walk@work

Using information and communication technology to reduce sitting and increase physical activity in office workers

Judit Bort Roig – 2015

DOCTORAL THESIS

Supervised by:
Dr. Anna Mª Puig Ribera and Dr. Nicholas D. Gilson

A thesis submitted for the degree of Doctor of Philosophy in:
Welfare, Health and Quality of Life

Universitat de Vic-Universitat Central de Catalunya

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Facultat d'Educació, Traducció i Ciències Humanes
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If we can now develop and implement effective policies and programs to encourage and enable more people be more active more of the time, this will truly be a "Triumph of Epidemiology"

Steven M. Blair and Jeremy N. Morris (2009, p.256)

Abstract

Background. Sitting too much and moving too little affects the development of many chronic diseases. Office workplaces are key settings to reduce and break up occupational sitting by replacing sedentary time with step counts. A better understanding of which strategies can encourage office workers to 'sit less and move more', and the role technology can play in delivering these strategies is needed.

Aims. The overarching aim of the thesis was to investigate the impact of an intervention to reduce occupational sitting time and increase physical activity in Spanish office workers. Assessment of technology based strategies and the role of web and mobile-based behaviour change platforms were a focus of the thesis, and were examined through three specific studies that: (a) evaluated the effectiveness of an automated web-based workplace program (*Walk@WorkSpain*-W@WS) on reducing occupational sitting, increasing step counts and improving physical risk factors among office Spanish workers (Study One); (b) investigated the uptake of W@WS strategies that reduced sitting time and increased walking, and explored factors that enabled or limited uptake of these strategies (Study Two); and (c) systematically reviewed evidence on measuring and influencing physical activity using smartphone technology (Study Three).

Methods. Study One used a quasi-experimental pre-post design. Administrative and academic workers at six Spanish university campuses (n=264; 42±10 years; 171 women) were randomly assigned by workplace and campus to an intervention (used W@WS; 19 weeks; n=129; 87 women) or a comparison group (maintained normal behaviour; n=135; 84 female). The intervention consisted of (a) a ramping phase (8 weeks) to progressively increase baseline step counts through incidental movement, short and long walks, and higher step count frequency and intensity; and (b) a

maintenance phase (11 weeks) with automated guidance. Changes in outcome measures (step counts, self-reported sitting time, body mass index, waist circumference and blood pressure) were assessed between baseline, ramping, maintenance and follow-up (two months) phases for intervention versus comparison groups, using linear mixed model analyses.

Study Two conducted semi-structured interviews with 12 W@WS participants (44±12 years; 6 women) at three points across the intervention. Workers (n=88; 42±8 years; 51 women) who finished the intervention completed a survey (generated from the interview thematic analysis) rating the extent to which ‘sit less, move more’ strategies were used (never [1] to usually [4]) and those factors that enabled or limited strategy uptake (no influence [1] to very strong influence [4]). Survey score distributions and averages were calculated and findings triangulated with interview data.

Progressing the learning of the previous two studies, Study Three systematically reviewed evidence on smartphones and their viability for measuring and influencing physical activity. The databases Web of Knowledge, PubMed, PsycINFO, EBSCO, ScienceDirect, and Scopus were searched for relevant articles up to September 2013. The search strategy used the keywords (physical activity OR exercise OR fitness) AND (smartphone* OR mobile phone* OR cell phone*) AND (intervention OR measurement). Reviewed articles were required to be published in international academic peer-reviewed journals or in full text from international scientific conferences. Data on study characteristics, technologies used, strategies applied, and the main study findings were extracted and reported.

Results. Study One identified a significant 2 (group) × 2 (program phases) interaction for self-reported occupational sitting ($F[3]=7.97$, $p=0.046$), daily step counts ($F[3]=15.68$, $p=0.0013$) and waist circumference ($F[3]=11.67$, $p=0.0086$). The intervention group decreased minutes of daily occupational sitting while also increasing step counts from baseline (446±126 minutes/day; 8,862±2,475 steps/day) through ramping (-21 minutes/day; +483 steps/day), maintenance (-24 minutes/day; +776 steps/day) and follow-up (-32 minutes/day; +924 steps/day). In the comparison group, compared to baseline (404±106), sitting time remained unchanged through ramping and maintenance, but decreased at follow-up (-16 minutes/day), while step counts diminished across all phases. Larger reductions in waist circumference were observed in the intervention (-2.1±0.3 cm) compared with the comparison group (-1.3±0.3 cm).

Study Two survey data indicated that 'active work tasks' (e.g. moving around the office while talking on the phone or reading documents) and 'increases in walking intensity' (e.g. using the stairs instead of lifts or escalators) were the strategies most frequently used by W@WS participants (89% and 94% sometimes or usually utilised these strategies respectively). 'Walk-talk meetings' and 'lunchtime walking groups' were the least used (80% and 96% hardly ever or never utilised these strategies respectively). Thematic analyses of interview data highlighted that inherent time pressures and existing cultural norms limited the use of these W@WS strategies. 'Sitting time and step count logging' (mean survey score of 3.1±0.8) was the most important enabler of behaviour change while 'screen based work' (mean survey score of 3.2±0.8) was the most significant barrier limiting the uptake of strategies.

Study Three identified 26 articles that met inclusion criteria. Studies measured physical activity using native mobile features, and/or an external device linked to an application. Measurement accuracy ranged from 52 to 100% (n=10 studies). Smartphone strategies to influence physical activity tended to be ad hoc, rather than theory-based approaches. Only five studies assessed physical activity intervention effects; all used step counts as the outcome measure. Four studies (three pre–post and one comparative) reported physical activity increases (12–42 participants, 800–1,104 steps/day, 2 weeks–6 months), and one case-control study reported physical activity maintenance (n=200 participants; 10,000 steps/day) over 3 months.

Strengths and limitations. Thesis findings provide important and original contributions to the evidence base on workplace physical activity interventions to reduce occupational sitting through ICTs. The studies included are the first to use a parallel mixed methods design targeting a combined range of occupational sitting and moving strategies, and undertake a systematic review synthesising the role of smartphones in physical activity promotion. The thesis responds to a growing need to develop, test and evaluate programs that have the potential to be easily implemented and translated into the day-to-day life of busy office based organisations and workers.

A number of limitations and learning for future research are also apparent. The heterogeneity of W@WS participants highlights the need for on-going research with other office-based workers. Adherence to behaviour change was measured two months post intervention, and provides short to mid-term evidence on impact. Future studies need to extend assessment duration to better evaluate program sustainability. Finally, although the use of web-based approaches can be considered valuable to promote behavioural change in workplaces at low cost, smartphone technology provides new and more accessible solutions in this regard.

Conclusions. W@WS was effective in achieving small but sustained changes in occupational sitting and step counts by facilitating the uptake of a menu of 'sit less and move more' strategies, that can overcome office work environmental barriers. The thesis findings provide practical information that can guide managers and occupational health services on promoting ecological and cost-effective interventions to elicit positive changes in energy expenditure. New smartphone technology needs to be a central feature of ICT based interventions that target occupational sitting and physical activity given the novel and engaging capabilities these devices provide for measuring and influencing behaviour change in real time.

Resum (Catalan version)

Introducció. Passar-se moltes hores assegut i moure's poc està associat al desenvolupament de malalties cròniques. Els llocs de treball d'oficina han estat considerats entorns clau per reduir aquests comportaments sedentaris amb substitució d'activitats que impliquen una major despesa energètica. Tot i això, es necessita una millor comprensió de les estratègies que millor s'adapten al dia a dia dels treballadors, així com també, del paper que juguen les noves tecnologies en aquest sentit.

Objectius. L'objectiu principal de la tesi és investigar l'impacte d'una intervenció per reduir el temps assegut i augmentar l'activitat física en treballadors d'oficina a l'estat espanyol; a través de tres objectius específics d'estudi: (a) avaluar l'efectivitat d'un programa a la feina, basat en tecnologia web (Walk@WorkSpain-W@WS), en la reducció del temps assegut, l'augment del nombre de passes caminant i la millora de factors de risc cardiovasculars de treballadors d'oficina (Estudi 1); (b) explorar la usabilitat de les estratègies per 'seure's menys i moure's més' emprades al programa W@WS i els factors facilitadors o limitadors d'aquestes estratègies (Estudi 2); i (c) revisar sistemàticament la literatura per entendre si els 'smartphones' poden ajudar a aconseguir aquest canvi de comportament, a través de la mesura i la promoció de l'activitat física (Estudi 3).

Mètodes. En l'estudi 1, es va dur a terme un disseny quasi-experimental amb grup control pre-post. Treballadors de sis campus universitaris espanyols (n=264; 42±10 anys; 171 dones) van ser assignats a l'atzar, per lloc de treball, al grup intervenció (utilitzant el programa W@WS durant 19 setmanes; n=129; 87 dones) o al grup control (mantenint el seu comportament habitual; n=135; 84 dones). La intervenció va consistir amb (a) una fase d'increment progressiu de nombre de passes (8 setmanes), mitjançant tasques laborals actives, rutes caminant, i l'augment de la intensitat caminant; i (b) una fase de manteniment (11 setmanes), amb un assessorament

automatitzat. Es va utilitzar un model mixt lineal per comparar entre grups les mesures pre-intervenció (temps assegut, passes caminant, índex de massa corporal, perímetre de cintura i tensió arterial) amb les de les fases d'increment i manteniment del programa així com també als dos mesos de seguiment.

En l'estudi 2 es varen realitzar entrevistes semi-estructurades a 12 participants del programa W@WS (44±12 anys; 6 dones) en tres moments al llarg de la intervenció. A partir de les dades generades qualitativament mitjançant un anàlisi temàtic, els treballadors del grup intervenció (n=88; 42±8 anys; 51 dones) varen completar una enquesta per identificar el grau d'ús de les estratègies [de mai (1) a habitualment (4)] i aquells factors que varen influir positiva o negativament en el seu ús [de cap influència (1) a forta influència (4)]. Es varen calcular les distribucions i les mitjanes de puntuació de l'enquesta i aquestes es varen triangular amb les dades de les entrevistes.

En l'estudi 3, una revisió sistemàtica (fins setembre 2013) va estudiar la viabilitat de l'ús dels 'smartphones' per mesurar i promoure estils de vida actius. Es varen cercar les bases de dades Web of Knowledge, PubMed, PsycINFO, EBSCO, ScienceDirect, i Scopus seguint la següent estratègia: (physical activity OR exercise OR fitness) AND (smartphone* OR mobile phone* OR cell phone*) AND (intervention OR measurement). Es varen incloure articles complerts publicats en revistes o en conferències científiques internacionals.

Resultats. L'estudi 1 va mostrar una interacció significativa 2 (grup) × 2 (fases) en temps assegut (F[3]=7,97, p=0,046), nombre de passes (F[3]=15.68, p=0,0013) i perímetre de cintura (F[3]=11,67, p=0,0086). El grup intervenció va disminuir el temps assegut i augmentar el nombre de passes diari al llarg del programa (-24 minuts/dia; 776 passes/dia), però també en la fase de seguiment (-32 minuts/dia; 924 passes/dia). En el grup control, el nombre de passes va disminuir al llarg del programa mentre que el temps assegut es va mantenir sense canvis però va disminuir a la fase de seguiment (-16 minutes/dia). El grup d'intervenció va reduir el perímetre de cintura significativament (-2.1±0,3 cm) i amb major magnitud que el grup control (-1,3±0.3 cm) des de l'inici del programa fins als dos mesos posteriors.

L'estudi 2 va descriure les tasques de treball més actives i l'augment de la intensitat caminant, com les estratègies més utilitzades (el 89% i el 94% respectivament, varen respondre de vegades o habitualment). Les reunions actives i els grups de caminar a l'hora del dinar van ser les menys utilitzades a causa la manca de temps i les normes culturals inherents als llocs de treball (el 80% i el 96% respectivament, varen respondre gairebé mai o mai). Registrar el nombre de passes i el temps assegut va ser el factor facilitador més important (mitjana de puntuació del qüestionari, 3.1±0.8), mentre que tenir una feina basada en tasques d'ordenador va ser la barrera més prevalent (mitjana de puntuació del qüestionari, 3.2±0.8).

En l'estudi 3, vint-i-sis articles van complir els criteris d'inclusió. La fiabilitat en la precisió de mesura d'aquests patrons d'activitat física i comportament sedentari va ser del 52-100% (n=10). Només cinc estudis van avaluar els efectes d'intervenció: utilitzant disseny pre-post (n=3) i un amb grup control (n=1). Els primers varen mostrar augments dels nivells d'activitat física (12-42 participants, 800-1,104 passes/dia, 2 setmanes-6 mesos), i el segon va mostrar-ne un manteniment (200 participants; 10.000 passes/dia) durant 3 mesos.

Fortaleses i limitacions. Els resultats de la tesi proporcionen contribucions rellevants sobre les intervencions d'activitat física en el lloc de treball per reduir el temps assegut ocupacional mitjançant les noves tecnologies. Els estudis inclosos són els primers en avaluar aquestes intervencions a través d'una metodologia mixta, i en revisar sistemàticament el paper dels 'smartphones' en la promoció de l'activitat física. També es fan evidents una sèrie de limitacions i aprenentatges per a futures investigacions, com són: (a) estudiar l'efecte del programa amb altres grups de treballadors d'oficina,

(b) avaluar la sostenibilitat del programa a més llarg termini, i (c) integrar l'ús de noves tecnologies com els 'smartphones' en intervencions per promoure el canvi de comportament a la feina.

Conclusions. La integració d'un menú d'estratègies per seure's menys i moure's més a la feina (W@WS) és efectiu en l'assoliment de canvis petits però sostinguts en el nombre de passes caminant i el temps assegut ocupacional. Degut al potencial dels 'smartphones' per mesurar patrons d´activitat física i influir en estils de vida actius, futurs estudis amb millor disseny haurien d´avaluar l´efectivitat d´aquests dispositius en intervencions de reducció del temps assegut en els llocs de treball.

Declaration by author

This thesis is comprised of original work. Jointly-authored works included, are clearly stated in each study that composes the thesis. Co-authors declare acceptance of being part of it.

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Publications during candidature

Journal publications

Study One:

- Puig-Ribera A, **Bort-Roig J**, González-Suárez AM, Martínez-Lemos I, Giné-Garriga M, Fortuño J, Martori JC, Muñoz-Ortiz L, Milà R, McKenna J, Gilson ND. Patterns of impact resulting from a ‘sit less, move more’ web-based program in sedentary office employees. PLOS One. 2015;**10**(4):e0122474.

Study Two:

- **Bort-Roig J**, Martin M, Puig-Ribera A, González-Suárez AM, Martínez-Lemos I, Martori JC, Gilson ND. Uptake and factors that influence the use of ‘sit less, move more’ occupational intervention strategies in Spanish office employees. International Journal of Behavioral Nutrition and Physical Activity. 2014;**11**:152.

Study Three:

- **Bort-Roig J**, Gilson ND, Puig-Ribera A, Contreras RS, Trost SG. Measuring and Influencing Physical Activity with Smartphone Technology: A Systematic Review. Sports Medicine Journal. 2014;**44**(5): 671-686.

Additional study:

- Puig-Ribera A, Martínez-Lemos I, Giné-Garriga M, González-Suárez AM, **Bort-Roig J**, Fortuño J, Martori JC, Muñoz-Ortiz L, McKenna J, Gilson ND. Self-reported sitting time and physical activity: Interactive associations with mental well-being and productivity in office employees. BMC Public Health. 2015;**15**:72.

Published abstracts

Bort-Roig J, Puig-Ribera A, Gonzalez AM, Martínez-Lemos I, Giné-Garriga M, Fortuño, Martori JC, Gilson ND. Walk@WorkSpain: Factores asociados a la reducción de grasa abdominal después de participar en un programa de “sentarse menos y moverse más” en empleados de oficina. Revista Española de Cardiologia. 2013; **21**(Suppl 1).

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Bort-Roig J, Puig-Ribera A, González-Suárez AM, Martínez-Lemos I, Giné-Garriga M, Fortuño, Martori JC, Gilson ND. Walk@WorkSpain: Factores asociados a la reducción de grasa abdominal después de participar en un programa de "sentarse menos y moverse más" en empleados de oficina. Oral presentation: Sociedad Española de Cardiología. Valencia, Spain, 2013.

Bort-Roig J, Puig-Ribera A, González-Suárez AM, Martínez-Lemos I, Giné-Garriga M, Fortuño J, Gilson ND. Walk@WorkSpain: Effectiveness on increasing physical activity levels in office employees. Oral presentation: 18th annual Congress of the European College of Sport Science (ECSS). Barcelona, Spain, 2013.

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Puig-Ribera A, **Bort-Roig J**, González-Suárez AM, Martínez-Lemos I, Giné-Garriga M, Fortuño J, Muñoz L, Gilson ND. Does it improve job productivity in office employees? Poster: 18th annual Congress of the European College of Sport Science (ECSS). Barcelona, Spain, 2013.

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Bort-Roig J, Contreras RS. State of the Art Reviews: The Measurement of Physical Activity Using Mobile Phones. Oral presentation: 4th International Congress On Physical Activity & Public Health (ICPAPH). Sydney, Australia, 2012.

Bort-Roig J, Puig-Ribera A, Gilson N, González-Suárez AM, Martínez-Lemos I, Giné-Garriga M, Fortuño J. A 5-months workplace pedometer-based intervention: Did it change employees! sedentary behaviour 2 months after removal? Oral presentation: 4th International Congress On Physical Activity & Public Health (ICPAPH). Sydney, Australia, 2012.

Martin. M, **Bort-Roig J**, Puig-Ribera A. "You're going to tell me off!" Promoting sitting less and walking more at the workplace. Oral presentation: ISSA World Congress of Sociology of Sport. Glasgow, UK, 2012.

Puig-Ribera A, Martínez-Lemos I, Giné-Garriga M, Fortuño J, González-Suárez AM, Gilson N, **Bort-Roig J**. Occupational sitting times, job productivity and related work loss in Spanish university employees: Preliminary analyses of baseline data. Poster: ACSM's 58th Annual Meeting. Denver, Colorado, US, 2011.

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INTRODUCTION

For most of evolutionary history, humans have directly depended on high levels of physical activity for survival.[1] However, the transition from hunter-gatherer and agriculturalist, to a modern technology based lifestyle, characterised by sedentary occupations, has drastically reduced overall physical activity levels.[2,3] Reductions in energy expenditure demands,[4] especially the loss of energy expenditure through low levels of occupational physical activity, have contributed to the development of a range of chronic diseases (such as cardiovascular diseases and diabetes) and the consequent loss of people's quality of live.[5,6]

In developed countries people spend approximately one third of their day in sedentary activities.[7] Although sedentary behaviour can include standing still,[8] it is typically used to denote sitting and is used in this regard throughout the thesis.[9]

Time spent sitting performing screen based work with computers or tablets is particularly prevalent.[10] Office workers, the largest and most sedentary occupational group,[11] have been found to spend approximately six hours/day sitting at work.[12–15] Consequently, office based work environments have been identified as a key setting to control and prevent the rising prevalence of chronic diseases.[16]

Following on from epidemiological studies that have established relationships between prolonged occupational sitting and poor health outcomes in office workers,[17,18] intervention research has begun to investigate the efficacy of strategies to reduce and break occupational sitting time.[13,19–24] These studies have reported reductions in occupational sitting time through standing or height adjustable desks, which allow workers to intersperse sitting with standing while working. However, while such desks facilitate transitions between sitting and standing at work, and seem valuable from a metabolic health perspective,[21] evidence indicates they are less effective at promoting physical activity and raising energy expenditure across the working day.[25] Comprehensive intervention strategies that encourage moving as well as standing are therefore needed.

In regard to promoting movement at work, treadmill desks are beginning to be investigated as an alternative workstation strategy to height adjustable desks,[26,27] and a number studies have evidenced the effectiveness of workplace walking programs.[28–31] For example, Gilson et al[32] investigated the effectiveness of routes and incidental walking strategies for reducing occupational sitting through increasing daily workday step counts. While trends for decreased sitting through incidental walking strategies were shown, findings were generally inconclusive. Although an inverse relationship has been suggested to exist between sitting time and step counts,[33] the impact of initiatives that target occupational sitting time through workplace physical activity remains unclear,[34] and few studies have purposely targeted these contextual behaviours in combination.[32,35,36]

Furthermore, little is know about the combined impact 'sit less and move more' occupational strategies have on office workers physical risk factors for chronic disease, or the extent to which these types of strategies encourage office workers to implement and sustain behaviour change. In regard to this latter need, information and communication technologies (ICTs) such as web or mobile phone-based interventions are increasingly being recognised as a potential cost-effective means of promoting healthy lifestyle changes in large numbers of people.[32,37–39]

Based on a number of research gaps in the current evidence base, the overarching aim of this thesis is to investigate the impact of an intervention to reduce occupational sitting time and increase physical activity in Spanish office workers. The use and viability of ICT based behaviour change strategies to encourage these workers to 'sit less and move more' at work is explored through three linked studies, published in peer reviewed, international journals.

Studies One and Two evaluate the effectiveness of an automated web-based workplace program termed *Walk@WorkSpain* (W@WS). Study One assesses the impact of the W@WS program on self-reported sitting time, step counts and physical risk factors over 19 weeks and at two months follow-up. Study Two evaluates the uptake of strategies to reduce sitting time and increase walking at work, and explores factors that enabled or limited uptake of these strategies with participant 'point of experience' perceptions during each key stage of the W@WS program.

Study Three progresses the learning from the previous two studies and provides a systematic review on the extent to which smartphones can effectively be used to measure and influence physical activity and sedentary behaviour. The study highlights the potential such technology has for workplace physical activity interventions that target sitting time reductions, and critiques the range of novel and engaging capabilities ICTs provide for measuring and influencing behaviour change in real time.

In terms of structure, the thesis consists of six chapters starting with a literature review (Chapter 1) describing key concepts and the current state of evidence concerning physical activity, sitting time and health relationships, behaviour prevalence, occupational interventions and ICT strategies. Chapters 2, 3, 4 and 5 constitute the main body of the thesis where the thesis aim is stated relative to the research needs identified through the literature review (Chapter 2) and the specific work from the three studies is presented (Chapters 3, 4 and 5).

The final section of the thesis (Chapter 6) synthesises the evidence from the three thesis studies to explore issues on the extent to which ICT based intervention strategies can effectively target occupational sitting and physical activity in office workers. The original contributions of knowledge the thesis makes to the extant body of evidence are highlighted and thesis strengths, limitations, and implications for future research and practice presented.

The thesis also includes a number of appendices describing a range of materials, outputs and research skills developed across the PhD candidature. The information presented in appendices includes a literature summary of workplace interventions for reducing sitting; study support materials (e.g. participant informed consent forms, a pedometer and self-report sitting diary, webpage screenshots, and health survey pro-forma), and an additional published article and abstracts accepted in scientific conferences during the candidature. Notifications of the granted fellowships during the candidature, and the six months international internship justification are also presented.

Chapter 1: LITERATURE REVIEW

1.1 Population health and quality of life in the 21st century

In the 19th century infectious diseases were the leading health concern and the primary cause of sickness and death among the world population.[40] However, in the last period of the 20th century, non-communicable diseases showed the largest population reach.[40] Non-communicable diseases are popularly called chronic diseases and are defined as diseases of long duration and slow progression (such as cardiovascular diseases and cancers). These conditions are presently the major cause of adult mortality and morbidity worldwide. [41]

1.1.1. Prevalence and health implications of chronic diseases

The 2011 Global Status Report presented by the World Health Organisation (WHO)[42] reported that more than 60% of global deaths in 2008 were due to chronic diseases. The four leading chronic diseases were cardiovascular diseases (contributing towards 17 million deaths), cancers (7.6 million), chronic respiratory diseases (4,2 million), and diabetes (1,3 million), with over 14 million of these deaths occurring in adults between 30 and 70 years of age.

While the number of deaths worldwide has increased from 47.5 million in 1990 to 54.9 million in 2013, global life expectancy for both sexes has also increased from 65.3 years to 71.5 years over the same interval.[43] These findings suggest that men and women worldwide have gained more years of life expectancy overall, but they spend more years living with chronic diseases.[43] The increase in the prevalence of chronic diseases has been partly caused by detrimental changes in people´s lifestyles (harmful use of alcohol, unhealthy diet, increases in smoking and decreases in physical activity). These lifestyle changes, in combination with the prevalence of other factors such as increasing age and psychological health-related conditions, have led to an increase in chronic disease risk factors such as overweight or obesity, hypercholesterolemia, hypertension and diabetes.[44]

Chronic diseases can have a dramatic impact on local and global economies, undercutting productivity and increasing healthcare costs. In 2011, the World Economic Forum and the Harvard School of Public Health carried out the first study to identify the global economic burden of diseases.[45] The findings of this report highlighted five key considerations: 1) Chronic diseases will cause a cumulative output loss of US$ 47 trillion over the next two decades (75% of global Gross Domestic Product in 2010), therefore 2) national governments are advised to invest on preventing it. 3) The most dominant contributors to the global economic burden will be cardiovascular disease and mental health. For this reason, 4) chronic diseases need to be on the agenda of business leaders to lessen the impact on work productivity; and 5) numerous options can be applied to prevent and control chronic diseases.

In this context, high and middle-income countries around the world - including the European region and Spain - need to develop strategies to control chronic diseases.[46] For example in Spain, 11% of the population between the ages of 30-70 years have a high probability of premature death due to the four main chronic diseases listed by the WHO. These conditions contributed towards 5 million deaths per year.[47] Recently, the Spanish National Health Survey[48] has reported an increase of these diseases over the last two decades. For example, while in 1987 obesity affected 7.4% of the adult Spanish population, in 2012 this percentage had increased to 17%. It has been estimated that the direct and indirect costs associated with obesity will make up 7% of total Spanish health care system expenditure, and cost over 2,500 million euros per year.[49]

1.1.2. Health promotion: A focus on adopting healthy lifestyles

Traditionally, health practice focused on identifying individuals more susceptible to having poor health; this reflected the view of *'What is the diagnosis, and what is the treatment?'*. It was not until 1985, that Geoffrey Rose[50] highlighted that priority should be placed on the prevention and control of the causes of incidence and consideration of "W*hy did this happen, and could it have been prevented?".* While medicine focused on treating and curing diseases and disabilities in individuals,[51] Rose's theory stated the new paradigm of public health, which was described as:

> "The science and art of preventing disease, prolonging life and promoting health through organized efforts and informed choices of society, organizations, public and private, communities and individuals."[52(p23-33)]

Health promotion is a key pillar of public health, which comprises not only actions directed at strengthening the knowledge and capabilities of individuals, but also those directed towards changing social, environmental and economic conditions.[53] Determinants of health were first recognised in a working document on a new perspective for the health of Canadians, by this country's Minister for National Health and Welfare, Marc Lalonde.[54] The determinants cited concerned human biology, lifestyle (such as diet, physical activity, toxic habits, psychological factors), environment, and policies.

Based on this report, in 1986 the first conference on health promotion in Ottawa[55] announced the importance of developing and implementing actions in order to enhance the adoption of healthy behaviours. Ten years later, the 'Jakarta Declaration on Leading Health Promotion into the 21st century'[56] endorsed the priorities to enhance the effectiveness of actions aimed at helping the population adopt healthy lifestyles, such as promoting social responsibility for health. Finally, the most recent global conference on health promotion held in Helsinki[57] pointed out intersectional actions and healthy public policies as central elements for the promotion of health.

Currently, and recognizing that up to 80% of chronic diseases could be prevented by eliminating shared behavioural risk factors (e.g. tobacco use, unhealthy diet, physical inactivity and harmful use of alcohol); the WHO endorsed the 'Global Action Plan for the Prevention and Control of Non-communicable Diseases 2013-2020' which focuses on reducing the morbidity and mortality related to chronic diseases by modifying the four before mentioned harmful lifestyles.[46]

The Action Plan recognises the importance of strengthening the capacity of individuals and populations to make healthier choices and follow lifestyle patterns that foster good health. It also highlights that these types of 'up stream' health promotion approaches are more cost-effective than waiting until chronic diseases have fully developed.[58]

1.2 Physical activity, sedentary behaviour and sitting time

Physical activity is a key lifestyle behaviour linked to chronic diseases, risk factors and health outcomes and can be defined as:

> "Any bodily movement produced by skeletal muscles that results in energy expenditure."[59(p29)]

Physical activity is a broad term that encompasses lifestyle related activities, such as walking or active play. Other terms such as sport, exercise or physical fitness, have become synonymous with physical activity, but are sub-categories or outcomes associated with being physical active. For instance, sport refers to an institutionalised type of competitive physical activity such as soccer, tennis or athletics.[60] The term exercise refers to those physical activities planned and performed repetitively to improve or maintain physical fitness outcomes such as aerobic capacity, strength or flexibility.[59]

Physical activity is a complex behaviour that occurs across the four domains of leisure, transport, domestic and occupational time,[61] and is expressed in metabolic equivalents (METs)[59] whereby one MET is defined as equivalent to a volume of oxygen consumption of 3.5 $ml/kg^{-1}/min^{-1}$.

The energy expended through physical activity can be categorized as light (1.6-2.9 METs), moderate (3-6 METs) or vigorous in intensity (>6 METs). The 'Compendium of Physical Activity'[8] provides a useful reference tool for estimating and classifying different physical activities relative to energy demands. For example, general jogging is categorised as vigorous in intensity, with an estimated energy expenditure of 7 METs. Leisure time brisk walking is classified as moderate intensity (4 METs), while doing housework, shopping or incidental walking, has an energy expenditure of 2.5 METs and are classified as light intensity activities.

Sedentary behaviour differs from lack of physical activity and is defined as activities that do not increase energy expenditure substantially above resting level (1.0-1.5 METs).[62] This behaviour can include standing still (1.2 METs), but is typically used to describe sitting, reclining, or lying down.[62–64] For example, sitting at a desk has an energy expenditure of 1.3 METs. In this thesis, the term sedentary behaviour is regarded as being synonymous with sitting.

