An exploration of the determinants of sedentary behaviour in desk-based employees

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An exploration of the determinants of sedentary behaviour in desk-based employees

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Abstract

Sedentary behaviour (SB) is highly prevalent within desk-based employees (Clemes, O'Connell, & Edwardson, 2014) and is associated with a number of negative health consequences, including cardiovascular disease and diabetes (Wilmot et al, 2012). Interventions to reduce SB in the workplace, including active workstations (AWSs), can reduce SB (Neuhaus et al, 2014a), yet initial reductions are not to be sustained beyond 12-months (Koepp et al, 2013). Moreover, equipment-based interventions (e.g. AWS's) are perhaps unaffordable for many areas of commerce and industry. Understanding the determinants of SB in the workplace could help in the design of pragmatic, scalable interventions to maintain reductions in SB.

A thorough exploration of the determinants of SB in desk-based workers was undertaken using an online questionnaire (Study 1, n=1,101), and semi-structured interviews (Study 2, n=14). Organisational norms, control to sit, intentions to sit, social influences, and awareness of SB were identified as determinants of SB, underlining the complexity of SB in the workplace. Sitting was also reported to be a habitual behaviour and interestingly participants with AWSs only sat for 36 minutes less/working day than those with fixed sitting-height desks. This observation is low compared to data from previous research (78 minutes; Neuhaus et al, 2014a).

Informed by the findings from Studies 1 and 2, a pragmatic pilot intervention (Study 3) was designed to form standing habits in the workplace to reduce SB. The Runscribe accelerometer was used to objectively measure SB, which was validated (Study 4) prior to the beginning of the intervention. SB reduced by 30 minutes/8-hour working day in the intervention group at 15 week follow-up. Following the intervention focus groups were conducted with participants to explore the acceptability and feasibility of the intervention (Study 5). Participants reported the intervention was feasible to implement within their workplace and did not interfere with their ability to carry out their work tasks, meaning that the intervention was pragmatic and could be implemented within workplaces with little disruption to working patterns.

This thesis explored the determinants of SB in the workplace, which informed the design of a pragmatic intervention to reduce SB in desk-based employees. Findings underline the complexity of SB in the workplace but show support for a pragmatic and potentially scalable solution to reducing SB in desk-based workers. Although the findings have highlighted the complexity of workplace SB, social factors appear to influence SB over other determinants. Therefore it would be recommended that future interventions and research focuses on changing social norms around sitting and standing in the workplace. Further research is needed to explore the unconscious and habitual nature of SB in desk-based workers.

Candidate's Statement

I declare that the work in this thesis was carried out in accordance with the regulations of Sheffield Hallam University and is original. No part of the thesis has been submitted as part of any other academic award. The thesis has not been presented to any other education institution in the United Kingdom or overseas.

Any views expressed in the thesis are those of the author and in no way represent those of the University.

Martin Adrian Lamb

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Lamb, M.A., Copeland, R.J., Breckon, J., & Till, S. (2018). A pilot study to reduce workplace sedentary behaviour through forming a standing habit. 7th International Society for Physical Activity & Health Congress, London. *Poster Presentation.*

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Abbreviations

ANCOVA	Analysis of co-variance
AWS	Active workstation
BMI	Body mass index
CHEW	Checklist of health promotion environments at worksites (Oldenburg, Sallis, Harris, & Owen, 2002)
CVD	Cardiovascular disease
EEG	Electroencephalography
ESM	Experience sampling methodology
HR	Hazard ratios
IBS	Irritable bowel syndrome
ICC	Intraclass correlation coefficient
ID	Identification
IPAQ	International Physical Activity Questionnaire
L-Cat	Stanford Leisure Time Activity Categorical Item (Kiernan et al, 2012)
METs	Metabolic equivalents
MRC	Medical Research Council
MSK	Musculoskeletal

MTB	'Moving to Business'
MVPA	Moderate to vigorous physical activity
NCD	Non communicable disease
NHS	National Health Service
NICE	National Institute for Clinical Excellence
OP	Occupational physician
OFFESS	Office environment and sitting scale (Duncan et al, 2014)
OSPAQ	Occupational Sitting Physical Activity Questionnaire (Chau et al, 2011)
RR	Relative risk
TPB	Theory of Planned Behaviour
TV	Television
SB	Sedentary behaviour
SD	Standard deviation
SRHI	Self-report habit index (Verplanken & Orbell, 2006)
UK	United Kingdom

Thesis Synopsis

Chapter 1

The introductory chapter provides an overview of sedentary behaviour (SB), a definition of SB, the negative health consequences of SB, and the need to research SB separately from physical activity. The prevalence of SB is highlighted, particularly the prevalence of SB within the workplace and desk-based employees. Collectively this chapter provides the rationale for researching SB specifically within desk-based employees.

Chapter 2

This chapter presents a critical narrative of interventions aimed to reduce SB in the workplace. This includes qualitative research that has explored SB in the workplace. This element of the thesis was conducted using a systematic search strategy to capture all relevant research.

Chapter 3

This chapter presents Study 1 of the thesis - a cross-sectional exploration of the determinants of SB within desk-based employees. An online survey was designed and implemented in desk-based workers across public and private sector organisations. Data provides insights into current workplace SB and potential determinants of SB.

Chapter 4

Chapter 4 presents a qualitative study (Study 2), which further explored the determinants of SB within participants that had an active workstation within their workplace.

Chapter 5

The Runscribe accelerometer was used in Study 4 (Chapter 6) to assess SB. The Runscribe has not been previously validated for workplace SB but represents a potentially acceptable alternative to commonly employed devices in this field of research. With this in mind, Chapter 5 (Study 3) presents the methods and outcomes of a validation exercise for the Runscribe against the ActivPAL accelerometer.

Chapter 6

This chapter presents the development, delivery, and outcomes of a pilot study to reduce workplace SB. Particular attention is given to the development of a pragmatic intervention informed by Studies 1 and 2 (Chapters 3 & 4). The outcomes following delivery of the intervention are also presented.

Chapter 7

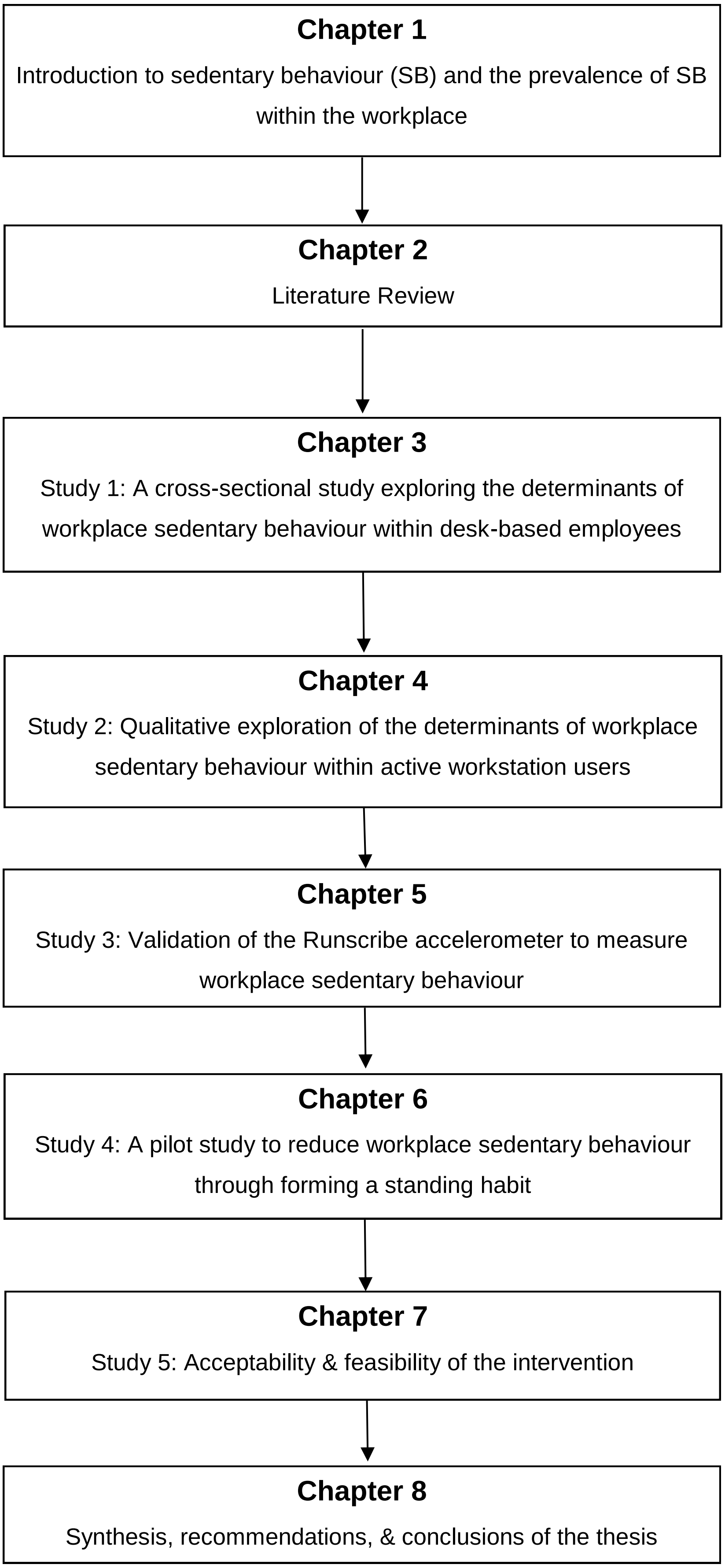
In this chapter, a qualitative exploration of the acceptability and feasibility of the aforementioned SB intervention (Study 4) is presented. Focus groups were conducted with participants that completed the intervention, exploring their experiences of participating in the study.

Chapter 8

The final chapter of the thesis discusses the findings from all five studies and provides the summative outcomes of the thesis. Recommendations for future research are also presented.

A structural diagram of the thesis is presented below.

Structural diagram of the thesis



Chapter 1: Introduction to workplace wellness & sedentary behaviour

1.1 Overview

This chapter outlines the topic of sedentary behaviour (SB) and explores its prevalence, health consequences and associated impact on workplace productivity. The chapter identifies SB as discrete from physical activity (PA) and briefly considers the impact of existing SB interventions. The chapter concludes by highlighting the need to further understand the determinants of SB to inform the design of future interventions.

1.2 Introduction

Since the 19th century employers have examined ways to improve the health and well-being or ‘wellness’ of their employees, beginning with the introduction of model villages such as Saltaire and Bournville. Employers have related improvements in employees wellness to improvements in productivity for their businesses (O'Hagan, 2008) resulting in large numbers of employers now offering some form of wellness scheme to their staff (Astrella, 2017; McCleary et al, 2017). Within the United States employees must, by law, invest in the health of their employees (Patient Protection & Affordable Care Act, 2010). As of yet there is no such policy in place within the United Kingdom (UK), but the National Institute for Health Care and Excellence (NICE) has called for organisations to support employee health and to promote PA within the workplace (NICE, 2008; 2015). Current workplace wellness programmes that typically include; discounted gym memberships, cycle to work schemes, and health checks, have demonstrated improvements in employee's health (Flint et al, 2016) and claim a return on investment for the employer (Pricewaterhouse Coopers, 2013). Increasing PA at work is often a component of a wellness scheme, but the amount of time employees spend in SBs such as sitting is often overlooked (Biswas et al, 2015).

1.3 Defining sedentary behaviour

Sedentary comes from the Latin word *sedere* - 'to sit', which fits with definitions of SB relating to periods of sitting and lying. In 2012 the Sedentary Behaviour Research Network published a letter proposing definitions aimed at clarifying differences between SB and physical inactivity (Tremblay et al, 2012). There remained variable uptake across disciplines of SB and physical inactivity, and a need for further standardised use of the definitions so that they could be used across all ages and abilities.

In 2017 a further terminology consensus statement was conducted again by the Sedentary Behaviour Research Network, aiming to provide standardised definitions which could be used by multi-disciplinary researchers, practitioners, and industries (Tremblay et al, 2017). The 2017 definition of SB added lying to the definition, as well as expanding the scope of the terminology covered, developing a conceptual model to illustrate the structural connections among various terms, and added examples of how to interpret the terms.

The most up-to date definition of SB shall be used for this thesis, which is;

> *'Sedentary behaviour is any waking behaviour characterized by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining or lying posture'*
> (Tremblay et al, 2017)

1.4 Physical activity & sedentary behaviour

PA is a key behaviour in reducing the risk of a number of non-communicable diseases (NCD's; Lee et al, 2012). Physically active individuals also experience improved physical and mental health as well as being more productive at work (Beaglehole et al, 2011; Lear et al, 2017). The movement continuum highlights the differences between the intensity of different types of activity, with PA research typically focusing on the effects of moderate-to-vigorous PA (MVPA). Tremblay and colleagues (2010) identified SB as being a behaviour independent to PA and added it to the movement continuum with SB being classified as any behaviour <1.5 METs. MVPA is at the opposite end of the continuum with any behaviour that is >3 METs and light-intensity activity being any activity that is >1.5 METs and <3 METs (Tremblay et al, 2010).

Recent research has highlighted that alongside being active, there is a need to reduce the amount of time spent sedentary (Owen et al, 2011), as this brings its own risks to health, independent of PA (Biswas et al, 2015; Wilmot et al, 2012). Indeed, a person can meet PA guidelines but still lead a sedentary lifestyle (Ford & Caspersen, 2012). For example, a person who is awake for 16 hours a day and completes 30 minutes of moderate to vigorous PA (to meet the PA recommendations), is still able to be inactive for 15 and a half hours a day (Dempsey, Owen, Biddle, & Dunstan, 2014; Owen, Healy, Matthews, & Dunstan, 2010). It is important to highlight that one behaviour does not necessarily displace the other behaviour.

It has been assumed that an increase in PA would lead to a reduction in a person's SB, yet research that has looked to change both PA and SB in the same interventions have typically only influenced one of these behaviours (Chau et al, 2010; Prince, Saunders, Gresty, & Reid, 2014). Findings from these studies highlight the need for future research to treat PA and SB separately, and to focus on SB as an independent behaviour, particularly as SB is a highly prevalent behaviour.

1.5 The prevalence of sedentary behaviour

Objective measures of SB have reported that adults spend over half of their waking hours (54.9%) being sedentary (Matthews et al, 2008). Self-report measures of SB, completed across multiple countries, have shown adults are sedentary between 300 and 320 minutes/day (Bauman et al, 2011; Bennie et al, 2013) underlining the scale of the issue. Since the 1960's there has been a mean reduction in energy expenditure due to a reduction in workplace PA – in part due to technological innovations limiting the number of labour-intensive activities in day-to-day life (Ford & Caspersen, 2012) - with only 20% of jobs now reported to entail MVPA (Church et al, 2011). The workplace has been found to be a domain where a large portion of our SB is accumulated (Saidj et al, 2015), particularly by those employed in desk-based roles, with objective measures reporting that desk-based employees spend between 70-80% of their working day sitting (Bird, Shing, Mainsbridge, Clemes et al, 2014; Cooley, & Pedersen, 2015; Fountaine, Piacentini, & Liguori, 2014; Kazi, Duncan, Clemes, & Haslam, 2014; Van Dommelen et al, 2016). .

1.6 Health consequences of sedentary behaviour

Typically the need for reducing SB has been related to musculoskeletal (MSK) problems, which have been a consequence of sitting for prolonged periods of time with poor posture (Robertson, Huang, & Larson, 2016; Thorp, Kingwell, Owen, & Dunstan, 2014). It has been found that 1 in 8 people of the working age report an MSK condition, with 23% of all working days lost in the UK being attributed to MSK conditions (Public Health England, 2017). As well as MSK conditions, recent research have found that SB is related to other negative health consequences (Biswas et al, 2015; Wilmot et al, 2012).

Cross-sectional research has reported associations between objectively measured SB and body mass index (BMI), waist circumference, high-density lipoproteins (HDL) cholesterol, and triglycerides (Bellettiere et al, 2017). Cohort and prospective studies have also provided evidence of high levels of SB being associated with negative health consequences. Greer, Sui, Maslow, Greer and Blair (2015) followed 930 men for an average of 9.6 years, and after adjusting for covariates, found that men who reported high levels of SB were at a higher risk of metabolic syndrome. Chau and colleagues (2015) also found sitting to be associated with an increased risk of all-cause mortality and cardio-metabolic disease mortality, from data of over 50,000 participants with a mean follow-up period of 3.3 years.

A number of systematic reviews and meta-analyses have concluded that SB is significantly associated with adverse health outcomes. Biswas and colleagues (2015) reviewed 47 cohort studies and reported that SB was associated with an increased risk of all-cause mortality, cardiovascular disease (CVD), cancer, and diabetes. A systematic review of 18 studies (n=794,577), of which 15 were reported to be of moderate or high quality, also found associations between SB and CVD, diabetes, and all-cause mortality (Wilmot et al, 2012).

Controlled trials have examined the impact of breaking-up SB and concluded that standing and interrupting sitting can attenuate blood glucose levels (Bhammar, Sawyer, Tucker, & Gaesser, 2017; Climie et al, 2018; Duvivier et al, 2016). This has also been tested with office workers using standing desks within a natural working environment, rather than a research laboratory (Buckley, Mellor, Morris, & Joseph, 2014). Following a 12-month intervention which successfully reduced workplace SB (Healy et al, 2016), reductions in sitting were significantly associated with lower blood pressure, weight, body fat, waist circumference, diastolic blood pressure, fasting triglycerides, HDL cholesterol, and insulin (Winkler et al, 2018).

Associations have also been reported between SB and some cancers. Johnsson, Broberg, Johnsson, Tornberg, and Olsson (2017) conducted a cross-sectional study with 29,524 women and found there was an association between breast cancer and women that reported being in an occupation with high levels of SB. Systematic reviews have also reported associations between SB and incidences of cancer and cancer mortality (Biswas et al, 2015; Lynch, 2010).

As well as physical health, mental health has been found to be associated with high levels of SB. Cross-sectional surveys have reported associations between SB and depression and psychological distress (Kilpatrick, Sanderson, Blizzard, Teale, & Venn, 2013; Teychenne, Ball, & Salmon, 2010). A meta-analysis of 13 cross-sectional studies and 11 longitudinal studies also concluded that high levels of SB were associated with depression (Zhai, Zhang, & Zhang, 2015).

The evidence shows that high levels of SB is associated with a number of negative physical and mental health issues, and that breaking up SB with standing can attenuate some of these effects. (See Appendix 1.1 for further details of the research mentioned).

1.7 Recommendations of changes to sedentary behaviour

There is debate around what change in SB would lead to improvements in the health consequences mentioned. In recent PA guidelines reference has been made to the need for a person to reduce SB as well as increase PA, for instance the latest PA guidelines from the USA encourage adults to *'move more and sit less'* (U.S. Department of Health & Human Services, 2018). Likewise the Start Active, Stay Active report by the Chief Medical Officer (Department for Health, 2011) also stated that adults should *'minimise the amount of time spent being sedentary (sitting) for extended periods'*. Countries including Australia, Germany, New Zealand, and Norway have also included SB components in their public health guidelines for adults, dating back to 2014 (Stamatakis et al, 2018). None of these guidelines have tried to quantify the amount of time that a person should be sedentary for, citing a lack of evidence to support this.

Buckley and colleagues (2015) were the first to produce guidelines on the amount of time employees should spend sitting within the workplace. They recommended that an employee should aim to stand for around four hours each working day (based on an 8-hour working day), and interrupt sitting every 30 minutes.

Rather than focusing on the total amount of time sitting, evidence has shown support for the benefits of interrupting SB (Healy et al, 2011; van der Berg et al, 2016). Due to the cross-sectional nature of these studies and other methodological limitations, such as the measurement of SB used, causation is unclear (Stamatakis et al, 2018). Therefore the introduction of guidelines on reducing SB is premature, due to the underdeveloped evidence base (Stamatakis et al, 2018).

People are still recommended to move more, particularly as breaking SB can benefit MSK issues (Thorp et al, 2014) and can lead to employees feeling more energised within the workplace (Grunseit et al, 2013). Buckley and colleagues (2015) have also claimed that encouraging standing is the first 'behavioural' step in getting people active. Therefore although the guidance on what constitutes a significant reduction in SB may not yet be clear in terms of a health benefit, it is still important to encourage people to reduce SB, due to the prevalence of SB in our daily lives.

Chastin and colleagues (2018) reviewed the impact of light-intensity PA upon adult's cardiometabolic health and mortality. From the 72 studies included in the review it was concluded that light-intensity activity could play a role in improving adult's cardiometabolic health, in particular for those that are the least active. Doing twice as much light-intensity PA cut the risk of premature death by almost 30%. Those that are the least active would stand to gain the most benefits from increasing their levels of light-intensity PA. Therefore although the PA guidelines focusing on MVPA should still be promoted, encouraging the least active to be increase light-intensity PA could be a more achievable first step for the inactive.

1.8 Purpose of the thesis

The negative health consequences associated with SB and the prevalence of SB in daily life, has led researchers to explore ways to reduce SB. Research has particularly focused upon reducing SB for employees in desk-based jobs. Interventions in this population have usually involved making an environmental change to the workplace to reduce SB (Neuhaus et al, 2014a; Torbeyns et al, 2014). While there is evidence that short-term reductions in SB are seen there is a lack of evidence that these changes are sustained. Multi-component interventions incorporating additional changes (e.g. motivational counselling, organisational support) alongside environmental changes have been found to further improve reductions in workplace SB (Healy et al, 2016; Neuhaus et al, 2014b). However introducing more complex interventions can be expensive for organisations, in terms of cost and time, meaning that not all organisations are or would be able to implement such changes. There is also currently a lack of understanding of the determinants of SB, particularly within the workplace, and this has perhaps limited the design of interventions to date (Owen et al, 2011). With this in mind, the primary aim of this thesis is to explore the determinants of SB within desk-based employees to inform the design of a pragmatic intervention to reduce SB in the workplace.

Chapter 2: Literature Review

2.1 Introduction to the chapter

The introduction to the thesis highlighted the negative health consequences associated with prolonged SB. A way to reduce the negative health consequences of SB is through standing and disrupting long periods of sitting (Buckley et al, 2014; Duvivier et al, 2016). Research has begun to explore ways to reduce SB, specifically within desk-based workers who are sat for most of their working day (Chu et al, 2016; Neuhaus et al, 2014a). The present chapter will discuss the impact of previous published interventions to reduce workplace SB and discuss the limitations of the current literature and areas of future research.

2.1.1 Sedentary behaviour research in the workplace

As mentioned in section 1.7 research has begun to focus on reducing SB within the workplace. Chau and colleagues (2010) conducted one of the first reviews into interventions aimed at reducing workplace SB and concluded that of the six interventions included they were mainly of poor quality and the primary aim was to increase workplace PA. These interventions were not found to be effective at reducing workplace SB and the authors called for future interventions to focus on targeting SB, rather than increasing PA.

Research into reducing workplace SB has primarily been by PA research and focused on increase PA as a way to reduce SB. Further reviews of interventions to reduce workplace SB have also reported that strategies used within the workplace to alter activity (e.g. increase PA or reduce SB) have only been effective when targeting one of these behaviours (Prince et al, 2014). Therefore it is important that research into workplace SB aims to specifically target SB and focusing on the relevant behaviour on the activity continuum (Tremblay et al, 2010).

Research has begun to focus solely on reducing workplace SB and to date a number of interventions have been conducted, and systematic and meta-analyses of these interventions have been conducted (Neuhaus et al, 2014a; Shrestha et al 2017; Tew et al, 2015; Torbeyn et al, 2014). Promising advances have been made in the field with a number of intervention strategies showing promise in reducing workplace SB, in particular the introduction of active workstation's (AWS; e.g. height adjustable workstations or treadmill desks; see figure 2.4-2.6 for images of different types of AWS's). Although promising the introduction of AWS's can be expensive, therefore restricting the number of organisations which would be able to afford to introduce AWS's into the workplace for their employees. Considering 99% of organisations in the UK are small-to-medium sized enterprises it is unlikely that they would have much disposable income to invest in new workstations for all employees.

Other strategies have been introduced into the workplace to further reduce workplace SB, such as the use of prompts to promote light-intensity activity (Evans et al, 2012) and walking interventions (Gilson et al, 2011). These reductions in workplace SB are not as large as the introduction of AWS's. Multi-component interventions have also been shown to be more effective at reducing workplace SB, which may be due to the fact that they incorporate behaviour change theories and target multiple determinants of behaviour as identified in these theories.

Primarily research in the workplace has focused on making environmental changes, such as introducing AWS's, and reviews have primarily focused upon the effectiveness of these interventions. As mentioned other strategies have been used within the workplace, but these have sometimes not been reviewed due to their lack of rigour or only being conducted as pilot studies. The purpose of this review will therefore be to explore all strategies that have been used within workplace to reduce SB. It will also consider what theories of behaviour change have been used to facilitate reducing workplace SB and highlight any particular determinants that are specifically influencing workplace SB.

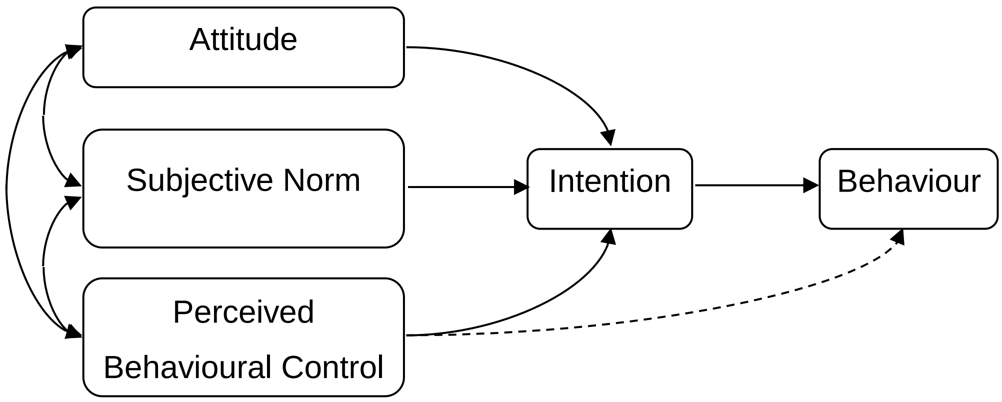
2.1.2 Theories of behaviour change

There are a number of theories of behaviour change available, which have been used for different behaviours, yet there is still a lack of uptake or explicit use of theory when designing and conducting interventions (Eccles et al, 2012; Michie, 2008). The Medical Research Council and Public Health England have called for interventions to be underpinned by theory in an effort to help understand why behaviour changes and the 'active ingredients' of an intervention (Moore et al, 2015). There has been a lack of theories used or stated to have been used in the research to date regarding SB. Studies that have specified a theory have generally used the Social Cognitive Theory (Bandura, 1986; 2004; SCT) or the Theory of Planned Behaviour (Azjen, 1991; TPB) as these theories have been primarily used in PA research. The following section shall briefly explain both of these theories.

The focal belief of SCT is in the foundation of human motivation and action, and that unless a person believes they can produce the desired effects by their actions, they have little incentive to act or persevere in the face of difficulties. The core determinants of SCT are; knowledge (precondition to change), perceived self-efficacy, outcome expectations, goals, and perceived facilitators (Bandura, 2004). Knowledge of potential health risks and benefits are an important precondition to change, as people need to be aware of their lifestyle habits and how these influence their health. Outcome expectations also influence behaviour and particularly if changes to behaviour are initiated and then maintained. If a person does not see the benefit in changing their behaviour and if this may be a challenge to them, then they would be reluctant to change their behaviour. It is important that any goals that are set are in the short-term so that a person can see the potential gains from changing their behaviour.

TPB is a model of purposeful human behaviour and an extension of the Theory of Reasoned Action (Ajzen & Fishbein, 1980). Figure 2.1 outlines the key determinants of the TPB. The theory outlines that behaviour is influenced by a person's intentions and intentions are influenced by a person's attitude, subjective norms, and perceived behavioural control. Attitude refers to a person trying to perform a behaviour and their behavioural beliefs if the change in behaviour will be favourable or not. Subjective norms relate to a person's perceptions of others beliefs about whether or not they should perform a behaviour. A person is more likely to change behaviour if they perceive to have significant other's approval of the behaviour and motivation to comply with others. Perceived behavioural control relates to whether or not a person feels able to perform the behaviour, similar to self-efficacy in SCT. The core beliefs of attitude, subjective norm, and perceived behavioural control influence a person's intentions and their willingness to perform the behaviour and how much effort they will apply to the behaviour. Although the theory hypothesises that intentions will lead to behaviour, other research has that there is an intention-behaviour gap, meaning intentions do not necessarily lead to behaviour (Hassan, Shiu, & Shaw, 2016; Sheeran & Webb, 2016).

Figure 2.1 The Theory of Planned Behaviour (Azjen, 1991)



2.2 Search methods

2.2.1 Search strategy

A systematic scoping review was conducted using online academic databases to find interventions related to workplace SB. A systematic scoping review was used as this technique brings together the strengths of a critical review with a comprehensive search strategy, and allows for broader questions to be answered (Booth, 2012). The search aimed to find interventions that have targeted reducing workplace SB, as well as research that has explored the barriers and facilitators to reducing workplace SB.

Articles were identified from the following academic databases; MedLine, SPORTdiscus and PsychINFO. The reference lists of a Cochrane review (Shrestha et al, 2016) and systematic reviews in workplace SB were also scanned to ensure that no appropriate papers had been missed (Chu et al, 2016; Neuhaus et al, 2014a; Torbeyns et al, 2014). The search strategy used was based upon a systematic review protocol published by Prince and colleagues (2014) which aimed to collect all available evidence on SB in adults. Search terms relating to the workplace were also included to ensure that literature relating to workplace SB was retrieved for the review. The search strategy can be found in figure 2.2.

The following inclusion criteria were used to select the relevant research:

- Original research.
- Experimental and quasi-experimental research designs.
- Research conducted and published in peer-reviewed journals before July 2018.
- Adult participants aged over 18 years old and in employment.
- Workplace sitting time was measured and reported as a primary or secondary outcome, through either self-report or objective measures.
- Articles published in the English language.
- Qualitative research exploring SB in the workplace.

Figure 2.2 Search strategy used for the literature review

Searched within '*Title & Abstract'*

Group 1:

"Sedentary Behaviour"

Sedentary

Sitting OR reclining

"Physical Inactivity"

"Screen Time"

Computer adj (time or use)

AND

Reduce

Reduc*

Group 2:

Promot*

Promote

Increase

Increas*

Encourage

Encourag*

AND

Standing

Stand*

Stand-Up

Once the two groups had been searched separately they were combined and searched with added terms for the workplace.

AND (applied to searches for group 1 & 2)

Workplace

Office

Worksite

Work*

"Place of Work"

Job

Employment

Occupation

2.2.2 Search results

The study selection process is shown in figure 2.3. In total 39 articles were retained which reported results from interventions which had aimed to reduce workplace SB. A brief description of each study and results can be found in Appendix 2.1. A further eight articles were retained which qualitatively explored barriers and facilitators to reducing workplace SB. A brief description of the findings of these studies can be found in Appendix 2.2. The results of the review will now be discussed and critiqued.

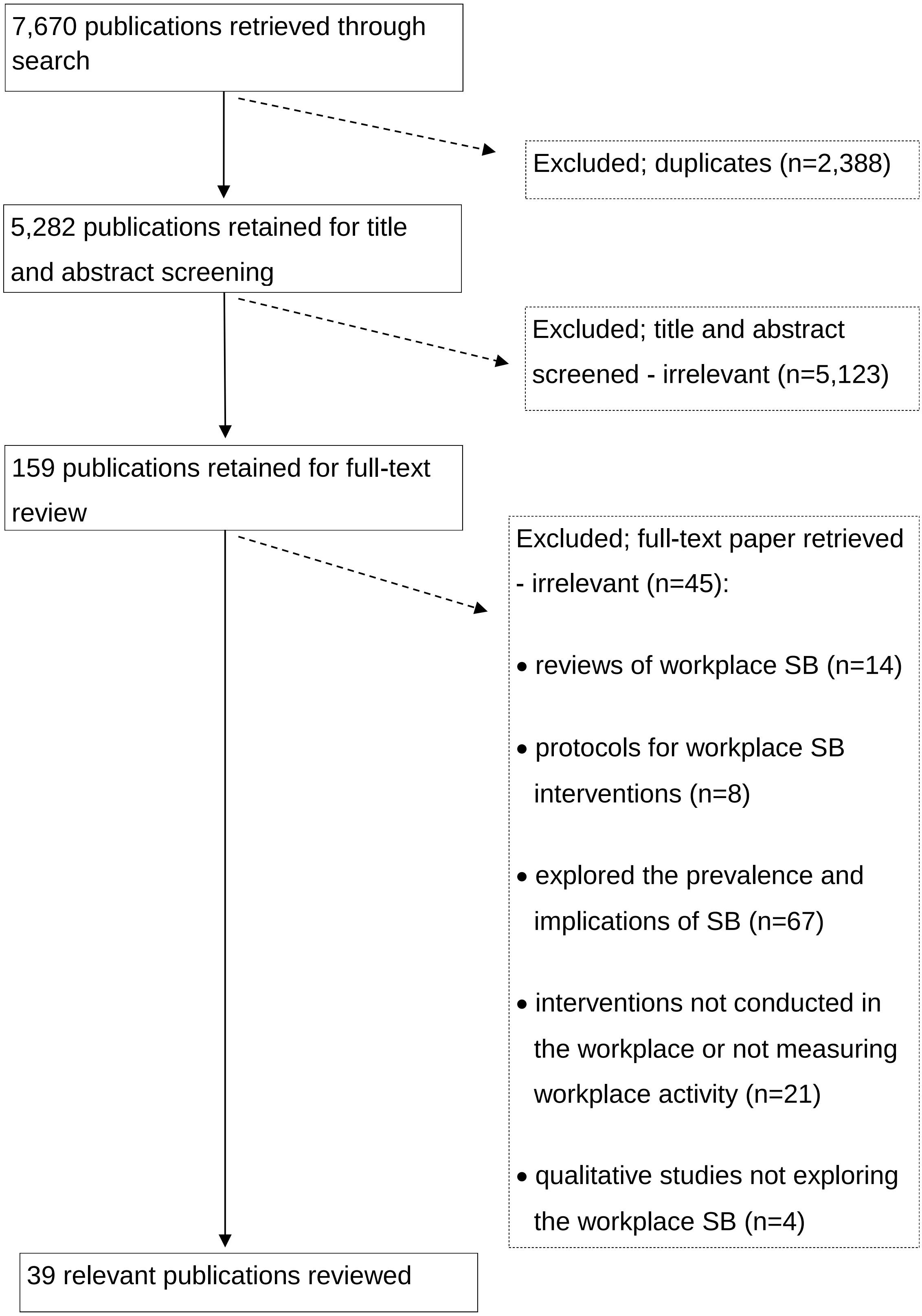


Figure 2.3 The study selection process

2.3 Interventions targeting reductions in workplace sedentary behaviour

The interventions retained from the database search can be categorised into three groups; environmental interventions, individual interventions, and multi-component interventions. The effectiveness and acceptability of the three types of intervention shall now be discussed. Examples of the types of intervention are cited in the following section, but readers are encouraged to consult Appendices 2.1 and 2.2 for the more information about the studies.

2.3.1 Environmental interventions

The majority of interventions aimed to reduce workplace SB through making environmental changes to the workplace, with the introduction of an AWS occurring in 20 of the interventions reviewed (e.g. Bouchard et al, 2016; Graves, Murphy, Shepherd, Cabot & Hopkins, 2015; Healy et al, 2016; Pronk et al, 2012). All AWS interventions reduced workplace SB, with sitting being replaced with standing to work at an AWS. Occupational sitting times were found to reduce by between 158 minutes/8-hour working day (MacEwen, Saunders, MacDonald, & Burr, 2017) and 23.4 minutes/8-hour working day (Carr, Walaksa, & Marcus, 2012). Systematic reviews have reported that the introduction of an AWS leads to a reduction in workplace SB of 78 minutes/8-hour working day (Neuhaus et al, 2014a).

A research team in Australia have published a number of studies on the use of AWS's in the workplace to reduce workplace SB with the project initally being called 'Stand-Up Australia' and leading to a multi-component intervention named ' Stand-Up Victoria' (Healy et al, 2016). The preliminary work carried out by the team consisted of a number of pilot studies to test to acceptability of introducing AWS's into the workplace. Alkhajah and colleagues (2012) conducted a three-month pilot study to assess the short (1-week) and medium-term (3-months) changes in workplace SB. Public health workers (n=32) were recruited from an Australian university (90% female, 87% Caucasian). In the intervention condition participants (n=18) received an Ergotron Work Fit-S (Figure 2.4) for the intervention period and instructions on how to use the desk and stand properly. They did not receive any further guidance on how long to stand for or the reasons why they should stand. Workplace SB was measured at three time points (baseline, 1-week, & 3-months) using the ActivPAL accelerometer. Body composition measures, blood profiles, and self-reported work performance data was also collected at each time point.

At 1-week and 3-months sitting was reduced by over two hours in the intervention group, with sitting primarily being replaced with standing. No changes in self-reported performance measures were observed with and 94% of participants agreed that the AWS was easy to use at 3-month follow-up. These findings highlight the potential benefit of introducing an AWS into the workplace and effectiveness of reducing workplace SB. Nevertheless caution should be taken when interpreting these results as the participants were all working within a public health department, therefore more likely to be aware of the negative consequences of SB and aware of the need to stand. It is unclear how much the other colleagues in their department also influenced participants to stand, as they may have been more inclined to stand if in an office with other participants in the intervention conditions. Meaning other factors may be influencing SB rather than just the AWS alone.

Figure 2.4 The Ergotron retrofit desk, which can be attached to the front of the desk

A concern reported by employers regarding the introduction of AWSs has been a potential loss of productivity if alternating between sitting and standing to work (De Cocker et al, 2015). The few studies that have measured employee's productivity whilst using an AWS, reported that standing has not impacted upon objective (Chau et al, 2016) and self-reported (e.g. Dutta, Koepp, Stovitz, Leving, & Pereira, 2014a; Healy et al, 2013) workplace productivity. Qualitative studies exploring the impact of AWSs, report that employees perceive them to be a positive intervention that helps them to feel more energised and alert at work (Chau et al, 2014a; Grunseit et al, 2013). Employees have also reported wanting to continue to have the option to stand following the end of an intervention (Chau et al, 2014b; Dutta et al, 2014a), meaning that participants must feel comfortable and able to complete their work standing. Overall the introduction of AWSs to the workplace are effective at reducing occupational sitting through promoting standing, whilst not impacting upon work productivity.

Although the introduction of AWS's to the workplace appears to be promising, the quality of interventions has been criticised by researchers (Shrestha et al, 2015; Tew, Posso, Arundel, & McDaid, 2015). Tew and colleagues (2015) systematically reviewed AWSs in office-based workers and of the five studies identified reported that no firm conclusions could be drawn about the effectiveness of AWSs. This was due to small samples sizes and high risk of bias towards an overestimation of the effect of the interventions. Lack of randomisation for group allocation and interventions being conducted with non-representative samples were also identified as limitations. Interventions that have introduced AWSs, have recruited samples that were health agencies or working within research departments looking at SB (e.g. Aittasalo et al, 2017; Mackenzie, Goyder, & Eves (2015). Shrestha and colleagues' (2015) Cochrane review of interventions to reduce workplace SB, reported evidence was of low or very low quality, due to small sample sizes and interventions being poorly designed. More representative samples are needed to further support the reductions in SB found from AWSs, particularly in more natural worksites and organisations where there may be other priorities than research.

There is a lack of evidence of reductions in SB being sustained in interventions that have introduced AWSs to the workplace. A number of studies have employed a 3-month follow-up or less (e.g. Alkhajah et al, 2012; Carr, Karvinen, Peavler, Smith, & Cangelosi, 2013; Neuhaus et al, 2014b). Research that has followed-up beyond 12-months has typically reported that reductions observed at 3-months tend to dissipate (e.g. Danquah et al, 2017; Koepp et al, 2013; Zhu et al, 2017). Ideally an intervention would lead to reductions in SB that could be maintained when an employee's environment changes, yet studies that have followed-up SB once AWS's have been removed, suggest behaviours revert to baseline upon removal (Dutta et al, 2014a; Pronk et al, 2012). Large initial reductions in SB could be explained by participant's initial interest in an AWS and the novelty of being able to stand to work, rather than an AWS being a feasible option to reduce workplace SB. In two qualitative studies of AWS's, participants reported being curious to try an AWS and wanting to experiment with standing as a reason to participate in AWS trials (Chau et al, 2014a; Grunseit et al, 2013). Participants are drawn to a novel item appears to be the factor influencing the use of AWSs in these interventions. This is something that is not uncommon as research has shown that people are generally drawn to new and novel things in their environments (Kahneman & Thaler, 2006; Vlaev, King, Dolan, Darzi, 2016). Therefore as humans if we are drawn to new and novels items, there is a strong possibility that participant's in AWS studies have also been drawn to using them due to their novelty in the workplace.

The cost of AWSs has also been raised as a concern and barrier to introducing AWS's to the workplace by employees and executives in focus groups and interviews (De Cocker et al, 2015; Hadgraft et al, 2016). This is perhaps unsurprising given that a desk conversion costs approximately £280-340 and a fully adjustable electric desk approximately £600-850. [1] Therefore, the introduction of AWSs across workplaces represents an expensive and potentially unfeasible adaptation for all organisations. Further if there is no guarantee that those reductions in SB will be sustained in the long term, then employers can be forgiven for not wishing to invest.

Other environmental interventions have involved whole office relocations to activity-permissive buildings (e.g. accessible staircases, open spaces, adjustable height furniture). Reductions in workplace SB of approximately 20 minutes have been found when employees have moved to these buildings (Gao, Nevala, Cronin, & Finni, 2015; Gorman et al, 2013; Jancey et al (2016). These interventions are only possible though if an organisation is able to move work

[1] Current prices in July 2018 from www.ergotron.com and www.sit-stand.com

premises, for the majority relocating or redesigning an office would not be affordable or practical. Employees would also need support to encourage changing their behaviour upon moving to the new office, as employees may not be aware of how to use the new features of the office or the purpose of the activity promoting environment. If an employee did not see the need to change their behaviour in the workplace, then it would be likely that they would continue to sit for most of their working day, highlighting the need for further intervention strategies to support behaviour change.

An important aspect of behaviour change is to ensure that changes are maintained once they have been adopted. It is common that changes to health behaviours frequently suffer from lapses or relapses to the former, usually negative/detrimental, health behaviour (Forman et al, 2017). Maintenance strategies and relapse prevention strategies such as coping planning and self-monitoring, have been found to successful encourage maintenance of behaviour change. Yet these have not been considered within SB interventions, as interventions have introduced AWS's into the workplace, with no further behaviour change or maintenance strategies (e.g. Alkhajah et al, 2012; Chau et al, 2014a; Parry, Straker, Gilson, & Smith, 2013). AWS interventions have also failed to educate or raise participants awareness of the negative consequences associated with prolonged SB (e.g. Chau et al, 2014a; Graves et al, 2015; John et al, 2011). A lack of awareness may explain why reductions in SB were not maintained if participants were not aware of the need to change.

2.3.2 Individual interventions

A number of interventions have made changes which have aimed to remind an individual to stand or motivate a person to walk (e.g. Donath, Faude, Schefer, Roth, & Zahner, 2015; Gilson et al, 2016; Swartz et al, 2014). The introduction of prompts has been effective at lowering and breaking up workplace SB (e.g. Evans et al, 2012; Green, Sigurdsson, & Wilder, 2016; Pedersen et al, 2014). Due to many desk-based employees working at computers, prompts have either been delivered via email or through computer software programmes. The prompts, typically provided following an educational workshop, were developed to either highlight an opportunity to break SB (e.g. Donath et al, 2015; Gilson et al, 2016) or encouraged employees to be active by suggesting possible light-intensity activities that could be done in the workplace (e.g. chair squats; Pedersen et al, 2014; Urda, Lynn, Gorman, & Larouere, 2016). Prompts used to highlight opportunities to break SB were found to significantly increase the number of breaks and reduce the length of sitting bouts, yet they did not significantly reduce workplace sitting in comparison to the control condition (Donath et al, 2015; Evans et al, 2012; Urda et al, 2016). Prompts that provided information on activities to do during breaks significantly reduced workplace SB and participants reported completing activities such as stair-walking and chair squats during these activity breaks, highlighting that they engaged with the intervention (Pedersen et al, 2014; Urda, et al, 2016).

Pedersen, Cooley, and Mainsbridge (2014) aimed to increase energy expenditure whilst in the workplace by interrupting prolonged periods of sitting with short-bursts of PA. From across eight Police and Emergency management offices, 29 desk-based employees were recruited in Australia. Participants were provided with a health software programme (Exertime) which was designed to encourage breaks after long periods of sitting. When a prompt appeared, participants had 30 seconds to engage with the prompt or postpone the prompt, otherwise it would automatically engage with the prompt. Participants were then provided with a suggested exercise (e.g. chair squats, walking flights of stairs) and were encouraged to record their activity and level of engagement.

The study lasted for 13 weeks, including a baseline measurement and then final measurements were taken at week-13. Activity and energy expenditure was measured using a self-report questionnaire (Occupational Sitting & Physical Activity Questionnaire). Energy expenditure significantly increased within the intervention group post-intervention, however there was no reduction reported in sitting time. The intervention was successful in increasing energy expenditure which it aimed to do, however showed no significant difference in sitting time. Therefore it is important to ensure intervention strategies are selected which will lead to changes for both energy expenditure and sitting time, as reductions in sitting time are more likely to lead to improvements in MSK related problems.

Promoting breaks in SB through prompts appears to be encouraging with changes in SB being reported. However it is not clear as to why participants are engaging with these prompts, as well as if these changes are sustained. Two of the interventions lasted for two weeks (Swartz et al, 2014; Urda et al, 2016) meaning it is difficult to draw conclusions about how sustainable changes in workplace SB were. Further research is also needed to assess the feasibility of prompts during the working day and how much participants engaged with the prompts, as there was the option to ignore the on-screen prompts. If participants received the prompts simultaneously, in the same office, this may have also encouraged them to take a break or perform an activity. Social factors have been reported to influence behaviour within the workplace, and employees have reported feeling more comfortable to stand or take a break if their colleagues did the same (Hadgraft et al, 2016; Such & Mutrie, 2017). The use of further maintenance strategies, such as self-monitoring, could also encourage reductions in SB, but these have yet to be tested.

Interventions to increase walking and stepping during the work day have been found to reduce workplace SB (e.g. Parry et al, 2013; Puig-Ribera et al, 2015). Although steps have significantly increased over the course of these interventions, reductions in workplace sitting time have been small (18-22 minutes/working day; Puig-Ribera et al, 2015; Swartz et al, 2014) or not significantly different to controls (Gilson et al, 2016). As discussed in the Introduction (Chapter 1), research has highlighted the difference between PA and SB, and the need to target SB as a discreet behaviour (Prince et al, 2014). Therefore, it is not surprising that walking interventions have not been successful in reducing workplace SB.

Although there is evidence of interventions reducing workplace SB through prompts and increasing steps, the reductions are not as substantial as what has been found when AWSs have been introduced into the workplace. Combining interventions targeting individuals with environmental changes to the workplace have also been conducted to increase reductions in workplace SB and shall be discussed in the following section.

2.3.3 Multi-component interventions to reduce workplace sedentary behaviour

Interventions taking an individual approach to changing health behaviours have been found to be unsuccessful in changing behaviour at the population level (Mikkleson, Novotny, & Gittelsohn, 2016). Multi-component interventions are built from several components and aim to make changes at different levels including, the environmental, organisational, social, and individual. Workplace SB multi-component interventions have typically been based upon the social ecological model for SB (Owen et al, 2011) which was adapted from the social ecological model for PA (Sallis, Owen, & Fisher, 2008).

A number of workplace SB multi-component interventions have consisted of making environmental changes through introducing AWS's, and then further supported behaviour change through individual changes (e.g. one-to-one counselling, self-monitoring), social (e.g. group workshops and activity champions), and organisational (e.g. manager involvement or emails of support from managers to stand) changes to the workplace (e.g. Carr, Karvinen, Peavler, Smith, & Cangelosi; Healy et al, 2016; Neuhaus, Healy, Dunstan, Owen, & Eakin, 2014b). Neuhaus and colleagues (2014b) conducted a three-arm randomised controlled cluster trial exploring; a multi-component intervention group, an AWS only group, and control group. Participants in the multi-component arm of the trail sat 89 minutes/working day less than the control group and 56 minutes/working day less than the AWS only group at 3-months.

Following on from Alkhajah and colleagues' (2012) study, Healy and colleagues (2016) developed the 'Stand-Up Victoria' intervention which consisted of three arms across three worksites. This cluster randomised-control trial was designed to reduce workplace SB and to measure changes in SB after 12-months. In total 231 participants were recruited from an Australian Government organisation, with work teams working in different locations. Participants were involved in the design of the intervention, which was based on SCT (Bandura, 1994) and the social ecological model (Owen et al, 2011). Participants were randomised to either the control arm, the AWS arm, or multi-component arm in which as well as receiving an AWS for the duration of the study, participants also received a number of individual health coaching sessions with a trained health worker with a psychological background. Workplace SB was measured at baseline, 3- and 12-months using the ActivPAL accelerometer and Actigraph.

Workplace SB was significantly reduced at 3-months (-99.1 minutes/8-hour working day) and 12-months (45.4 minutes/8-hour working day) in the intervention group compared to the control groups. Participants only received individual support during the initial 3-months of the intervention, highlighting the benefits of this support as SB was higher after 12-months than 3-months. Although this intervention was effective, the amount of resources that would have been input into this study may not justify the reductions in workplace SB. Particularly as these reductions do not appear to be being sustained by participants, meaning further changes or understanding of workplace SB is needed to lead to sustainable changes in SB.

This finding demonstrates that there must be other factors influencing workplace SB, other than just the environment alone. Due to the nature of the multi-component conditions it is unclear as to which factor is specifically helping to further reduce workplace SB other than the environment. Although it is positive that multi-component interventions are leading to further reductions in workplace SB, the cost of AWS's as well as the additional resources may still not be feasible for organisations. Individual level components such as counselling (e.g. Aittasalo et al, 2017; Gilson et al, 2012) would require a lot of resources, particularly in terms of time for counsellors and for employees to take off work to participate in these sessions.

Multi-component interventions have been designed with the aim of being more cost-effective for organisations, and have not introduced AWS's as part of interventions. Mackenzie, Goyder, and Eves (2015) introduced environmental changes to the workplace by altering the current office layout (e.g. centralising bins) and providing point-of-choice prompts to encourage activity. Participants reported that this intervention reduced workplace SB. However the study was not powered to test for a significant change and no objective measure of SB was used. It is promising that reductions can occur with little investment, and further highlights that workplace SB is influenced by factors other than the environment.

