yy)

Item:
What is the HIGHEST qualification you have completed? (Please select one response in each column).

Scale:
  a) No formal qualifications
  b) Year 10 or equivalent (e.g. School Certificate)
  c) Year 12 or equivalent (e.g. Higher School Certificate, final year of secondary school)
  d) Trade/apprenticeship (e.g. hairdresser, chef)
  e) Certificate/diploma (e.g. childcare, technician)
  f) University degree
  g) Higher University degree (e.g. Graduate Diploma, Masters, PhD)

Item:
Which of the following BEST describes your current MAIN DAILY activities and/or responsibilities? (Please select one response).

Scale:
  a) Working full-time
  b) Working part-time
  c) Unemployed or laid off
  d) Keeping and/or raising children full-time
  e) Studying full-time
f) Studying part-time

g) Retired

**Item:**
What is the average gross (before tax) income that you receive each WEEK, including wages, salary, pensions and allowances? (Please tick one response)

**Scale:**

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>No income</td>
<td>1</td>
</tr>
<tr>
<td>$1-$119 per week ($1-$6,239 annually)</td>
<td>2</td>
</tr>
<tr>
<td>$120-$299 per week ($6,240-$15,999 annually)</td>
<td>3</td>
</tr>
<tr>
<td>$300-$499 per week ($16,000-$25,999 annually)</td>
<td>4</td>
</tr>
<tr>
<td>$500-$699 per week ($26,000-$36,999 annually)</td>
<td>5</td>
</tr>
<tr>
<td>$700-$999 per week ($37,000-$51,999 annually)</td>
<td>6</td>
</tr>
<tr>
<td>$1,000-$1,499 per week ($52,000-$77,999 annually)</td>
<td>7</td>
</tr>
<tr>
<td>$1,500 or more per week ($78,000 or more annually)</td>
<td>8</td>
</tr>
<tr>
<td>Don’t know</td>
<td>9</td>
</tr>
<tr>
<td>Don’t want to answer</td>
<td>10</td>
</tr>
</tbody>
</table>

**Item**
Are you a manager?
YES- directed to next question
NO – directed to employee version of questionnaire

*If indicated YES to being a manger:*

**Item**
Are you in a position where you can directly or indirectly influence the workplace environment of co-workers?
YES – directed to manager questionnaire
NO- directed to employee questionnaire

********************************************************************

**SECTION 2: PHYSICAL ACTIVITY & SITTING TIME**

**Instructions**
The following questions are about any physical activities that you may do in a typical week. Please answer the questions based on the past year:

**Item:**
1. In a typical week, how many times have you walked continuously, for at least 10 minutes, for recreation, exercise or to get to or from places?

**Scale:**
**Item:**
2. What do you estimate was the total time that you spent walking in a continuous way during a typical week?

**Scale:**
In hours and/or minutes

_____ Minutes
_____ Hours

**Item:**
3. In a typical week, how many times did you do any vigorous household chores, gardening or heavy yardwork, which made you breathe harder or puff and pant?

**Scale:**

_____ Times

**Item:**
4. What do you estimate was the total time that you spent doing vigorous household chores, gardening or yardwork, in a typical week?

**Scale:**
In hours and/or minutes

_____ Minutes
_____ Hours

**Instructions:**
The next questions exclude household chores, gardening or yardwork:

**Item:**
5. In a typical week, how many times did you do any vigorous physical activity which made you breathe harder or puff and pant? (e.g., jogging, cycling, aerobics, competitive tennis)
Item: 6. What do you estimate was the total time that you spent doing this vigorous physical activity in a typical week?

Scale:
In hours and/or minutes
____ Minutes
____ Hours

Item: 7. In a typical week, how many times did you do any other more moderate physical activities that you have not already mentioned? (e.g. gentle swimming, social tennis, golf)

Scale:
____ Times

Item: 8. What do you estimate was the total time that you spent doing these activities in a typical week?

Scale:
In hours and/or minutes
____ Minutes
____ Hours

Instructions:
The last two questions are about the time you spend sitting at a) work or b) during your leisure-time. The first questions are about the time spent sitting at work. This may include time spent sitting at a desk or using a computer. Do not include any time spent sitting when travelling to work.

Item:
During the last 7 days, how much time did you usually spend sitting at work on a weekday (if you did not work on a week day your answer would be 0 hours per day)?