1.2.1 Measures

A range of different measurement techniques are available to assess physical activity, sedentary behaviour and sitting. Measures can be categorised as either subjective and involve participants self-reporting or recording the intensity, time, type and frequency of activities undertaken, or objective, involving the use of devices which record posture, movement and/or physiological responses such as heart rate or acceleration.[40]

All measures have their strengths and limitations and vary in regard to costs and practicality. Subjective measures are suitable to collect data from large populations and study samples because they are relatively cheap and easy to administer.[65,66] Meanwhile, objective measures tend to be more accurate and provide more detailed data (especially for intervention studies), on aspects of behaviour such as time spent in activities of certain intensities or positions, or the frequency of step counts, etc.[40] Some devices, such as accelerometers are relatively expensive. High participant burden and poor compliance because participants have to wear devices, and lack of context on where and why physical activity, sedentary behaviour and sitting occurred, must also be considered by researchers when selecting objective measurement devices.[67]

Questionnaires and diaries

Subjective assessments include self-report measures, such as surveys, questionnaires or diaries[40] and these are the most widely used measures in epidemiological studies.[66] Diaries are particularly helpful in understanding the context and type of activities undertaken. Since study participants tend to record these activities each day as they occur, they are less likely to forget meaningful details during extended periods of assessment time.[40] Seven day diaries have been found to moderately correlate (r=0.61) gold standard measures (i.e. doubly labelled water).[68] Diary reported active and sedentary behaviours validated well against accelerometers, with criterion validity reported to be moderate-to-high (sedentary: r=0.60-0.81; active: r=0.52-0.80).[69] Diaries have also been identified as being valuable in measuring the specific type, location, and purpose of activity-related behaviors.[69,70]

Surveys and questionnaires are the most common used instrument to assess physical activity prevalence.[71] 'The International Physical Activity Questionnaire (IPAQ)' was developed to evaluate physical activity at work, while commuting, during leisure time, and for household tasks.[72] It has been the most widely used survey instrument globally, specially the 9-item short form.[73] The IPAQ short form records physical activity at four intensity levels: vigorous intensity activity, moderate intensity activity (except walking), general walking, and sitting. It has been translated and validated in numerous languages, which allow for consistent measurement across countries.[40] The Spanish version of the IPAQ has shown good reliability for total physical activity, vigorous activity, moderate activity, and time spent walking (r=0.73-0.82), whereas reliability for time spent sitting has reported moderate correlation coefficient (r=0.40).[74] Total time spent on work, household, and leisure-time physical activities (excluding walking) also showed good correlation (r=0.82-0.92). When the IPAQ, Spanish version, was validated against an accelerometer, criterion validity was reported as acceptable for total and vigorous physical activity (r=0.29-0.30), and time spent sitting (r=0.34); but poor for moderate intensity activities.[74] The short Catalan version of the IPAQ also has acceptable validity for measurement of total and vigorous physical activity (r=0.27-0.38) when compared against accelerometery.[75] These results are similar to other validation studies that have used objective measurement devices (correlations ranging from 0.09 to 0.39 for total physical activity,[76] and 0.34 for sitting time).[77]

As well as IPAQ, other survey based measurement techniques provide estimates of sitting. Marshall's Sitting Questionnaire[78] focuses on measuring sitting on weekdays and weekend days in the different domains of work, watching television, using computers at home, travelling to and from places, and for leisure time. High reliability coefficients were reported for weekday sitting time at work, watching television, and using a computer at home (r=0.78-0.84), but lower coefficients were found for weekend days across all domains (r=0.23-0.74). When sitting time was validated against accelerometer data, validity criterion showed high agreement for weekday sitting at work and using computers at home (r=0.69-0.74).

More specifically, a range of studies have validated questionnaires for measuring occupational sitting time and physical activity.[79–81] These studies have reported moderate-to-high test-retest reliability for occupation sitting, standing, and walking (r=0.63-0.90).[79,80] Criterion validity was found to be acceptable for estimating time spent sitting (r=0.39-0.65)[79–81] and standing at work (r=0.49).[80] However, wide limits of agreement suggested caution in estimating individuals' sitting time with high precision.

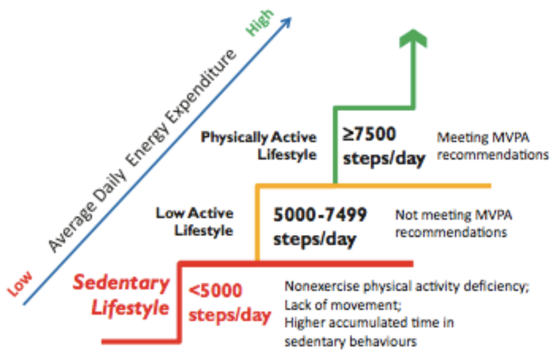
Although self-report measures are cost effective in large-scale studies, they may also lead to measurement bias.[66] Respondents may misinterpret terms such as 'moderate activity', as well as over or under estimate time spent in physical activity and sedentary behaviours.[66,82] The use of objective measures such as pedometers and accelerometers overcome these limitations, allowing a greater level of accuracy than self-report instruments, especially in regard to sedentary and light intensity activities.[83]

Pedometers

Pedometers are objective devices that typically measure the frequency of step counts, and are especially useful for studies that focus on walking. A key strength of pedometers is that they are relatively inexpensive and easy to use.[40] Pedometers can also be used as motivational tools for increasing daily walking, and can provide feedback to participants in real time.[84] The level of validity and reliability of pedometers various relative to the make and model; the most widely used research pedometer is the Yamax digi-walker SW-200 (Yamasa Co., Tokyo, Japan). A systematic review[85] of pedometer validation studies found a strong correlation (r=0.86) with accelerometer data for step counting, but also consistent evidence of reduced accuracy during slow walking. Authorities have also suggested that step counts have an inverse relationship with time spent sitting (r=-0.38).

Tudor-Locke et al[33,86–88] classified physical activity level relative to steps per day, introducing the concept of a step-index for healthy adults i.e. <2,500 steps/day (basal activity); 2,500-4,999 steps/day (limited activity); 5,000-7,499 steps/day (low active); 7,500-9,999 steps/day (somewhat active); 10,000-12,499 steps/day (active); and ≥12,500 steps/day (highly active).[86,87] Taking into account the time to accumulate steps, the authors stated that a cadence of 100 steps/minute represents a reasonable value indicative of moderate intensity walking.[88] A more recent review examined the utility, appropriateness and limitations of using the step-defined sedentary lifestyle index, where sedentary time has been defined as a missed opportunity to accumulate steps from 1-120 every minute.[89] Taking <5,000 steps/day was associated with spending between 522 to 577 min/day in sedentary behaviours, compared with 348 to 412 min/day in those who take >10,000 steps/day.[90] Thus, <5,000 steps/day was proposed as the cut-point to describe sedentary lifestyles, 5,000 to 7,499 steps/day as thresholds for a low active lifestyles and ≥7,500 steps/day as the threshold for a physically active lifestyle (Figure 1).[33]

Figure 1. Step-defined sedentary lifestyle index adapted from Tudor-Locke et al[33]



Step counting has been widely accepted by researchers, practitioners and the general public as a good practice for assessing, tracking, and communicating walking activity doses.[33] However, a substantial drawback to using pedometers for measuring physical activity is that they do not directly measure velocity or time and thus cannot estimate acceleration.[40]

<u>Accelerometers and inclinometers</u>

Accelerometers are small waist or wrist worn devices [91] that measure movement as a result of changes in the velocity of the body.[40,92] The acceleration data recorded by the device as a result of movement (in one, two or three axes) is then processed into counts per minute.[93] Several studies have analysed the relationship between accelerometer measured activity counts and energy expenditure, and counts relative to intensity classifications (sedentary, light, moderate and vigorous physical activity).[67] The most commonly used cut-point thresholds in physical activity research are light ≤1951 counts/minute; moderate 1952-5724 counts/minute; vigorous 5725-9498 counts/minute and; very vigorous ≥9499 counts/minute.[94] Sedentary behaviours have been classified as <100 counts per minute.[95] The ActiGraph (ActiGraph LLC, Pensacola, FL, USA), one of the most commonly used acceleometers in this field, has shown moderate-to-very strong correlations (r=0.30-0.96) with energy expenditure assessed using doubly labelled water.[96]

While accelerometers assess movement and are accurate and objective devices for measuring physical activity, they cannot distinguish between sitting (1.3 METs) and standing (1.2 METs) positions.[97] Therefore, devices that measure postural change such as ActivPAL (PAL Technologies Ltd, Glasgow, Scotland) have been suggested as an alternative to accelerometers for measuring sitting patterns.[98] The ActivPAL is an inclinometer-based accelerometer device, identified as a valid measure of posture, and motion by several studies.[99–101] Strong correlations between the ActivPAL and video observation in sitting/lying, standing, slow walking and sit-to-stand and stand-to-sit transition counts have been observed (r = 0.88-1.00).[99] However, the device did not accurately measure steps taken during fast walking and running (r = 0.21-0.46).[99]

In conclusion, the application of measures is an important consideration for research. The measurement technique, or combination of measures used, informs understanding of complex relationships with health, the prevalence of physical activity and sedentary behaviour, and the efficacy of interventions that target these behaviours.[71]

1.2.2 Relationships

Although the health benefits of physical activity can be traced back to ancient Greece, it was not until the 20th century that the first epidemiological studies began to explore relationships between physical activity and health. In 1953, Morris[5] observed a large cohort of London transport workers between the ages of 35 to 64 years, exploring the amount of physical activity that bus drivers and conductors performed during their jobs, and relationships with heart disease. The findings showed that bus drivers who spent most of their working hours sitting had higher rates of cardiovascular mortality than conductors, who ascended and descended between 500 and 750 steps per day while collecting fares on London's double-decker buses. This work was extended by Paffenbarger[102] who performed the San Francisco Longshoremen Study on shipyard workers. This study observed that the least active workers spent less than 1003 Kcal per work shift than the most active, and that those workers categorised as low active had an increased rate of cardiovascular death.

The research of Morris and Paffenbarger set the platform for subsequent observational studies and reports that have established a strong link between physical activity and health outcomes.[40] Arguably, the most significant of these was the release of 'The US Surgeon General's Report[103] outlining the scientific consensus on the beneficial effects of physical activity on chronic diseases, health related quality of life and overall mortality.

Compared to the study of physical activity and health, research into the relationships between sedentary behaviour, sitting and chronic disease is relatively new. Papers have conceptualised sedentary behaviour as being distinct from being inactive[104–107] and have hypothesised that sitting, standing or lying down for long periods causes the loss of opportunity for accumulating energy expenditure through reductions in muscular contractions.[108]

In regard to the emerging evidence base, laboratory based animal studies have shown that transitioning rats from high daily activity (access to running wheels) to low activity (locking running wheels) induced negative changes in body composition, insulin sensitivity, and tissue metabolism in a short period of time.[109–112] Hamilton et al[113] explained this mechanism by the suppression of skeletal muscle activity and a decrease in lipoprotein lipase activity, which regulates lipid concentrations and maintains cardio metabolic homeostasis. Australian researchers also identified that sedentary time was detrimentally associated with an the C-reactive protein,[114] an inflammatory marker associated with an increased risk of several chronic diseases.

Inflammation and reduced muscular contractions may explain the impact of prolonged sedentary time on chronic diseases.

Epidemiological studies have investigated the health implications of sedentary behaviour in populations. Associations have been found with metabolic syndrome,[115–117] diabetes, cardiovascular diseases, cancer,[18,117–119] and an increase in all-cause mortality.[104,119–122] In addition, several studies have stated that regular interruptions of sitting time could minimise the excessive sitting risk for health.[114,123–125]

Some studies have speculated that prolonged sitting is an independent risk factor for chronic disease development.[18,119,126] A recent meta-analysis showed that long periods of time spent sitting (in excess of 7 hours) throughout the day was associated with a 8% increased risk of all-cause mortality for each 1-hour increment of daily sitting. However, when analyses were adjusted for physical activity, this risk decreased by up to 5%.[121] Similarly, Maher et al[127] found no associations between sitting time and health outcomes when physical activity was not taken into account. Research into the interactive effects physical activity and sitting have on disease risk factors and outcomes is still on-going, but data is beginning to indicate that reductions in sitting and increases in physical activity levels, are important to improve population health.

For example, Bailey et al[128] examined the effects of breaking up sitting and consequently reducing sitting time with standing or light-intensity walking. Findings suggested that interrupting sitting with frequent bouts of light intensity walking (2 minutes every 20 minutes) beneficially impacted postprandial responses. These responses were not observed with standing bouts.

According to a study by Levine et al,[129] walking briskly for 30 minutes every day or running 56km/week produces less total energy expenditure than extending the duration of weekly light intensity physical activity bouts. In addition, evidence suggests that maintaining a high level of daily light-intensity activities plays an important role in regulating healthy blood glucose levels[130] and lipids (e.g. triglyceride and HDL)[113,131] as well as improving physical function among cancer survivals.[132] These data highlight the importance of accumulating incidental, low intensity activities that can reduce sedentary behaviour and increase energy expenditure across the day.

1.2.3 Policies and guidelines

The extensive evidence base linking physical activity participation to a range of health outcomes had led to the development and evolution of physical activity guidelines and policy documents for population translation. In 2004, the first global strategy on diet, physical activity and health, endorsed by the WHO,[133] identified key statements for physical activity promotion that are prominent in the agenda of the Global Action Plan 2013-2020.[46] This document stressed the need to adopt and implement national guidelines on physical activity for health, through developing policy measures in cooperation with pertinent sectors to promote active living and leisure time physical activity, through cost-effective actions.

In Spain, the Ministry of Health and Consumer Affairs set up the strategy for nutrition, physical activity and prevention of obesity (NAOS) in 2005, which aimed to improve diet and to encourage regular participation in physical activity for all.[49] The NAOS Strategy provides a platform to encourage initiatives that contribute to achieving the necessary social change in healthy diets and the prevention of inactive and sedentary lifestyles. In Catalonia, the comprehensive plan to promote health through physical activity (PAAS) presents a similar strategy to promote physical activity and healthy diets through educational and environmental initiatives and actions.[134]

National physical activity guidelines for the Spanish population are described in the NAOS Strategy and stipulate participation in 30 minutes of moderate intensity physical activity every day of the week.[49] These recommendations are similar to the 1995 report from the 'Centers for Disease Control and Prevention' and the 'American College of Sports Medicine', who emphasised the accumulation of 30 minutes of moderate intensity activity most of the days.[135] In 2007 the American College of Sports Medicine and the American Heart Association updated previous recommendations for adults.[136] The WHO adopted guidelines for global dissemination as follows:

- 150 minutes of moderate intensity activity per week,
- or 75 minutes of vigorous intensity activity per week,
- or an equivalent combination of both;
- with minimum bouts of 10 minutes.

In 2008, the United States published physical activity classification describing highly active (more than 300 minutes of physical activity a week), medium active (150 minutes of moderate intensity activity per week, or 75 minutes of vigorous intensity activity per week, or an equivalent combination of both), low active (fewer than the previous category but beyond baseline), or inactive (no activity beyond baseline) categories.[137] Most recently, in 2014, the Australian Federal Government updated physical activity recommendations based on evidence advocating the accumulation of at least 150-300 minutes of moderate-to-vigorous intensity activity through the week. These guidelines also highlighted the health benefits of doing some physical rather than none, even if the volume of physical activity was not achieving recommended levels.[138]

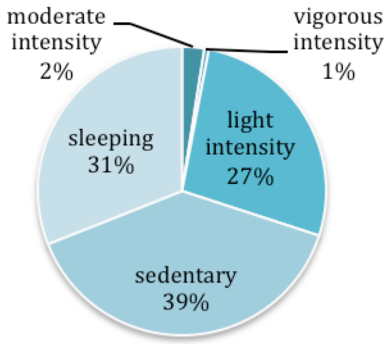
While there is scientific consensus on physical activity recommendations for health, specific guidelines for sedentary behaviour in adults are yet to be developed due to the emerging epidemiological evidence base.[18,119,121,126] Some national guidelines refer to limiting screen time and sedentary behaviour in children. For example, Canadian guidelines for this population group advocate no more than two hours per day of recreation screen time, reductions in sedentary transport, prolonged sitting and time spent indoors throughout the day.[139] Although specific guidelines have yet to emerge for adults, authorities have started to describe general sedentary behaviour recommendations, with the broad message of creating more opportunities to limit sitting time and to avoid prolonged periods of sitting.[138]

1.2.4 Prevalence of physical inactivity, sedentary behaviour and sitting

Thirty-one per cent of adults worldwide are insufficiently active and not reaching physical activity recommendations that stipulate 150 minutes of moderate intensity activity per week, or 75 minutes of vigorous intensity activity per week, or an equivalent combination of both.[140] A recent study from Lee et al[141] estimated that physical inactivity relative to recommendations caused 6% of the burden of disease from coronary heart disease, 7% of type 2 diabetes, 10% of breast cancer and 10% of colon cancer. Approximately, 5.3 million of deaths that occurred in 2008 were attributable to insufficient physical activity representing 9% of premature mortality that year.

In Europe by 2010, the highest physical inactivity levels were reported in the United Kingdom (63% of population) while in Spain around 50% of the population did not achieve recommended physical activity levels [142] Nevertheless, even if achieving physical activity recommendations, objective measured data indicates that adults spend only a small proportion of the day performing moderate and vigorous activities (3% of the 24-h day), with most of daily time spent in light and sedentary activities (27% and 39% of the 24-h day respectively), and about 31% sleeping (Figure 2).[7]

Figure 2. Patterns of daily physical behaviours adapted from Norton et al.[7]



Other data highlights high levels of sedentary behaviour in populations. A study based on the American Time Use Survey, indicated that American adults spent 80% of the waking day in activities that expend very little energy.[143] More specifically, four large scale self-report studies identified sitting times ranging from 4 to 7 hours at day.[144–146] Similarly, in three studies of 1,200 Belgium, 2,000 German, and 7,720 Dutch adults, average self-reported sitting times were between 5 and 7 hours/day.[147–149]

Matthews et al[150] performed the first surveillance study using accelerometer measured time spent in sedentary behaviour. They reported that 6,329 United States adults spent approximately 55% of their waking hours or 7.7 hours/day in sedentary activities. In this context, sedentary behaviour is considered a complex behaviour that cannot be treated as the simple absence of moderate-vigorous physical activity.[151]

1.2.5 Replacing sedentary behaviour by light to moderate walking

Reducing the high prevalence of sedentary behaviour through increases in walking has been identified as an important strategy for increasing energy expenditure in populations.[152] Given its accessibility and practicality, walking has been consistently reported as a preferred type of health-related physical activity,[137,153,154] playing a key role in cardiovascular disease prevention.[155,156] Swarts et al[157] suggested that taking walking breaks from sedentary time could prevent weight gain and have a positive impact on chronic diseases.

A meta-analysis evaluated the associations of pedometer use with physical activity and sitting time behaviour.[158] Although significant increases in physical activity and clinically relevant reductions in weight and blood pressure were reported, the study also highlighted that little is known about the effects of pedometer-based interventions on sitting time. De Cocker et al[159] evaluated changes in self-reported sitting time with participants engaged in a pedometer-based community intervention focused on increasing steps/day. Walking increased by 2,840 steps/day, while sitting time decreased by 18 minutes/day. De Greef et al[160] also documented an increase of 2,744 steps/day and a decrease in accelerometer-determined sedentary behaviour of 23 minutes/day in a pedometer-based behavioural modification program with telephone support. Since walking may be a potential solution for adjusting the amount of time spent sitting,[161] more studies are needed to better identify the effects of pedometer-based interventions for reducing sitting time, as well as their effects on physical risk factors to prevent and control chronic diseases.

1.3 The workplace and energy expenditure

High levels of inactivity and sedentary behaviour have led to decreases in energy expenditure in day-to-day life and this is an overall trend across all countries around the world.[144,162] Ng and Popkin[163] examined changes in energy expenditure over time in several countries using self-reported data in all domains. In 1965 United States adults were estimated to expend 235 MET hours/week mainly through occupational physical activity. By 2009, this was estimated to have reduced to 160 MET hours/week, and is predicted to decrease further to 142 MET hours/week by 2020 due to declines in work, domestic, and transport-related physical activity.

Populations in China and Brazil showed a similar but slower trend, and these countries are projected to reach United States levels by 2030. In the United Kingdom, workplace physical activity has declined, which has contributed to an energy expenditure decrease from 216 MET hours/week in 1961 to 173 MET hours/week in 2005. This trend is set to continue with a population energy expenditure value of 153 MET hours/week predicted by 2020. Ng and Popkin[162] conclude that projected increases in travel and leisure based physical activity would not be sufficient to counteract continued declines in energy expenditure linked to occupational and domestic physical activity.

Decreases in daily energy expenditure overtime can be explained by the changing nature of work, and population movement from active, high energy expenditure occupations such as farming or manual labour, to sedentary, low energy expenditure occupations such as office work. A systematic review of the literature supports this hypothesis, showing that while leisure time physical activity levels have tended to increase over time, occupational physical activity has decreased.[163] Church et al[164] examined the daily energy expenditure for occupations in United States over five decades. In 1960, 48% of all occupations were categorised as labour intensive and this reduced to 20% by 2008. Most occupations now offer few opportunities to move, with sitting time being prevalent among many workers, particularly in office-based jobs.[165]

1.3.1 Physical activity and sedentary behaviour patterns in office workers

Large sample self-reported studies in the United States[143] and Australia[116,166] have found that employed populations engaged in sedentary occupations range from 30 to 47%. In Spain – one of the most sedentary countries in Europe[167] – 30% of Spanish workers self-reported that most of their working hours were spent sitting.[11] This percentage increased substantially within transport and communication staff, and within academic and administrative office-based jobs (68% and 66% respectively).[11] More specifically, office workers in the Netherlands[147] and Australia[116,168] have self-reported an average of 3.5 to 5.6 hours of occupational sitting/day.

Two accelerometer based studies found that office workers (n=170 and 193) spent 71-77% of work time sedentary (approximately 6 hours).[83,169] Using inclinometers, Ryan et al[170] showed an average of 5.3 hours (66%) of sitting while working, on a sample of 83 office university workers. Similarly, three other inclinometer based studies found that office workers spent most of their working time sitting (70-80%), followed by standing (16-21%), and then stepping (8-9%).[14,15,171]

Time spent sitting at work has also been found to impact workers daily accumulated step counts. Clemes et al[172] explored step count differences among low, moderate, and high sitters (n=72). Results showed that workers who sat less accumulated significantly more step counts/day during working hours compared with moderate and high sitters (differences of 2,355 and 2,973 steps respectively). In this context, evidence indicates that office based occupations are associated with high sitting times and low levels of physical activity.[173] Since adults spend between a third to almost half of their waking day at work,[143] the workplace would appear to be the ideal setting to help reduce total daily sitting time, increase walking and improve population health.

1.3.2 Epidemiology of occupational sitting

The impact occupation has on health has long been recognised.[174] The first comprehensive dissertation on workers´ diseases was carried out in the 18th century.[175] More than 50 occupations and their subsequent disease patterns were investigated. The health problems resulting from spending long working hours without moving were identified and links between work and the workers´ well-being, and physical and emotional health highlighted.[176]

The studies by Morris[5] and Paffenbarger[102] (see section 1.2.2; p35 and 38), not only informed the development of physical activity guidelines but also highlighted the contributions work related physical activity make to disease development and energy expenditure. They postulated that those workers who sat more while working had more health risks than those who were more active. The field of ergonomic science has broadly investigated the repercussions of maintaining static positions at work such as sitting, and documented associations between computer based work and musculoskeletal disorders,[177] especially neck and shoulder complaints.[178]

Over the last decade, a number of studies have documented positive associations between high occupational sitting time and increased risk of cardiovascular disease, obesity, diabetes mellitus, some cancers and mortality.[17] More specifically, Léon-Latre et al[179] performed a cross-sectional study in a sample of 929 Spanish workers, reporting that the most sedentary workers had increased metabolic and cardiovascular risk and higher levels of biomarkers of insulin resistance and inflammation, compared to those who spent less time sitting. In addition, Freak-Poli et al[180] suggested that the majority of office-based occupations do not met the healthy guidelines for several physical and behavioural chronic disease risk factors.

In summary, a convincing body of evidence is beginning to emerge which links occupational sedentary behaviour, and high levels of prolonged sitting, with low energy expenditure and a range of chronic disease outcomes. These epidemiological data, in combination with population studies that document the increasing prevalence of low energy expenditure, sedentary occupations, highlights the urgent need for workplace interventions to consider practical and effective ways of encouraging office workers to sit less and move more.

1.4 Workplace interventions to increase energy expenditure

Over the last two decades, workplace health promotion has gradually become an important component of health policy and procedure. Based on the rationale of reaching populations, providing natural social networks, and the large amount of time people spent at work,[181] the World Health Assembly (1994) endorsed the 'Global Strategy for Occupational Health for All'[182], which encouraged the inclusion of occupational health at the organisation level.

The 60th World Health Assembly endorsed the 'Global Plan of Action on Workers' Health 2008-2017', which pointed out the key role of promoting health in the workplace to prevent and control chronic diseases.[183] This global plan was built on previous initiatives such as the joint WHO and World Economic Forum (2008) organised for preventing chronic diseases in the workplace through diet and physical activity.[181] One year later, the WHO published a review highlighting that engaging workers in physical activity programmes could bring about positive health outcomes to workers and companies. In 2010, the 'Global Framework for Healthy Workplaces' highlighted the importance of collaboration between workers and managers to promote workplace health, safety and well-being, and prevent chronic diseases.[184] This framework, along with other key policy initiatives, has established the workplace as one of the best buys for public health and chronic disease prevention and treatment.

Research evidence supports the efficacy of the workplace as a context for health intervention initiatives. The first review to evaluate the effectiveness of multicomponent workplace health interventions on workers´ health was carried out in 1997.[185] Despite inconclusive results, due to the variability of intervention characteristics and methodological weaknesses, this review highlighted the workplace as a key setting to change workers´ behaviour patterns and reduce physical risk factors for chronic disease.

Most recently, systematic reviews have shown that workplace health promotion programs can improve workers´ overall health,[186] dietary behaviour,[187,188] and physical activity levels.[189] However, a recent meta-analysis evidenced that the effects of workplace health promotion programs on workers´ behavioural and physical risk factors for health tend to be small and suggested more good-quality randomised controlled trials in order to correctly assess program effects.[190]

1.4.1 Workplace physical activity interventions

A number of reviews have aimed to summarise the evidence on the effectiveness of workplace physical activity interventions and the impact these interventions have had on workers health. A literature research undertaken as part of this thesis (up to September 2014; Web of Knowledge; key words of physical activity AND workplace OR worksite) identified 10 systematic reviews[191–200] and four meta-analyses concerning workplace physical activity interventions.[189,201–203] Key findings from these studies are chronologically summarised below.

In 1983, Pate et al[191] provided a systematic review of the literature on exercise programs and workers health. Findings indicated that successful exercise programs at the workplace should attain two fundamental goals: (a) provide a dose of exercise which is sufficient to stimulate physiological adaptations (e.g. 20-30 minutes of moderate intensity activity, 3 or more days per week) and, (b) influence long-term exercise adherence by using motivational strategies (e.g. leadership, motivational schema, program activities, convenience of participation, and social support).

A meta-analysis performed by Dishman et al (1998),[201] evaluated the impact of 26 workplace exercise interventions and reported small and non-significant results regarding increases in workers physical activity levels and fitness. Findings suggested this was due to the heterogeneity of the physical activity prescribed in the studies reviewed, which primarily involved aerobic programs, and muscular strength and endurance training. Intervention strategies also varied by type (i.e. health education and behavioral modification), motivational factors (i.e. financial incentives, prizes, awards and release time) and exercise setting (i.e. exercise sessions conducted at worksite in a designed area or off-site).

In 2003, a systematic review from Proper et al,[192] presented strong evidence on the effectiveness of structured exercise programs for increasing workers physical activity and decreasing musculoskeletal disorders. However, while reporting evidence of positive impact, this review concluded that the methodological quality of the studies included was generally poor. Recommendations highlighted the need for better quality studies that accounted for randomization, blinding, and compliance.

Another systematic review performed by Marshall et al in 2004[193] added that corporate fitness programs which provided individually tailored materials for workers were more successful than those which provided general health education. The review concluded by highlighting important future recommendations to increase program effectiveness, such as incorporating contemporary theories of behaviour and organisational change into workplace physical activity interventions.

In 2008, a systematic review by Dugdill et al[194] suggested that workplace walking interventions represented the most effective way to increase workers daily physical activity levels. Goal setting, diaries, self-monitoring, walking routes and active travel were identified as strategies through which workday step counts could increase.

Focusing on those with specific health needs, Anderson et al (2009)[195] and Verweij et al (2010)[203] carried out systematic reviews on the effectiveness of workplace nutrition and physical activity interventions to promote healthy weight among overweight and obese workers. Both reviews concluded that combination interventions (physical activity + nutrition) that provided informational and behavioural strategies, achieved the highest reductions in weight-related outcomes. The investigators suggested that physical activity interventions that used walking routes and maps, team competitions, prompts, point-of-choice messages, business goals and management commitment were the most effective at reducing weight.

Conn et al (2009)[189] performed a comprehensive meta-analysis of workplace physical activity interventions. Findings documented significant positive effects not only for physical activity and fitness, lipids and anthropometric measures, but also for work attendance and job stress. Brown et al (2011)[196] confirmed the positive impact of workplace physical activity programmes on workers well-being and presenteeism, although evidence was limited. These reviews were important in highlighting the impact workplace physical activity programs may have on workers psycho-social health.

In 2011, Vuillemin et al[197] systematically reviewed physical activity promotion interventions in the workplace setting in Europe, focusing on obesity-related outcomes. Results suggested that active travel interventions linked to the workplace were moderately effective at increasing workers physical activity and fitness outcomes. However, effects on obesity-related outcomes were limited.

Wong et al (2012)[198] specifically reviewed the effects of workplace physical activity interventions for men. Literature searches identified only thirteen workplace studies focusing on men, from which only five showed significant increases in physical activity. Findings concluded that workplace physical activity interventions for men were equivocal and future studies should focus on men's needs and their physical activity preferences.

In the same year, Taylor et al[202] confirmed in a meta-analyses that the effectiveness of workplace physical activity interventions was positively associated with the extent to which theory had been explicitly used to inform intervention design. However, researchers only reported increased effectiveness from using one behavioural change technique (self-monitoring outcomes), partly because of the lack of theory-based constructs found in the studies reviewed. The authors identified the importance of considering a combination of behaviour change techniques within intervention design.

Two systematic reviews were published in 2013. Quyen et al[199] evidenced improvements in workers physical activity levels, step counts and body mass index in 60% out of 20 selected workplace physical activity interventions reviewed. Recommendations from this review included; the need to widen the scope of workers involved in workplace physical activity interventions, for example designing interventions that attract both men and women to long-term programs; and using internet-based approaches, pedometers and strategies that target the workplace at the social and environment level.

Lastly, Freak-Poli et al[200] concluded there was insufficient evidence to assess the effectiveness of pedometer interventions at the workplace. Only four studies met inclusion criteria for the review. Interventions ranged in length from three to six months, and were heterogeneous in terms of offering counselling, a website, group-based incentives for reaching goals and prompts. The authors identified the need to carry out higher-quality studies reporting the impact of workplace pedometer-based programs on a wide variety of behavioural outcomes (e.g. sitting time), physical risk factors (body mass index, waist circumferences and blood pressure) and quality of life.

In summary, the extant systematic and meta-analytic literature evidences that workplace physical activity interventions have evolved from exercise programming to active organisational strategies. Overall, workplace interventions seem to be effective at improving workers physical activity levels and some health outcomes. However, several issues need to be addressed such as poor methodology and lack of theory-based strategies.

1.4.2 Interventions to reduce and break occupational sitting time

While physical activity intervention research is well established, studies that target reductions in occupational sitting time are emerging. The first systematic review in the area was conducted by Chau et al (2010).[34] Sitting time was self-reported as a secondary outcome in all six studies included in the review, with study findings reporting no significant impact on reducing occupational sitting time.