It is unclear as to the effectiveness of all of components of a multi-component intervention and what the 'active ingredients' are as there are a number of strategies being implemented in these interventions. AWS's are the main focus of a number of these interventions but it is not clear how the other strategies facilitate further reductions in SB. The accompanying strategies used alongside AWS's have not been tested independently as their primary purpose is to function as part of a larger model that leads to behaviour change. 2.4 Overview of strategies used to reduce sedentary behaviour in the workplace As discussed in the previous sections there have been a number of different strategies implemented with the intention of reducing workplace SB. At present the most commonly implemented and effective strategy is the introduction of AWS's to the workplace. AWS's which an employee can add to their current workstation and adjust the height throughout the day have been reported to lead to reductions in workplace SB as well as being acceptable and feasible within the workplace. There are a number of different types of AWS, some which can fitted to existing desks, and those that are standalone electronic desks. Figures 2.4-2.6 display images of AWS's to demonstrate the different types currently available.

Figure 2.5 The Vari-Desk which can be added to existing desks

Figure 2.6 A fully adjustable electric standing desk

Further environmental changes which have been introduced to the workplace have shown some promise in reducing SB, such as treadmill workstations or pedal workstations. Nevertheless these reductions have not been as significant or long lasting as those found with height-adjustable workstations. Interventions that have made large-scale environmental changes to workplaces or relocated offices have also found some significant reductions in workplace SB, but nowhere near as large as the changes seen when employees have been given personal AWS's. Participants reported needing further support and strategies to help reduce SB and to understand how this could be done within the new work premises.

Multi-component interventions have been introduced to workplaces, primarily with AWS's as the main intervention strategy within the intervention. Further intervention strategies have then been introduced to support the use of AWS's by participants. The addition of these strategies has shown further reductions in workplace SB, above the introduction of an AWS alone. Nevertheless it is unclear which of these strategies are effective and how effective they are, as they have not been tested individually to determine their influence upon workplace SB. It is therefore not clear how necessary all of these intervention strategies are for reducing workplace SB.

Individual strategies that have been introduced to the workplace have typically been computer prompts that are sent to participants at different times during the day or after a set period of time (e.g. every hour). The prompts will either encourage standing breaks or promote a particular form of light-intensity activity which an employee could perform at their desk or easily within their workplace. These intervention strategies have typically lead to significant increases in breaks and light-intensity activity, but not necessarily reductions in workplace SB.

2.4 Limitations of the current research & areas of future research

The review of literature identified few studies that were explicitly underpinned by theory. NICE (2016) have suggested that interventions designed to change individuals behaviour should be underpinned by psychological theory and this is perhaps a significant omission in the research to date. The interventions that have reported an underpinning theory have used Social Cognitive Theory (SCT; Bandura, 1986; 2004) . SCT-based interventions have been found to be effective in changing PA and diet behaviours within different populations (Stacey, James, Chapman, Courneya, & Lubans, 2015, Young, Plontnikoff, Collins, Callister, & Morgan, 2014). As workplace SB research is in its infancy and as there has been success in using SCT to promote behaviour change, particularly in PA, this would explain why SB researchers have adopted SCT when designing interventions. Nevertheless, this does not mean that SCT is the most appropriate theory to base SB interventions upon.

As mentioned in section 2.2.2, knowledge and awareness of the need to change behaviour are a precursor to behaviour change in SCT (Bandura, 1986; 2004). The present review found that a number of interventions did not report educating or raising awareness of the negative consequences of SB at the outset of the study (e.g. Alkhajah et al, 2012; Chau et al, 2016; MacEwen et al, 2017). If there is a lack of awareness as to why an employee would reduce their SB, then this could explain why reductions in SB are not sustained. Duncan and colleagues (2014) reported a lack of awareness of the negative consequences of SB in Australian adults, yet research to date has not explored this within a UK sample.

As well as a lack of understanding around awareness of SB, employee's motives to sit and stand within the workplace are unclear. Grunseit and colleagues (2013) reported that employees felt the main benefits of standing were to reduce MSK pain and feel more energised. Future research needs to take a deeper examination into employee's motives for standing within the workplace. Currently qualitative research either explored the barriers and facilitators to reducing workplace SB or the acceptability of AWS's. Understanding employee's motives to reduce workplace SB and supporting these motives could help to reduce and maintain reductions in workplace SB.

2.5 Summary of findings

The literature review identified 39 interventions that aimed to reduce SB in the workplace. Taken collectively these studies suggest that environmental changes such as the introduction of AWS's can derive significant reductions in SB. These interventions have also been reported to be acceptable to employees and feasible to implement within the workplace. Multi-component interventions, which make individual, organisational, and social changes to the workplace alongside environmental changes, present most promise and point to a complex underpinning of what determines workplace SB, beyond the physical environment. Due to the nature of these multi-component interventions it is unclear as to what these determinants are currently.

Although AWS's have led to reductions in workplace SB, there have been a number of methodological shortcomings identified, such as small and unrepresentative samples recruited, as well as short follow-up periods. The few studies which have measured workplace SB over 12-months have found that initial reductions in SB are not sustained at 12-months. This indicates that an AWS alone may not be sufficient for reducing workplace SB and that other factors are influencing SB. If AWS's do not lead to sustained reductions in SB, then it is important to further explore cheaper and more pragmatic interventions to reduce SB in the workplace.

Based on the current literature it appears that there is a lack of understanding as to why employees sit or stand within the workplace, and why an employee changes their behaviour. Further research is needed to understand the determinants of SB in the workplace, which can aid in designing interventions. Sustained reductions in SB in the workplace can then lead to improvements and a reduced risk of a person suffering from negative health consequences later in life. Exploring the determinants of workplace SB would also then inform the selection of an appropriate theory to underpin workplace SB interventions.

2.6 Aims of the thesis

The findings of this review highlight two linked areas that are worthy of future research; 1) gaining a deeper understanding of the determinants of workplace SB, 2) a need for further research exploring effective strategies to reduce workplace SB that are based on this deeper understanding of determinants.

The aims of the current programme of research are therefore to;

- Explore the determinants of workplace SB within desk-based employees.
- Design a pragmatic and sustainable intervention to reduce workplace SB, which can be adopted by all employees in different organisations with little resources required.

The following chapters set out the research methods and underlying theories adopted to satisfy these aims. The narrative begins with the first study of the thesis – a cross-sectional exploration the determinants of SB in the workplace.

Chapter 3: Study 1 - A cross-sectional study exploring the determinants of workplace sedentary behaviour within desk-based employees

3.1 Introduction to the chapter

Chapter 2 critically appraised the evidence base for interventions to reduce workplace SB. Despite a growth in the number of studies exploring SB in the last decade, few have demonstrated sustainable outcomes (e.g. initial reductions in SB beginning to return back to baseline within 12 months; Koepp et al, 2013) and most fail to assess change beyond the initial intervention period (Pronk et al., 2012). AWS interventions which have been successful in reducing workplace SB are also expensive to implement due to the cost of AWS's, meaning not all organisations are or would be able to implement such changes. From a health perspective this represents cause for concern as maintaining any reduction in workplace SB is critical to achieving longer-term health benefit, particularly in individuals in sedentary roles at work (Van Dommelen et al, 2016). One explanation for the lack of long-term impact on SB could be that interventions are failing to target the necessary agents for change. This is understandable, given little is known about the actual determinants of SB within a workplace setting, particularly for people in desk-based roles (Owen et al, 2011). With this in mind, the following chapter describes a cross-sectional study that explored the determinants of workplace SB within desk-based employees.

3.2 Background to the determinants of workplace sedentary behaviour

Within the workplace SB is ubiquitous, especially for desk-based employees (Clemes et al, 2014; Kazi et al, 2014). Due to the number of hours each week and number of years that employees potentially spend in the workplace, and at their desk, it is important that interventions targeted at reducing workplace SB can sustain change.

With the intention of improving the long-term impact of interventions, Owen and colleagues (2011) proposed an epidemiological research agenda for exploring

SB within different contexts. The stages of this are; (1) understand the relationship between SB and health outcomes; (2) measure SB; (3) characterise the prevalence and variations of SB in populations; (4) identify the determinants of SB, and (5) develop and test interventions to influence SB. There is research to support the first three phases of the agenda within the workplace (Bauman et al, 2011; Healy, Matthews, Dunstan, Winkler, & Owen, 2011; Thorp, Owen, Neuhaus, & Dunstan, 2011); however less evidence is available for the fourth phase, which importantly here precedes the development of interventions (the fifth phase). The following sections shall discuss the research that has been conducted into the determinants of workplace SB and highlight avenues for future research.

3.2.1 Research into the determinants of sedentary behaviour

Rhodes, Mark and Temmel (2012) conducted a systematic review of the correlates of SB among adults in different populations. Most of the research included in the review focused upon television (TV) viewing time and it was reported that those with the highest TV viewing time tended to be less educated, older, unemployed or working less than full time, and have a higher BMI. Socio-demographic variables are hard to modify and the authors identified an absence of research that has focused on cognitive, social, and environmental factors. Identification of these variables could be used for interventions to reduce SB as, unlike socio-demographic variables, they are potentially modifiable.

It is important to gain an understanding of the determinants specific to SB in the workplace, as the workplace appears to provide an opportunity to substantially reduce SB. Research has begun to focus solely on the correlates and determinants of workplace SB with two studies examining the correlates of occupational sitting through questionnaires (De Cocker et al, 2014; Wallmann-Sperlich, Bucksch, Schneider and Froboese, 2014). Wallmann-Sperlich and colleagues (2014) surveyed 1,515 German adults, to examine the associations between socio-demographic, behavioural and cognitive correlates with occupational sitting time. De Cocker and colleagues (2014) further explored similar factors in Australian workers with psychosocial factors also included in their questionnaire. Both studies found that occupational sitting was associated with socio-demographic factors, in particular people with a higher education and income were found to report higher occupational sitting times. De Cocker and colleagues (2014) reported that psychosocial factors were not strongly related to occupational sitting.

While both these studies investigated adults in employment they failed to consider the type of work that respondents undertook. Participants reported sitting an average of two hours (Wallmann-Sperlich et al, 2014) and 3.75 hours (De Cocker et al, 2014) per working day, significantly less than data reported by desk-based workers in other studies (6.5 hours; Clemes et al, 2014; Kazi et al, 2014). These results may not be representative of the determinants of desk-based workers SB, as the authors did not distinguish between the roles that employees were completing (e.g. manual or non-manual work). Research needs to focus specifically upon desk-based workers, rather than all workers, as there would likely be differences in occupational sitting times between manual workers and desk-based workers that need considering.

De Cocker and colleagues (2014) attributed the lack of relationship between psychosocial variables and occupational sitting to the habitual nature of sitting. The habitual and automatic nature of sitting has also been mentioned in qualitative research that has explored the facilitators and barriers to reducing workplace SB (De Cocker et al, 2015). If occupational sitting is habitual this could mean that it is an unconscious behaviour that a person is not aware of performing. Research has yet to explore the habitual nature of SB in the workplace. Nevertheless if sitting is an unconscious behaviour this could influence the design of future interventions.

The limited evidence base concerning the determinants of workplace SB means there is a dearth of data to inform the development of interventions to reduce workplace SB, potentially explaining the short-term outcomes of interventions. Gaining an understanding of the determinants of workplace SB might increase the potential for achieving a sustainable change in SB.

3.2.2 Awareness of sedentary behaviour

Further exploration of the determinants of workplace SB is warranted to aid in the selection of appropriate theories to underpin the design of interventions. Of the few studies that have identified an underpinning theory, Bandura's (1986; 2004) SCT has typically been adopted (Carr et al, 2013; Dunstan et al, 2013; Neuhaus et al, 2014b). As highlighted in the Literature Review (Chapter 2), knowledge is a precursor to behaviour change according to SCT (Bandura, 1986; 2004). Duncan and colleagues (2014) however reported that 67% of Australian workers were not fully aware of the negative health consequences associated with SB, which may explain why reductions in SB have not been maintained.

As sitting has been a behaviour adopted by many workers in offices for decades, it is likely that employees are unaware of the need to stand as they are used to sitting and have been exposed to colleagues sitting for the majority of their working days. There are campaigns to promote PA within the UK, but not until recently have these campaigns emphasised the need to also reduce sitting as well as increasing PA. Gaining an understanding of employee's current awareness of the negative implications of SB will help inform the design of future interventions and campaigns, and help determine whether education is an appropriate starting point for an intervention.

3.3 Study aims

The aim of Study 1 was to explore and quantify desk-based employee's awareness of the negative consequences of SB and the habitual nature of sitting in the workplace. It was hoped that data would contribute to what is known about the determinants of workplace SB and expand current data on reported sitting times in desk-based workers in the UK. Previous SB research has focused on adults in a wide variety of occupations and this therefore represents one of the first studies to explore the determinants of SB specifically within desk-based employees.

The objectives of the study were to explore:

- The prevalence of SB during working days (both whilst at and away from work).
- The relationship between different determinants and workplace SB.
- Employee's awareness of the negative consequences of SB.

- The strength of sitting as a habit.

3.4 Methods

3.4.1 Participant recruitment

Participants were purposefully recruited from organisations in which employees primarily completed desk-based jobs. A range of different types (e.g. public, private and third sector organisations), sizes of organisations (ranging from 10-7,000 employees), and job roles (e.g. managers, team leaders, team members) were recruited to ensure that the sample was representative of all employees within different organisations. Managers from 31 different UK work organisations were contacted via email and asked if they and their desk-based employees would be willing to participate in a study.

3.4.2 Participants

Twenty-two organisations distributed the questionnaire, with a total of 1,101 participants taking part in the study. Responses were included in the analysis if participants were aged 18 years or older, did not report working in a manual job and reported daily sitting times which were less than 24 hours. Eleven participant's results were removed from the dataset due to; working in a manual job (n=10) and reporting daily sitting times which were not feasible (n=1; e.g. >24 hours). In total 1,090 responses were analysed.

3.4.3 Ethical approval

Prior to organisations and participants being contacted, the study protocol was reviewed and approved by Sheffield Hallam University research ethics committee (Appendix 3.1).

3.4.4 Questionnaire design

The questionnaire was designed online using Google Forms. This meant that the questionnaire could be easily sent to employees, as the vast majority of desk-based employees have access to a computer and the internet. It also increased the ease of completing the questionnaire and extracting the data once completed.

Demographic data was collected including: age, ethnicity, gender, highest education attained, which business sector they worked in, number of employees in their office, and job role. Information about each of the measures used in the questionnaire is provided in Table 3.1 (see appendix 3.2 for the full questionnaire).

Table 3.1. Measures used in the questionnaire & details on the nature of the items included.

Measuring	Information	Number of Items	Scoring system	Reference
Awareness of the negative consequences of SB	The first question looked at implications of sitting at work.	4	Multi-choice (question 1).	
	The following three questions focused on SB and CVD.		Five point Likert scale, 'Strongly Disagree' to 'Strongly Agree'.	Duncan et al (2014)
Habit strength	Self-report index of habit strength (SRHI).	8	Seven point Likert scale ranging from 'Strongly Disagree' to 'Strongly Agree'.	Verplanken and Orbell (2003)
Intentions to reduce SB	The first two questions were based on general intentions to move around in the workplace. The second two questions were based on the workplace SB guidelines (Buckley et al, 2015).	4	Five point Likert scale, ranging from 'Strongly Disagree' to 'Strongly Agree'.	Conroy, Maher, Elavsky, Hyde, and Doerksen (2013)
Sitting time	The Workforce Sitting Questionnaire measured sitting times in different situations on both work and non-work days.	10	Participants fill in time in hours and minutes	Chau, Van Der Ploeg, Dunn, Kurko, & Bauman (2011)
Perceived behavioural control	Looked at the control employees felt they had over reducing SB at work.	5	Five point Likert scale, ranging from 'Strongly Disagree' to 'Strongly Agree'.	Dunstan et al (2013)
Organisational norms	Looked at the organisational norms around sitting at work.	6	Five point Likert scale, ranging from 'Strongly Disagree' to 'Strongly Agree'.	Dunstan et al (2013)
Office environment	Questions from the office environment and sitting scale assessing employee's physical office environment.	3	Two questions were multi-choice with four options. One question on a four-point Likert scale, ranging from 'Strongly Disagree' to 'Strongly Agree'.	Duncan et al (2013)
Physical activity	Stanford Leisure-Time Activity Categorical Item (L-Cat). Measures a person's PA.	1	Multi-choice from six options.	Kiernan et al (2013)

3.4.5 Questionnaire pilot

Prior to distributing the questionnaire, an online and paper version of the questionnaire was piloted with 28 people including individuals who were; aware of the aims of the study, experienced in research methods, native and non-native English speakers, and currently working in offices external to the university. After completing the pilot questionnaire, participants were asked for their feedback on it.

As a result of the pilot, the following changes were made to the questionnaire;

- The question about the negative consequences of prolonged sitting was changed to 'What, if any, do you think are the implications of sitting for long periods of time?' This question previously did not include 'if any'.

- More multi-choice options were added for the question asking participants about the implications of prolonged sitting, with a greater mix of positive and negative choices (e.g. 'higher work productivity').

- Four of the items were removed from the SRHI measure as participants felt they were not appropriate for sitting in the workplace, leaving eight questions to measure sitting as a habit in the workplace. (NB: Previous research has also removed items from the SRHI and has found that this has not impacted upon the validity of the measure – see Lally, Van Jaarsveld, Potts, & Wardle, 2010).

The final questionnaire consisted of 43-items including an assessment of the demographic profile of participants.

3.4.6 Procedure for distributing and completing the questionnaire

Organisations that were willing to participate in the study were sent a unique web-link to the questionnaire to distribute to their desk-based employees. The web-link was sent to employees either by email or advertised on their organisation's Intranet page so that employees could complete the questionnaire in their own time if they wished.

The questionnaire consisted of a participant information sheet (page 1 – see Appendix 3.3) followed by nine pages of questions, which took up to ten minutes to complete. Participants were able to leave the questionnaire at any point and their responses would not be recorded; however once they had submitted their answers they were unable to withdraw due to all responses being anonymous.

3.4.7 Statistical analysis

Exploratory analysis was conducted to determine the relationships and differences in means between the variables with workplace sitting time. Bivariate analysis was conducted to assess the relationship between workplace sitting time and the continuous scored independent variables (i.e. age, awareness score, SRHI score, control score, organisational norm score, intentions, total work day sitting, total non-work day sitting and out of work sitting). ANOVA and t-tests were also conducted to determine whether significant differences existed between groups occupational sitting time. Significance was set at $p<0.05$ and the relationships, or differences between groups that were found to be significant, were retained for the multivariate analysis.

Due to the size of the sample, central limit theorem proposes that tests of normality are not relevant for large sample sizes (Wilcox, 2012). It is proposed that when a sample consists of more than 30-40 participants that the sampling distribution tends to be normal and that statistical tests for normality cannot be sensitive enough to test normality (Altman & Bland; Ghasemi & Zahediasl, 2012). Meaning that parametric assumptions could be assumed and bivariate analysis was conducted using Pearson's correlation analysis. Multicollinearity was explored using a bivariate correlation matrix of all the included variables. A backwards elimination method of multiple regression was undertaken as this method removes variables which are not significant, until only variables that significantly influence the model remain. The model examined the relationship between the main effects and dependent variable as well as two-way interactions between the independent variables. Occupational sitting time was set as the dependent variable and all other significant variables were entered into the model as independent variables. All analysis was conducted using IBM SPSS Statistics Version 24 for Windows (IBM United Kingdom Limited, Hampshire, UK).

3.5 Results

3.5.1 Participant characteristics

In total n=1090 responses were included in the final analysis. This consisted of 64% female (n=700) and 88% white British ethnicity (n=954). Participant's characteristics are presented in table 3.2 along with mean workplace sitting times.

Table 3.2. Participant demographics & mean reported occupational sitting times (minutes) for each group.

	n (%)	**Mean minutes sitting in the workplace/day (SD)**
Mean self-reported sitting times		
Occupational Sitting	1090 (100)	394.18 (81.55)
Sitting Outside of Work Time	1090 (100)	265.70 (110.92)
Total Work Day Sitting	1090 (100)	659.98 (137.24)
Total Non-Work Day Sitting	1090 (100)	463.116 (250.91)
Gender*		
Female	700 (64.0)	399.38 (80.18)
Male	382(36.0)	385.11 (83.70)
Education		
GCSE's / O-Level's / CSE's	121 (11.3)	405.33 (71.05)
A-Level / AS-Level	81 (7.6)	397.96 (75.27)
BTEC / GNVQ / NVQ	140 (13.1)	397.21 (82.03)
Degree (e.g. BSc, BA)	373 (34.8)	386.00 (79.88)
Higher Degree (e.g. MSc, PGCE)	246 (23.0)	393.25 (89.38)
Doctorate	63 (5.9)	395.71 (87.69)
No Qualification	8 (0.7)	442.50 (61.59)
Other	39 (3.6)	399.23 (80.90)
Number of employees in department		
1-5	46 (4.2)	384.78 (75.18)
6-20	220 (20.1)	390.59 (82.74)
21-50	269 (24.6)	393.05 (79.16)
51-100	186 (17.0)	402.47 (73.36)
100+	373 (34.1)	394.42 (86.94)
Employment sector*		
Public	890 (81)	396.36 (76.10)
Private	138 (12.6)	396.01 (99.81)
Not-for-Profit	66 (6.0)	361.14 (101.98)
Desk type**		
Is at a fixed sitting height	945 (86.4)	399.03 (76.21)
Is at a fixed standing height	29 (2.7)	357.41 (147.19)
Can be moved up or down	119 (10.9)	365.59 (92.64)
Is attached to a treadmill / pedal station	1 (0.1)	390
Physical activity guidelines*		
Achieving Guidelines	495 (45.4)	385.67 (83.81)
Not Achieving Guidelines	595 (54.6)	401.27 (79.00)
Awareness score		
0 (No Awareness)	110 (10.1)	408.14 (78.77)
1	228 (20.8)	398.62 (68.00)
2	342 (31.3)	389.35 (86.27)
3 (Fully Aware)	414 (37.8)	392.27 (84.67)

*denotes p<0.05
**denotes p<0.01

3.5.2 Exploratory analysis

Self-reported occupational sitting time was 394 minutes/day, which accounted for 60% of daily sitting. Participants reported sitting for a total of 660 minutes on a typical work day and 463 minutes on a non-work day (e.g. the weekend). Mean self-reported sitting times are presented in table 3.2.

Table 3.3 presents the correlation coefficients and significance values of the bivariate analysis that was conducted. Bivariate analysis indicated no significant relationship between age (p=0.91) or sitting time away from the workplace (p=0.70) with occupational sitting. The association between total work day sitting and occupational sitting was moderately related (r=0.59). The remaining six associations were weakly associated with occupational sitting (r= -0.29 - 0.38).

For variables which had distinct groups (e.g. gender, desk type), comparison of means testing was conducted comparing the occupational sitting times of each group. No significant difference was found in occupational sitting time between groups based on awareness total scores (p=0.14), ethnicity (p=0.25), number of employees in department (p=0.54) and office type (p=0.24). Variables which showed significant differences are highlighted in table 3.2. Variables that were found to have non-significant associations with occupational sitting or non-significant differences between mean occupational sitting times were excluded from further analysis.

Table 3.3. Correlation coefficients for continuous variables with reported occupational sitting times.

	Pearson Coefficient (r)	**p-value**
Total work day sitting	0.59	<0.001
Total non-work day sitting	0.08	0.01
Sitting away from the workplace	-0.01	0.70
Age	0.004	0.91
SRHI score	0.38	<0.001
Control score	-0.19	<0.001
Organisational norm score	-0.23	<0.001
Intentions score	-0.29	<0.001
Standing options score	-0.19	<0.001

3.5.3 Multivariate analysis

Multivariate analysis was conducted to look at the interactions between the variables in explaining occupational sitting. Ten independent variables, found to significantly influence occupational sitting in the exploratory analysis, were included in the multivariate analysis, along with one dependent variable (occupational sitting). Assessment of multicollinearity of the variables found that total work day sitting and occupational sitting were strongly correlated (r=0.59), therefore total work day sitting was omitted from the multivariate analysis. All other variables were found to have weak relationships with the independent variables (r<0.4). The ten variables included in the analysis were; habit strength (SRHI), total non-work day sitting, control to stand score, organisational norms score, intentions score, standing options, gender, employment sector, PA, and desk type.

PA behaviour and desk type were dichotomised before being analysed. PA was divided based on participants self-reporting meeting the PA guidelines (i.e. achieving 150 minutes of moderate-intensity activity a week). Desk type was split dependent upon self-reported access to an AWS or fixed sitting height desk.

Multiple regression was applied to investigate the relationship between habit strength (SRHI), total non-work day sitting, control to stand score, organisational norms score, intentions score, standing options, gender, employment sector, PA, and desk type with occupational sitting time as the dependent variable. The final model, containing ten independent variables and ten two-way interactions between the variables, accounted for 28.5% (R^2=0.285) of the variation in desk-based employees occupational sitting. Table 3.4 shows the coefficients for the main effects and interactions of variables on occupational sitting, as well as the partial eta squared value for each variable and interaction.

Table 3.4 The effects of each variable and interactions between variables in the final multiple regression model on occupational sitting time

	Beta (SE)	95% Confidence Intervals		p-value	Partial Eta Squared
		Lower Bound	Upper Bound		
Intercept	3.13 (1.29)	0.59	5.66	0.02	0.006
Gender (Female)	-0.09 (0.34)	-0.76	0.57	0.78	<0.001
Gender (Male)	0[a]				
SRHI Score	0.11 (0.02)	0.07	0.6	<0.001	0.02
Total Non-Work Day Sitting	-0.06 (0.04)	-0.13	0.01	0.09	0.003
Standing Options	-0.80 (0.18)	-1.16	-0.44	0	0.02
Control Score	0.03 (0.02)	-0.007	0.06	0.13	0.002
Norm Score	-0.04 (0.04)	-0.11	0.03	0.28	0.001
Intentions Score	0.02 (0.04)	-0.06	0.09	0.65	<0.001
No Active Desk	-0.38 (0.77)	-1.88	1.13	0.63	<0.001
Active Desk	0[a]				
Public	2.99 (1.00)	1.03	4.94	0.003	0.008
Private	1.30 (1.18)	-1.02	3.61	0.27	0.001
Non-for-Profit	0[a]				
Physical Activity - Not meeting recommended guidelines	-0.24 (0.14)	-0.51	0.04	0.10	0.003
Physical Activity - Meeting recommended guidelines	0[a]				
Public*No Active Desk	1.42 (0.52)	0.40	2.44	0.007	0.007
Public*Active Desk	0[a]				
Private*No Active Desk	1.48 (0.62)	0.27	2.69	0.02	0.005
Private*Active Desk	0[a]				
Non-for-Profit*No Active Desk	0[a]				
Non-for-Profit* Active Desk	0[a]				
No Active Desk*SRHI	-0.03 (0.01)	-0.05	-0.007	0.008	0.007
Active Desk*SRHI	0[a]				
No Active Desk*Standing Options	0.25 (0.09)	0.08	0.41	0.005	0.008
Active Desk *Standing Options	0[a]				
Female*Control Score	-0.05 (0.02)	-0.09	-0.01	0.01	0.006
Male*Control Score	0[a]				
Public*SRHI	-0.07 (0.02)	-0.11	-0.04	<0.001	0.01
Private*SRHI	-0.04 (0.02)	-0.08	0.004	0.07	0.003
Non-for-Profit*SRHI	0[a]				
Female*Norm Score	0.07 (0.02)	0.03	0.11	0.001	0.01
Male*Norm Score	0[a]				
Total Non-Work Day Sitting * Norm Score	0.004 (0.002)	0.00	0.01	0.04	0.004
Not meeting Physical Activity Guidelines*Standing Options	0.15 (0.07)	0.01	0.29	0.03	0.004
Meeting Physical Activity	0[a]				

Guidelines*Standing Options					
Norm Score *Intentions Score	-0.005 (0.002)	-0.01	-0.001	0.03	0.005
Standing Options*SRHI Score	0.01 (0.004)	0.003	0.02	0.004	0.008

[a] This parameter is set to zero because the other parameters are compared to this score

SE = standard error

3.5.4 Awareness of the implications of prolonged sitting

A third (n=412; 38%) of participants reported being fully aware of the negative health consequences of prolonged SB. Ten percent of participants (n=110) reported no awareness of the negative health consequences of SB. Table 3.2 presents the number of participants in each group of the awareness categories and the mean occupational sitting times.

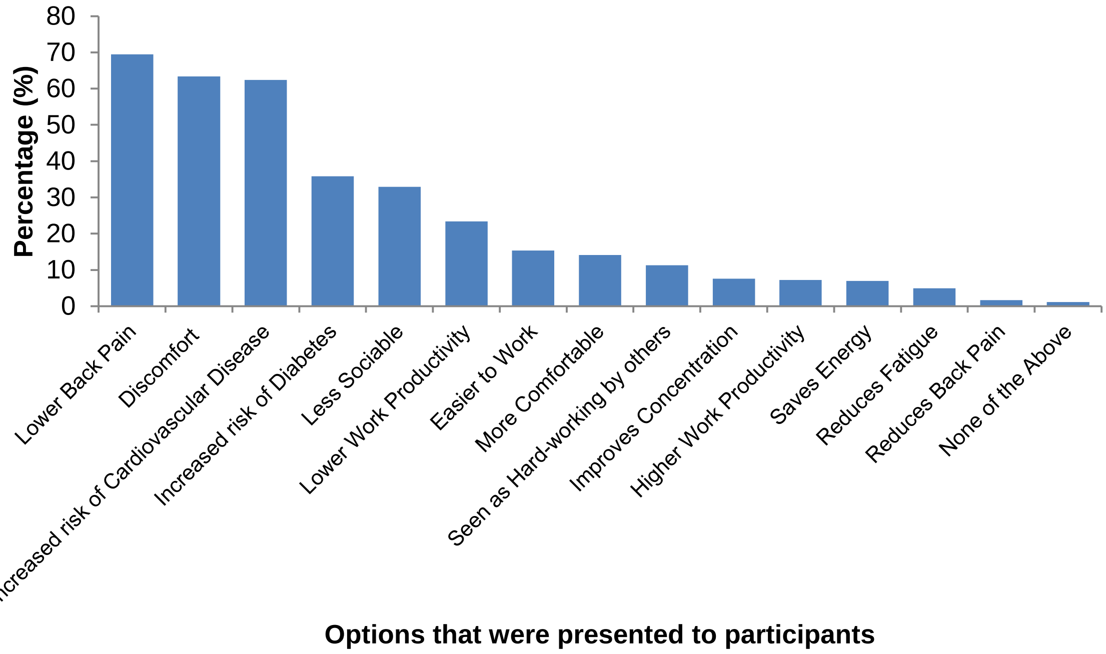
Figure 3.1 illustrates the frequency each option was chosen by participants when asked about the implications of sitting. In total 3,964 options were chosen, with participants choosing an average of four options each (mean=3.64). The most frequently selected options were; 'lower back pain' (69%), 'discomfort' (63%), and 'increased risk of cardiovascular disease' (62%). The least frequently chosen options were; 'reduces fatigue' (5%), 'reduces back pain' (2%) and 'none of the above' (1%).

3.5.5 Reported standing options

The vast majority of participants (n=848; 77.8%) either 'strongly disagreed' or 'disagreed' that they had the option to stand to work in the workplace. Only 11.8% (n=129) 'strongly agreed' they had the option to stand to work.

Out of the participants that reported having an AWS (n=148), 55% (n=81) reported that they either 'strongly disagreed' or 'disagreed' that they had the option to stand to work in the workplace. The majority of those with fixed sitting-height desks (n=942), 81% (n=767) reported that they either 'strongly disagreed' or 'disagreed' that they had the option to stand to work.

Figure 3.1. Participants responses to the question 'What, if any, do you think are the implications for yourself of sitting for long periods of time?' The bars represent the percentage of participants that selected each option.



3.6 Discussion

Study 1 measured workplace SB via a self-report measure, as well as examining the relationship between different determinants and workplace SB. This was the first study to explore the determinants of workplace SB specifically within desk-based workers. The present study also measured the strength of sitting as a habit and explored participant's awareness of the implications of SB. The following sections discuss the findings of this study and presents conclusions and implications for future research.

3.6.1 The determinants of workplace sedentary behaviour

Data suggests workplace SB was influenced by; habit strength (SRHI), total non-work day sitting, control to stand score, organisational norms score, intentions score, standing options, gender, employment sector, PA, and desk type. The findings support previous studies that show multiple determinants influence workplace SB (De Cocker et al, 2014; Wallmann-Sperlich et al, 2014). Findings here extend existing evidence by measuring the influence of interactions between variables upon workplace SB. This underlines the complexity of workplace SB, and a need for interventions to consider numerous interacting factors to reduce workplace SB in desk-based employees.

Previous studies have found that SB is correlated with an employee's level of education (De Cocker et al, 2014; Wallmann-Sperlich et al, 2014), yet this was not found to be the case in the present study. The present study also found that out of the psychosocial variables measured, control to stand, organisational norms, and intentions were related to workplace SB. Previously it has been reported that out of eight psychosocial variables measured, only higher awareness of the advantages of sitting less was correlated with workplace SB (De Cocker et al, 2014), yet awareness was not related to workplace SB in the present study. These findings support the reason why the present study specifically investigated desk-based employees, and highlights that there may be other differences influencing workplace SB specifically within desk-based employees. It also adds to the current literature in highlighting that psychosocial variables influence workplace SB and that this may be something that is specific to employees working in desk-based occupations.

The influence of multiple determinants upon workplace SB supports the use of multi-component interventions to reduce workplace SB. It seems unlikely from the present findings that a change to a single factor would lead to a significant reduction in SB that can be sustained. This might explain why previous interventions that have only made a single change to the workplace, such as introducing an AWS, have failed to sustain reductions in SB (Dutta et al, 2014b; Pronk et al., 2012). There is evidence to support multi-component interventions reducing workplace SB (Mackenzie et al, 2015; Neuhaus et al, 2014b), particularly those based on the social ecological model (Owen et al, 2011). Nevertheless there is also evidence that multi-component interventions have not sustained the initial reductions in workplace SB at 12 months (Healy et al, 2016). Due to the lack of research on the determinants of workplace SB, multi-component interventions may not have targeted the relevant determinants. The habitual nature of workplace sitting may also be influencing the ability for these interventions to maintain reductions in SB.

3.6.2 Habit strength

Data suggested a significant relationship existed between sitting and habit strength. This is supported by previous qualitative research but is the first study in desk-based workers to identify this relationship quantitatively. Although the SRHI has no pre-defined cut-off to identify behaviour as a habit, participants here reported mean habit scores of 6.1 out of a possible 7 (strongly agree). What is more data from previous research suggests that an SRHI score below half (i.e. <3.5) would indicate a lack of a habit (Lally et al., 2010), findings from this study make a strong case for occupational sitting to be considered as habitual and an unconscious behaviour. Further research is needed to explore the habitual nature of workplace SB. The habitual nature of occupational sitting would offer an explanation as to why previous interventions showing initial reductions in workplace SB have not been sustained (Ben-Her et al, 2014; Healy et al, 2016). As discussed in the Literature Review (Chapter 2) people are drawn to novel things, which would explain initial reductions in workplace SB, but the unconscious nature of sitting has led to participants reverting back to sitting in the workplace.

3.6.3 Awareness of the implications of sedentary behaviour

In the present study 63% of participants reported not being fully aware of the negative health consequences associated with SB. This supports previous research from Australia which found that 67% of adults were unaware of the negative health consequences associated with SB (Duncan et al, 2014). Considering SB is a new public health concern and that messages about the distinction between PA and SB are only just starting to emerge, it is not surprising that awareness of the negative health consequences associated with SB are not particularly high. This might also explain why previous workplace SB interventions, have not educated participants of the negative implications associated with SB at the outset (Alkhajah et al, 2012; Dunstan et al, 2013; Pedersen et al, 2014). This could also help understand why studies based on SCT, in which knowledge is a precursor to behaviour change (Carr et al, 2013), have failed to derive long-term impact.

Even though participants were not fully aware of the negative health consequences of SB, the majority of participants reported an appreciation of the adverse implications of prolonged sitting. It seems paradoxical that employees report sitting for long periods in the workplace when they understand that it has negative implications for their health. Employees would appear to have other motives to sit and complete their work, yet these are not apparent from the results of this study and other research. Understanding employee's motives to sit and stand would strengthen the workplace SB interventions, to encourage participants to stand at work.

The questions which explored awareness in this questionnaire also focused upon the negative health benefits associated with prolonged sitting rather than the potential benefits of standing and light-intensity activity. Further research is needed to explore participant's awareness of the implications of sitting and light-intensity activity. The primary emphasis of public health guidelines is around encouraging MVPA rather than light-intensity activity; therefore it may be that people are unaware of the implications of light-intensity activity. Awareness of the benefits of light-intensity activity may influence their levels of SB and motives for reducing SB, but as mentioned this questionnaire did not explore this. Further research into the awareness of the benefits of light-intensity activity could also be conducted alongside the exploration of employee's motives to sit and stand in the workplace.

3.6.4 Self-reported sitting times

Sitting time in the present study were self-reported, and allowed participants occupational sitting, work day sitting, and non-work day sitting times to be calculated. Average daily occupational sitting time was reported to be 394 minutes, which accounted for the majority of employee's total daily sitting time. These reported sitting times are consistent with previous self-reported (Kazi et al., 2014) and objectively measured studies (Thorp et al., 2012; Waters et al, 2016). This further supports the evidence that SB is highly prevalent within desk-based occupations.

Somewhat surprisingly, the present study found a minimal difference (36 minutes per day) in reported sitting times between participants with AWS's and those with fixed sitting height desks. This is substantially less than data reported in the reviews conducted by Neuhaus and colleagues (2014a) and Torbeyns and colleagues (2014). Previous research that has explored AWS users sitting times have typically done so following the implementation of an intervention, rather than employees that have received an AWS in a more natural work setting, which might be the case of the participants in the present study.

It is unclear why participants are not standing to work at their AWS's, but over half of participants with AWS's (n=81) reported not having an option to stand in the workplace. Previous research has reported that the introduction of AWS's has reduced workplace SB by increasing opportunity to stand (Neuhaus et al, 2014a; Torbeyns et al, 2014), as well as qualitative research reporting that AWS's are an acceptable way to reduce workplace SB (Chau et al, 2014a) and therefore the data here is surprising. Further research is needed to explore the reasons why employees sit and stand within the workplace.

3.7 Strengths & limitations

The present study benefitted from a large sample size, from a range of different organisations within the UK (e.g. accountancy, council, voluntary organisations). Previous research has reported small sample sizes (Waters et al, 2016) or samples of employees from different occupations rather than specifically desk-based employees (De Cocker et al, 2014; Wallmann-Sperlich et al, 2014). Gaining knowledge from a large representative sample of desk-based workers supplements the understanding of determinants within desk-based workers to help with the development of future interventions. Tew and colleagues (2015) reported that a number of AWS interventions were limited due to research being conducted within universities and health organisations, with a vested interest in SB research. The sampling framework adopted here intended to overcome this limitation by recruiting participants from a range of organisations.

Due to the cross-sectional nature of the study, assumptions about causality are limited. Longitudinal analysis of the determinants and monitoring of changes in SB and the determinants could provide a clearer picture of the influence of different determinants. Whilst the online questionnaire facilitated a high number of responses, it did not provide an opportunity for employees to discuss in any depth, factors that might influence workplace SB. Qualitative research methods would complement the findings of this study and allow further exploration of the reasons why employees sit and stand in the workplace.

Objective measures of SB could provide more reliable measures of SB and greater insight into how SB is accumulated daily. Objective measures have been recommended due to people reporting that it is hard to conceptualise sitting (Conroy & Maher, 2013). Whilst objective measures would have been preferable, this was not feasible or practical within the timescales for this PhD.

3.8 Conclusions

The present study explored the determinants of desk-based employees SB via a cross-sectional online survey. Habit strength, total non-work day sitting, control to stand score, organisational norms score, intentions score, standing options, gender, employment sector, PA, and desk type were found to influence workplace SB. A lack of awareness of the negative consequences of SB was also identified. Although the duration of workplace-sitting was similar to previous research (Kazi et al, 2014; Thorp et al, 2012; Waters et al, 2016), the reported difference between AWS and non-AWS users was much smaller (36 minutes/working day). Therefore Study 2 (Chapter 4) explored the determinants of workplace SB, particularly in employees that have the option to stand, to determine what underlies employee sitting and standing in the workplace.

Chapter 4: Study 2 - Qualitative exploration of the determinants of workplace sedentary behaviour within active workstation users

4.1 Introduction to the chapter

The previous chapter (Study 1) found that workplace SB was influenced by habit strength, total non-work day sitting, control to stand score, organisational norms score, intentions to stand score, standing options, gender, employment sector, PA, and desk type. Sitting was also found to be a habitual behaviour in the workplace, and that the majority of participants were unaware of the negative health consequences associated with SB. Self-reported occupational sitting times were over six hours - similar to previous studies (Kazi et al, 2014) - surprisingly, participants that reported having an AWS reported sitting only 36 minutes/working day less compared to participants with fixed sitting height desks. This suggested that research was warranted to explore the determinants of workplace SB, particularly in employees that have the option to stand, to determine what underlies employee sitting and standing in the workplace. With this in mind, Study 2 aimed to better understand employee's with AWSs experiences of sitting and standing within the workplace via qualitative research methods.

4.2 Background to the study

Study 1 (Chapter 3) explored the determinants of workplace SB via an online questionnaire. A number of determinants were identified which influenced workplace SB, nonetheless due to the cross-sectional nature of the study it was unclear if any one particular determinant has a larger influence upon workplace SB. With the intention of understanding the determinants of SB to aid in the design of interventions, a more in depth understanding of the determinants was needed.

The social ecological model of SB (Owen et al, 2011) has been used to underpin workplace SB interventions (Healy et al, 2016; Mackenzie et al, 2015) as discussed in the Literature Review (Chapter 2). The findings of Study 1 support this, as individual, social, organisational, and environmental factors were found to influence SB. Further exploration of these factors at the different levels of the social ecological model will provide evidence as to an appropriate theory to underpin future interventions. Other theories and models of behaviour change such as SCT (Bandura, 1986; 2004), and the Theory of Planned Behaviour (TPB; Ajzen, 1991) typically only consider the intrapersonal variables that influence a person's behaviour. Therefore these theories would seem to be only partially relevant for workplace SB. The present study aimed to explore the influences of workplace SB at the different levels of the social ecological model.

A finding of particular interest from Study 1 was that participants with AWSs only reported sitting 36 minutes/working day less than employees with regular fixed sitting-height desks. The AWS interventions identified in the Literature Review and reviews conducted looking at AWS interventions reported that workplace sitting reduced by 78 minutes/working day (Neuhaus et al, 2014a; Torbeyns et al, 2014). Therefore one might have expected the difference between participants with and without AWSs occupational sitting times to have been larger. Clearly there are factors influencing occupational sitting and standing other than the environment alone, which need exploring in greater detail.

The present study aimed to explore the determinants of workplace SB, using qualitative interviews, specifically within employees that reported having an AWS in Study 1. As previous qualitative research has reported that the environment limits employees opportunities to stand and work (De Cocker et al, 2015; Such & Mutrie, 2016), it was anticipated that employees with AWSs would discuss other factors influencing sitting and standing within the workplace.

Previous qualitative research into workplace SB has either explored participants experiences of using an AWS following an intervention (Chau et al, 2014a; Dutta et al, 2014a; Hadgraft et al, 2016) or the barriers and facilitators to reducing workplace SB (De Cocker et al, 2015; Gilson et al, 2011). The present study is therefore the first to explore the determinants of workplace SB in employees that already have access to an AWS for different reasons. As well as gaining a greater insight into the determinants of workplace SB, the interviews will explore employee's motives for getting an AWS and their motives for standing to work. These results can then, alongside the results of Study 1, further inform the design of workplace SB interventions.

4.3 Study aims

Study 2 explored the determinants of workplace SB for employees with AWSs and aimed to:

- Better understand why an employee has an AWS.
- Explore the different influences upon workplace SB.
- Examine how an employee could increase their standing during the working day.

4.4 Methods

4.4.1 Participant's criteria

Participants that reported having an AWS in Study 1 were purposively recruited. One organisation was found to have a high prevalence of AWS's (37% reported having an AWS; n=35) compared to all other organisations in the sample (10% reported having an AWS; n=113). Participants recruited from this organisation were used as a comparison group to explore if there were differences between SB dependent upon the prevalence of AWS's. Mean occupational sitting times were also reported to be lower in the organisation with a high prevalence of AWSs. As it appeared that employees may already be standing to work at their AWSs within this organisation, results from these participants' interviews were compared to participants' results from the other organisations.

4.4.2 Recruitment of participants

Managers within each organisation were contacted via email and asked if they were able to distribute an invitation email to those employees that had access to an AWS. Participants were recruited from three public sector organisations, including the organisation with a high prevalence of AWS users. Data saturation has been reported to be reached within the first 12 interviews, with basic elements appearing within the first six (Guest, Bunce, Johnson, 2007). Therefore the present study aimed to recruit at least 12 participants.

4.4.3 Participants

Participants were included if they were aged 18 years or older, worked primarily in a desk-based role and had access to an AWS whilst in the workplace. Fourteen participants were interviewed; all participants reported having had access to an AWS for over one year in their workplace. Six of the participants were recruited from the organisation that reported a higher prevalence of AWSs.

4.4.4 Procedures

The semi-structured interviews were conducted in September and October 2016 at the participant's place of work, in a private room away from colleagues and managers. Before agreeing to participate, participants were presented with the information for participants sheet (Appendix 4.1) and given time to read and ask any questions about the study. Three participants were unable to meet at a convenient time; therefore these interviews were conducted via telephone. All interviews were voice recorded and lasted on average 32 minutes (range of 20-60 minutes). Recordings were transcribed verbatim and anonymised.

4.4.5 Ethical approval

Before any participants were recruited ethical approval was received from the Sheffield Hallam University research ethics committee (Appendix 4.2). Once all interviews were transcribed identifiable information about the participant and their organisation were removed, including; their name, colleague's names, job role, department name, organisations name, location of offices, and name of offices. Participants were informed at the beginning of the interview that they did not have to answer all the questions, and that they would be able to withdraw up to two weeks following the end of the interview.

4.4.6 Interviews

4.4.6.1 Interview guide

The interviews were semi-structured in nature, allowing for comparisons across interviews whilst remaining flexible and allowing issues to emerge that the participants felt were important to discuss. An interview guide was developed to ensure similar topics were discussed with each participant (Appendix 4.3). The questions focused on; understanding factors that influenced sitting and standing within the workplace, why an employee had an AWS and other influences upon sitting and standing in the workplace. The guide also included prompts to encourage the participant to provide further explanation and clarity as required.

4.4.6.2 Interviewer

The lead researcher conducted all the interviews with participants, which helped ensure that similar topics were discussed. The interviewer aimed to keep the discussions open and conversational to build rapport, whilst remaining impartial to the topic and refraining from offering judgement on the behaviours of the participant. The interviewer had an understanding of the current literature and theoretical ideas relating to SB, and had worked in desk-based job roles for a number of years in both the public and private sector.

4.4.7 Data analysis

Data was analysed using the framework analysis approach (Ritchie & Spencer, 1994). The analysis was led by the lead researcher following the five steps set out by Ritchie and Spencer (1994) beginning with familiarisation of a sub-set of transcripts. The research team consulted on each of the stages of the analysis to avoid bias in interpretation. As participants had been recruited from organisations where AWSs were and were not prevalent, this approach allowed the research team to explore differences between organisations. The software Nvivo 11 was used to organise the transcripts and to code relevant quotes within the transcripts.

4.4.8 Establishing trustworthiness

Based on the concept of trustworthiness (Lincoln & Guba, 1985) several methods were used by the research team to ensure the quality of the analysis. Multiple-analyst triangulation was conducted with the lead researcher and another member of the research team coding transcripts. This was done to ensure agreement of the items coded and interpretation of the raw data. Two of the transcripts were also independently coded by peers who were trained in qualitative research but were not directly involved in the research, familiar with the area of SB, or aware of the aims of the research. Agreement was reported between the peers and the researcher on the items coded and labelling of the themes.

The thematic framework and final framework was also developed in discussion with the whole research team, again to ensure that lower and higher-order themes were representing what was being said in the raw data. A 'critical friend' reviewed, discussed, and challenged the labelling and ordering of the final framework to ensure the labelling of themes was appropriate. The 'critical friend' was not part of the research team or aware of the research in SB, and had not previously coded the transcripts. Throughout the interviews member checking took place with the interviewer summarising and reflecting on the points that the participant was making. This was to ensure that the point the participant was making was clear and allowed the participant to clarify their point if the interviewer had interpreted it incorrectly.

4.5 Results

The 14 participants (10 female) interviewed had a mean age of 49 years old (age range of 33-62 years old). Participants working in the two organisations which had a lower prevalence of AWSs are represented below as A, whereas participants from the organisation with the higher prevalence of AWSs are represented as B.

The results are displayed according to the higher and lower-order themes that arose in line with the framework analysis approach (Ritchie & Spencer, 1994). Twenty-four lower-order themes emerged from the data, which were then grouped into five higher-order themes. The higher and lower-order themes are presented in table 4.1. The higher and lower-order themes shall now be discussed with quotes.