Scale:
_____ hours per day
_____ minutes per day
Item:
During the last 7 days, how much time did you usually spend sitting at work on a weekend day? (if you did not work on the weekend your answer would be 0 hours per day)
Scale:
_____ hours per day
_____ minutes per day

Instructions:
The next questions are about the time spent sitting in your leisure-time. This may include visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting while travelling.

Item:
During the last 7 days, how much time did you usually spend sitting during your leisure-time on a weekday
Scale:
_____ hours per day
_____ minutes per day

Item:
During the last 7 days, how much time did you usually spend sitting during your leisure-time on a weekend day
Scale:
_____ hours per day
_____ minutes per day

SECTION 3: WORK PLACE BREAKS FROM SITTING

WORKPLACE BREAKS FROM SITTING
An area we wish to explore is whether you take breaks from sitting while at work, in a typical week and over the last 7 days. Specifically, we are interested in sitting breaks that include standing or involve being on your feet as opposed to just sitting down. For example, standing up, moving around your workstation to perhaps to get a drink, have a bathroom break or even continuing a work task while standing.

Item:
In a typical work day, how many breaks from sitting do you take per hour? This could include standing, stretching, taking a short walk etc. Please do not count lunch breaks or tea breaks.
Scale:
___ breaks per hour

Item:
In the last 7 days, how many breaks from sitting did you take per hour while at work? This could include standing, stretching, taking a short walk etc. Please do not count lunch breaks or tea breaks.
Scale:
___ breaks per hour

SECTION 4: CHARACTERISTICS OF WORKPLACE SITTING BREAKS

Instructions:
When/if you take a break from sitting at work, how often do you do each of the following? (Please select? one response for each)
Items:

a) Stand up/ walk a short distance from my desk/ workstation to get a drink or something to eat
b) Stand up/ walk around during my work breaks (e.g., lunch, morning tea)
c) Stand up/walk outside to have a smoking break
d) Stand up/ walk to visit the bathroom
e) Stand up/ walk a short distance and have a chat with my coworkers
f) Stand up/ walk to the printer/ scanner
g) Participate in work tasks while standing or on the move (e.g., standing/ walking meetings)
h) Stand up at my work desk/ workstation
i) Stand while talking on the phone

Item:
Does your workplace currently have any policies/incentives to promote employee health and wellbeing (e.g., healthy eating, physical activity, stress reduction)?

Scale:
No
Yes

Item:
Does your workplace currently promote ways/ offer opportunities for employees to reduce their sitting time (e.g., regular breaks involving standing or walking, standing desks)?

Scale:
No
Yes

Item:
Would you support/be in favour of strategies to reduce sitting time in your workplace?

Scale:
Yes
No
Maybe
Comments

Instructions:
We are interested in wanting to know what would be the most likely strategies you could engage in to reduce sitting time in your workplace. Indicate your reaction to the following suggestions

Items:

a) Having standing meetings
b) Having walking meetings  

c) Encouragements to stand up at regular hourly intervals  

d) Using standing desks in the workplace  

e) Having printers and scanners in a position that requires walking to  

f) Encouragements to stand and work for short intervals throughout the day

**Scale:**  
Yes  
No  
Possibly

**Item:**  
What do you believe the consequences/benefits may be for both employees and the workplace if sitting time could be reduced (if any)?

**Scale:**  

a) Employee consequences (positive/ negative)?

b) Workplace consequences (positive/ negative)?

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**SECTION 5: THINGS THAT AFFECT MY ABILITY TO TAKE BREAKS FROM SITTING AT WORK**

**Instructions:**  
During your working day there may be opportunities for you to take breaks from sitting, such as standing or being on your feet (e.g., standing up, moving around your workstation to perhaps get a drink, have a bathroom break or even continuing a work task while standing).

Various factors may affect your ability to take breaks from sitting at work, please rate how much you agree with the following statements (Please select one answer for each)

**Scale:**  
Strongly agree  
Agree  
Neither agree nor disagree  
Disagree  
Strongly disagree  
Not applicable

**Items:**  
a) I do not have enough free time throughout the working day to take breaks from sitting  
b) It would be helpful if Workplace Health and Safety (OH&S) supported workers taking breaks from sitting at work  
c) Seeing most of my work colleagues also take breaks from sitting would encourage me to do so  
d) Taking breaks from sitting at work would be a low priority for me
e) My workplace should provide me with information about appropriate ways that I can take breaks from sitting
f) Stress at work would affect my ability to take breaks from sitting at work
g) I would not be motivated to take breaks from sitting at work
h) It would be helpful if management supported my attempts to reduce sitting time
i) My workplace has limited physical opportunities for me to take breaks from sitting (e.g., insufficient space to walk around at work)
j) My work demands would not allow me to take breaks from sitting at work
k) I would not have enough energy to take breaks from sitting at work