Five systematic reviews and meta-analyses were published between 2013 and 2015, covering evidence based interventions to reduce sitting time or sedentary activities, up until February 2014. Four of the studies summarised the evidence for active workstation interventions (i.e. height adjustable desks, and treadmill or pedal desks).[204–206] Torbeyns et al[205] and Neuhaus et al[21] concluded that the implementation of active workstations might contribute to occupational sitting time reductions. Effects on health and work-related outcomes were moderate-to-low. MacEwen et al[207] reported greater health improvements when using treadmill desks than height adjustable desks. This might be explained by the review of Tudor-Locke et al,[206] who suggested that while treadmill and pedal desks increase energy expenditure substantially, energy expenditure associated with the use of height adjustable desks is comparable to traditional seated conditions.

The most recent review from Shrestha et al[208] conducted in 2015, examined a wide spectrum of workplace interventions to reduce sitting at work such as active workstations, walking strategies, information and counselling, or computer prompting. Findings reported very low quality evidence for height adjustable desks, and intervention effects for walking strategies, information and counselling, and computer prompting, were inconsistent.

To add to evidence emerging from existing systematic reviews, an additional literature review was conducted for this thesis, whereby relevant articles on workplace interventions targeting sedentary behavior and more specifically sitting time reductions were identified. The database of Web of Knowledge (Medline and Web of Science) was searched up to February 2015, using the following key words: sitting time OR sedentary behaviour AND workplace. To attain additional eligible articles, the reference lists of the located studies were also checked.

The search yielded 25 field-based trials. Included studies were classified relative to main intervention type as follows:

- Workstation based studies (n=17):[13,14,19–24,26,27,209–215] Using height adjustable desks, treadmill desks or pedal devices incorporated underneath the desk, which enabled office workers to stand, walk, or pedal while working.
- Walking based studies (n=5):[32,35,36,216,217] Focused on encouraging office workers to increase step counts during work time away from their desks.
- Computer software based studies (n=3):[98,218,219] Prompted workers to reduce long periods of uninterrupted occupational sitting

In addition, one study[220] evaluated the combined impact of workstation use, walking strategies, and computer based software on sedentary time.

For selected articles, details on source (authors and year), study aim, design, population, intervention characteristics and physical behavioural measurements tools were extracted (see Appendix I). Primary intervention results were also summarized for intervention effects on behavioural risk factors (sitting time, sedentary behaviour and where appropriate physical activity), physical risk factors, work-related outcomes and participant's perceptions of feasibility.

Workstation based studies

Early research into the impact of workstations on musculoskeletal disorders occurred in the field of occupational ergonomics.[19,213] Initially, these devices were used to increase the frequency of work breaks, and improve musculoskeletal health and work performance. Research on the health implications of workstations has therefore evolved from ergonomics and musculoskeletal/productivity issues to research into chronic disease prevention and management.[165]

Eight RCT studies were found which evaluated the impact of workstations on health outcomes in office workers. These studies used height adjustable desks only[19–21] or multi-component interventions comprising height adjustable desks or pedal devices and behavioural elements (e.g. pedometer use, internet program, organization consultation, phone calls, information booklets).[14,21,209,212,213,220] Sample sizes ranged from 25-62 office workers (both genders, mostly middle aged and highly educated people) who enrolled in interventions lasting from 1-12 months.

Office workers provided with height adjustable desks only, self-reported a 16% reduction in sitting time at work and [19] objectively reported decreases between 33 minutes/8hr and 73 minutes/8hr of occupational sitting time with inclinometers.[20,21] Multi-component programs[14,21,209,212,213,220] reported data through a variety of devices: Two studies using accelerometer data reported around a 4% reduction in sedentary time at work.[209,220] Using inclinometer data, two studies found occupational sitting time reductions between 80 and 125 minutes/8hr,[14,21] whereas another study showed 58 minutes reduction in daily sitting time with a multi sensor device (i.e. accelerometer and gyroscope).[213] Occupational sitting time was also self-reported by another study, reporting 40% reductions.[212]

In these interventions, sitting was almost exclusively replaced by standing with non-significant[20,21,212] or moderate[213,220] changes in walking. Findings also showed decreases in the prevalence of musculoskeletal and fatigue discomfort symptoms, as well as improvements in wellbeing and productivity.[19,213] Physical risk factors such waist circumference and body mass index were also reduced.[209,213]

Nine pre-post studies were found which assessed the effectiveness of workstations on reducing occupational sitting time. Sample sizes ranged from 11 to 36 office workers who enrolled in interventions lasting from one week to one year. Interventions consisted of (a) sharing standing desks in an open plan office,[13] (b) having an purpose-built movement orientated physical workplace environment (i.e. height adjustable desks and meeting rooms with options to sit or stand),[214] (c) working on height adjustable desks,[22–24] treadmill or pedal devices[26,27,210] and, (d) height adjustable desks with tailored support for individual behavioural change through goal setting and motivational interviewing.[215]

Most studies objectively measured sitting, standing and walking using an inclinometer,[23,26,214,215] and sedentary and active time using accelerometer data[27] or workstation software.[210] The remaining three studies, used self-reported measurement tools such as questionnaires,[24] logbooks[13,24] or experience-sampling through mobile phone text messages.[22] Findings reported non-significant positive changes in the main outcomes for the shared standing desk intervention,[13] while workers using height adjustable desks reported sitting time reductions between 66 and 143 minutes/8hr.[22–24] Transition from a traditional workplace environment (i.e. desk bound) to a purpose-built, movement orientated physical workplace environment resulted in significant increases in standing time at work (19 minutes/8hr), and a reduction in sitting time (20 minutes/8hr), but no significant changes in stepping time (+1 minutes/8hr).[214]

When introducing treadmill or pedal devices, sedentary time was reduced and physical activity levels increased.[26,27,210] Although most intervention participants reduced total workplace sitting time and reduced sitting bout duration relative to controls, a wide individual variability in sitting time reductions (from -29 to -262 minutes/8hr) was identified.[215] Positive health-related benefits were also described such as improvements in waist and hip circumferences, low-density lipoproteins, total cholesterol,[23,26,27] upper back and neck pain, fatigue, confusion and total mood disturbance.[22]

Three recent studies not only explored the quantitative impact of using height adjustable desks for behavioural and physical risk factors[20,24] but also evaluated workers´ perceptions and experiences after use.[24,211] The main benefit from using height adjustable desks was a perceived improvement in personal health and productivity. Although some concerns identified using the desk in standing positions, authors concluded that height adjustable desks had high usability and acceptability between users. In addition, another study tested the feasibility of using a pedal exercise machine for reducing workplace sedentary time.[210] Most participants reported positive feedback regarding preference, ease of use, comfort, no visual disturbance and no inference with work-tasks.

Walking based studies

Despite the inverse relationship between accumulation of daily steps and time spent sitting,[33] few studies (n=6) have targeted reductions in occupational sitting through walking-based intervention strategies.

Two RCTs investigated the effects of pedometer-based programs using sample sizes in 179 and 655 office workers respectively.[32,36] Gilson et al[32] undertook a 10-week intervention which comprised route-based walking strategies (at least 10 minutes sustained walking each workday) and incidental walking strategies (walking while performing work tasks). Results showed an increase in daily step counts for the route (968 steps/day; $p<0.000$) and incidental (699 steps/day; $p<0.014$) groups compared to the control group. Although self-reported sitting time decreased by around 20 minutes/day in the incidental walking group, changes were not statistically significant among groups.

Marshall et al[36] evaluated an 8-week intervention to increase workers step counts by using either a print delivery program (e.g. goal setting, self-monitoring, rewards, using cues, and social support) or a web-based delivery program (website included interactive and animated features, stage-based quiz with feedback on responses, as well as personalized sections on goal setting, activity planning, determining target heart rates, and a physical activity readiness questionnaire). Findings identified a significant trend in the web-based group for decreased self-reported sitting time on weekdays (21 minutes/day; $p=0.03$).

Three pre-post studies that lasted from 3-6 months, evaluated the effectiveness of web-based interventions on workers step counts,[29,221] as well as program sustainability.[216] Office workers (samples sizes ranging from 390 to 762) were given a pedometer and access to a website program that targeted accumulated walking for at least 10,000 steps per day[216,221] or increasing 1,000 daily steps above baseline every two weeks.[29]

Whereas two studies showed improvements in office workers step counts (+1477 steps/day; $p=0.001$)[29] and increases of 6.5% in the proportion of workers meeting current physical activity guidelines,[221] only one study showed self-reported sitting time reductions (-36 minutes/day; $p<0.05$). Occupational sitting was associated with improvements in blood pressure and waist circumference at post intervention and after four months.[221] At eight-months follow-up, sustained improvements were observed for sitting time and blood pressure but not for physical activity and waist circumference.[216]

One study explored the experiences of university workers (n=15) who participated in a 10-week workplace walking program that consisted of either using walking route or incidental walking strategies.[217] Workers highlighted the feasibility of moving while completing working tasks (incidental walking strategies) and opportunities to reduce long periods of sitting at their desk. In both intervention groups, workers benefited from improved feelings of health, well-being, and work productivity. However, difficulties of managing time pressures were identified for the walking routes group, and issues of peer acceptance and management subcultures for the incidental walking strategies group.

Computer software based studies

Two RCTs investigated the effects of installing prompt software on workers' computers.[98,218] The software was designed to encourage workers to periodically break up sitting for 1 minute every 30 minutes[98] and every 45 minutes[218] through short bouts of physical activity. Studies were performed in 30-34 desk-based workers who used the software program from 1-week to 13-weeks. Sitting time and energy expenditure measures were taken at pre-post intervention with an inclinometer[98] and a self-report questionnaire.[218]

Using a software program that encouraged a 1-minute break every 30 minutes was associated with significant increases in sitting break events during work hours (number and duration of breaks), but non-significant differences in total sitting time.[98] Whereas a software program that encouraged workers to break up sitting every 45 minutes through short bouts of physical activity significantly increased the calories expended during the workday.[218]

Cooley et al[219] presented a qualitative, socio-ecological evaluation of a computer software program designed to reduce workers' prolonged occupational sitting time by introducing regular short breaks. The prompting software used by participants in the study was described as a feasible tool to increase light intensity occupational activities such as standing and walking. A range of positive outcomes were also described, such as experiencing increases in individual health status, changes to workplace interactions (social support), and to perceptions of having the opportunity to become healthier at work. Negative outcomes were also experienced and included disruption to work flow and work habit. The study concluded that using subjective evaluations provided a comprehensive picture of the factors that could influence the effectiveness of workplace sitting reduction interventions.

In summary, a number of recent occupational sitting time reduction studies have integrated technologies into their intervention approaches (e.g. internet approaches or mobile phone texting) or used technology as their main intervention feature (e.g. computer prompts). The advent of technology in the workplace has contributed to decreases in population energy expenditure, but can ironically also create new opportunities to encourage workers to sit less and move more.

1.4.3 Behaviour change theories and ICTs in workplace interventions

Expanding the concept of health promotion to a workplace setting implies a review of how the workplace community is organized and how corporate practices and polices are detrimental or beneficial to workers health.[222] Successful workplace health promotion programs are based on understanding the workforce and the influences on worker health behaviours.[222] Evidence suggests that those programs built on theoretical frameworks are the most effective.[202]

Ecological models provide an ideal means of understanding workplace health behaviours such as sitting and physical activity in that they emphasise multiple levels of influence that include intrapersonal, interpersonal, organisational and environmental factors.[223,224] At the inter and intra personal level one of the most commonly adopted theoretical frameworks to promote behaviour change in physical activity interventions is the Transtheoretical Model,[225] which describes an individual's motivations and readiness to change behaviours through different stages.[226] According to Prochaska,[226] people in later stages perceive more benefits and feel more confident with the behaviour engaged in, than those in lower stages of change. These constructs are linked to other important behaviour change theories such as Janis and Mann's decision-making theory,[227] that explains how people decide whether to engage in a particular behaviour based on their comparison of the perceived benefits versus the perceived costs of the behaviour; and Bandura's self-efficacy construct, which links to the confidence or perceived ability to be active across different challenging situations.[228]

Ecological models are consistent with Social Cognitive Theory which highlights the importance of creating physical and social environmental opportunities to enhance healthy behaviours at the community level.[229] Critical behavioural change constructs identified at the community level include empowerment, critical consciousness, community capacity, issue selection, and participation and relevance.[224]

ICTs such as web or mobile phone technologies provide an ideal platform for ecologically based, workplace interventions in that they are able to combine and deliver interventions that target behaviour change at the individual, environmental and organisational and community level. Korp,[37] highlighted the empowering aspects of

ICTs for health promotion, including the enabling of information and knowledge retrieval, anonymity and convenience in accessing information, creation of social constructs and support independent of time and space, and the challenging of expert standards. In addition, these technologies can create communities of individuals with similar health concerns [230] enabling a process of participation.[231]

A number of reviews have aimed to summarise the evidence on the use of ITCs for physical activity interventions, especially using web technology. In 2007, Vandelanotte et al[232] systematically reviewed web-based physical activity interventions. Findings reported intervention effects over short periods of time, but limited evidence of the maintenance of physical activity changes. The authors suggested that more research was needed to identify intervention characteristics related to adherence of behavior change.

Two meta-analyses, in 2010, examined web-based interventions across multiple outcomes, and reported statistically small but significant effects for interventions focusing on increasing levels of physical activity.[233,234] In one of these studies, Webb et al[233] concluded that interventions that incorporated a more extensive use of theory, behavior change techniques, and additional methods of communicating with participants (such as text messages or emails), were associated with increases in effect sizes. Similarly, in 2012, another meta-analysis reported small effect sizes for web-based intervention studies that targeted increases in physical activity.[235] However, the authors supported the use of this technology in producing positive changes in physical activity, and stated that adherence to behavior change needs to be further studied.

Several reviews have also evaluated the efficacy of mobile phones in general health promotion interventions, reporting that these devices can help improve health outcomes and care processes through monitoring, managing, and educating individuals.[38,236,237]. In 2011, a systematic review provided evidence supporting the positive effects of interventions using web-based and mobile phone technology in young people.[238] Another systematic review in 2013, focused on mobile phone interventions to reduce inactivity and weight and demonstrated the beneficial impact of text messaging or apps for this purpose.[239] Finally, in 2012, a meta-analysis of studies that principally used mobile devices and text messaging to increase physical activity, highlighted the potential that mobile devices have for positively influencing physical activity behaviours.[240] However, this review did not specifically focus on smartphone technology, or, importantly, evaluate data on the application and accuracy of this technology for physical activity measurement, or user engagement.

Use of ICTs, and specifically mobile, smartphone technology, seems a novel solution to reach and influence behaviour change at the community level. However, little is known about how effective these technologies are at encouraging sitting time reductions and physical activity increases. This lack of evidence is particularly applicable to initiating and maintaining behavioural changes in the workplace setting.

Chapter 2: AIMS OF THE THESIS

2.1 Summary of research needs

The previous review of literature in Chapter 1 of this thesis identified the workplace as an important context for worker health. More specifically the advent of office-based jobs that are highly sedentary and require little physical activity during the work day has led to loss of occupational energy expenditure, that has in turn contributed to increases in the prevalence of a range of chronic diseases and associated risk factors.

In an effort to provide a strong evidence base for translation and change at the organisational and population level, research needs to test the efficacy of strategies to encourage energy expenditure increases in office-based occupations. Importantly, these strategies need to target prolonged occupational sitting and workday physical activity, and must complement, not detract from work pressures, tasks and demands.

Height adjustable desks have been put forward as a potential solution, although while effective at reducing sitting through standing, significant effects have not been observed for walking or physical activity levels. Workstations that allow workers to cycle or walk while working, appear to be effective at reducing sitting and increasing physical activity. However, these workstations are expensive (around 1,000€) and would require dramatic changes in office environments if all workers were to be provided with access. Outlay of cost, relative to large-scale sustained use is therefore questionable.

Workplace walking programs may represent the most ecologically viable and cost-effective means of targeting energy expenditure increases in office workers. The evidence base is limited, but supportive of the premise that programs that promote incidental and more structured walking opportunities may reduce long periods of occupational sitting and increase workplace physical activity. However, more and better quality studies are needed to assess the combined impact of 'sit less and move more' strategies on occupational sitting, physical activity and associated risk factors if the evidence base is to develop sufficiently for translation. The role ICT based strategies may play in facilitating changes in occupational sitting and physical activity is a particularly important and contemporary research need.

Studies in this thesis make an original contribution in this regard. The last of these studies (Chapter 5) focuses on the emerging potential of smartphones, and is preceded by two studies centred on a web-based initiative termed Walk@Work Spain (W@WS).

Specific details on the components of W@WS are provided in the following two thesis chapters, but in brief W@WS is an automated web-based program that provides a range of ecological support strategies to facilitate office workers to progressively 'sit less and move more' during the working day. Program participants target reductions in occupational sitting through progressive increases in walking over eight weeks; an 11-week maintenance period then provides automated guidance with periodic emails encouraging workers to sustain changes in sitting and walking, achieved in the previous ramping phase.

W@WS emerged from the collaborative International Universities Walking Project (IUWP), established in 2009. This project developed an expert consensus framework for intervention in university academics and office administrators,[241] with three interrelated themes highlighting: a) research design, capacity and mixed method approaches; b) implementation with a variety of walking opportunities, while providing feedback, educational forums, social support and rewards and; c) program evaluation assessing physical activity, sitting time at and outside work, as well as health and work-related outcomes.[241] Following on from the development of this framework, the project progressed into an environmental audit and implementation at different university workplaces around the world.[29,32,242]

The Spanish arm of the program builds on previous research in that it utilises a comparative as opposed to a pre-post group trial design, in multiple Spanish worksites, over a longer-term intervention (19 weeks as opposed to six weeks), with an additional intervention stage designed to elicit increases in physical activity intensity. Therefore, W@WS provides a unique contribution to the evidence base through an improved research design, a more comprehensive program and evaluation stage, and higher quality data to inform intervention effectiveness.

2.2 Thesis aims

The research needs identified through the literature review and summarised in section 2.1 of this chapter underpin the overarching aim of the thesis, which as the introductory chapter identified is to:

> Investigate the impact of an intervention to reduce occupational sitting time and increase physical activity in Spanish office workers.

The use and viability of ICTs as a means of encouraging office workers to 'sit less and move more' is a particular focus of the thesis, and in this regard the overarching thesis aim is explored through three studies which explore the efficacy of the W@WS program (Studies One and Two; Chapters 3 and 4), and the current evidence and future directions for research using mobile, smartphone technology (Study Three; Chapter 5).

The specific aims of these studies are as follows:

> Study One assesses the impact of the W@WS program on self-reported sitting time, step counts and physical risk factors over 19 weeks and at two months follow-up.
>
> Study Two investigates the uptake of W@WS strategies that reduced sitting time and increased walking at work, and explored factors that enabled or limited uptake of these strategies.
>
> Study Three undertakes a systematic review of available evidence and examines the extent to which smartphones can effectively be used to measure and influence physical activity.

Chapter 3: STUDY ONE

Puig-Ribera A, **Bort-Roig J**, González-Suárez AM, Martínez-Lemos I, Giné-Garriga M, Fortuño J, Martori JC, Muñoz L, Milà R, McKenna J, Gilson ND. Patterns of impact resulting from a ‘sit less, move more’ web-based program in sedentary office employees. PLOS One. 2015;**10**(4):e0122474.

PLOS ONE

RESEARCH ARTICLE

Patterns of Impact Resulting from a 'Sit Less, Move More' Web-Based Program in Sedentary Office Employees

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Abstract

Purpose

Encouraging office workers to 'sit less and move more' encompasses two public health priorities. However, there is little evidence on the effectiveness of workplace interventions for reducing sitting, even less about the longer term effects of such interventions and still less on dual-focused interventions. This study assessed the short and mid-term impacts of a workplace web-based intervention (Walk@WorkSpain, W@WS; 2010-11) on self-reported sitting time, step counts and physical risk factors (waist circumference, BMI, blood pressure) for chronic disease.

Methods

Employees at six Spanish university campuses (n=264; 42±10 years; 171 female) were randomly assigned by worksite and campus to an Intervention (used W@WS; n=129; 87 female) or a Comparison group (maintained normal behavior; n=135; 84 female). This phased, 19-week program aimed to decrease occupational sitting time through increased incidental movement and short walks. A linear mixed model assessed changes in outcome measures between the baseline, ramping (8 weeks), maintenance (11 weeks) and follow-up (two months) phases for Intervention versus Comparison groups.

Results

A significant 2 (group) × 2 (program phases) interaction was found for self-reported occupational sitting (F[3]=7.97, p=0.046), daily step counts (F[3]=15.68, p=0.0013) and waist circumference (F[3]=11.67, p=0.0086). The Intervention group decreased minutes of daily occupational sitting while also increasing step counts from baseline (446±126; 8,862±2,475) through ramping (+425±120; 9,345±2,435), maintenance (+422±123; 9,638±3,131) and follow-up (+414±129; 9,786±3,205). In the Comparison group, compared to baseline (404±106), sitting time remained unchanged through ramping and maintenance, but decreased at follow-up (-388±120), while step counts diminished across all phases. The Intervention group significantly reduced waist circumference by 2.1cms from baseline to follow-up while the Comparison group reduced waist circumference by 1.3cms over the same period.

Conclusions

W@WS is a feasible and effective evidence-based intervention that can be successfully deployed with sedentary employees to elicit sustained changes on "sitting less and moving more".

Introduction

Sitting dominates many employees' work life; 80% of adults in developed countries spend one third of the day in offices doing sedentary, desk-based tasks [1–3]. As a result, over the last 50 years employees´ average daily energy expenditure has decreased by more than 100 kcals [4]. Given the evidence linking prolonged occupational sitting to chronic disease risk and all-cause mortality [5–8], it is clear that developing effective workplace initiatives for reducing total sitting and breaking prolonged bouts of sitting in office workers is an important public health priority [9].

While there is scarce evidence regarding the effectiveness of workplace interventions for reducing sitting [10], there is also a need to explore how evidence-based interventions can be successfully applied in workplaces in order to sustain improvements on employees´ health [11, 12]. Though use of height-adjustable desks and active workstations effectively reduce prolonged occupational sitting time [13–16], and increase standing [13–15] or occupational energy expenditure [16] respectively, that technology involved requires significant changes in the physical office environment and in employees´ work routines. All this can compromise uptake among employers [17]. Most importantly, the lack of evidence regarding the effectiveness of these strategies for sustaining improvements on behavioural risk factors indicates incomplete 'real world' understanding of adherence patterns [13–15, 18, 19].

Encouraging workplace walking in office environments may be a practical and feasible means of reducing and breaking occupational sitting time [20]. Notwithstanding that an increase of 2,500 daily steps may reduce daily sitting by 37–45 minutes [21], it remains unclear whether workplace walking initiatives that increase step counts will inevitably reduce occupational sitting over time. Previous studies have assessed the indirect impact of walking strategies on total and occupational sitting time and found no significant intervention effects [10, 20, 22]. While Freak-Poli et al [23] reported reduced sitting time (-0.6 hours/day) among employees who participated in a pedometer-based workplace programme, studies have yet to assess the longer-term impact of workplace sitting and walking interventions on behavioural and physical risk factors for chronic disease [23].

Walk@WorkSpain (W@WS; 2010–11) is an automated 'sit less, move more' office-based intervention which targets the prevention and management of chronic disease risk factors. Linked to the international 'Walk@Work' initiative, the program provides employees with a pedometer and access to a website which supports them to displace occupational sitting with incidental movement, and short (5–10 minutes) and longer (10+ minute) walks [22]. A recent 10-week evaluation indicated that "Walk@Work" added almost 2,000 extra workday step counts in under-active office workers (<5,000 steps/day) [22].

W@WS builds on these findings and addresses limitations in the current evidence base. Specifically, the present study aims to evaluate program efficacy for the primary outcomes of self-reported sitting, step counts and physical risks factors for chronic disease. Importantly, this study also aims to assess longer-term impacts, within a comparative, rather than pre-post research design in order to show how well an accessible PC-based intervention (W@WS) translates for use in busy office environments.

Methods

Study design and sample

The study used a quasi-experimental comparison group pre-post design. Participants were administrative and academic staff working at six campuses in four Spanish Universities in Galicia, the Basque Country and Catalonia (x2). Campuses were randomly assigned by worksite to an Intervention (n = 3; deployed W@WS) or Comparative group (n = 3; maintained normal behavior). In each region, one university campus was randomly assigned to the program (intervention group; IG) and another campus that acted as a comparison group (CG). After assignment, participants were blinded to the existence of other groups receiving different programs. As campuses were located in different cities across Spain, this minimised contamination across groups. The study was approved by the following ethics committee of each university: Ethics Committee of the Faculty in Psychology, Education and Sport Sciences (University Ramon Llull); Research Commission of University of Vic; Ethics Committee of Clinical Research in Conselleria de Sanidad (CEIC; Xunta de Galicia); Ethics Committee of Applied Research in Human Beings (CEISH/GIEB; University of the Basque Country). Participants provided their written informed consent to participate in the study prior to the intervention.

Around 2,500 emails were sent to target campuses. Office workers were first invited to participate in an on-line survey to identify those most in need of intervention (employees located at the low end of the continuum for volume of physical activity) [21, 24]. Physical activity (PA) levels were measured using the International Physical Activity Questionnaire (IPAQ) short form [25]. A total of 704 employees completed the survey [26]. Those employees with low and moderate PA levels (0 to 3,000 $MET \cdot min \cdot wk^{-1}$) were invited to participate in the intervention by email or phone calls (n = 345, 62%). Highly active employees (>3,000 $MET \cdot min \cdot wk^{-1}$) were excluded as they tend to accumulate higher step counts/day [21] and spend lower amounts of time sitting at work [2] than their low or moderately active counterparts. At baseline, both the CG (n = 135) and the IG (n = 129) were given a pedometer and a paper diary to register daily step counts and self-reported sitting time throughout the intervention. During delivery, the IG had access to the W@WS website program while the CG was asked to maintain habitual behavior. The intervention was implemented from September 2010 to June 2011 to fit within the university academic year.

Intervention

W@WS is an automated web-based intervention that focuses on decreasing occupational sitting time through incidental walking and short walks during the working day. W@WS consists of a ramping (8 weeks) and a maintenance phase (11 weeks). During the ramping phase, every two weeks employees are challenged to progressively increase their movement by 1,000 to 3,000 daily steps above baseline [27, 28]. Strategies to achieve these goals initially focus on breaking occupational sitting time by integrating incidental walking into work tasks (e.g. moving rather than sitting during lectures and seminars, not sitting to take phone calls; weeks 1–2). This progresses to short walks ranging from 5–10 minutes by targeting active mobility within University campuses (e.g. choosing the "longest route" to go to another Department within the campus; weeks 3–4) and then longer walks of +10 minutes by targeting active transport (e.g. walking to work whenever possible) or active lunch breaks (i.e. taking walks after lunch, alone or with colleagues, that fitted within an one-hour lunch break; weeks 5–6). Maps are provided as examples of walks within and around the campus [22, 24, 27]. During weeks 7–8, workers are given information about the extra health benefits of walking faster at a comfortable pace and encouraged to raise their intensity of movement whenever possible (e.g. during active travel or lunch time walks).

During the maintenance period (weeks 9–19), W@WS sends automated emails encouraging workers to sustain sitting reductions and step count increases achieved in the ramping phase. These are sent weekly (weeks 9–12) and then fortnightly; no emails are sent during the last 3 weeks of the program.

W@WS provides a range of ecological support strategies to reduce and break occupational sitting time and increase step counts. These strategies include (a) setting goals every two weeks for increasing step counts as means of reducing occupational sitting time, (b) monitoring the achievement of goals by logging daily step counts into the employee´s personal account (i.e. the resulting graphics provide individual feedback on progress), (c) providing support strategies to achieve the targets and social networking for sharing experiences (i.e. using the blog to share personal strategies for sitting less, walking more and/or ways to overcome personal barriers), (d) increasing employees´ awareness and knowledge of the health benefits of achieving 10,000 steps/day (i.e. preventing weight gain) and reducing sitting time (i.e. providing articles in the web-page published in the mass media or information from well-known scientific organizations), (e) increasing employees´ self-efficacy by suggesting feasible strategies and encouraging them to generate innovative strategies that best enable them to sit less and move more [22, 24, 27].

Data collection

Trained and experienced researchers implemented a standardized research protocol across the sites. Daily step counts (Pedometer, Yamax-200) and daily self-reported occupational sitting time (paper diary log) were reported during five working days (i) at baseline, (ii) throughout ramping (weeks 1–8) and (iii) maintenance phases (weeks 9–19) and (iv) during two weeks at two months follow-up (week 20–21). Every participant was provided with standard detailed written information on how to use the pedometer and the diary. The physical risk factors measured were body weight and height in light clothing and without shoes (electronic scale—Seca 899/217) and waist circumference (WC) taken at the narrowest part of the torso (directly above the umbilicus) using a flexible steel tape (Seca 203). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) was assessed after the participant sat quietly for 5 minutes (digital automatic blood pressure monitor—Omron M7). At each campus, trained researchers conducted the assessments for the IG and CG at baseline (week 0) and in the final week of each stage using standardized protocols [28]. Demographic details including age, gender and job roles were also recorded during the first scheduled meeting. Trained researchers forwarded SPSS files electronically to a coordinating researcher who pooled and treated the data.

Statistical analyses

The magnitude of difference (average of weekly measurements on step counts and self-reported occupational sitting) between (i) baseline, (ii) throughout the ramping phase (weeks 1–8), (iii) throughout the maintenance phase (weeks 9–19) and (iv) for two weeks at two months follow-up (weeks 20–21), was used to identify intervention effects across phases on these behavioural risk factors. Employees not providing data at baseline for at least three separate workdays on step counts and self-reported occupation sitting were excluded from the analyses (based on the need to capture the majority of days within a five day working week). A criterion of at least three separate workdays was also applied to the calculation of averages for each phase. Where this criterion was not met, intention to treat was applied and data imputed sequentially using the previously entered average from either baseline or the ramping and maintenance phases as appropriate.

A linear mixed model assessed changes within groups in step counts, self-reported sitting time and behavioural risk factors (WC, BMI, SBP and DBP) across the four program time points. Differences between groups for changes in the main outcomes were assessed using the same model. The model was adjusted by gender and age. The design of the model included participants (fixed factor), group (experimental and comparison group) and program time points (baseline, ramping, maintenance and follow-up). When the interaction between program time points*group was significant, changes 2 x 2 were assessed using post-hoc test adjusted by the Sidak method. Preliminary checks ensured no violation of assumptions of normality, homogeneity of variance and homogeneity of regression slopes.

Binary logistic regression was performed to predict relationships between improved physical risk factors and changes in step counts and self-reported sitting time at maintenance. A first model integrated self-reported sitting time and step count changes into one independent variable adjusted by age and gender (increasing ≥1,000 daily steps and reducing ≥10 minutes sitting a day from baseline). Previous research has reported changes in WC related to 1,000-step incremental changes in step defined PA [29]. Following the criterion of "every minute of sedentary activity is a missed opportunity to accumulate any number of steps taken between 1 and 120 step counts", replacing 10 minutes of occupational sitting time by 100 step counts/minute could explain an increase in 1,000 daily step counts [30]. A second model contained self-reported sitting time and step count changes as two independent variables adjusted by age and gender. Statistical analyses were performed using PROC MIXED (SAS 9.3 software).