Table 4.1 The higher- and lower--order themes created from the interview data

Higher-order themes	Lower-order themes
Experiences of standing	Benefits from standing Effort to use standing options Negative consequences of standing Adapting to standing
Individual motives to stand	Musculoskeletal problems Health conscious Preference to stand Confidence to stand Uncomfortableness of sitting Reason to stand
Organisational influences on behaviour	Access to standing options Effects of office layout on behaviour Movement due to role Flexibility within job role to manage own time and tasks Normal working behaviours Culture change
The habitual nature of sitting	Unconsciousness of sitting Consciously thinking about standing Triggers to encourage standing Prioritising work over standing
Social influences on behaviour	Social comparison Self-consciousness of standing Colleagues' awareness of why a person stands How standing is perceived by others

4.5.1 Experiences of standing to work

Having had access to an AWS for at least a year, participants had different experiences of standing to work. For the most part the experiences of standing to work were positive and led to participants maintaining standing to work at their AWS. Productivity was reported to increase through standing to work, typically as a consequence of relieving another issue *"I find I'm more productive, I feel like I'm more productive somehow, erm and it's probably just because I'm not uncomfortable" (3A)*. Some participants also reported being surprised by the variety of benefits gained from standing to work:

What surprised me was the range of different reasons why they found them [AWS] useful, erm initially I thought it was going to be a bad back type issue but it went everything through to Crohn's disease and IBS [irritable bowel syndrome], people were getting relief by being able to stand up, especially after lunch and they all acknowledged that after lunch they felt a bit, a bit dopey, a bit sleepy and that just standing for half an hour helped, erm so yeah it was all really positive feedback. (2B)

Although the majority of participants found standing to work beneficial some participants also found that standing was physically an effort. Switching between sitting and standing was not straight forward as some employees were using multiple things on their desks making it challenging and effortful to keep adjusting the height of the workstation *"Once you've got set up with all their sort of associated papers and you know the whole set-up, you then tend to stand from what I've seen; it's not quite so easy to just keep alternating" (5B).*

Participants also reported some problems resulting from standing for too long as they became tired, which led to them sitting down to work *"I probably would sit down because when you stand for a long time it does get tiring" (5B)*. It was also reported that it took time to adapt to standing and feel comfortable to stand for long periods:

My experience of it is that it takes a while it takes, it's like training for sport you know you kind of need to build up to it as well it's not like a snap, you go from sitting all day to then doing half and half, you know it's taken me quite a few months to build up to how much I stand now. (6B)

4.5.2 Individual motives to stand

Participants all reported individual factors that influenced whether or not an employee stood to work. The majority of employees reported suffering with a long-term health conditions which was normally the reason why they had an AWS. Typically employees suffered with a debilitating MSK problem which was either relieved by standing or limited the amount of time they were able to sit for. Inability to sit for long periods and relief from these problems led to participants standing to work *"I broke my pelvis, erm and subsequent to that for various reasons, I've been unable to sit for a prolonged period of time" (6A).*

A number of participants were also aware of the importance of maintaining a healthy lifestyle and strived to lead a healthy lifestyle. 'Health conscious' participants were generally more aware of the negative consequences of SB, suggesting that they would be more likely to respond to messages about the negative consequences of prolonged sitting *"I knew it was healthier for me to do so [standing] and because I'd read that study I was inclined to do it [standing] from that perspective" (3A)*. They would also see standing as an opportunity for them to be active within the workplace *"I do stuff out of work but if I'm just coming into work and sitting down all day that's not going to be conducive to my fitness levels" (4B)*.

A number of participants reported having a preference to stand in the workplace, regardless of whether or not there were options to stand and work. Employees that had a preference to stand had previously held job roles which were not desk-based and had experience of standing in their previous role *"I'm happy standing up, I'd rather stand up, I'd rather not sit down, I might get up and stand up anyway" (9A)*.

Participants spoke of how there were opportunities for any employee to stand to work, regardless of whether or not they had an AWS, yet they needed to have the confidence to stand when the situation arose during the working day. Therefore the confidence that a participant had to stand up in different work situations influenced whether a participant would stand or not in different situations away from their AWS:

> *INTERVIEWER: Do you think though there is the opportunity for you to stand during meetings?*
> *PARTICIPANT: Yes you just have to be a stronger personality I think than myself, that's about it. (3B)*

The majority of participants also talked about the need for a reason to stand either at their AWS or in other working situations. Without a purpose to stand (e.g. to relive a health issue or standing as part of a work task), participants did not understand why someone would choose to stand:

If somebody has got no problem at all then it probably wouldn't be of any advantage to them would it [to stand], you know if they're quite happy and able to sit for long periods, they probably couldn't even see the sense in having something like that [AWS]. (1A)

The uncomfortableness of sitting was also reported to motivate a participant to stand and work:

To be honest I don't like sitting down all day … I find my back aches and my legs ache, erm and I don't know if that is because I'm just not used to it but I find it quite uncomfortable. (4B)

4.5.3 Organisational influences on behaviour

Sitting and standing within the workplace was reported to be influenced by the organisation in which the participant worked. The availability of standing options influenced whether a participant or their colleague could and would stand to work. Within some organisations it was reported that there was a lack of AWSs and options to stand in their office *"I'm the only one in my team with a standing desk; I'm probably the only one on my floor" (5A)*.

The physical office environment was also reported to facilitate or restrict employees standing whilst in the workplace. When working away from their AWS's, participants talked about how the office environment was typically set-up for employees to sit down:

You go into a room and you sit down naturally and I think that's just because of the way that the rooms are set up …. all our meeting rooms are kind set up where there's a big desk in the middle with erm chairs around the desk so everybody can like naturally does that [sit] because erm it's there. (6B)

Regardless of whether or not an employee had an AWS, participants highlighted opportunities to move throughout the day to complete their work tasks. Employees reported having to stand and move to use facilities around the office or to speak with colleagues:

I do, in my job, tend to need to contact other teams because mine's quite specialist so I tend not to email people, I'll get up and walk over to them; one to

> *stretch and have a walk and another because I often can't explain a complex case in an email. (1A)*

It was felt that the normal working practices within organisations promoted sitting, regardless of whether or not an employee had an AWS. This *meant that employees would be more inclined to sit in typical working situations "But erm in a normal meeting sat around a table I think it would erm, it's not the norm [standing] unless you're actually in some sort of programme" (5B)*.

Employees from organisation B reported that the culture within the organisation had changed, which made standing more acceptable *"I'm surprised how quickly the office has adapted and just got used to the fact that they're there [AWSs], people have accepted them, I suppose within six months they just accepted that they were there" (2B)*.

4.5.4 The habitual nature of sitting

Employees discussed the habitual nature of sitting during the working day and how new habits were created to encourage standing. Sitting was spoken about being an unconscious process that participants did each day. It was common for them to forget about how long they had been sat for due to focusing on completing their work *"I get into it and just switch off and when I'm allowed to switch off and people aren't asking me questions I probably do sit for longer" (2A)*.

To combat the unconsciousness of sitting for prolonged periods participants discussed triggers and prompts to remind them to stand. Seeing colleagues standing to work or leaving their AWS in the raised position was reported to encourage standing *"The other thing I do is put the desk up each night before I go home, so that when I come in I start out standing and I think it would be very easy to start out sitting and not get up" (2B)*.

As well as needing to consciously remember to stand, participants talked about how they needed to consciously think about how to stand correctly. It was important for participants, especially those with health issues, to ensure they were standing properly and comfortably *"Getting used to like being stood and* *typing and like being conscious and making sure that I'm standing straight as well … so it's making that conscious decision to stand properly" (2A)*.

Completing their workload was also reported as being the priority for a number of participants, rather than making the effort to stand. In contrast to the earlier theme, employees reported sitting to increase productivity in times when there was pressure to complete work as they perceived it would allow them to focus on their work better. Participants reported sitting even if they knew health issues would worsen, highlighting that sitting may be the position which allows employees to fully focus on their workload:

> *The last two weeks of summer they were a nightmare, hardly stood up because I was too busy, you know there were like two of us in for two weeks, it was just a nightmare. So the pressure doesn't help. (9A)*

4.5.5 Social influences on behaviour

A number of social factors were reported to influence sitting or standing in the workplace. Some participants felt self-conscious standing in the workplace, especially if colleagues were sitting *"I'm in the middle of the office as well so I'm quite conscious about the fact that I'm stood up in the middle of the office" (2A)*.

Other colleagues' behaviours were also reported to influence sitting and standing with participants reporting that they would be more likely to compare themselves and to copy the behaviour of their colleagues in different situations *"If everyone else is sitting you sit, because you feel the odd one out if you stand" (4A)*.

A number of judgements were made about colleagues' perceptions of standing in the workplace. Participants reported they were comfortable to stand only when their colleagues understood why they needed to stand and would be more likely to sit when with people who were unaware of why they would stand:

> *We have one of these meeting rooms and I'm sort of stood looking supposedly towards it, and now if there's a big meeting I will sit down…I look like I'm looking over at them, and I must admit I'm conscious of that and I think just oh I'll sit down, you know when you see like of loads of official looking people coming in*

and I am very near to that, so that does effect it, so I will sit down even if I'm slightly uncomfortable you know physically. (3B)

Participants also felt that their colleagues had preconceptions about why a person would stand or why they would need to stand themselves in the workplace.

But the mind-set of the vast majority of people, which is something that I now don't agree with is that "Oh I couldn't stand all day, oh it would kill me to stand all day, I don't know how you stand all day?" (5A)

4.5.6 Comparisons between organisations

Participants in organisation B talked about there being a culture change within the organisation which led to standing being more accepted and acknowledged as a way of working. All participants in organisation A reported that they needed a reason to stand to work, which may be due to AWSs being less prevalent. Meaning that employees felt they needed to justify standing because they perceived it was not a normal behaviour within the workplace.

The majority of participants from organisation B also spoke about how sitting was an unconscious behaviour. All participants in organisation A reported an MSK related issue, which typically prompted them to stand. As MSK issues were not as prevalent with participants from organisation B, this highlights the need for prompts to encourage an employee to stand due to the unconsciousness of sitting.

4.6 Discussion

The primary aim of Study 2 was to further explore the determinants of workplace SB in employees with AWSs, following on from the results of Study 1 (Chapter 3) which found workplace SB to be influenced by multiple determinants. Study 1 also found that the difference in AWS users occupational sitting times were not as large as previously reported (Neuhaus et al, 2014; Torbeyns et al, 2014), therefore Study 2 purposefully recruited participants with AWSs. Sitting and standing within the workplace was found to be influenced by individual motives, social factors, organisational factors, and sitting was reported to be a habitual behaviour which meant that standing required conscious deliberation. The results help further understand the habitual nature of occupational sitting and determinants found to influence workplace SB in Study 1. These determinants provide a platform upon which to build future interventions, in particular focusing on the habitual and unconscious nature of sitting.

Participants all reported standing at their AWSs to varying degrees (i.e. multiple times a day or a few times a week), yet they all described having positive experiences of standing to work. Standing to work was reported to lead to a number of benefits including reduced back pain and fatigue, which meant participants maintained using their AWS to stand. The positive experiences of standing at an AWS supports results from other qualitative research that has explored employees' experiences following a short-term AWS intervention (Chau et al, 2014b; Dutta et al, 2014a). The fact that participants reported standing due to MSK pain aligns with the findings of Study 1, that participants reported that back pain and discomfort were the consequences of sitting.

Although participants' experiences were mainly positive, some participants experienced negative issues when standing to work. Participants reported experiencing pain or discomfort, typically in their legs, which would result in them sitting down. Participants also reported that it took time to adapt to being able to stand to work and use their AWS effectively. Standing exacerbating physical pain has also been reported in previous qualitative research by Grunseit and colleagues (2013). Guidance is available for workplace sitting and standing times (Buckley et al, 2015), but it may be that employees are not provided with guidance or support when receiving their AWS. Considering the lack of awareness about the negative health consequences associated with SB reported in Study 1, it is also not surprising that employees are not aware of the available guidance around workplace SB. Further support and guidance on sitting and standing times is needed for employees in desk-based roles. Physical pain, uncomfortableness, and standing being effortful, may also explain why previous AWS interventions have found that the use of AWSs has reduced over a 12-month period (Healy et al, 2016; Koepp et al, 2013). Participants in Study 2 reported that the benefits of standing greatly outweighed the negative implications felt when sitting (i.e. back pain), therefore they persevered to adapt to standing to work.

All participants reported being motivated to stand to work for individual reasons, typically because they had a MSK problem, which was relieved through standing to work. Gilson and colleagues (2011) reported that employees felt that SB was linked to MSK problems, rather than cardio-metabolic health issue (e.g. CVD, diabetes). Employees appear to be motivated to stand to relieve MSK pain, as standing can provide immediate relief from this pain. Promoting standing to relieve MSK related issues may appeal to more employees within the workplace if they can relate to it. It has been reported that 63-86% of employees suffer with some form of upper extremity MSK problem or discomfort (Robertson, Huang, & Larson, 2016). If MSK problems impact upon the majority of workers and standing can relieve this pain, this immediate benefit felt by employees may encourage them to maintain standing. Participants in the present study reported maintaining standing due to the immediate relief in MSK pain gained when standing.

Interestingly participants also spoke of how they would feel more productive when standing at their desk and able to concentrate better on their work. Nevertheless they also reflected on the fact that when they were particularly busy with work, they would remain seated to focus on their work, which seems a paradox. Based on the first finding it would be expected that participants would be more likely to stand if they reported being more productive standing. Previous qualitative research conducted following the introduction of AWS's to the workplace as part of an intervention has also reported that participants have felt more productive when working at an AWS (Chau et al, 2014; Dutta et al, 2014b). Therefore there does appear to be some evidence to support that AWS's can increase employee productivity, yet this can be hard to show objectively. It also appears that the default and habitual nature of sitting in the workplace may be the overriding influence upon employee's behaviours, particularly when busy. The habitual nature of sitting has been reported in previous work (De Cocker et al, 2015; Hadgraft et al, 2016), as well as the present study and the findings of Study 1.

Participants reported that sitting was the typical behaviour within their workplaces, but that they felt comfortable to stand around their colleagues because they had a reason to stand (e.g. back problem). Such and Mutrie (2017) also reported that participants felt sitting was the typical behaviour within workplaces. Participants also spoke of how they would copy the behaviours of their colleagues, in particular within the organisation where AWSs were more prevalent; participants spoke of how they would stand if they saw a colleague stand. It would seem that employees are more likely to feel comfortable standing if more of their colleagues also stood. Therefore encouraging more employees to stand in the workplace could make employees feel more comfortable when standing. Participants in De Cocker and colleagues (2015) focus groups reported that they would like to see more employees standing as role models within the workplace. This again could lead to employees feeling more comfortable standing in the workplace.

Participants in organisation B also reported how they felt there was a change in culture which lead to them using their AWS's more frequently and standing more frequently. This was attributed to the number of AWS's that were available within their workplace, which made colleagues aware of the reasons why a person would be standing to complete their work. The acceptance and reason to stand within the workplace appears to influence employee's behaviour, particularly as standing is against the norm. Further research is needed to explore the organisational norms within workplaces and how these influence SB. These norms may even reach wider than the workplace and stem from the norms which are developed outside of the workplace and as children in schools, where we are expected to sit. It is positive however that the workplace culture did appear to change through the introduction of more AWS's in organisation B, meaning that this can influence SB.

Within a working day, participants spoke of how they and their colleagues would typically stand to complete different tasks, regardless of having an AWS. This highlights that there are opportunities for employees to stand within the workplace, regardless of their environment. Therefore expensive environmental changes to workplaces are not necessarily needed to promote standing. Previous interventions which have looked to reduce workplace SB through breaks have tried to introduce new behaviours into the workplace, such as light-PA at employees' desks, which may disrupt employees work productivity (Cooley & Pedersen, 2013; Evans et al, 2012). Promotion of behaviours performed as part of an employee's job, would be well received by employees and employers as it would limit the impact upon work productivity.

Even when there are opportunities to stand, employees could be limited by the habitual and unconscious nature of sitting in the workplace. Participants reported that even with the facilities to stand, that sitting was their typical behaviour, as it was an unconscious behaviour. If busy, participants would sit down to focus on their work or forget to stand due to being focused on their work. Participants have previously reported that sitting is a habitual behaviour when discussing the barriers and facilitators to reducing workplace SB (De Cocker et al, 2015; Hadgraft et al, 2016). This contradicts the view that employees felt they were more productive whilst standing to work.

To combat the unconscious nature of sitting employees reported using 'triggers' or 'prompts' to remind themselves to stand throughout the day. This could be an external cue (e.g. leaving the workstation raised) or via internal regulation such as discomfort from a MSK issue. Interventions have shown success in breaking up prolonged bouts of sitting through introducing computer prompts to the workplace highlighting the need for conscious reminders (Cooley & Pedersen, 2013; Evans et al, 2012). The results from Study 2 suggest that the introduction of prompts could reduce workplace SB, by bringing standing into an individual's conscious thought processes. This is the first study to report sitting to be habitual even when employees have access to an AWS.

Habits are automatic actions which are based on learned stimulus-response relationships (Gardner et al, 2016). Due to the majority of employees sitting to work and the length of time that employees have spent working in desk-based roles, it is not surprising that the association between sitting and working has been learned and reinforced, leading to the formation of the habit. As well as sitting being ubiquitous in the workplace, sitting is also prevalent in other domains of life (Dempsey et al, 2014) which would further strengthen the habit, as sitting is constantly being reinforced throughout a person's typical day.

The results of this study highlight that sitting and standing within the workplace is influenced by a number of different factors and that the combination of these factors has led to sitting becoming habitual. These findings support the findings of Study 1 in that workplace SB is a complex behaviour influenced by multiple determinants. Nevertheless these findings provide further depth to the understanding of sitting and standing, and provides insight into strategies that employees use to stand in the workplace. The influence of multiple determinants further supports the need for future interventions to use multi-component interventions to target reducing workplace SB at different levels of the social ecological model (Owen et al, 2011). As mentioned in the Literature Review (Chapter 2), the use of multi-component interventions has not necessarily led to sustained reductions in workplace SB (Healy et al, 2016). This may be due to interventions failing to acknowledge the habitual and unconscious nature of sitting which employees will end up doing regardless of employee's intentions to reduce the amount of time sitting. Previous interventions have been based on SCT (Bandura, 1986; 2004) meaning that a person is required to make a conscious decision to change their behaviour (Dunstan et al, 2013; Neuhaus et al, 2014b). The present study questions this paradigm, suggesting that sitting is an unconscious behaviour, requiring alternative theoretical underpinnings for interventions. Future research should therefore explore theories which acknowledge the unconscious nature of behaviour.

Overall the findings of this study would suggest that the unconscious and habitual nature of behaviour within the workplace is the most influential determinant upon an employee's behaviour. Habitual behaviours tend to override other behaviours. Therefore as it appears that sitting within the workplace is habitual, particularly when employees are focused on other tasks, focusing on breaking or changing these habits would be beneficial to reducing workplace SB. No previous workplace SB interventions have acknowledged this when designing interventions, therefore this needs exploring further. Influencing the habitual behaviours within the workplace would likely lead to the largest and most sustainable changes to workplace SB.

4.7 Strengths & limitations

This study has a number of strengths and some limitations that are worthy of brief consideration. The use of qualitative methods provided employees and the interviewer an opportunity to explore in depth the issue of workplace SB and how to reduce workplace SB. This is also the first study to purposively sample employees that had access to an AWS, for over a year, in a natural working environment. Previous qualitative work on the effectiveness of AWSs has sampled employees that have been part of short-term interventions using AWSs (Chau et al, 2014a; Dutta et al, 2014a).

Whilst quantitative designs might enhance the ability to generalise, the qualitative approached adopted here provides a deeper exploration into the determinants of SB. Saturation of data was reached providing confidence that the insight was representative of those sampled. The sample used in the present study consisted of employees all working in public sector organisations and some participants spoke about the financial constraints and austerity that was affecting their organisation. This may have meant that employees were faced with more pressures to complete their work, which was reflected in the information around prioritising work (Such & Mutrie, 2016). Nonetheless the cost of making changes to reduce workplace SB has been reported as a barrier in different public and private sector organisations (De Cocker et al, 2015; Hadgraft et al, 2016). This means that financial constraints are not limited to this sample and are applicable to a number of different organisations. Although limitations of the sample have been identified, the results may reflect issues experienced by employees in different desk-based job roles, with access to AWSs. No firm conclusions can be drawn from the current data regarding the most influential determinant upon SB within the workplace. Future research could add a question to the interview guide which explicitly asks the participants what they feel the most influential determinant of sitting and standing in the workplace is.

4.8 Chapter summary

The results of this study show that occupational sitting is influenced by social, organisational, and individual factors and not just the environment. This further supports the findings of Study 1 and provides richer detail into the social, organisational, and individual factors influencing SB and participants motives to sit and stand in the workplace. Whilst there was some support for the use of AWS's, data pointed towards future interventions looking to make changes at multiple levels of the social ecological model (Owen et al, 2011). Interventions should also look to take advantage of the opportunities employees already have to stand in the workplace. As data from Studies 1 and 2 suggest that sitting is habitual, future research could seek to promote standing opportunities present within the working day, rather than only reducing sitting.

The findings from Study 2 provide insight into how employees could potentially reduce workplace sitting, the need for prompts to encourage standing, and that there are already opportunities to stand within the workplace. Future interventions should look to utilise these opportunities to stand, providing potentially feasible and cheap ways for workplace SB to be reduced. As discussed, future interventions should consider the habitual and unconscious nature or SB, and therefore the need to underpin interventions with an appropriate theory.

Chapter 5: Study 3 - Validation of the Runscribe accelerometer to measure workplace sedentary behaviour

5.1 Introduction to the chapter

The Runscribe accelerometer was used to measure workplace SB during the intervention. As Study 4 was the first study to use the Runscribe to measure SB, the accelerometer was validated to ensure SB was accurately measured. The rationale, methods, and results of the validation study shall be discussed in the following sections.

5.2 Background to the study

Accelerometers are a valid tool to objectively measure daily sitting and standing (Grant et al, 2006). Accelerometers are sufficiently sensitive to detect postural changes and to determine whether a participant is sitting or standing (Kozey-Keadle et al, 2011; Ryan et al, 2006). Although self-report measures of sitting are valid (Chau et al, 2011), they lack sensitivity due to the limitations of participant recall.

Different accelerometers have been used to measure SB in interventions. The Literature Review (Chapter 2) identified 25 interventions that objectively measured workplace SB using nine different types of accelerometer, such as the ActivPAL, ActiGraph, and SenseWear (e.g. Chau et al, 2016; Evans et al, 2012; Gorman et al, 2013). An important consideration when using accelerometers for measuring SB is where the monitor is worn on the body. For example, accelerometers such as the ActiGraph are worn on the hip, and classify the intensity of activity to determine the type of behaviour a person is performing (Fortune et al, 2014). Although these accelerometers have been found to be a valid measure of SB, they are not as sensitive as other accelerometers worn on the thigh (Chastin & Granat, 2010; Healy et al, 2011). If a person is stood still or sat still the ActiGraph may classify both of these behaviours as the same, due to the absence of activity or movement. For the purpose of this study distinguishing between sitting and standing is clearly important, meaning that hip worn accelerometers would not be suitable.

One of the most commonly used accelerometers in SB research is the ActivPAL, which is a thigh worn accelerometer. The ActivPAL is able to determine the angle of the leg, meaning that if it is worn on the thigh it can determine if a person is sitting or standing. The ActivPAL has been found to be a valid and reliable measure of SB within the workplace (Grant et al, 2006).

Although the ActivPAL has been found to be an acceptable measure of SB, researchers have reported that data has been lost or not recorded properly when using the ActivPAL accelerometers (Chau et al, 2016; McGuckin, Sealey, & Barnett, 2017). A pilot study conducted by the present research team prior to this PhD, looking at the impact of AWSs within the workplace, also encountered problems with ActivPAL monitors (Lamb & Till, 2016). The study found that the monitors did not record properly when they were returned by participants, and it was not clear to a participant if the monitor is recording properly. Participants also reported being unhappy with wearing the monitors, particularly the dressing used to attach the monitor to the leg. This meant that data were lost due to lack of compliance by the participants and unreliability of the monitors.

Due to the issues reported with the ActivPAL accelerometers, Study 3 used a different accelerometer to measure workplace sitting and standing. This was to limit the risk of potentially losing data due to unreliability or non-compliance of the accelerometers, particularly with having a small sample. The intervention used the Runscribe accelerometer, which is a motion sensor containing a tri-axial accelerometer.

The Runscribe has not previously been used to monitor SB; therefore before the intervention began the accelerometer was validated against the ActivPAL accelerometer. The following sections will report how the Runscribe was validated and the results of this study.

5.3 Study Aims

The aim of the present study was to test the validity and reliability of the Runscribe accelerometer in measuring SB.

5.4 Methods

5.4.1 Study Overview

The study consisted of two testing phases; a controlled phase and a workplace activity phase. For the controlled phase, Runscribe accelerometers were placed in different stationary positions for predetermined periods of time, with the lead researcher observing this and the length of time the monitors were in each position. The same monitor was then worn by the lead researcher, who again performed predetermined tasks for specific periods of time. The second phase of the study, the workplace activity section, involved participants wearing both a Runscribe accelerometer and ActivPAL accelerometer side-by-side. Participants were asked to wear both the monitors for at least five working days so that the results of the two accelerometers could be compared. This was due to the batteries on the Runscribe lasting for approximately six days, therefore participants were asked to remove both accelerometer when they noticed the Runscribe was no longer recording data.

Before the study began ethical approval was received from the Sheffield Hallam University ethics board (Appendix 5.1).

5.4.2 Participants

A convenience sample of six participants was recruited for the workplace activity phase. All participants reported being comfortable to stand and walk without any physical impairment and worked in the same office at a UK University. Although participants were based in the same workplace, they were conducting a range of different tasks within their roles ranging from desk-based work, lab work, research, and teaching. This meant that throughout the study period participants completed a range of different tasks, which involved sitting, standing, and activities at different intensities.

5.4.3 Accelerometers

The Runscribe sensor is a tri-axial accelerometer capable of measuring movement across the x, y, and z axis. The accelerometers are approximately 2 centimetres' (cm) long, 0.5cm wide and 0.3cm deep (see figure 5.1 for the measurements). The accelerometers are worn midline on the anterior aspect of the thigh and attached using clear wash proof tape which can be bought on the high street. The Runscribe starts recording once a battery is placed in the monitor, with a battery typically lasting up to six days. Once the battery has started the recording, the monitor cannot be stopped.

Preparatory software was used to set-up the monitors to record activity for seven days (168 hours) at a frequency of 10 hertz. Once the battery has been placed into the Runscribe and the recording has started, the device is fully waterproof meaning it can be worn for 24 hours. A specific script for SB was written using Matlab to allow for the data on the accelerometers to be classified into activity types. The script converted the acceleration from the x and z axis into an angle which represented the angle at which the thigh was at. The angle was converted from radians to degrees, and then all angles were made absolute to eliminate any negative values. Each data point was then classified as either sitting or upright depending upon the angle. An angle of 0º meant that the accelerometer was stood upright, representing standing. An angle of 90º meant that the accelerometer was lying horizontal, representing sitting. Data points were classified as 'Upright' if the angle was 0 ≥ 45º, or 'Sitting' if the angle was >45º. This classification was decided upon by the research team and classifications previously used by other research teams (Karantonis et al, 2006).

Once the data points were classified, they were converted into time with one data point representing 0.1 of a second. The times were calculated in hours (e.g. Sitting time = 'sitting variable' x 60 x 60) due to the number of data points being too large and for ease of interpretation. The Matlab script allowed the researcher to isolate times of interest so that workplace activity times could be calculated. For the present study participants working hours were input into the script so that activity data for just these time periods was collected.

As the Runscribe was worn on the thigh, the decision was made to use the ActivPAL as the comparator accelerometer as this is also worn on the thigh, unlike other accelerometers such as the Actigraph. As mentioned the ActivPAL has also been validated for workplace SB and is the most commonly used accelerometer for sedentary behaviour research. The ActivPAL accelerometer is uniaxial accelerometer which produces a signal related to thigh inclination. This device was worn midline on the anterior aspect of the thigh, again taped to the thigh using clear wash proof tape. The ActivPAL was not waterproof, therefore had to be removed if the participant was to swim or bathe. Proprietary software was used to classify the data as sitting, standing or walking, and provided a breakdown of data for each 24 hour day. Further software developed by Dr Philippa Dall and Professor Malcolm Granat (School of Health, Glasgow Caledonian University) was used to isolate times of interest, allowing the researcher to select the data for each participants working hours.

Figure 5.1 Runscribe specifications

5.4.4 Procedures

The first phase of the study consisted of the lead researcher placing the Runscribe in different positions off the body for one minute periods of time, and then attaching the monitor to the thigh and performing different tasks again for one minute periods. This allowed the researcher to control the positions that the monitor was in, so it could be certain of the angle and behaviour, and then how it should be classified. Tasks ranged from lying horizontally on a desk to walking upstairs whilst attached to the thigh. A list of the positions and behaviours performed by the researcher can be found in appendix 5.2. The same tasks were completed on three separate occasions and then analysed using the Matlab script.

Table 5.1 List of the positions the Runscribe was placed in during Study 3

Time (minutes)	Position
0-1	Lying flat - light facing up
1-2	Lying flat - light facing down
2-3	Standing up right - lock at the top
3-4	Standing upright - lock at the bottom
4-5	Standing at 45° angle - light facing up
5-6	Standing at 45° angle - light facing down
6-7	Transition - accelerometer stuck to the leg
7-8	Sat still in a chair
8-9	Standing still
9-10	Walking
10-11	Sat in a low chair
11-12	Leaning against the edge of a table
12-13	Fast walking
13-14	Sat down with legs crossed
14-16	Walking through buildings
16-16:30	Walking up stairs
17-17:30	Walking down stairs
18-18:30	Jogging

The second phase of the study looked to compare the results from the Runscribe to the ActivPAL accelerometer. Participants were asked to wear a Runscribe and ActivPAL accelerometer on both their right and left thighs for up to four working days (four accelerometers in total at one time). Each participant was given an ID so that they would not be identifiable but allowed the researcher to match the results from the different accelerometers and to determine which leg the accelerometers had been worn on. Each Runscribe had a sticker placed on the front with an arrow on to highlight which way the Runscribe should be worn, and also allowed their ID to be written on the accelerometer. The ActivPAL's already had unique codes on them, so these were recorded by the researcher and a sticker was placed on each one to identify which leg the participant should wear them on.

The accelerometers were attached next to each other on the thigh using clear wash proof tape. A plaster was placed on the reverse of the Runscribes as there was a rough edge, which may have caused participants discomfort. Therefore the plaster was added to help eliminate this being a problem. Figure 5.2 shows how the two monitors were attached to the thigh and worn by participants. Participants were asked to wear the monitors for all five days, or until they noticed the Runscribe had stopped flashing, indicating that it was no longer recording. All six participants reported wearing the Runscribe until the lights stopped flashing, which was at least five days. As mentioned, the ActivPAL was not waterproof, therefore participants were asked to remove both monitors if they were doing any activity which would lead to the accelerometers getting wet. Although the Runscribe is waterproof, participants were still asked to remove it alongside the ActivPAL to ensure consistency of the measures. Each participant was given a paper diary (Appendix 5.3) and asked to note their working hours and any times when they did not wear either of the accelerometers.

Figure 5.2 The ActivPAL & Runscribe attached to the leg

5.4.5 Data Analysis

Data from the first phase of the study was analysed initially before the second phase of the study commenced. This was to ensure that the Runscribe accelerometers were able to classify behaviours before they were tested with participants. As the tasks had been predetermined the classification and angle of the Runscribe was known. Once the data from the Runscribe was classified, a graph was produced which showed the angle of the Runscribe over time. This allowed the researcher to determine whether the correct angle of the Runscribe had been calculated, meaning Matlab would have classified it as sitting or upright.

For the second phase of the study the data was classified using the Matlab script to calculate total upright and sitting times in hours. The Runscribe and ActivPAL data was then entered into SPSS version 24 (IBM United Kingdom Limited, Hampshire, UK) as separate variables. The intraclass correlation coefficient (ICC) was calculated to determine the relationship between the Runscribe and ActivPAL data. A Bland-Altman plot was also created to support the findings of the ICC. ICC's were also calculated to determine the relationship between Runscribes worn on the left and right leg.

5.5 Results

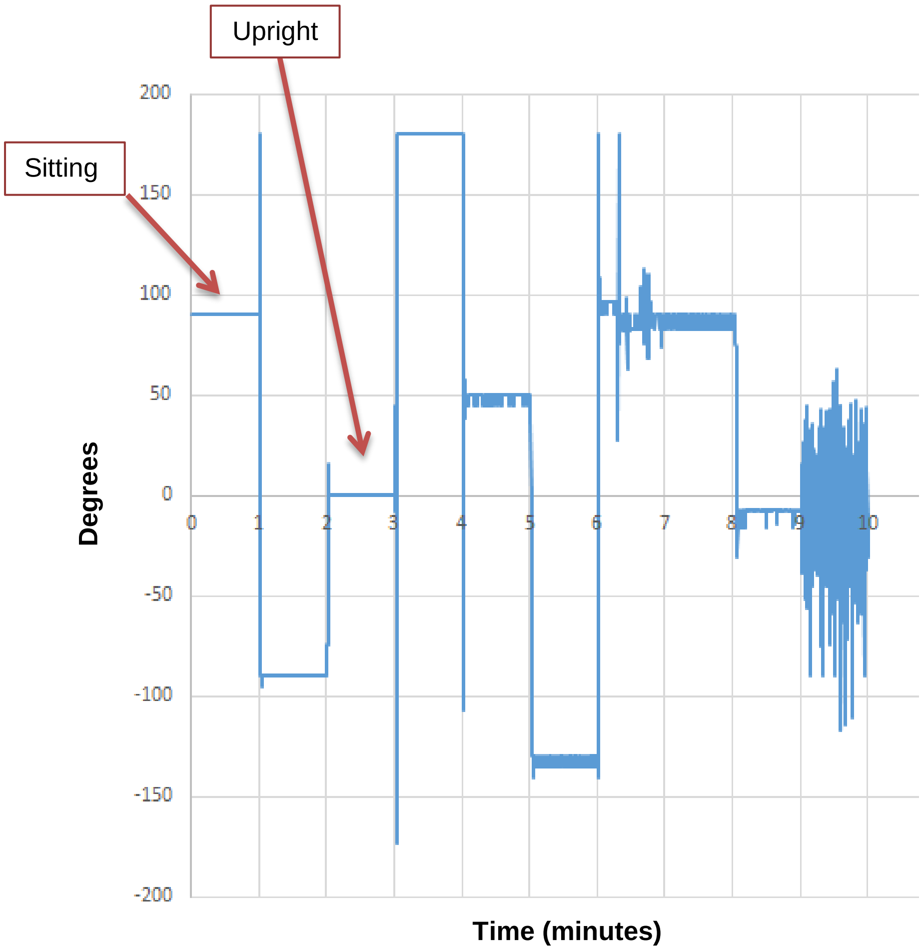
Six participants (three female; mean age 27 years, SD = 1.30) completed the study and wore the accelerometers for at least four days, meaning in total 12 Runscribes and 12 ActivPAL's were worn by participants. Although the ActivPAL's had been set-up correctly and participants were asked to ensure that the devices were flashing to indicate that they were recording, one of the ActivPAL's did not record any activity. This data could therefore not be compared against the Runscribe worn on the same leg, but the data from the Runscribe was used to compare the activity data from the corresponding leg.

Even though participants were asked to remove the corresponding accelerometer from the same leg if an accelerometer came off or had to be taken off, to ensure that the same activity data was collected, one participant reported that they did not remove both monitors at the same time. When looking at the raw data for these monitors, vast differences between the times were found. The data from this participant was therefore not used in the analysis as it did not appear to be reliable. Runscribe reliability was determined by comparing simultaneous measurements from nine Runscribes and nine ActivePAL monitors.

5.5.1 Validity of the Runscribe

For the first phase of the study agreement was found between the observations of the researcher with the angles calculated and classification of the behaviours by the Runscribe. Figure 5.3 is a line graph which highlights the angles reported by the Runscribe. When the line is at 0, this represents the monitor being stood upright and a person standing. When the line is at 90, this represents the monitor being lay flat on a table or a person being sat down. When the line changes from 0 to 90, or vice versa, this indicates that there is a change in behaviour (e.g. moving from standing to sitting). Labels have been added to the graph to highlight how the different behaviours are presented.

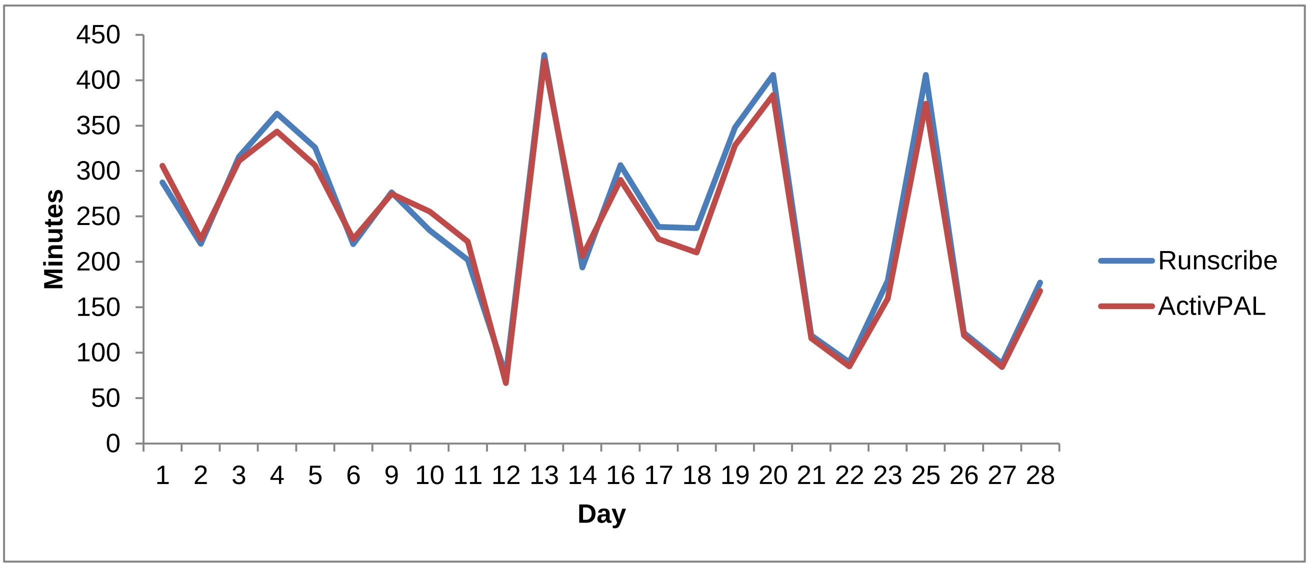
Figure 5.3 A line graph showing the changes in angles reported by the Runscribe



5.5.2 Reliability of accelerometers

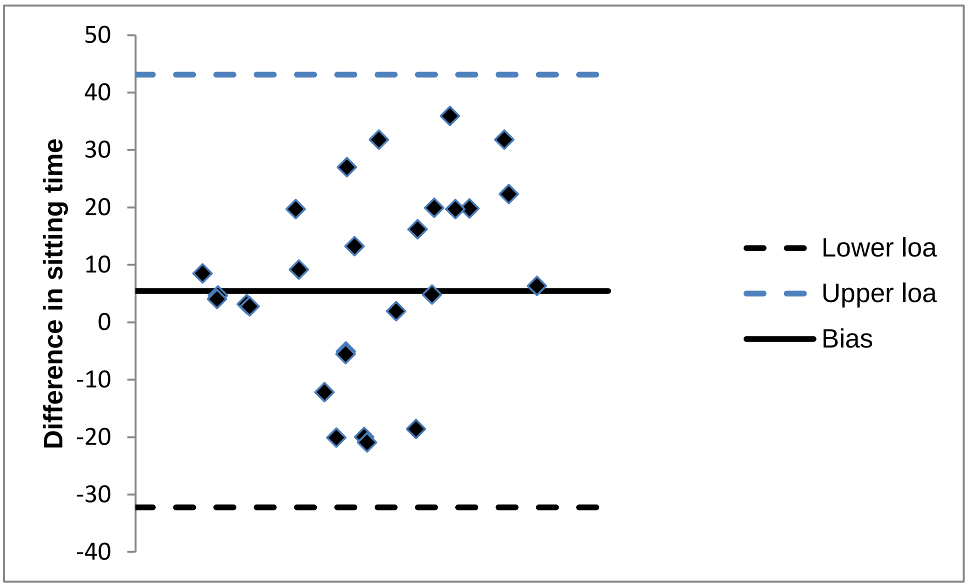
For upright times the mean Runscribe time is 0.02 hours higher, which equates to 1.2 minutes, which is a small variance. Figure 5.4 contains an example of some of the reported siting times on individual days for the Runscribe and ActivPAL. The closer the points are together the similar they are in the upright times reported for those days. There are a number of days where the reported upright times are identical, as well as days where there are slight variations with either the Runscribe or ActivPAL reporting a higher upright time.

Figure 5.4 Sitting Runscribe and ActivPAL results for days during the reliability study



The ICC (3,1) coefficient was 0.98 ($p>0.001$) with 95% confidence intervals (0.96, 0.99), for sitting times between the Runscribe and ActivPAL accelerometers worn on the same leg. The ICC (3,1) coefficient was 0.99 ($p>0.001$) with 95% confidence intervals (0.97, 0.99), for upright times between the Runscribe and ActivPAL accelerometers worn on the same leg. A coefficient over 0.9 has been reported to show excellent agreement between the two measures. A Bland-Altman plot was also created to display the agreement between the two accelerometers. The mean bias for sitting time was 7.40 minutes (figure 5.5). The mean bias and upper and lower levels of agreement are similar to other accelerometers studies which have used Bland-Altman plots to explore agreeability of devices (Martin et al, 2011; Ridgers et al, 2012).

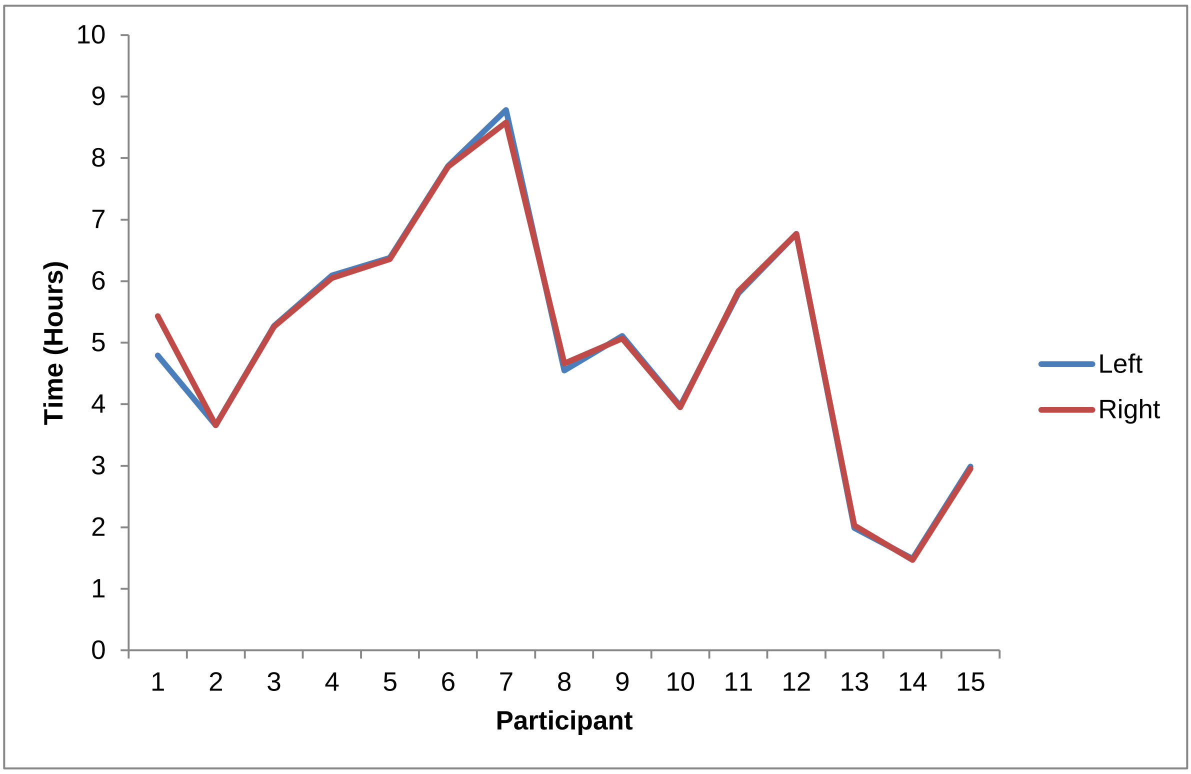
Figure 5.5 Bland-Altman plot of the difference in time spent sitting between the Runscribe and ActivPAL.



5.5.3 Runscribe reliability between legs

The ICC (3,1) coefficient was 0.99 ($p>0.001$) with 95% confidence intervals (0.988, 0.999), for the right and left leg sitting times found from the Runscribe accelerometers. Again, a coefficient over 0.9 has been reported to show excellent agreement between the two measures on either leg. Figure 5.6 presents each participant results for their right and left leg. As you can see from the line graph, the two lines are almost perfectly aligned indicating very little difference between the Runscribe measurements on each leg.

Figure 5.6 The Runscribe sitting times for participant's right and left legs.



5.6 Discussion

Participants wore the Runscribe accelerometer alongside an ActivPAL accelerometer, which has already been validated for different activities (Grant et al, 2006). Data here reported excellent agreement between the two accelerometers. Excellent agreement was also found between Runscribe monitors worn on either the right or left leg.

Future research should consider using the Runscribe as an alternative to the ActivPAL for measuring SB as it has been found to be valid and reliable. The Runscribe accelerometer is smaller than the ActivPAL and waterproof, which means they can be worn for 24 hours reducing the risk of participants forgetting to wear the accelerometer. The Runscribe may be more appealing to other research teams conducting research within PA as the device could also be adapted and used to measure different types of activity and worn on different parts of the body. A Matlab script was written specifically for SB for the present study, meaning other scripts could be written to interpret the data for other activities making it a more versatile and appealing accelerometer for research teams to have.

As the Runscribe is waterproof and allows participants to wear the monitor for 24 hours, this means that this accelerometer may be more applicable to use when measuring SB in different populations. For example research with older adults or children may benefit from using the Runscribe as it would mean they would not need to be taken on and off, reducing the opportunity for a participant to remember to wear the accelerometer. Another benefit of the Runscribe to aid researchers is the obvious nature of the flashing light on the front of the accelerometer indicating whether or not data is being recorded. As previously reported, researchers have been unable to collect data due to the ActivPAL not recording correctly, but also participants being unaware of this whilst wearing it (Chau et al, 2016). The light on the front of the Runscribe allows participants to know whether or not the device is working correctly, meaning researchers ensure data is being recorded in the time periods where they want the data collecting.

5.7 Strengths & Limitations

The strengths of this included the fact that participants wore the accelerometers in office environments in which participants were completing a range of tasks. This meant that the reliability of the Runscribe could be tested in different situations, not just whilst sat at a desk for example. Wearing four accelerometers simultaneously could also have been intrusive and uncomfortable for participants; nevertheless the participants were cooperative and wore all the accelerometers, meaning that more data could be collected. Previous studies have not compared scores between the right and left leg, which this study did, providing further support for the validity of the Runscribe. This also meant more data could be collected with fewer participants, strengthening the results.

The present study is limited by the small sample size, nevertheless the excellent agreement score between the devices does indicate that the Runscribe is valid. Participants in the present study are also all from the same organisation and working within the same office. Nevertheless the type of roles and activities that participants completed were not relevant within the present study as it focused upon checking the validity between the Runscribe and

ActivPAL measures. Participants may have altered their activity levels due to wearing the accelerometers, yet this would not matter for the present study as long as the accelerometers monitored the activities.

5.8 Conclusion

As the findings of the present study have shown the Runscribe to be a valid and reliable measure of SB, these accelerometers were therefore used to determine the impact of the SB intervention described here. This was the first study to use the Runscribe accelerometers for SB, providing support for the use of these accelerometers in SB research.

Chapter 6: Study 4 - A pilot study to reduce workplace sedentary behaviour through forming a standing habit

6.1 Introduction to the chapter

Study 2 (Chapter 4) has highlighted that workplace SB is influenced by a number of determinants including; previous experiences of standing, individual motives to stand, organisational influences, habitual nature of sitting, and social influences upon sitting. The findings from the previous two studies (Chapters 3 & 4) will now be used to inform the design of a pragmatic intervention to reduce workplace SB. As these studies have used different methods, this chapter shall begin by bringing together the results of Studies 1 and 2 via an interpretive integration approach (Moran-Ellis et al, 2006).

6.2 Interpretive integration of studies 1 & 2

This section aims to synthesise the findings from Study 1 (Chapter 3 – cross sectional quantitative exploration of SB) and Study 2 (Chapter 4 – a qualitative enquiry of the determinants of SB in desk-based workers) to inform the design of an intervention to reduce SB in desk-based workers (Study 3). Previous research that has utilised mixed methods to explore social behaviours has integrated the methods at different stages of the research process (i.e. analysing results from each method together in one analysis; Moran-Ellis et al, 2006). As the two previous studies (Studies 1 & 2) have been conducted, analysed discretely, and within the parameters of its own paradigm, the findings from these studies shall be integrated at the point of the process of interpretive integration (Moran-Ellis et al, 2006). This approach does not combine the methods or analysis, but rather takes the findings and brings them together in an explanatory framework.

Study 1 (Chapter 3) found that employees reported high occupational sitting, in line with previous findings from objective and self-report data (Kazi et al., 2014; Thorp et al., 2012). Study 1 also highlighted that an environmental change alone to a workplace might not be sufficient to lead to sustained reductions in workplace SB (e.g. participants in Study 1 with an AWS only sat for 36 minutes less than employees with fixed sitting-height desks – less than previously reported [Neuhaus et al, 2014a; Torbeyns et al, 2014]).

Study 1 highlighted that multiple factors underpin SB in the workplace including; habit strength, total non-work day sitting, control to stand score, organisational norms score, intentions score, standing options, gender, employment sector, PA, and desk type. The influence of multiple factors was further supported by findings of Study 2 (Chapter 4) that showed workplace SB was influenced by individual, social, and organisational factors. Taken collectively, the complexity of SB adds weight to the notion that the different levels of the social ecological model could be used to influence workplace SB through intervention (Owen et al, 2011).

Study 1 found that habit strength was high for sitting, which again was supported by participants in Study 2 who reported that sitting was an automatic and unconscious behaviour. Participants in Study 2 also spoke about how they were more likely to remain sitting if they were focused upon their work and would prioritise completing their work over standing. Participants in Study 2 highlighted that they felt all employees have opportunities to stand during the working day, regardless of whether or not they have an AWS. To encourage others and themselves to stand, prompts were needed to remind them to stand due to the habitual and unconscious nature of sitting.

Participants in Study 1 reported not being fully aware of the negative health consequence associated with SB, which is in line with Duncan and colleagues (2014) findings in Australia. As found in the Literature Review (Chapter 2) a number of interventions did not educate participants about the negative health consequences associated with SB prior to the intervention beginning. Awareness and understanding of the need to change behaviour would help form intentions to change behaviour and the process of behaviour change.

The majority of participants in Study 1 also felt that the implications of sitting were typically negative and related to discomfort and back pain. All but one participant in Study 2 reported having an AWS due to MSK related issues, indicating that a common reason for having an AWS and to stand is related to MSK issues. It was reported that it took time to adapt to be able to stand to work and to feel comfortable standing. Participants would typically only stand if they felt they had a reason to or were around people that understood why they needed to stand. These findings highlight that employees may be motivated to reduce SB reasons which would lead to them gaining satisfaction immediately, rather than for health reasons which may impact them later in life. Previous interventions have not reported discussing with participants, prior to an intervention, what their motives for reducing occupational sitting would be. Yet understanding employee's motives to reduce SB could help encourage a participant to change their behaviour and maintain behaviour change. It is important to understand the conditions preceding behaviour and a person's motives for change (Kelly & Barker, 2016).