SECTION 6: MY ABILITY TO TAKE BREAKS FORM SITTING

In light of each of the following situations, please rate how confident you are that you could take breaks from sitting in your workplace? (E.g., standing up, moving around your workstation to perhaps get a drink, have a bathroom break or even continuing a work task while standing) (please select one response for each)

I could take breaks from sitting at work even if…

Scale:
Not at all confident
Slightly confident
Moderately confident
Very confident
Extremely confident

Items:
  a) I did not have support from management
  b) I felt mentally tired
  c) My other work colleagues were not also taking breaks
  d) I was stressed at work
  e) OH&S did not recommended it
  f) I did not have enough free time
  g) My work place had limited space
  h) I was not motivated to do so
  i) My work demands were high
  j) I did not have the energy
  k) It was a low priority for me

SECTION 7: PREFERENCES FOR WORK ACTIVITIES

Instructions:
There may be different ways that you can perform your tasks at work. We are interested in finding out if you could choose among alternative ways of doing these tasks, what would you prefer to do? (Please select your most preferred work activity).

Item:
If you have to work on your computer to complete a task, would you prefer to

Scale:
  a) Sit at your desk until you completed the work task
  b) Break up your sitting time with standing while you were completed the work task
c) \textit{Move around} while you completed the work task

\textbf{Item:}
When at work and you need to talk to a co-worker in your building, would you prefer to (\textit{please select only one}):  
\textbf{Scale:}
\begin{itemize}
  \item[a)] Email/ telephone the co-worker while \textit{sitting} at your desk  
  \item[b)] Email/ telephone the co-worker while \textit{standing} at your desk  
  \item[c)] \textit{Walk} over to talk with your co-worker face-to-face  
\end{itemize}

\textbf{Item:}
When in a work meeting, would you prefer to (\textit{please select only one}):  
\textbf{Scale:}
\begin{itemize}
  \item[a)] \textit{Sit} through the duration of the meeting  
  \item[b)] \textit{Stand} at regular intervals or throughout the meeting  
  \item[c)] \textit{Move} around during the meeting/ have a \textit{walking} meeting  
\end{itemize}

\textbf{Item:}
When at work, would you prefer to (\textit{please select only one}):  
\textbf{Scale:}
\begin{itemize}
  \item[a)] Have the printer/scanner/fax right next to your computer so you could stay \textit{sitting} and use it  
  \item[b)] Have the printer/scanner/fax close by so that all you had to do to use it was \textit{stand up}  
  \item[c)] Have the printer/scanner/fax away from your workstation so you had to \textit{walk} to use it  
\end{itemize}

\textbf{Item:}
During your work breaks, would you prefer to (\textit{please select only one}):  
\textbf{Scale:}
\begin{itemize}
  \item[a)] Stay at your desk or go somewhere else and \textit{sit}  
  \item[b)] \textit{Stand up} during your breaks  
  \item[c)] \textit{Walk} or \textit{move} around during your breaks  
\end{itemize}

\textbf{SECTION 8: HABIT}
\textbf{Instructions:}
There are various types of behaviours you can do at work and often we can do these behaviours without being completely aware we are doing them (eg, sitting at your desk to work on your computer). We’d like you to think about how much you agree/disagree with the following situations (\textit{Please select one response for each})?

\textbf{Scale:}
\begin{itemize}
  \item[1-] Strongly Agree  
  \item[2-]  
  \item[3-]  
  \item[4-]  
  \item[5-] Strongly Disagree  
\end{itemize}

\textbf{Items:}
\textit{Sitting at work is something} ...
1 I do often
2 I do almost automatically
3 I do without having to remember to do so
4 That makes me feel comfortable if I do it
5 I do without thinking
6 That would require conscious effort not to do
7 That belongs to my (daily, weekly, monthly) routine
8 I start doing before I realise I am doing it
9 I would find hard not to do
10 I have no need to think about when I’m doing it
11 That’s typically me
12 I have been doing for a long time

Items:

Breaking up my sitting time at work (e.g., by standing or being on my feet) is something...