Results

Pre-intervention characteristics

A total sample size of 264 workers was recruited (42±years of age; n = 171 women; n = 129 administrative staff). In Catalonia, 115 people agreed to participate (IG = 63), with 109 in the Basque Country (IG = 44) and 40 in Galicia (IG = 22). Two hundred and thirty seven employees completed full data measurements from baseline through the ramping period for self-reported occupational sitting time, pedometer-determined step counts and physical risk factors. Full data sets, from baseline through the maintenance period, was provided by 198 (75%) participants, while 190 (72%) completed 19 weeks of data from baseline through follow-up (Fig 1). Drop out after the maintenance period in the Intervention group (n = 38, 29%) was related to sick leave and lack of time (Fig 1).

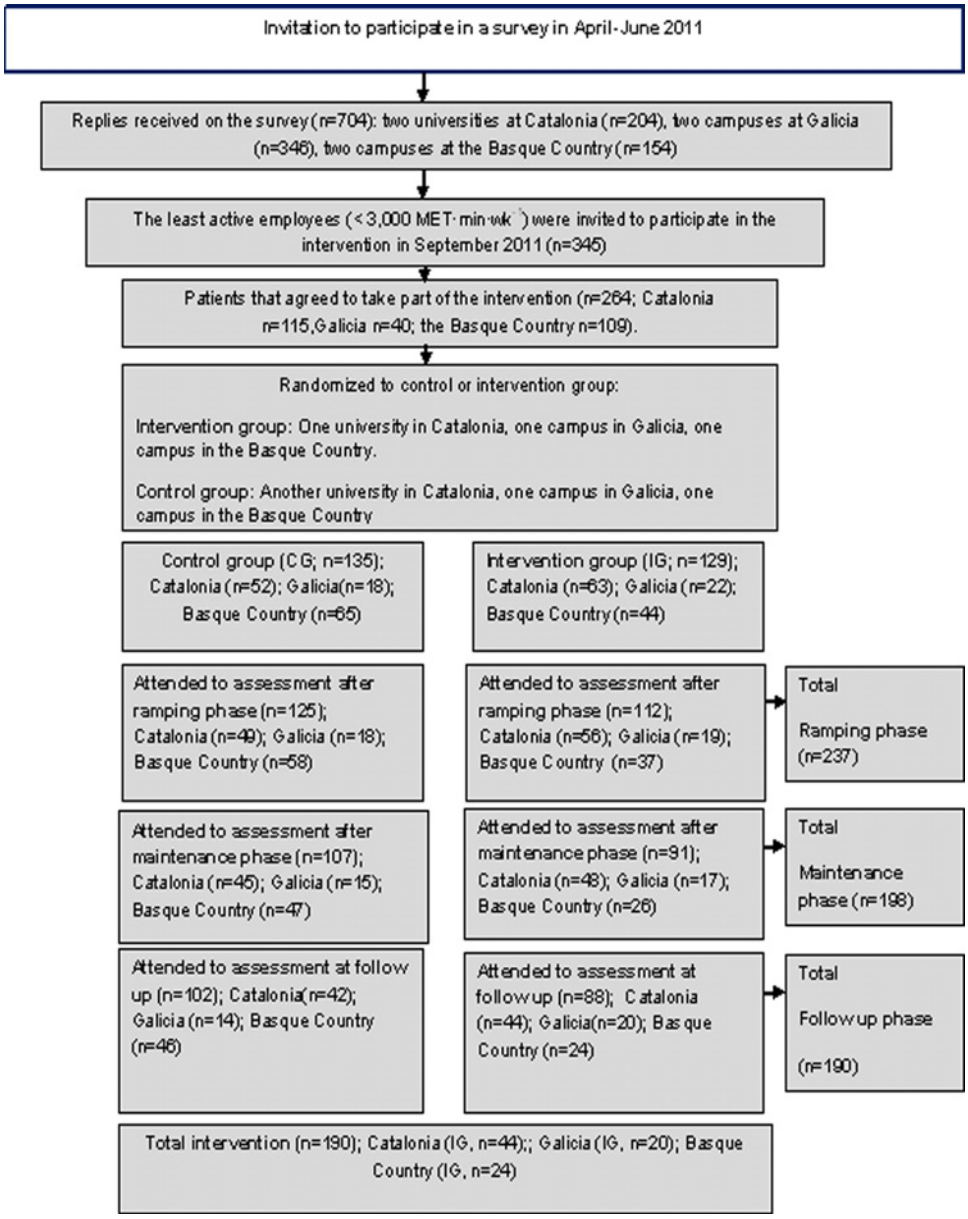

Fig 1. Flowchart of participant´s recruitment across all phases of the intervention.

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Intervention effects on behavioural risk factors

There was a significant 2 (group) × 2 (program time points) interaction for self-reported occupational sitting ($F[3] = 7.97$, p-value interaction = 0.046) and daily step counts ($F[3] = 15.68$, p-value interaction = 0.0013) (Table 1). The IG decreased occupational sitting time from baseline (446.4 minutes ± 126.7) through ramping (425.8 minutes±120.6), maintenance (422.9 minutes ± 123.4) and follow-up (414.2±129.4) ($p<0.05$) (Table 1), whereas the CG maintained occupational self-reported sitting time through the ramping and maintenance phases but decreased sitting time at follow-up (Table 1; Fig 2). For walking, the IG increased daily step counts across all four program time points (baseline 8,862 ±2,475.75; ramping 9,345±2,435.8; maintenance 9,638±3,131.6 and follow-up 9,786±3,205; Table 1), whereas the CG decreased

Table 1. Outcome measures during the program phases within the Intervention (used W@WS) and Comparison group (maintained habitual behavior).

	Baseline		Rampling phase[a]		Maintenance phase[b]		Follow-up[c]		P values		
	Comparison (n = 135)	Intervention (n = 129)	Comparison (n = 125)	Intervention (n = 112)	Comparison (n = 107)	Intervention (n = 91)	Comparison (n = 102)	Intervention (n = 88)	Group	Program time points	Interaction
Step counts/ day; mean (SD)	9920(3484)	8862(2475)	9544(3137)	9345(2435)	9264(3435)	9638(3131)	9427(3744)	9786(3205)	0.372	0.746	0.0013
Sitting time; minutes/ day (SD)	404.6(106)	446.4(126)	405.5(110)	425.8(120)	402.8(113)	422.9(123)	388.9(120)	414.2(129)	<0.001	0.048	0.046
Body Mass Index; Kg/ m^2 (SD)	25.9(4.7)	25.5(4.1)	26.1(4.5)	25.6(4.2)	26(4.4)	25.5(4.3)	25.9(4.4)	25.4(4.3)	<0.001	0.711	0.008
Systolic Blood Pressure; mmHg (SD)	122.4(18)	120(16.7)	123.8(17.3)	121.7(16.3)	121.1(16.1)	119.1(15.9)	119(16.5)	117(15.8)	<0.001	0.611	0.995
Diastolic Blood Pressure; mmHg (SD)	78.9(10.8)	77.6(11.9)	78.9(10.6)	78.1(10.5)	77.7(10.3)	77.1(11)	76.7(10.9)	75.7(11.1)	<0.001	0.87	0.898

[a] After the ramping phase (week 8),
[b] After the maintenance phase (week 19),
[c] At two months follow-up (week 21).

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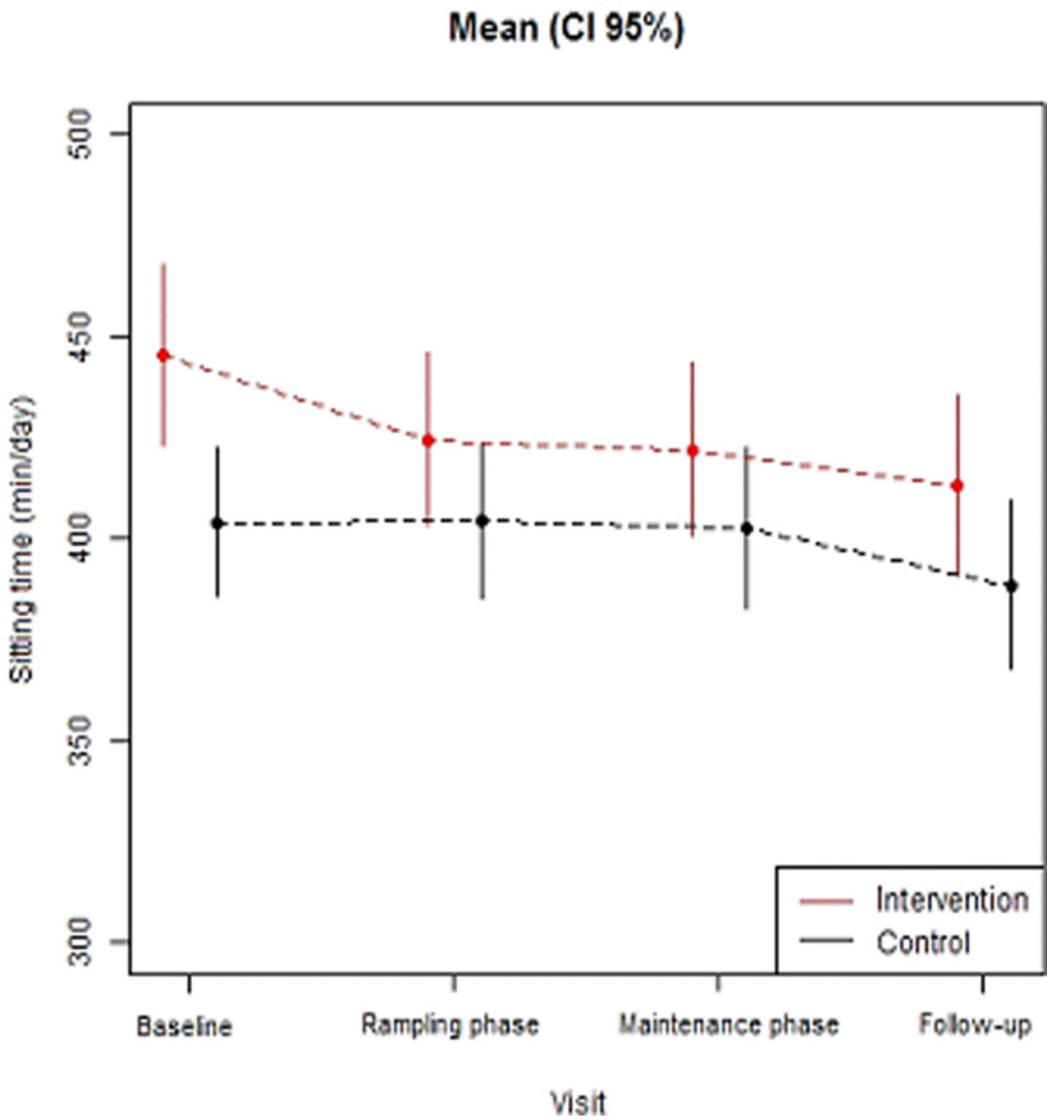

Fig 2. Change in average occupational sitting time for the intervention and comparison groups across program phases.

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step counts across the 19 weeks of program delivery and at follow-up compared to baseline (Table 1; Fig 3).

Significant differences between groups were found for changes in self-reported occupational sitting time (-22±11 minutes; $p<0.005$) and workday step counts (+1,432 step/counts; $p<0.001$; Table 2) at the maintenance phase. At two months follow-up, only increases in step counts remained significant between groups (+1,417 step/counts; $p<0.001$; Table 2).

Intervention effects on physical risk factors

There was a significant 2 (group) × 2 (program time points) interaction for waist circumference, $F[3] = 11.67$, p-value interaction = 0.0086 (Table 1). The IG decreased WC from baseline (85.3 cm ± 13.7) through ramping (84.5 cm±13.8), maintenance (83.5 cm ± 13.7) and follow-up (83.2±13.8) ($p = 0.001$) (Table 1), whereas the CG reduced waist circumference across program time points with a lower magnitude of change (Table 1; Fig 4). Participants

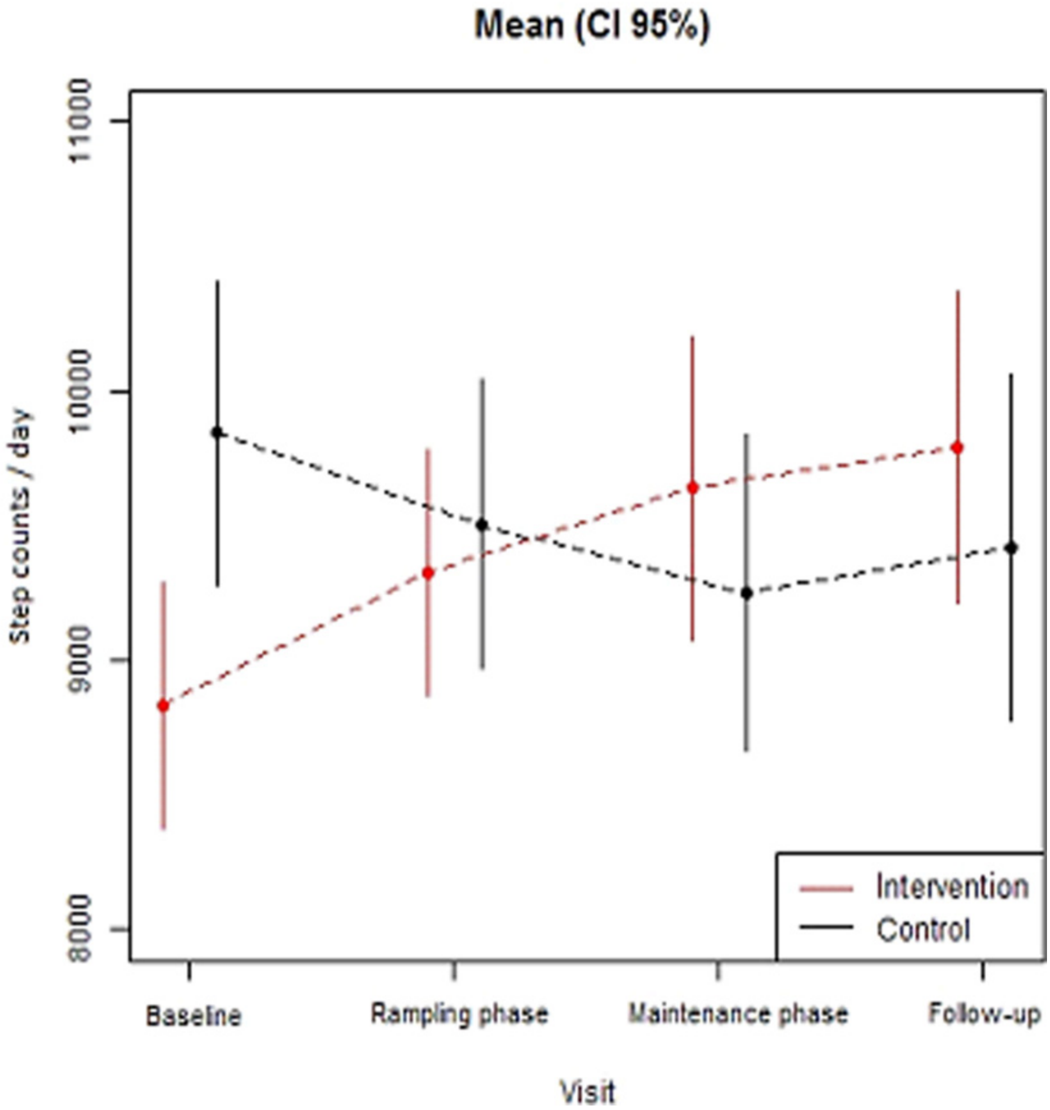

Fig 3. Change in average steps/day for the intervention and comparison groups across program phases.

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in the IG significantly reduced WC by 1.1cm (p = 0.01) compared to the CG after the maintenance phase and 0.8cms (p = 0.10) at two months follow-up (Table 2). No significant interactions were identified between group and program time points for BMI, SBP and DPB (Table 1).

Employees who combined an increase of ≥1,000 daily steps with a ≥10 minutes/day reduction in sitting time (at maintenance) were twice more likely to reduce WC [OR = 2.07, 95% CI 1.07 to 4.01; x^2(3, N = 264) 8.08, p = 0.04]. When sitting time and step counts were modelled as independent variables, only step count changes contributed to the model (x^2[4, N = 264] = 11.82, p = 0.02), yielding an odds ratio of 2.26 (95% CI 1.29 to 3.94). Reductions in waist circumference were not solely influenced by cutting back on self-reported occupational sitting time.

Table 2. Mean differences relative to baseline across program phases within the Intervention (used W@WS) and Comparison group (maintained habitual behavior) on daily step counts, occupational sitting and waist circumference.

	Intervention Group						Comparison Group					
	Ramping[a]	P-value	Maintenance[b]	P-value	Follow-up[c]	P-value	Ramping[a]	P-value	Maintenance[b]	P-value	Follow-up[c]	P-value
Step counts/day; mean (SD)	+483(145)	0.004**	+776(226)	0.002**	+924(245)	0.000***	-376(174)	0.282	-656(284)	0.202	-493(311)	0.676
Sitting time; minutes/day (SD)	-20.6(6)	0.004**	-23.5(9)	0.040*	-32.2(10)	0.007**	+0.9 (5)	1.000	+1.8(9)	0.999	-15.7(9)	0.414
Waist circumference; cm (SD)	-0.8(0.2)	0.011*	-1.8(0.3)	0.000***	-2.1(0.3)	0.000***	-0.7(0.3)	0.030*	-0.7(0.3)	0.107	-1.30(0.3)	0.000***

[a]After the ramping phase (week 8),

[b]After the maintenance phase (week 19),

[c]At two months follow-up (week 21),

* $p<0.05$,

** $p<0.01$,

*** $p<0.001$.

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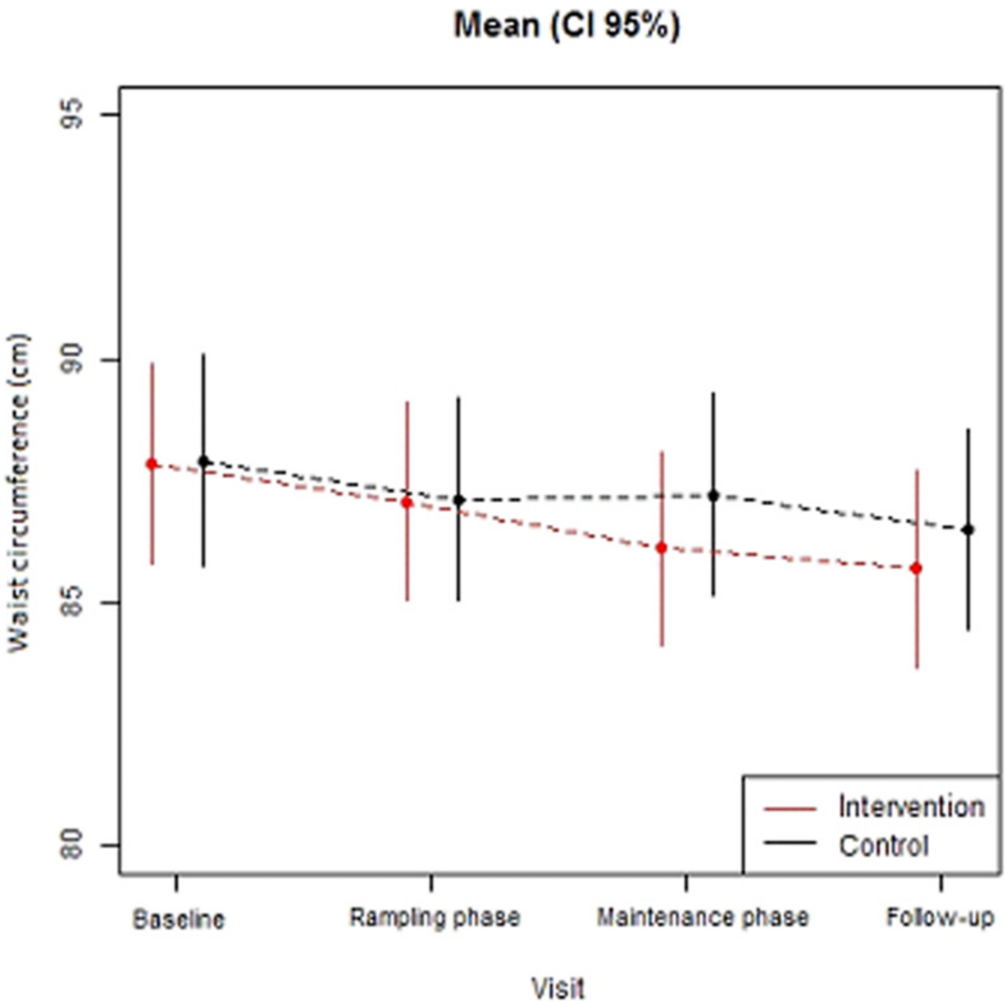

Fig 4. Change in average waist circumference for the intervention and comparison groups across program phases.

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Discussion

This study assessed the impact of a "sit less, move more" workplace intervention on self-reported occupational sitting time, step counts and physical risk factors over 19 weeks and at two months follow-up. The study provides evidence—which has been called for—that theoretically-derived strategies can be successfully and effectively embedded into workplaces [31]. W@WS represents an effective, low-cost translational program that can be applied to sedentary, desk-based employees. Three main findings stem from identifying the impact of W@WS against a comparison group. First, an automated internet-delivered intervention was effective at reducing occupational daily sitting time while concurrently increasing daily step counts in office employees. Second, beneficial changes in step counts and occupational sitting time were sustained at two months, although only step counts differences between groups remained significant. Third, observed behavioural changes in step counts benefited waist circumference.

The main result of the current study indicated that employees using W@WS decreased daily occupational sitting by 22 minutes/day while also increasing step counts by 1400 steps/day compared to employees in the CG. These findings are similar to previous iterations of W@W established with English-speaking university employees. Although previous studies deployed different program durations and measurement points, occupational sitting time was also reduced (by almost 20 minutes) [20]; and daily step counts increased (averaging +1,400) [22], which gives some indication of the overall potential for change in such employees. Compared to those data, W@WS (i) delivered a longer program (19 weeks vs. 10 weeks), (ii) employed a Comparison group and (iii) was deployed among Spanish university employees. With these features, Walk@Work represents a program with in-built flexibility that can adapt to local environmental and socio-cultural conditions. Data for our Spanish employees reflected that W@WS elicited small and sustainable changes in occupational PA, representing an effective intervention that can be successfully deployed with sedentary Spanish-speaking employees. Eighty-six employees (66.7%) from the IG increased daily step/counts, while 77 (60%) reduced sitting time; for them deploying innovative strategies fitted with daily working routines. This change in routine could help to reduce the health risks related to their sedentary workplace lifestyle.

Recent interventions have reported larger effects on occupational sitting time than W@WS. They showed reductions of 33 minutes sitting per 8-working hours, achieved using height adjustable workstations and 89 minutes and 125 minutes/ 8-working hours day adding an array of other strategies [13, 14]. However, in these interventions workplace sitting was almost exclusively replaced by standing rather than increased step counts, whereas W@WS increased concurrent measures of step counts. Since the energy costs of sitting and standing are similar [17], W@WS represents a potential program for mitigating the diminished energy expenditure inherent to office-based workplaces. Our concurrent data identified that employees from the IG increased energy expenditure by an average of 108 (510; 726) METs–minutes/week when compared to the Comparison group (measured by the IPAQ short-form). Active workstations have been also identified as effective strategies for reducing both occupational sitting time and energy expenditure (~2–4 kcal min^{-1}) [16, 17]. However, there are important gaps in the evidence regarding their optimal use and accessibility for both employers´ and workers´ uptake [17]; potentially this compromises longer-term effectiveness in busy office environments. In W@WS, introducing incidental movement and short walks did not seem to interfere with employees´ working routines; the relative small proportion of drop-outs at follow-up from this extended program (n = 41, 32%) seems to confirm this. Therefore W@WS represents a low-cost automated programme, implemented by employees without the need to change the office environment.

W@WS also impacted behavioural risk factors at two months follow-up. While only the increases in step counts remained significant over time between groups, even two months after withdrawing the intervention the IG continued averaging 16.5 minutes less sitting per day at work when compared to the CG. Surprisingly, at two months follow-up our data show that while the percentage of employees increasing daily step counts dropped to 58.9% (-7.8%) the percentage who reduced their sitting time increased to 66.7% (+6.7%). However, since most workplace research has not tracked reductions in total sitting over time, adherence profiles remain unclear [13–15, 18, 19]. Future research should identify the most potent facilitators and barriers influencing individual variability in reducing workplace sitting at the long-term.

Finally, observed changes in step counts and sitting time were significantly associated with an average WC reduction of 1cm after maintenance but not at follow-up. However, WC measurements at follow-up remained lower in the IG compared to the Comparison group (-0.8 cm); with the IG showing a WC reduction of a bigger magnitude than the CG. Our study suggests that improving both behaviors up to specific thresholds (≥1,000 daily steps and ≥10 minutes sitting a day) as well as step counts solely (≥1,000 daily steps) was more likely to predict a WC reduction than reducing sitting time alone over the same threshold. This is consistent with recent cross-sectional evidence identifying no associations between sedentary time and weight outcomes in adults (n = 5,712 adults) [32]. Nonetheless, for a 1cm increase in WC the relative risk of cardiovascular disease events increased by 2% (95% CI = 1–3%) in both men and women [33]; indicating that W@WS can be an effective intervention for chronic disease prevention in sedentary workplaces. Our results also support cross-sectional associations on the added cardio-metabolic health benefits (i.e. reducing waist circumference) of substituting sitting time with MVPA [34, 35].

This study has several strengths and limitations. First, sitting time was measured by self-report. Self-reported sitting time has validity and is an acceptable measure [36], but self-reported measurements might have not been sensitive to detecting all changes in occupational sitting. Future workplace research should use objective measures for sitting time. Nonetheless, W@WS is an original intervention that has evaluated the effectiveness of occupational sitting reduction strategies and increasing walking against a comparison group. This represents the best scientific design for identifying which health interventions achieve the best effects [31]. Secondly, it is important to recognize that this test of W@WS was based on highly educated middle-age men and women working at universities. Ongoing research should focus on more heterogonous samples of office employees from a range of workplaces. However, results from W@WS have identified effective occupational sitting reduction and step counts increase strategies that could be applied to any desk-based occupation. In this regard, W@WS represents a contribution to implementation research that is needed to enhance population health [12].

Conclusions

W@WS is an evidence-based intervention that successfully encouraged office employees to 'sit less and move more', resulting in the improvement of abdominal fatness which is a key physical risk factor for chronic disease. Most importantly, W@WS elicited sustained behavioural changes over time indicating that it is a feasible and effective program for preventing chronic disease in sedentary workplaces. This study contributes to the existing evidence on implementing effective workplace sitting reduction strategies by increasing step counts. The strategies provided by W@WS can be a potential tool to increase office employees´ levels of occupational PA in every day practice. Future research should identify the most potent facilitators and barriers influencing individual variability in reducing workplace sitting at the long-term.

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Author Contributions

Conceived and designed the experiments: AP NG. Performed the experiments: AP IM MG AG JF JB. Analyzed the data: LM JCM RM. Wrote the paper: AP JM NG.

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Chapter 4: STUDY TWO

Bort-Roig J, Martin M, Puig-Ribera A, González-Suárez AM, Martínez-Lemos I, Martori JC, Gilson ND. Uptake and factors that influence the use of ‘sit less, move more’ occupational intervention strategies in Spanish office employees. International Journal of Behavioral Nutrition and Physical Activity. 2014;**11**:152.

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Uptake and factors that influence the use of 'sit less, move more' occupational intervention strategies in Spanish office employees

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Abstract

Background: Little is known about the types of 'sit less, move more' strategies that appeal to office employees, or what factors influence their use. This study assessed the uptake of strategies in Spanish university office employees engaged in an intervention, and those factors that enabled or limited strategy uptake.

Methods: The study used a mixed method design. Semi-structured interviews were conducted with academics and administrators (n = 12; 44 ± 12 mean SD age; 6 women) at three points across the five-month intervention, and data used to identify factors that influenced the uptake of strategies. Employees who finished the intervention then completed a survey rating (n = 88; 42 ± 8 mean SD age; 51 women) the extent to which strategies were used [never (1) to usually (4)]; additional survey items (generated from interviewee data) rated the impact of factors that enabled or limited strategy uptake [no influence (1) to very strong influence (4)]. Survey score distributions and averages were calculated and findings triangulated with interview data.

Results: Relative to baseline, 67% of the sample increased step counts post intervention (n = 59); 60% decreased occupational sitting (n = 53). 'Active work tasks' and 'increases in walking intensity' were the strategies most frequently used by employees (89% and 94% sometimes or usually utilised these strategies); 'walk-talk meetings' and 'lunchtime walking groups' were the least used (80% and 96% hardly ever or never utilised these strategies). 'Sitting time and step count logging' was the most important enabler of behaviour change (mean survey score of 3.1 ± 0.8); interviewees highlighted the motivational value of being able to view logged data through visual graphics in a dedicated website, and gain feedback on progress against set goals. 'Screen based work' (mean survey score of 3.2 ± 0.8) was the most significant barrier limiting the uptake of strategies. Inherent time pressures and cultural norms that dictated sedentary work practices limited the adoption of 'walk-talk meetings' and 'lunch time walking groups'.

Conclusions: The findings provide practical insights into which strategies and influences practitioners need to target to maximise the impact of 'sit less, move more' occupational intervention strategies.

Keywords: Workplace, Occupational sitting, Sedentary behaviour, Walking, Multi-method study, Employee experiences

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Introduction

Prolonged periods of sitting have been linked to a range of chronic conditions such heart disease, type II diabetes and obesity [1-3]. A recent meta-analysis using data from over half a million adults indicated a 5% increased risk of all-cause mortality for each incremental hour of sitting, in those who sat for more than seven hours/day [4]. Office employees spend much of their work-related time sitting at a desk for up to six hours/day [5], and are therefore particular exposed to the health risks of prolonged sitting.

Height adjustable sit-stand desks have been proposed as one strategy to reduce and break occupational sitting [6-8]. Yet, the energy costs of sitting and standing are similar [9,10]. While valuable for metabolic health [11,12] such desks may therefore be less suitable for the prevention and management of weight related issues, because they do not raise energy expenditure across the working day.

Comprehensive intervention strategies that encourage moving as well as standing are therefore needed. Numerous studies have evidenced the effectiveness of workplace walking programs [13-15], but even though an inverse relationship has been suggested to exist between sitting time and step counts [16], few studies have purposely targeted reductions in occupational sitting and increases in workplace walking. Two such studies, of a 'sit less, move more' web-based program termed *Walk@Work* (W@W), which utilises incidental, and sustained walking strategies, reported average reductions in sitting time of up to 20 minutes/day and increases in walking in the most inactive of around 2,000 steps/day [14,17]. However, intra and inter individual variability in sitting and walking changes were evident across the program, suggesting that combination strategies were effective in some, but not all employees.