6.3 The reflective-impulsive model in explaining workplace sedentary behaviour

Integration of these findings leads to the suggestion that SB within the workplace is influenced by both conscious and unconscious processes. The reflective-impulsive model is a dual-process model used to explain social behaviours and acknowledges the role of both conscious and unconscious processes in decision making. Unlike other dual-process models (Smith & DeCoster, 2000) the reflective-impulsive model sees social behaviour as a two-system model in which the reflective and impulsive systems are concurrently active and working in parallel (Strack & Deutsch, 2004). The reflective system is slow and requires cognitive capacity to process stimulus in the environment and develop a response. The impulsive system is quick, automatic and requires little cognitive capacity. The impulsive system is constantly engaged and would typically respond if we do not have the cognitive capacity and time to process the stimuli around us. The model also proposes that behaviour does not follow on from a decision and that there are a number of determinants operating in accord or conflict with each other (Strack & Deutsch, 2004).

Initiation of behaviour in the reflective system is determined by four factors; social norms, attitude, control, and intentions. Within the reflective system behaviour is likely to be maintained if a person gains satisfaction from their behaviour change, whereas behaviours in the impulsive system is generally maintained due to the formation of a habit as these behaviours can be performed quickly and automatically. The reflective-impulsive model explains how behaviours are both initiated and maintained by the reflective and impulsive systems. Table 6.1 is adapted from the figure created by Rothman and colleagues (2009), outlines how behaviour is initiated and maintained by both systems.

Table 6.1. Reflective and automatic processes in the initiation and maintenance of behaviours (adapted from Rothman et al, 2009).

Action control	**Behaviour Change**	
	Initiation	***Maintenance***
Reflective	Attitudes Control Intentions Social Norms	Satisfaction with behaviour change
Automatic	Implicit attitudes Behavioural primes	Habits

Table 6.2 outlines how the key attributes of the reflective impulsive model are related to workplace SB based upon the findings from Studies 1 and 2.

Table 6.2 How the key attributes of the reflective-impulsive model relates to workplace SB and the findings of Studies 1 and 2

Attribute of the reflective-impulsive model	**Findings from studies 1 & 2**	**Reflective-impulsive model & sedentary behaviour**
Multiple determinants influence behaviour.	*Study 1;* Workplace SB was influenced by multiple factors and interactions between factors. *Study 2;* Different environmental, social, and organisational factors were reported to influence workplace SB.	The findings of these studies show that workplace SB is influenced by multiple determinants.
Behaviour does not follow on from a rational decision.	*Study 1;* Occupational sitting times were not significantly lower in participants that reported being aware of the negative health consequences of SB. Participants reported that sitting led to negative consequences, yet still reported high levels of occupational SB. *Study 2;* Participants would remain seated in certain situations, even if they were uncomfortable and they knew that their MSK pain could be relieved by standing.	If participants were aware of the negative consequences of sitting and suffered issues from sitting, it would be expected that they would stand. Yet they still sat meaning that their behaviours appear to not follow rationally.
If a person has little cognitive capacity available to respond to stimuli then the impulsive system will be engaged rather than the reflective system.	*Study 2;* Participants reported prioritising their work, which would lead to them forgetting how long they had been sat for.	Participants have limited cognitive capacity within the workplace due to focusing on their work, which leads to them remaining seated as the impulsive system is engaged.
If the reflective system is engaged a person can make a decision based on their knowledge and previous experiences.	*Study 2;* Internal and external prompts were used by participants to encourage them to stand throughout the day as they were aware of the benefits that they would gain from standing.	Prompts were needed to engage the reflective system to encourage participants to stand based on their positive experiences of standing.
Behaviour is maintained by the reflective system if a person is satisfied with the behaviour.	*Study 2;* Standing to work relieved employees MSK pain, leading to them maintaining standing for over a year.	Participants with MSK problems gained satisfaction from standing due to the relief they got compared to sitting.
Behaviour is maintained by the impulsive system if behaviour has become a habit.	*Study 1;* Occupational sitting was reported to be a strong habit by participants. *Study 2;* Participants spoke about how they would forget how long they had been sitting for and that sitting was a	As occupational sitting is a habit, this is the default behaviour performed by the impulsive system when there is limited cognitive capacity.

Attribute of the reflective-impulsive model	Findings from studies 1 & 2	Reflective-impulsive model & sedentary behaviour
	habitual behaviour.	
Behaviour is a consequence of schemata, which will be formed based on previous experiences and exposure to environments.	*Study 1;* The majority of employees (78%) reported having limited opportunities to stand within the workplace and 86% reported having a fixed sitting height desk. This will have led to the development of a schema which supported sitting in the workplace. *Study 2;* Participants reported that most work environments were set-up to encourage sitting and typically they were the only employees within their workplaces that had an AWS.	If the majority of workplace environments are designed to encourage sitting, then schemas will be based upon sitting to work.

The results of Studies 1 and 2 (Chapter's 3 & 4) show that workplace SB could be explained by the reflective-impulsive model (Strack & Deutsch, 2004). As reported in Study 1 participants sit for the majority of their working day, this is likely due to the habits that have been formed within the workplace. With employees having limited cognitive capacity in the workplace, the impulsive system is most likely to engage in the decision making process leading to an employee sitting because of the habits that have previously been formed. Cheval and colleagues (2018) investigated the cortical activity underlying automatic responses to SB and PA using electroencephalography (EEG). Results from participants that were physically active and inactive showed that more cortical resources were needed to avoid stimuli depicting SB than were required to avoid stimuli depicting PA, supporting that cognitive capacity is required to reduce SB.

As completing work was reported to be the priority within the workplace, the majority of employees would sit due to gaining satisfaction from being able to complete their work seated. Participants with AWS's reported that it took time to adapt to being able to stand to work. If the majority of employees have been able to work at their fixed sitting height desk for a number of years, then they would be unlikely to go through the process and effort of adapting to standing. The reflective system would therefore not maintain standing to work if satisfaction was not gained. Research in other health behaviours has shown that satisfaction or enjoyment of behaviour leads to maintenance of behaviour, after a behaviour has been initiated (Kassavou, Turner, Hamborg, & French, 2014; Kwansnicka, Dombrowski, White, Sniehotta, 2016). This highlights the need for new standing behaviours to promote satisfaction for the individual, leading to maintenance of the standing behaviour in the reflective system.

6.4 Theoretical underpinning of the intervention

As the reflective-impulsive model (Strack & Deutsch, 2004) explains both sitting and standing within the workplace and considers the automatic and reflective nature of these behaviours, then this would appear to be an appropriate model to base an intervention upon. Previous workplace SB interventions that have mentioned a theory have typically been underpinned by SCT (Bandura, 1986; 2004). It would seem that the reflective-impulsive model would be more appropriate than SCT as it does not consider the unconscious nature of behaviour. Following the findings of Studies 1 and 2 it would be inappropriate to ignore the habitual and unconscious nature of sitting, when designing an intervention.

Due to the length of time people spend at work, it is important that any changes to increase standing are maintained. Given a potential lack of cognitive capacity available in the workplace, due to employees prioritising their work, it would seem that for behaviour to be maintained it would need to become habitual. With participants in Study 2 (Chapter 4) highlighting that there are opportunities for any employee to stand, regardless of whether or not they have access to an AWS, focusing on increasing these opportunities to stand would seem logical. No previous research has focused on the development of standing habits or the opportunities that employees already have available to stand.

Previous research has also reported that habits can be hard to break or reverse due to the automatic nature of them, and interventions have generally focused on disrupting habits to change a habitual behaviour (Wood & Neal, 2008). If there is a lack of cognitive capacity to change behaviour and previous research has reported breaking habits to be challenging, this further supports the reasons why any future intervention needs to include a focus upon creating a standing habit.

A drawback of the reflective-impulsive model is that it only takes into consideration individual factors that influence behaviour, such as intentions and attitudes. As reported in Studies 1 and 2, workplace SB is influenced by multiple factors, not just individual factors, meaning that this needs to be taken into consideration when designing the present intervention. One way to overcome the shortfalls or individual approach of the reflective-impulsive model is to sit it within the social-ecological model as proposed by Owen and colleagues (2011). In doing so, this intervention will consider the individual, social, organisational, and environmental factors influencing workplace SB.

6.5 Study aims

The study aimed to:

- Develop a standing habit within the workplace to disrupt and reduce workplace SB.
- Measure habit strength during the intervention.
- Conduct follow-up measurements following the end of the intervention to explore the maintenance in behaviour change.

6.6 Methods

6.6.1 Study design

The Medical Research Council's (MRC) framework for complex interventions, states that interventions should be developed systematically, using the best available evidence and appropriate theory, and then to be tested using a phased approach (Craig et al, 2008). Prior to testing the effectiveness of an intervention, the feasibility of the trial should be tested (Moore et al, 2015). The present intervention is a pilot study, focusing on understanding the feasibility of implementing the intervention and developing a standing habit within the workplace.

This pilot study adopted a cluster randomised design, with work offices being the unit of randomisation. Randomisation was conducted prior to baseline measurements as the workshop that was delivered at the start of the intervention needed to be scheduled into participant's diaries as soon as possible. The cluster design was selected to prevent contamination between participants, as all participants would be working within close proximity. Previous interventions have reported participants being influenced by their colleagues when participating in interventions (Chau et al, 2014a), and the findings of Study 2 have also highlighted that employees are influenced by their colleagues behaviours. Therefore if control participants were in the same office as intervention participants, this could influence participant's behaviour.

6.6.2 Recruitment

Participants were recruited from the professional services departments within a University. All participants were primarily desk-based and had not previously participated in Studies 1 or 2. Employees within the professional services departments, although working within a University, did not have a vested interest in research or health related outcomes, which has been a criticism of previous research (Tew et al, 2015). The demographics of participants in the present study were compared to the demographics of participants from Studies 1 and 2, and were found to be similar in nature.

6.6.2.1 Participant eligibility

Individual participants were eligible to participate if they were:

- Aged 18 years or older.
- Worked primarily within a desk-based role and had a personal email address.
- Were able to complete baseline measurements and attend a workshop (if in the intervention group).
- Felt comfortable to stand and walk without any physical impairment.
- Had the support of their manager to participate in the study.

6.6.2.2 Participant recruitment

Managers from different teams of the professional services department were asked if they and their team would be willing to participate. The intervention was described as a '*study looking at activity within the workplace*'. It was decided not to specifically mention SB in the initial promotion information as this may either prompt a person to research what is SB or if they were already aware, it would highlight to them that the study was specifically focusing upon sitting and standing.

Four teams expressed an interest in participating; two of these teams consisted of less than 10 employees therefore were not pursued any further but were offered to be informed of the outcomes of the study. The two other teams that expressed interest in participating both reported having over 20 employees in each team. The lead researcher set-up a briefing session with each team separately. The briefing session lasted approximately 10-15 minutes during which the study was explained and attendees were given the opportunity to ask any questions. An information sheet outlining the study (appendix 5.1), which had the lead researchers and Director of Studies contact details on, was provided to all potential participants. Post briefing, potential participants were asked to contact the lead researcher if they were willing to participate in the study.

6.6.2.3 Sample size

It has been suggested that for a pilot study researchers should aim to recruit at least 10 participants per condition (Julious, 2006; Whitehead et al, 2016). In total 27 participants were recruited.

6.6.3 Study intervention

6.6.3.1 Overview of intervention

Figure 6.1 provides a detailed account of the different stages to the intervention and the times at which these occurred. The intervention lasted for ten weeks, followed by a five week follow-up. In total, participants were involved in the study for 16 weeks including baseline measurements. Following baseline measurements, participants in the intervention group attended a one-hour workshop led by the lead researcher (week 1). A PowerPoint presentation was used in the workshop to ensure that all aspects of the workshop were covered and to ensure participants were aware of how the workshop was progressing (Appendix 6.2).

Table 6.3 outlines the components of the intervention, what they entailed, as well as the rationale for using them.

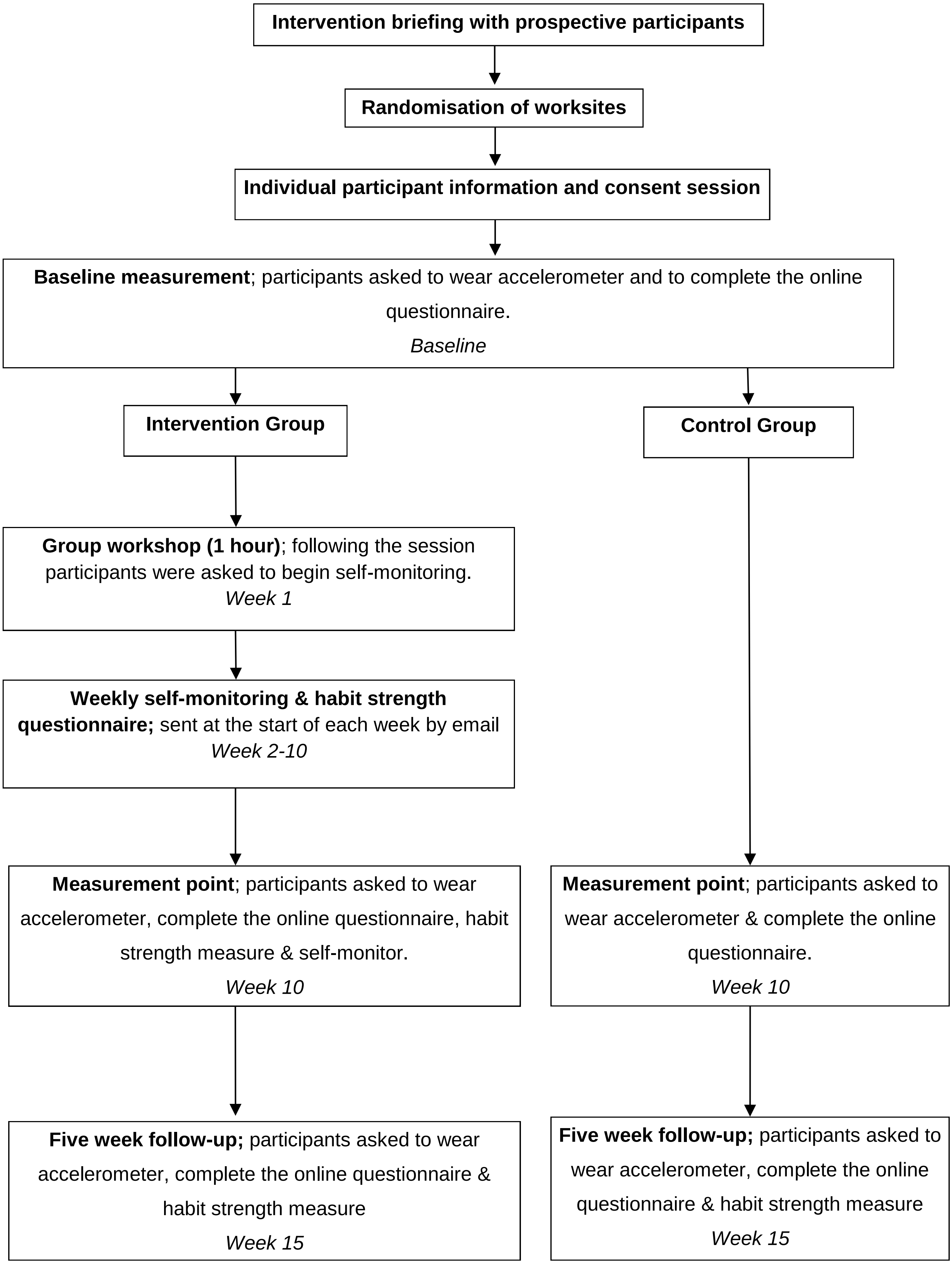


Figure 6.1 Study overview including recruitment, intervention procedures and data collection.

Table 6.3 Details the components of the intervention and rationale for these components.

Intervention component	How the component was presented in the intervention	Theoretical underpinning	Evidence	
			Literature	**Studies 1 & 2**
1.0 Workshop				
1.1 Group meeting	All members of the same work team attended the workshop at the same time.	Bringing all members of the team together helped to change social norms, a precursor to change in the reflective system of the reflective-impulsive model. Participants will be able to see their colleagues participating would understand why they are standing and want to stand in the workplace.	Focus groups have been used to change social norms around different health behaviours (Miller & Prentice, 2016). The group setting of like-minded people that are looking to make similar changes has been found to influence social norms and behaviour change.	Participants in study 2 reported that they were reluctant to stand when with people who did not understand why they would stand. Bringing colleagues together would reduce this uncertainty.
1.2 Understanding participants current awareness of SB and consequences of SB	Participants were asked about what they felt the implications of sitting for long periods were for themselves and others, and then if they had experienced any of these implications. Participants were not informed of any of the implications by the researcher; all information came from the participants.	Maintenance is more likely to occur within the reflective system if a person is satisfied with the behaviour change. Therefore finding out from the participants their experiences and consequences of SB can then be used as motivators/incentives to encourage participants to change their behaviour.	A number of workplace SB interventions have been conducted with employees conducting health research, which would motivate them to stand given the opportunity (Tew et al, 2015). The present intervention gave employees the	Participants in study 2 reported standing due to MSK problems and gaining immediate relief when standing, therefore participants responded to gaining immediate satisfaction.

Intervention component	How the component was presented in the intervention	Theoretical underpinning	Evidence	
			Literature	Studies 1 & 2
			opportunity to discuss the implications that they felt were relevant to themselves and to identify factors that would be relevant to themselves.	
1.3 Awareness of the negative consequences of SB	Participants shall be made aware of the negative health consequences associated with prolonged SB. These will include information on the links of SB with CVD, diabetes, and some cancers, as well as MSK issues related to SB.	For a behaviour change to occur in the reflective system a participant needs to understand the reasons why they need to change their behaviour, helping to change their attitude and form intentions to change behaviour.	Duncan and colleagues (2014) reported that 67% of Australian adults were unaware of the negative health consequences associated with SB.	In Study 1, 63% of participants reported not being fully aware of the negative health consequences associated with SB.
1.4 Awareness of the workplace recommendations for SB	Participants were informed of the workplace SB guidelines, which recommends sitting for no more than 30 minutes at one time, and aiming to stand for four hours (50% of the time) whilst at work (Buckley et al, 2015).	This component helps give participants a specific change to aim for and knowing what a change would look like.	Giving participants specific goals to aim for encourages behaviour change and reduces the ambiguity of how a change can be interpreted (Locke & Latham, 1990; Samdal et al, 2017).	Participants in Study 2 were unaware how long they should be standing for whilst in the workplace. Participants also reported standing for prolonged periods, which can also lead to detrimental health effects. Therefore it is important that participants understand

Intervention component	How the component was presented in the intervention	Theoretical underpinning	Evidence	
			Literature	**Studies 1 & 2**
				the need to keep breaking up both sitting and standing.
1.5 Discussion of current opportunities to stand	Participants were asked when they currently stood during their working day and what opportunities they had to stand.	This again helps to translate a decision into an action. It also highlights the control that participants and their colleagues have to change their behaviour.	Including participants in the design and development of interventions and behaviour change increases their commitment to the behaviour and increases their autonomy (Williams et al, 2017).	Participants in Study 2 highlighted that they and their colleagues had opportunities to stand within the working day, regardless of whether or not they had an AWS.
1.6 Commitment to behaviour	Participants were asked to collectively decide upon a standing behaviour which they would look to do during the working day.	This gave participants the control and belief that they can perform the standing behaviour and control of when and where they would like to do the behaviour. Collectively deciding upon the behaviour to perform would also influence social norms, again ensuring that all participants are aware of why they want to stand. Committing to behaviour will also form intentions to stand within	When individuals have committed to health behaviour changes, particularly publically to their peers, adherence to changing their behaviour has been more successful (Jaegar & Schultz, 2017; Prestwich et al, 2017).	Participants felt they needed to know what to do and how to reduce workplace SB, as well as being more willing to stand if others were standing. Therefore encouraging a commitment to a behaviour gives them a clear goal, as well as giving them the

Intervention component	How the component was presented in the intervention	Theoretical underpinning	Evidence	
			Literature	Studies 1 & 2
		the workplace.		knowledge that their colleagues are doing the same.
1.7 Implementation-intentions	Implementation-intentions specify the behaviour that will be performed when intention realisation and the situational context in which one will enact it, and have the format *'when x occurs I will perform y'.*	Implementation-intentions help to bridge the gap between intentions and behaviour, through highlighting opportunities when behaviours can be performed. This will come after they have committed to changing their behaviour earlier in the workshop.	Research has found that implementation-intentions have been successfully used to increase a person's commitment to a behaviour change and increased the likelihood of a behaviour being performed (Hagger & Luszczynska, 2014).	The implementation-intentions will act as a further reminder to participants to move, which is something that previous participants spoke about needing.
2.0 Self-monitoring	To encourage maintenance and repetition of the behaviour participants were encouraged to monitor whether or not they performed the behaviour when the opportunity arose. Participants were given a tick sheet (Appendix 5.3) to monitor their behaviours each week.	Self-monitoring will help to further encourage maintenance of the behaviour alongside the implementation-intentions. The tick sheet will act as a physical reminder to perform and monitor their behaviour, keeping the initiation of the behaviour in the reflective system.	Michie and colleagues (2009) conducted a review of behaviour change techniques and reported that the use of self-monitoring was the most effective behaviour change technique when conducted alongside at least one other behaviour change	Participants spoke of being unaware of the times when they were sitting and how long they had been sat for if caught up in their work. The use of the self-monitoring sheet will act as a reminder to think about these opportunities that they have to stand.

Intervention component	How the component was presented in the intervention	Theoretical underpinning	Evidence	
			Literature	**Studies 1 & 2**
			technique.	
3.0 Posters	Posters were put up to encourage chosen behaviours to be performed. Figure 6.2 shows an example poster for encouraging stair use.	Prompts within the environment will help to bring the decision making process into the reflective system, so that participants thinking about performing behaviours. The impulsive system responds to schemas which have been developed and the environment, therefore these posters would disrupt the schema and engage the reflective system.	Point-of-choice prompts have been successfully used to encourage other health behaviours, such as stair use (Bellicha et al, 2015).	Participants reported responding to their current work environments, and would behave however an environment was configured. Adding prompts to this environment would encourage participants to think about their behaviours.

Figure 6.2 A sign encouraging stair use (displayed on a single A4 side)

6.6.4 Measures

6.6.4.1 Activity Measures

Activity and in particular SB were measured objectively using the Runscribe accelerometer. This is the first study to use the Runscribe to measure SB, therefore the accelerometers were validated before the start of the intervention. The rationale, procedures, and results of the validation study are presented in Chapter 5.

Participants wore the accelerometers on their thigh for a week to measure workplace sitting and standing. The Runscribes were worn by all participants at baseline, week 10, and 15.

As well as wearing the Runscribe, participants were also asked to complete a self-report measure of SB. The Workforce Sitting Questionnaire (Chau et al, 2011) was completed by participants each time they were asked to wear the Runscribe's. This is the same measure that was used to measure workplace SB in Study 1 (Chapter 3).

6.6.4.2 Questionnaire measures

At baseline, week 10, and 15 participants were asked to complete a number of measures looking at participant's demographics, organisational norms, control to stand, intentions to stand, and habit strength. Qualtrics, which is an online computer software programme for creating questionnaires, was used as this allowed the measures to be easily distributed to and completed by participants. Responses could then be automatically returned to the research team and stored securely. Examples of the measures sent to participants can be found in Appendix 6.8.

6.6.4.3 Demographics

At baseline demographic data was collected including; age, ethnicity, gender, highest education attained, and job role. Current PA level was also collected using the Stanford leisure-time activity categorical item (Kiernan et al, 2013). This is a single item measure of PA, asking participants to rate their current

PA on a Likert scale of one to six, one being no activity during a week. It has been found to be a valid measure of PA as well as being easier to complete than other measures as it is only a single item (Kiernan et al, 2013). Demographic measures were only taken at baseline, except for PA which was also taken at the 15-week follow up to see if participants PA had changed over the intervention period.

6.6.4.4 Work-related variables

There are a limited number of measures of organisational social norms and control in relation to standing within the workplace. The 'Stand-Up Victoria' intervention, delivered in Australia, created and piloted measures for these variables from other PA measures (Dunstan et al, 2013; Healy et al, 2013; Hadgraft et al, 2017). Organisational social norms were assessed using six items (e.g. *'My colleagues would not mind if I chose to stand during a work meeting'*) scored on a five point Likert scale ('strongly disagree' to 'strongly agree'). Scores from the six items were added together to give a total score for organisational social norms. Control to stand was assessed using five items (e.g. *'It is my choice whether I walk over to talk to a colleague or send them an email'*) scored on a five point Likert scale ('strongly disagree' to 'strongly agree'). Scores from the five items were added together to give a total score for participants control to stand.

6.6.4.5 Intentions to stand

Intentions to sit and stand in the workplace were measured using four items adapted from items used by Maher and Conroy (2015). The first two items asked participants if they aimed to sit and stand whilst at work (e.g. *'I intend to not sit at my desk all day tomorrow'*), followed by two similar statements which specified length of time sitting or standing (e.g. '*I intend to spend no more than 30 minutes at a time sitting in the next working day'*). The specific times were based upon Buckley and colleagues (2015) guidelines around workplace sitting. Each of the four items was assessed on a five point Likert scale ('strongly disagree' to 'strongly agree').

6.6.4.6 Habit strength

The SRHI was used to assess habit strength of both sitting and standing at the three different measurement points. The SRHI has been found to be a valid and reliable measure of habit strength as a dependent variable (Verplanken & Orbell, 2003; Lally et al, 2010). Participants were asked to complete this measure twice at each measurement point, for both sitting and standing separately. Preceding the items was a statement relating to the behaviour (i.e. sitting or standing; e.g. '*Sitting down in the workplace is something…*') followed by each item individually (e.g. '*I do frequently'*). Behaviours were assessed using seven items on a seven point Likert scale ('strongly disagree' to 'strongly agree'). In total participants were asked to complete 14 items in relation to their sitting and standing habits within the workplace.

Participants in the intervention group were also asked to complete the SRHI measures each week, which were specifically relevant to the behaviours that they had chosen to change following the intervention workshop. At the start of each working week participants were emailed the SRHI measure and asked to complete the items which were relevant to the behaviour they were aiming to change. This allows for monitoring of the development of habit strength over the 10 week intervention period.

6.6.4.7 Self-monitoring

As presented in the intervention section each participant in the intervention group was asked to self-monitor the behaviour they aimed to change over the 10 week intervention period. Participants were provided with a new self-monitoring sheet (see Appendix 6.3) at the start of each working week and asked to place either a tick or a cross in the relevant column depending upon whether or not they successfully completed the behaviour when the cue presented itself. This allowed for monitoring of how often the behaviour was done and compliance with the intervention. Only participants that were in the intervention group were asked to complete this during the initial 10 week period.

6.6.4.8 Environmental audit

As the environment has been found to influence workplace SB (Gorman et al, 2015; Neuhaus et al, 2014a) and as the intervention and control group were based in different buildings, an environmental audit was conducted to ensure the work environments were not too dissimilar. Significant differences between office environments may lead to changes in workplace SB, regardless of any of the intervention components. Previous interventions that have conducted cluster trials, with conditions in different offices or worksites, have not reported doing a similar comparison between offices (Healy et al, 2016). This was the first study to use an audit to measure the office environments of the two groups in the study.

The OFFESS (Duncan et al, 2013) was created to assess the spatial configuration of office environments. The measure was completed by all participants once and also the lead researcher went to each office and completed it themselves. This was to ensure that the audit was completed thoroughly and that any ambiguous decisions could be made by the same person to ensure consistency. The measure consists of 18 items (e.g. *'My office building has many rooms which are difficult to find'*) which was scored on a four point Likert scale. The measure has shown good test-retest and internal consistency.

To further complement the OFFESS questions from the Checklist of Health promotion Environments at Worksites (CHEW; Oldenburg, Sallis, Harris, & Owen, 2002) were also completed for each office. The CHEW is a 112-item checklist of workplace environmental features focusing upon; the physical environment, informational environment, and neighbourhood factors in relation to PA, nutrition, smoking, and alcohol. Only items that were related to PA were used for the environmental audit in the intervention, which meant that 29-items were added to the items from the OFFESS. Due to the length of the CHEW and number of measures that participants were already completing, it seemed appropriate to only include the questions regarding activity, as the intervention did not aim to influence any of the other behaviours measured (e.g. smoking, healthy eating). Items were also added about participant's current workstation and access to AWS's to gain a better understanding of their physical environment. The full environmental audit can be found in Appendix 5.9 and the results of the audit.

6.6.5 Statistical analysis

The effect of the intervention on sitting time, habit strength, organisational norms, control to stand, and intentions to stand was evaluated using an analysis of covariance model. The change between time points was the dependent variable and trial arm (intervention and control) was the independent variable. The baseline value of the outcome variable was included as a covariate (Vickers et al, 2001). Where data could not be normalised, a Mann-Whitney U test was performed on the delta scores between assessment points (Bourke et al, 2011). In accordance with previous studies (Graves et al, 2015; Healy et al, 2016) objective sitting times were standardised to an 8-hour work day to control for variations in work schedules [standardised minutes = outcome minutes * 480/observed workplace minutes]. To be retained for analyses, participants had to provide ≥2 valid days at each time point. All analyses were conducted using IBM SPSS Statistics Version 24 (IBM United Kingdom Limited, Hampshire, UK) with statistical significance set at $p \leq 0.05$.

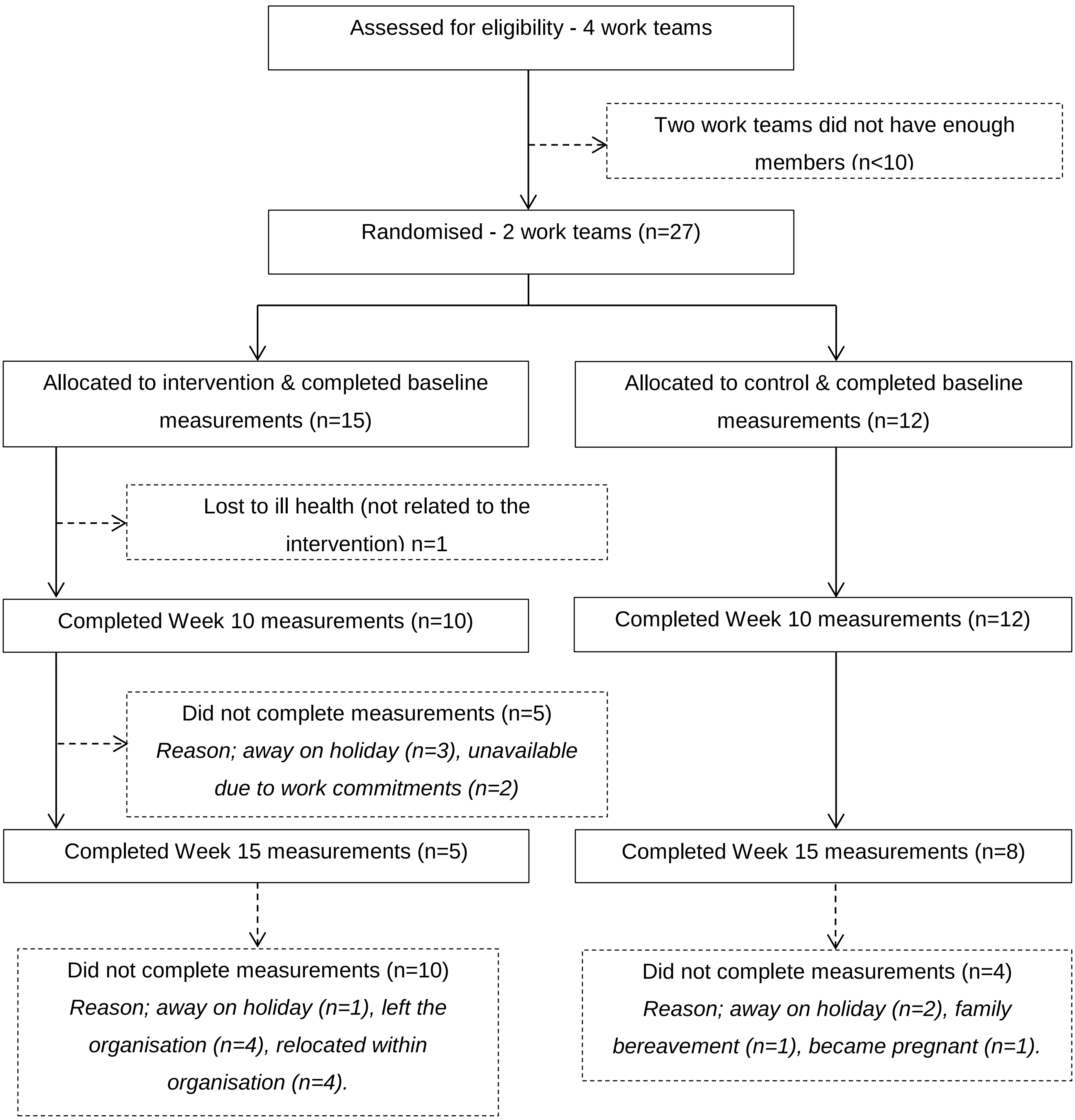
6.7 Results

6.7.1 Sample characteristics

Work teams were contacted and recruited in June 2017 from organisations within Sheffield. Two work teams were recruited from the same organisation. Although both of the teams worked within the same organisation, their roles were not directly related and they were based in different buildings (approximately a five minute walk separated the buildings). In total 27 participants were recruited from both teams (18 female; mean age 42 years old; 85% white British, 77.8% reported having an undergraduate degree or higher). As participants within the same work teams were kept together, this meant that participants were not evenly allocated to the two conditions and the intervention group consisted of 15 participants.

During the intervention participants dropped out or were able to complete each of the measures for a number of reasons. Figure 6.3 highlights the number of participants at each time point and when and why participants dropped out of the study.

Figure 6.3 Retention of participants through the different stages on the intervention.



6.7.2 Objective activity outcomes

The Runscribe's successfully recorded all the data for each day they were in use, however 10 days were lost due to participants forgetting to wear the monitors and four days were lost due to participants not recording their working hours fully.

Table 6.5 The descriptive statistics for the objectively collected activity data. The scores are presented in minutes.

	Intervention				***Control***			
	n	***Mean***	***Median***	***SD***	***n***	***Mean***	***Median***	***SD***
Sitting								
Baseline	15	354.19	352.09	41.39	12	383.07	385.80	34.35
Week 10	10	345.96	349.87	42.44	12	394.03	396.48	36.46
Week 15	5	324.06	330.83	34.84	8	394.12	412.71	41.98
Upright								
Baseline	15	125.82	127.91	41.38	12	96.93	94.20	34.35
Week 10	10	134.07	130.13	42.41	12	85.97	83.52	36.46
Week 15	5	155.94	149.17	34.84	8	85.88	67.29	41.98

Table 6.5 presents the means and standard deviations for sitting and upright times for participants in both conditions at each measurement point. The table shows that sitting and upright times remained fairly consistent within the control group when comparing baseline measures with measures at week 10 and 15. Sitting times in the intervention group reduced at week 10 and continued to reduce at week 15. Upright times also changed in the opposite direction to sitting times.

Due to the small sample size at week 15 scores could not be included in the statistical analysis, meaning that only baseline and week 10 measurements were used for statistical analysis. Normality checks were conducted before statistical analysis and found that the data was non-normally distributed. Reciprocal transformations were used for the upright times so that the data was normally distributed, however no transformations increased the normality of the sitting time data. The sitting data was therefore analysed using a non-parametric Mann-Whitney U test between groups, whereas an analysis of co-variance (ANCOVA) was conducted to analyse the changes in upright times.

The Mann-Whitney U test reported that there was no significant differences in change scores between the control and intervention group at 10 week, U=40.00, p=0.19. The ANCOVA reported that there was also no significant difference in the change scores between groups at the 10 week, F(1)=2.00, p=0.17.

Although the results from week 15 were not included in the statistical analysis, observations about the mean scores can be made. The results show that participants sitting times and upright times continued to change in a favourable manner following the completion of the intervention.

Due to the small sample size at week 15, the individual data for the five participants in the intervention group that completed measurements at week 15 are presented below in table 6.6. The individual results show that four of the five participants reported reductions in workplace sitting between baseline and week 15.

Table 6.6 The individual sitting times (minutes) for each participant in the intervention condition at the different time points.

Participant	Baseline (minutes)	Week 10 (minutes)	Week 15 (minutes)	Difference between Baseline & Week 15 (minutes)
1	372.96	-	330.78	42.18
2	395.52	384.42	406.83	-11.31
3	398.94	373.08	354.96	43.98
4	334.38	358.32	286.32	48.06
5	362.01	356.28	335.04	26.97

6.7.3 Questionnaire outcomes

Table 6.7 shows the means, medians, and standard deviations for each measure at different time points. ANCOVA's were used to compare the differences in change scores between groups at week 10 and 15 in comparison to baseline measures. The analysis showed that there was no significant difference between groups change scores for SRHI sitting scores at week 10 ($F(1)=3.57$, $p=0.08$) and week 15 ($F(1)=0.08$, $p=0.78$), SRHI standing scores at week 10 ($F(1)=1.40$, $p=0.26$) and week 15 ($F(1)=0.10$, $p=0.92$), organisational norms scores at week 10 ($F(1)=2.26$, $p=0.16$) and week 15 ($F(1)=0.16$, $p=0.70$), workplace control scores at week 10 ($F(1)=3.50$, $p=0.08$) and week 15 ($F(1)=0.97$, $p=0.35$), intentions to sit at week 10 ($F(1)=0.14$, $p=0.71$) and week 15 ($F(1)=0.07$, $p=0.80$), and intentions to stand at week 10 ($F(1)=0.01$, $p=0.92$). Scores for intentions to stand at week 15 were non-normally distributed, therefore a Mann-Whitney U test was conducted and found that there was no significant differences between the delta scores at week 15 ($U=7.00$, $p=0.07$). There was also no reported change in the levels of PA between baseline and week 15, as well as between groups at either baseline or week 15.

Table 6.7 Mean scores for the questionnaire data at each measurement point

	Baseline		**Week 10**		**Week 15**	
	Intervention	**Control**	**Intervention**	**Control**	**Intervention**	**Control**
SRHI standing	21.33	23.33	22.67	24.67	27.33	26.83
SRHI sitting	45.33	33.67	45.00	43.44	44.50	43.67
Organisational norms	13.93	17.25	14.67	17.67	16.00	17.33
Control	10.29	13.33	8.00	12.33	8.33	11.00
Intentions to sit	3.43	3.58	3.33	2.33	2.33	2.00
Intentions to stand	3.21	3.58	3.00	2.33	2.33	3.00
Workplace sitting (minutes)	366.43	380.00	350.00	391.36	408.00	400.00
Total work day sitting (minutes)	631.43	639.58	650.00	733.33	640.00	770.00
Total non-work day sitting (minutes)	468.21	413.75	600.00	520.00	353.33	500.00

6.8 Discussion

The intervention was designed to promote the formation and strengthening of a standing habit, leading to changes in workplace SB. The intervention lasted for 10 weeks with follow-up measures at week 15 (five weeks following the end of the intervention). Participants in the intervention group showed a reduction in occupational sitting at week 15, compared to baseline measures. This is encouraging as it shows that following the intervention, occupational sitting continued to decrease and improvements in workplace SB were observed. Previous interventions have found that reductions in SB have returned to baseline, based on shorter follow-up periods after an intervention (Pronk et al, 2013). These results need to be viewed with caution though as significance testing could not be conducted due to the small sample size. Nevertheless the results indicate that introducing interventions which target standing behaviours could produce long lasting reductions in workplace SB. When looking at the individual participants sitting times, four out of five of the participants did show a reduction in workplace sitting further supporting the success of the intervention.

This was the first SB focused intervention to be based on the reflective-impulsive model (Strack & Deutsch, 2004), a two-systems model which acknowledges the role of conscious and unconscious thought processes in behaviour. This model was used as participants in Studies 1 and 2 (Chapters 3 & 4) reported sitting to be a habitual and unconscious behaviour, as well as a conscious effort needed to stand. Although the results indicate that occupational sitting has decreased, which could infer that a standing habit has been created, there were no significant changes in habit strength scores in either group for sitting or standing. Although the SRHI has been validated, there has been criticism of the measure and researchers have questioned the measure, as it is measuring a behaviour, which is unconscious (Ersche, Lim, Ward, Robbins, & Stochl, 2017). If a person is unaware that they are performing the behaviour, then they may also be unable to self-reflect and report what factors influence these unconscious behaviours. This means that changes in habit strength are not detected during the intervention period. Implicit association tests have been suggested as a solution to habit measurement (Hagger, Rebar, Mullan, Lipp, & Chatzisarantis, 2015; Keatley, Clarke, & Hagger, 2013). However these measures come with the caveat that they lack ecological validity in health research (Gardner, 2014).

Participants in the intervention group were asked to complete weekly habit strength measures specific to the standing behaviours they were trying to change, again there was no significant changes in these scores over the study period. As these behaviours were decided upon by the participants, a baseline measure could not be obtained as the research team did not know what the specific behaviours would be. It may be the case that there were changes in habit strength relating to the specific standing behaviours, yet these differences were not observed due to there being no baseline measure. Lally and Gardner (2011) found that habit strength increased following an asymptotic curve. Habit strength may have initially increased following the workshop but had already begun to plateau when the weekly measures began. Previous research has found that habits have begun to form initially within the first week (Lally, van Jaarsveld, Potts, & Wardle, 2010), which may have been the case in this study.

Although a positive reduction in workplace sitting was observed in the intervention arm, more could still be done to reduce the amount of time employees spend sitting, aiming to reduce occupational sitting in line with the guidelines recommended by Buckley and colleagues (2015). Interventions which have found larger reductions in sitting have made environmental changes to workplaces and introduced AWSs (Graves et al, 2015; Healy et al, 2016). A strength of this intervention was that it capitalised upon standing behaviours already being performed within the workplace, making it more pragmatic and at no expense to the organisation, an aim of the intervention from the outset. Interventions focusing upon more pragmatic and feasible strategies to reduce workplace SB would be beneficial to all organisations and could be rolled out to reach a larger number of employees and be implemented immediately if behaviours are already performed in the workplace. Study 3 is one of few interventions which has focused on cheaper more pragmatic intervention (alongside Evans et al, 2012; Mackenzie et al, 2015) and the first to focus on encouraging behaviours which are already performed rather than introducing new behaviours.

The Runscribe accelerometer has not been previously used to measure workplace SB. The Runscribe was chosen to be used for this study due to previous studies (Chau et al, 2016; McGuckin, Sealey, & Barnett, 2017) and pilot work conducted by the research team finding that the ActivPAL accelerometer would occasionally lose data, and with a small sample size we aimed to avoid this. Across all the measurement points no days were lost due to the reliability of the Runscribes. On three occasions the batteries in the monitors did not work, however it is obvious whether or not the accelerometer is recording due to the flashing light. This meant that on the occasions that batteries did stop the researcher was able to get the participant a replacement accelerometer, minimising data loss to approximately eight hours for three instances combined. Due to the success of the Runscribe accelerometers, future research teams would be encouraged to consider using the Runscribe as a measure of SB. The potential versatility of the accelerometers would also be appealing as researchers could look to record different types of data and modify the classification script to suit their needs.

These findings highlight that an intervention based on the reflective-impulsive model has begun to show reductions in workplace sitting through increasing standing habits in the workplace. As well as exploring activity data the present study looked at the feasibility of making these changes within the workplaces, through focus groups with the participants.

6.9 Strengths & limitations

Study 4 benefitted from using a sample of participants who were not actively involved in conducting research or working within a health discipline. This has been a criticism of previous research aimed at reducing workplace SB as participants may have had a vested interested in the success of the research or be aware of the negative health consequences associated with SB (Tew et al, 2015). The Runscribe accelerometer used to objectively measure workplace SB was widely accepted by participants and successfully recorded data for almost all participants. The use of the Runscribe would be encouraged for further SB research as a way to measure SB as participants found that they were comfortable to wear, plus they have the potential to be used to monitor different behaviours because of the versatility to be able to write script for analysis of other behaviours.

The present study was limited by the small sample size, particularly the lack of participants in the intervention group at the 15 week measurement point, which meant that inferential statistical analysis could not be conducted. It seems that in between weeks 10 and 15 a number of staff in the intervention group were restructured to different parts of the organisation, as well as some participants retiring or leaving the organisation. Participants that were leaving or colleagues of those participants that left after week 10, informed the researcher either at week 10 or 15 that these changes were occurring. Participants did not address this issue at the start of the study; therefore the research team were unaware that they would not be available during week 15. Due to participants leaving the organisation this also meant that they could not be contacted to discuss their participation in the study as their organisation email address was the primary source of contact. The questionnaire measures used within the present study, particularly habit strength, may not have been sensitive enough to detect change within participants. Different measures could be used to explore changes in these variables, however at present there are a limited number of these measures available to measure the variables within workplace SB. Future research should look to develop and validate measures which could be used to measure these variables specifically for workplace SB.

6.10 Conclusion

This chapter has discussed the development, methods, and results of a pragmatic intervention designed to reduce SB in desk-based workers informed by the reflective-impulsive model (Strack & Deutsch, 2004). The intervention found that participants within the intervention group reduced their workplace sitting by 30 minutes/8-hour working day. Due to drop out of participants these results could not be tested for significance. This study was the first to encourage standing behaviours that employees are already performed within the workplace. It is therefore promising that encouraging these behaviours can lead to reducing workplace SB, as they could potentially be used within any organisation at little cost. Further research within different organisations and with larger sample sizes are required to support the findings of this study. The following chapter will discuss the follow-up focus groups conducted with participants following the end of the study (Study 5).

Chapter 7 - Study 5: Acceptability & feasibility of the intervention

7.1 Introduction to the chapter

As Study 4 (Chapter 6) was a pilot study, it was important to assess the acceptability and feasibility of the intervention. Following completion of the intervention and follow-up period, focus groups were conducted with participants from the intervention and control groups to gain insight into their experiences of participating in the study. The following chapter discusses the findings from these focus groups, and considers how the experiences of participants relate to the activity findings of the intervention.

7.2 Background to the study

The MRC's framework for complex interventions proposes that interventions should be developed through a number of iterative stages (Craig et al, 2008). These stages involve development of an idea, piloting, evaluation, and implementation. The intervention designed in Study 3 was developed based on the findings of Studies 1 and 2 (Chapters 3 & 4) alongside the Literature Review (Chapter 2). This allowed an appropriate theory to be identified to underpin the intervention as well as appropriate intervention techniques which could lead to successfully reducing SB.

Study 3 was the pilot of the intervention in a sample of desk-based employees. Alongside piloting the intervention to measure changes in activity outcomes, the pilot provides an opportunity to assess the acceptability and feasibility of the materials used with participants and for them to participate in the study. Understanding the acceptability and feasibility of an intervention is an important prerequisite for any large study as it provides an opportunity to test procedures being used and to determine if intervention strategies would be welcomed, particularly within a workplace where there may be other priorities for employees and employers (Leon et al, 2011). Study 3 had several components which had not been previously trialled in other workplace SB interventions, such as; creating a standing habit, the Runscribe accelerometers, and self-monitoring standing behaviours. Therefore it was important that the acceptability and feasibility of these components in particular were assessed.

Previous interventions have assessed the feasibility of their interventions through qualitative methods (Chau et al, 2014a; Graves et al, 2015). Qualitative methods have been recommended when exploring the feasibility of an intervention as it allows the researchers to explore in depth participants experiences of the study, as well as to discuss any issues that they experienced (Moore et al, 2015). Participants are also provided with an opportunity to ask any questions about the study and gain an understanding of the aims of the intervention. Understanding these issues and experiences is valuable to ensure that the research team can further develop and improve the intervention.

7.3 Study aim

The present study aimed to explore participants' experiences of participating in the study to understand the acceptability and feasibility of the intervention. These findings could then be used to improve and develop the intervention and in addition provide insight for further research to reduce SB in the workplace.

7.4 Methods

7.4.1 Participants

All participants from Study 3 were offered the opportunity to participate in the focus groups, yet they were not expected to and were informed that this has no bearing on the study. In total eight participants volunteered to participate in the focus groups; five participants in the intervention focus group (mean age = 42.67 years, 3 female) and three in the control focus group (mean age = 43.0 years, 2 female). Two focus groups were conducted, one with participants from the intervention group, and one with participants from the control group.

7.4.2 Procedures

The focus groups were conducted in week 16, which was the week following the final follow-up measurement (week 15). Focus groups were conducted in private meeting rooms away from colleagues. With the participant's permission, each focus group was recorded and then transcribed verbatim. The control groups focus group lasted for 30 minutes and the intervention groups focus groups lasted for 50 minutes.

All identifiable information was anonymised, including names, colleagues/managers names, locations, and organisation name.

7.4.3 Focus groups

The focus groups allowed an opportunity for participants to discuss why they had participated and how they found participating in either the control or intervention group. It provided information on which elements of the intervention participants interacted with and what they felt helped in reducing workplace SB and further changes that could be made. This also provided an opportunity to feedback the results of the study and explore whether or not the control group felt that they had been influenced by the study, particularly whilst wearing the accelerometers.

Prior to the focus groups an interview guide was developed (Appendix 7.1) which focused on the different elements of the intervention.

7.4.4 Data analysis

The data obtained from the focus groups were transcribed verbatim and then thematically analysed following the steps described by Braun and Clark (2006). The data was coded into lower-order themes and then grouped into higher-order themes. Multiple-analyst triangulation was conducted within the research team to ensure that the coding and allocation of the themes was agreed upon. Member checking also took place with the final higher and lower-order themes with all participants as this allowed participants that did not attend the focus groups to contribute any further information that they felt was necessary.

7.5 Results

The focus groups were coded and results structured into higher-order and lower-order themes. The higher and lower-order themes are also presented in table 7.1. Direct quotes from the participants are provided in the following sections along with the themes, which have been anonymised. Where a participant is represented with a letter (e.g. Participant A) this means they were in the control group, whereas participants represented with a number (e.g. Participant 1) were in the intervention group.

Table 7.1 The lower and higher order themes from focus groups with participants following the intervention.

Higher-order theme	Lower-order theme
Participation	To help with University research Find out about own activity Participated as part of a group Interested in health & well-being Expected to be sedentary at work
Questionnaires & measures	Encouraged reflection on own activity Hard to estimate own activity Unable to distinguish between habit questions A good number of questions
Accelerometers	Unaware of the behaviours being measured Unaware they were being worn Could fall off Initial encouragement to be more active
Facilitators	Self-monitoring prompts Engaging workshop Choosing & having agreed upon behaviours Being around colleagues also participating
Barriers	Unconsciousness of sitting Unusual to stand in meetings Being around people that did not know why they were stood Hard to change SB
Further changes needed	Environmental changes Standing meeting desks Organisational change by all More than awareness needed to change behaviour

7.5.1 Participation

The reasons why participants decided to participate in the study and types of participants were discussed within each focus group. Participants discussed two main reasons for deciding to participate in the study. The first reason was that participants felt that they should help out with the research to help the University and improve the student experience *'I did it because I thought it would be helpful for you, so to be involved in something to help someone at the University' (Participant A)*. Another reason participants agreed to participate was because they were interested in finding out about their own levels of activity within the workplace and saw participating as an opportunity to get something out of it for themselves *'Just to see how much you actually sit down at work because obviously you do it a lot but it's just good to see how much we've moved around and when you've done it' (Participant B).*

Participants in the intervention group also mentioned how they were willing to participate as they knew that a number of their colleagues were also participating and wanted to participate as part of a group '*The fact that it was suggested that a group of us might go in with a sort of shared experience I guess was a driver' (Participant 2)*. Participants in both groups also talked about being interested in their own health and well-being, and were motivated to lead healthy lifestyles and promote others to as well *'I'm a massive advocate of being active when I'm at work because just by default we are lazy animals and I'm interested in anything that means that if I'm more active at work' (Participant 1)*. The majority of participants expected that they would be very sedentary within the workplace and that they sat for the majority of their working day because of their job roles *'I knew I was in a job where I was sat down quite a bit' (Participant A)*.