1 I do often
2 I do almost automatically
3 I do without having to remember to do so
4 That makes me feel comfortable if I do it
5 I do without thinking
6 That would require conscious effort to do
7 That belongs to my (daily, weekly, monthly) routine
8 I start doing before I realise I am doing it
9 That I would find hard not to do
10 I have no need to think about when I’m doing it
11 That’s typically me
12 I have been doing for a long time

SECTION 9: HOW HEALTHY ARE EACH OF THESE LIFESTYLES?
*Randomised for each participant

Instructions:
Below you will find descriptions of various people’s physical activity levels throughout the day.
Please read each description carefully and rate each person out of 10 for how physically healthy you think they are.

<table>
<thead>
<tr>
<th>Extremely unhealthy</th>
<th>Extremely healthy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

Person 1.
This person has a desk job in which they sit all day and rarely get up and move around. They spend much of their free time sitting watching TV or surfing the internet.
Person 2.
This person has a desk job in which they sit all day and rarely get up and move around. They spend much of their free time doing light physical activities such as gardening and going for leisurely walks.

Person 3.
This person has a desk job in which they sit all day and rarely get up and move around. They spend much of their free time doing vigorous physical activities such as playing sport.

Person 4.
This person works standing up all the day and rarely gets to sit down. They spend much of their free time sitting watching TV or surfing the internet.

Person 5.
This person works standing up all the day and rarely gets to sit down. They spend much of their free time doing light physical activities such as gardening and going for leisurely walks.

Person 6.
This person works standing up all the day and rarely gets to sit down. They spend much of their free time doing vigorous physical activities such as playing sport.

Person 7.
This person works in a physically demanding job in which they rarely get to rest or sit down. They spend much of their free time sitting watching TV or surfing the internet.

Person 8.
This person works in a physically demanding job in which they rarely get to rest or sit down. They spend much of their free time doing light physical activities such as gardening and going for leisurely walks.

Person 9.
This person works in a physically demanding job in which they rarely get to rest or sit down. They spend much of their free time doing vigorous physical activities such as playing sport.

Person 10.
This person has a desk job but they stand at their desk for extended periods of time and often get up to move around. They spend much of their free time and weekends at home sitting watching TV or surfing the internet.

Person 11.
This person has a desk job but they stand at their desk for extended periods of time and often get up to move around. They spend much of their free time doing light physical activities such as gardening, household chores, and going for leisurely walks in the park.

Person 12.
This person has a desk job but they stand at their desk for extended periods of time and often get up to move around. They spend much of their free time being physically active playing sports with their friends.

**SECTION 10: HOW HEALTHY ARE EACH OF THESE ACTIVITIES?**

Finally, please rate out of 10 each activity separately in terms of how **physically healthy** it is.

<table>
<thead>
<tr>
<th>Extremely unhealthy</th>
<th>Extremely healthy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

**Activity 1.** Sitting all day at work and rarely getting up to move around

**Activity 2.** Sitting at home watching TV or surfing the internet

**Activity 3.** Standing for extended periods of time at work and often getting up to move around

**Activity 4.** In leisure time doing light physical activities such as gardening and going to leisurely walk

**Activity 5.** Working in a physically demanding job and rarely getting to rest or sit down.

**Activity 6.** In leisure time doing vigorous physical activities such as playing sport
APPENDIX J: Workplace sedentary study (study two) manager questionnaire

SECTION 1: DEMOGRAPHICS
- Completed and the same as previously detailed in Appendix J.

SECTION 2: PHYSICAL ACTIVITY & SITTING TIME
- Same as previously detailed in Appendix J.

SECTION 3: WORK PLACE BREAKS FROM SITTING
- Same as previously detailed in Appendix J.

SECTION 4: CHARACTERISTICS OF WORKPLACE SITTING BREAKS

Item:
Does your workplace currently have any policies/incentives to promote employee health and wellbeing (e.g., healthy eating, physical activity, stress reduction)?
Scale:
No
Yes
If “yes” is selected, prompt with; could you please describe these policies/incentives ______

Item:
Does your workplace currently promote ways/offer opportunities for employees to reduce their sitting time (e.g., regular breaks involving standing or walking, standing desks)?
Scale:
No
Yes
If “yes” is selected, prompt with; could you please describe these policies/incentives ______

Item:
Would you be willing to implement, if you have not already, strategies to reduce sitting time in your workplace?
Scale:
No
Yes
Maybe

Instructions:
We are interested in wanting to know what would be the most likely strategies you could use to promote reductions in sitting time in your workplace. Please indicate your reaction to the following suggestions?