Furthermore, the emerging intervention evidence base concerning occupational sitting reduction strategies has tended to focus on outcome measures [14,15,18,19], rather than comprehensive process evaluation of intervention effectiveness. Grunseit et al. [20] and Chau et al. [21] have conducted interviews and focus groups respectively, among employees after using sit-stand desks, and authors concluded that sit stand desks had high usability and acceptability between users, identifying some barriers (e.g. issues with sit-stand workstation design) and facilitators (e.g. perceived health and work benefits). Nonetheless, very few studies have examined participants' perceptions of 'sit less, move more' strategies [22,23].

Recognising these gaps in the extant literature, and using data from a subsequent program which implemented W@W in Spanish employees (W@WS; 2010–11), this study aimed to assess the uptake of strategies to reduce sitting time and increase walking at work. The study also explored factors that enabled or limited uptake of strategies to inform ongoing intervention efforts.

Methods

Study design

The study adopted a multi-strand parallel design, which combines qualitative and quantitative approaches at different study stages, [24] to better explore enablers and barriers that may have influenced the uptake of 'sit less and move more' strategies throughout the intervention process. Participants (n = 129) were self reported inactive (<3,000 MET · min · wk-1; IPAQ Short Form [25]) administrative and academic employees from four universities in the Spanish regions of Galicia, the Basque Country and Catalonia. The study was approved by the following ethics committee of each university: Ethics Committee of the Faculty in Psychology, Education and Sport Sciences (University Ramon Llull); Research Commission of University of Vic; Ethics Committee of Clinical Research in Conselleria de Sanidad (CEIC; Xunta de Galicia); Ethics Committee of Applied Research in Human Beings (CEISH/GIEB; University of the Basque Country).

The W@WS program

W@WS is an automated web-based program which aims to encourage office employees to progressively 'sit less and move more' during workdays. The Spanish program is based on previous W@W initiatives, but implemented over a longer duration (19 weeks compared to 6 weeks), with an additional intervention stage designed to elicit increases in walking intensity. Table 1 describes the specific W@WS strategies used at different intervention stages. The first two weeks target breaking occupational sitting time through incidental movement during work tasks (Phase I). Subsequent weeks build on this 'small changes' approach by reducing overall sitting time through short walks (5–10 minutes), during morning/afternoon work breaks and/or commuting time (Phase II; weeks 3–4); and longer walks (10 minutes or more) at lunchtime (Phase III; weeks 5–6). During weeks 7–8 (Phase IV), employees are presented with the aim of regularly achieving at least 10,000 daily steps, and also encouraged to increase walking intensity. An 11-week maintenance period then provides automated guidance with periodic emails encouraging workers to sustain changes in sitting and walking, achieved in previous phases.

Program participants use a pedometer (Yamax SW-200) and diary to self-report daily step counts and sitting time (hours and minutes of daily sitting) in conjunction with the W@WS website, which provides a range of ecological support strategies to facilitate sitting time reductions and step count increases at work. This includes logging daily step counts into a personal account and receiving feedback on the achievement of goals through visual graphics and prompts. Furthermore, the website provides tips for achieving the targets in each phase, social networking for sharing experiences, and educational materials on the health benefits of 'sitting less and moving more'.

Table 1 W@WS 'sit less and move more' intervention strategies relative to program phases

Stages	Aim	Strategies
Incidental movement Phase I (weeks 1–2)	Integrate incidental movement into work tasks.	Take advantage of centralized office equipment (e.g. photocopier or printer) and spread these work tasks out through the day.
		When agreed and appropriate with colleagues, deliver some messages in person, rather than always sending emails.
		Stand up and/or move around the office while talking on the phone or reading documents.
		When appropriate, organise walk-talk, rather sit-talk meetings.
Short walks Phase II (weeks 3–4)	Implement short, regular walks of 5–10 minutes at opportune times across the work day.	Active morning and afternoon work breaks.
		Active travel during commuting (e.g. park the car further and walk, or walk and take public transport).
Longer walks Phase III (weeks 5–6)	Undertake a longer, daily walk of 10 minutes or more during the working week.	Organise walks with colleagues, or plan to walk alone, at lunch time or before/after work.
Higher step count frequency and intensity Phase IV (weeks 7–8)	Regularly achieve 10,000 daily steps and raise the intensity of some short and longer walks.	Identify opportunities to increase the frequency of incidental movement and short/longer walks.
		When moving around the workplace, use the stairs instead of lifts or escalators.
		Use the natural environment and plan longer walking routes that include inclines or steps.
		Increase step cadence, or the number of steps taken each minute on short and longer walks.

Interviews

The qualitative strand of the study occurred through semi-structured interviews, carried out at the end of the phase II, phase IV, and after the maintenance phase (with four interviews in each phase to achieve data saturation). We choose interviews over focus groups, to provide detailed and in depth insights into individual employee experiences at multiple points across the program. We aimed to recruit 12 employees for interviews from the W@WS sample, with four employees from each region (Galicia, Basque Country and Catalonia). To capture different viewpoints, heterogenic selection criteria were used, relative to baseline inactivity level, gender and job role. Beginning from the least active at baseline, male and female academics and administrators were approached by email individually until these categories were represented within each region.

Semi-structured interviews were undertaken with the purpose of exploring factors that were perceived to enable or limit the implementation of strategies to reduce sitting and increase walking. Interviews used open ended questions which captured, at each relevant period of the intervention, a) employee motivations and personal expectations for program involvement; b) the types of strategies adopted or discarded and; c) the reasons why this was the case (i.e. factors that enabled or limited strategy uptake).

Interviews lasted for around 40–60 minutes and were conducted in Catalan or Spanish. Employee responses were audio recorded, then fully transcribed and subjected to inductive open coding to identify emerging categories. Two researchers performed analyses independently, and then met to discuss and agree key themes. Employee quotes to support themes were identified and then back translated from Catalan/Spanish to English.

Post intervention surveys

The quantitative strand of the study involved administering a survey to all employees who completed the W@WS program, two months following intervention (n = 88). The survey contained seven items assessing the uptake of each strategy described, with response options ranging from 1 (never) to 4 (usually). An additional 17 items assessed factors that enabled (9 items) and limited (8 items) the uptake of strategies; response options for these items ranged from 1 (no influence) to 4 (highly influential). Survey items assessing enabling and limiting factors were developed using the thematic outcomes from the qualitative study strand, and reviewed independently by three researchers to establish face validity.

Demographic (age, gender, BMI and job role), and behaviour data (self-reported sitting by diary logging and pedometer derived step counts), collected as part of the main W@WS program, were used to describe the characteristics of interviewees and those employees who completed the survey. Mean and proportion item scores for the surveys were analysed to report factor distributions. Quantitative findings were triangulated with interview data to provide comprehensive, mixed method insights into participant experience.

Results

Table 2 describes the demographic and behavioural characteristics of interviewees and survey participants. Those in both samples tended to be middle aged employees (42–44 years), approaching or just over the overweight BMI threshold (24.9-25.4 kg/m^2). Survey participants were relatively evenly split between academics and administrators, although two thirds were women. At baseline, employees averaged between 6,000 – 8,000 daily steps and 7–9 hours/day sitting; 60% and 67% of employees who completed W@WS decreased sitting time and increased step counts respectively.

Uptake of strategies

Post-intervention survey data at two months follow up (Table 3) examined the uptake of 'sit less, move more' strategies. 'Active work tasks' (incidental movement) and 'stairs, natural inclines and step count cadence' (higher intensity walking) were the most popular in terms of uptake, with a high percentage of employees reporting that they usually or sometimes used these strategies during the program (89-94% respectively).

Moderately used strategies were 'active work breaks' and 'active travel during commuting'. Around 60% of employees reported sometimes or usually using these short walk approaches.

'Walking alone' (longer walks) and 'walk-talk meetings' (incidental movement) were reported to be hardly ever or never used by the majority of employees (60-80% respectively). 'Walking in groups' (longer walks), was the least popular strategy in terms of uptake, with 96% of employees reporting that they hardly ever or never used this type of approach.

Table 2 Interviewee and survey participant demographics at baseline, and sitting time and step count changes post intervention

	Interviewees (n = 12)	Survey (n = 88)
Age	44 ± 12 years	42 ± 8 years
Gender		
Men	n = 6	n = 35 (39%)
Women	n = 6	n = 53 (61%)
Job role		
Academic	n = 6	n = 52 (59%)
Administrative	n = 6	n = 37 (41%)
Body Mass Index (BMI)	24.9 ± 2.8 kg/m^2	25.4 ± 4.0 kg/m^2
Walking		
Baseline	6,800 ± 1,844 steps/day	8,788 ± 2,691 steps/day
Number who increased	n = 10 (87%)	n = 59 (67%)
Sitting		
Baseline	8.8 ± 1.8 hours/day	7.4 ± 2.2 hours/day
Number who decreased	n = 4 (37%)	n = 53 (60%)

Data presented as mean ± SD for continuous variables and n (%) for categorical variables.

Factors that enabled uptake

Qualitative analyses of interviewee data identified two sets of enablers (Table 4) facilitating uptake across strategies. Program supports provided through the W@WS website were a strong theme highlighted by all employees. Supports included web-based automated features that provided access to educational materials and visual representation of progress through graphics. For example two interviewees reported that:

> *"An important factor has been the information the program has provided for me. This has helped me to be aware of the benefits of being less sedentary and more active".* (Interviewee 7; Female Academic)

> *"Checking my global progress visually* [using the individualised graphs provided by the W@WS website] *has helped me to be more motivated".* [to sit less and move more (Interviewee 8; Female Administrator)

Interviewees also highlighted the value of receiving regular fortnightly emails, logging steps and sitting into a personal diary, and following a goal for each phase. These factors were evidenced by three employees who indicated that:

> *"The messages [the fortnightly emails] I receive regularly are very valuable. They encourage me to persevere. The overall message is clear: Keep going!"* (Interviewee 1. Male Academic)

> *"At the end of the day when you are recording the hours you've been seated during work time and the number of steps, you realise how sedentary you've been. This is an extra motivation for the next day to try to move more".* (Interviewee 5. Male Academic)

> *"Keeping* [the program] *goals in mind helps you … you try to achieve and surpass these goals.*" (Interviewee 12. Female Administrator)

A second set of enablers were themed under the area of work context and health. The majority of interviewees (11 employees), specifically mentioned being aware of spending too many hours sitting at work. This awareness encouraged them to take part in the W@WS program and follow the strategies to change this behaviour. Linked to this, nine employees mentioned that program strategies raised awareness of how to implement 'sit less and move more' approaches into the working day. As the following quotes illustrate:

Table 3 Number (%) of employees using W@WS strategies and survey score averages at two months follow up

Strategies	Never (1)	Hardly ever (2)	Sometimes (3)	Usually (4)	Survey score (Mean ± SD)
Incidental movement (phase I: weeks 1–2)					
Active work tasks (e.g. using a centralized Printer or active emails)	2 (3)	7 (8)	47 (56)	28 (33)	3.1 (0.7)
Walk-talk meetings	48 (59)	17 (21)	9 (11)	7 (9)	1.7 (1.0)
Short walks (phase II: weeks 3–4)					
Active work breaks	15 (18)	20 (24)	36 (44)	11 (14)	2.5 (0.9)
Active travel during commuting	23 (29)	9 (12)	15 (19)	31 (40)	2.7 (1.3)
Longer walks (phase III: weeks 5–6)					
Groups	70 (83)	11 (13)	2 (3)	1 (1)	1.2 (0.5)
Alone	26 (30)	24 (30)	22 (27)	11 (13)	2.2 (1.0)
Higher intensity walking (phase IV: weeks 7–8)					
Stairs, natural inclines and step cadence	2 (2)	3 (4)	22 (27)	55 (67)	3.6 (0.7)

> *"Because of the nature of the job, I'm sitting all day.... When I saw the program I thought it would be an opportunity for me* [to sit less at work]*".* (Interviewee 1; Male Academic)

> *"Sometimes I realise that what I am doing* [at work] *I could do walking up and down, for instance when I have to read a document..."* (Interviewee 10; Male Administrator)

> *"If I have to go from A to B, I do a little detour and I pass though C, instead of it being 5 minutes it takes me 10 minutes... I take advantage of my time".* (Interviewee 11; Female Academic)

Four interviewees directly attributed their health issues (e.g. back pain or hypertension) with their sedentary work context. Therefore, having a health condition that could benefit from intervention was perceived as enabling (as opposed to limiting) the uptake of strategies. As one of these interviewees contested:

> *"I have high cholesterol and the doctor told me I had to do something, then I thought that this program could be a very good way for me to fix it".* (Interviewee 6; Male Administrator)

Concurrent with this idea, ten interviewees highlighted that they experienced improvements in physical and mental health through the W@WS program. For example:

> *"Now after lunch, instead of going to have a coffee next to my office I go to the main square in town... then I get out of the Uni,... it's not only about doing more steps, it's about mental relaxation as well".* (Interviewee 3; Female Academic)

Table 4 Factors that enabled strategy uptake: survey score distributions (number of employees and [%]) and averages

Facilitators	No influence (1)	Some influence (2)	Strong influence (3)	Very strong influence (4)	Survey score (Mean ± SD)
Program supports					
Pedometer and diary logging	2 (3)	16 (19)	38 (45)	28 (33)	3.1 (0.8)
Educational materials	8 (10)	18 (21)	43 (51)	15 (18)	2.8 (0.9)
Following an aim for each phase	9 (11)	18 (21)	42 (50)	15 (18)	2.8 (0.9)
Following progression by visual graphics	8 (10)	39 (46)	26 (31)	11 (13)	2.5 (0.8)
Receiving fortnightly emails	16 (19)	47 (56)	21 (25)	-	2.1 (0.7)
Health-related work context					
Being aware of too much occupational sitting	2 (2)	27 (32)	36 (43)	19 (23)	2.9 (0.8)
Being aware of opportunities to 'sit less and move more' at work	4 (5)	22 (26)	44 (52)	14 (17)	2.8 (0.9)
Percieved improvements in health	17 (21)	40 (49)	20 (24)	5 (6)	2.2 (0.8)
Previous or current health conditions	55 (65)	17 (21)	11 (13)	1 (1)	1.5 (0.8)

"Before when I climbed up the stairs I used to get out of breath. Now when I take the steps to the 3rd floor I'm not out of breath; I could even go up one more floor! This increases my self esteem and encourages me to keep going with the program". (Interviewee 1; Male Academic)

Survey data which built on qualitative themes and captured level of influence across the W@WS sample, indicated that 'pedometer and diary logging' was perceived to be the most important enabler (mean survey score of 3.1 ± 0.8); 78% of employees rated this factor as a strong or very strong influence. Conversely, 'previous or current health conditions' was considered to be the least important enabler (mean survey score of 1.5 ± 0.8); 65% of employees reported this factor to be uninfluential. Remaining enablers were influential to some degree along this continuum, with mean survey scores for factors ranging from 2.1-2.9, and composite influence percentages (categories 2–4) ranging from 81-98%.

Factors that limited uptake

Thematic analyses of interviewee data identified eight factors that limited uptake of W@WS strategies (Table 5). Two of these factors, identified by six interviewees, described generalised barriers such as poor goal setting, and not being able to accurately estimate the amount of time sitting at work. As three of these employees stated:

"I am unable to know how long I sit every day. I get up from the chair quite frequently, so it's impossible". (Interviewee 12; Female Administrator)

"I think it's more difficult to reduce sitting time than to increase walking... it's difficult because we can't count [minutes spent sitting] *with the same accuracy as the number of steps".* (Interviewee 7; Female Academic)

"I got frustrated with not getting to my target. I thought 'fail, fail' and ended up not achieving ..." (Interviewee 2; Male Administrator)

Other limiting factors were specifically linked to the strategies listed in Table 3. For example, for Phase I strategies, seven interviewees encountered difficulties in carrying out 'active work tasks' and 'walk-talk meetings', because colleagues did not perceive these strategies to be suitable for the workplace, or the nature of work involved (which mainly concerned sitting in front of the computer) limited the opportunity to move. As two academics commented:

"... I sometimes send stuff to the printer and I walk a bit more around the office, but I don't do it much because I think my colleagues would think I'm crazy". (Interviewee 7; Female Academic)

"When I have a meeting with a student, I try to walk up and down, but it's difficult because we need to write things down or work with the computer". (Interviewee 9; Male Academic)

Relative to Phase II strategies (short walks), interviewees reported time pressures and an excessive workload as factors that limited the uptake of active breaks. However, perceptions of impact for this factor tended to differ between occupational roles. This was attributed to the inherent flexibility in job tasks, where administrative employees reported to have a more structured (and supervised) schedule than academics, who within limits, could choose how and when to work. A recurring theme amongst interviewees was the perception that managers viewed administrator absenteeism from desks for walking unfavourably, whereas academics did not feel obliged to justify their absence for a walking break. As the following quote illustrates:

Table 5 Factors that limited strategy uptake: survey score distributions (number of employees and [%]) and averages

Barriers	No influence (1)	Some influence (2)	Strong influence (3)	Vey strong influence (4)	Survey score (Mean ± SD)
Screen based work	3 (4)	13 (15)	32 (38)	36 (43)	3.2 (0.8)
Lack of time, time pressure, and excessive workload	12 (14)	16 (19)	27 (32)	29 (35)	2.9 (1.1)
Not being fully aware of the amount of time spent sitting at work	19 (23)	31 (37)	23 (28)	10 (12)	2.3 (1.0)
Bad weather	26 (31)	34 (41)	17 (20)	7 (8)	2.1 (0.9)
Lack of support from colleagues	45 (56)	15 (19)	12 (15)	8 (10)	1.8 (1.0)
Poor goal setting	40 (48)	31 (37)	11 (13)	2 (2)	1.7 (0.8)
Lack of support from management team	57 (69)	11 (13)	9 (11)	6 (7)	1.6 (1.0)
Belief that physical activity outside work offsets long periods of sitting at work	50 (60)	22 (27)	11 (13)	-	1.5 (0.7)

"… I have my boss round the corner… I don't have much excuse to move around". (Interviewee 12; Female Administrative)

Ten interviewees cited time pressures inside work as a key barrier limiting longer walks during Phase III. Having an active leisure time after work was viewed as a feasible alternative. For example:

"I prefer to get the best out of my time in the office, and then to be able to leave a bit earlier and go to the gym…." (Interviewee 5; Male Academic)

"Because I sit for so long during my work hours, I compensate by walking after work". (Interviewee 8; Female Administrator)

However, four employees tried to find time during lunchtime for movement and highlighted this period of the day as being flexible enough to allow longer walks to occur regularly across the working week. Two employees disagreed with this viewpoint and did not find longer lunchtime walks appealing as it meant missing important social interactions with other workers. As one interviewee commented:

"Walking at lunch time means… less social time with colleagues…" (Interviewee 11; Female Academic)

Seven interviewees also highlighted inclement weather during wintertime as a factor limiting the uptake of longer walks. As one employee from the North of Spain highlighted:

"Here we have very severe winters and do not want to move much. You sometimes have to go to another building and you get wet, with or without umbrella." (Interviewee 6; Male Administrator)

Post interview survey data identified 'screen based work' (i.e. sitting at a desk working on a computer) as the most influential barrier (mean survey score of 3.2 ± 0.8); 81% of employees reported this factor to be highly influential in limiting W@WS strategy uptake. 'Lack of time, time pressure, and excessive workload', 'not being fully aware of the amount of time spent sitting at work' and 'bad weather' were rated as second tier influences; mean survey scores for these barriers ranged from 2.1-2.9, and 64-69% of employees suggested that these factors limited strategy uptake to some degree. The remaining four factors were lower level influences, with mean survey scores ranging from 1.5-1.8; 'belief that physical activity outside work offsets long periods of sitting at work' and 'lack of support by management team' were the lowest ranking factors in this group; 60-69% of employees classified these limiting factors identified by interviewees as uninfluential.

Discussion

The aims of this study were twofold. Using a multi-method approach, we assessed the uptake of 'sit less, move more' strategies, and also explored factors that enabled and limited sitting time reductions and walking increases in Spanish university office employees from the W@WS project. Exploring the specific types of strategies that facilitated these changes was a novel and valuable aspect of the present study, particularly for health practitioners interested in gaining practical advice on how to maximize intervention efficacy.

Accordingly, the findings suggest that promoting workplace strategies that target 'active work tasks, active work breaks, active travel, and higher step count frequency and intensity' may appeal to office employees. Conversely, strategies that require employees to engage in walk-talk meetings or longer individual or group based lunchtime walking sessions may be less popular and therefore less effective at encouraging employees to reduce sitting time and increase step counts.

Investigating factors that enabled the uptake of intervention strategies was also a unique aspect of the present study. Using a pedometer and diary to report sitting time and step counts throughout the program was reported to be the most important factor enabling sitting and walking changes in the survey sample. Several studies highlight pedometer-based interventions and step count logging in particular as an effective means of motivating people to be more active [26-28]; our findings suggest that this may also be an effective approach for reducing occupational sitting. However our interview participants also raised concerns about the practicality and accuracy of logging sitting times, highlighting the role new technologies, such as smartphones, may play in this regard [29].

Similar to previous research [27,30], provision of educational materials and goal setting were also considered useful enablers of strategy uptake. However, in contrast to other research [28], email reminders did not facilitate strategy use.

Mixed method data identifying key influences that limited the use of specific strategies are particularly valuable for practitioners and employers interested in overcoming barriers that discourage active workplaces. For example, while the concept of integrating 'active work tasks' into the working day was highly used, 'active work breaks and longer lunchtime walks' were negatively influenced to some degree by lack of time, socio-cultural expectations and excessive workloads. Although the belief that physical activity outside of work offsets long periods of sitting at work was identified as possible barrier, this did not influence strategy uptake.

Based on our qualitative and quantitative data sedentary work tasks were highlighted as the principal barrier discouraging meaningful engagement with strategies. From one perspective this supports the importance of targeting workstation based strategies (such as sit-stand, or treadmill desks [31]). From another perspective, our findings highlight the value of employee reflexivity and the provision of different types of strategies that target a range of occupational sitting and moving contexts. A key recommendation emerging from our study therefore concerns the value of providing a 'menu' of 'sit less, move more' strategies that employees can choose from and fit within and around the day-to-day demands of the office work environment.

It is important to set study recommendations against the context of our sample, which was relatively small and consisted of academic and administrative employees from Spanish universities. Given that occupational sitting and walking data were similar to those observed in office workers from other countries who have used the W@W program, patterns of strategy use and enabling/limiting factors may also be similar. However, to best inform translational efforts, on going research should aim to investigate these issues in other occupational groups from different cultures.

Other factors that may have influenced study outcomes include timing of the administration of the survey; which strategies were used by employees prior to and during early intervention; and the fact that most of our interviewed employees (from 60% to 67%) reduced sitting and increased walking. This latter point highlights the value of accessing employees who were less successful at implementing behaviour change.

The present study also had a range of strengths which future work in the area should build upon, such as the use of a mixed method approach, which combined quantitative data, with rich and meaningful qualitative experiences in a real world office setting. Other studies that have targeted occupational sitting or walking have assessed employee experiences post program, relative to single strategy approaches such as sit-stand desks [20,21] or pedometer based, walking interventions [22,27]. Our study comprehensively explored uptake and influences in a number of 'sit less' and 'move more' approaches, throughout the intervention process. Consequently, the findings provide valuable employee insights across a broad range of strategies, as and when experiences were taking place.

Conclusions

This mixed method study found that 'higher intensity walking and active work tasks' were the most frequently used intervention strategies to decrease occupational sitting and increase workplace walking in Spanish university office employees. 'Walk-talk meetings and lunchtime walking groups' were used the least. Key facilitators and barriers to strategy uptake included 'sitting time and step count logging' and 'screen based work' respectively, with these data providing insights into which influences practitioners need to target to encourage employees to 'sit less and move more' at work.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

JB, MM and AP conceived the study and NG oversaw its conduct. All authors participated in the design of the study. AP, IM, and AG led data collection at the universities, with support from JB. MM developed and MM and JB transcribed the semi-structured interviews. JB analysed the data assisted by JM with the quantitative analysis, and MM by the qualitative analysis. JB, MM and NG interpreted the results. JB drafted the manuscript, and MM, AP and NG edited and revised the manuscript. All authors commented on drafts, and read and approved the final manuscript.

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Chapter 5: STUDY THREE

Bort-Roig J, Gilson ND, Puig-Ribera A, Contreras RS, Trost SG. Measuring and Influencing Physical Activity with Smartphone Technology: A Systematic Review. Sports Medicine Journal*.* 2014;**44**(5):671-686.

Chapter 6: GENERAL DISCUSSION

6.1 Main results and discussion with the literature

This thesis aimed to investigate the impact of an intervention (W@WS) to reduce occupational sitting and increase physical activity in Spanish office workers. The use of ICT based behaviour change strategies to encourage workers to sit less and move more was a specific focus of the thesis.

The findings make an original contribution to the limited evidence base on sitting time reduction interventions, particularly in respect to sedentary Spanish office workers. Studies One and Two also respond to a growing need to develop, test and evaluate programs that have the potential to be easily implemented and translated into the day-to-day life of busy office based organisations and workers.[243,244] In this regard, the W@WS program has been shown to be a practical and effective strategy to promote small but sustainable short to mid-term changes in both target behaviours.

The main results of Study One indicated that Spanish office workers enrolled in W@WS significantly decreased occupational sitting time by 22 minutes/day, increased step counts by 1,400 steps/day and reduced waist circumference by 1.1 cm, relative to workers in a comparison group. Most importantly, step count increases were maintained two months after the intervention, and sitting time continued averaging 16 minutes less per day, relative to the comparison group.

The main results of Study Two provided insights into which strategies and influences practitioners need to target to maximise the effectiveness of 'sit less, move more' occupational intervention strategies. 'Higher intensity walking and active work tasks' were the most frequently used intervention strategies while 'walk-talk meetings and lunchtime walking groups' were used the least. Key facilitators to strategy uptake included 'sitting time and step count logging', and 'screen based work' was identified as the most significant barrier limiting the uptake of these strategies.

The findings of Study One and Two provide new evidence on practical strategies that are capable of targeting increases in occupational energy expenditure through changes in sitting time and physical activity. The studies compared the impact W@WS had in a group of workers that had access to a pedometer and a diary with another group that also had access to a web page, where workplaces were randomly assigned to one of those groups. To date, 12 studies have included comparison groups to test the effectiveness of workplace sitting time reduction strategies.[14,19–21,32,36,98,209,212,213,218,220] These studies showed mixed results on the short-term effectiveness of workplace interventions to reduce occupational sitting. Furthermore, sitting time was mostly replaced by standing without substantial increments in daily energy expenditure.[14,20,21,23,212,214] Fewer studies have investigated combined effectiveness on reducing sitting time and increasing physical activity,[35,213,218,220] and only one of these studies has included follow-up measures to track changes on behavioral risk factors over time.[216] In this regard, the thesis provides new data and insights into the positive impact a technology-based intervention had on the maintenance of change in office workers, following intervention completion.

The thesis also used a qualitative, mixed method research approach, which is fundamental to understanding the reasons why participants adopt intervention strategies.[61,219] Four previous studies[24,211,217,219] have used qualitative methods as part of a mixed method design. Three of these studies[24,211,219] focused on height adjustable desks or computer software programs and identified usage issues associated with disruption of work flow and work habit. One study,[217] explored factors that influenced occupational sitting changes through walking strategies. Findings highlighted the feasibility of reducing long periods of desk sitting through moving while completing working tasks. None of these studies assessed workers uptake of strategies over time.

Thesis Study Two therefore makes a unique contribution to the limited mixed-method evidence base, in that it comprehensively explored worker perceptions of occupational sitting and physical activity, using interviews conducted during the intervention process. Data were subsequently used to develop a questionnaire. This approach provided detailed data on the uptake of 'sit less and move more' strategies and factors that enabled and limited combined behaviour change. The findings highlight the value of providing a range, or menu, of occupational sitting and moving strategies that office workers can choose from, and provide particular insights for managers and occupational health practitioners interested in gaining practical advice on how to maximize intervention efficacy.

The qualitative findings presented in Study Two also highlighted the value of monitoring sitting time and step counts from a participant perspective, as well as identifying the need to consider the practical and accurate measurement of sitting time and step counts for self-monitoring purposes. The advent of new mobile technologies will play a key role in providing accurate and prompt feedback on sitting and physical activity.[245] Consequently, the thesis systematically reviewed available evidence on the extent to which smartphones can effectively be used to measure and influence physical activity and sedentary behaviour.

The review presented in Chapter 5 is the first to summarise the extant and emerging literature on smartphones, physical activity and sedentary behaviour, and provides a framework for on-going research and translational efforts. Review outcomes highlighted smartphone technology as an emerging and fast developing field of enquiry, with the first studies published in 2007.[246,247] Several protocol papers were identified, which provide encouraging indications that intervention research is developing and progressing.[248,249] The 26 studies identified in the thesis review covered a range of settings across the lifespan, although only one of them was focused on reducing sitting time in office-based workers.[250] These studies reported moderate-to-excellent real-time measurement accuracy for a range of physical activity but also sedentary behaviours (e.g. sitting and standing).

Findings also highlighted key features to influence physical activity and sedentary behaviour engagement and compliance, such as behavioural profiles, real-time feedback, social networking, expert consultation, and goal setting. These features provide significant potential for encouraging changes in occupational sitting and physical activity at the individual and organisational level, given the extent to which populations now interact with mobile technology. In Spain for example, data indicates that 54% of the adult population interact with their personal smartphone an average of 150 times a day.[251]

6.2 Strengths, limitations and directions for future research

The specific strengths and weaknesses of each thesis study, described in Chapters 3, 4 and 5 are summarized in Table 1.

Table 1. Summary of strengths and limitations of studies.

	Strengths	Limitations
Study One	- Intervention that evaluated effectiveness of a range of 'sit less and move more' strategies against a comparison group. - Multisite intervention from four Spanish workplaces that were randomly assigned to the intervention or comparison group.	- Use of self-reported sitting measures that may not have detecting small but meaningful changes in occupational sitting. - Lack of heterogeneity of the sample (i.e. highly educated middle-age men and women working at universities).
Study Two	- Mixed method approach, which combined qualitative experiences with subsequent quantitative data. - First comprehensive study to explore workers' perceptions on 'sit less and move more' strategies throughout the intervention process.	- Relatively small sample size. - Lack of heterogeneity in terms of behavioural change process, due to most participants (60-67%) reduced sitting and increased walking.
Study Three	- Comprehensive search strategy. - First systematic review on smartphone technology and its use in physical activity and sedentary behaviour measurement and promotion.	- Relatively small number of studies due to the emerging evidence base. - Poor quality research designs, small sample sizes, and short study periods.

The thesis as a whole also has a number of generic strengths that should be considered. For example, the progressive nature of the thesis studies is a key strength, whereby the use and viability of ICT based behaviour change strategies to encourage workers to 'sit less and move more' is explored through three linked studies. The first two studies investigate different and complementary arms of the W@WS project, while the third study extends findings from a web-based program, to review next phase research using mobile, smartphone technology.

The thesis utilised a range of research skills that included, intervention development and implementation, measurement of health behaviours and risks, interviewing, data treatment, statistical and thematic analyses, and systematic reviewing. In addition, the thesis was developed as part of a funded national project with four partner universities across Spain. The multi-site nature of the W@WS program required comprehensive coordination of research activities at these partner institutes.