7.5.2 Questionnaires & measures

Participants were asked about the acceptability and feasibility of the questionnaires and measures which they completed during the course of the trial. A number of participant's spoke of how completing the self-report measure of daily sitting encouraged them to reflect on their activity levels each day and emphasised how much time they spent sitting.

> *'Yeah I think for me and completing the questionnaire each time has made me realise exactly how sedentary I am, when you go through and say well how many hours in a typical day would you say you sit when you're doing this activity or that activity, which is probably most of the time' (Participant 3)*

A challenge of completing the self-report measure of SB was also that participants found it hard to estimate the amount of time that they spent sedentary in different situations each day, and also that their levels of SB would actually change each day depending upon their schedules.

'The one thing about the questionnaire that I thought I found difficult, I mean it said on a typical day, erm but the thing that frustrated me a little was that there are days when I'm really quite busy but that makes you feel like if you put down six and a half hours, that's what it's like every day' (Participant C)

Participants in the intervention group, who completed weekly habit questionnaires, spoke of how they found the questions very similar and hard to distinguish the differences between the questions.

'PARTICIPANT 1: *I think the questionnaire itself I found a little awkward to fill in because …*
PARTICIPANT 3: *The language was quite strange…*
PARTICIPANT 1: *… it seemed to be same versions of the same questions, yeah*
PARTICIPANT 3: *… yeah because I was like it's the same as the other questions*
PARTICIPANT 2: *You may have had a subtle distinction when you were writing it but it was perhaps maybe lost on us when you know we thought is this something you do without thinking or is this something you do automatically'*

Participants in both groups spoke about there not being too many questionnaires to complete and that they were easy and not too time consuming to complete *'It just became one of those normal things you know, Monday here's my survey and you sort of just stop noticing it you just do it' (Participant 5)*. Regardless of the ease of completing the questionnaires some participants did comment on needing to remember to complete the questionnaires and self-monitoring sheets and that they could forget if they did not have an obvious reminder to complete them.

'PARTICIPANT 3: *It was alright as long as I put it in front of me*
PARTICIPANT 5: *Otherwise you forget [laughing]*
PARTICIPANT 3: *Yep unless it was literally next to me every time I needed to do it.'*

7.5.3 Accelerometers

Both groups were asked about their experiences of wearing the accelerometers at each of the different time points. Some participants did remark on the fact that they were unsure as to what the monitors were measuring whilst they were wearing them and what activity they would measure *'So if you were at your desk, it knows you're stood, it's not just a pedometer tracking your steps?' (Participant 1).* The majority of participants mentioned that they would forget they were wearing the accelerometers on their leg, therefore not interfering with their activity *'There were a few clothing related incidents [laughing] you've forgotten you're wearing it and then all of a sudden it's there' (Participant 2)*. A couple of participants did have issues with the accelerometers coming off because they would forget they were wearing them whilst removing clothes or when participating in intense exercise they had a tendency to come off *'I remember power walking somewhere and it popped out my trousers [laughing]' (Participant A)*. Whilst wearing the accelerometers during the measurement periods participants mentioned that the accelerometers would initially encourage them to be more active but this would not be sustained.

> *'I think in the first time I thought 'ooh' I was very conscious that it was there, but I think as the weeks have gone on personally I think I have just been very constant with my data, I imagine. So it's almost at first I knew I was wearing it and thought 'oh wouldn't it be nice to see if I was active', a bit more active, but I think now I've just sat there [laughing] and done nothing' (Participant B).*

7.5.4 Facilitators

Participants in the intervention group were asked about what factors encouraged them to change their behaviour and stand more during the intervention. Completing the self-monitoring sheets each week and that they acted as a prompt to remind them to perform the behaviours.

> ***'PARTICIPANT 3:*** *It [self-monitoring sheet] was there reminding you to do it*
> ***PARTICIPANT 4 & 5:*** *Yeah'*

The workshop at the start of the intervention was also found to be engaging and participants left feeling as though they wanted to change their behaviours.

> ***'PARTICIPANT 3:*** *Erm it [the workshop] was pretty engaging, if I remember*
> ***PARTICIPANT 5:*** *Yeah I thought it was alright. Yeah everyone had something to say didn't they?*
> ***PARTICIPANT 2 & 3:*** *Yeah'*

Following the workshop the participants liked the fact that they came away with behaviours which they had decided and agreed to change as well, rather than having to go away and decide what or how to change their behaviour.

> *'I think kind of having the options you know so taking the stairs or going to the loo on a different floor, so you didn't have to think about 'oh what could I change' you know there were ready made options for you to choose from and I think that helped' (Participant 4)*

Participating in the study as part of a group and being around colleagues that were also participating or knew what they were doing, encouraged them to perform the standing behaviours.

> *'What I did find was that because the reception team for instance had gotten into the habit of collecting questionnaires and they knew the study was on and others would be sat down there so you felt you were just on your routine, it kind of validated my unusual behaviour erm you know because it became something that people weren't going to question 'why's he walked through here three times today' (Participant 2)*

7.5.5 Barriers to standing

Participants in the intervention group also spoke about a number of different barriers which led to them not changing their behaviour during the intervention. All participants mention that sitting was an unconscious behaviour and prioritising their work meant that they would forget how long they had been sat for at certain times.

> *'It's when you're like sat doing a certain task and then before you know it it's like two hours later and you're like 'oh gosh' and you didn't actually move at all in all that time, it's quite bad really when you think about it' (Participant 4)*

Standing in meetings was a behaviour which participants decided to try to do, nevertheless if participants were in a meeting with colleagues not involved in the study they felt that this was an unusual behaviour to perform and that other people in the meeting may interpret standing differently '*If someone stands up you all suddenly think well why are they standing up what's happening' (Participant B)*. Outside of meetings participants also spoke about being reluctant to stand if colleagues did not understand why they would stand as the typical behaviour would be to sit *'That's the sort of thing where it's not conventional behaviour you know people think "well they're away from their desk half the time"' (Participant 2)*.

Participants spoke about how they found it hard to change their SB and to stand more in the workplace *'I found it difficult anyway, just finding more time to go down onto another floor and coming back but yeah' (Participant 5)*. Reducing SB was also spoken about being hard to do due to sitting being a normal behaviour in the workplace that people had been doing for a long time.

> *'Yeah and if you were to, you know every other hour go to do something like you say people would be like 'where have they gone, they're never here' but no one ever batters an eyelid when someone goes off to smoke every other hour' (Participant 1)*

7.5.6 Further changes needed to facilitate standing

Participants in both the intervention and control groups spoke about factors that could and would need to be changed to further encourage standing within the workplace. Changes to the environment were discussed by the intervention group and how more environmental options to stand would facilitate standing.

> *'I found in [university building] that there are odd little pockets where around the central stairs, where it's higher than a kitchen worktop, with stools, but when I was carrying the little laptop around if I actually set-up and put the screen back slightly further perhaps then that was ideal for me to stand at, the stools just next to me not looking very comfortable either' (Participant 2)*

One particular environmental change, which was identified was the introduction of standing meeting desks and how if there were standing meeting rooms, these would be used by employees for standing meetings.

> ***'PARTICIPANT 4:*** *yeah but I think you're right going back to when we had the standing meeting table in room in [old building name] and we used to have standing meetings…*
> ***PARTICIPANT 3:*** *We loved it, we were quite excited to have that there*

> ***PARTICIPANT 4:*** *… but it's because it was in a room as well because sometimes you need a room to get away from the rest of the office*
> ***PARTICIPANT 3:*** *Yeah it needs to be a closable room, but now it's sort of out in the floor you can't really have the same meetings'*

Participants in the intervention group highlighted how they felt changes and encouragement to reduce workplace SB needed to come from the organisation and that an organisational change would be needed to encourage more standing at work.

> *'The big thing for me is doing it outside of our office because I would say that 95% of our meetings are outside of our office and in those meetings with other people from the university yeah it just feels wrong having to stand and we do need to get a message out to the university that we should be doing this more, and then like I say you wouldn't feel as awkward doing it if everyone has been given that message' (Participant 1)*

Although participants spoke about how awareness to reduce SB had been raised and that this would help reduce workplace SB, they also felt that more needed to be done than just raising awareness.

> *'Yeah, I'm definitely more aware but absolutely hopeless at doing these things, I really am, erm so it's like I'm aware that I'm doing it and I'm aware that I shouldn't be doing it but [laughing]' (Participant 4)*

7.6 Discussion

The aim of Study 5 was to explore participants' experiences of participating in Study 4 (Chapter 6) and to understand the acceptability and feasibility of implementing the intervention into the workplace. These findings could then be used to improve and develop the intervention, as well as provide insight for future research to reduce workplace SB. Two focus groups were conducted with participants following the final measurement week (week 16). Participants in the intervention and control groups participated in separate focus groups but were asked the same questions which focused on the feasibility of the study, the measures used, the accelerometers, and their understanding of SB. Intervention participants were also asked additional questions about the intervention, which control participants were not asked as they did not experience the intervention. Overall the intervention was reported to be acceptable and that standing behaviours were facilitated by the self-monitoring prompts, the workshop, having the option to choose standing behaviours, and being around colleagues that were also standing and participating. Barriers still remained which limited participants from standing including; the unconsciousness of sitting, it being unusual to stand in meetings, and being around people that did not understand why they were standing.

Results of the focus groups showed that there were a number of different reasons why participants chose to participate, including the fact that they would find out about how active they were and the expectation that they were sedentary at work. The measures that participants were asked to complete in both groups were reported to be acceptable and not time consuming, yet some participants did report issues with trying to calculate typical sitting times and questions in the SRHI. The Runscribe accelerometers were reported to be comfortable to wear during measurement periods and participants would forget they were wearing the accelerometers, therefore not influencing their behaviours in either group. Both focus groups offered suggestions to encourage further changes to workplace SB including organisational support and having a reason to stand. Overall these findings support the acceptability and feasibility of the present study, highlighting that it is an intervention which could be conducted in different organisations in an effort to reduce workplace SB.

Understanding the acceptability and feasibility of an intervention is particularly important within a workplace where there may be other priorities for employees and employers (Leon et al, 2011). It maybe that an intervention could lead to reductions in SB, but if the intervention strategies are not feasible within the workplace then it is unlikely that employees would sustain these behaviours following the completion of the intervention. Given the length of time people spend at work, it is particularly important that workplace SB interventions implement strategies which can be sustained. It is therefore reassuring that participants in both conditions felt that the procedures were acceptable and that overall participants in the intervention group felt that the strategies to reduce sitting were feasible. Nevertheless there were issues highlighted with the measures and implementing the strategies that need addressing.

7.6.1 Measures used in Study 4

Participants in the intervention group spoke about how they felt that the SRHI questions were at times confusing and hard to understand. If participants struggled with the measure then this may have led to responses not reflecting participant's true feelings. Study 4 (Chapter 6) also discussed issues with the SRHI measure, and the findings from the focus groups may further support the reasons why no changes in the SRHI measures were detected over the course of the intervention.

Since the present study commenced a new self-report measure of habit strength has been developed by Ersche and colleagues (2017) consisting of 27 items. This is considerable longer than the SRHI used here, which consisted of seven-items, and would reduce the likelihood of participants completing the measures each week. At present it seems as though the SRHI is the most suitable measure of habit strength. Reviews of measures of habit have also reported issues with choosing the most appropriate method, due to the unconsciousness of habits meaning that some measures are more likely to measure behavioural activation (Gardner, 2015). This was the first study to measure changes in habit strength during a SB intervention. Introducing a familiarisation process at the outset of the study to ensure that participants are comfortable with all the measures may be of benefit in future research.

7.6.2 Organisational changes to further reduce sedentary behaviour

Participants in the intervention group spoke about several barriers which they felt were still present and stopped them from reducing their workplace SB. Being unaware of sitting for long periods due to being focused and prioritising their work stopped a number of participants taking opportunities to stand. Similarly this was reported by participants in Study 2 (Chapter 4) and clearly is a challenge to change as it appears that employee's priorities are to complete their work. The unconsciousness of sitting has also been reported to limit standing in the workplace following interventions (Koepp et al, 2013; Mackenzie et al, 2015) To counteract this issue, organisations could play a greater role in promoting and encouraging reductions in sitting, allowing employees to feel as though they can take breaks. The involvement of the organisation was mentioned as an area that is needed for further behaviour change, but can be challenging within large organisations where there are different departments and teams to manage.

Study 4 had organisational level involvement as managers supported the intervention and reducing SB, as well as participating in the study. Nevertheless each work team within the intervention was only a small team within a much larger organisation, meaning there were other organisational influences when working outside of the immediate teams. Promoting standing and reductions in sitting across the whole organisation would eliminate this issue as arguably all employees within an organisation would then understand why their colleagues were standing.

Further encouragement and prioritising standing during the working day may come once employees experience standing and experience the benefits of standing. Participants in previous studies (Grunseit et al, 2013) and participants in Study 2 reported that standing to work made them feel more productive whilst working and reduced feelings of fatigue. Work productivity is difficult to measure; the few studies that have measured productivity have reported that there has been no change in productivity when standing has increased (Chau et al, 2015). Further research into how productivity changes alongside reducing SB is needed to support the qualitative data for improvements in work productivity. If research is able to demonstrate improvements in work productivity, this could encourage organisations to promote reductions in SB and incentivise employees to stand more. Satisfaction from standing could also motivated an employee to carry on standing, as the reflective-impulsive model states that behaviours are maintained if they are found to be satisfying (Strack & Deutsch, 2004).

7.6.3 Social influences on sedentary behaviour

The workshop conducted at the outset of the Study 4 was reported to be informative and engaging by participants. Participants appreciated the opportunity to discuss potential standing behaviours, and receiving clear and specific ways to change their behaviour. Colleagues participating in the intervention also encouraged standing behaviours, as participants felt more comfortable to stand around those that understood what they were doing. Study 4 purposefully recruited participants from the same work teams, as participants in Study 2 had reported being more likely to stand around colleagues that understood why they stood or when others stood. Future studies should be encouraged to take a similar approach and where possible conduct cluster trials as a way to encourage all participants to be around those behaving in similar ways to themselves.

The social influence on behaviour was a common theme in both focus groups. As mentioned, behaviour was reported to be influenced by others understanding of their behaviour, participants agreed to participate knowing their colleagues were participating, and others standing behaviours encouraged standing. These factors highlight the importance of social influence upon behaviour and the need for future research to look at how these influences can be changed. Study 2 found that participants felt all employees had opportunities to stand and reduce sitting within the workplace. Therefore placing emphasis upon taking advantage of the standing opportunities already available in the workplace could lead to reductions in SB.

Participants in the intervention group also reported being limited by being around colleagues did not understand why they would be standing, which was also reported in Study 2. Previous research has also reported similar issues when AWS's have been introduced to the workplace (Chau et al, 2015; Dutta et al, 2014b). Interventions that have introduced standing hot-desks to workplaces have also showed limited use, which could be attributed to participants being the only person standing in that workplace (Gilson et al, 2012). The social perception of standing in the workplace still appears to be a barrier as reported in this study and previous research, and could potentially be reduced by larger organisational changes.

Large organisational changes could encourage these changes in social influence, but may be harder to implement. Future interventions may benefit from focusing on changes to specific settings and situations in the workplace. Participants in the intervention group spoke about previously having had access to a standing meeting table which encouraged them to have standing meetings. Having a clear setting and opportunity to stand could help facilitate standing, and would be easier and cheaper to introduce one standing desk rather than desks for all employees. Initiating standing in certain situations could raise awareness of other opportunities to stand during the working day.

Overall the participants in the focus groups found that the present intervention was acceptable and did not disrupt their working days. Further strategies were suggested to encourage standing as there were still barriers preventing participant's from standing. These findings are promising for future research and highlight that employees have pragmatic options to reduce SB within the workplace. The following section shall bring together the findings of the present study and then discuss the strengths and limitations, along with avenues for future research.

7.7 Conclusion

In line with the MRC's framework for complex interventions, Study 5 explored the acceptability and feasibility of the intervention implemented in Study 4 (Chapter 6). Focus groups with participants from both the control and intervention groups participated following the end of the follow-up period (week 16) to discuss their experiences of participating and discuss further changes that could be made to the intervention. Overall participants in both conditions reported that the intervention was acceptable and feasible for the workplace. This is promising as it shows that a pragmatic intervention could be implemented in a number of workplaces to reduce SB.

Issues were raised around the measures used during the intervention, but generally participants in both conditions were able to complete them accurately. Barriers to reducing SB were identified and recommendations made about how to further reduce SB in the workplace. Social influences were reported to be a factor which affected participant's involvement in the study and opportunities to stand.

Chapter 8: Synthesis, recommendations, & conclusions of the thesis

8.1 Introduction to the chapter

This thesis set out to explore the determinants of workplace SB in desk-based employees driven by a knowledge of the negative health consequences associated with SB (Duvivier et al, 2016; Wilmot et al, 2011) and the current prevalence of SB in the workplace (Kazi et al, 2014; Waters et al, 2016). The results of Studies 1 and 2 (Chapter 3 & 4) led to the development of a pragmatic intervention to reduce SB in the workplace (Study 3-5; Chapter 5-7). The following chapter considers the findings from all five studies and the contribution this body of work has made to the extant literature exploring SB in the workplace. Recommendations for future research are also presented.

8.2 Synthesis of findings

8.2.1 Synthesis of the data concerning the determinants of sedentary behaviour (Chapters 2-4)

The Literature Review (Chapter 2) identified a lack of long-term evidence of reductions in workplace SB being maintained, and that this could be due to a lack of understanding of the determinants of workplace SB. Studies 1 and 2 set out to explore the determinants of workplace SB specifically within desk-based employees and then focused upon the determinants of SB in employees with an AWS. Previous research into the determinants of SB in adults had reported that a number of factors were found to be related to SB (De Cocker et al, 2014; Rhodes et al, 2012).

The findings of Study 1 reported that workplace SB was influenced by habit strength, total non-work day sitting, control to stand, organisational norms, intentions, standing options, gender, employment sector, PA, and desk type. Study 2 found that workplace SB was also influenced by; previous experiences of standing, individual motives to stand, social factors, organisational factors, and sitting being a habitual behaviour. Together these studies highlight that workplace SB is a complex behaviour, influenced by a number of determinants and that no clear determinant appears to be influencing SB. This supports the need for interventions to take a multi-component approach to reducing workplace SB rather than just focusing on changing a single factor (e.g. an environmental change). Interventions that have conducted multi-component interventions have led to reductions in workplace SB (Healy et al, 2016; Mackenzie et al, 2015; Neuhaus et al, 2014b). Interventions based upon the social ecological model (Owen et al, 2011) have made changes at individual, social, environmental, and organisational levels, and have shown to be more effective than making an environmental change alone (Neuhaus et al, 2014b).

The Literature Review reported that interventions which had only introduced AWS's to the workplace, without further intervention components (e.g. education, motivational counselling) did not lead to initial reductions in workplace SB being sustained (Ben-Her et al, 2015; Koepp et al, 2013). This highlights that other factors are influencing workplace SB, further supported by the findings of Studies 1 and 2 which found that multiple factors influenced workplace SB. Participants with AWS's (n=115) in Study 1 reported sitting 36 minutes/working day less than participants with fixed-sitting height desks. This is substantially less that what has been reported in previous reviews of AWS interventions (78 minutes/working day; Neuhaus et al, 2014a; Torbeyns et al, 2014). It would appear that an environmental change alone is not sufficient for reducing and sustaining reductions in SB.

Study 1 was the first body of work to report the sitting times of AWS users in a natural work setting. Cross-sectional studies of SB in the workplace have not reported the type of desk that participants have access to in their workplace (Fountaine et al, 2014; Kazi et al, 2014; Van Dommelen et al, 2016). Presumably the desk that an employee has would influence the levels of workplace SB, based upon the findings from interventions. Previous reviews which have reported the SB of employees with AWS's, have done so following AWS's being introduced as part of an intervention (Neuhaus et al, 2014a; Torbeyns et al, 2014). Therefore, these AWS users may want to have and use an AWS, as they presumably volunteered to participate in these interventions. AWS users in natural settings may have been provided one due to a health problem or at the discretion of their employer, but not necessarily be aware of why they have one. The difference in sitting times between AWS and non-AWS users reported in this study may more realistically reflect the influence of AWS's in the workplace, giving a clearer understanding of how AWS's are used in different workplaces.

Participants reported a lack of awareness around the negative health implications of SB in Study 1. This may explain why an environmental change alone does not lead to sustained reductions in SB. A number of theories propose that behaviour occurs when a person is aware of a reason why they need to perform a behaviour and for intentions to perform the behaviour (e.g. TPB; Ajzen, 1991; Health Action Process Approach; Schwarzer, 1992; SCT; Bandura, 1986, 2004). If a person is not aware of the need to change and consequences of their current behaviour, then they may be unlikely to change their behaviour. Study 1 was the first study to measure employee's awareness of the negative health consequences of SB in a UK sample, and highlights the need for future interventions to include an education component to raise awareness of SB.

Participants in Study 1 reported that the implications of sitting were mainly negative (e.g. discomfort, back pain), yet still reported high levels of workplace sitting. All but one participant in Study 2 reported having an AWS due to a MSK related issue, suggesting they would likely stand at work when they were in discomfort. Participants in Study 2 also reported that their priority was to complete their work, which would lead to them forgetting how long they had been sat for. An employee completing their work appears to be the priority, rather than standing to reduce health risks. Therefore, interventions need to consider strategies that would facilitate an employee being able to complete their work and keep disruption to a minimum.

The results of Studies 1 and 2 also indicate that employees are not motivated to stand for health reasons, but rather they would stand when they are suffering from a problem, which is impacting upon their work. Initiation and maintenance of health behaviours has been explained by perceived satisfaction and expected outcomes of behaviour change (Baldwin et al, 2006; Finch et al, 2005). Further understanding of employee's motives to stand and what potential immediate benefits they may receive from standing, could help shape interventions to promote the benefits that employees want.

As well as understanding employee's motives to stand, consideration needs to be given to the unconscious and habitual nature of sitting. Study 1 was the first study to measure the habit strength of SB in any context, and that occupational sitting habit strength was reported to be high. The results of Studies 1 and 2 both indicated that sitting was a habitual behaviour performed in the workplace. The habitual and unconscious nature of sitting has not been considered by previous workplace SB research and this is a particular strength of this thesis.

8.2.2 Synthesis of the findings from the intervention (Chapters 5-7)

As highlighted in the previous section the findings of Studies 1 and 2 have found that workplace sitting is a habitual behaviour and that multiple determinants influence workplace SB. The findings of Studies 1 and 2 have led to the conclusion that workplace SB can be understood using the reflective-impulsive model (Strack & Deutsch, 2004) as the reflective (conscious) system explains workplace standing, whereas the impulsive (unconscious) system explains sitting. Previous interventions aimed at reducing workplace SB have not considered the unconscious nature of sitting and interventions that have mentioned theory have typically focused on SCT (Bandura, 2004) which relies on a person making a conscious effort to change their behaviour. This thesis highlights the need for future interventions to acknowledge the unconscious nature of sitting and proposes that SCT may not be an appropriate theory to underpin interventions.

Previous research has reported difficulty in breaking habits due to their automatic nature (Wood & Neal, 2009). Study 4 therefore focused upon creating a standing habit as a way to reduce and disrupt workplace SB, something that no previous interventions have attempted. Changes based upon the different levels of the social ecological model (Owen et al, 2011) were made to initiate standing behaviours in the reflective system of the reflective-impulsive model. Repetition of these behaviours was then encouraged to make the standing behaviour habitual in response to a particular cue within a participant's working day. The results of the intervention showed that encouraging a standing behaviour in this way was effective at reducing workplace sitting times in the intervention group. The reductions in workplace SB were in line with other interventions that had not introduced AWS's but had made multiple changes to the workplace (Brakenridge et al, 2016; Mackenzie et al, 2015). The reductions in SB were also similar to the differences between AWS and non-AWS users in Study 1. This highlights that cheaper and more pragmatic options to reducing workplace SB may be as effective as AWS's in natural working environments.

Participants from the intervention group reported in the follow-up focus groups (Study 5) that they sometimes struggled to remember to stand and that more noticeable cues were needed. More prominent cues could further reduce and disrupt workplace SB, and could have led to reductions from the outset of the intervention. The introduction of prompts on employee's computers has shown to be effective in previous interventions (Cooley & Pedersen, 2013; Evans et al, 2012). Point-of-choice prompts have also been found to be effective at changing behaviours when in the relevant position (Bellicha et al, 2015). Reductions in SB found later on in the intervention group may be related to continued reminders of the study through weekly questionnaires and completing the self-monitoring sheets. Future research should look to create more prominent cues within the workplace, as well as determining where the most effective position for a prompt may be. For desk-based employees computer prompts may be most effective if they are working at a computer for the majority of their working day.

A benefit of the present intervention was the use of standing behaviours which were already performed within the workplace, rather than the introduction of new behaviours as tested in previous research (e.g. Cooley & Pedersen, 2013). This was due to participants in Study 2 reporting that there were already opportunities for all employees to stand within the workplace, as well as them highlighting that their priority was to complete their work. Making the most of the standing opportunities already available within the workplace would reduce the likelihood of disrupting employees work. Encouraging behaviours already performed is also a more pragmatic option for organisations, as it would require very few resources. Participants in the intervention focus group (Study 5) reported that the standing behaviours did not interfere with their work productivity and that they had the time to do them during the day. These findings highlight that there are opportunities to stand already within the workplace, which any organisation could encourage, helping to reduce and disrupt workplace SB. Utilising standing behaviours which facilitate working would likely be well received by employers as well as employees, as it had previously been stated that standing may interrupt employees work productivity (De Cocker et al, 2015).

To further encourage changes in workplace SB, changes to the social environment and social norms may be a suitable starting point. A reappearing barrier to standing in Studies 2 and 5 is the social influence upon behaviour. Participants in Study 5 spoke of being encouraged to participate in the study due to their colleagues participating and working as a team. They also described being reluctant to stand when around colleagues that did not know they were participating in a study or unaware of why they would stand, which is a similar finding to that of Study 2. This links to the earlier point that employees stand to gain an immediate benefit from standing. It seems that the social threat is greater than the potential gain in comfort. Participants in Study 2, who reported MSK discomfort would benefit more from relieving MSK pain, therefore would be happy to stand around others that were seated.

Raising awareness of the implications of SB and reasons why people stand would be a good starting point for promoting standing within organisations. The use of email or poster campaigns could easily reach a number of employees and begin to raise awareness around standing, making employees that want to stand feel able and comfortable to do so. Previous interventions have raised awareness of the negative consequences of SB (MacEwan, Saunders, MacDonald, & Burr, 2017; Mackenzie et al, 2015;), however awareness alone is not sufficient to change behaviour which is why changes need to be made at the different levels of the social ecological model (Owen et al, 2011). Previous interventions have focused upon highlighting the negative consequences of SB; however they have not promoted the positive impact of increasing standing. Future interventions should look to promote the potential gains of standing, rather than just focusing on the negative implications. Based on the number of people that report MSK problems in the UK (Public Health England, 2017; Robertson et al, 2016) this is likely to be particularly beneficial for improving employee health.

The promotion of standing in meetings and workshops could also encourage standing, and provide a smaller and potentially more comfortable environment for employees to stand in. Participants in Studies 2 and 5 reported standing and participating in the intervention due to their colleagues also participating and standing. Meetings therefore provide an opportunity to encourage standing due to the social comfort of group norms. Lang, McNeil, Tremblay, and Saunders (2015) reported that conference delegates were more likely to stand when provided with a verbal prompt at the start of a presentation session. These prompts could also be used in workplace meetings, and based on the findings of this thesis; smaller groups of familiar colleagues may facilitate further standing. Participants in the intervention focus group spoke of how they had previously had a standing meeting table and that they and their colleagues were receptive to using it. Purchasing a standing meeting table would also be a cheaper option than buying individual AWS's for employees, and could benefit a group of employees. Currently no workplace research has explored the impact of changing meeting environments, but further research of how adaptions to certain environments could influence SB is warranted.

Overall the findings of Studies 4 and 5 shows that promotion of a standing habit has led to encouraging reductions in workplace SB, which have been sustained over 15 weeks. Participants have reported that the intervention was acceptable and was found to be feasible within the workplace, with the standing behaviours that they promoted not interfering with work productivity. Changes do still need to be made to facilitate further changes to workplace SB, particularly with the introduction of more prominent cues to encourage standing.

8.3 Recommendations for practice & future research

The following section suggests how the findings of the thesis could be used within the workplace, as well highlighting areas for future research.

8.3.1 Recommendations for practice

- As there are opportunities for employees to stand during the working day, regardless of their physical environment, health promotion campaigns and employers should consider further encouraging these standing behaviours, rather than introducing new behaviours which may disrupt employees work productivity.
- Organisations should encourage groups of employees to stand together, as the social influence could lead to more employees standing. This could be done by introducing standing meeting rooms and raising awareness of the benefits of standing to all employees. Employees may feel more comfortable to stand in other work environments, as well as repetition of standing in meetings potentially leading to the formation of a standing habit.
- Health promotion campaigns and organisations could raise awareness of the negative health consequences of SB to their employees, as well as promoting opportunities to stand and the benefits of standing. This

could be done easily and relatively cheaply in workplaces through poster and email campaigns.

8.3.2 Recommendations for future research

- The habitual and unconscious nature of sitting within the workplace needs to be acknowledged by researchers when conducting and designing interventions. Acknowledging the habitual nature of sitting would also ensure that an appropriate theory is selected to underpin an intervention, such as the reflective-impulsive model (Strack & Deutsch, 2004).
- Due to the complexity of workplace SB found in Studies 1 and 2, it is recommended that future interventions are multi-component in nature, based upon an appropriate theory such as Owen and colleagues (2011) social ecological model of SB.
- If AWSs are introduced to the workplace as part of an intervention, it is recommended that they are supported with other intervention components (e.g. education, self-monitoring) to facilitate maintenance of the AWSs use. It is apparent from the findings of Studies 1 and 2 that the introduction of an AWS alone may not lead to reductions in workplace SB, as well as research finding that the use of AWSs tails off if there are no further intervention strategies to support their use (Ben-Her, et al, 2014; Koepp et al, 2013).
- Further research is needed to explore employee's motives to stand within the workplace and how these could be promoted, particularly as a number of benefits from standing were reported by participants in Study 2. Exploring the impact of reducing SB upon productivity could be used to motivate employees to stand more within the workplace, and would be positively received by organisations.

8.4 Further research into the health consequences of sedentary behaviour

Since the beginning of this programme of research, studies have been published suggesting that the implications of prolonged sitting may not be as severe as originally suggested (Ekelund et al, 2016; Pulsford, Stamatakis, Britton, Brunner, & Hillsdon, 2015). It is now proposed that if a person is active and performing over 60 minutes of moderate intensity activity each day they may be protected against the negative implications of sitting (Ekelund et al, 2016; Pulsford et al, 2015). However, only 66% of men and 58% of women currently meet the guidelines of at least 150 minutes of moderate activity a week (NHS England), let alone the 420 minutes required to mitigate the effects of SB. Whilst further research might be needed to fully understand the health consequences of SB, continued efforts to proactively reduce SB remain relevant as most employees will not achieve sufficient MVPA to offset their own SB risk.

8.5 Strengths & limitations of the thesis

The specific strengths and limitations of the individual studies have been discussed and addressed in the relevant chapters. This section will therefore consider the strengths and limitations of the research as a whole.

This body of research benefits from the use of both qualitative and quantitative research methods to explore the determinants of workplace SB. This allowed a clearer picture of the determinants of workplace SB to be developed, leading to the design of the workplace intervention. This research also focused upon desk-based employees, rather than exploring the determinants of SB in all employees, which previous research had done (De Cocker et al, 2014; Wallmann-Sprelich et al, 2014). Research is needed to focus upon specific populations, as there can be vast differences between the work environments of different employees.

The samples used for each of the studies primarily consisted of employees working in the public sector. Working conditions and priorities may be different to those experienced by employees working within either the private or non-for-profit organisations. Even though the intervention consisted of all public sector employees, the intervention was a pilot and further testing of this intervention within more diverse samples is needed.

Consideration also needs to be given to the fact that the majority of the samples were recruited within a certain region of the UK. Research that has found the health consequences of SB to be less severe were based on participants working in London (Pulsford et al, 2015). Interestingly this sample reported walking significantly further each day than national averages. This could be attributed to their physical environment (e.g. commuting on public transport) but nevertheless serves to demonstrate that future research would benefit from recruiting larger, more diverse samples, from different regions of the country.

The majority of participants in the studies were also primarily working in open plan or shared offices. Social influences may be different for those employees based in their own offices away from their colleagues. It is possible that they may feel more comfortable to stand due to no colleagues being around, or they may be more likely to sit for prolonged periods due to colleagues not prompting them to stand. Consideration needs to be given to how the office layouts influence employees SB levels, for example Study 4 (Chapter 6) purposefully recruited employees that worked together in the same office.

In addition to understanding the determinants of workplace SB, this thesis also aimed to develop pragmatic ways for employees to reduce SB within their workplace. This is a strength of this body of work; the pragmatic intervention that has been developed could be implemented in any organisation straight away at very little cost. This means that employees could start to reduce their SB immediately, particularly as the intervention was reported to be acceptable by participants in Study 5. However the success of the intervention may in part be due to the primary researcher driving participant's involvement in the studies. To truly demonstrate the pragmatic nature of the intervention, future research needs to be driven by the employees themselves to engage and encourage their colleagues to reduce workplace SB. The introduction of workplace champions could be a starting point to ensure that there is someone within workplaces that is invested in making a change to workplace SB.

Smith and McGannon's (2018) paper published after this study was conducted and analysed has reported that there are limitations to Lincoln and Guba's (1986) methods for establishing the trustworthiness of data. The authors propose that instead of conducting member checking and inter-rater reliability that other methods could be used, including using a 'critical friend' which this study did. Further qualitative research conducted following this PhD thesis would take into these consideration and designing and conducting qualitative research.

8.6 Critical self-reflection on the research process

Reflexivity has been highlighted as being an important component of research practice, particularly within qualitative research, with researchers needing to acknowledge the nature of their research and demonstrate the trustworthiness of their findings (Finlay & Gough, 2002). The purpose of this section is to discuss my experiences of undertaking this research project, including the positives and challenges I have encountered and what I have learnt from the research process.

The most enjoyable part of the research process has been working with the participants and collecting data, particularly working with the participants in the intervention (Study 4). Working with the participants highlighted to me the complexity of the issue of workplace SB, which was crucial in understanding participant's priorities within the workplace. Although I appreciate the need for people to be active, working with participants is a reminder that the importance of being active and health issues vary between people. This was important for the development of the research and for future research looking to engage people in being more active. At the beginning of the PhD programme I was possibly naïve to think that all health issues were of importance to people, this view has now changed as I appreciate that everybody has different priorities due to different challenges in their lives. It is also important to understand what a change may look like for different people.

Due to this appreciation of the differences between individuals it was felt that a mixed methods approach was important for this project as it allowed richer data and better insights of the participants to be collected. I would be an advocate of future researchers also using both qualitative and quantitative methods to improve their understanding of different behaviours, particularly when implementing interventions. Gaining qualitative insight into the feasibility of interventions is important for future research as arguably the biggest challenge faced is for individuals that change their behaviours to maintain these changes for the rest of their lifetime.

A challenge I have faced over the course of the PhD is the realisation that the more you know, the more you know you don't know. Although I have enjoyed pushing myself to gain as much knowledge as possible, it was also a challenge at times to realise when to move on with the sufficient knowledge that I had. This impacted upon the other challenge of project management throughout the PhD, and having little experience of this previous I had to quickly learn how to manage my time and keep progressing with my work. The support of peers and supervisors was important to help with these challenges. Utilising peers that were not directly involved in the research was found to be of great benefit, as an outside view would usually help the process.

Throughout the PhD process I have learnt a lot about research, including my understanding of both qualitative and quantitative research methods, and knowledge of PA and SB research. I have also learnt a great deal about myself, how I can work in different situations, the need to be assertive and to have confidence in my ability to pursue areas. There is no doubt that I have developed through completing this programme of research and have learnt a number of skills which I will be able to adapt and use throughout the rest of my life.

8.7 Thesis Conclusions

This thesis advances understanding of workplace SB, the influences upon sitting and standing within the workplace, and proposes a novel way to reduce workplace SB. The following conclusions can be drawn:

- This thesis makes a unique contribution through exploring the determinants of SB specifically within desk-based employees, who report high workplace sitting.
- This body of work demonstrates that workplace SB is a complex behaviour influenced by multiple determinants at individual, social, environmental, and organisational levels. Future interventions should focus on making multiple changes to reduce workplace SB, rather than focusing on a single change.
- Study 1 was the first study to measure the workplace sitting times of AWS users in natural working environments, rather than during an intervention. Users of AWS's did not report substantial reductions in workplace sitting, contrary to previously reported AWS interventions (Neuhaus et al, 2014a; Torbeyns et al, 2014). This highlighted that an environmental change alone is insufficient to engender substantial changes in workplace SB and instead multiple changes to the workplace are required.
- Participants in Study 1 reported a lack of awareness of negative health consequences associated with SB. A number of previous interventions reported in the Literature Review (Chapter 2) did not report educating employees about the negative health consequences of SB. Future researchers should acknowledge that participants may lack the awareness and consider educating participants at the outset of an intervention.
- Findings from this thesis identified occupational sitting as a habitual behaviour, which previously had not been acknowledged by interventions. It is important for future research to acknowledge the habitual nature of workplace SB when selecting an appropriate theory to underpin interventions.

- Studies 1 and 2 highlighted how workplace SB can be explained by the reflective-impulsive model (Strack & Deutsch, 2004). This could be used as an underpinning theory in the design of future workplace SB interventions, particularly as it acknowledges the role of unconscious and habitual behaviours.
- This thesis found that employees, regardless of their environments, have opportunities to stand during the working day. Encouragement of these behaviours in Study 4 were reported to be an acceptable and feasible way for reducing workplace SB. Organisations should look to utilise standing behaviours already occurring within the workplace to disrupt SB.
- This body of work showed that social influences played a key role in influencing workplace SB. Raising awareness of the reasons why people stand and encouraging more employees to stand would help to normalise standing within the workplace, leading to people feeling more comfortable to stand at work.
- Studies 3 and 4 support the use of the Runscribe accelerometer as a valid and reliable measure for workplace SB, and would encourage other researchers to consider using this accelerometer for SB and PA research.

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Appendices

Chapter 1

Appendix 1.1 Research into the health consequences of sedentary behaviour

Chapter 2

Appendix 2.1 Interventions retrieved from the systematic search that aimed to reduce workplace sedentary behaviour.

Appendix 2.2 Qualitative studies exploring workplace sedentary behaviour

Chapter 3

Appendix 3.1 SHUREC1 form & confirmation of ethical approval

Appendix 3.2 Questionnaire completed by participants in Study 1

Appendix 3.3 Information for participants sheet presented before the questionnaire

Chapter 4

Appendix 4.1 Information for participants sheet presented to participants

Appendix 4.2 SHUREC1 form & confirmation of ethical approval

Appendix 4.3 Interview guide

Chapter 5

Appendix 5.1 SHUREC1 form and confirmation of ethical approval

Appendix 5.2 Diary given to participants to record their working hours

Chapter 6

Appendix 6.1 SHUREC1 form and confirmation of ethical approval

Appendix 6.2 Information sheet for participants used in Study 3

Appendix 6.3 PowerPoint slides used for the intervention workshop

Appendix 6.4 Self-monitoring sheet (presented on a single A4 side)

Appendix 6.5 Measures sent to participants in Study 3

Appendix 6.6 Environmental audit measure and results

Chapter 7

Appendix 7.1 Focus group guide

Appendix 1.1 Research into the health consequences of sedentary behaviour

Table 1.1. Research that has highlighted the associations between physical and mental health outcomes with sedentary behaviour

Authors	Method	Findings
Bhammar, Sawyer, Tucker, & Gaesser (2017)	Aimed to examine the effects of interrupting prolonged sitting with activity breaks (2-minutes moderate walking, 2-minutes vigorous activity, 30-minutes moderate walking) on glucose and blood pressure scores.	Compared with the continuous sitting condition, glucose levels were lower in the activity conditions, with 30-minutes moderate walking having the greatest effect.
Biswas et al (2015)	Systematic review and meta-analysis examining the associations between SB and hospitalisations, all-cause mortality, CVD, diabetes and cancer in adults independent of PA.	Forty-seven studies met eligibility criteria for the review. The majority of the studies were cohort studies with self-report measures of SB. Significant hazard ratio (HR) associations were found with all-cause mortality (HR, 1.240), CVD mortality (HR, 1.179), CVD incidence (HR, 1.143), cancer mortality (HR, 1.173), cancer incidence (HR, 1.130) and type II diabetes incidence (HR, 1.910)
Chau et al (2013)	Meta-analysis aiming to quantify the association between daily sitting time and all-cause mortality risk.	Six studies were included in the analysis, involving data from over 590,000 participants. The model estimated a 34% higher mortality risk for adults sitting 10 hours/day, after taking PA into account. With every additional daily hour of sitting being associated with a 2% increased risk of all-cause mortality.
Chau et al (2015)	The objective of the study was to examine the prospective associations of total sitting time, TV-viewing, and occupational sitting with mortality from all causes and cardiometabolic diseases. Data from over 50,000 participants who had completed the Nord-Trøndelag Health Study 3 (HUNT3) in 2006–2008 was linked with the Norwegian death registry.	After mean follow-up of 3.3 years HR's for all-cause mortality were found 1.12, 1.18, and 1.65 for total sitting time 4-<7, 7-<10, and >10-hours/day, respectively, relative to <4-hours day. A similar pattern was found between sitting time and cardiometabolic disease mortality. These results suggest that total sitting time is associated with all-cause mortality and cardiometabolic disease related mortality, meaning adults should be encouraged to sit less throughout the day.
Duvivier et al (2017)	A randomised crossover study examining the impact of three regimes (sitting -14-hours sitting; exercise - 1-hour of cycling; sit less - replace	The incremental area under the curve for 24-hour glucose was significantly lower during the sit less intervention than sitting, and was similar between the sit less and exercise regimes. Exercise

	sitting with standing/walking) upon glucose levels and insulin resistance in diabetic participants.	failed to reduce insulin resistance compared with sitting, however sit less did significantly reduce insulin resistance compared to sitting. The results suggest that breaking up sitting with standing and light-intensity activity may be an alternative to structured exercise to promote glycaemic control.
Greer, Sui, Maslow, Greer & Blair (2015)	This prospective study examined the relationship between SB and incidence of metabolic syndrome, whilst considering the effects of PA and cardiorespiratory fitness.	A total of 930 men enrolled in the trial, with an average follow-up period of 9.6 years, with 124 men developing metabolic syndrome. After adjusting for covariates, men with middle (65%) and high (76%) SB had higher risk of metabolic syndrome than men with low SB. The findings highlight the need to reduce SB as well as increasing PA, and improving cardiorespiratory fitness for preventing metabolic syndrome.
Johnsson, Broberg, Johnsson, Tornberg, & Olsson (2017)	The study investigated the link between sedentary occupations and the risk of breast cancer in pre- and postmenopausal women.	Participants (n=29,524) were classified dependent upon the level of activity within their job. Women with a working history of occupational sedentariness had a significantly increased risk of breast cancer (HR 1.20) compared to those reporting mixed or non-sedentary occupations.
Kilpatrick, Sanderson, Blizzard, Teale, & Venn (2013)	A survey was used to examine the association between occupational sitting and psychological distress in working adults, independent of PA.	Compared to those sitting less than 3 hours/working day, men sitting greater than 6 hours/working day had increased prevalence of moderate psychological distress. Women sitting more than 6 hours/working day had increased prevalence of moderate and high psychological distress. These results suggest that reducing occupational sitting could lead to mental health benefits.
Lynch (2010)	A systematic review evaluated the research on SB and different cancers.	The review identified 18 articles that examined SB and cancer risk. Ten of the papers found a significantly positive association between SB and cancer outcomes, including; increased colorectal, endometrial, ovarian, and prostate cancer risk; cancer mortality on women; and weight gain in colorectal cancer survivors.
Teychenne, Ball, & Salmon (2010)	This study examined the associations between PA, SB and the risk of depression in women from disadvantaged neighbourhoods.	Over 3,500 women completed a survey, self-reporting their PA, SB and depressive symptoms. Women that reported greater sitting time had higher odds of risk of depression compared to those reporting low levels of sitting. This highlights that reducing SB could promote better mental health in women.

Wilmot et al (2012)	A systematic review and meta-analysis was conducted to examine the association of SB with diabetes, CVD, cardiovascular and all-cause mortality.	Eighteen studies were included in the review (n=794,577), 15 of these were of moderate to high quality. The greatest SB time compared with the lowest was associated with a 112% increased risk of diabetes, a 147% increase in cardiovascular event, a 90% risk of cardiovascular mortality and a 49% increase in the risk of all-cause mortality. SB is associated with and increased risk of diabetes, CVD, and cardiovascular and all-cause mortality.
Zhai, Zhang, & Zhang (2015)	A meta-analysis was conducted to quantitatively summarise the evidence that has linked SB with depression.	The meta-analysis included 13 cross-sectional and 11 longitudinal studies. For all included studies the RR of depression for the highest versus non-occasional/occasional SB was 1.25 for all included studies. The analysis indicates that SB is associated with an increased risk of depression.