Items:
  g) Having standing meetings
  h) Having walking meetings
  i) Encouraging employees to stand up at regular hourly intervals
  j) Incorporating standing desks into the workplace
  k) Placing printers and scanners in a position that requires walking to
  l) Encouraging employees to stand and work for short intervals throughout the day
Can you think of any other strategies? If so, please list them here: __________________________________________

Item:
What do you believe the consequences/benefits may be for both employees and the workplace if sitting time could be reduced- if any?

Scale:
  c) Employee consequences (positive/ negative)?
  d) Workplace consequences (positive/ negative)?

SECTION 5: Things that affect my employee’s ability to take breaks from sitting

Instructions:
During the working day there may be opportunities for your employees to take breaks from sitting, such as standing or being on their feet (e.g., standing up, moving around their workstation to perhaps get a drink, have a bathroom break or even continuing a work task while standing).

Various factors may affect your employee’s ability to take breaks from sitting at work, please rate how much you agree with the following statements (Please select one answer for each)

Scale:
Strongly agree
Agree
Neither agree nor disagree
Disagree
Strongly disagree
Not applicable

Items:
l) Employees do not have enough free time throughout the working day to take breaks from sitting
m) It would be helpful for employees if Workplace Health and Safety (OH&S) supported workers taking breaks from sitting at work
n) Employees seeing their work colleagues also take breaks from sitting would encourage them to do so also
o) Taking breaks from sitting at work would be a low priority for employees
p) The workplace should provide employees with information about appropriate ways to take breaks from sitting
q) Stress at work would affect employees ability to take breaks from sitting at work
r) Employees would not be motivated to take breaks from sitting at work
s) Having management support for breaks from sitting at work would be important for employees
t) The workplace has limited physical opportunities for employees to take breaks from sitting (e.g., insufficient space to walk around at work)
u) The work demands would not allow employees to take breaks from sitting at work
v) Employees would not have enough energy for taking breaks from sitting at work

SECTION 6: EMPLOYEE’S ABILITY TO TAKE BREAKS FROM SITTING

In light of each of the following situations, please rate how confident you are that your employees could take breaks from sitting in the workplace? (E.g., standing up, moving around their workstation to perhaps to get a drink, have a bathroom break or even continuing a work task while standing) (please select one response for each).

Employees could take breaks from sitting at work even if…

Scale:
Not at all confident
Slightly confident
Moderately confident
Very confident
Extremely confident

Items:
l) They did not have support from management
m) They felt mentally tired
n) Other work colleagues were not also taking breaks
o) They were stressed at work
p) OH&S did not recommended it
q) They did not have enough free time
r) The workplace had limited space
s) They were not motivated to do so
t) The work demands were high
u) They did not have the energy
v) It was a low priority for them

SECTION 7: HOW HEALTHY ARE EACH OF THESE LIFESTYLES AND ACTIVITIES?

- Same as previously detailed in Appendix J.
APPENDIX K: proportion of work time spent sitting.

Proportion of sitting time at work (Katzmarzyk, Church, Craig, & Bouchard, 2009).

Proportion of workplace sitting time was obtained by asking participants to indicate the approximate proportion of their workday they spent sitting. Response items consisted of: a) almost never, b) one-fourth of the time, c) half of the time, d) three-fourths of the time, and e) almost-all of the time. This question was only asked of participants once, at the start of the validation week. Items were adapted from Katzmarzyk et al. (2009) to reflect the proportion of time spent sitting on a ‘typical workday’.

The proportion of workplace sedentary time was calculated from the total work time, as identified in the behavioural log and expressed as a proportion out of one (Chau et al., 2012). When comparing the self-report proportion of sitting to the accelerometer-derived sedentary proportion, the accelerometer data were categorized at the following proportional thresholds: 1) almost never = 0.00-.05, 2) one-fourth of the time = 0.06-0.25, 3) half of the time = 0.26-0.50, 4) three-fourths of the time= 0.51-0.75, and 5) almost-all of the time =0.76-1 (Katzmarkyz et al., 2009).