The thesis also has a number of limitations and opportunities for on-going research. Although multiple worksites were used, external validity of W@WS data is presently limited to office workers who are university academics and administrators. To best inform translational efforts, the effectiveness of W@WS 'sit less and move more' strategies need to be investigated in other types of office workers, whose work routine and task demands will be different.

Adherence to change was measured at two months post intervention and these follow-up data provide insights on mid-term sustainability. However, longer-term data is required and on-going research now needs to assess the sustainability of change at six months and one-year.

Finally, the use of web-based intervention approaches can be considered valuable to promote behavioural change in a workplace community. However, the three studies presented in this thesis, conducted over a time period of four years, reflect how rapid technology advances now firmly place the lifestyle research focus on smartphone technology. Transition and testing of the W@WS program from a web-based platform, to a mobile, smartphone application, is a future research aspiration based on thesis outcomes.

6.3 Conclusions

This thesis investigated the impact of an intervention to reduce occupational sitting time and increase physical activity in Spanish office workers. Three studies explored the intervention efficacy of an automated web-based program (W@WS) and the current evidence and future directions for research using smartphone technology.

The W@WS program elicited small and sustainable changes in occupational sitting time and physical activity as well as improvements in abdominal fatness, a key physical risk factor for chronic diseases. A key recommendation emerging from the thesis concerned the value of providing a range of occupational sitting and moving strategies that can overcome office work environmental barriers.

In addition, the thesis identified smartphone technology as a new and exciting research field, capable of measuring and influencing behaviour change in real time. Ongoing research in office workers will focus on developing and testing workplace physical activity interventions targeting sitting time reductions through smartphone technologies.

The thesis findings make a number of original contributions to the ICT intervention evidence base and, through reflection on thesis limitations, highlight a number of key research needs for future studies. Importantly, the findings also provide practical information that can guide managers and occupational health services on promoting ecologically viable and cost-effective interventions to elicit sustainable, positive changes in sitting, moving and occupational energy expenditure among office workers.

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APPENDIX

APPENDIX I: Summary table of interventions for reducing occupational sitting time

Study	Aim	Design	Intervention characteristics and theoretical framework	Physical behavioural measurements	1) Physical behaviour, health and work related outcomes 2) Feasibility
WORKSTATION BASED STUDIES (n=17)					
Alkhajah 2012[23]	To examine the efficacy of a height adjustable desk program to reduce office workers' sitting time.	Pre-post comparison study (QUANTY); N=32	1 week and 3 months follow-up: Participants received an height adjustable desk.	Sitting, standing and walking time were measured using an inclinometer (ActivPAL3).	1) Sitting time was reduced by more than 2 hours at both the 1-week and 3-month follow-ups (p<0.001), which was almost exclusively replaced by standing, with minimal changes to stepping time. Intervention group increased HDL cholesterol by an average of 0.26 mmol/L (p=0.003). 2) There was strong acceptability and preference for using height adjustable desks, though some design limitations were noted (e.g. insufficient room to use the mouse and insufficient support for their hands and wrists while typing).
Carr 2012[210]	To test de feasibility and use of a pedal device for reducing workplace sedentary time.	Pre-post study (QUANTY); N=18	4 weeks: Participants were provided access to a portable pedal device.	Sedentary and physical activity behaviour measured objectively through an accelerometer (StepWatch)	1) Participants pedalled on 12.2 of 20 days on average for 23.4 min. 2) Majority of participants reported positive feedback regarding preference, ease of use, comfort, no visual disturbance, and no inference with work-tasks.
Carr 2013[209]	To test the efficacy of a multicomponent technology intervention for reducing daily sedentary time and improving cardiometabolic disease risk.	Blinded, randomised controlled trial (QUANTY); N=49	12 weeks: Participants received a social cognitive theory-based, internet-delivery programme, a portable pedal device and a pedometer.	Sedentary and physical activity behaviour measured objectively through an accelerometer (StepWatch)	1) Sedentary time was reduced by 57.7 min/day (p<0.01), which was appeared to had been at least partially replaced by and increase in moderate intensity activity (average of 31.1 min/day pedalling). 2) Majority of participants rated the pedal machines as helpful in reducing their workplace sedentary time.
Chau 2014a and 2014b[20,211]	To examine the effects of using height adjustable desk program on office workers' sitting time at and out work. To qualitatively evaluate the acceptability, feasibility and perceptions of using a height adjustable desk program.	Randomised cross-over trial (QUANTY and QUALY) N=42	4 weeks: Participants used height adjustable desk.	Sitting, standing and walking time were measured using an inclinometer (ActivPAL3) and with a self-reported questionnaires (OSPAQ and WSQ).	1) Objectively measures sitting time was significantly reduced by 73 min/8hr (p=0.004) and standing time was increased by 65 min/8hr (p=0.001). Whereas there were no changes in time spent stepping. Self-reported assessments found similar patterns. 2) Common barriers were working in an open plan office, and issues with the workstation design. Common facilitators were a supportive work environment conductive to standing, perceived physical health and work benefits. Most participants indicated they were interested in using it in the future.

Study	Aim	Design	Intervention characteristics and theoretical framework	Physical behavioural measurements	1) Physical behaviour, health and work related outcomes 2) Feasibility
Dutta 2014[212]	To determine whether installation of height adjustable desks could lead to decreased sitting time during the workday among sedentary office workers.	Randomised cross-over trial (QUANTY); N=28	4 weeks: Participants were provided with height adjustable desks and received weekly emails reminding the study goal of replacing 50% of their sitting time at work by standing time.	Sitting and standing were self reported (OSPAQ) and objectively measured with an accelerometer (MSR). Physical activity and sedentary behaviours were also objectively measured with the accelerometer Gruve.	1) Using the MSR accelerometer, sitting time was reduced by 21% at work, and using the Grove accelerometer sedentary time was reduced by 4.8 min/8hr. Participants self-reported decreasing occupational sitting time by of 40% and increasing standing time by 39%, whereas walking was not changed. Participants also reported being significantly more relaxed, calmed, more energetic, less tired, less sluggish and felt a higher overall sense of well-being. 2) Most participants reported experiencing lower back and lower extremities discomfort. The major complain was the loss of work-surface, although at the end of the study, 26 out of the 28 participants reported willingness to continue using the height adjustable desks.
Ellegast 2012[213]	To develop and test a comprehensive assessment inventory for physical activity and related health outcomes at office workplaces.	Randomised controlled trial (QUANTY); N=25	12 weeks: Participants were introduced environmental (e.g. height adjustable desks) and behavioural elements (e.g. pedometers, face-to-face motivation and rewards).	Sitting, standing, walking were measured through a multi-sensor device using accelerometer and gyroscope (CUELA Activity System).	1) Sitting time was decreased with 80 min/8hr ($p<0.001$), and sanding ($p<0.001$) and walking ($p<0.01$) were increased. They also showed significant improvements in BMI, resting heart rate, perceived well-being, and maximum trunk strength.
Gilson 2012[13]	To assess the use of standing desks in an open plan office and their impact on sedentary work time.	Pre-post study (QUANTY); N=11	1 week: Participants received initial counselling session of benefits of reducing sitting and were encouraged to use the standing desk.	Activity intensities were measured with an armband accelerometer (SenseWear^{TM}Pro$_2$).	1) Non-significant changes in mean percentage times in sedentary, light and moderate intensity categories.
Gorman 2013[214]	To evaluate changes in workplace activity and sitting, as well as health- and work-related outcomes, in office-based workers before and after transitioning from a conventional workplace to an 'activity-permissive' physical workplace environment.	Natural pre-post study (QUANTY); N=27	Participants moved to a, 'activity-permissive' building (i.e. height adjustable desks and meeting rooms with options to sit or stand).	Sitting, standing and walking time were measured using an inclinometer (ActivPAL3).	1) Standing time was increased with 19 min/8hr ($p=0.03$), which was more likely due to a reduction in sitting time (-20 min/8hr; $p=0.08$), than changes in walking time (+1 min/8hr; $p=0.7$).

Study	Aim	Design	Intervention characteristics and theoretical framework	Physical behavioural measurements	1) Physical behaviour, health and work related outcomes 2) Feasibility
Grunseit 2013[24]	To evaluate the acceptability and usability of manually and electrically operated height adjustable desks in a medium-size governmental organisation.	Pre-post formative study (QUALY & QUANTY); N=11	3-month: Participants received an height adjustable desk.	Sitting was self-reported measured with questionnaires (OSPAQ and WSQ).	1) Sitting time was decreased with 102 min/8hr ($p=0.014$). 2) Reasons for using height adjustable desks were the potential health benefits, the perceived productivity while working, and practical accommodation of transitions. However, some concerns were expressed using the desk in the standing positions.
Healy 2013[14]	To investigate the short-term efficacy of a multicomponent intervention to reduce office workers' sitting time	Pre-post comparison study (QUANTY); N=43	4 weeks Intervention comprised organizational, environmental and individual elements.	Sitting, standing and walking time were measured using an inclinometer (ActivPAL3).	1) Sitting time was decreased with 125 min/8hr ($p<0.001$) and standing time increased with 127 min/8hr ($p<0.001$). Non-significant changes to walking time and number of steps. Non-sadistically significant intervention effects were observed for any health- and work related outcome.
Hedge 2004[19]	To test the effects of using electronic height adjustable worksurfaces in offices.	Randomized controlled trial (QUANTY); N=33	4-6 weeks: Participants were changed from a fixed height worksurface to an electronic height adjustable worksurface.	Sitting time was self-reported.	1) Sitting time was decreased in 16.5% ($p=0.000$) during work hours. There were significant decreases in the prevalence of musculoskeletal discomfort symptoms and improvements on productivity. 2) Written comments about the feasibility generally were positive.
John 2011[26]	To determine if a treadmill desk increases physical activity and influences anthropometric, body composition, cardiovascular, and metabolic variables in overweight and obese office workers.	Pre-post study (QUANTY); N=12	9 months: Participants were allowed to work while walking (self-selected speeds and durations), standing, or sitting; with a treadmill desk.	Sitting, standing and walking time were measured using an inclinometer (ActivPAL3).	1) Walking was increased with 4351-7080 steps/day ($p<0.05$), and sitting was decreased with 182-88 min/8hr ($p<0.05$). There were decreases on waist and hip circumference (5.5cm and 4.8cm; $p<0.05$), low-density lipoproteins (16 $mg \cdot dL^{-1}$; $p<0.05$), and total cholesterol (15 $mg \cdot dL^{-1}$; $p<0.05$).
Koepp 2013[27]	To assess a 1-year intervention with treadmill desks for increasing workers daily physical activity and decreasing daily sedentary time.	Pre-post study (QUANTY); N=36	1-year: Participants were allowed to work while standing and walking at low speed with a treadmill desk installation.	Sedentary and physical activity behaviour measured through a hip-worn accelerometer (Actical).	1) Sedentary time was reduced with 91 minutes ($p<0.001$) during total waking hours at 6 months and 43 minutes ($p<0.001$) at 12 months. While physical activity time was increased (+58 and +38 min/day; $p<0.001$). For the whole group, weight loss averaged 1.4kg ($p<0.05$). While obese participants decreased 2.3kg ($p<0.03$), and 5cm of waist circumference.

Study	Aim	Design	Intervention characteristics and theoretical framework	Physical behavioural measurements	1) Physical behaviour, health and work related outcomes 2) Feasibility
Neuhaus 2014[21]	To compare the efficacy of a multi-component intervention to reduce workplace sitting time, to a height adjustable workstation-only intervention, and to a comparison group.	3-arm randomized controlled trial (QUANTY); N=44	3 months: Intervention comprised organizational, environmental and individual elements to workstation-only and to comparison.	Sitting, standing and walking time were measured using an inclinometer (ActivPAL3).	1) Sitting time in the multi-component group was reduced with 89 minutes (p<0.001) and 33 minutes in the workstation-only group (p=0.285). Non-significant changes to walking time and number of steps. Non-sadistically significant intervention effects were observed for any health and work related outcome.
Pronk 2012[22]	To study the effect of height adjustable desks on time spent sitting at work and its health and work related outcomes.	Pre-post comparison study (QUANTY); N=34	4 weeks: Participants received fully height adjustable desk and height adjustable desk mount for computer only.	Sitting time was self-reported using 'experience sampling methodolohy'.	1) Sitting time was reduced with 66 min/day (p=0.03). Sitting time reduction was associated with declined upper back and neck pain (r=0.47; p= 0.006), fatigue (r= 0.44; p= 0.01), confusion(r=0.46; p= 0.007), and total mood disturbance (r=0.35; p= 0.46). 2) Overall participants reported positive feedback and non-adverse events.
Stephens 2014[215]	To investigate how and when changes in workplace sitting time occurred following a workplace intervention to inform evaluation of intervention success.	Pre-post study with comparison group (QUANTY) N=43	4 weeks: Intervention comprised organizational, environmental and individual elements.	Sitting, standing and walking time were measured using an inclinometer (ActivPAL3).	1) Sitting time was reduced with wide individual variability observed (range -29 to -262 min/8hr). Sitting bouts duration was also reduced (-5.6 min; p=0.011). 2) Participants successfully adopted the Stand Up and Sit Less intervention messages across the day. However, there was minimal uptake of the Move More message.
WALKING BASED STUDIES (n=5)					
Freak-Poli 2011 and 2014[35,216]	To evaluate whether in a four-month, pedometer-based, physical activity, workplace health programme results in an improvement in risk factors for diabetes and cardiovascular diseases.	Pre-post study (QUANTY); N=620	4 months: Web-site, pedometer and emails	Sitting time and physical activity were self-reported with a questionarire.	1) Improvements were observed for physical activity (an increase of 6.5% in the proportion meeting guidelines; p=0.01), sitting time (-0.6 hours/day; p=0.001), blood pressure (-1.8mmHg; p<0.01), and waist circumference (-1.6 cm; p=0.02). In contrast an increase was found for fasting total cholesterol (0.3mmol/L; p=0.003) and triglycerides (0.1mmol/L; p=0.008). Eight-month postprogram, sustained improvements were observed for sitting time and blood pressure, and modest improvements in physical activity and waist circumference.

Study	Aim	Design	Intervention characteristics and theoretical framework	Physical behavioural measurements	Physical behaviour, health and work related outcomes Feasibility
Gilson 2008 and 2009[32,217]	To compare the impact of two-workplace walking strategies on step counts and sitting time.	Randomized control trial (QUANTY & QUALY); N=179	10 weeks: Incidental walking and walking routes based on the ecological model.	Walking (step counts) was measured with a pedometer (Yamax SW-200) and sitting time was self-reported using a logbook.	1) Walking was increased for route (968 steps/day; t=3.9, p<0.000) and incidental (699 steps/day; t=2.5, p<0.014) groups. Non-significant changes in sitting time were found. Trend for decreased sitting in incidental walking group 21 min/day (t=1.9; p<0,057) 2) Workers highlighted the feasibility of moving while completing working tasks and opportunities to reduce long periods of sitting at their desk. They also benefited from improved feelings of health, well-being, and work productivity. Difficulties of managing time pressures were identified for the walking routes group, and issues of peer acceptance and management subcultures for the incidental walking strategies group.
Marshall 2003[36]	To compare the effect of physical activity interventions delivered through website and print.	Randomized control trial (QUANTY); N=655	8 weeks: Printed vs Web-based and emails counselling intervention, based on transtheoretical model of behaviour change.	Sitting time and physical activity were self-measured with a questionnaire (IPAQ).	1) Sitting time was decreased with 21 min/day in the web group (t [1,326]=2.2, p=0.03), whereas physical activity only showed significant increases in those more inactive in the printed group.
COMPUTER SOFTWARE BASED STUDIES (n=3)					
Evans 2012[98]	To investigate the effects of point-of-choice prompting software, on the computer used at work, to reduce long uninterrupted sedentary periods and total sedentary time at work.	Randomized controlled trial (QUANTY); N=30	1 week: Participants received initial counselling session of benefits of reducing sitting and standing every 30 minutes.	Sitting, standing and walking time were measured using an inclinometer (ActivPAL3).	1) Number (p=0.014) and duration (p=0.007) of sitting time events > 30 minutes, were reduced. However, there were no significant differences in total sitting time between groups.
Pedersen 2014 and Cooley 2014[218,219]	To increase work daily energy expenditure by interrupting periods of prolonged sitting with short-bursts of physical activity during daily works. To assess participants' perceptions of experienced outcomes while undergoing an electronic health workplace intervention.	Randomized controlled trial (QUANTY & QUALY) N=34/46	13 weeks: A prompting software program (Exertime) was delivered each participant, which was designed to prompt workers every 45-minute break sitting by short period of physical activity. Study was based on the socio-ecological model.	Sitting, standing, walking and heavy labour were self-reported using a questionnaire (OSPAQ). Subsequently energy expenditure was estimated following the Compendium of Physical Activity Tracking Guide.	1) Average sitting time overall sample was 6.10 hours per day. There was significant 2x2 interaction [F(1,32)=9.26, p<0.05]. The intervention group increased the calories expended during the workday, whereas the control group decreased. 2) The prompting software program was shown to be feasible to increase light-activities such as standing and walking. Participants reported a range of positive outcomes across multiple system of influence, but their experienced some negative outcomes because of distribution to work flow and a changing of work habit.

Study	Aim	Design	Intervention characteristics and theoretical framework	Physical behavioural measurements	Physical behaviour, health and work related outcomes Feasibility
WORKSTATION, WALKING AND COMPUTER SOFTWARE BASED STUDY (n=1)					
Parry 2013[220]	To determine if participatory workplace interventions could reduce sedentary time and promote light and moderate/vigorous physical activity during work hours	Randomized controlled trial (QUANTY); N=62	12 weeks: Participants were divided into three intervention groups (active workstations, physical activity strategies, computer software). Participatory action	Sitting time, light activity time and transitions were measured with an accelerometer (ActiGraph).	Total sedentary time and number of breaks were decreased on working days (-1.6%; p=0.006 and 0.64 breaks/sedentary hour; p=0.005) and during work hours (-1.7%; p=0.014 and 0.72 break/sedentary hour; p=0.015). There was a significant increase in light activity during work hours (1.5%; p=0.012) and moderate/vigorous physical activity on working days (0.6%; p=0.012).

APPENDIX II: Study support materials

- Participant informed consent forms
- Pedometer and self-report sitting diary
- Webpage screenshots
- Health survey forma
- Physical screening measurements
- Workers' perceptions: Interview guide
- Workers' perceptions: Survey forma

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Internet: http://walkatworkspain.uvic.es

FULL D'AUTORITZACIÓ PER A PARTICIPANTS

***Nom*___________________*Data de naixement* _____________**
***Adreça*_________________________________DNI_______________**
***Adreça electrònica* __________________ *Telèfon*__________**

He llegit i entenc la informació per a participants relativa a aquesta iniciativa i estic d'acord a participar en Walk@Work, un programa portat a terme pel Departament de Ciències i Ciències Socials de la Universitat de Vic.

En el marc de la iniciativa, entenc que se'm demanarà que:

- Segueixi amb la meva rutina habitual a la feina durant una setmana.
- Completi un programa de 8 setmanes de durada amb l'objectiu d'augmentar el temps que camino i reduir el temps que sec a la feina.
- Completi un programa de 11 setmanes de durada amb l´objectiu de mantenir l´augment aconseguit en el temps de caminar i la reducció en el temps assegut a la feina.
- Enregistrar els recomptes de passes i el temps que sec abans del programa i durant el dit programa, així com durant dues setmanes més un cop el programa hagi acabat.

També entenc que la iniciativa inclourà:

- Portar un podòmetre i mesurar la meva activitat física els dies feiners.
- Emplenar un diari de recomptes de passes i del temps que sec.
- Accedir a la pàgina Web del programa.
- Emplenar un breu qüestionari sobre l'activitat física general que realitzo, la salut que tinc i el meu benestar.
- Prendre mesures de talla, pes, tensió arterial i circumferència de cintura.
- Enviar comentaris a l'equip de recerca sobre les meves experiències durant la iniciativa. Aquests comentaris podran enregistrar-se amb la meva autorització en cas que vulgui participar en una entrevista.

Entenc que si tinc qualsevol alteració que m'afecti la salut, hauria de consultar amb el metge abans de començar el programa. Puc notar rigidesa muscular o cansament el primer cop que camini, però aquests problemes haurien de remetre a mesura que continuï en el programa. No obstant això, si sento dolor o malestar durant el programa, m'hauria d'aturar i consultar amb el metge.

Participo en l'estudi de manera voluntària. Puc deixar-lo en qualsevol moment, informant l'equip del projecte, però no cal que n'expliqui els motius.

Totes les dades recollides per mitjà d'aquesta iniciativa seran confidencials i només es faran informes de dades resumides i anònimes. Les dades es publicaran de tal manera que no s'utilitzin els noms i que no se'm pugui identificar de cap manera.

He resolt tots els dubtes en relació amb el projecte i estic d'acord a participar-hi.

Signatura ___________________________________ Data ___________________

Walk@Work Spain
Adreça electrònica: ________

FULL D'AUTORITZACIÓ PER A PARTICIPANTS

Nom****____________________*****Data de naixement** ______________
Adreça____________________________________**DNI**________________
Adreça electrònica ___________________ ***Telèfon***__________

He llegit i entenc la informació per a participants relativa a aquesta iniciativa i estic d'acord a participar en Walk@Work, un programa portat a terme pel Departament de Ciències i Ciències Socials de la Universitat de Vic.

En el marc de la iniciativa, entenc que se'm demanarà que:

- Segueixi amb la meva rutina habitual a la feina i amb la pauta d´activitat física que faig normalment durant vint-i-una setmanes.
- Utilitzi el podòmetre i enregistri els recomptes de passes i el temps que sec a la feina durant les vint-i-una setmanes que dura el programa.

També entenc que la iniciativa inclourà:

- Portar un podòmetre i mesurar la meva activitat física els dies feiners.
- Emplenar un diari de recompte de passes i del temps que sec.
- Emplenar un breu qüestionari sobre l'activitat física general que realitzo, la salut que tinc i el meu benestar.
- Prendre mesures de talla, pes, tensió arterial i circumferència de cintura.

Entenc que al setembre del 2011 tindré la oportunitat de participar en un programa que fomentarà "seure menys i caminar més a la feina", la participació en el qual serà totalment voluntària.

Participo en l'estudi voluntàriament. Puc deixar-lo en qualsevol moment, informant l'equip del projecte, però no cal que n'expliqui els motius.

Totes les dades recollides per mitjà d'aquesta iniciativa seran confidencials i només es faran informes de dades resumides i anònimes. Les dades es publicaran de tal manera que no s'utilitzin els noms i que no se'm pugui identificar de cap manera.

He resolt tots els dubtes en relació amb el projecte i estic d'acord a participar-hi.

Signatura ____________________________________ **Data** ____________________

walk@Work

Facultat de Psicologia, Ciències de l'Educació i de l'Esport Blanquerna
Universitat Ramon Llull

Universidad del País Vasco / Euskal Herriko Unibertsitatea

Universidad de Extremadura

Universida de Vigo

UVIC Universitat de Vic
Facultat d'Educació

DIARI DEL PODÒMETRE

(Grup intervenció)

Nom ______________________________

Benvingut/Benvinguda a Walk@Work!

Ens complau que hagueu decidit participar en aquesta iniciativa i esperem gaudir-ne tots plegats!

Si us plau, llegiu la informació que hi ha a continuació, la qual us proporcionarà dates clau del programa i us aportarà més informació sobre el podòmetre, el diari i la pàgina Web.

Si teniu qualsevol pregunta, no dubteu a contactar amb un membre de l'equip de recerca per correu electrònic judit.bort@uvic.cat

Data d'inici i altres dates importants

Data d'inici del programa: 4 d'octubre del 2010

La primera fase del programa (del 4 al 8 d'octubre del 2010) consisteix en mesurar l'activitat física que normalment feu caminant; és el que el programa anomena «línia de base». Així que intenteu mantenir les vostres pautes habituals de feina al llarg d'aquest temps i intenteu no participar en cap activitat física més enllà de la que faríeu normalment.

El **4 d'octubre** caldrà començar a comptar el nombre de passes caminant, utilitzant el podòmetre que us enviarem per correu intern l´1 d'octubre. Caldrà enregistrar el recompte de passes que feu cada dia en aquest diari, i també caldrà introduir-lo en la pàgina Web del programa http://walkatworkspain.uvic.es. Aquesta Web utilitzarà les dades que heu entrat a la línia de base per fixar els vostres objectius relatius a caminar.

Trobareu el nom d'usuari i contrasenya al vostre correu electrònic professional el divendres 1 d´octubre; utilitzeu-los per registrar-vos al més aviat possible.

El funcionament de la Web s'explicarà durant la trobada individual que un membre de l'equip Walk@Work realitzarà amb cadascú de vosaltres entre el 6 de setembre i 1 d'octubre del 2010. També podreu seguir els passos del tutorial que es troba a la mateixa Web sobre la manera d'utilitzar el programa, cosa que us durà uns 10-15 minuts. Podeu fer-ho abans o després de la feina o durant un descans.

A partir del 18 d'octubre, el programa fomentarà, a través de la pàgina Web, que augmenteu progressivament el temps que camineu i disminuïu el temps que seieu a la feina. Així doncs, la propera data important és el **dilluns 18 d'octubre.**

Comencem a augmentar el número de passes: dilluns 18 d'octubre

En aquesta data entrareu a la fase que té com a objectiu augmentar el temps que camineu i disminuir el temps que seieu; utilitzarem les dades que enregistrareu en el diari i introduireu en la pàgina Web per dissenyar-vos un programa a mida que reflecteixi les vostres necessitats i els vostres objectius personals.

En un període de 8 setmanes, entre el 18 d'octubre i el 12 de desembre, la pàgina Web us proposarà 4 estratègies diferents per augmentar progressivament el número de passes sobre la vostra línia de base (vegeu el següent requadre).

Estratègia 1: **Caminar tot fent tasques laborals**	Estratègia 2: **Breus passejades planificades**	Estratègia 3: **Llargues passejades planificades**	Estratègia 4: **Passejades breus, llargues + tasques laborals**
Objectiu: Desplaçament habitual + *1.000 passes/dia*	Objectiu: Desplaçament habitual + *2.000 passes/dia*	Objectiu: Desplaçament habitual + *3.000 passes/dia*	**Objectiu** **Arribar a prop de les 10.000 passes o més**
Setmanes 1-2 (18-31 octubre)	Setmanes 2-4 (1-14 novembre 2010)	Setmanes 5-6 (15-28 novembre 2010)	Setmanes 7 – 8 (29 Novembre-12 Desembre 2010)

Les estratègies apareixeran progressivament a la Web cada dues setmanes i rebreu un correu electrònic avisant-vos del moment a partir del qual les podreu consultar. Les estratègies us proporcionaran informació detallada sobre com podreu augmentar 1.000 passes/dia cada dues setmanes.
Així doncs, en el transcurs de les primeres 6 setmanes de programa (del 18 d'octubre al 28 de novembre) es recomana haver assolit un increment de 3.000 passes/dia sobre el desplaçament habitual. Durant les dues últimes setmanes (del 29 de novembre al 12 de desembre) el programa intentarà incrementar el nombre de passes diari fins arribar tant a prop com sigui possible a la fita de les 10.000 passes/dia e inclús sobrepassar-la.

Recordeu que caldrà continuar enregistrant el recompte de passes/dia en aquest diari i també introduir-les en la pàgina Web, la qual us donarà feedback immediat sobre el vostre progrés.

Entre el 13 i el 22 de desembre, un membre de l'equip Walk@Work es posarà en contacte amb vosaltres per acordar un dia i hora d'aquesta setmana per tornar-vos a veure individualment. En aquest moment ens haureu d'entregar el diari amb el registre de passes i també rebreu un resum de la vostra progressió al llarg del programa. Us donarem un nou diari per recomptar les passes després de Nadal i us explicarem en què consistirà el programa de manteniment fins a Setmana Santa.

El podòmetre

El Yamax SW-200 és un dels podòmetres més precisos i fiables del mercat; és perquè l'utilitzeu i us el quedeu. Serà una part crucial del programa, així que heu d'intentar portar-lo cada dia feiner com a part de la vostra rutina diària.

A continuació us donem alguns consells útils sobre el podòmetre:

- Hauríeu d'utilitzar el podòmetre els dies feiners si podeu. Intenteu que sigui la primera cosa que us poseu el matí quan esteu llest per anar a treballar.
- Obriu la capsa i reinicieu el podòmetre a «0» utilitzant el botó groc. **Assegureu-vos que no premeu aquest botó en cap altre moment, atès que esborraríeu els recomptes diaris per complet**.
- Traieu-vos-el quan us dutxeu o us banyeu.
- Podeu obrir el podòmetre per fer un seguiment dels recomptes de passes, però el podòmetre només enregistra dades quan està tancat.
- Intenteu-lo portar tant com us sigui possible els dies feiners. Al final del dia, obriu el podòmetre quan encara el porteu i enregistreu les passes en aquest diari. Un cop fet això, traieu-vos-el fins al proper dia feiner.
- Podeu portar el podòmetre a la part davantera del cinturó o a una cinturilla resistent. Poseu-vos-el alineat amb la meitat de la cuixa. Podeu utilitzar una pinça de seguretat (també inclosa) per subjectar el podòmetre a la roba i evitar que caigui.

El diari

Utilitzeu el podòmetre amb aquest diari per portar un registre escrit dels progressos que feu a mesura que avanceu pel programa Walk@Work. És important que ho feu, perquè el diari serà una còpia en paper de la informació, que haureu de passar a la pàgina Web amb regularitat.

Quan utilitzeu el diari, teniu en compte les següents consideracions:

- Cada pàgina representa les activitats d'una setmana laboral. Trobareu la data del primer dia de la setmana a la part superior de cada pàgina. Introduïu les dades del major nombre de dies possible i seguiu fins i tot si us salteu algun dia.
- Intenteu fer una estimació de l'hora en què us poseu i us traieu el podòmetre, així com del temps que seieu cada dia feiner.
- També trobareu un espai davall de cada taula per enregistrar les setmanes amb circumstàncies que no siguin habituals.
- És una bona idea guardar el diari al costat del llit amb el podòmetre i que enregistreu la informació just abans d'anar a dormir, quan us traieu el podòmetre.
- Les taules es divideixen en dos seccions anomenades «línia de base» (1 taula) i «setmanes del programa» (8 taules), que es corresponen a les dates clau esmentades anteriorment

Pàgina Web

Recordeu introduir el recompte de passes a la pagina Web amb regularitat i, si és possible, us recomanem introduir les passes cada dia o bé al final de cada setmana laboral. Així podreu observar la vostra progressió amb detall.

Podreu introduir les dades dia a dia. L'únic a tenir en compte és que el programa no deixa opció de canviar les dades que aquestes ja han estat introduïdes.

Resum de punts clau

- Inicieu la sessió a la pàgina web el **dilluns 4 d'octubre**. Us enviarem els detalls de registre a la vostra adreça electrònica professional el divendres 1 d´octubre. Seguiu el tutorial en línia per a més informació sobre el vostre programa.