Appendix 2.1 Interventions retrieved from the systematic search that aimed to reduce workplace sedentary behaviour.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
1. Aittasalo et al. (2017)	The study aimed to support small and medium-sized workplaces to plan and implement a multilevel intervention to increase PA and reduce SB among employees.	Three to five small (<50 employees) and medium (50-249 employees) businesses were recruited in Finland through the collaborating regional sports federation. Workplaces paid a participation fee of 2000 or 3000 euros to cover the cost of implementing the intervention. Twelve workplaces agreed to participate in the study, with a total of 396 employees across the 12 workplaces. At baseline 295 completed the questionnaire and	The intervention was called 'Moving to Business' (MTB) and based on the social ecological model. Each workplace nominated an internal MTB team to implement the intervention in their workplace, which was supported by the MTB regional contact. MTB teams initially met to discuss the needs of the organisation in promoting PA and reducing SB, and to set goals and action plan based on baseline measures. The MTB teams were provided with support and tools to implement their actions, including; 4-hour training session on health promotion, personal support from regional contacts, and employees were offered a workshop on	Baseline measures were completed in November 2013 and then baseline measures were repeated one year after baseline (November 2014). Questionnaires were completed by participants at baselines and follow-up looking at; demographics, work, work ability, work engagement and recovery, PA, SB (workforce sitting questionnaire; Chau et al, 2011), perceived health, smoking, and sleep. Hip-worn accelerometers (Hookie, AM13) were worn to measure PA and SB. Participants were asked to wear them during waking hours for seven consecutive days. Feedback was provided to participants after baseline and follow-up. Participants were also asked to keep a diary of their	Self-reported and objectively measured SB (-44 minutes) decreased at work and minutes spent in total and light-intensity PA at work increased. No significant differences in PA or SB were observed between organisations that implemented more or fewer actions, or between organisations implementing actions at all three levels. On average 6.8 actions were implemented per organisation. This finding contradicts findings from other research that favour multilevel approaches to workplace changes. Employees appeared to compensate their PA at work with a decrease in leisure PA. This study benefitted from a diverse number of workplaces which allowed organisations to plan and implement their own actions and was conducted in a

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		266 had valid accelerometer data. At 1-year follow-up, 201 completed the questionnaire and 175 had valid accelerometer data. Mean age of 42.6 years (64% female).	reducing SB and a free internet-based platform to monitor their PA. A closing MTB meeting was held between MTB teams to share feedback on implementation and results. The regional contact person reported monthly to MTB coordinators on progress.	working hours and transport mode used. A number of different strategies were implemented by the organisations, including strategies from the organisational, the work unit and individual. No control group included.	real-world setting.
2. Alkhajah et al. (2012)	Pilot study to assess the short (1 week) and medium-term (3 months) changes in objectively measured SB and activity levels in office-based employees with AWS's. Assess the acceptability of changes in health and work-related outcomes.	Desk-based workers aged 20-65 years were recruited from two public health research centres within academic institutions in Australia. The sample consisted of 90% female and 87% Caucasian.	Employees in the intervention condition had Ergotron WorkFit-S workstation fitted to their desks. They received instructions on how to use the AWS and written instructions on correct posture and recommended regular changes. Control; no modification, carried on working the same.	Three different 7-day assessment phases; baseline, 1-week follow-up and 3-month follow-up. ActivPAL's were worn by participants to measure sitting, standing and stepping time, and sit to stand transitions. BMI, weight, height, body composition, waist and hip circumference were measured. Fasting blood lipids and glucose were measured at baseline and 3-months. Self-report data; possible	Sitting reduced in the intervention group by more than two hours at both 1-week and 3-month follow-ups. Sitting was primarily replaced with standing. HDL cholesterol increased in the intervention group. Self-report data showed no significant change in health or work outcomes. In the intervention group 94% of participants agreed that the AWS was easy to use at 3-month follow-up. Participants in the intervention group also showed an increase

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				benefits, fatigue, eye strain, work performance, and workstation acceptability.	in the number of sit to stand transitions made each hour at 3-month follow-up.
3. Bouchard et al. (2016)	The purpose of this pilot study was to test if SB would reduce, when office workers were provided with a shared treadmill workstation.	Participants were recruited from a health contact centre in Canada, where the majority of employees were nurses and dieticians. All employees were approached as long as they felt comfortable walking for one hour continuously. Twenty-two participants were recruited (20 female; mean age of 51.2 years), with 13 participants completing follow-up measures.	Four treadmill workstations were purchased to replace fixed sitting height desk and aimed to be shared by up to four employees. Employees were asked to walk for two hours per shift for a three month period. Due to others trying to access the device employees were encouraged to undertake their two hours of walking at one time each day. Participants wore a pedometer every time they used the treadmill workstation to act as a motivator.	Measurements were taken at baseline and three months after the introduction of the workstation. PA was assessed using Actical accelerometers and SB was classified as low intensity. Accelerometers were worn 7-days before introducing the treadmill workstation and during the final week of study. Participants were also asked to record the number of steps completed each time they used the treadmill workstation and mean speed. Oxygen consumption could then be calculated from these measurements. Sleep, dietary intake, fatigue and pain, and interest-expectations were measured using self-report items.	The study demonstrates that a shared treadmill workstation can contribute to reducing time spent at low intensity activity at work. Participants engaged in 20.1% less low intensity activity when sharing a treadmill workstation. Time spent in moderate-to-vigorous activity did not change over the course of the study. The majority reported no problems using the treadmill workstation whilst at work, however there were problems reported in having access to all documents through the network. The daily number of minutes spent of the treadmill workstation was; 80.6 during month one, 96.2 during month 2, and 56.1 at month 3. Time spent using the treadmill workstation significantly

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					reduced during month 3.
4. Brakenridge et al. (2016)	This study aimed to assess the short-term (3-month) effectiveness of two interventions involving organisational changes and activity trackers. The long-term (12-month) effectiveness of these primary outcomes was also evaluated.	An international property and infrastructure group based in Australia were recruited. The company was based across two offices in two different cities. The workplace champion approached team managers to participate in the study. In total 153 participants were recruited at baseline (54% male; 38.9 years old). Eighteen teams were recruited (nine in each condition). A significant number of participants dropped out of the	The intervention was named 'Stand-Up Lendlease'. The intervention had two conditions; organisational support group and organisational support plus activity monitor. The workplace champion for the study was the head of workplace well-being at the company. The workplace champion was responsible for recruitment and delivery of the intervention. Support for the intervention was gained from the CEO of the company and the workplace champion chose which strategies to implement, from a list of strategies which had been implemented as part of the 'Stand-Up Australia' intervention. Week 1, participants	Data was collected at baseline, 3- and 12-months. ActivPAL accelerometer was used to assess participant's activity at the three time points, participants were asked to wear the monitors for seven consecutive days. An online questionnaire was sent after ActivPAL data had been collected to measure health and work outcomes. Work outcomes; job performance scores, job control score, and work satisfaction. Health outcomes; stress score, and physical and mental health quality of life assessment.	At 3-months reductions in sitting or any activity were small (<15 minutes) in both conditions and not statistically significant. However many of the confidence intervals were wide and contained potential meaningful effects. At 12-months changes in sitting were statistically significant with approximately half to three-quarters of an hour reduction in sitting. These reductions appeared primarily through increases in standing. Periods of prolonged sitting also appeared to significantly reduce. When comparing the conditions over the long-term, the organisational plus activity tracker group was significantly more effective than the organisational group at increasing stepping. No significant changes were reported in the work or health

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		study over the 12-month period, due to various reasons, including being unable to provide valid ActivPAL data. Ninety-seven participants were included in the analysis.	received an information booklet via email, providing information on the intervention, the implications of sitting and strategies to reduce sitting. Information on the baseline activity measures were also provided to participants. Five, fortnightly emails were then sent to participants providing activity prompts and comments from participants. Senior executives took part in the study to show the organisations support for the program. Over the 12-month period the workplace champion delivered 10 workplace presentations and had informal chats with team managers about employees SB. Participants were also provided with feedback from the activity monitors at baseline, 3- and 12-		outcomes in either group. Overall this study shows support for an organisational intervention in reducing long-term sitting overall and specifically during working hours.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
			months. Participants in the activity tracker condition also received a LUMOback monitor which is worn as belt and synced with a smartphone. Participants were free to wear them as much or as little as they liked.		
5. Carr, Karvinen, Peavler, Smith, and Cangelosi (2013)	The study aimed to test the effectiveness of a multi-component intervention at reducing sitting time in adults. Secondary aim was to test the effect of the intervention on cardiometabolic markers.	Participants were apparently healthy but inactive (<60mins per week MVPA), overweight (>25BMI) adults working full-time in desk-based jobs. Forty participants completed baseline and follow-up measures. Participants were recruited from a university in the USA.	The intervention was named "Pedal@Work: Reducing time spent sedentary..." The intervention had three components; pedal machine at their worksite, access to a motivational website, and a pedometer. Pedal machines were linked to participant's computers, allowing for objective data to be collected and provided instant feedback to participants. There was no interaction between research staff and	Measures were completed at baseline and then 12 week follow-up, research staff were blinded to participants groups. StepWatch activity monitor objectively measured the primary outcome of SB. StepWatch was worn around the ankle so that it could measure pedalling and walking (more effective than hip-worn accelerometers for pedalling). Worn for seven consecutive days during all waking hours. Body measurements; blood pressure, heart rate, body	Significant increases in moderate activity and reductions in sedentary time (58 min/day) were found in the intervention group at 12 weeks. Waist circumference was the only cardiometabolic risk factor to significantly change. Participants logged onto the website 71.3% of days during the 12 weeks (including weekends). Participants pedalled on average 37.7% of all days that they had access to the machine (31.1 min/day). Pedal machine feedback display, pedometer and self-monitoring activity were rated

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			employees during the study. The motivational website was customised to local culture (i.e. local pictures). Messages included encouraging breaks or pedalling. Messages were based on Social Cognitive Theory; self-monitoring, social support, self-efficacy and perceived environment. Participants were prompted via email to self-monitor and log their daily cycling time and steps on the website. The activity participants logged was also used in a virtual competition between participants. Participants were also emailed theory-based messages and encouraged to set themselves goals, plus had the opportunity to post their achievements in a forum. *Control* - were placed on a	mass, height, waist circumference and fasting blood lipids. Aerobic fitness measured by a submaximal treadmill walking test. Compliance with the pedal machine and website was objectively recorded through each participant's computer. Participants completed a process evaluation survey at 12 weeks rating each part of the intervention on a Likert scale.	as 'extremely helpful' by participants. Email reminders were rated as 'quite helpful'. These findings build on previous research through demonstrating significant reductions in objectively measured SB, suggesting that these reductions can result in improved health benefits independent of PA. Website compliance was high, and compliance with the pedal machine is promising due to them being portable and easier to use than a height-adjustable workstation.

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			12-week waiting list and asked to maintain their usual behaviour.		
6. Carr, Walaska, and Marcus (2012)	Aimed to test the feasibility, acceptability and use of a portable pedal exercise machine, to reduce SB in working adults.	Eighteen healthy adults, in full-time employment, working in desk/computer-dependent job roles were recruited. Recruitment took place in Rhode Island, USA.	Participants were provided with a pedal exercise machine to use for four weeks whilst at work. The pedal machine connected to their computers so that pedal time could be objectively measured and participants received real-time feedback. Participants were only provided with the machine and did not receive any other behavioural intervention.	The study lasted for 4-weeks, with participants having to report for assessments at baseline and 4-week follow-up. Measures that were conducted at each time point were; body mass, height, 7-day PA recall questionnaire (with questions targeting sitting). Participants were also asked to complete a 23-item acceptability/feasibility questionnaire about the pedal machines at the 4-week follow-up.	Participants reported pedalling on 12 out of a possible 20 working days, pedalling an average of 23.4 minutes/day. The number of participants using the machines declined over the four weeks. Participants reported that the pedal machines were 'easy to use', that they would use one in their workplace if offered and they had no effect on work productivity or quality. These findings indicate that a portable pedal machine is a feasible option for reducing SB in the workplace.
7. Chau et al (2014b)	The aim of the study was to examine the effects of AWSs on employees SB at work and outside of work.	Participants were recruited from a non-government health agency in Australia. The study was advertised to staff	This was a pilot RCT named 'Stand@Work'. Participants were randomly drawn from a ballot. The first four were part of the intervention, the following four were part of the control	The intervention lasted for four weeks, with three measurement points; 6-weeks pre intervention, 2-weeks pre intervention and the third week of the intervention. Changes	Objectively measured occupational sitting (-73 minutes/day) and self-reported occupational sitting during working hours significantly reduced in the intervention group. Standing significantly

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		through the workplace wellness programme. All participants worked >3 days per week, >18 years old and spoke English. Forty-two participants were recruited.	condition, and the remaining participants were placed on a waiting list. After the first four weeks, the control group became the intervention group and four more participants were drawn for the control - this process continued with a total of nine groups. Participants received an AWS for four weeks, before installation they received brief training on how to use the desk.	between time one and two were treated as the control condition, and changes between time two and three were treated as the intervention condition. Activity was measured using ActivPAL accelerometers, which were worn for each working day during the measurement periods. An additional questionnaire assessed occupational sitting and PA.	increased during working hours (65 minutes/day). No significant change in stepping was found. This study shows that changing the current working environment can reduce desk-based workers sitting time. There was also a reduction in sitting time over the whole day. Reductions in whole day sitting seem to be due to reductions in TV viewing.
8. Chau et al (2016)	Aimed to explore the impact of AWS's on workplace productivity in a real-world setting. It is an important gap to explore before employers invest in AWS's.	Call centre staff from a large telecommunications company in Australia were recruited. Two teams were recruited; one team was assigned to the intervention condition. Both teams carried out similar duties.	Participants in the intervention condition received an AWS, brief instructions on how to use it and daily reminder emails to stand more during the working day for the first two-weeks after installation of the AWS. Participants in the control condition carried on using their regular desk.	The intervention lasted for 19 weeks, with four measurement points; baseline (pre-installation of AWS), 1-week, 4-week and 19-weeks after installation of AWS. Sitting and PA was measured objectively with an accelerometer (ActivPAL or ActiGraph) during each measurement week. Self-report measures of	A low amount of objectively measured sitting data was collected due to device malfunctions and participants adherence to wearing the monitors. Participants self-reported reducing their workplace sitting time (−64,−74 and−100min per workday at weeks 1, 4, and 19, respectively). The control group showed no significant change across the

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				sitting and PA were collected through an online questionnaire at each measurement point. The Occupational Sitting Physical Activity Questionnaire (OSPAQ) and International Physical Activity Questionnaire (IPAQ) were used to measure workplace sitting and PA respectively. Productivity measures were provided by the company. The productivity indicators used were; call handling time, time spent talking, time spent on hold, time spent wrapping up a call, attendance and sick leave. Subjective productivity was assessed by asking participants about their work-related perceptions, energy and feelings.	measurement points. Reductions in sitting time appeared to be mostly due to increases in standing time. There were no significant changes in productivity indicators within or between groups. There were non-significant trends towards more positive work perceptions in the interventions group which were not evident in the control condition. This study was limited by the small sample size and data lost due to monitor malfunctions and participant non-compliance with wearing the monitors. This may be due to staff not being health or research invested and reflects the real-world setting of the study.
9. Danquah et al. (2017)	A multi-component cluster randomised trial	Participants were recruited from organisations in Denmark and	This multi-component intervention was called 'Take a Stand!' The intervention was based on	The intervention lasted for three months, with measurements taking place at baseline, 1- and 3-months.	Sitting time in the intervention group reduced by 71 minutes/day at 1-month and 48 minutes/day at 3-months. At 1-

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	aimed at reducing sitting among office workers. AWS's are prevalent within Danish workplaces, therefore the study tested whether a multi-component intervention could enhance the use of AWS's.	Greenland. All participants had an AWS. Four workplaces met the inclusion criteria and participated in the study. Nineteen offices in total participated in the intervention, with 297 participants being recruited across the offices.	Social Cognitive Theory and consisted of five components: 1, appointment of ambassadors to encourage social support and management involvement. Managers agreed to act as role models. 2, environmental changes were made and standing height meeting tables were introduced. 3, a 15-minute lecture was held to increase participant's knowledge of SB and health. This information was also communicated in a leaflet. 4, a workshop was held at each workplace and guided participants through four strategies; using an AWS, breaking up prolonged sitting, having standing/walking meetings, and setting common office goals. 5, participants could elect	ActiGraph accelerometers were worn by participants for five days on their thigh. An online questionnaire collected demographic data and information about participant's office environment, working conditions, tenure at workplace, health and illness, health behaviour, education, and motivation for participating in the project. Anthropometric measurements were taken at each measurement points. Measurements taken were; weight, fat mass and body-fat percentage, height, and waist circumference.	month the number of sit-to-stand transitions had increased and periods of prolonged SB had reduced in the intervention condition compared with the control condition. At 3-months these differences were less pronounced.

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			to receive weekly emails or texts to reinforce the strategies discussed in the workshop.		
10. De Cocker, De Bourdeaudhuij, Cardon, and Vandelanotte (2016)	The study aimed to investigate the effect of a theory-driven, web-based, computer-tailored intervention upon workplace sitting.	Two Belgium companies (a university and environmental agency) were recruited through convenience. Both companies had >100 employees and were based over different worksites. At baseline 213 employees completed the questionnaire (31.5% male; 40.3 years old).	The study consisted of three conditions; control, generic advice and computer tailored advice. The web-based intervention (tailored advice) provided participants with personalised feedback on their sitting time including tips and advice on how to interrupt and reduce sitting. The feedback was based on participants responses to questions about; job-related information, knowledge of SB, sitting times in different domains, frequency of interruptions in sitting, and level of PA. Feedback to each participant was then based on responses to these questions. The intervention was based on self-	The study lasted for three months, with measurements at baseline, 1- and 3-months. Activity was measured using a thigh-worn accelerometer (ActivPAL) and provided three full days of data. An online questionnaire assessed a number of variables at each time point. The questionnaire looked at; sociodemographic variables, work-related variables, workforce sitting questionnaire and PA using the IPAQ. Website usage was also collected through Google analytics to determine which sections of the website had been accessed.	Self-reported workplace sitting times significantly reduced in the tailored condition compared to the generic condition and control condition in which sitting times increased over the 3-months. Objective measures of workplace sitting found that there was no significant difference across the 3-months in sitting and standing at work. There was a slight increase in the number of breaks taken at work by participants in the tailored condition. Self-reported reductions in workplace sitting time were -59 minutes and -79 minutes at 1- and 3-months respectively. These results are similar to changes that have been reported when AWS's have been introduced to the

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			determination theory, theory of planned behaviour and self-regulation theory. After receiving this advice participants were given the option to receive further information on five other sections if they were interested. Those employees that were motivated to complete the sections were also invited to create an action plan to convert intentions into specific actions. In the generic advice group participants received information about the importance of reducing SB and tips on how to do this in the workplace. The same topics were covered as in the tailored advice condition, however participants received no feedback.		workplace. This result is promising considering this intervention targeted only an individual change to workplace SB. This study highlights the difference between objective and self-report measures of SB and encourages future studies to use both measures.
11. Donath,	The aim of the	Thirty-eight office	All participants were	The intervention lasted for 12	There was no significant group

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Faude, Schefer, Roth, and Zahner (2015)	study was to assess the impact of daily point of choice prompts to increase standing time in office workers.	workers were recruited from a Swiss health insurance company. All participants had an AWS but had not started using it yet.	provided with an AWS. A three lined pop-up message appeared daily at 10am, 1pm and 3pm to promote standing to work. Participants could immediately clear the prompt from their screen. The control group received no further information.	weeks. Measurements were taken at baseline, 6- and 12-weeks. Sitting and standing was objectively measured using the Actigraph accelerometer, worn on the thigh. Secondary outcomes were; concentration, postural sway and heel raise test to measure plantar flexor strength.	x time interactions for the percentage values of sitting and standing. Prompts appearing three times a day did lead to notable changes in occupational sitting and standing between groups. Half of the intervention group (n=7) achieved more than 60 minutes of daily occupational standing. No significant changes were found in concentration, postural sway or strength. Employing point of choice prompts is a relatively cheaper option to encouraging standing, rather than a larger multi-component intervention.
12. Dutta, Koepp, Stovitz, Levine & Pereira (2014a)	Assessed the effects of using an AWS on reducing SB in the workplace. The effects on perceived energy, fatigue, appetite, productivity and	Participants were recruited from a private company in the USA. Participants were >18 years old, worked >20 hours/week and had to be willing to	Participants were given an AWS (allowed to choose which style would be best for them). They were given a goal of gradually replacing 50% of their sitting time with standing - this goal was sent in an email reminder at	A randomised crossover design was used, lasting for a total of 10 weeks; 4 weeks using an AWS, 2 weeks wash-out, 4 weeks control. Sitting was measured objectively through a thigh worn accelerometer (no published validation studies	The accelerometer data showed that during the control period participants sat for 67% of their work-time sitting, intervention reduced to 46%. Meaning a reduction in sitting of 21% was found during working time and a 14% reduction in overall daily sitting.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
	dietary intake were also examined.	stand for 50% of their working day. In total 28 participants took part in the study (19 female; 40.4 years old).	the start of each week. Control - carried on as normal.	conducted) which was worn on two random days each week. Participants also wore a Gruve, hip-worn accelerometer and sitting and standing time was also self-reported through the OSPAQ. Energy, relaxation measured by ecological momentary assessment at two random times each day. Participants were asked to complete a 24-hour energy intake diary once a week on a random day along with measures of workplace productivity.	Participants reported being more relaxed, calm, energetic and less tired, along with a higher sense of well-being during the intervention. A lower calorie intake was reported during the intervention period, no difference in productivity was found. Participants reported that they enjoyed the flexible nature of the AWS.
13. Evans et al. (2012)	Aimed to test whether prompting software on personal computers, plus education, reduced prolonged periods of SB at work.	Office-based workers from a UK university. Thirty participants were recruited, 11 were excluded for the final analysis due to different reasons.	The education group received a workshop informing them of the negative consequences of prolonged sitting and that standing every 30 minutes might be beneficial. The point of choice group received the same educational workshop, plus had prompting software	The intervention lasted for five working days. Sitting and standing was objectively measured using the ActivPAL accelerometer. Participants were asked to wear them for five days prior to the beginning of the intervention and then a further five days after the workshop to measure the	There were significant between group differences in the total number of sitting events and for the number and duration of prolonged sitting events. Sitting events and duration of events were lower in the point of choice group. There were no objective differences in time spent sitting between groups after the

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
			installed on their computer, which reminded them to stand every 30mins. The reminder could not be closed but participants could work on open screens around it.	effects of the intervention.	intervention.
14. Graves, Murphy, Shepherd, Cabot, and Hopkins (2015)	Aimed to evaluate the changes in workplace sitting following the installation of an AWS.	Office workers from a UK university were recruited. Departments were located across four different locations in different office types (e.g. open plan, individual office). Forty-seven participants were randomised, 44 participants data was analysed at 8-weeks. Participants were primarily white British women educated at the tertiary level.	Participants in the intervention condition were provided with an AWS. They received brief instructions on how to use the AWS and sent a link to the manufacturer's website which had further information on how to use the AWS. Participants were not told how much they should sit or stand and no further behaviour change techniques were delivered. Participants in the control condition were offered the opportunity to have an AWS installed after the eight week period was up.	The intervention lasted for eight weeks. Measurements were taken at baseline, 4- and 8-weeks. Ecological momentary assessment was conducted to measure workplace activity. Employees were asked to keep a diary and record what behaviour (sitting, standing, or walking) they were doing every 15 minutes. Reported behaviours were then multiplied by 15 to determine the amount of time participants spent in a behaviour. Vascular, MSK, blood sampling, work-related and office environmental	At 4- and 8-weeks there were clear reductions in sitting time and increases in standing time reported in the intervention group. A beneficial reduction in total cholesterol was observed and no significant difference in MSK. Participants reported that the AWS was easy and comfortable to use and that their productivity did not reduce whilst using the AWS. This study shows the short-term effectiveness in reducing sitting and feasibility of introducing AWS to the workplace.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
				outcomes were also measured as secondary outcomes.	
15. Gao, Nevala, Cronin, and Finni (2015)	The primary aim of the intervention was to explore the effectiveness of an AWS on occupational sitting time, MSK comfort and workability after a 6-month intervention.	Participants were recruited from a university in Finland and were highly educated office workers. In total 45 individuals were included in the analysis with 24 participants being part of the intervention condition.	Part of the faculty at the university moved to a new office, in which they had access to AWS's.	Baseline and follow-up measures were taken using a questionnaire at 6-months post move. The questionnaire consisted of items concerning computer use, SB, PA level, perceived health and MSK comfort, and self-rated work ability.	In the intervention group it was found that sitting time at work decreased by 6.7% and standing time increased by 11.6% in the intervention group. Both of which were significantly different to the control group at six months. Perceived MSK uncomfortable scores were lower in the intervention condition at six months compared to the control condition. Correlation analysis showed that a reduction in sitting time was associated with increased back comfort. At six months 75% of participants reported that they were satisfied with their AWS and 41% reported using their AWS daily. Only one participant reported not changing the height of their desk during the six months.

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					Adequate prompting might be needed to encourage daily usage of AWS's.
16. Gilson et al. (2016)	The aim of this study was to assess the impact of real time feedback and prompts on reducing workplace SB and increasing PA.	Two work teams were recruited from a telecommunications company in Australia. The two teams were based on different floors. In total 57 participants completed the study (n=46 men; mean age of 47 years).	A seat pad was developed which could be easily fitted to an employee's chair and provide real time feedback and prompts to encourage employees to reduce sitting. The seat pads were fitted to employee's chairs at baseline and remained there for the duration of the study. Following baseline assessments employees attended a one hour workshop in which they discussed the benefits of standing and being active, and strategies that could be used to encourage further workplace activity. The strategies were collated and thematically analysed by two researchers. A final list of strategies was distributed to all	A five month intervention was conducted, with measurements occurring at baseline and then five months. Participants wore a GENEActiv wrist accelerometer to measure SB and PA. They were asked to wear these for one week at baseline and 5-month follow-up. The seat pads provided information on the amount of time employees spent sitting at their desk.	Sitting time decreased by 8% and in the feedback condition and by 2% in the no feedback condition. It is unclear as to whether or not these changes are across the whole day or specific to working time. In total seven strategies were used by the participants. Previous studies have had substantially more options, which may be more beneficial and appealing to a wider number of participants.

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			participants. Following the workshop and distribution of strategies, employees were allocated to either a condition with in which they would receive feedback from the seat pad or no feedback. Participants in the feedback condition received real time prompts encouraging them to break-up sitting.		
17. Gilson et al. (2009)	The study examined the impact that two different walking strategies had upon increasing steps and reducing sitting time.	White-collar university staff were recruited from universities in the UK, Spain and Australia. A final sample of 179 participants was analysed, 35 removed due to incomplete data (141 female).	Participants were allocated to either an intervention group or a control wait-list. Participants in the first intervention group were told to increase their steps through brisk walking, during their work breaks along designated routes. The second intervention group were told to increase their steps through incidental walking in line with their work-based tasks. Participants were	The intervention lasted for 10 weeks. Steps were measured using the pedometer at baseline and then again at 10 weeks. Measurements were taken from pedometer readings from five consecutive work days. Participants received pedometers to record how many steps they completed at baseline and they kept the pedometers for the remainder of the study.	Both intervention groups showed an increase in the number of steps taken per day (+986 steps route group; +699 incidental group). Increase in steps was greatest in those participants that were the least active. There was no significant change in reported sitting time in either group. Although both conditions increased in the number of steps per day, the average began to tail-off towards the end of the 10

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
			encouraged to use their pedometers as a motivational tool and aimed to achieve >10,000 steps a day. Weekly emails were sent out encouraging goals and providing strategies on how to do this. Route-based participants also received maps and directions of routes that they could take to gain the amount of steps.	Participants also kept log books in which they recorded how long the sat for in the morning and afternoon whilst at work.	weeks, particularly in the route group. Participants walked the most at week 1 in the route group, possible highlighting that participants were attracted to a new idea.
18. Gilson, Suppini, Ryde, Brown, and Brown (2012)	The aim was to assess the impact of an AWS 'hot-desk' in an open plan office.	Employees working in an office in Australia were approached to participate in the study. In total 11 employees participated.	Following a briefing on the study and the benefits of standing, four AWS's were installed into the centre of the open plan office. Participants could use any desk in the office.	The study lasted two weeks; one week baseline, one week intervention. Activity was measured using an armband accelerometer (SenseWear). This monitored energy expenditure, with SB being set at <1.6METs.	During the intervention one participant did not use the AWS at all, three used it every day. No significant difference was found between the baseline and intervention, possible due to the accelerometer used. Low uptake of the AWS maybe due to participants not being sure how to use the desk (no education given).
19. Gorman et al. (2013)	Aimed to evaluate changes in	Participants were recruited from an	In this naturalistic study participants moved to an	There were two measurement points' pre and	Post-move a significant increase in standing was found

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
	workplace activity and sitting time, as well as health and work related outcomes, in office-based workers before and after a transition from a conventional workplace to an 'activity-permissive' workplace.	academic research centre. In total 27 participants data was analysed.	activity-permissive office which had been purposely built. Features of the building included; glass enclosed stairwells, AWS's, and standing meeting rooms. No education given, however research on the consequences of SB was just emerging and participants may have been aware of it through their research areas.	post move - at least four months apart. ActivPAL accelerometers were used to objectively measure activity for seven days at each measurement point. Height and weight measured, fasting blood samples, work performance and job satisfaction self-reported.	(18.5 minutes). Standing appeared to replace sitting, but changes in sitting time was found to be non-significant. Considering the building was designed to be 'activity-permissive' there was found to be no significant change in stepping time. This highlights that further behaviour change techniques are required to encourage employees to use the facilities and move more.
20. Green, Sigurdsson, and Wilder (2016)	The purpose of this study was to evaluate the effect of three behaviour interventions to reduced prolonged bouts of sitting in office workers.	Three female office workers were recruited from a university in the USA. They were all employed full-time and primarily desk-based. They did not work together.	The three behaviour interventions were delivered to participants in stages. The first stage was the information stage in which participants were informed of the negative consequences of SB and encouraged to take two minute breaks every 30 minutes. During the tactile prompt phase, participants were told to wear a watch which	ActiGraph accelerometer was used to measure activity. The dependent variable for the study was bouts of sitting longer than 30 minutes (a 61 minute bout of sitting would be classed as two prolonged bouts).	Overall the tactile prompt plus feedback and goal setting was most effective at reducing bouts of sitting. The number of bouts per day reduced by about 40%. Bouts of over 60 minutes were also found to reduce during this phase. Participants reported following the study that all devices were comfortable to wear, motivated them to stand and did not influence productivity.

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			vibrated every 30 minutes and they were told they should stand when it vibrates. The reminder was independent of activity and participants were asked to wear this each day. The third phase consisted of the tactile prompt, feedback and goal setting. At the beginning of this phase participants were provided with feedback on the number of bouts they engaged in and told to make a goal to reduce that for the next working day. Each day following they received feedback on the number of bouts they had engaged in via email and asked to set a new goal.		
21. Healy et al (2013)	Aimed to assess the short-term efficacy of an intervention integrating individual,	An Australian government agency was recruited, which employed 130 employees based over two	The intervention had the key message 'Stand Up, Sit Less, Move More'. Organisational changes began with a researcher led workshop encouraging	The intervention lasted for four weeks. Activity was measured at baseline and 4-week follow-up using an ActivPAL accelerometer.	Participants in the intervention condition significantly increased standing (127 minutes) and reduced sitting (125 minutes) in comparison to the control condition.

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	environmental and organisational changes to reduce occupational sitting.	open plan offices. Allocation to the intervention condition was based upon which floor an employee was based on. Each condition recruited 20 participants.	management participation and generating ideas for organisation specific ideas to be more active. The research team then led a workshop with all participants discussing the negative consequences of SB and the strategies to reduce SB. Participants were provided with AWS's for the four week intervention and given instructions on how to use the AWS. Individually each participant received a face-to-face consultation and three follow-up telephone calls. These sessions emphasised goal setting, self-monitoring and prompts to reduce workplace SB.	Anthropometric measurements and fasting blood samples were also taken at both measurement points.	These changes appeared to occur without influencing workplace productivity or MSK discomfort. There was no significant difference in stepping and participants found it hard to enforce the 'Move More' message. The findings of this short-term study are promising however it is unclear as to which component of the intervention influences activity most effectively.
22. Healy et al (2016)	The study aimed to overcome previous limitations that	Participants were recruited from an Australian government	'Stand-Up Victoria was a multi-component intervention targeting; organisational,	The individual and organisational elements lasted for 3-months, the whole study lasted 12-	Significant intervention effects for the activity outcomes were found favouring the intervention group at both time

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
	have been reported in multi-component interventions by assessing the impact of a multi-component intervention in reducing workplace SB over 12 months.	organisation. Different sites were identified and teams were identified to participate at each site. Fourteen sites were recruited, seven randomised to each condition. In total 231 participants completed baseline measurements (68% female).	environmental and individual elements. It was based on SCT; self-efficacy, outcome expectations and sociostructural factors. Organisational - senior management consultation, representative's consultation workshop and participant information and brainstorming session. Ongoing support through tailored emails from management. Environmental - AWS's for 12-months. Information given on how to use the desk and recommended postures. Individual - face-to-face health coaching session (following AWS installation) and four telephone calls (weeks 2, 4, 8, & 12). Coaches had a psychology background and knowledge of motivational interviewing. Control - usual practice	months, with measurements collected at baseline, 3 and 12-months. Sitting, standing and moving time was measured using ActivPAL accelerometers. Participants wore them for 24 hours on seven consecutive days at each measurement point. Participants also wore the ActiGraph during waking hours and complete daily logs of sleeping and work hours. Anthropometry; waist, hip circumference, fat-mass, weight and height. Cardio-metabolic markers; blood lipids and insulin. Self-report; socio-demographic characteristics, physical health history, PA and sitting, work performance, work history and environment, dietary intake.	points, except for stepping. Participants in the intervention group sat less at 3-months (-99.1 minutes) and 12-months (-45.4 minutes) than the control condition. Significance scores were stronger at 3-months rather than 12-months. This may highlight the need to carry on with the health coaches or another behaviour change technique.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
23. Jancey et al. (2016)	The study looked at the changes in office workers SB and PA following their office being relocated to a new purpose built office building.	The company, based in Australia, employed 80 staff and was responsible for marketing, policy and management of accounts. In total 67 participants were recruited, with 42 completing pre- and post-relocation measurements (64% female; 97% full-time employees).	Pre-relocation, the company was based over two levels and did not have easy access to stairs. The new building had a similar floor space as the old, but was built across one level. The space was open plan and had a number of breakout spaces and centralised facilities for employees to use. Upon entering the building there was clear access to a glass staircase leading to the organisation's office space.	Participants completed an online questionnaire and wore an accelerometer (ActiGraph) for five days. Participants were asked to do this on two occasions (pre- and post-relocation). Both measurement points were timed to not be influenced by pre -move packing or post-move settling in (at least two weeks post-move). The online questionnaire collected demographic data and data on self-reported stair use. Anthropometric measurements were also taken by the research team.	Time spent sitting in the new building significantly decreased (-19.6minutes) and standing significantly increased (22 minutes). There was no change in moderate-to-vigorous physical activity (MVPA). The average length of sedentary bouts significantly increased post-relocation. There was no significant change in reported use of stairs during a working day. Increases in sedentary bouts maybe explained by the relocation allowing teams to be clustered together and desks by windows meaning that employees were less likely to want to get up and move. This provides support for the argument of designing 'inconvenient' offices, in which employees want to move.
24. John et al. (2011)	Examined the influence of	Participants were recruited from an	Participants had a treadmill desk installed at their	The study lasted for nine months.	Time spent sitting decreased and steps significantly

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
	treadmill workstations on PA and physiological variables in overweight and obese office workers.	American university. Twelve employees were recruited, aged 20-65 years old and BMI >28.	workstation, which allowed them to walk or sit whilst working. No recommendations on speed or time spent walking were given.	Measurements were taken at baseline, 3- and 9-months. Activity was measured using ActivPAL accelerometers. Participants wore them for two working days at each measurement point. Anthropometric measures; height, weight, hip and waist measurements. Resting heart rate, blood pressure, body composition, fasting blood lipids and glucose were all measured. Participants were asked to complete a 24 hour dietary recall at each measurement point.	increased between baseline, 3- and 9-months. Standing also increased between baseline and 9-months. No significant differences were found between body weight and BMI. Reductions in hip and waist measurements were also recorded, along with improvements in lipid and metabolic profiles. Improvements in sitting and standing times were larger at 3-months rather than 9-months.
25. Koepp et al. (2013)	Examining whether changing a person's desk on its own is sufficient to increase daily PA and reduce SB.	An educational credit management corporation was recruited from the USA. All employees had desk-based sedentary jobs. In total 36 participants were	Participants were provided with a treadmill desk in place of their usual workstation. It was not reported that participants were provided with any further information. Participants started the study at two different time points, May and November.	The study lasted for 12-months; a two week baseline preceded the intervention. Measurements were conducted at baseline, 6- and 12-months. SB and PA monitored through hip-worn accelerometer (Actical), 7-days a week for the whole	Daily SB decreased by 91min/day at 6 months, then 43min/day at 12 months compared to baseline. Increases in daily PA were predominately found to occur during working hours. Baseline PA was higher in participants starting in May than November.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
		recruited.		year. Blood samples, blood pressure, lying, sitting and walking energy expenditure were assessed at the measurement points. Workplace performance was assessed by employees and their supervisors. Surveys were administered weekly and a more detailed one every 3-months.	There was modest weight loss over the intervention period; obese participants lost more than lean participants. HDL increased over the year for all participants. No change in work performance was reported by employees or supervisors.
26. MacEwen, Saunders, MacDonald, and Burr (2017)	The study investigates the impact of AWSs on markers of cardiometabolic risk in office workers with abdominal obesity.	Participants were recruited from different employers working in a town in Canada, through posters and word-of-mouth. Participants had a waist circumference greater than 88cm for women and 102cm for men. In total 28 participants were recruited (23 female) with 25	Participants in the intervention condition received an AWS. They were not provided with any further information or prompts, both groups were told to sit and stand as much as they liked.	The study lasted for 12-weeks, with measurements collected at baseline and 12-weeks. Activity was monitored using an ActivPAL accelerometer. Blood samples were collected to test cholesterol levels and a VO_{2max} test was conducted at both measurement points.	The intervention group experienced significant reductions in workday sitting (-158 minutes) and total sitting time (-117 minutes), as well as increases in workday standing (147 minutes). Participants in the intervention group also increased the number of transitions between sitting and standing more during the working day. No significant changes in cardiometabolic markers were observed between groups.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
		participants data being analysed. The mean BMI of the sample was 35.8 kg/m^2.			
27. Mackenzie, Goyder, and Eves (2015)	This study assessed the acceptability and feasibility of a trial to reduce daily sitting time in the workplace.	Participants were recruited from a public health department based within a UK university.	A formative workshop was conducted with participants to provide information on the associations between health and SB, and then strategies to reduce workplace sitting were explored. The socio-ecological model was used to support the development of the intervention. The content of the intervention consisted of individual, social, organisation and environmental levels of influence. Included strategies from the workshop were; weekly emails from management with standing tips, workplace champions,	The study lasted for five weeks, with measurements being taken in the first and last week. Measures were collected via online questionnaire. At baseline, demographic and lifestyle data was collected and participants were asked to complete the IPAQ. Sitting was assessed using a 7-day sitting log which participants were asked to complete at both time points. At week five, awareness of the various elements of the intervention was assessed through a questionnaire. Qualitative data was also collected exploring the acceptability and feasibility of the study.	Participants reported a reduction in workplace sitting time post-intervention (-26 minutes). Sitting was also reported to be lower in the morning rather than the afternoon. The study had not been sufficiently powered to detect a statistically significant effect. The intervention as a whole was well received and there were different levels of awareness for different elements of the intervention. Participants felt that the intervention had a positive impact on the workplace. Participants also talked about improvements in productivity and reductions in stress during the intervention period.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
			lunchtime walks, management leading by example, point-of-choice prompts.		
28. McGuckin, Sealey & Barnett (2017)	The aim of the study was to evaluate the effectiveness of a theory-informed, multi-component intervention, personalised intervention to reduce workplace SB in office workers.	Participants were recruited from a university in Australia. Participants worked full-time in an office environment and did not perform any teaching duties.	Baseline measures of activity were taken, and then each participant received a one-to-one consultation with the lead researcher. In the session participants received generic information about SB and a sample of their activity data from baseline measurements. They were then asked to come up with six goals to reduce their workplace SB, which they would introduce one at a time each week. In addition to the goals participants were asked to sign a self-contract which indicated that they would achieve their goals during the intervention period. During the 6-week intervention period,	The intervention lasted for 6-weeks, with the participants wearing an ActivPAL at baseline and during week 6. Follow-up interviews were also conducted with participants exploring their motives for participation and feasibility of the study.	In total 38 participants completed the intervention, but only 27 had sufficient data to be included in the trial (23 females). The objective data showed that there was a reduction in sitting of 45.2 minutes post-intervention. Even when controlling for the participants that had access to AWS's (n=6), there still remained a significant difference. An intervention with individualised consultations with strategies including goal setting, the provision of information, self-commitment, and self-monitoring, resulted in a significant reduction in workplace SB.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
			participants received a weekly phone call, email or personal visit from the lead research to ask if they were achieving their goals or not. Further support was offered if the participant was unsure of their goals.		
29. Neuhaus, Healy, Dunstan, Owen, & Eakin (2014b)	Aim of the study was to compare objectively measured workplace sitting time following a multi-component intervention, versus the installation of AWS's alone.	Full-time office workers from three different departments within an Australian university were recruited. Each department was randomised to a condition. In total 44 participants were recruited. There were no males in the multi-component group, but seven males participated in other conditions.	"Stand Up UQ" The intervention was based on social cognitive theory; self-efficacy, outcome expectancies and sociostructural factors. There were three groups; control, AWS only and multi-component intervention group. The overall message for the multi-component intervention group was 'Stand Up, Sit Less, Move More'. Organisational level; consultation with managers, all staff information sessions (does not specify if the health consequences of sitting	The intervention lasted for three months. Activity was measured using ActivPAL accelerometers, which were worn for seven consecutive days at baseline and 3-months. The online questionnaire measured; demographics, work-related performance, absenteeism, MSK and adverse events. Questions were also asked about the acceptability and feasibility of the intervention at 3-months.	The multi-component group showed a significant overall reduction in sitting of 89 minutes compared to the control group, and almost an hour compared to the workstation only group. Within groups there was a 94 minutes change in the multi-component group. Standing time increased by 93 minutes in the multi-component group. Acceptability and feasibility was high in both of the workstation and multi-component groups and the emails were rated as useful in the multi-component condition. Reductions in sitting were not as large as the results found by

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
			were discussed), fortnightly emails were sent from managers to staff encouraging them to participate. Environmental; participants received an AWS. Individual; face-to-face coaching, self-monitoring tool and information booklet. Goals were developed from the coaching.		Healy and colleagues (2013) in a similar study. This may be due to the fact that the participants not being from a health organisation, meaning they had less awareness and education of the issue of SB.
30. Parry, Straker, Gilson, and Smith (2013)	Aimed to see if a participatory workplace programmes could reduce SB, increase break frequency, light activity and MVPA on work days and during working hours.	Participants reported being office bound for more than six hours per day and worked four or more days a week. Recruited from three large government organisations in Australia; data management, call centre, data processing. All had	Three different intervention conditions were developed, with each organisation being allocated to one condition. Intervention A - active office work. Aimed to modify the way office workers completed their tasks. Had access to AWS. Intervention B - encouraged traditional PA during the working day and active travel. Participants were provided with a pedometer.	The study lasted for12-weeks. Activity was measured using ActiGraph accelerometers, worn for seven days around the time of the first meeting and then for another seven days during the last 2-3 weeks of the intervention.	All interventions showed significant reductions in SB in office workers and a concurrent increase in light intensity activity. There was an increased break rate during working hours. Intervention effects were greatest in intervention A, which may be due to participants reporting the greatest work autonomy. However there was no significant difference between the effectiveness of the

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
		different breaks/flexibility of working. In total 62 participants were recruited.	Intervention C - office ergonomics. Focused on active computer sitting and breaking up computer tasks. Two structured meetings were held before each intervention for workers to help with the development of the interventions.		interventions.
31. Pedersen, Cooley, and Mainsbridge (2014)	The purpose of the study was to increase workday energy expenditure by interrupting periods of prolonged sitting with short-bursts of PA.	Desk-based employees from Police and Emergency management (Australia) working across eight different worksites. In total 29 participants were recruited (24 female).	Participants were provided with a health software program (Exertime) which was designed to encourage breaks, after long periods of prolonged sitting. Before the study began participants took part in an educational induction, providing information on the negative consequences of SB, strategies to increase activity in the workplace and instructions on how to use the software. All participants attended the induction before randomisation.	The study lasted for 13 weeks, with measurements taken pre- and post-intervention. At each time point participants had their blood pressure assessed and completed questionnaires on the health and activity. Energy expenditure was measured using an adapted version of OSPAQ; there were four categories of activity (sitting, standing, walking and heavy labour).	The intervention group significantly increased their energy expenditure between pre and post-test, whereas the control group decreased their energy expenditure. Both groups did report a reduction in sitting time - this could be due to education from the introduction session or social factors influencing employee's behaviour. As the control group showed a decrease in energy expenditure, this may highlight that education on its own is not enough.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
			After 45 minutes a prompt would appear on the screen encouraging participants to take a break and offer a suggestion of an activity to do. Participants would have 30 seconds to engage with the prompt or postpone the prompt otherwise it would automatically engage. Participants recorded their activity and level of engagement. The control group carried on as normal.		
32. Pesola et al (2017)	The study aimed to reduce workplace and leisure time SB in office workers with young children. As well as to increase their non-exercise PA and their child's PA.	Participants were recruited from primary schools and kindergartens in Finland. Participants worked in sedentary job roles.	The intervention consisted of a lecture, face-to-face discussion including goal setting, and phone counselling (each parent separately). The lecture was designed to give participants information on the health hazards of prolonged sitting and challenges of reducing sitting. Phone calls were	The study lasted for 12-months with activity being measured at baseline, 3, 6, 9, and 12-months. Activity was measured using a wrist worn accelerometer. Cardio-metabolic measures were also taken including; health markers, energy intake, and diet disposition.	At 12-months 117 participants (n=62 intervention condition) completed the measurement points in the study. No significant changes in workplace SB were observed at any of the measurement points. There was a significant reduction in leisure time SB of 21 minutes.

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			conducted at 2- and 5-months following the initial sessions to promote compliance with their goals.		
33. Pronk, Katz, Lowry, and Payfer (2012)	The study had two objectives; to study the effect of an AWS on time spent sitting at work and assess the effects of reduced sitting on selected health outcomes, mood states and indices of work performance.	Participants were recruited from a health promotion department in the USA. In total 34 participants were recruited (24 intervention). At baseline participants rated their health as good to excellent, were physically active, reported good or excellent cardiorespiratory fitness, were normal weight and reported no major limitations on work performance because of physical or emotional health	AWS's were installed for the intervention group only during the four week intervention period. Participants were given no other behaviour change techniques or information.	The study lasted for seven weeks; 1 week baseline, 4 weeks intervention, 2 weeks follow-up. Activity was measured throughout the 7 weeks through experience-sampling methodology (ESM). Participants were given pre-paid mobile phones and received text messages at three random time points during the working day asking if they were sitting, standing or walking. Self-report measures were collected at baseline, week 5 and the end of week 7. Questions included participant's demographics, self-perceived health status, problems with physical and emotional issues at work. Participants also estimated	The intervention groups sitting time reduced by 224% during period 2 compared to period 1, based on the ESM scores. Self-reported sitting time reduced by 66 minutes between period 1 and 2 in the intervention group. The intervention group also reported improvements in neck pain and mood states during period 2. The removal of the AWS's largely negated all observed improvements within a 2-week period.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
		concerns.		time spent sitting at work, lower back pain and profile of mood states.	
34. Puig-Ribera et al. (2015)	The study aimed to evaluate the effectiveness of a workplace programme aimed at reducing sitting and increasing steps.	Participants were administrative and academic staff working at six campuses in four Spanish universities. Participants that reported low to moderate levels of PA were recruited. In total 264 workers were recruited, with 237 participants completing the study.	'Walk@WorkSpain' is a 'sit less, move more' office-based intervention. The web-based intervention focused on decreasing occupational sitting time through incidental walking and short walks during the working day. Each participant was provided with a pedometer. Weeks 1-8 were the 'ramping up' phase in which participants were encouraged to increase their workplace activity. Every two weeks participants were challenged to up there steps by 1,000 to 3,000 a day. Strategies to achieve these goals initially focused on breaking occupational	The study lasted for 22 weeks. Participants were asked to log their daily step count and self-reported occupational sitting time for five working days at baseline and then for the remaining weeks. Body measurements and blood pressure were taken at baseline and in the final week of each stage.	Participants in the intervention condition reduced workplace sitting time after 8- and 22-weeks by 22 minutes per working day. Steps also increased in the intervention group by 1,400 steps per day, whereas the control group's steps decreased. Participants in the intervention group significantly reduced their waist circumference across the time points. Evidence suggests that increasing step counts will have a bigger impact on reducing waist circumference, than solely reducing sitting time.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
			sitting, leading up to longer walks. Maps were provided of walking routes during the initial eight weeks and later participants were informed of the benefits of walking faster. Weeks 9-19 were the maintenance phase in which participants received automated emails encouraging sustaining sitting reductions and step counts. Participants were asked to set goals every two weeks, monitor achievements of goals by logging daily step counts, sharing experiences to promote social support, increased awareness of the benefits of 10,000 steps, and increase self-efficacy by suggesting feasible strategies to move more.		
35. Swartz et al. (2014)	The objective of this study was to	Full-time clerical staff were recruited	The intervention aimed to disrupt 60 continuous	Baseline measurements and intervention measurements	All participants significantly reduced sitting by 5% (18

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
	assess SB and PA in response to a workplace intervention to disrupt prolonged sitting time.	from a university in the USA. Participants reported sitting for more than 60% of their working day. In total 60 participants completed the study, average BMI of 28.5, 68% women.	minutes of SB with 5 minute break. Two intervention groups; step group in which participants were asked to walk 100 steps when they received the prompt. The stand group were asked to stand when they received the prompt. Both groups wore a wrist-worn prompt which vibrated and had software installed on their computer. The step group were also given a pedometer to help facilitate reaching their goal.	were completed over two consecutive weeks. Each period required the participant to wear an ActivPAL for three consecutive working days. Pre-intervention, participant's height and weight were measured, plus they completed the health history questionnaire. Participants completed a paper diary of when they wore the monitors.	minutes). Stand participants reduced sitting by 6.6%, whereas the Step participants showed no significant change in sitting time. The average duration of sitting bouts reduced by 19% among Step participants and 16% among Stand participants. Sitting bouts of longer than 60mins decreased by 54% in the Stand group and 36% in the Step group. Standing significant increased for the Stand group by 23% but not for the Step group. Results show that the aim of the message influences the behaviour that will be changed, e.g. when the step message was received PA increased. Meaning a single message cannot influence SB and PA, and future interventions should target a particular behaviour.
36. Torbeyns, de Gues, bailey, Decroix, &	The aim of the study was to investigate the	Participants were recruited from a human resources	During the intervention participants received a bike desk and were instructed to	Participants had the bike desks for 20 weeks. Measurements were taken at	Participants had an average cycle time of 98.1 minutes/week, covered

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
Meeusen (2017)	use of a bike desk in an office and participants experiences of using the bike desk.	company in Belgium. Participants were required to sit for longer than 75% of their working day and to participate in a maximum of 2.5 hours PA each week. In total 19 participants completed the study (2 male; 39.9 years old).	cycle for 8x25 minute sessions a week. Participants could accumulate the bouts in 4x50 minute sessions if they wished. Every four weeks participants received information about the amount of time and distance they had accumulated during this period.	baseline and 20-weeks. Demographic information, body measurements and VO_{2peak} were measured at both measurement points. Cycle time, distance and cycling intensity was recorded each week of the intervention. At the end of the study participants were asked about their experiences of using the bike desk.	27.3km/week, and had an average power output of 55.8 Watts/week. Cycle times and distances were significantly longer at the start of the intervention (weeks 1-4) than the later weeks of the intervention. The majority of participants responded positively about their bike and desks and said they would maintain using one. A third of participants reported a positive effect on their work outcomes such as attention and work performance.
37. Urda, Lynn, Gorman, and Larouere (2016)	The objective of the study was to determine whether a prompted alert to get up and move once an hour while at work would reduce workplace SB, increase standing transitions and	Female administrative employees working at a university in the USA were recruited. In total 44 participants completed the study.	During the second week of the study participants in the intervention condition received an alert every hour during the working day to disrupt occupational sitting by engaging in light PA. The alert was audible and sent through the universities scheduling system, with participants	The study lasted for two consecutive weeks. Participants were asked to wear ActivPAL accelerometers for the duration of the study. Week 1 was the baseline measurement and participants were asked to carry on as normal. The perceived wellness questionnaire was completed	No significant effect was found within or between groups for sitting time and number of sitting transitions. There was an increase in perceived wellness scores within groups for both the intervention and control groups. Anecdotally participants reported that they became aware of their sitting time

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
	improve perceived wellness in women with sedentary jobs.		receiving a text message alert. The alert was received on the hour, regardless of when participant's last break was. A hand-out was given to participants with suggestions for light PA and information on the risks of prolonged SB.	by participants at on the first day, end of week 1 and end of week 2.	during the baseline week, meaning they stood more at baseline. Different measures of SB and a longer follow-up period may provide more information on the effects of prompts to reduce SB.
38. Verweij, Proper, Weel, Hulshof, and van Mechelen (2012)	The study evaluated the effectiveness of draft workplace guidelines that were developed to reduce SB, increase PA and increase fruit consumption.	Participants were recruited from different work organisations in the Netherlands. Occupational physicians (OP's) were used to recruit organisations. In the Netherlands OP's assist employees in improving working conditions and preventing sick leave at work. There were seven OP's in the	OP's in the control group provided care as usual. OP's in the intervention group provided care based on the guidelines that were developed. Guidelines were based around three points; prevention at the environmental level (advice for employer), prevention at the individual level (advice for employee), and evaluation and maintenance of previously mentioned sections. OP's discussed environmental issues with	The intervention lasted for six months. Employee's measurements were taken at baseline and six months by their OP. Questionnaires measured dietary behaviour, PA and SB. Body measurements were also taken by the OP.	The intervention significantly reduced sitting time during working hours, in the intervention group. There was a slight reduction in sitting time over the whole day, but this was not significant. No significant effects were found for PA or snacking/fruit intake. This may highlight that SB is an easier behaviour for OP's to target changing within the workplace, if employees do not have the time or facilities to change their PA or dietary behaviours.