To examine the criterion validity of self-report proportion of work time spent sitting, kappa statistic and percent agreement were calculated. Kappa coefficients ($k$) is an estimate of the proportion of agreement between two categorical instruments, and takes into account the amount of agreement that could have occurred by chance (Maclure & Willett, 1987). Kappa was defined as poor or slight (Kappa= 0.00-0.20), fair (Kappa =0.21-0.40), moderate (Kappa =0.41-0.60), substantial (Kappa = 0.61-.80) and almost perfect (Kappa =0.81-1.0; Landis & Koch, 1977). Percent agreement was also calculated in recognition that $k$ can be unstable when the proportion of responses
are not balance between the categories, which was evident within the observed data (i.e., most participants reported sitting for most of their work time; Hoehler, 2000; Maclure & Willett, 1987). Percent agreement between 50 to 75%, has been proposed to represent evidence of acceptable agreement between two categorical measures (Hoehler, 200).

The kappa measure of agreement was 0.21, with a significance level of \(p=.047\), which represents fair agreement. The percentage agreement between the self-reported and accelerometer-derived proportion of workplace sitting/sedentary time was 64.70%, indicating acceptable agreement (Hoehler, 2000; Maclure & Willett, 1987).
APPENDIX L: Employees’ barriers and managers’ rating of employees’ barriers towards taking sitting-breaks

Employees’ ecological barriers towards sitting-breaks

To explore what items the employees endorsed as barriers, means and standard deviations for each item was calculated. Results are presented in Table 1, in order of the highest mean to the lowest. A mean score of > 0 reflects ‘agreement’, ‘0’ reflects ‘neither agreement of disagreement’, and < 0 reflects ‘disagreement’; that the various items may influence workplace sitting-breaks. To examine if there was a significant difference in the rating of these barriers, an ANOVA was conducted between adjacent items (i.e., items ordered based on level in which they were endorsed as barriers). A significant multivariate effect revealed significant differences in mean ratings for the various barrier items (Wilks’ Lambda =.18, $F[10, 192] = 88.83, p=.00, \eta^2 = .82$. The within subject contrasts significant values are also presented in Table 1. Table 1 indicates that the employees agreed that a number of ecological barriers would influence their ability to take sitting-breaks. The ANOVA results indicated that colleagues taking breaks, management support, and OH&S support were the highest rated ecological barriers to taking sitting-breaks ($F[1, 201]= 16.91, p=.00, \eta^2 = .08$). Workplace information and workplace stress ($F[1, 201] = 31.06, p=.00, \eta^2 = .13$) were rated as the next-highest barriers.
Table 1 Employees’ ecological Barrier Means, Standard Deviations, and ANOVA results

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Mean (SD)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colleagues taking breaks</td>
<td>0.97 (0.89)</td>
<td>.50</td>
</tr>
<tr>
<td>Management support</td>
<td>0.93 (0.84)</td>
<td>1.00</td>
</tr>
<tr>
<td>OH&amp;S support</td>
<td>0.91 (0.90)</td>
<td>.00**</td>
</tr>
<tr>
<td>Workplace information</td>
<td>0.65 (0.92)</td>
<td>.13</td>
</tr>
<tr>
<td>Workplace stress</td>
<td>0.56 (1.08)</td>
<td>.00**</td>
</tr>
<tr>
<td>Limited free time</td>
<td>0.02 (1.20)</td>
<td>.05</td>
</tr>
<tr>
<td>Workplace demands</td>
<td>-0.15 (1.09)</td>
<td>.02*</td>
</tr>
<tr>
<td>Low priority</td>
<td>-0.37 (1.11)</td>
<td>.13</td>
</tr>
<tr>
<td>Limited physical opportunities</td>
<td>-0.60 (1.10)</td>
<td>.01*</td>
</tr>
<tr>
<td>Low motivation</td>
<td>-0.79 (0.93)</td>
<td>.00</td>
</tr>
<tr>
<td>Low energy</td>
<td>-1.17 (0.79)</td>
<td>-</td>
</tr>
</tbody>
</table>

a. *Correlation is significant at the 0.05 level (2-tailed).