- La setmana del **4 al 8 d´octubre** manteniu i enregistreu el nombre de passes que feu i el temps que seieu; i passeu les dades del diari a la pàgina web. Després d'aquest període, la pàgina web establirà els vostres objectius personals i potenciarà que augmenteu el temps que camineu i disminuïu el temps que seieu a la feina.
    - Rebreu el podòmetre per correu intern el divendres 1 d´octubre.

- La pàgina web, el podòmetre i el diari estan dissenyats per funcionar conjuntament per ajudar-vos a progressar al llarg del programa (del 18 d´octubre al 12 de desembre); si us plau, utilitzeu-los amb regularitat.

- Recordeu-vos de guardar el diari en un lloc segur perquè l'haureu de retornar completat a l'equip de Walk @ Work durant la trobada que farem entre el 13 – 22 de desembre

- El programa finalitza el **27 de març** del 2011.
- Si teniu preguntes o inquietuds, no dubteu a contactar amb l'equip de Walk @ Work. Som aquí per ajudar-vos!

Exemple registre setmanal

	Enregistreu l'hora en la qual us heu posat el podòmetre		Al final del dia, quins són els recomptes de passes del podòmetre?	Feu una estimació del temps que heu segut cada dia
	Començament del dia	Final del dia		
Dilluns				h min
Dimarts				h min
Dimecres				h min
Dijous				h min
Divendres				h min

Ha estat una setmana laboral atípica (és a dir, heu estat malalt, heu estat temps sense anar a treballar o heu anat a conferències o tallers)?

☐ Sí ☐ No

En cas afirmatiu, feu una breu descripció del que ha estat diferent de l'habitual

Moltes gràcies!

walk@Work

Aquí s'acaba el vostre diari del podòmetre.

Si us plau, guardeu aquest diari en un lloc segur i un membre de l'equip de recerca us indicarà el lloc on heu de retornar la informació que heu enregistrat.

DIARI DEL PODÒMETRE

(Grup control)

Nom ______________________________

Benvingut/Benvinguda a Walk@Work!

Ens complau que hagueu decidit participar en aquesta iniciativa i esperem gaudir-ne tots plegats!

Si us plau, llegiu la informació que hi ha a continuació, la qual us proporcionarà dates clau del programa i us aportarà més informació sobre el podòmetre i el diari.

Si teniu qualsevol pregunta, no dubteu a contactar amb un membre de l'equip Walk@Work per correu electrònic MariaGG@blanquerna.url.edu, jesusFG@blanquerna.url.edu.

Data d'inici i altres dates importants

Data d'inici del programa: 4 d'octubre del 2010

El programa s'iniciarà el **4 d'octubre del 2010**, dia en què començareu a mesurar l'activitat física que normalment feu caminant i el temps que esteu asseguts/des en un dia laborable habitual. Així doncs, intenteu mantenir les vostres pautes habituals de feina i intenteu no participar en cap activitat física més enllà de la que faríeu normalment.

Del **4 d'octubre** fins el **12 de desembre** caldrà començar a comptar el nombre de passes caminant utilitzant el podòmetre que us enviarem per correu intern l´1 d'octubre. Caldrà enregistrar el recompte de passes que feu cada dia i el temps que esteu asseguts/des en aquest diari.

Aquesta informació ens ajudarà a estudiar la vostra conducta habitual de caminar i sedentarisme (temps assegut/da). Serà molt valuosa per donar-vos un feedback personalitzat – al final del programa – sobre si feu prou activitat física per obtenir beneficis saludables o si la quantitat de temps que esteu asseguts/des perjudica la vostra salut.

Un membre de l'equip Walk@Work us explicarà el funcionament del podòmetre i us lliurarà el diari durant la trobada individual que realitzarà amb cadascú de vosaltres entre el 6 de setembre i 1 d'octubre del 2010. En aquesta trobada també mesurarem alguns indicadors de salut per poder proporcionar-vos – al final del programa - informació sobre el impacte de la vostra conducta de caminar o sedentarisme (temps assegut) en el vostre estat de salut. A partir del 18 d'octubre rebreu correus electrònics cada dues setmanes de l'equip Walk@Work.

Entre el 13 i el 22 de desembre, un membre de l'equip es posarà en contacte amb vosaltres per acordar un dia i hora d'aquesta setmana per tornar-vos a veure individualment. En aquest moment ens haureu d'entregar el diari amb el registre de passes. També us donarem un nou diari per començar a utilitzar-lo després de Nadal (10 de gener del 2011) i fins el 27 de març. Us explicarem en què consistirà el programa després de vacances.

A partir del més de gener, analitzarem la informació per fer-nos una idea de la vostra conducta habitual de caminar i temps que esteu asseguts/des. Us farem arribar un resum dels vostres resultats a finals de març de 2011.

El podòmetre

El Yamax SW-200 és un dels podòmetres més precisos i fiables del mercat; és perquè l'utilitzeu i us el quedeu. Serà una part crucial del programa, així que heu d'intentar portar-lo cada dia feiner com a part de la vostra rutina diària.

A continuació us donem alguns consells útils sobre el podòmetre:

- Hauríeu d'utilitzar el podòmetre els dies feiners si podeu. Intenteu que sigui la primera cosa que us poseu el matí quan esteu llestos per anar a treballar.

- Obriu la capsa i reinicieu el podòmetre a «0» utilitzant el botó groc. **Assegureu-vos que no premeu aquest botó en cap altre moment, atès que esborraríeu els recomptes diaris per complet**.
- Traieu-vos-el quan us dutxeu o us banyeu.
- Podeu obrir el podòmetre per fer un seguiment dels recomptes de passes, però el podòmetre només enregistra dades quan està tancat.
- Intenteu-lo portar tant com us sigui possible els dies feiners. Al final del dia, obriu el podòmetre quan encara el porteu i enregistreu les passes en aquest diari. Un cop fet això, traieu-vos-el fins al proper dia feiner.
- Podeu portar el podòmetre a la part davantera del cinturó o a una cinturilla resistent. Poseu-vos-el alineat amb la meitat de la cuixa. Podeu utilitzar una pinça de seguretat (també inclosa) per subjectar el podòmetre a la roba i evitar que caigui.

El diari

Utilitzeu el podòmetre amb aquest diari per portar un registre escrit de la quantitat d'activitat física que feu habitualment i el temps que esteu asseguts/des en una jornada laboral típica. És important que ho feu, perquè el diari serà una còpia en paper de la informació que haureu d'enregistrar amb regularitat.

Quan utilitzeu el diari, teniu en compte les següents consideracions:

- Cada pàgina representa les activitats d'una setmana laboral. Trobareu la data del primer dia de la setmana a la part superior de cada pàgina. Introduïu les dades del major nombre de dies possible i seguiu fins i tot si us salteu algun dia.
- Intenteu fer una estimació de l'hora en què us poseu i us traieu el podòmetre, així com del temps que seieu cada dia feiner.
- També trobareu un espai davall de cada taula per enregistrar les setmanes amb circumstàncies que no siguin habituals.
- És una bona idea guardar el diari al costat del llit amb el podòmetre i que enregistreu la informació just abans d'anar a dormir, quan us traieu el podòmetre.

Resum de punts clau

- A partir del **4 d'octubre i fins el 12 de desembre** enregistreu el nombre de passes que feu, utilitzant el podòmetre, i el temps que seieu; passeu les dades al diari.
    - Rebreu el podòmetre per correu intern el <u>divendres 1 d'octubre.</u>

- El podòmetre i el diari estan dissenyats per funcionar conjuntament per ajudar-vos a prendre consciència de la quantitat d'activitat física que realitzeu diàriament <u>(del 18 d'octubre al 12 de desembre)</u>; si us plau, utilitzeu-los amb regularitat.

- Recordeu-vos de guardar el diari en un lloc segur perquè l'haureu de retornar completat a l'equip de Walk @ Work durant la trobada que farem entre el <u>13 – 22 de desembre</u>

- El programa finalitza el **27 de març** del 2011.
- Si teniu preguntes o inquietuds, no dubteu a contactar amb l'equip de Walk @ Work. Som aquí per ajudar-vos!

Exemple registre setmanal

	Enregistreu l'hora en la qual us heu posat el podòmetre		Al final del dia, quins són els recomptes de passes del podòmetre?	Feu una estimació del temps que heu segut cada dia
	Començament del dia	Final del dia		
Dilluns				h min
Dimarts				h min
Dimecres				h min
Dijous				h min
Divendres				h min

Ha estat una setmana laboral atípica (és a dir, heu estat malalt, heu estat temps sense anar a treballar o heu anat a conferències o tallers)?

☐ Sí ☐ No

En cas afirmatiu, feu una breu descripció del que ha estat diferent de l'habitual

Moltes gràcies!

Walk@Work

Aquí s’acaba el vostre diari del podòmetre.

Si us plau, guardeu aquest diari en un lloc segur i un membre de l’equip de recerca us indicarà el lloc on heu de retornar la informació que heu enregistrat.

Image 1: Home page

Image 2: Step counts logging

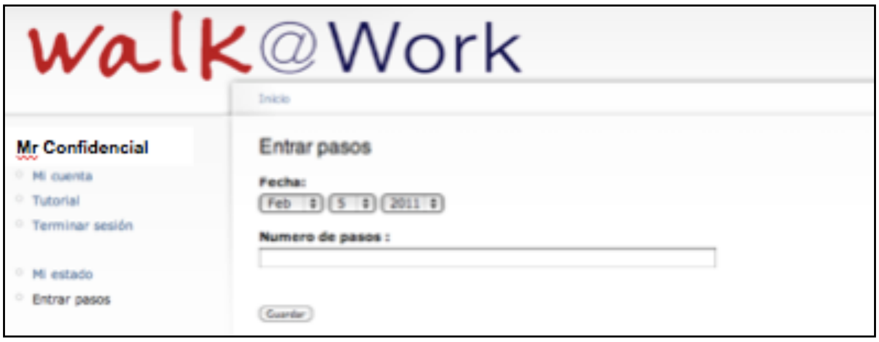

Image 3: Progression graphs

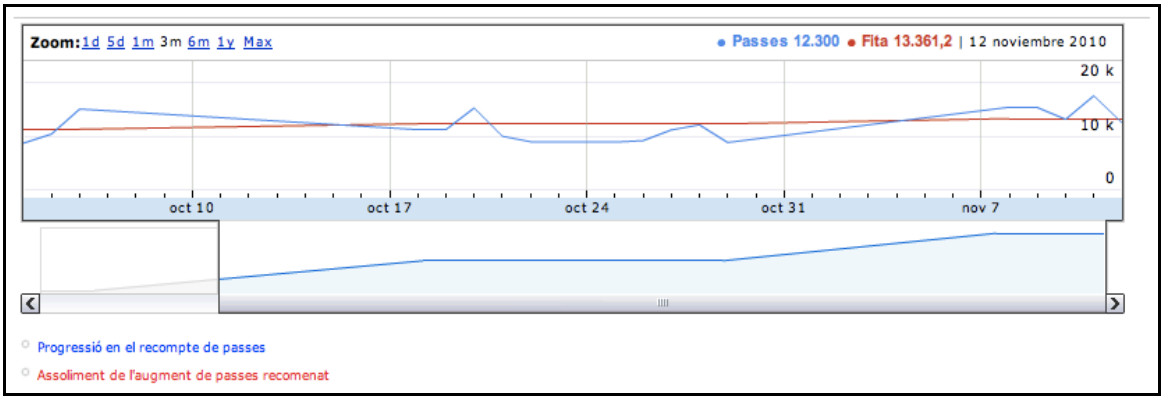

Image 5: 'Sit less and move more' strategies

Estrategias

Introducción
07/07/2010 - 20:01
El programa
Walk@Work...

Caminar realizando las
tareas laborales
10/18/2010 - 09:00
Aumento pasos: 1000
Durante la primera fase
del...

Breves caminatas
planificadas
11/01/2010 - 09:06
Aumento pasos: 2000
Durante la segunda fase
del...

Largas caminatas
planificadas
11/12/2010 - 09:00
Aumento pasos: 3000
En la tercera parte del...

Llegar a los 10 000
pasos por día o más
11/26/2010 - 12:00
Aumento pasos: 10000
Utilizando una
combinación...

Mantener el incremento
de pasos
01/10/2011 - 13:00
Aumento pasos: 10000
Ha hecho grandes
progresos...

Image7: Informational materials

informativostelecinco.com SOCIEDAD

Jueves 25 de Noviembre de 2010 | 11:46 h

Estar sentado mucho tiempo puede ser mortal

Los científicos advierten del riesgo aún cuando se hace ejercicio a diario

Al pasar más de cuatro horas sentado "el cuerpo manda señales dañinas"

21.01.10 | 07:58 h. Informativos Telecinco/Agencias

Los científicos están incrementando sus advertencias de que permanecer sentado por periodos prolongados, por más que se haga ejercicio con regularidad, puede ser malo para la salud. Advierten que no importa dónde sea "la oficina, la escuela, el automóvil o frente a una computadora o la televisión", lo que cuenta son las horas totales pasadas en esa posición.

Image 8: Forum

Forums

- Explica la teva experiència!
  Explica les teves experiència al caminar
- Quedem per caminar?
  Fòrum per cercar persones per quedar per caminar.
- Utilitat de les estratègies
  Quina utilitat trobes a les estratègies proposades?

55685

Facultat de Psicologia, Ciències de l'Educació i de l'Esport Blanquerna
Universitat Ramon Llull

Universidad del País Vasco Euskal Herriko Unibertsitatea

Universidade de Vigo

UVIC Universitat de Vic Facultat d'Educació

Caminar i el benestar integral de les comunitats universitàries

walk@Work

ID: ____

Data d'avui: __ / __ / ____

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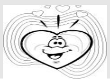
Instruccions per contestar el qüestionari

Aquest qüestionari pretén recollir informació sobre: (a) dades demogràfiques *(secció 1),* (b) la seva activitat física habitual *(secció 2),* (c) el temps que està assegut/da *(secció 3),* (d) com es sent mentre està a la feina (secció 4), i les seves percepcions i sensacions vers les tasques laborals *(secció 5).* **La seva participació és molt important** per obtenir les dades necessàries per poder fer aquest estudi.

Cal contestar totes les preguntes i *seguir les instruccions en cursiva* que es troben al qüestionari. Tota la informació serà tractada amb **confidència i anonimat** totals. Llegeixi detingudament les preguntes i instruccions, i contesti amb **honestedat**.

Moltes gràcies per la seva participació!



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SECCIÓ 1: Informació personal

1. Edat *(en anys)*

|__|__| anys

2. Sexe *(Marqui la resposta amb una creu)*

☐ Home ☐ Dona

3. Pes (amb roba lleugera i sense sabates) *(Escrigui la seva resposta)*

|__|__|__| Kg

4. Alçada sense sabates *(Escrigui la seva resposta)*

|__|__|__| cm

5.En general, com descriuria la seva salut? *(Encercli la resposta)*

☐ Excel·lent ☐ Molt Bona ☐ Bona ☐ Regular ☐ Dolenta

6. Les preguntes següents fan referència a activitats que podria fer en un dia normal.

La SALUT EL LIMITA a l'hora de fer aquestes activitats? Si la resposta és afirmativa, en quin grau? *(Marqui només una resposta per línia)*

	Sí, em limita molt	Sí, em limita una mica	No, no em limita gens
ACTIVITATS MODERADES, com ara moure una taula, passar l'aspirador, jugar a bitlles o jugar a golf	☐	☐	☐
Pujar DIVERSOS trams d'escales	☐	☐	☐

7. Quin és el nivell d'estudis més alt que ha obtingut ?
(Marqui la resposta amb una creu)

☐ No tinc estudis reglats
☐ Certificat d'Educació Secundària (4t ESO o equivalent)
☐ Títol de Batxillerat/Grau Mitjà
☐ Ofici/aprenent (ex. perruqueria, cuina)
☐ Certificat/diploma en formació professional (ex. Pericultura, tècnic)
☐ Títol universitari o superior

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8. Per quina universitat treballa? *(Marqui la resposta amb una creu)*

☐ Universitat de Vic

☐ Universitat de Vigo

☐ Universidad de Extremadura

☐ Universitat Ramon Llull

☐ Universidad del País Vasco

9. Quin és el seu càrrec dins la universitat? *(Marqui la resposta amb una creu)*

☐ Personal Docent Investigador (PDI) ☐ Personal d'Administració i Serveis (PAS)

10A. Quina és la seva dedicació laboral? Contesti només si treballa en una **universitat pública.** *(Marqui la resposta amb una creu.)*

PDI

☐ Completa

☐ Temps parcial

PAS

☐ Completa

☐ Temps parcial

10B. Quina és la seva dedicació laboral? Contesti només si treballa en una **universitat privada.** *(Marqui la resposta amb una creu.)*

PDI

☐ Completa (Exclusiva)

☐ Temps parcial 1 (Plena)

☐ Temps parcial 2 (Normal)

☐ Associat (Hores)

PAS

☐ Completa

☐ Temps parcial

11. Quin tipus de relació laboral manté en l´actualitat amb la Universitat *(Marqui la resposta amb una creu)*

☐ Contracte temporal

☐ Contracte indefinit

☐ Funcionari (només si treballa en univesitat pública)

☐ Una altre. Quina? ________________________________

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SECCIÓ 2: Activitat física habitual

Si us plau, respongui totes les preguntes encara que no es consideri una persona físicament activa. Al respondre les preguntes tingui present,

- *l'activitat física* ***vigorosa*** *es refereix a activitats que requereixen un esforç físic dur i que fan respirar més fort del normal.*
- *l'activitat física* ***moderada*** *es refereix a activitats que requereixen un esforç físic moderat i que fan respirar una mica més fort del normal.*

12. En els últims 7 dies, quants dies ha realitzat activitat física *vigorosa* com és ara aixecar pesos pesants, cavar, fer aeròbic o similar, anar amb bicicleta a marxa ràpida? *(Escrigui la seva resposta)*

|__| dies de la setmana

13. En total, quant de temps sol fer activitat física *vigorosa* en un d'aquests dies? *(Escrigui la seva resposta)*

|__|__|:|__|__| (hores:minuts)

14. Un vegada més, pensi *únicament* en l'activitat física que ha realitzat almenys 10 minuts. En els últims 7 dies, quants dies ha realitzat activitat física *moderada*, com per exemple transportar pesos lleugers, anar amb bicicleta a ritme regular, jugar a tenis partits dobles? No hi compti el temps de caminar. *(Escrigui la seva resposta)*

|__| dies de la setmana

15. En total, quant de temps sol fer activitat física *moderada* en un d'aquests dies? *(Escrigui la seva resposta)*

|__|__|:|__|__| (hores:minuts)

16. En els últims 7 dies, quants dies *ha caminat* com a mínim 10 minuts? Compti si camina a la feina i a casa, si camina per anar d'un lloc a un altre, i qualsevol altra vegada que camini per esbarjo, per practicar esport, exercici o com a lleure. *(Escrigui la seva resposta)*

|__| dies de la setmana

17. En total, quant de temps sol fer activitat física *caminant* en un d'aquests dies? *(Escrigui la seva resposta)*

|__|__|:|__|__| (hores:minuts)

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SECCIÓ 3: Temps assegut/da

*Les preguntes següents fan referència als **últims 7 dies***

18. Nombre d'hores totals que calcula que passa ASSEGUT/DA AL DIA. *(Escrigui la seva resposta)*

Dia laborable ___ : ___ (hores:minuts)

Dia no laborable ___ : ___ (hores:minuts)

19. Nombre d'hores totals que calcula que passa ASSEGUT/DA AL DIA mentre es desplaça d'un lloc a l'altre. *(Escrigui la seva resposta)*

Dia laborable ___ : ___ (hores:minuts)

Dia no laborable ___ : ___ (hores:minuts)

20. Nombre d'hores totals que calcula que passa ASSEGUT/DA AL DIA al seu lloc de treball. *(Escrigui la seva resposta)*

Dia laborable ___ : ___ (hores:minuts)

Dia no laborable ___ : ___ (hores:minuts)

21. Nombre d'hores totals que calcula que passa ASSEGUT/DA AL DIA mentre mira la televisió. *(Escrigui la seva resposta)*

Dia laborable ___ : ___ (hores:minuts)

Dia no laborable ___ : ___ (hores:minuts)

SECCIÓ 4: Com es sent mentre està a la feina?

*Aquestes preguntes fan referència a com es sent a la feina durant les **últimes 2 setmanes***

22. Com descriuria les seves experiències a la feina durant les últimes dues setmanes? *(Marqui només una casella per cada pregunta)*

	Mai	Poques vegades	A vegades	Sovint	Sempre
a. M'he sentit optimista sobre el futur	☐	☐	☐	☐	☐
b. M'he sentit útil	☐	☐	☐	☐	☐
c. M'he sentit relaxat/da	☐	☐	☐	☐	☐
d. M'he interessat per les altres persones	☐	☐	☐	☐	☐
e. He tingut prou energia	☐	☐	☐	☐	☐
f. He afrontat bé els problemes	☐	☐	☐	☐	☐
g. He pensat amb claredat	☐	☐	☐	☐	☐
h. M'he sentit a gust amb mi mateix/a	☐	☐	☐	☐	☐
i. He treballat a gust amb els companys de feina	☐	☐	☐	☐	☐
j. M'he sentit confiat/da	☐	☐	☐	☐	☐
k. He pogut prendre decisions sobre assumptes	☐	☐	☐	☐	☐
l. M'he sentit valorat/da	☐	☐	☐	☐	☐
m. M'he interessat per coses noves	☐	☐	☐	☐	☐
n. M'he sentit content/a	☐	☐	☐	☐	☐

SECCIÓ 5: Percepcions i sensacions vers les tasques laborals

Les persones treballadores poden tenir dificultats amb certes parts de la seva feina per problemes de salut. Estem interessats a saber com la salut ha pogut afectar la seva feina les darreres 2 setmanes.

Aquestes preguntes pretenen avaluar la quantitat de temps en què ha tingut dificultats per afrontar certes parts de la seva feina. Llegeixi i respongui cada pregunta seleccionant una resposta.

- *Marqui la casella "no es aplicable a la meva feina" només si la pregunta descriu alguna cosa que no forma part de la seva feina.*
- *Si té més d'una feina, només respongui d'acord amb la seva feina principal.*

23. Les darreres 2 setmanes, quan està treballant, en quina mesura <u>li ha estat difícil</u> complir els aspectes següents per problemes de salut física o problemes emocionals... (*Marqui una casella a cada fila)*

	Difícil sempre (100%)	**Difícil** moltes vegades	**Difícil** algunes vegades (50%)	**Difícil** poques vegades	**Difícil** mai (0%)	No és aplicable a la meva feina
a. Treballar el nombre d'hores exigit	☐	☐	☐	☐	☐	☐
b. Arrencar la jornada laboral sense problemes	☐	☐	☐	☐	☐	☐
c. Posar-vos a treballar tan bon punt arribàveu a la feina	☐	☐	☐	☐	☐	☐
d.Treballar sense parar per fer una pausa o un descans	☐	☐	☐	☐	☐	☐
e. Seguir una rutina o una planificació	☐	☐	☐	☐	☐	☐
f. Tenir el camp a la feina sense distreure-us	☐	☐	☐	☐	☐	☐
g. Pensar amb claredat mentre treballàveu	☐	☐	☐	☐	☐	☐
h. Treballar amb deteniment	☐	☐	☐	☐	☐	☐
i. Concentrar-vos en la feina	☐	☐	☐	☐	☐	☐
j. Mantenir la concentració en la feina	☐	☐	☐	☐	☐	☐
k. Llegir o fer servir la vista sense problemes mentre treballàveu	☐	☐	☐	☐	☐	☐
l. Parlar amb la gent en persona, en reunions o per telèfon	☐	☐	☐	☐	☐	☐
m. Contenir-vos el geni davant les persones mentre parlàveu	☐	☐	☐	☐	☐	☐
n. Ajudar altres persones a acabar la feina	☐	☐	☐	☐	☐	☐
o. Afrontar el volum de feina	☐	☐	☐	☐	☐	☐
p. Treballar amb la rapidesa suficient	☐	☐	☐	☐	☐	☐
q. Acabar la feina a temps	☐	☐	☐	☐	☐	☐
r. Fer la feina sense errors	☐	☐	☐	☐	☐	☐
s. Sentir que heu fet allò que sou capaços	☐	☐	☐	☐	☐	☐

Per contactar amb nosaltres

Si té qualsevol dubte o vol saber alguna cosa més sobre l'enquesta, pot posar-se en contacte amb els caps de projecte de la seva universitat:

- **Universitat Ramon Llull**: Dra. Maria Giné (mariagg@blanquerna.url.edu) i Prof. Jesús Fortuño (jesusfg@blanquerna.url.edu)

- **Universitat de Vic**: Judit Bort (judit.bort@uvic.cat) i Dra. Anna Puig Ribera (annam.puig@uvic.cat)

Moltes gràcies per la seva ajuda!

walk@Work

DOCUMENT DE REGISTRE DE LES DADES DELS PARTICIPANTS

Nom i Cognoms:____

ID: ____

Universitat:____

A. Dades pre-intervenció (6 de setembre – 1 octubre 2010)

	Dades	Observacions
Data de presa de les mesures:		
Hora en què s'han pres les mesures:		
Alçada (cm):		
Pes (kg):		
Tensió arterial sistòlica (mmHg):		
Tensió arterial diastòlica (mmHg):		
Circumferència de cintura (cm):		

B. Dades finals de la *"ramping phase"* (setmana 9: 13 al 23 de desembre 2010)

	Dades	Observacions
Data de presa de les mesures:		
Hora en què s'han pres les mesures:		
Alçada (cm):		
Pes (kg):		
Tensió arterial sistòlica:		
Tensió arterial diastòlica:		
Circumferència de cintura:		

C. Dades finals de la fase de manteniment (setmana 11: 21 de març al 3 d´abril 2011)

	Dades	Observacions
Data de presa de les mesures:		
Hora en què s'han pres les mesures:		
Alçada (cm):		
Pes (kg):		
Tensió arterial sistòlica:		
Tensió arterial diastòlica:		
Circumferència de cintura:		

D. Dades finals de la fase d'adherència (setmana 8: 20 de juny al 2 de juliol 2011)

	Dades	Observacions
Data de presa de les mesures:		
Hora en què s'han pres les mesures:		
Alçada (cm):		
Pes (kg):		
Tensió arterial sistòlica:		
Tensió arterial diastòlica:		
Circumferència de cintura:		

GUIA DE L'ENTREVISTA

1ª FASE Universitat de Vic 2-5 de Novembre 2010

INTRODUCCIÓ

Primer de tot agrair-te el teu interès per participar amb nosaltres en aquest projecte Walk@Work pioner a l'estat espanyol, i per suposat també agrair-te la teva generositat a l'hora d'accedir a participar en aquest entrevista.

L'objectiu d'aquesta entrevista és aprofundir sobre com estàs vivint aquest inici de projecte. Sobretot ens interessa copsar les teves experiències i opinions personals sobre tot el que és i envolta l'estudi del qual hi formes part.

L'entrevista és totalment anònima, el teu nom no surt, ni sortirà enlloc i el que fem és utilitzar pseudònims per assegurar-nos que la informació no es relacionarà mai amb el teu nom ni ara ni en el futur.

L'entrevista està dividida en 5 aparts: Coneixements previs; Raons per participar-hi; Us de la Web; Expectatives i Avaluació de les estratègies proposades durant la primera intervenció.

L'entrevista està calculada perquè duri entre 30 i 45 minuts.

Per qualsevol cosa que necessitis aclarir sobre l'entrevista et pots posar en contacte amb Montse Martín m.martin@uvic.cat, o Judit Bort judit.bort@uvic.cat

CONEIXEMENTS PREVIS A LA PARTICIPACIÓ

Objectius: Trobar les raons per les quals la gent participa en aquest estudi. És gent que ja participa en qualsevol projecte, o aquest projecte té alguna cosa especial que els atrau (web, podòmetre, augmentar l'AF per augmentar la QV …). Indagar quin coneixement específic tenen sobre aquest tipus d'estudis.

- És el primer cop que participes en un estudi de promoció de l'AF?
- Què saps dels estudis que volen promocionar l'AF en la nostra vida diària? Què en penses d'aquests estudis? Creus que serveixen per alguna cosa? Per a què?
-Abans de conèixer aquest projecte Wak@Work ja estaves interessada/t en augmentar el teu nivell d'AF?
- Creus que és factible augmentar l'AF i disminuir l'estona de seure en el teu lloc de treball? Quins problemes veus ara, al principi de l'estudi?

RAONS PER FORMAR PART DE L'ESTUDI

Objectius: Investigar possibles temes relacionats amb la participació en el projecte.

Quan vas rebre el qüestionari abans de l'estiu què és el que et va decidir a omplir-lo i enviar-lo? Per què volies formar part de la base de dades?
Què és el que més t'ha motivat/cridat l'atenció a formar part de l'estudi?
Creus en aquest estudi com a mitjà per augmentar la teva AF dins de l'horari laboral?

US DE LA WEB

Objectius: Conèixer l'ús que en fan i el què pensen de la web

---

El fet de tenir accés a una web específica et va animar a formar part del Walk@Work?
Què és el que més t'agrada d'aquesta web?
I el que més et desagrada? Canviaries alguna cosa?
Et conectes a la web? Amb quina regularitat, quants dies per setmana?
Què és el que et motiva per conectar-te a la web? Els emails, els articles penjats, les noves estratègies, apuntar les passes, mirar el teu progress, el forum – comunicar amb gent de la universitat que està fent el mateix programa que tu …
Has participat en el forum? Per què? Com creus que es podria fer per a que el forum fos una eina més propera i de comunicació entre els participants?
Se t'acut alguna altra manera a posar en practica per facilitar la comunicació entre la gent que participa en el projecte? Creus que la web ens pot arribar a donar identitat?

EXPECTATIVES

Objectius: Indagar sobre què és el que i el que no esperen d'aquest projecte. Quins són els seus objectius amb la seva participació en el projecte

---

Què esperes aprendre d'aquest projecte?
Creus que aquest projecte et pot fer adquirir hàbits saludables a llarg termini?
Com creus que ho pot fer?
Has parlat amb altres participants del projecte? Quins són els comentaris? I amb col·legues del teu espai de treball? Què en pensen del projecte?
Saps quin és l'objectiu del projecte?
Per què creus que aquest és l'objetiu?
T'has marcat algun objectiu personal en el desenvolupament del projecte apart dels objectius de l'equip responsable del projecte?
Quin penses què sera la barrera o les dificultats més important que et trobaràs o ens trobarem per assolir els objectius proposats?

AVALUACIÓ DE LES PRIMERES DUES SETMANES D'INTERVENCIÓ

Objectius: Indagar com ha anat la primera intervenció. L'han trobat massa exigent per portar-la a terme amb el seu dia-a-dia. Com han viscut aquesta primera intervenció. Us de la web. Del diari. Les eines proposades al seu abast són les suficients (facilitadors).