Author (Year)	Aim	Sample	Intervention	Study Duration / Measures	Results / Discussion
		intervention group and nine in the control group. In total the OP's recruited 524 employee's across both conditions.	the employee's (e.g. showers, bikes). OP's provided brief motivational interview counselling in five 20-30 minutes sessions over 6 months. Not all employees attended all of these sessions.		
39. Zhu et al (2017)	This study aimed to evaluate workplace SB during a workplace re-design, which included the installation of AWS's.	Worksites within the USA were recruited, including those that were going through a re-design with the introduction of AWS's. Staff within the university were recruited as the comparison arm.	Participants in the intervention are received an AWS, as well as access to treadmill workstations in communal areas. Participants received letters of support for standing from their line managers, promotional material was posted in public areas. Staff also received weekly 'e-newsletter' covering information on SB, goal setting, overcoming barriers, and social support. Participants in the control arm received the same promotional information and 'e-newsletter' yet did not receive the AWS.	The information element of the intervention lasted for 4-months, but AWS's were a permanent fixture. Measurements took place at baseline, 4-months, and 18-months. SB was objectively measured using the ActivPAL. Cardio-metabolic measurements were taken including; height, weight, BMI, blood pressure, HDL and LDL cholesterol, triglycerides, glucose and insulin levels. Work productivity was also measured using a self-report questionnaire.	In total 36 participants were analysed at 18 months (24 intervention; 27 female). At 4-months SB had reduced by 56.7 minutes/8-hr working day, and by 52.6 minutes/8-hr working day at 18-months in the intervention group. Cardio-metabolic and work productivity changes were mixed. This intervention supports the short- and long-term effects of the installation of AWS's and accompanied motivational support materials on objectively-measured workplace SB.

Appendix 2.2 Qualitative studies exploring workplace sedentary behaviour

Author (Year)	Aim	Method	Results	Conclusion
Chau et al (2014a)	Aimed to qualitatively assess the acceptability, feasibility and perceptions of using AWS's in office-based Australia employees.	Followed on from the 'Stand@Work' study (Chau et al, 2014b). After trailing an AWS for four weeks, participants were asked to attend focus groups. Nine focus groups were held with between 4-5 participants in each (n=42).	*Motivation for participating in the study & trying out an AWS;* three main themes emerged around motivation to participate. Curiosity about trying the AWS, especially before committing to buying/having one. Interested in the potential health benefits, MSK/posture issues, energy levels and cardiovascular health. The desks were relevant to their area of work also, so they wanted to experience the desks first hand. *General impressions of the AWS;* Surprise and delight - a number of participants discussed how they used the AWS more than they thought they would. Impact on ability to work through increased alertness. Having a choice - participants liked to have the flexibility to be able to sit or stand. *Use of AWS - Sitting vs Standing;* patterns were grouped into three sub-categories; task-based, time-based and no particular routine. Some participants mentioned how they looked to build new habits and progressively began to stand for longer periods. *Barriers to using the AWS in a standing position;* working in an open office and feeling self-conscious, concerned about disrupting others and their privacy. Standing was also seen as a distraction, yet it did lessen over time as employees learnt to adapt to using the desks and working in the environment more. AWS design was also seen as a potential barrier, with participants reporting that the	The AWS's were implemented through a collaborative approach, with managers being responsible for initiating the trial and promoting it to employees. A number of employees participated as they felt that they were helping research within the organisation, as the AWS's may be rolled out across the organisation in the future. It was important for employees to have the choice over whether they sat or stood, and this was encouraged by managers. Guidelines on how much to stand are needed, as employees need more education and information on the issue. A different type of AWS is needed as participants were willing to use an AWS, but not the ones from the present study. Beneficial to carry out these short trial periods with staff before buying them.

Author (Year)	Aim	Method	Results	Conclusion
			unstable work surface impacted upon their work. *Facilitators to using the AWS in a standing position;* supportive work environment, helped to normalise standing at work and prompted others to stand. Perceived health improvements such as; reduced back pain and fatigue, and increased energy levels. *Willingness to continue using AWS;* mixed views in regards to continuing to use the workstations, a lot of participants would have preferred a different model AWS. All negative responses were due to the design of the desk. Some suggested having a standing 'hot-desk' rather than all employees having their own AWS *Changes in sitting and standing behaviours since the trial;* a number of participants mentioned an increase in awareness of their sitting and standing each day and having a greater willingness to stand in meetings and on public transport.	
Cooley, Pedersen, and Mainsbridge (2014)	Evaluation of participant's perceptions and experiences following an e-health workplace intervention (Cooley et al, 2013).	Semi-structured interviews, which were designed around Bronfenbrenner's (1992) social ecological model; micro, meso and exo systems. Macro system was excluded as it	*Microsystem level outcomes;* all participants indicated that the intervention had been beneficial to them on an individual level, as it provided them with an opportunity to engage in healthy behaviours. The opportunity to participate in activity increased freedom and enjoyment. Participants enjoy the autonomy and freedom to participate and to do activities which suited themselves. The intervention increased awareness about prolonged sitting. Although unexpected, participants reported starting to lose weight and change their eating habits. Changes in leisure time activity were also reported, especially TV	There was preliminary evidence to support the notion of reciprocal determinism. Numerous benefits above the physiological indices were reported. Willingness to accept passive prompts or to persevere and adapt to prompts was reported. The uniqueness of activities possible and the ability to receive immediate feedback were leverage points for changes to behaviour.

Author (Year)	Aim	Method	Results	Conclusion
		involves laws and cultural values. Participants were employed in desk-based roles for an Australian police force.	viewing times and smoking. *Mesosystem level outcomes;* changes were identified in both the physical and social environments. Workflow was initially interrupted by the passive prompts and participants were required to adjust how they work. The immediate work colleagues and supervisors noticed a change in workplace climate, and participants reported feeling at ease and able to be away from their desks. There was an increase in communication between participants and non-participants, non-participants also began doing some of the activities. *Exosystem Level Outcomes;* increased awareness of health-related issues for desk-based employees. There was also an increase in perceptions related to organisational concern and willingness to act on health concerns.	The initiation of the health intervention resulted in outcomes at the meso-level as participants perceived that there were changes to their work environment. The activity breaks were successful possibly due to breaks fitting in with work routines and an opportunity for all to participate due to the choice and freedom to choose activities.
De Cocker et al. (2015)	Focus groups were conducted with employees and executives to gain their opinions of occupational SB and potential interventions to reduce SB	Three organisations were randomly selected based on their location (Belgium). Within each organisation 6-10 employees were recruited. Each organisation had a separate focus group (seven in total across the three	*Reflections on occupational sitting;* all focus groups reported that they spent most of their working days sitting. Most participants believed that they did break up their sitting time regularly through completing other task; e.g. printing, coffee, bathroom. Participants had questions about the difference between reducing sitting and interrupting sitting, plus they expressed doubts about prolonged standing. *Acceptability and feasibility of strategies to change occupational sitting;* most of the strategies for change were perceived as useful and acceptable; however barriers were also suggested for each strategy. The first	A lack of knowledge about the negative consequences of SB was found, with a number of participants unsure as to what they should do. They also doubted the health implications of prolonged standing and linked sitting to MSK problems (maybe due to the European focus on ergonomics). Clear evidence based guidelines are needed for employees in Europe to help educate employees and also advise them on what is best to do.

Author (Year)	Aim	Method	Results	Conclusion
	in the workplace.	organisations). The FG's began with the facilitator discussing what is known about the negative consequences of SB. In total 55 full-time employees participated (21 executives, 31 female) and self-reported occupational sitting ranged between 6.2 to 7.3 hours/day.	barrier was the fear of being seen to be unproductive and that they would get a negative reaction if they were not sat at their desk working - however executives did not see this as a problem. Some strategies were seen as impractical, e.g. standing to make phone calls when computers are needed. Suggestions that higher desks would also be needed, yet the cost of AWS's could be a problem. Standing was mentioned as potentially disrupting others or meetings and potentially an awkward situation. Sitting was also mentioned as being habitual. *Intervention delivery, content & implementation;* both employees and executives believed that any intervention should be raising awareness and providing information. Another facilitating factor was providing a reason or alternative to be able to stand, as well as interventions being short and competitive. A change to workplace culture was mentioned by participants. There was disagreement on who should be implementing strategies; executives believed everyone should be making their own choices, whereas employees wanted mandatory strategies.	Future implications; awareness needs to be continually raised due to the habitual nature of sitting, more alternatives to sitting (telling people to stand is not enough), strategies need to be simple and easy to implement (not decreasing productivity and remaining task focused), social support and executives as role models may also help. Employees in favour of top-down interventions.
Dutta, Walton & Pereira (2014b)	The study aimed to understanding experiences of transition from a sitting desk to an AWS.	The study follows on from a 4-week randomised crossover trial conducted in an American company (Dutta et al, 2014).	Overall 96% of participants reported having a positive experience of using the AWS and wanted to continue using their AWS. Participants reported that limited desk-space was a drawback of the AWS and anti-fatigue mats increased comfort. There was short-term MSK discomfort during an early	The findings point towards future recommendations such as; highlighting the evidence behind SB to create enthusiasm to use AWS's. Encourage managers and supervisors to use AWS's to act as role models. Relaxed dress code and providing anti-fatigue mats to increase

Author (Year)	Aim	Method	Results	Conclusion
		Interviews were conducted at the mid-point and also the end of the trial. Focus groups were also conducted to look at participant's perceptions of the study's impact and opinions on the research design.	adjustment period but that disappeared after two weeks. Participants reported alleviation in back pain, heightened awareness of posture, and frequent adjustments occurred more often whilst using the AWS. Changes to the social environment occurred through increased communication and more face-to-face interaction. Participants were not concerned about noise and privacy, and productivity did not change whilst using the AWS.	employees comfort when standing was recommended. Highlighting the potential changes that might occur to employees and that it may take time to adjust. Highlight the benefits of standing (e.g. increased energy) as well as implementing the use of AWS's as part of the larger culture change to improve health (e.g. healthy eating).
Gilson, Burton, van Uffelen, and Brown (2011)	The study examined office-based employees' perceptions of the health risks associated with prolonged sitting and strategies to reduce or break occupational sitting time.	Focus groups were conducted with a convenience sample, recruited from an Australian government agency. In total 24 employees participated in the focus group's (17 non-management employees; two men). Three focus groups were set-up (two non-managerial).	*Associations between sitting and health;* general consensus that too much sitting was bad for health, primarily bad for MSK problems. Lethargy and fatigue were also identified as consequences of prolonged sitting. The working day was reported to consist of too much sitting and it was believed that even PA could not reduce the issues. *Sitting in the workplace;* work was identified as the major context for prolonged sitting, as well as commuting to and from work. Activity did seem to vary between job roles, with some employees stating that they had opportunities for incidental activities (e.g. filing) and others felt that they had more freedom to move within their role. The amount of client time was found to be a factor related to sitting time. Employees felt mentally and physically drained from prolonged sitting, which was demotivating to stand. *Strategies to interrupt or reduce sitting in the workplace;*	The workplace was identified as an environment where sitting is a dominant behaviour, meaning that the workplace is an important setting for interventions to reduce SB. Participants talked about a link between prolonged sitting and health, however linked sitting with MSK problems, rather than chronic or metabolic health issues. A number of different strategies were suggested which is encouraging as this shows that participants are willing to make changes and engaged with ideas. Participants were constrained to sitting depending upon their job roles, meaning a number of strategies may need to be used to accommodate all job roles. 'One size

Author (Year)	Aim	Method	Results	Conclusion
			most participants felt it was possible to reduce SB in the workplace. Potential strategies suggested were; structured and unstructured breaks, opportunities for incidental activity, opportunities for purposive PA and workload planning. *Barriers to strategies to break or reduce sitting in the workplace;* loss of productivity and focus, negative responses from management, organisational culture, and cost barriers. *Enabling strategies to break or reduce sitting in the workplace;* organisational and managerial support, leaders and managers needed to be actively involved in encouraging staff to participate in activities. 'Champions' or a 'well-being' committee could be used to discuss health issues and ways to increase awareness. Shared responsibility between the organisation, management and staff. Strategies need to be tailored to occupational roles and workgroups. Strategies would also need environmental support and multiple strategies may be more effective for employees.	fits all' approach would be ineffective. A significant challenge would be the perception that most employees have that reducing sitting time would lower productivity in the workplace. Managers, in particular middle-managers have been found to play a significant role in this.
Grunseit, Chau, van, and Bauman (2013)	The aim of the study was to conduct formative research to examine the impact, acceptability	Participants were recruited from an Australian government organisation, which had recently had AWS's installed. Focus groups were	The median proportion of sitting was 85% (6.9hours) at baseline, which reduced to 60% (5.4 hours) per working day once the employees had moved to the new office. *Initiation:* there were no formal instructions about how to use the AWS's and for some employees the idea of using the AWS was lost in the myriad of other changes due to the refurbishment. The two main reasons employees used standing options were; anticipated health benefits and	The installation of AWS's within a medium sized organisation was well received and resulted in a reduction in reported sitting at work. Initiation and maintenance of using the desks could be split into three different trajectories. One group committed pre-installation to using the desks and worked

Author (Year)	Aim	Method	Results	Conclusion
	and usability of AWS's among office workers.	then conducted at the worksite. The staff that chose and purchased the desks were interviewed. Focus groups where then conducted with employees that had been using AWS's. Three focus groups were conducted, each with four participants.	experimentation with no particular expectations. Participants did comment on the need for a motivating reason to use the desks, which would encourage all employees to use them. *Maintenance;* health/physical factors were related to maintained use of the AWS's. Positive factors; reduce back pain, more energy, more movement/activity. Negative factors; limited time standing if tired and exacerbation of physical complaints from standing. A number of employees felt standing helped increase their alertness, although one did see it as a distraction. Tasks also seemed to effect whether a person stood or sat, and past experiences influenced these. Desk/office set-up effected how much staff used the desks, some felt restricted due to other office furniture not being at a standing height, therefore a holistic office furniture approach needed to be addressed. *Manual vs electric desk;* although none of the differences mentioned appear to be due to the type of desk, manual desks were reported to take longer to change. The manual desks may have discouraged staff from trying the desks or prolonged periods of sitting/standing.	around barriers to use them. The second group enjoyed using the desks and the discovery was unexpected, they continued to regularly stand. The third group experimented with the desks but due to difficulties did not maintain using the desks.
Hadgraft et al. (2017)	This study explored office workers perceptions of barriers to reducing	Participants were recruited from three different organisations based in Australia. No formal programme to	*Barriers to reducing workplace sitting;* the nature of participants work and the reliance on computers meant employees needed to sit down. Volume of work would also influence activity and if there was pressure to prioritise work employees would take fewer breaks as these would consume time. Employees commonly	The nature of work and current office furniture was seen as the most significant barriers to reducing workplace SB. Barriers to reducing SB were apparent at the social, individual and environmental level, supporting the need for interventions

Author (Year)	Aim	Method	Results	Conclusion
	workplace SB and the feasibility of commonly identified strategies.	reduce SB had been implemented within any of the organisations, yet AWS's were present within the organisations. Employees were all working primarily in desk-based roles. Semi-structured interviews were conducted with 20 employees. The interviews were developed with reference to the ecological model of SB (Owen et al, 2011).	reported becoming immersed in their work and therefore being aware of the amount of time that had passed. The advancements in technology and encouragement for employees to leave 'paper trials' meant that employees were therefore less likely to engage in face-to-face communication with colleagues. *Organisational social norms;* there was a perceived need to have a reason to stand up and feeling self-conscious when taking breaks away from desks. Other workers standing in meetings and modelling these behaviours, made behaviours appear more normal. *Office furniture and layout;* participants were restricted in standing due to the fact that they did not have access to an AWS. Although an AWS 'hot-desk' was available this was not used by employees, due to the inconvenience of moving desks. *Promoting and optimising existing opportunities to reduce sitting;* senior leaders noted that the office layout had been set up to encourage employees to move more, however this did not appear to have been taken up. Standing meetings were generally viewed as acceptable and feasible, but as a way to have a shorter meeting, not necessarily to reduce sitting. Communication with colleagues in person was seen as acceptable, but again would be restricted by work pressures if an employee was too busy. *Workplace interventions need a suite of additional strategies - not just AWS's;* although there was a call for more AWS's, they were seen as being too expensive for	to target behaviour at different levels of the social ecological model. Although there was an interest in having AWS's within the workplace, this was considered unlikely due to the cost of the workstations. One organisation had AWS's available for employees but reported that they were not used, highlighting that further considerations are needed other than just environmental changes.

Author (Year)	Aim	Method	Results	Conclusion
			smaller organisations, especially if they were to replace all desks in their offices. Managers pointed out that the introduction of an AWS alone is not enough and that further advice is needed alongside the introduction of AWS's. The use of prompts to encourage breaking up sitting was accepted by some, but not all employees as they felt it would break their concentration if busy. *Perceived individual responsibility or motivation;* while organisational support is seen to be important, ultimately it is down to the individual to make the behaviour change. *Addressing MSK issues vs universal health promotion;* typically participants spoke of standing or using AWS's as a way to relieve MSK issues, not necessarily health issues associated with SB.	
Such and Mutrie (2017)	The aim of the study was to examine the organisational cultural factors that impeded and promoted reduced workplace sitting.	Participants were selected from a large Scottish public sector organisation that had participated in an employee engagement project. The project aimed at increasing awareness around the issues with sitting, provided pedometers for 4-weeks and posters	*Underlying assumptions (value & belief system);* a belief system that emphasised the inevitability of time pressure, intensiveness of desk-based work and work ethic to get things done. It was suggested that the introduction of these strategies however highlighted that the principle of reducing SB had been legitimised at an organisational level. *System;* a formal organisational strategy was not frequently communicated by interviewees. Participants made suggestions of what could be done. The organisational policies did not refer to sitting time and only reported on the procedures for assessing desk-posture to reduce MSK pain. *Artefacts (visible behaviour);* little reference to formal	The domains (e.g. values, strategy, etc.) do not operate independently and mutually reinforce each other, therefore time sitting could be seen as the outcome of interplay between the domains that act to construct and re-construct sedentariness as both a practice and an ethos. Sitting had not been problematised through formal policy, leaving a vacuum in the dynamics of the organisation whereby values are not explicit and the informal norms ('get the job done') were dominant. Informal beliefs may have developed due to the absence of formal policy.

Author (Year)	Aim	Method	Results	Conclusion
		placed in decision-making points around the workplace. Thirteen in-depth interviews were conducted with volunteers from the project focusing on; 1) the key workplace cultural factors that promote/hinder opportunities to sit less, 2) how the barriers/opportunities manifest, 3) how they might be challenged within an organisational cultural framework.	practices, highlighting the potential operational vacuum in this area. Comments on home working and flexi-time spoke of how these policies encouraged SB, due to guilt and fewer opportunities to move (e.g. no canteen). Although no formal policies, working norms that encouraged sitting were spoken about including; line management, emailing, meetings, leadership, and managerial practice. Self-reported patterns of behaviour were related to the underlying assumptions and norms, and breaking these norms would appear to be unorthodox and unprofessional (e.g. standing in meetings). The silos of the office and each team being separated were also reported to encourage sitting and teams would communicate through emails as there was limited face-to-face contact. *External factors;* SB was experienced in the context of everyday lives and the nature of modern working environments encouraged SB, as well as SB being inevitable.	This study calls for the use of whole-system approaches to reducing SB, with colleagues coming together to tackle/commit to reducing SB.

Appendix 3.1 SHUREC1 form & confirmation of ethical approval

RESEARCH ETHICS CHECKLIST (SHUREC1)

This form is designed to help staff and students to complete an ethical scrutiny of proposed research. The SHU Research Ethics Policy should be consulted before completing the form.

Answering the questions below will help you decide whether your proposed research requires ethical review by a Faculty Research Ethics Committee (FREC). In cases of uncertainty, members of the FREC can be approached for advice.

Please note: staff based in University central departments should submit to the University Ethics Committee (SHUREC) for review and advice.

The final responsibility for ensuring that ethical research practices are followed rests with the supervisor for student research and with the principal investigator for staff research projects.

Note that students and staff are responsible for making suitable arrangements for keeping data secure and, if relevant, for keeping the identity of participants anonymous. They are also responsible for following SHU guidelines about data encryption.

The form also enables the University and Faculty to keep a record confirming that research conducted has been subjected to ethical scrutiny.

- For student projects, the form may be completed by the student and the supervisor and/or module leader (as applicable). In all cases, it should be counter-signed by the supervisor and/or module leader, and kept as a record showing that ethical scrutiny has occurred. Students should retain a copy for inclusion in their research projects, and staff should keep a copy in the student file.
- For staff research, the form should be completed and kept by the principal investigator.

Please note if it may be necessary to conduct a health and safety risk assessment for the proposed research. Further information can be obtained from the Faculty Safety Co-ordinator.

General Details

(Table cells will expand as you type)

Name of principal investigator or student	Martin Adrian Lamb
SHU email address	m.lamb@shu.ac.uk

Course or qualification (student)	PhD Health & Well Being
Name of supervisor (if applicable)	Dr Rob Copeland
email address	r.j.copeland@shu.ac.uk
Title of proposed research	
Proposed start date	
Proposed end date	
Brief outline of research to include, rationale & aims (250-500 words). In addition for research with human, participants, include recruitment method, participant details & proposed methodology (250-500)	Sedentary behaviour (SB) has been found to be associated with type II diabetes, cardiovascular disease and all-cause mortality (WIlmot et al, 2012). Office workers are reproted to spend 6.9 hours seated in a typical day (Grunseit et al, 2013). Active workstations have been found to reduce sitting at work (Neuhaus et al, 2014) however no long-term effects have been found. A lack of awareness of the negative consequences of SB and understanding of the determinants of SB in the workplace may explain why people are not making changes or adhering to interventions that are designed to reduce their SB. The present study plans to explore office workers awareness of the negative consequences of SB and determinanats of SB within the workplace. A questionnaire will be sent out to different workplaces around the UK, asking employees to complete an online questionnaire. Companies will be approached by email or telephone, and asked if they are willing to distribute the questionnaire amongst their employees. All data will be anonymous and the answers will be emailed back to the researcher once the participant has submitted their answers. All participants will be 18 years or older and work primarily in a desk-based job. Before beginning the questionnaire participants will be presented with an information for participants sheet, which they will be required to read through before beginning the questionnaire. This will inform them that all data will remain anonymous, that they do not have to answer any questions which they do not want to and their right to withdraw at any point up until submitting their answers. Participants will not be able to withdraw their data after submission due to the fact that all data will be anonymous, therefore there will be no way of identifying their results. SB will also be measured objectively in a smaller sample, than the sample used for the questionnaire. This will be to support the self-reported sitting time that participants will be asked to complete in the questionnaire and to look at the number of sit to stand transitions a participant makes during a typical working day. Participants will be asked to wear an ActivPAL accelerometer on their thigh for 5 working days, whilst they are at work. Again this data will be anonymous and remain confidential. Participants will have the opportunity

	to withdraw at any point before or during the study.
Will the research be conducted with partners & subcontractors?	**Yes/No** No (If **YES**, outline how you will ensure that their ethical policies are consistent with university policy.)

1. Health Related Research Involving the NHS or Social Care / Community Care or the Criminal Justice Service or with Research participants unable to provide informed consent

Question		**Yes/No**
1.	Does the research involve? • Patients recruited because of their past or present use of the NHS or SC • Relatives/carers of patients recruited because of their past or present use of the NHS or SC • Access to data, organs or other bodily material of past or present NHS patients • Foetal material and IVF involving NHS patients • The recently dead in NHS premises • Prisoners or others within the criminal justice system recruited for health-related research* • Police, courts, prisoners or others within the criminal justice system* • Participants who are unable to provide informed consent due to their incapacity even if the project is not health related	
2.	Is this a research project as opposed to service evaluation or audit? *For NHS definitions please see the following website* http://www.nres.nhs.uk/applications/is-your-project-research/	

If you have answered **YES** to questions **1 & 2** then you **must** seek the appropriate external approvals from the NHS, Social Care, or Criminal Justice System under their Research Governance schemes. Further information is provided below.

NHS https://www.myresearchproject.org.uk/Signin.aspx

* All prison projects also need National Offender Management Service (NOMS) Approval and Governor's Approval and may need Ministry of Justice approval. Further guidance at: http://www.ohrn.nhs.uk/toolkit/Toolkit4thEdition.pdf

NB FRECs provide Independent Scientific Review for NHS or SC research and initial scrutiny for ethics applications as required for university sponsorship of the research. Applicants can use the NHS proforma and submit this initially to the FREC.

2. Research with Human Participants

Question		**Yes/No**
1. *Note*	Does the research involve human participants? This includes surveys, questionnaires, observing behaviour etc. *If YES, then please answer questions 2 to 10* *If NO, please go to Section 3*	Yes
2. *Note*	Will any of the participants be vulnerable? *'Vulnerable' people include young people under 18, people with learning disabilities, people who may be limited by age or sickness or disability from understanding the research, etc.*	No
3	Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	No
4	Will tissue samples (including blood) be obtained from participants?	No
5	Is pain or more than mild discomfort likely to result from the study?	No
6	Will the study involve prolonged or repetitive testing?	No
7 *Note*	Is there any reasonable and foreseeable risk of physical or emotional harm to any of the participants? *Harm may be caused by distressing or intrusive interview questions, uncomfortable procedures involving the participant, invasion of privacy, topics relating to highly personal information, topics relating to illegal activity, etc.*	No
8	Will anyone be taking part without giving their informed consent?	No
9 *Note*	Is it covert research? *'Covert research' refers to research that is conducted without the knowledge of participants.*	No
10	Will the research output allow identification of any individual who has not given their express consent to be identified?	No

If you answered **YES only** to question **1,** you **must** submit the signed form to the FREC for registration and scrutiny. If you have answered **YES** to any of the other questions you are **required** to submit a SHUREC2A (or 2B) to the FREC. If you answered **YES** to question **8** and participants cannot provide informed consent due to their incapacity you must obtain the appropriate approvals from the NHS research governance system.

3. Research in Organisations

Question		Yes/No
1	Will the research involve working with/within an organisation (e.g. school, business, charity, museum, government department, international agency, etc)?	Yes
2	If you answered YES to question 1, do you have granted access to conduct the research? *If YES, students please show evidence to your supervisor. PI should retain safely.*	No
3 *Note*	If you answered NO to question 2, is it because: A. you have not yet asked B. you have asked and not yet received an answer C. you have asked and been refused access. *You will only be able to start the research when you have been granted access.*	A

4. Research with Products and Artefacts

Question		Yes/No
1.	Will the research involve working with copyrighted documents, films, broadcasts, photographs, artworks, designs, products, programmes, databases, networks, processes or secure data?	No
2. *Notes*	If you answered YES to question 1, are the materials you intend to use in the public domain? *'In the public domain' does not mean the same thing as 'publicly accessible'.* – *Information which is 'in the public domain' is no longer protected by copyright (i.e. copyright has either expired or been waived) and can be used without permission.* – *Information which is 'publicly accessible' (e.g. TV broadcasts, websites, artworks, newspapers) is available for anyone to consult/view. It is still protected by copyright even if there is no copyright notice. In UK law, copyright protection is automatic and does not require a copyright statement, although it is always good practice to provide one. It is necessary to check the terms and conditions of use to find out exactly how the material may be reused etc.*	

Question		Yes/No
	If you answered YES to question 1, be aware that you may need to consider other ethics codes. For example, when conducting Internet research, consult the code of the Association of Internet Researchers; for educational research, consult the Code of Ethics of the British Educational Research Association.	
3.	If you answered NO to question 2, do you have explicit permission to use these materials as data? *If YES, please show evidence to your supervisor. PI should retain permission.*	
4.	If you answered NO to question 3, is it because: A. you have not yet asked permission B. you have asked and not yet received and answer C. you have asked and been refused access.	**A/B/C**
Note	*You will only be able to start the research when you have been granted permission to use the specified material.*	

Adherence to SHU policy and procedures

Personal statement	
I can confirm that: – I have read the Sheffield Hallam University Research Ethics Policy and Procedures – I agree to abide by its principles.	
Student / Researcher/ Principal Investigator (as applicable)	
Name: Martin Adrian Lamb	Date:
Signature:	
Supervisor or other person giving ethical sign-off	
I can confirm that completion of this form has not identified the need for ethical approval by the FREC or an NHS, Social Care or other external REC. The research will not commence until any approvals required under Sections 3 & 4 have been received.	
Name:	Date:
Signature:	
Other signing box	
Name:	Date:
Signature:	

Please ensure the following are included with this form if applicable, tick box to indicate:

	Yes	**No**	**N/A**
Research proposal if prepared previously	☐	☐	☒
Any recruitment materials (e.g. posters, letters, etc.)	☒	☐	☐
Participant information sheet	☒	☐	☐
Participant consent form	☒	☐	☐
Details of any measures to be used (e.g. questionnaires, etc.)	☒	☐	☐

Details of any support materials provided to participants	☐	☐	☒
Debriefing materials	☒	☐	☐

Confirmation of ethical approval email

Dear Martin

I acknowledge receipt of your Research Ethics Checklist (SHUREC1) for the following proposed research:

Movement @ Work; Awareness of the negative consequences and relationship with the office environment in employees completing desk-based jobs.

I will register the details with the Faculty of Health & Wellbeing Research Ethics Sub-Committee.

Kind regards

Sue

Sue Wallace
Faculty of Health & Wellbeing Research Ethics Sub-Committee Administrator
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email: s.wallace@shu.ac.uk

Appendix 3.2 Questionnaire completed by participants in Study 1

Age: ______

Gender: ________________

What is the first part of your residential postcode? E.g. S10, NW1

____

Which employment sector do you work in?

Public

Private

Non-for-Profit

Social Enterprise

How many employees are based in the department where you work?

1-5

6-20

21-50

51-100

100+

Which of the following best describes your job role?

Management

Full-Time Employee

Temporary Employee

Self-Employed

If you are a manager, how many employees are you responsible for?

____

Awareness

What, if any, do you think are the implications of sitting for long periods of time? *(Circle or highlight all that apply)*

Increased risk of Diabetes

Less Sociable

Lower Back Pain

Easier to Work

Reduces Fatigue

Higher Work Productivity

More Comfortable

Lower Work Productivity

Discomfort

Increased risk of Cardiovascular Disease

Seen as Hard-working by others

Reduces Back Pain

Saves Energy

Improves Concentration

None of the Above

Please rate on a scale of 1(Strongly Disagree) to 5 (Strongly Agree) how much you agree with the following statements:

1) Sitting for long periods of time increases my risk of cardiovascular disease.

1 2 3 4 5

Strongly Disagree Not Sure Strongly Agree

2) Even if I do regular physical activity, like brisk walking or exercise for 30 minutes most days of the week, sitting for long periods of time increases my risk of cardiovascular disease.

1 2 3 4 5

Strongly Disagree Not Sure Strongly Agree

3) When sitting for long periods of time, taking short breaks by standing or slowly moving around for a minute or two to break up my sitting is a good way to reduce my risk of cardiovascular disease.

1 2 3 4 5

Strongly Disagree Not Sure Strongly Agree

Please rate on a scale of 1 (Strongly Disagree) to 7 (Strongly Agree) how much you agree with the following statements:

Sitting down in the workplace is something……

1. I do frequently.

1 2 3 4 5 6
7

Strongly Disagree Not Sure Strongly Agree

2. I do automatically.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

3. I do without having to consciously remember.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

Strongly Disagree Not Sure Strongly Agree

4. I do without thinking.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

5. That belongs to my (daily, weekly, monthly) routine.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

6. I start doing before I realise I'm doing it.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

7. I have no need to think about doing.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

8. I have been doing for a long time.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

Daily Activity - Working Day

Please estimate on a typical WORKING day and NON-WORKING day, how much time you spend sitting in the following situations

(Please enter the number of hours and minutes e.g. 1 hour 45mins. Enter 0 if you are not sat down in any of these situations)

	Working Day		**Non-Working Day**	
	Hours	Minutes	Hours	Minutes
a. For TRANSPORT (e.g. in car, bus, train, etc)				
b. At WORK (e.g. sitting at a desk or using a computer)				
c. Watching TV				
d. Using a computer at home (e.g. email, games, information, chatting)				
e. Other leisure activities (e.g. socialising, movies etc, but NOT including TV or computer use)				

During the last 7 days, how many days were you at work? __________

Days

How many hours do you work in a typical week?

__________Days

Office Environment

Please answer the following questions in relation to your office environment:

1. My desk is: *(Please pick one that is most relevant)*

At a fixed sitting height	Can be moved up or down
Is at a fixed standing height	Is attached to a treadmill/pedal station

2. Within my office there are options for me to stand up to complete my work…

(Please select how much you agree or disagree with this statement)

1	2	3	4
Strongly Disagree			Strongly Agree

3. Which of the following best describes the location of the majority of desks/workstations in your building? *(Please circle the option that is most relevant)*

1. In an office separated from other offices by floor to ceiling walls, door, not shared with anyone else
2. In an office separated from other offices by floor to ceiling walls, door, shared by 2–4 people
3. In a single area containing many desks/workstations separated by high partitions (greater than 1.5m (5 feet) in height)
4. In a single area containing many desks/workstations separated by low partitions (less than 1.5 m (5 feet) in height)
5. In a single area containing many desks/workstations separated by no partitions.

Perceived Control

Please indicate how much you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
It is my choice whether I stand up or sit at my desk while at work					
It is my choice whether I stand up or sit during a meeting with <u>colleagues</u> at work					
It is my choice whether I stand up or sit during a meeting with my <u>supervisors</u> at work					
It is my choice whether I walk over to talk to a <u>colleague</u> or send them an e-mail					
It is my choice whether I walk over to talk to a <u>supervisor</u> or send them an e-mail					

Please indicate how much you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
My workplace is committed to supporting staff health and well-being					
It would be strange if I was to stand whilst doing my work					
My <u>colleagues</u> would not mind if I chose to stand up while working at my desk					
My <u>supervisors</u> would not mind if I chose to stand up while working at my desk					
My <u>colleagues</u> would not mind if I chose to stand during a work meeting					
It would be strange for me to stand during a meeting if all of my colleagues were sat down					

Intentions

Please indicate on a scale of 1(Strongly Disagree) to 5 (Strongly Agree) how much you agree with the following statements.

1) I intend to move around throughout the day tomorrow.

1 2 3 4 5

Strongly Disagree Not Sure Strongly Agree

2) I intend to not sit at my desk all day tomorrow (or next working day).

1 2 3 4 5

Strongly Disagree Not Sure Strongly Agree

3) I intend to spend no more than 30 minutes at a time sitting in the next working day (e.g. in cars/buses, at work/home).

1 2 3 4 5

Strongly Disagree Not Sure Strongly Agree

4) I intend to stand for more than 2 hours in the next working day (e.g. during transport, at work/home).

1 2 3 4 5

Strongly Disagree Not Sure Strongly Agree

Thank you for completing the questionnaire.
There will be no further testing. If you have any questions then please feel free to contact the research team.

Thanks
Martin Lamb
m.lamb@shu.ac.uk

Appendix 3.3 Information for participants' sheet presented before the questionnaire

<u>Movement @ Work</u>

You are invited to complete an online questionnaire about your movement at work. Before completing the questionnaire it is important that you understand why the research is being completed and what will happen with the results. Please take time to read the following information carefully and ask any questions if something is not clear or if you would like more information. Thank you for reading this.

This study is being completed as part of a PhD at Sheffield Hallam University (SHU). Employees that work in an office and are primarily desk-based are being asked to complete this questionnaire on their movements whilst at work.

The questionnaire only needs to be completed once and it can be done online by following the link at the end of this page. All information that you choose to give in the questionnaire will remain anonymous and confidential. The only people that will have access to your answers will be the research team at SHU; your employers will not receive any of your answers.

If there are any questions that you are not comfortable with answering then you can choose not to answer them. There are no right or wrong answers and employees are asked to answer the questions as honestly as possible. You have the right to withdraw from the study at any point, up until you have submitted your answers. Answers cannot be withdrawn once you have submitted your questionnaire due to the results being anonymous, meaning that there would be no way to identify your results.

After the completion of the study we will not be able to discuss your results with you; however we will be happy to share the results of the study with you once it has been completed and written up. Please get in touch with the research team for a copy of the results.

By moving on to the next page you are agreeing that:

- You are 18 years or older.

- You have read and understood the information above regarding this study.

- You consent to the information collected for the purposes of this research study, once anonymised (so that you cannot be identified), to be used for any other research purposes.

- You wish to participate in the study under the conditions set out above.

If you have any questions about the study please get in touch with the principal researcher, Martin Lamb (m.lamb@shu.ac.uk) or the Director of Studies for the PhD, Dr Rob Copeland (r.j.copeland@shu.ac.uk).

The questionnaire will take about 10 minutes to complete. We would greatly appreciate you taking the time to complete the questionnaire.

Thank You

Appendix 4.1 Information for participants sheet presented to participants

Sheffield Hallam University | Centre for Sport and Exercise Science

Qualitative exploration of how desk-based employees use their workstations and how to break sedentary behaviour - *Information for Participants Sheet*

I would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask questions if anything you read is not clear or would like more information. Take time to decide whether or not to take part.

What is the purpose of the study?

This study is being completed as part of a PhD at Sheffield Hallam University (SHU) which is exploring how sitting can be reduced or within the workplace.

Why have I been invited?

You have been invited to participate as you currently work in an office, in a job role which is primarily desk-based and you use a standing or height-adjustable desk.

Do I have to take part?

It is up to you to decide. We will describe the study and go through the information with you. If you decide to participate, we will then ask you to sign a consent form to show you agreed to take part. You are free to withdraw at any time, without giving a reason.

What will I have to do?

If you agree to take part you will be interviewed by the researcher, which will be conducted in private with just the researcher present. You will be asked questions about your sitting and activity whilst you are at work. The interview will last for approximately 30-45 minutes and you will only be interviewed once. The interview will be recorded so that it can be transcribed, but the transcription will only be seen by the research team. It will also be anonymised so that your name and workplace cannot be identified.

Will my taking part in the study be kept confidential?

Yes, everything shall be kept confidential, only members of the research team shall discuss the content of the interview. Once the interview has been completed you will be given a unique participant code which shall be used to link your interview recording and transcript with your contact details. Only the principal researcher will have access to this. This is so that your transcript can be identified if you decide to withdraw, however after a period your unique ID will be removed from the transcript. During the interview if you use the names of colleagues, the organisation or yourself, these will be removed so that the data cannot identify you or your organisation.

What will happen if I don't carry on with the study?

If you decide that you no longer want to take part in the study or you do not want your interview to be used that is fine, all of your data shall be removed from the study. You will be free to withdraw at any time before or during the interview. Also during the interview you do not have to answer all of the questions if you do not want to. However once you have completed the interview you will then have two weeks to withdraw from the study. After this time you will no longer be able to withdraw as your data will have been fully anonymised so we will no longer be able to identify your data to withdraw.

What will happen to the results of the research study?

The results from the study will be written up as part of the final PhD thesis and potentially for publication in a journal or conference presentation. As mentioned all data that is used will be anonymised. We will also be happy to send you a copy of the results once all analysis has been completed.

Further information and contact details:

You will be given the opportunity to ask the researcher any questions before you agree to participate in the study. You can also contact the primary researcher (Martin Lamb) or the Director of Studies for the PhD (Professor Rob Copeland) at any point to ask any questions.

Martin Lamb
Health and Wellbeing Research Institute
Sheffield Hallam University
Chestnut Court,
Collegiate Crescent,
Sheffield. S10 2BP

Email: m.lamb@shu.ac.uk

Professor Rob Copeland: r.j.copeland@shu.ac.uk

Appendix 4.2 SHUREC1 form & confirmation of ethical approval

RESEARCH ETHICS CHECKLIST (SHUREC1)

This form is designed to help staff and postgraduate research students to complete an ethical scrutiny of proposed research. The SHU Research Ethics Policy should be consulted before completing the form.

Answering the questions below will help you decide whether your proposed research requires ethical review by a Faculty Research Ethics Committee (FREC). In cases of uncertainty, members of the FREC can be approached for advice.

Please note: staff based in University central departments should submit to the University Ethics Committee (SHUREC) for review and advice.

The final responsibility for ensuring that ethical research practices are followed rests with the supervisor for student research and with the principal investigator for staff research projects.

Note that students and staff are responsible for making suitable arrangements for keeping data secure and, if relevant, for keeping the identity of participants anonymous. They are also responsible for following SHU guidelines about data encryption and research data management.

The form also enables the University and Faculty to keep a record confirming that research conducted has been subjected to ethical scrutiny.

- For postgraduate research student projects, the form should be completed by the student and counter-signed by the supervisor, and kept as a record showing that ethical scrutiny has occurred. Students should retain a copy for inclusion in their thesis, and staff should keep a copy in the student file.
- For staff research, the form should be completed and kept by the principal investigator.

Please note if it may be necessary to conduct a health and safety risk assessment for the proposed research. Further information can be obtained from the Faculty Safety Co-ordinator.

Name of principal investigator or postgraduate research student	Martin Lamb
SHU email address	m.lamb@shu.ac.uk
Name of supervisor (if applicable)	Professor Rob Copeland
email address	r.j.copeland@shu.ac.uk

Title of proposed research	Qualitative exploration of how active workstations can reduce workplace sedentary behaviour in desk-based employees
Proposed start date	23/08/16
Proposed end date	31/10/16
Brief outline of research to include, rationale & aims (500 - 750 words).	Sedentary behaviour (SB) is associated with type II diabetes, cardiovascular disease and all-cause mortality (Wilmot et al, 2012). Office workers are reported to spend 6.9 hours seated in a typical working day (Grunseit et al, 2013). The introduction of active workstations (AWS's; e.g. standing desks, treadmill desks) into the workplace have been found to reduce sitting time and therefore reduce SB (Neuhaus et al, 2014; Torbeyns et al, 2014), however there is no long-term evidence that these changes are sustainable. Owen and colleagues (2011) proposed a research agenda to help reduce SB in different settings, specifically the workplace. The stages of this are as follows; (1) understand the relationship between SB with health outcomes; (2) measure SB; (3) characterise the prevalence and variations of SB in populations; (4) identify the determinants of SB, and (5) develop and test interventions to influence SB. There is research to support the first three phases of the agenda within the workplace (Thorp et al, 2011; Healy et al, 2011, Bauman et al, 2011); however there is less evidence within the fourth phase which precedes the development of interventions. The present study is the second in a PhD programme which aims to answer the overall research question; 'How can sustainable reductions in workplace SB be achieved?' Study 1 began to explore the determinants of SB within the workplace through an online questionnaire with a sample of 1000 desk-based employees from 21 different organisations. Previous research has found that the introduction of AWS's into the workplace significantly reduces employee's workplace sitting times (Neuhaus et al, 2014; Torbeyns et al, 2014). Nevertheless, study 1 found participants that had an AWS (n=115) did not report sitting less than employees with fixed sitting height desks. As this data was collected using an online questionnaire, it is unclear why these participants are not using their AWS's. Understanding why employees have AWS and what determines their use is essential to understand the role that AWS have in sustaining a change in SB and whether interventions need to go further than solely introducing AWS's. Due to the number of responsibilities that employees have, it may be that making positive health changes is not a priority, meaning that employees may not consciously consider reducing SB (Mackenzie et al, 2015). Previous interventions to reduce SB have been based on social cognitive theory (SCT; Bandura 2004; Carr et al, 2013;

	Healy et al, 2013), which assumes a person consciously deliberates and initiates a behaviour. Sitting has been reported to be habitual and an automatic behaviour, rather than a behaviour which is always consciously deliberated and initiated (DeCocker et al, 2015). If sitting is an automatic behaviour, targeting a conscious behaviour change may not be effective, especially for long-term change. Exploration of employee's priorities within the workplace and whether or not they have the capacity to make a health behaviour change is important for influencing the design and development of future workplace interventions. Gilson et al (2011) have reported in their qualitative work that employees do not feel they have opportunities to reduce SB whilst at work. What defines these opportunities is uncertain and therefore improving our understanding of how SB is currently reduced could help in the design of future interventions. As an example capitalising on existing behaviours e.g. existing natural breaks that interrupt sedation are likely to be more beneficial than introducing new behaviours. The present study aims to explore why employees have AWS's and how they currently use them, what opportunities employees have to reduce SB and their willingness to reduce workplace SB. Qualitative interviews will be conducted to gain deeper insight to the results from study 1. Knowledge from this second study could help in the design of future workplace interventions aiming to reduce SB and the related negative health consequences. The objectives of the present study are: • Understand why employees have an AWS • Understand when and why employees use their AWS • Explore ways in which SB can be interrupted within the workplace
Where data is collected from human participants, outline the nature of the data, details of anonymisation, storage and disposal procedures if these are required (300 -750 words).	Qualitative semi-structured interviews will be conducted with desk-based employees from a variety of organisations who currently have access to AWS in their workplace. An interview guide has been developed to prompt questions during the interview (Appendix A). The interviews shall be recorded and then transcribed verbatim. The transcriptions will be analysed using thematic analysis following Braun and Clarke's (2006) process for thematic analysis. This will create higher and lower order themes which will be used as the results of the study. The intention is that the interviews will be conducted face-to-face in a private room. It may be more convenient for some participants to be interviewed by telephone or Skype due to where they are located in the country. Regardless of how the participant is interviewed they shall all be given the same information and have the same opportunities to ask questions before the interview. To ensure the trustworthiness of the data the results will be

	triangulated between the research team, to ensure that the themes that have been found are relevant and have been interpreted correctly. Participants for the present study will be purposively approached and asked to participate within the study; this is to ensure that participants who currently use AWS's are recruited. Organisations which participated in study 1 shall be asked if they would be willing to advertise the study to their employees, as the research team already has contacts within the organisations (Appendix B). The study will aim to recruit in total 10 to 15 participants in total, from different organisations. Participants shall be recruited until saturation is reached in the emerging data, which has been suggested to be at around 12 participants (Guest, 2006). Employees will be working in jobs which are primarily desk based and primarily be using a standing or height-adjustable desk instead of a fixed sitting height desk. Participants will be sent an information sheet (Appendix C) and consent forms (Appendix D) via email prior to the interview and shall be given at least 48 hours to read the documents. Before the interview begins the participant shall be asked if they have read the documents and if they understood them and then given the opportunity to ask the investigator any questions related to the study. Once the participant is happy to participate and the researcher is happy that they understand their involvement in the study the participant will be asked to sign the consent form. The participant shall keep their own copy of the signed consent form along with a copy of the information sheet. The same procedures shall be followed with participants completing the interviews over the telephone or Skype. The participants will be asked to email back a copy of the signed consent form before the interview begins. It will be made clear to participants that they will be able to withdraw at any point during the study or refuse to answer any questions that they will be uncomfortable answering. Following the interview the participants will have two weeks to withdraw from the study, following this time participants will no longer be able to withdraw as all of their data shall be fully anonymised. Details of their right to withdraw shall be made clear in the information sheet (Appendix C) and again in the debrief sheet (Appendix E) as well as being told in person by the researcher conducting the interview. During the recording of the interview the participants name shall not be mentioned and if names are used by the participant during the interview these will be removed when the interview is transcribed. The recording of the interview shall be given a unique code that can be used to identify each participant. This is so that each participant can be identified if they choose to withdraw. Once the withdrawal period has passed, however all data shall be anonymised and the recording and transcriptions of the

	data will no longer be identifiable. All data, transcriptions and recordings, shall be stored on the universities Q drive, which is password protected and regularly backed up so that only members of the research team can access the data. Signed consent forms shall be stored in lockable storage at the primary researcher's office. Please see attached Data Management Plan for further details on how the data will be stored during and after the study (Appendix F).
Will the research be conducted with partners & subcontractors?	**Yes/No** (If **YES**, outline how you will ensure that their ethical policies are consistent with university policy.)

1. Health Related Research involving the NHS or Social Care / Community Care or the Criminal Justice System or with research participants unable to provide informed consent

Question	**Yes/No**
1. Does the research involve? • Patients recruited because of their past or present use of the NHS or Social Care • Relatives/carers of patients recruited because of their past or present use of the NHS or Social Care • Access to data, organs or other bodily material of past or present NHS patients • Foetal material and IVF involving NHS patients • The recently dead in NHS premises • Prisoners or others within the criminal justice system recruited for health- related research* • Police, court officials, prisoners or others within the criminal justice system* • Participants who are unable to provide informed consent due to their incapacity even if the project is not health related	No
2. Is this a research project as opposed to service evaluation or audit? *For NHS definitions please see the following website* http://www.nres.nhs.uk/applications/is-your-project-research/	No

If you have answered **YES** to questions **1 & 2** then you **must** seek the appropriate external approvals from the NHS, Social Care or the National Offender Management Service (NOMS) under their independent Research Governance schemes. Further information is provided below.

NHS https://www.myresearchproject.org.uk/Signin.aspx

* Prison projects may also need National Offender Management Service (NOMS) Approval and Governor's Approval and may need Ministry of Justice approval. Further guidance at:
http://www.hra.nhs.uk/research-community/applying-for-approvals/national-offender-management-service-noms/

NB FRECs provide Independent Scientific Review for NHS or SC research and initial scrutiny for ethics applications as required for university sponsorship of the research. Applicants can use the NHS proforma and submit this initially to their FREC.

2. Research with Human Participants

Question		Yes/No
1.	Does the research involve human participants? This includes surveys, questionnaires, observing behaviour etc.	Yes
Note	*If YES, then please answer questions 2 to 10*	
If NO, please go to Section 3		
2.	Will any of the participants be vulnerable?	No
Note	*'Vulnerable' people include children and young people, people with learning disabilities, people who may be limited by age or sickness or disability, etc. See definition*	
3	Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	No
4	Will tissue samples (including blood) be obtained from participants?	No
5	Is pain or more than mild discomfort likely to result from the study?	No
6	Will the study involve prolonged or repetitive testing?	No
7	Is there any reasonable and foreseeable risk of physical or emotional harm to any of the participants?	No
Note	*Harm may be caused by distressing or intrusive interview questions, uncomfortable procedures involving the participant, invasion of privacy, topics relating to highly personal information, topics relating to illegal activity, etc.*	
8	Will anyone be taking part without giving their informed consent?	No
9	Is it covert research?	No
Note	*'Covert research' refers to research that is conducted without the knowledge of participants.*	
10	Will the research output allow identification of any individual who has not given their express consent to be identified?	No

If you answered **YES only** to question **1,** you must complete the box below and submit the signed form to the FREC for registration and scrutiny.

Data Handling

Where data is collected from human participants, outline the nature of the data, details of anonymisation, storage and disposal procedures if these are required (300 -750 words).

Qualitative semi-structured interviews will be conducted with desk-based employees from a variety of organisations who currently have access to AWS in their workplace. An interview guide has been developed to prompt questions during the interview (Appendix A).

The interviews shall be recorded and then transcribed verbatim. The transcriptions will be analysed using thematic analysis following Braun and Clarke's (2006) process for thematic analysis. This will create higher and lower order themes which will be used as the results of the study.