Managers perceived ecological barriers towards employees sitting-breaks

To explore what items the managers’ endorsed as barriers for employees’ sitting-breaks, means and standard deviations for each item was calculated. Results are presented in Table 2, in order of the highest mean to the lowest. A mean score of > 0 reflects ‘agreement’, ‘0’ reflects ‘neither agreement of disagreement’, and < 0 reflects ‘disagreement’; that the various items may influence workplace sitting-breaks. To examine if there was a significant difference in the rating of these barriers, an ANOVA was conducted between adjacent items. A significant multivariate effect revealed significant differences in mean ratings for the various barrier items (Wilks’ Lambda = .18, $F[10, 90]= 40.91, p=.00, \eta_p^2 = .82$). The within subject contrasts significant values are also presented in Table 2. On in inspection of the between subject effects it was evident that the managers’ perceived: management support, workplace information, colleagues taking breaks, OH&S support, and work stress, as the highest barriers towards employees’ taking sitting-breaks ($F[1, 99]= 19.83, p=.00, \eta_p = .17$).
Table 2 Means, standard deviations and ANOVA results for Managers’ perceived ecological Barriers to employees sitting-breaks

<table>
<thead>
<tr>
<th>Barriers to sitting-breaks</th>
<th>Manager mean (SD)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colleagues taking breaks</td>
<td>1.02 (0.66)</td>
<td>.88</td>
</tr>
<tr>
<td>Management support</td>
<td>1.27 (0.78)</td>
<td>.00**</td>
</tr>
<tr>
<td>OH&amp;S support</td>
<td>0.88 (0.86)</td>
<td>.69</td>
</tr>
<tr>
<td>Workplace information</td>
<td>1.09 (0.66)</td>
<td>.00**</td>
</tr>
<tr>
<td>Work stress</td>
<td>0.81 (1.09)</td>
<td>.03*</td>
</tr>
<tr>
<td>Limited free time</td>
<td>-0.13 (1.28)</td>
<td>.67</td>
</tr>
<tr>
<td>Work demands</td>
<td>0.06 (1.24)</td>
<td>.05</td>
</tr>
<tr>
<td>Low priority</td>
<td>0.23 (0.86)</td>
<td>.00**</td>
</tr>
<tr>
<td>Limited physical opportunities</td>
<td>-0.43 (1.16)</td>
<td>.29</td>
</tr>
<tr>
<td>Low motivation</td>
<td>-0.19 (0.89)</td>
<td>.00*</td>
</tr>
<tr>
<td>Low energy</td>
<td>-0.89 (0.87)</td>
<td>.00**</td>
</tr>
</tbody>
</table>

a. *Correlation is significant at the 0.05 level (2-tailed).

b. **Correlation is significant at the 0.01 level (2-tailed).

Results examining employees’ and managers’ ratings of employees’ sitting-breaks, indicate that both the employees’ and managers’ perceive colleagues taking breaks, and management and OH&S support for sitting-breaks, as the most important ecological barriers towards taking sitting-breaks.
APPENDIX M: Relationship between behaviour and health ratings

Pearson correlations indicate that employees’ who perceive leisure time physical activity (i.e., LPA and MVPA) as healthy, take fewer breaks from sitting while at work; and employees who do not perceive sitting (both at work and during leisure) to not be as detrimental to health, take more workplace sitting-breaks. There did not appear to be a relationship between MVPA health beliefs and MVPA time, nor sitting health beliefs and sitting time. These results are displayed in Table 1.

Table 1. Pearson Correlations between Activity Health ratings and Behaviour

<table>
<thead>
<tr>
<th>Activity health rating</th>
<th>Behaviour levels ($r_p$)</th>
<th>MVPA time</th>
<th>Leisure sitting time</th>
<th>Occupational sitting time</th>
<th>Occupational sitting-breaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVPA in leisure</td>
<td></td>
<td>.07</td>
<td>.06</td>
<td>.10</td>
<td>-.14*</td>
</tr>
<tr>
<td>MVPA at work</td>
<td></td>
<td>.09</td>
<td>-.13</td>
<td>.06</td>
<td>.01</td>
</tr>
<tr>
<td>LPA in leisure</td>
<td></td>
<td>.02</td>
<td>.01</td>
<td>-.01</td>
<td>-.14*</td>
</tr>
<tr>
<td>LPA at work</td>
<td></td>
<td>.06</td>
<td>.08</td>
<td>-.03</td>
<td>-.07</td>
</tr>
<tr>
<td>Sitting in leisure</td>
<td></td>
<td>-.06</td>
<td>.02</td>
<td>-.05</td>
<td>.15*</td>
</tr>
<tr>
<td>Sitting at work</td>
<td></td>
<td>-.07</td>
<td>.05</td>
<td>-.02</td>
<td>.14*</td>
</tr>
</tbody>
</table>

a. *Correlation is significant at the 0.05 level (2-tailed).
b. ** Correlation is significant at the 0.01 level (2-tailed).