The intention is that the interviews will be conducted face-to-face in a private room. It may be

more convenient for some participants to be interviewed by telephone or Skype due to where they are located in the country. Regardless of how the participant is interviewed they shall all be given the same information and have the same opportunities to ask questions before the interview. To ensure the trustworthiness of the data the results will be triangulated between the research team, to ensure that the themes that have been found are relevant and have been interpreted correctly. Participants for the present study will be purposively approached and asked to participate within the study; this is to ensure that participants who currently use AWS's are recruited. Organisations which participated in study 1 shall be asked if they would be willing to advertise the study to their employees, as the research team already has contacts within the organisations (Appendix B). The study will aim to recruit in total 10 to 15 participants in total, from different organisations. Participants shall be recruited until saturation is reached in the emerging data, which has been suggested to be at around 12 participants (Guest, 2006). Employees will be working in jobs which are primarily desk based and primarily be using a standing or height-adjustable desk instead of a fixed sitting height desk. Participants will be sent an information sheet (Appendix C) and consent forms (Appendix D) via email prior to the interview and shall be given at least 48 hours to read the documents. Before the interview begins the participant shall be asked if they have read the documents and if they understood them and then given the opportunity to ask the investigator any questions related to the study. Once the participant is happy to participate and the researcher is happy that they understand their involvement in the study the participant will be asked to sign the consent form. The participant shall keep their own copy of the signed consent form along with a copy of the information sheet. The same procedures shall be followed with participants completing the interviews over the telephone or Skype. The participants will be asked to email back a copy of the signed consent form before the interview begins. It will be made clear to participants that they will be able to withdraw at any point during the study or refuse to answer any questions that they will be uncomfortable answering. Following the interview the participants will have two weeks to withdraw from the study, following this time participants will no longer be able to withdraw as all of their data shall be fully anonymised. Details of their right to withdraw shall be made clear in the information sheet (Appendix C) and again in the debrief sheet (Appendix E) as well as being told in person by the researcher conducting the interview. During the recording of the interview the participants name shall not be mentioned and if names are used by the participant during the interview these will be removed when the interview is transcribed. The recording of the interview shall be given a unique code that can be used to identify each participant. This is so that each participant can be identified if they choose to withdraw. Once the withdrawal period has passed, however all data shall be anonymised and the recording and transcriptions of the data will no longer be identifiable. All data, transcriptions and recordings, shall be stored on the universities Q drive, which is password protected and regularly backed up so that only members of the research team can access the data. Signed consent forms shall be stored in lockable storage at the primary researcher's office. Please see attached Data Management Plan for further details on how the data will be stored during and after the study (Appendix F).

If you have answered **YES** to any of the other questions you are **required** to submit a SHUREC2A (or 2B) to the FREC. If you answered **YES** to question **8** and participants cannot provide informed consent due to their incapacity you must obtain the appropriate approvals from the NHS research governance system.

3. Research In Organisations

Question		**Yes/No**
1	Will the research involve working with/within an organisation (e.g. school, business, charity, museum, government department, international agency, etc.)?	Yes

2	If you answered YES to question 1, do you have granted access to conduct the research? *If YES, students please show evidence to your supervisor. PI should retain safely.*	No
3	If you answered NO to question 2, is it because: A. you have not yet asked B. you have asked and not yet received an answer C. you have asked and been refused access. *Note* *You will only be able to start the research when you have been granted access.*	B

4. Research with Products and Artefacts

Question		Yes/No
1.	Will the research involve working with copyrighted documents, films, broadcasts, photographs, artworks, designs, products, programmes, databases, networks, processes, existing datasets or secure data?	No
2.	If you answered YES to question 1, are the materials you intend to use in the public domain? *Notes ‘In the public domain’ does not mean the same thing as ‘publicly accessible’.* – *Information which is 'in the public domain' is no longer protected by copyright (i.e. copyright has either expired or been waived) and can be used without permission.* – *Information which is 'publicly accessible' (e.g. TV broadcasts, websites, artworks, newspapers) is available for anyone to consult/view. It is still protected by copyright even if there is no copyright notice. In UK law, copyright protection is automatic and does not require a copyright statement, although it is always good practice to provide one. It is necessary to check the terms and conditions of use to find out exactly how the material may be reused etc.* *If you answered YES to question 1, be aware that you may need to consider other ethics codes. For example, when conducting Internet research, consult the code of the Association of Internet Researchers; for educational research, consult the Code of Ethics of the British Educational Research Association.*	N/A
3.	If you answered NO to question 2, do you have explicit permission to use these materials as data? *If YES, please show evidence to your supervisor. PI should retain permission.*	N/A
4.	If you answered NO to question 3, is it because: A. you have not yet asked permission B. you have asked and not yet received and answer C. you have asked and been refused access. *Note* *You will only be able to start the research when you have been granted permission to use the specified material.*	**A/B/C**

Adherence to SHU policy and procedures

Personal statement	
I can confirm that: – I have read the Sheffield Hallam University Research Ethics Policy and Procedures – I agree to abide by its principles.	
Student / Researcher/ Principal Investigator (as applicable)	
Name: Martin Lamb	Date: 12/08/2016
Signature:	
Supervisor or other person giving ethical sign-off	
I can confirm that completion of this form has not identified the need for ethical approval by the FREC or an NHS, Social Care or other external REC. The research will not commence until any approvals required under Sections 3 & 4 have been received.	
Name: Professor Rob Copeland	Date: 12/08/2016
Signature: RCopeland.	
Additional Signature if required:	
Name:	Date:
Signature:	

Please ensure the following are included with this form if applicable, tick box to indicate:

	Yes	**No**	**N/A**
Research proposal if prepared previously	☐	☐	**X**
Any recruitment materials (e.g. posters, letters, etc.)	**Appendix B**	☐	☐
Participant information sheet	**Appendix C**	☐	☐
Participant consent form	**Appendix D**	☐	☐
Details of measures to be used (e.g. questionnaires, etc.)	☐	☐	**X**
Outline interview schedule / focus group schedule	**Appendix A**	☐	☐
Debriefing materials	**Appendix E**	☐	☐

Health and Safety Project Safety Plan for Procedures	☐	☐	**X**
Data Management Plan*	**Appendix F**	☐	

If you have not already done so, please send a copy of your Data management Plan to rdm@shu.ac.uk
It will be used to tailor support and make sure enough data storage will be available for your data.

Completed form to be sent to Relevant FREC. Contact details on the website.

Confirmation email of ethical approval

Dear Martin

I acknowledge receipt of your Research Ethics Checklist (SHUREC1) for the following proposed research:

Qualitative exploration of how active workstations can reduce workplace sedentary behaviour in desk-based employees.

I will register the details with the Faculty of Health & Wellbeing Research Ethics Sub-Committee.

Kind regards
Sue

Sue Wallace
Faculty of Health & Wellbeing Research Ethics Sub-Committee Senior Administrator

Health and Wellbeing Research Institute
Sheffield Hallam University
A017, Collegiate Hall,
Collegiate Crescent,
Sheffield S10 2BP

Telephone +44 (0)114 225 5628
email: s.wallace@shu.ac.uk

Appendix 4.3 Interview guide

Interview Guide

Introduction - aims of the interview, what will happen with the information gained in the interview. Why they have been asked to participate [for having an AWS]. Explain what is meant by an AWS. Give opportunity to any questions.

- What is your job role? *Administrative, sales, marketing, IT, management, manual*
- How long have you worked for the organisation?
- Have you always been in a similar role [within the organisation / elsewhere]?

- Tell me about a typical day at work?
  - *tasks,*
  - *responsibilities,*
  - *where are you based,*
  - *who do you interact with,*
  - *breaks*

In relation to your current workstation:

- Why do you have an AWS?
  - *How long have you had your AWS?*
  - *What factors influenced you getting an AWS?*
  - *Did you get to choose the workstation - [if no] who / how was it decided? [If yes] how did you decide / what options were there for you to select from?*
  - *What desk would you chose if given the option?*

- When / why do you use your AWS?
  - *Are there any particular tasks / jobs when you use it?*
  - *Which tasks is it suitable for?*
  - *What times of the day do you use your AWS?*

- How has the AWS impacted upon your work?
  - *How have you adapted to using the workstation?*
  - *What difference does using your AWS make?*
  - *Does the AWS help with [reason why they have the AWS]?*

- What are your colleague's views of you using an AWS?
  - *Do they also have AWS's?*
  - *How supportive are your employers / colleagues in you using your AWS?*

  - *How supportive were you employers / manager when requesting [if requested] your AWS?*

SUMMARY

- You have mentioned [frequency of using AWS]. How has the use of your AWS changed since receiving it?
  - *Do you use it more / less?*
  - *Why has this changed?*
  - *What information (how to use it, how frequently) did you receive when you got your AWS?*

- What changes have you seen in sitting / standing at work away from your workstation?
  - *How has your AWS affected whether you sit or stand when with colleagues / in meetings?*
  - *Outside of work do you sit or stand more / less?*

- You've already mentioned [refer back to earlier question about how frequently you sit/stand at AWS], what other opportunities are there for you to stand at work [away from AWS]?
  - *Are there any particular tasks/times of day/opportunities which require you to stand?*
  - *How/why/when do these occur?*
  - *How frequently do these occur?*
  - *Who / what influences these breaks?*

- When would be a good opportunity for you to break up prolonged sitting in the workplace?
  - *Time of the day / week / month?*
  - *Task related?*
  - *With colleagues around / meetings?*

SUMMARY

- Is there anything you would like to say/discuss in relation to what we have been talking about?

Appendix 5.1 SHUREC1 form and confirmation of ethical approval

Sheffield Hallam University

RESEARCH ETHICS CHECKLIST (SHUREC1)

This form is designed to help staff and postgraduate research students to complete an ethical scrutiny of proposed research. The SHU Research Ethics Policy should be consulted before completing the form.

Answering the questions below will help you decide whether your proposed research requires ethical review by a Faculty Research Ethics Committee (FREC). In cases of uncertainty, members of the FREC can be approached for advice.

Please note: staff based in University central departments should submit to the University Ethics Committee (SHUREC) for review and advice.

The final responsibility for ensuring that ethical research practices are followed rests with the supervisor for student research and with the principal investigator for staff research projects.

Note that students and staff are responsible for making suitable arrangements for keeping data secure and, if relevant, for keeping the identity of participants anonymous. They are also responsible for following SHU guidelines about data encryption and research data management.

The form also enables the University and Faculty to keep a record confirming that research conducted has been subjected to ethical scrutiny.

– For postgraduate research student projects, the form should be completed by the student and counter-signed by the supervisor, and kept as a record showing that ethical scrutiny has occurred. Students should retain a copy for inclusion in their thesis, and staff should keep a copy in the student file.

– For staff research, the form should be completed and kept by the principal investigator.

Please note if it may be necessary to conduct a health and safety risk assessment for the proposed research. Further information can be obtained from the Faculty Safety Co-ordinator.

Name of principal investigator or postgraduate research student	Martin Lamb
SHU email address	m.lamb@shu.ac.uk

Name of supervisor (if applicable)	Professor Rob Copeland
email address	r.j.copeland@shu.ac.uk
Title of proposed research	Validation of the Runscribe accelerometer in measuring workplace sedentary behaviour in desk-based
Proposed start date	26/06/2017
Proposed end date	17/07/2017
Brief outline of research to include, rationale & aims (500 -750 words).	Sedentary behaviour (SB), defined as any behaviour in which a person is exerting less than 1.5 METs in a seated or reclined position (Tremblay et al, 2012), has been found to be associated with a number of negative health consequences including diabetes and cardiovascular disease (Wilmot et al, 2012). Employees primarily working in desk-based occupations are exposed to prolonged periods of SB on a daily basis, with research finding that desk-based employees sit for over 70% of their working day (Thorp et al, 2012; Kazi et al, 2014). Due to the negative consequences associated with SB and the amount of time that desk-based employees spending sitting each day, research has begun to explore ways to reduce workplace SB. For studies to be able to monitor changes in SB objective measures of activity are needed. People have reported finding it hard to contextualise sitting as it is an unconscious behaviour and self-report measures of sitting have been found to be inaccurate (Maher & Conroy, 2015). A number of accelerometers have been used to measure SB, yet the ActivPAL accelerometer has been found to show better sensitivity to change in posture than other measures (Chastin et al, 2015). Due to the monitor being worn on the mid-thigh it is able to distinguish accurately between sitting, standing and stepping activities (Grant et al 2006; Ryan et al, 2006). Other accelerometers are available to measure the sitting, standing and stepping, however they have yet to be validated. The present study proposes to test the reliability and validity of the Runscribe accelerometer in measuring workplace sitting,

	standing and stepping. Once validity of the measure has been gained this accelerometer can then be used to measure changes in workplace SB.
Where data is collected from human participants, outline the nature of the data, details of anonymisation, storage and disposal procedures if these are required (300 -750 words).	Data will be collected from participants using the Runscribe accelerometer, which will provide data on the amount of time a participant has spent sitting, standing and stepping. Data on the number of transitions between postures will also be obtained. All data will be anonymous. Whilst participants are wearing the Runscribe accelerometers they will also be asked to simultaneously wear the ActivPAL accelerometer. The ActivPAL is a validated measure of sitting, standing and stepping (Grant et al 2006; Ryan et al, 2006). Participants will be asked to wear the ActivPAL next to the Runscribe on their leg, ensuring that both accelerometers capture the same data. Total sitting, standing and stepping times can then be calculated from both devices and compared to assess the accuracy of the Runscribes in measure workplace SB. Participants will also be asked to log their working hours and any time that they do not wear the accelerometers (Appendix C). All data collected will be stored on the universities Q drive, which is password protected and can only be accessed by the research team. All data will be anonymous so that participants cannot be identified in the results or any of the raw data.
Will the research be conducted with partners & subcontractors?	**Yes/No** (If **YES**, outline how you will ensure that their ethical policies are consistent with university policy.)

1. Health Related Research involving the NHS or Social Care / Community Care or the Criminal Justice System or with research participants unable to provide informed consent

Question	Yes/No
Does the research involve? Patients recruited because of their past or present use of the NHS or Social Care Relatives/carers of patients recruited because of their past or present use of the NHS or Social Care Access to data, organs or other bodily material of past or present NHS patients Foetal material and IVF involving NHS patients The recently dead in NHS premises Prisoners or others within the criminal justice system recruited for health- related research* Police, court officials, prisoners or others within the criminal justice system* Participants who are unable to provide informed consent due to their incapacity even if the project is not health related	No
Is this a research project as opposed to service evaluation or audit? *For NHS definitions please see the following website* http://www.nres.nhs.uk/applications/is-your-project-research/	No

If you have answered **YES** to questions **1 & 2** then you **must** seek the appropriate external approvals from the NHS, Social Care or the National Offender Management Service (NOMS) under their independent Research Governance schemes. Further information is provided below.

NHS https://www.myresearchproject.org.uk/Signin.aspx

* Prison projects may also need National Offender Management Service (NOMS) Approval and Governor's Approval and may need Ministry of Justice approval. Further guidance at: http://www.hra.nhs.uk/research-community/applying-for-approvals/national-offender-management-service-noms/

NB FRECs provide Independent Scientific Review for NHS or SC research and initial scrutiny for ethics applications as required for university sponsorship of the research. Applicants can use the NHS proforma and submit this initially to their FREC.

2. Research with Human Participants

Question	Yes/No
Does the research involve human participants? This includes surveys, questionnaires, observing behaviour etc. *Note If YES, then please answer questions 2 to 10* *If NO, please go to Section 3*	Yes

Will any of the participants be vulnerable? *Note ‘Vulnerable’ people include children and young people, people with learning disabilities, people who may be limited by age or sickness or disability, etc. See definition*	No
3 Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	No
4 Will tissue samples (including blood) be obtained from	No
5 Is pain or more than mild discomfort likely to result from the	No
6 Will the study involve prolonged or repetitive testing?	No
7 Is there any reasonable and foreseeable risk of physical or emotional harm to any of the participants? *Note Harm may be caused by distressing or intrusive interview questions, uncomfortable procedures involving the participant, invasion of privacy, topics relating to highly personal information,*	No
8 Will anyone be taking part without giving their informed	No
9 Is it covert research? *Note ‘Covert research’ refers to research that is conducted without the knowledge of participants.*	No
10 Will the research output allow identification of any individual who has not given their express consent to be	No

If you answered **YES only** to question **1,** you must complete the box below and submit the signed form to the FREC for registration and scrutiny.

Data will be collected from participants using the Runscribe accelerometer, which will provide data on the amount of time a participant has spent sitting, standing and stepping. Data on the number of transitions between postures will also be obtained. All data will be anonymous.

Whilst participants are wearing the Runscribe accelerometers they will also be asked to simultaneously wear the ActivPAL accelerometer. The ActivPAL is a validated measure of sitting, standing and stepping (Grant et al 2006; Ryan et al, 2006). Participants will be asked to wear the ActivPAL next to the Runscribe on their leg, ensuring that both accelerometers capture the same data. Total sitting, standing and stepping times can then be calculated from both devices and compared to assess the accuracy of the Runscribes in measure workplace SB. Participants will also be asked to log their working hours and any time that they do not wear the accelerometers (Appendix C).

All data collected will be stored on the universities Q drive, which is

password protected and can only be accessed by the research team. All data will be anonymous so that participants cannot be identified in the results or any of the raw data.

If you have answered **YES** to any of the other questions you are **required** to submit a SHUREC2A (or 2B) to the FREC. If you answered **YES** to question **8** and participants cannot provide informed consent due to their incapacity you must obtain the appropriate approvals from the NHS research governance system.

3. Research in Organisations

Question	**Yes/No**
1 Will the research involve working with/within an organisation (e.g. school, business, charity, museum, government department, international agency, etc.)?	No
2 If you answered YES to question 1, do you have granted access to conduct the research? *If YES, students please show evidence to your supervisor. PI should retain safely.*	
3 If you answered NO to question 2, is it because: A. you have not yet asked B. you have asked and not yet received an answer C. you have asked and been refused access. *Note You will only be able to start the research when you have been granted access.*	

4. Research with Products and Artefacts

Question	**Yes/No**
1. Will the research involve working with copyrighted documents, films, broadcasts, photographs, artworks, designs, products, programmes, databases, networks, processes, existing datasets or secure data?	No

If you answered YES to question 1, are the materials you intend to use in the public domain? *Notes ‘In the public domain’ does not mean the same thing as ‘publicly accessible’.* *Information which is 'in the public domain' is no longer protected by copyright (i.e. copyright has either expired or been waived) and can be used without permission.* *Information which is 'publicly accessible' (e.g. TV broadcasts, websites, artworks, newspapers) is available for anyone to consult/view. It is still protected by copyright even if there is no copyright notice. In UK law, copyright protection is automatic and does not require a copyright statement, although it is always good practice to provide one. It is necessary to check the terms and conditions of use to find out exactly how the material may be reused etc.* *If you answered YES to question 1, be aware that you may need to consider other ethics codes. For example, when conducting Internet research, consult the code of the Association of Internet Researchers; for educational research, consult the Code of Ethics of the British Educational Research Association.*	
If you answered NO to question 2, do you have explicit permission to use these materials as data? *If YES, please show evidence to your supervisor. PI should retain permission.*	
If you answered NO to question 3, is it because: A. you have not yet asked permission B. you have asked and not yet received and answer C. you have asked and been refused access. *Note You will only be able to start the research when you have been granted permission to use the specified material.*	**A/B/C**

Adherence to SHU policy and procedures

Personal statement	
I can confirm that: I have read the Sheffield Hallam University Research Ethics Policy and Procedures	
Student / Researcher/ Principal Investigator (as applicable)	
Name: Martin Lamb	Date: 25/05/17
Signature: 	
Supervisor or other person giving ethical sign-off	
I can confirm that completion of this form has not identified the need for ethical approval by the FREC or an NHS, Social Care or other external REC. The research will not commence until any approvals required under	
Name: Robert Copeland	Date:25/05/17

Signature: 	
Additional Signature if required:	
Name: Dr Simon Till	Date: 26th May 2017
Signature: 	

Please ensure the following are included with this form if applicable, tick box to indicate:

	Yes	No	N/A
Research proposal if prepared previously	☐	☐	**X**
Any recruitment materials (e.g. posters, letters, etc.)	☐	☐	**X**
Participant information sheet	**Appendix A**	☐	☐
Participant consent form	**Appendix B**	☐	☐
Details of measures to be used (e.g. questionnaires, etc.)	**Appendix C**	☐	☐
Outline interview schedule / focus group schedule	☐	☐	**X**
Debriefing materials	☐	☐	**X**
Health and Safety Project Safety Plan for Procedures	☐	☐	**X**
Data Management Plan*	**X**	☐	

If you have not already done so, please send a copy of your Data management Plan to rdm@shu.ac.uk
It will be used to tailor support and make sure enough data storage will be available for your data.

Completed form to be sent to Relevant FREC. Contact details on the website.

Confirmation email of ethical approval

Dear Martin

I acknowledge receipt of your Research Ethics Checklist (SHUREC1) for the following proposed research:

Validation of the Runscribe accelerometer in measuring workplace sedentary behaviour in desk-based employees.

I will register the details with the Faculty of Health & Wellbeing Research Ethics Sub-Committee.

Kind regards
Sue

Sue Wallace
Senior Administrator

Health and Wellbeing Research Institute

Sheffield Hallam University
A017, Collegiate Hall,
Collegiate Crescent,
Sheffield S10 2BP

Telephone +44 (0)114 225 5628
email: s.wallace@shu.ac.uk

@CSES_Shu

www.shu.ac.uk/research/cses/

Appendix 5.2 Diary given to participants to record their working hours

Participant ID: ____________________________

	Started Work	Finished Work	Time not wearing monitor
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			
Saturday			
Sunday			

Appendix 6.1 SHUREC1 form and confirmation of ethical approval

Sheffield Hallam University

RESEARCH ETHICS CHECKLIST (SHUREC1)

This form is designed to help staff and postgraduate research students to complete an ethical scrutiny of proposed research. The SHU Research Ethics Policy should be consulted before completing the form.

Answering the questions below will help you decide whether your proposed research requires ethical review by a Faculty Research Ethics Committee (FREC). In cases of uncertainty, members of the FREC can be approached for advice.

Please note: staff based in University central departments should submit to the University Ethics Committee (SHUREC) for review and advice.

The final responsibility for ensuring that ethical research practices are followed rests with the supervisor for student research and with the principal investigator for staff research projects.

Note that students and staff are responsible for making suitable arrangements for keeping data secure and, if relevant, for keeping the identity of participants anonymous. They are also responsible for following SHU guidelines about data encryption and research data management.

The form also enables the University and Faculty to keep a record confirming that research conducted has been subjected to ethical scrutiny.

- For postgraduate research student projects, the form should be completed by the student and counter-signed by the supervisor, and kept as a record showing that ethical scrutiny has occurred. Students should retain a copy for inclusion in their thesis, and staff should keep a copy in the student file.

- For staff research, the form should be completed and kept by the principal investigator.

Please note if it may be necessary to conduct a health and safety risk assessment for the proposed research. Further information can be obtained from the Faculty Safety Co-ordinator.

General Details

Name of principal investigator or postgraduate research student	Martin Lamb

SHU email address	m.lamb@shu.ac.uk
Name of supervisor (if applicable)	Professor Rob Copeland
email address	r.j.copeland@shu.ac.uk
Title of proposed research	A feasibility study examining the development of a standing habit in desk-based workers
Proposed start date	11/07/2017
Proposed end date	30/10/2017
Brief outline of research to include, rationale & aims (500 - 750 words).	Prolonged sedentary behaviour (SB) has been found to be associated with a number of negative health consequence (Wilmot et al, 2012). Employees primarily working in desk-based occupations are exposed to prolonged periods of SB on a daily basis, with research finding that desk-based employees sit for over 70% of their working day (Thorp et al, 2012; Kazi et al, 2014). Workplace interventions that have targeted reducing SB have looked to make environmental changes to the workplace, typically by introducing active workstation's (AWS's; e.g. height-adjustable desks, treadmill desks). Although AWS's have been found to significantly reduce workplace sitting by 78 mins/8-hour working day (Neuhaus et al, 2014), there is a paucity of research showing these reductions being maintained over 12-months (Ben-Her et al, 2013; Healy et al, 2016). Due to the length of time employees spend in the workplace and number of years they could be employed for, it is important that any reductions in workplace SB can be sustained over time. Before designing interventions to reduce workplace SB, there needs to be a better understanding of the determinants of SB, specifically within the workplace which is currently missing from the literature (Owen et al, 2011). The current study is part of a PhD project exploring the determinants of workplace SB. The project has consisted of two studies; an online questionnaire with desk-based employees (n=1,101) which then informed a qualitative interviews with 14 employees that had access to an AWS. The results of the two studies suggest that workplace SB is influenced by a number of interacting factors, meaning that future research needs to look at taking a whole systems approach, rather than just focusing upon a single change. The research so far has found that sitting is an unconscious behaviour and standing requires a conscious effort due to employees primarily being focused upon completing their work. The Reflective-Impulsive Model (RIM; Strack & Deutsch, 2004) is a

	two-system model which states there is a reflective and impulsive system which determines our behaviours. The RIM could be used to explain workplace SB as sitting has been reported to be an automatic and unconscious behaviour which occurs when employees are focused on their work, therefore activated by the impulsive system. Compared to sitting, standing was found to be a conscious behaviour that employees made, activated through the reflective system. According to the RIM, behaviour also does not follow on from rational decisions and behaviour is influenced by a number of different factors, which was found to be the case in studies 1 and 2 of the PhD project. Behaviour will be maintained by the impulsive system if a behaviour becomes habitual. Therefore the present studies aims to create a standing habit through encouraging employees to repeat a standing task which they already do within the workplace. Habit formation theory (Lally & Gardner, 2011) states that there are four stages progress through in developing a habit. These are; decide that a change needs to be made, translate this decision into an action, repetition of the action with continued motivation and finally repetition in a stable context to promote automaticity. As found from the previous studies a number of factors from different levels of the social ecological model appear to influence workplace behaviour. Therefore the present study will aim to make changes to the different levels of this model to encourage habit formation.
Where data is collected from human participants, outline the nature of the data, details of anonymisation, storage and disposal procedures if these are required (300 -750 words).	A two-arm cluster pilot study will be conducted with desk-based employees, aiming to create a standing habit in the workplace. The intervention arm will receive a one-hour group motivational interviewing session (MI; Velasquez et al, 2006) with the lead researcher. This session (week 1) will elicit from the participants their motivation for changing their behaviour and which standing behaviour would be most realistic to encourage and to make habitual within the workplace. The session will be conducted with a work team with the aim of encouraging all members to commit to the same goal and ensuring that the whole team understand why a colleague might stand and the benefits of standing for themselves. Support for the intervention will be gained from the organisations management and this will be explicitly stated within the session to encourage participants to stand whilst in the workplace. This stage of the intervention will aim to make individual, social and organisational changes. Once employees have collectively decided on a

	particular standing habit to introduce, implementation-intentions will be used as a way to encourage employees to commit to making a behaviour change. The implementation-intention will take the form on "if situation x arises, I will stand". Employees will be asked to self-monitor this behaviour by putting a tick or cross on a self-monitoring sheet dependent upon whether or not they complete the behaviour when an opportunity to stand arises. Environmental changes will be made to the workplace to further facilitate standing and movement. These changes could include stacking chairs in meeting rooms, movement of bins and/or printers and re-configuration of employee's desks. These changes will be dependent upon the information elicited from the participants, as employees may state that certain changes will not be suitable for their workplace. The control arm will receive no intervention; they will be monitored at the same time points as the intervention arm to see if there are any changes in their workplace SB. At the end of the trial they will receive an information booklet providing them with information of the negative consequences of SB and also strategies that can be used to reduce SB specifically within the workplace. Workplace SB and daily SB will be measured by self-report and objective measures at baseline (1 week before the group MI session), week 5 and week 10 (final week of intervention). As well as these measures of SB, completion of the standing behaviour will be measured weekly by the self-monitoring sheet and habit strength will be measured weekly using a shortened form of the self-report habit index (SRHI; Verplanken & Orbell, 2003). A shortened version of the SRHI has been used in previous research to measure change in habit strength over time (Lally et al, 2010). This will allow for the strength of the potential standing habit to be measured to see if automaticity of the habit is reached. Measures of social norms, organisational norms, intentions to stand and self-efficacy to stand shall also be measured at baseline, week 5 and week 10. The MI session will aim to influence these determinants of behaviour change; therefore the measures will highlight any significant changes in these factors. These measures will be administered through an online questionnaire sent to employees via email. Following the end of the trial (week10), participants will

	be debriefed about the study and asked to complete a feasibility questionnaire. This questionnaire will consist of open-ended questions for participants to complete in relation to how they felt the study went and opportunities for this to be implemented on a larger scale.
Will the research be conducted with partners & subcontractors?	**Yes/No** (If **YES**, outline how you will ensure that their ethical policies are consistent with university policy.)

1. Health Related Research involving the NHS or Social Care / Community Care or the Criminal Justice System or with research participants unable to provide informed consent

Question	Yes/No
1. Does the research involve? • Patients recruited because of their past or present use of the NHS or Social Care • Relatives/carers of patients recruited because of their past or present use of the NHS or Social Care • Access to data, organs or other bodily material of past or present NHS patients • Foetal material and IVF involving NHS patients • The recently dead in NHS premises • Prisoners or others within the criminal justice system recruited for health- related research* • Police, court officials, prisoners or others within the criminal justice system* • Participants who are unable to provide informed consent due to their incapacity even if the project is not health related	No
2. Is this a research project as opposed to service evaluation or audit? *For NHS definitions please see the following website* http://www.nres.nhs.uk/applications/is-your-project-research/	No

If you have answered **YES** to questions **1 & 2** then you **must** seek the appropriate external approvals from the NHS, Social Care or the National Offender Management Service (NOMS) under their independent Research Governance schemes. Further information is provided below.

NHS https://www.myresearchproject.org.uk/Signin.aspx

* Prison projects may also need National Offender Management Service (NOMS) Approval and Governor's Approval and may need Ministry of Justice approval. Further guidance at:
http://www.hra.nhs.uk/research-community/applying-for-approvals/national-offender-management-service-noms/

NB FRECs provide Independent Scientific Review for NHS or SC research and initial scrutiny for ethics applications as required for university sponsorship of the research. Applicants can use the NHS proforma and submit this initially to their FREC.

2. Research with Human Participants

Question		Yes/No
1.	Does the research involve human participants? This includes surveys, questionnaires, observing behaviour etc.	Yes
Note	*If YES, then please answer questions 2 to 10*	
If NO, please go to Section 3		
2.	Will any of the participants be vulnerable?	No
Note	*'Vulnerable' people include children and young people, people with learning disabilities, people who may be limited by age or sickness or disability, etc. See definition*	
3	Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	No
4	Will tissue samples (including blood) be obtained from participants?	No
5	Is pain or more than mild discomfort likely to result from the study?	No
6	Will the study involve prolonged or repetitive testing?	No
7	Is there any reasonable and foreseeable risk of physical or emotional harm to any of the participants?	No
Note	*Harm may be caused by distressing or intrusive interview questions, uncomfortable procedures involving the participant, invasion of privacy, topics relating to highly personal information, topics relating to illegal activity, etc.*	
8	Will anyone be taking part without giving their informed consent?	No
9	Is it covert research?	No
Note	*'Covert research' refers to research that is conducted without the knowledge of participants.*	
10	Will the research output allow identification of any individual who has not given their express consent to be identified?	No

If you answered **YES only** to question **1,** you must complete the box below and submit the signed form to the FREC for registration and scrutiny.

Data Handling

Where data is collected from human participants, outline the nature of the data, details of anonymisation, storage and disposal procedures if these are required (300 -750 words).

See section above, answering the same question.

If you have answered **YES** to any of the other questions you are **required** to submit a SHUREC2A (or 2B) to the FREC. If you answered **YES** to question **8** and participants cannot provide informed consent due to their incapacity you must obtain the appropriate approvals from the NHS research governance system.

3. Research in Organisations

Question		Yes/No
1	Will the research involve working with/within an organisation (e.g. school, business, charity, museum, government department, international agency, etc.)?	Yes
2	If you answered YES to question 1, do you have granted access to conduct the research? *If YES, students please show evidence to your supervisor. PI should retain safely.*	No
3	If you answered NO to question 2, is it because: A. you have not yet asked B. you have asked and not yet received an answer C. you have asked and been refused access. *Note* *You will only be able to start the research when you have been granted access.*	A

4. Research with Products and Artefacts

Question		Yes/No
1.	Will the research involve working with copyrighted documents, films, broadcasts, photographs, artworks, designs, products, programmes, databases, networks, processes, existing datasets or secure data?	No

2. If you answered YES to question 1, are the materials you intend to use in the public domain? *Notes ‘In the public domain’ does not mean the same thing as ‘publicly accessible’.* – *Information which is 'in the public domain' is no longer protected by copyright (i.e. copyright has either expired or been waived) and can be used without permission.* – *Information which is 'publicly accessible' (e.g. TV broadcasts, websites, artworks, newspapers) is available for anyone to consult/view. It is still protected by copyright even if there is no copyright notice. In UK law, copyright protection is automatic and does not require a copyright statement, although it is always good practice to provide one. It is necessary to check the terms and conditions of use to find out exactly how the material may be reused etc.* *If you answered YES to question 1, be aware that you may need to consider other ethics codes. For example, when conducting Internet research, consult the code of the Association of Internet Researchers; for educational research, consult the Code of Ethics of the British Educational Research Association.*	
3. If you answered NO to question 2, do you have explicit permission to use these materials as data? *If YES, please show evidence to your supervisor. PI should retain permission.*	
4. If you answered NO to question 3, is it because: A. you have not yet asked permission B. you have asked and not yet received and answer C. you have asked and been refused access. *Note You will only be able to start the research when you have been granted permission to use the specified material.*	**A/B/C**

Adherence to SHU policy and procedures

Personal statement	
I can confirm that: – I have read the Sheffield Hallam University Research Ethics Policy and Procedures	
Student / Researcher/ Principal Investigator (as applicable)	
Name: Martin Lamb	Date: 09/06/2017
Signature: 	
Supervisor or other person giving ethical sign-off	
I can confirm that completion of this form has not identified the need for ethical approval by the FREC or an NHS, Social Care or other external REC. The research will not commence until any approvals required under	
Name: Professor Rob Copeland	Date: 09/06/2017

Signature: R Copeland.	
Additional Signature if required:	
Name:	Date:
Signature:	

Please ensure the following are included with this form if applicable, tick box to indicate:

	Yes	No	N/A
Research proposal if prepared previously	☐	☐	☐
Any recruitment materials (e.g. posters, letters, etc.)	☐	☐	☐
Participant information sheet	**Appendix C**	☐	☐
Participant consent form	**Appendix B**	☐	☐
Details of measures to be used (e.g. questionnaires, etc.)	**Appendix A**	☐	☐
Outline interview schedule / focus group schedule	☐	☐	☐
Debriefing materials	**Appendix D**	☐	☐
Health and Safety Project Safety Plan for Procedures	☐	☐	☐
Data Management Plan*	**Appendix C**	☐	

If you have not already done so, please send a copy of your Data management Plan to rdm@shu.ac.uk
It will be used to tailor support and make sure enough data storage will be available for your data.

Completed form to be sent to Relevant FREC. Contact details on the website.

Confirmation of ethical approval

Dear Martin

I acknowledge receipt of your Research Ethics Checklist (SHUREC1) for the following proposed research:

A feasibility study examining the development of a standing habit in desk-based workers

I will register the details with the Faculty of Health & Wellbeing Research Ethics Sub-Committee.

Kind regards
Sue

Sue Wallace
Faculty of Health & Wellbeing Research Ethics Sub-Committee Senior Administrator

Health and Wellbeing Research Institute

Sheffield Hallam University
A017, Collegiate Hall,
Collegiate Crescent,
Sheffield S10 2BP

Telephone +44 (0)114 225 5628
email: s.wallace@shu.ac.uk

Appendix 6.2 Information sheet for participants used in Study 3

A feasibility study examining the development of a standing habit in desk-based workers

I would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask questions if anything you read is not clear or would like more information. Take time to decide whether or not to take part.

What is the purpose of the study?

This study is being completed as part of a PhD at Sheffield Hallam University (SHU) which is exploring activity (sitting, standing and walking) within the workplace.

Why have I been invited?

You have been invited to participate as you currently work in an office, in a job role which is primarily desk-based.

Do I have to take part?

It is up to you to decide. We will describe the study and go through the information with you. If you decide to participate, we will then ask you to sign a consent form to show you agreed to take part. You are free to withdraw at any time, without giving a reason.

What will I be required to do?

The study is looking to measure changes in workplace activity (sitting, standing and walking) over an 11 week period. You will either be randomly allocated to a control or intervention group. If you are in the intervention group you will be asked to attend a 1-hour session with the lead researcher and some of your colleagues to discuss the study and your activity within the workplace. Participants in the control condition will not have to attend a workshop and at the end of the intervention receive information on workplace activity.

All participants will be asked to wear a device called an accelerometer which can be used to monitor activity within the workplace. This is a small device worn on the thigh and is designed to be worn under clothing. When wearing the device you will hopefully not notice that it is there and you would not be expected to do anything with the device. We will be asking participants to wear one of these devices for three, 5-day periods over the 11 weeks at week 1, 6 and 11. As well as wearing the device we will be asking participants to complete short questionnaires about themselves and their behaviours within the workplace again at weeks 1, 6 and 11. These questionnaires will be sent to you via email and are designed to be short and easy to complete, typically consisting of tick-box questions. The questions are not designed to test you and all data collected will be anonymous. Each week you will also be sent four questions to answer but should be quick and easy for you to complete.

Where will this take place?

This will take place where you work; the researcher will come to you. All questionnaires will be completed online and sent to you via an email.

When will I have the opportunity to discuss my participation?

Before agreeing to participate in the study, if interested, you will be contacted by the lead researcher to discuss the study and ask any questions about what will be expected. Throughout the study period you will also have contact details for the research team so that if you wish you can discuss any issues with them. Following completion of the 11 weeks the lead researcher will debrief you so that again you have the opportunity to discuss the study with the researcher.

Will my taking part in the study be kept confidential?

Yes, all information that you provide will remain confidential and will be anonymised following completion of the 11 weeks, so that you cannot be identified. Your organisation and job role will also be anonymised. If you participate in the group session you will be with colleagues, therefore others will know what you have said in that session, however the whole group will be asked to keep anything discussed confidential and within the group. Any other information that is provided in the questionnaires or activity data will not be shared with any other participants, only the research team will have access to this.

At the beginning of the study, if you decide to participate, you will be asked to create a unique ID for yourself to use throughout the study. As data will be collected in different ways and at different points over the 11 weeks, this ID will be used to link all of your data together so that changes can be monitored. However the ID will not be able to identify yourself and these ID's will not be used when discussing the findings of the research outside of the research team.

What will happen if I don't carry on with the study?

If you decide at any point that you do not want to carry on with the study that is fine, all the data that you have provided will be removed from the study. You will be free to withdraw from the study at any point before or during the study, and you do not have to answer any questions on the questionnaires if you do not feel comfortable answering them. Once you have completed the study you will then have two weeks to withdraw. After this time you will no longer be able to withdraw as your data will have been fully anonymised so we will no longer be able to identify your data to withdraw.

What will happen to the results of the research study?

The results from the study will be written up as part of the final PhD thesis and potentially for publication in a journal or conference presentation. As mentioned all data that is used will be anonymised. We will also be happy to send you a copy of the results once all analysis has been completed.

Further information and contact details:

You will be given the opportunity to ask the researcher any questions before you agree to participate in the study. You can also contact the lead researcher (Martin Lamb) or the Director of Studies for the PhD (Professor Rob Copeland) at any point to ask any questions.

Martin Lamb
Health & Wellbeing Research Institute
Sheffield Hallam University
Chestnut Court,
Collegiate Crescent,
Sheffield. S10 2BP

Email: m.lamb@shu.ac.uk

Professor Rob Copeland: r.j.copeland@shu.ac.uk

Appendix 6.3 PowerPoint slides used for the intervention workshop


When to
Stand...


Standing Strategy

Monitoring Standing

Any Questions...

Appendix 6.4 Self-monitoring sheet (presented on a single A4 side)

Did you stand to ....

....

Yes	No

Participant ID:

....

Week Commencing:

....

Appendix 6.5 Measures sent to participants in Study 3

A feasibility study exploring the development of a standing habit in desk-based workers

Demographic Information: *(baseline measure)*

Age: ______

Gender: ________________

To which of the following groups do you consider you belong? *(Please circle one)*

White - British	Black or Black British - African
White - Irish	Black or Black British - Any other Black background
White - Any other White background	Asian or Asian British - Indian
Mixed - White & Black Caribbean	Asian or Asian British - Pakistani
Mixed - White & Black African	Asian or Asian British - Bangladeshi
Mixed - White & Asian	Asian or Asian British - Any other Asian background
Mixed - Any other Mixed background	Chinese
Black or Black British - Caribbean	Prefer not to say

What is the highest level of education you have achieved? *(Please circle one)*

GCSE / O-Level's / CSE's

A-Level / AS-Level

BTEC / GNVQ / NVQ

Degree (e.g. BSc, BA)

Higher Degree (e.g. MSc, MA, MEng, PGCE)

Doctorate

No Qualification

Other; ____________________________

During the past month, which statement best describes the kinds of physical activity you usually did? Do not include the time you spent working at a job.

Please read all six statements before selecting one.

1. I did not do much physical activity. I mostly did things like watching television, reading, playing cards, or playing computer games. Only occasionally, no more than once or twice a month, did I do anything more active such as going for a walk or playing tennis.	
2. Once or twice a week, I did light activities such as getting outdoors on the weekends for an easy walk or stroll. Or once or twice a week, I did chores around the house such as sweeping floors or vacuuming.	
3. About three times a week, I did moderate activities such as brisk walking, swimming, or riding a bike for about 15–20 minutes each time. Or about once a week, I did moderately difficult chores such as raking or mowing the lawn for about 45–60 minutes. Or about once a week, I played sports such as football, rugby, or badminton for about 45–60 minutes.	
4. Almost daily, that is five or more times a week, I did moderate activities such as brisk walking, swimming, or riding a bike for 30 minutes or more each time. Or about once a week, I did moderately difficult chores or played sports for 2 hours or more.	
5. About three times a week, I did vigorous activities such as running or riding hard on a	

bike for 30 minutes or more each time.	
6. Almost daily, that is, five or more times a week, I did vigorous activities such as running or riding hard on a bike for 30 minutes or more each time.	

Habit Strength: *(this will be completed weekly by participants in the intervention group after the group MI session and then weekly)*

"Behaviour X" in the workplace is something . . .

I do automatically.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

I do without having to consciously remember.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

I do without thinking.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

that would require effort not to do it.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

I start doing before I realise I’m doing it.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

I would find hard not to do.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly
Agree

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly
Agree

[This will be completed by both the intervention and control arms at baseline, week 5 and week 10]

Standing in the workplace is something . . .

I do automatically.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

I do without having to consciously remember.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

I do without thinking.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

that would require effort not to do it.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

I start doing before I realise I'm doing it.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly Agree

I would find hard not to do.

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly
Agree

1 2 3 4 5 6 7

Strongly Disagree Not Sure Strongly
Agree

Organisational Norms: *(The following measures will be completed at baseline, week 5 and week 10, by both the intervention and control arms)*

Please indicate how much you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
My workplace is committed to supporting staff health and well-being					
It would be strange if I was to stand whilst doing my work					
My colleagues would not mind if I chose to stand up while working at my desk					
My supervisors would not mind if I chose to stand up while working at my desk					
My colleagues would not mind if I chose to stand during a work meeting					
It would be strange for me to stand during a meeting if all of my colleagues were sat down					

Behavioural Control:

Please indicate how much you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
It is my choice whether I stand up or sit at my desk while at work					
It is my choice whether I stand up or sit during a meeting with <u>colleagues</u> at work					
It is my choice whether I stand up or sit during a meeting with my <u>supervisors</u> at work					
It is my choice whether I walk over to talk to a <u>colleague</u> or send them an e-mail					
It is my choice whether I walk over to talk to a <u>supervisor</u> or send them an e-mail					

Daily Activity:

Please estimate on a typical WORKING day and NON-WORKING day, how much time you spend sitting in the following situations

(Please enter the number of hours and minutes e.g. 1 hour 45mins. Enter 0 if you are not sat down in any of these situations)

	Working Day		**Non-Working Day**	
	Hours	Minutes	Hours	Minutes
a. For TRANSPORT (e.g. in car, bus, train, etc)				
b. At WORK (e.g. sitting at a desk or using a computer)				
c. Watching TV				
d. Using a computer at home (e.g. email, games, information, chatting)				
e. Other leisure activities (e.g. socialising, movies etc, but NOT including TV or computer use)				

How many *days* do you work in a typical week? __________
Days

How many *hours* do you work in a typical week? __________
Days

Appendix 6.6 - Environmental audit measure and results

Environmental Audit

OFFESS (Duncan et al, 2014)

My desk is: (Please pick one that is most relevant)

- At a fixed sitting height
- Can be moved up and down
- At a fixed standing height

Do you have or could you access a standing or height-adjustable desk within your office?

- Yes
- No
- Don't know

Within my office there are options for me to stand up to complete my work… (Please select how much you agree or disagree with this statement)

- Strongly agree
- Agree
- Neither agree or disagree
- Disagree
- Strongly disagree

Which of the following best describes the location of the majority of desks/workstations in your building? *(Please circle the option that is most relevant)*

6. In an office separated from other offices by floor to ceiling walls, door, not shared with anyone else

7. In an office separated from other offices by floor to ceiling walls, door, shared by 2–4 people
8. In a single area containing many desks/workstations separated by high partitions (greater than 1.5m (5 feet) in height)
9. In a single area containing many desks/workstations separated by low partitions (less than 1.5 m (5 feet) in height)
10. In a single area containing many desks/workstations separated by no partitions.

Hallways and passageways in my building frequently intersect each other

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

Clearly defined pathways for travel between workstations frequently intersect with each other

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

I can access kitchen or coffee rooms directly from hallways/passageways

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

I can take many different travel routes through the office to reach the same destination when travelling

- Strongly agree
- Agree
- Disagree

- Strongly Disagree

My office building has many rooms that are difficult to find

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

Walking in my building requires frequent changes in direction one after another

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

To travel from my workstation/desk to the closest toilet requires many changes in direction

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

To travel from my workstation/desk to the closest meeting room/area requires many changes in direction

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

To travel from the main entry of my building/floor to my workstation/desk requires many changes in direction

- Strongly agree
- Agree

- Disagree
- Strongly Disagree

Walking from my own workstation/desk to most others in the building requires many changes in direction

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

There are many other workstations/desks located in my building within a short walk of my workstation/desk

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

In the area surrounding my workstation/desk there are lots of other workstations/desks

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

From my workstation/desk I can see several colleagues sitting or standing at their workstations/desks (do not include offices with the door closed)

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

I frequently "bump in to" other people when walking in my building

- Strongly agree

- Agree
- Disagree
- Strongly Disagree

I frequently see people/other employees walking around inside the building

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

I frequently see people/other employees standing and talking inside the building

- Strongly agree
- Agree
- Disagree
- Strongly Disagree

CHEW

Office Building	
Work offices are based on which floor?	
Worksite is on how many floors?	
Is the building freestanding or connected to other buildings?	
Where are the nearest showers located?	
Office Space	
Does the worksite have standing or height-adjustable desks? If Yes how many?	

Are the AWS's available for all employees to use?	
Number of signs/posters generally encouraging physical activity (other than related to stairs)	
Number of notices about onsite exercise classes	
Number of notices about offsite physical activity/sports sponsored by the specific worksite	
Number of notices about offsite physical activity/sports sponsored by other organisations (this can include the parent company)	
Number of other notices about physical activity/sports	
Number of bulletin boards dedicated to health promotion	
Number of postings related to combination of diet, physical activity, smoking, or alcohol	
Where are the nearest kitchen/catering facilities located?	
Where are the nearest toilets located?	
Are there central printers or personal printers?	
Elevator Checklist	
Elevator (or sign) visible from major employee entrance	
Sign encouraging use of stairs at elevators	
Stair Checklist	
Staircase not enclosed in stairwell	
Able to see stairs from entrance	
Carpeted painted/decorated/finished walls	

Utilities not visible in stairwell (e.g., gas pipes, electric wires)	
Door is ajar on most or all floors	
Door is unlocked on most floors	
Door marked ‘‘stairs’’ (not just exit)	
No warnings or cautions on door	
Floor number labelled inside of stairway	
No restricted exit (locked from inside)	
Signs encouraging use of stairs	

Environmental audit results

Participants in each group completed a self-report measure which rated connectivity within the workplace on three scales; local connectivity, overall connectivity, and proximity of co-workers. Parametric assumptions were met for each of the scales; therefore independent samples t-tests were conducted to compare the differences between groups. Descriptive statistics for each group and scale are presented in table 5.6.

Table 5.6 The descriptive statistics for the environmental audit

	Intervention		***Control***	
	Mean	***SD***	***Mean***	***SD***
Local Connectivity	7.67	1.97	9.00	1.41
Proximity of Co-Workers	5.17	1.72	4.67	2.07
Overall Connectivity	14.33	4.18	15.50	2.88

Results from the three t-tests found that there was no significant difference between groups for local connectivity ($t(10)=-1.35$, $p=0.21$), overall connectivity ($t(10)=-0.56$, $p=0.59$), or proximity of co-workers ($t(10)=0.46$, $p=0.66$).

The lead researcher also conducted an observational audit of each of the worksites and offices where the teams were based. Both offices had access to AWS's, were located on the third floor, and the locality of bathrooms and refreshment facilitates were within a similar proximity. The remaining items of the measure explored the stairs available and notices about PA within the workplace. No direct scores can be calculated for these; nevertheless the observations for each were similar for each worksite.

Appendix 7.1 Focus group guide

- **Confidentiality** - aim of the session, honesty, confidentiality between participants.
- Withdrawal & Anonymity

- **Why did you decide to participate in the study?**
  - What were your expectations?
  - What was your motivation for participating?
  - What would have led to you not participating?
  - What do you think the study was trying to do?
  - What was your prior knowledge of sedentary behaviour?

- **How have you found participating in the study?**
  - Have your expectations changed?
  - Did you expect more or less from the study?
  - How do you think your behaviours have changed over the intervention period?

- **How did you find the workshop at the start of the study?**
  - Did you learn anything from it?
  - Was it clear at the end of the session what was expected?
  - How did it change your motivation?
  - Did this motivation change over time?
  - How comfortable did you feel being in the session with your colleagues?
- **How did you find the self-monitoring/tick sheets?**
  - How did they influence your behaviour?
  - Did you remember to complete them?
  - Did it encourage/remind you to change your behaviour?

- **How did your colleagues influence your behaviour?**
  - Did colleagues in the study make you more active?
  - Did you feel comfortable to be more active around your colleagues in the study?
  - Has this changed over the course of the study?

- **How did your organisation/managers influence your behaviour?**
  - Has this changed over the course of the study?

- **How in control of your behaviours/choices to stand do you feel?**

    - Has this changed over the course of the study?

- **How did you find wearing the activity monitors?**
    - How did they influence your behaviour?
    - Do you/have you tracked your activity before and how did you find this?
    - How comfortable was it wearing the monitor and remembering to wear it?

- **How did you find completing the online questionnaires?**
    - Were they easy to complete and to follow?
    - How long did they take to complete?
    - How did they influence your participation or affect your behaviour?

- **How have your behaviours changed over the intervention period?**
    - What have you taken away from the study?
    - What will stick with you?
    - Are you glad it's over?!

- **What did you want from participating in the study?**

- **Do you have any questions about the research?**