Creus que el diari t'ajuda a portar el control de les passes que vas realitzant dia a dia, o és més un problema haver de fer servir el diari? Se t'acut alguna altra manera?
T'és fàcil calcular i portar un registre de les hores que seus durant la teva jornada laboral?
Durant aquesta primera intervenció, has seguit fil parranda les consignes assignades per augmentar el nombre de passes durant l'horari laboral?
Què t'han semblat? Què inclouries? I què treuries? Quina és la que t'ha estat més fàcil de seguir i creus que és més efectiva? Perquè?
I quina la més difícil? La que no has pogut posar en pràctica de cap manera, Per què?
T'han semblat raonables? Es poden portar a terme? Tu creus que alguna de la gent que t'envolta i no les coneix les podria seguir en un futur no molt llunyà?
Quin creus és el problema més punyent per a que no es portin a terme de forma generalitzada? La desconeixença, la mandra, la manca d'hàbit, la manca de facilitat per fer-les per part dels caps...

ALTRES TEMES A AFEGIR

Objectiu: Donar l'oportunitat de manifestar tant la seva satisfacció com insatisfacció amb tot el que suposa participar en un programa d'aquestes característiques

---

Alguna altre qüestió que pensis que ens hem oblidat i vulguis afegir?

Per exemple, el tema de la comunicació amb el personal responsable de la recerca. Creus que és adient i correcta? Si necessites alguna cosa o alguna informació extra creus que són accesibles?

Et sents acompanyat/da en la realització d'aquest projecte?

MERCÈS PER LA TEVA COL·LABORACIÓ

GUIA DE L'ENTREVISTA

2ª FASE Universitat de Vic 20-22 de Desembre 2010

INTRODUCCIÓ

Primer de tot agrair-te el teu interès per participar amb nosaltres en aquest projecte Walk@Work pioner a l'estat espanyol, i per suposat també agrair-te la teva generositat a l'hora d'accedir a participar en aquest entrevista.

L'objectiu d'aquesta entrevista és aprofundir sobre les teves experiències després d'aquestes 10 setmanes de programa. Sobretot ens interessa copsar les teves experiències i opinions personals sobre tot el que és i envolta l'estudi del qual hi formes part.

L'entrevista és totalment anònima, el teu nom no surt, ni sortirà enlloc i el que fem és utilitzar pseudònims per assegurar-nos que la informació no es relacionarà mai amb el teu nom ni ara ni en el futur.

L'entrevista està dividida en 5 aparts: Assoliment dels objectius, Canvi de comportament, Avaluació de les estratègies, Us de la Web, Diferències de gènere, Els teus resultats personals, Altres temes.

L'entrevista està calculada perquè duri entre 20 i 30.

Per qualsevol cosa que necessitis aclarir sobre l'entrevista et pots posar en contacte amb Montse Martín m.martin@uvic.cat, o Judit Bort judit.bort@uvic.cat

ASSOLIMENT DELS OBJECTIUS

Objectius: Aprofundir sobre com s'han assolit els objectius i si no s'han assolit recercar sobre les principals barreres que han tingut

- Has assolit els objectius proposats per l'estudi? T'has apropat a les 10.000 passes recomanables? Els has mantingut aquestes últimes setmanes que no havien propostes específiques de caminar?

- Has notat com augmentaves les passes a mesura que passaven les setmanes? De quina forma?

- Quina ha estat la fase més difícil d'assolir?

CANVI DE COMPORTAMENT

Objectius: Investigar sobre els elements que incideixen en el canvi d'hàbits a llarg termini.

- Has pogut augmentar les passes?
- Què creus que t'ha ajudat a augmentar les passes? Els objectius, els feedbacks, els e-mails recordatoris, les idees per les estratègies, apuntar les passes cada dia...
- Has pogut disminuir les hores d'estar assegut/da?
- Què creus que t'ha ajudat a reduir les hores d'estar assentat/da? La lectura d'articles demostrant la nocivitat de la vida sedentària...
- Com ha afectat a aquests canvis el fet de conscienciar-te de la necessitat de caminar més i de la negativitat que suposa seure tantes hores seguides?
- Què creu es que és el més important per poder mantenir i no deixar de caminar a la feina?
- Creus que els mantindràs després de Nadal? Què penses que necessites per mantenir-los? Com et podem ajudar?
- Quina creus és la motivació principal per canviar el comportament a llarg termini?

AVALUACIÓ DE LES ESTRATÈGIES

Objectius: Indagar com ha anat totes les fases de la intervenció. Quines han estat les estratègies que han funcionat i quines no i per què? Sobretot la importància de les que han adaptat i quan ho han fet, i quin han estat els motius per fer-ho

Com va anar la primer estratègia: **Caminant tot realitzant les tasques laborals**? Vas poder portar a terme totes les tasques suggerides? Quines han estat les més útils per caminar més? I quines les més útils per seure menys? Per quins motius creus que algunes no van funcionar? Vas adaptar o crear noves tasques laborals en les quals s'incrementaven les passes? Per què creus que van funcionar? I algunes per seure menys?

Com va anar la segona estratègia: **Breus passejades planificades**? Vas poder fer totes les rutes suggerides? Quines si i Quines no? Per quins motius algunes no van funcionar? Vas planificar noves rutes amb les quals també vas incrementar les passes? Quines? Quan les feies? Van funcionar? Per quins motius creus que van funcionar?

Com va anar la tercera estratègia: **Llargues passejades planificades**? Vas poder fer totes les rutes suggerides? Quines si i Quines no? Per quins motius algunes no van funcionar? Vas planificar noves rutes amb les quals també vas incrementar les passes? Quines? Quan les feies? Van funcionar? Per quins motius creus que van funcionar?

Finalment com ha anat la quarta fase? T'has llegit alguns dels articles? T'han ajudat a **apropar-te a les 10.000 passes** i/o mantenir-te? Per quins motius t'han ajudat? O per quins motius no t'han ajudat? Quines estratègies has fet servir les dues darreres setmanes? Per quines raons? Quines has desestimat, per quines raons? Has fet alguna adaptació pròpia teva? Te n'has inventat alguna?

Quins motius creus han estat cabdals per seure menys temps a la feina i què creus que necessitaries per seure-hi encara menys?

Si creus que has estat igual temps assegut/da, explica el motiu?

Explica, descriu els motius, les accions i els canvis que consideres necessaris per estar menys temps assegut/da a la feina.

US DE LA WEB/FORUM/DIARIS

Objectius: Conèixer l'ús que en fan i el què pensen de la web, el fòrum i el diari trobéssim

- Com ha anat l'ús de la web? Quin efecte ha tingut el poder veure la teva gràfica sobre les teves passes?
- Has parlat amb altra gent de les teves experiències en el projecte? Què els hi expliques?
- El fòrum no ha funcionat, sabries explicar alguna raó per la que creus que el fòrum no ha funcionat?
- Has caminat acompanyat/da per alguna altra persona del projecte.
- Si no és a partir del fòrum com t'has comunicat amb altres participants del projecte?
- Com ha anat l'ús del diari?

LES DIFERÈNCIES DE GÈNERE

Objectiu: Explorar les percepcions sobre el tema que la majoria de participants siguin dones. En estudis que s'han fet anteriorment, les dones hi participen molt més que els homes, per exemple a ..... 50% més o menys de personal treballador en les universitats on s'ha portat a terme anteriorment (Leeds, Queensland, Vic), la participació ha estat 80% dones, 20%, per exemple en aquest estudi, són 84% dones 16% homes

- Tu per què creus que passa això? Creus que és casual? Quins deuen ser els motius?
- Creus que es una intervenció pensada majoritàriament per dones? Per quines raons? Pel tipus d'exercici... que no és gaire intens?
- O es perquè la preocupació per la salut està més lligada al gènere femení? Tu què creus que potser?
- I tu per què has participat?

ELS TEUS RESULTATS PERSONALS

Objectius: Aprofundir sobre si s'han complert les expectatives que tenien a l'inici de la intervenció

- Quina utilitat té per a tu personalment participar en aquest projecte?
- Què has tret d'aquestes 8 setmanes d'intervenció?
- Creus factible mantenir el nombre de passes en la segona fase del projecte, de després de Nadal a Setmana Santa?
- Qui creus que serà el factor clau perquè continuïs caminant i seient menys al teu horari laboral?

ALTRES TEMES A AFEGIR

Objectiu: Donar l'oportunitat de manifestar tant la seva satisfacció com insatisfacció amb tot el que suposa participar en un programa d'aquestes característiques

- Alguna altre qüestió que pensis que ens hem oblidat i vulguis afegir?

- Encara et sents acompanyat/da en la realització d'aquest projecte?

MERCÈS PER LA TEVA COL·LABORACIÓ

walk@Work

ID….. Universitat…………………….Grup ……. ☐ **PDI** ☐ **PAS** ☐ **Dona** ☐ **Home**

Quins aspectes t'han influït més en el fet de seure menys a la feina i augmentar el nombre de passes caminant en horari laboral? *Si us plau, contesta les següents preguntes. Cada pregunta té 4 opcions de resposta que marquen diferents graus d'influència des de "no m'ha influït gens" (1) fins a "m'ha influït molt" (4).*

	1 No m'ha influït gens	2 M'ha influït poc o una mica	3 M'ha influït força	4 M'ha influït molt
Patir algun tipus de patologia que fa que el meu estat de salut no sigui l'òptim, com per exemple mal d'esquena, colesterol alt, etc.				
Percebre que la majoria del temps a la feina me'l passo assegut/da sense gairebé moure'm.				
Ser conscient dels beneficis saludables de seure menys i caminar més a partir d'haver llegit els articles penjats a la web.				
Comptar el nombre de passes amb el podòmetre.				
Enregistrar el temps assegut/da i el nombre de passes a la Web i/o diari.				
Rebre correus electrònics periòdicament avisant de les novetats i canvis d'estratègies per seure menys i caminar més a la feina.				
Seguir l'enregistrament de les passes amb les gràfiques diàries, setmanals i mensuals a la web i comprovar si anava assolint els objectius personals.				
Tenir accés al fòrum per relacionar-me amb altres participants del projecte.				
Buscar una intencionalitat per caminar més i seure menys a la feina (per exemple: aprofitar a fer una passejada per anar a recollir un document, fer un cafè o altres).				
Esdevenir conscient dels aspectes que puc canviar en la meva jornada laboral per caminar més i seure menys.				
Auto imposar-me realitzar un nombre mínim de passes diaris.				
Percebre que em fatigo menys en la realització de les meves tasques diàries i/o que la meva condició física va millorant.				

Hi ha altres aspectes els quals creus han estat importants? En cas afirmatiu, si us plau escriu-los i marca el grau d'influència.

Al llarg del programa han anat apareixent un seguit d'estratègies a la pàgina Web per reduir el temps que esteu asseguts a la feina i augmentar el número de passes caminant. Amb quina freqüència he dut a terme les següents estratègies? *Si us plau, llegeix les diferents estratègies que s'exposen a continuació. Hi ha 4 opcions de resposta les quals marquen diferents freqüències des de "mai" (1) fins a "habitualment" (4).*

	1 Mai	2 Gairebé mai	3 Algunes vegades	4 Habitu-alment
Aparcar el cotxe més lluny o anar a la feina caminant.				
Anar caminant a la feina.				
Si vaig a la feina amb transport públic, intentar baixar unes parades abans i/o pujar unes parades més enllà.				
Realitzar reunions de peu i/o caminant.				
Aixecar-me de la cadira tantes vegades com sigui possible durant les hores de feina.				
No utilitzar l'ascensor, pujar i baixar per les escales.				
Fer passejades ràpides de deu minuts.				
Planificar rutes de 15-20 minuts a l'hora de dinar o esmorzar, abans d'iniciar la jornada laboral o per marxar de la feina.				
Integrar-me en grups de passeig de la feina o crear-ne altres de nous.				
Heu realitzat algun altra estratègia que no s'hagi proposat des del programa? En cas afirmatiu, si us plau escriu-los i marca la freqüència				

També, ens agradaria conèixer **quins han estat aquells factors que han dificultat més el fet de reduir el temps assegut a la feina i augmentar el teu nombre de passes caminant en horari laboral.** *Si us plau, contesta les següents preguntes. Hi ha 4 opcions de resposta les quals marquen diferents graus d'importància des de "no m'han dificultat gens" (1) fins a "m'han dificultat molt" (4).*

	1 No m'han dificultat gens	2 M'han dificultat poc o una mica	3 M'han dificultat força	4 M'han dificultat molt
Percebre que no tinc prou temps en horari laboral.				
Tenir un tipus de feina que m´obliga a estar a l´ordenador assegut/da.				
Percebre que les actituds dels directius/ves no afavoreixen el fet de moure´m del lloc.				

No ser capaç de mesurar de forma objectiva les hores que estic assegut/da a la feina.				
Creure que l'activitat física i l'esport que realitzo durant la setmana ja és suficient.				
L´adversitat de les condicions climatològiques (per exemple, poques hores de sol, pluja, vent, fred, etc).				
La incomoditat d´enregistrar diàriament el nombre de passes i el temps assegut/da.				
Disminució del grau de seguiment al llarg del programa (menys correus periòdics,tancament de la Web, etc).				
No assolir l´objectiu suggerit de passes caminant en les diferents fases del programa.				
Dificultat per poder coincidir amb els companys de feina per realitzar passejades conjuntament.				
Tenir la sensació de frustració quan passen les setmanes i no s'arriba a les 10 mil passes recomanades				
Haver de fer un esforç extra per pensar la manera de fer més passes i seure menys mentre estic treballant.				
Hi ha altres aspectes els quals creus han estat importants? En cas afirmatiu, si us plau escriu-los i marca el grau d'importància				

Finalment, ens agradaria preguntar sobre un hàbit molt integrat a la nostra societat i que pot influir amb **el fet de reduir el temps assegut a la feina i augmentar el teu nombre de passes caminant diaris en horari laboral.**
Si us plau, contesta les següents preguntes. Hi ha 4 opcions de resposta les quals marquen diferents graus d'importància des de "No hi estic gens d'acord" (1) fins a "Hi estic totalment d'acord" (4).

	1 No hi estic gens d'acord	2 No hi estic del tot d'acord	3 Hi estic més o menys d'acord	4 Hi estic totalment d'acord
Els fumadors tenen el dret de fer un descans de 5-10 min cada dues hores per la seva necessitat a fer una cigarreta.				
Els no fumadors també tenen el dret a fer descansos de 5-10 minuts cada dues hores, per moure's de la cadira i estirar les cames.				

APPENDIX III: Self-reported sitting time and physical activity: Interactive associations with mental well-being and productivity in office employees (Additional study)

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Self-reported sitting time and physical activity: interactive associations with mental well-being and productivity in office employees

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Abstract

Background: Little is known about how sitting time, alone or in combination with markers of physical activity (PA), influences mental well-being and work productivity. Given the need to develop workplace PA interventions that target employees' health related efficiency outcomes; this study examined the associations between self-reported sitting time, PA, mental well-being and work productivity in office employees.

Methods: Descriptive cross-sectional study. Spanish university office employees (n = 557) completed a survey measuring socio-demographics, total and domain specific (work and travel) self-reported sitting time, PA (International Physical Activity Questionnaire short version), mental well-being (Warwick-Edinburg Mental Well-Being Scale) and work productivity (Work Limitations Questionnaire). Multivariate linear regression analyses determined associations between the main variables adjusted for gender, age, body mass index and occupation. PA levels (low, moderate and high) were introduced into the model to examine interactive associations.

Results: Higher volumes of PA were related to higher mental well-being, work productivity and spending less time sitting at work, throughout the working day and travelling during the week, including the weekends ($p < 0.05$). Greater levels of sitting during weekends was associated with lower mental well-being ($p < 0.05$). Similarly, more sitting while travelling at weekends was linked to lower work productivity ($p < 0.05$). In highly active employees, higher sitting times on work days and occupational sitting were associated with decreased mental well-being ($p < 0.05$). Higher sitting times while travelling on weekend days was also linked to lower work productivity in the highly active ($p < 0.05$). No significant associations were observed in low active employees.

Conclusions: Employees' PA levels exerts different influences on the associations between sitting time, mental well-being and work productivity. The specific associations and the broad sweep of evidence in the current study suggest that workplace PA strategies to improve the mental well-being and productivity of all employees should focus on reducing sitting time alongside efforts to increase PA.

Keywords: Sitting time, Physical activity, Mental well-being, Work productivity, Office employees

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Background

Combining sitting reduction strategies with efforts to increase physical activity (PA) are important and complementary public health priorities [1-8]. In a recent meta-analysis, each additional hour of daily sitting – in adults who sat for >7 hours/day - increased risk in all-cause mortality by 2% [4]. The risk of dying from all causes increased to 5% for those who were also inactive, suggesting that PA may offer some protection against the harm of prolonged sitting time.

While the chronic disease benefits of sitting less and being more active are increasingly well documented [1-8], and associations observed between PA and mental well-being and work performance/productivity improvements [9-13], little is known about how sitting time influences these important workplace indices. Instead, existing research has explored associations between sitting time and markers of mental health, such as depressive symptoms, rather than well-being [14]. Further, what is known has only addressed non-occupational sitting time [15]. Recently, a small study of Australian office employees (n = 108) identified that more time spent sitting before and after work was associated with lost work productivity (odds ratio =2.58; 95% CI: 1.08 to 6.20) [16]. This study used an objective indicator of sitting time (accelerometers) to explore relationships with 'on the job' productivity indicators; interactions between behaviors were not assessed.

Given a limited evidence base, research is required to investigate the potential interactions between sitting time and PA, relative to mental well-being and work productivity. Such formative research will be valuable for developing interventions targeting specific employee behaviors that improve both health and efficiency-related outcomes. Consequently, this study examined relationships between self-reported sitting time, PA, mental well-being and work productivity in a sample of Spanish office employees.

Methods

Participants

Following ethics clearance, around 2,500 emails were sent to academic and administrative employees at each of four Spanish universities in Galicia, the Basque Country and Catalonia (×2). Emails invited employees to participate in a workplace PA program to increase step counts and reduce occupational sitting time. Respondents to this initial email (n = 704) were asked to complete an on-line survey (April- December 2010) prior to intervention. Informed consent was provided during survey completion. The study was approved by the following ethics committee of each university: Ethics Committee of the Faculty in Psychology, Education and Sport Sciences (University Ramon Llull); Research Commission of University of Vic; Ethics Committee of Clinical Research in Conselleria de Sanidad (CEIC; Xunta de Galicia); Ethics Committee of Applied Research in Human Beings (CEISH/GIEB; University of the Basque Country).

Measures

A 22-item survey assessed socio-demographic variables (age, gender, weight, height and occupation [academic or administrator], PA levels [17], sitting time [18], mental well-being [19] and work productivity loss [20]. For PA, the *International Physical Activity Questionnaire* (IPAQ) short form assessed walking, moderate and vigorous intensity PA [17]. The IPAQ short form shows good reliability (Spearman's $\rho = 0.80$) and moderate criterion validity with accelerometers (Spearman's $\rho = 0.30$) in the general [17] as well as Catalan and Spanish populations [21].

Time spent in these activities was combined to show the volume of activity relative to energy expenditure (Metabolic Equivalent Units - METs), yielding a score in weekly MET-minutes. Employees were classified into either low (≥599 MET-minutes/week), moderate (at least 600–2,999 MET-minutes/week) or high (3,000+ MET-minutes/week) PA categories.

A seven-day total and domain-specific sitting questionnaire assessed weekly sitting time (minutes/day) at work and while travelling [18]. These domains were targeted within a workplace PA intervention that aimed to reduce sitting time (i) at work and (ii) while commuting. This questionnaire has high validity and reliability in the adult population for weekday sitting time at work (r = 0.69-0.74), while it is lower for weekend days across all domains (r = 0.23-0.74) [18]. Forward-backward translation into Catalan and Spanish identified linguistic equivalence [22].

The Warwick-Edinburg Mental Wellbeing Scale (WEMWBS) assessed positive mental well-being (positive functioning, happiness and subjective wellbeing) over the previous two weeks [19]. The 14-item scale has five response categories; 1 ("None") to 5 ("All the time"). Responses are summed to identify the final score, 14–70, indicating low to high positive mental well-being. WEMWBS shows high internal reliability (Cronbach's alpha = 0.93) and one week test-retest reliability (r = 0.97) in the Spanish population [23].

The *Work Limitations Questionnaire* (WLQ) was used to assess performance and the degree to which health problems interfered with the ability to perform job roles [20]. Spanish [24] and Catalan [25] versions of the WLQ have been developed and validated. In the WLQ, respondents self-report levels of difficulty in performing 25 specific job roles across four scales, with scores expressed as an average of responses. The 5-item "Time Scale" addresses difficulty in scheduling demands. For the "Mental-Interpersonal Scale" six items cover difficulty performing cognitive tasks involving the processing of sensory information and interacting with others on-the-job. The

Table 1 Baseline data on the main outcomes and socio-demographic variables

	N = 557
Gender, n (%)	
Male	215 (38.7)
Female	314 (61.3)
Age, mean (SD)	42 (9)
Body Mass Index (kg/m^2), mean (SD)	24.86 (10.82)
University, n (%)	
Vic (Catalonia)	110 (19.8)
Basque Country	112 (20.1)
Ramon Llull – Blanquerna (Catalonia)	73 (13.1)
Vigo	261 (46.9)
Occupation, n (%)	
Academic Staff	340 (63.4)
Administrative Staff	196 (36.6)
Physical Activity (MET-minutes/week), median (interquartile range)	2,742 (1,238 - 4,921)
Physical Activity[1] (MET-minutes/week), n (%)	
Low	169 (31.5)
Moderate	151 (28.1)
High	217 (40.4)
Mental Well-Being at work (WEMWBS)[2], mean (SD)	52.6 (7.1)
Presenteeism (WLQ)[3], median (interquartile range)	
Time scale[4]	15 (5–25)
Mental-Interpersonal scale[5]	17 (8–28)
Output scale[6]	21 (8–29)
% of work productivity loss (WLQ Index Score)[7], median (interquartile range)	4.5 (2.5 - 6.6)
SITTING	
Time spent sitting at work (min/day), mean (SD)	287 (147)
Time spent sitting traveling to and from places (min/day), mean (SD)	
Weekdays	72 (48)
Weekend days	50 (48)
Total time spent sitting (min/day), mean (SD)	
Weekdays	383 (209)
Weekend days	322 (186)

SD: Standard Deviation.
[1]High category: achieving a minimum total physical activity of at least 3,000 MET-minutes/weeks.
Moderate category: achieving a minimum total physical activity of at least 600 MET-minutes/weeks.
Low category: Individuals who do not meet criteria for categories 2 or 3.
[2]Warwick-Edinburgh Mental Well-being Scale (WEMWBS): The minimum score is 14 and the maximum is 70. Higher scores indicate better positive mental well-being.
[3]Each scale score indicates the percentage of time in the previous two weeks when the respondent was limited in performing a specific dimension of job tasks (from low to high rate of difficulty in performing job demands). The minimum score is 0 (limited none of the time) to 100 (limited all of the time).
[4]Five items addressing difficulty in scheduling demands.
[5] Six items covering difficulty performing cognitive tasks at work.
[6]Five items addressing decrements in the ability to meet demands for quantity, quality and timeless of completed work.
[7]A percentage estimate of work loss based on the weighted sum of the scores from the WLQ scales.

"Output Scale" has five items exploring limitations in meeting demands for quantity, quality and timeliness of completed work. The nine-item "Physical Scale" assesses ability to perform job tasks that involve bodily strength, movement, endurance, coordination and flexibility.

Sub-scales scores are transformed to a 0–100 continuum to represent the amount of time in the previous two weeks affected by limited on-the-job performance (from low to high rate of difficulty). These scales estimate work loss, known as the WLQ index [20], which is the weighted sum of the scores from the WLQ scales. In the present study, the WLQ index was calculated by summing the scores of three WLQ scales; the "Physical Scale" was excluded from the current analyses as it was not relevant to these job roles.

Analyses

Data on key outcome variables were described using frequencies (percentage), means (standard deviation) and medians (interquartile range). Bivariate linear regression analyses assessed associations between self-reported sitting time (total and domain specific), PA, mental well-being and work productivity. The model was adjusted for demographics and stratified by PA level introducing an interaction term between PA level (low, moderate or highly active) [17] and sitting time into a multivariate regression model. Significance was set at $p < 0.05$ and analyses performed using Strata software, version 12.

Results

Five-hundred and fifty-seven university office employees completed the survey, giving a response rate of 79% (557/704) from the initial respondents. Table 1 shows descriptive baseline data on the main variables as well as gender, mean age, mean body mass index, universities and staff occupation. Compared to males, females averaged 2.09 points lower on the WEMWBS scale indicating lower mental well-being ($p < 0.05$; Table 2).

A higher body mass index was also significantly associated with greater losses in work performance ($p < 0.05$; Table 2) and an increased difficulty in achieving scheduling demands, performing cognitive tasks and interacting with others on the job ($p < 0.05$; Table 2). No significant associations were identified between body mass index, mental well-being or meeting demands for quantity and quality of completed work.

Higher volumes of PA (MET-minutes/week) were positively related to better mental well-being ($p < 0.05$; Table 2). While the least active employees reported the lowest WEMWBS scores, employees who did more PA reported higher scores (Figure 1). As PA rose from zero METs-minute/week, average WEMWBS scores rose sharply. However, WEMWBS averages were similar with higher levels of PA (Figure 1). Higher PA (MET-minutes/week) was also beneficially associated with the percentage of lost work performance ($p < 0.05$; Table 2). The least active employees reported the greatest percentages of lost productivity compared to the most active employees (Figure 2). As PA rose from zero METs-minute/week, the percentage of lost work performance was sharply reduced; the lowest level of lost work performance was

Table 2 Associations between mental well-being, work productivity loss and the scales for presenteeism with sitting time, PA and socio-demographic characteristics

	Mental Well-Being at work (WEMWBS)[1]	WLQ Index Score[2]% of lost work productivity	Presenteeism (WLQ)[3] Time scale[4]	Presenteeism (WLQ) Mental-Interpersonal scale[5]	Presenteeism (WLQ) Output scale[6]
Gender					
Male	1	1	1	1	1
Female	−2.09 (−3.33, −0.85)*	0.22 (−0.60, 1.05)	2.45 (−1.29, 6.20)	2.37 (−1.44, 6.18)	−0.22 (−4.30, 3.87)
Age	0.05 (−0.02, 0.11)	0.002 (−0.041, 0.045)	−0.10 (−0.30, 0.09)	−0.09 (−0.29, 0.10)	0.08 (−0.13, 0.30)
Body Mass Index (kg/m^2)	−0.02 (−0.07, 0.04)	0.033 (0.004, 0.063)*	0.15 (0.01, 0.29)*	0.16 (0.02, 0.31)*	0.13 (−0.03, 0.28)
Occupation					
Academic Staff	1	1	1	1	1
Administrative Staff	−0.22 (−1.46, 1.03)	−0.39 (−1.18, 0.39)	−0.29 (−3.86, 3.27)	−1.70 (−5.46, 2.05)	−4.39 (−8.45, −0.33)*
Physical Activity (MET-minutes/week)[7]	0.66 (0,09, 1,22)*	−0.50 (−0.91, −0.09)*	−1.47 (−3.32, 0.38)	−1.14 (−3.00, 0.72)	−3.25 (−5.25, −1.25)*
Physical Activity (MET-minutes/week)					
Physical activity low level	1	1	1	1	1
Physical activity moderate level	0.53 (−1.26, 2.31)	−1.21 (−2.16, −0.26)*	−7.31 (−11.64, −2.99)*	−4.84 (−9.28, −0.41)*	−4.69 (−9.50, 0.11)
Physical activity high level	2.33 (0.63, 4.02)*	−1.71 (−2.68, −0.75)*	−7.88 (−12.24, −3.52)*	−7.27 (−11.76, −2.77)*	−7.70 (−12.52, −2.88)*
SITTING[8]					
Time spent sitting at work (min/day)	−0.004 (−0.072, 0.064)	0.05 (−0.009, 0.1)	0.17 (−0.08, 0.42)	0.25 (−0.02, 0.52)	0.30 (−0.01, 0.59)*
Time spent sitting travelling (min/day)					
Weekdays	0.02 (−0.17, 0.20)	−0.002 (−0.13, 0.12)	0.15 (−0.41, 0.72)	−0.03 (−0.61, 0.55)	−0.11 (−0.73, 0.50)
Weekend days	−0.18 (−0.37, 0,01)*	0.14 (0,01, 0.27)*	0.70 (0.12, 1.29)*	0.75 (0.16, 1.34)*	0.62 (−0.01, 1.26)*
Total sitting time (min/day)					
Weekdays	0.02 (−0.03, 0.06)	0.02 (−0.02, 0.07)	0.11 (−0.08, 0.31)	0.13 (−0.06, 0.33)	0.11 (−0.10, 0.32)
Weekend days	−0.10 (−0.14, −0.05)*	0.01 (−0.03, 0.05)	0.09 (−0.11, 0.28)	0.14 (−0.06, 0.33)	0.16 (−0.05, 0.37)

*$p < 0.05$.
[1] Warwick-Edinburgh Mental Well-being Scale (WEMWBS): Scores range 14 to 70. Higher scores indicate better positive mental well-being.
[2]A percentage estimate of work loss based on the weighted sum of the scores from the Work Limitations Questionnaire (WLQ) scales.
[3]The estimated percentage of time in the previous two weeks spent feeling limited in performing a specific dimension of job tasks (rated from low to high difficulty).
[4]Five items addressing difficulty in scheduling demands.
[5]Six items cover difficulty performing cognitive tasks involving the processing of sensory information and a person's problems interacting with people on-the-job.
[6]Five items address decrements in the ability to meet demands for quantity, quality and timeless of completed work.
[7]Coefficient (95% Confidence Interval) corresponding to the physical activity logarithm.
[8]The coefficients of the different domains of sitting correspond to an increase of 15 min/day.

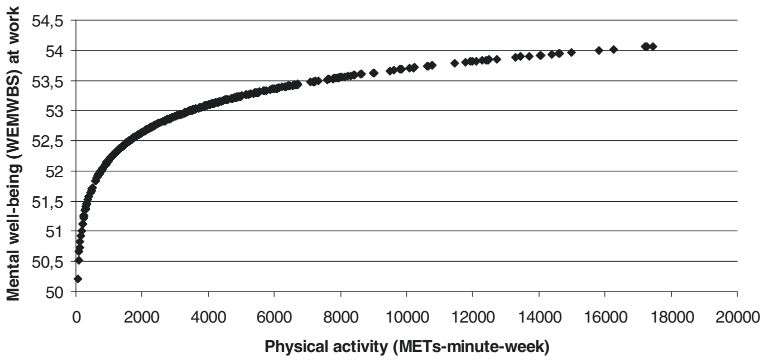

Figure 1 Significant positive non-linear association between physical activity (METs-minute-week) and mental well-being (WEMWBS) at work. [1]Warwick-Edinburgh Mental Well-being Scale (WEMWBS): The minimum score is 14 and the maximum is 70. Higher scores mean better positive mental well-being.

reported among employees doing most PA (Figure 2). A consistent pattern showed that progressively more PA was inversely linked to the time employees spent feeling limited in their capacities (Table 2). This was shown for (i) scheduling demands (linked to a 22.60%, 15.86% and 14.67% of time feeling limited for the low, moderate and high PA categories respectively), (ii) performing mental-interpersonal tasks (24.42%, 20.16% and 17.12%) and (iii) delivering outputs (28.16%, 23.73% and 21.24%) (Table 2). Each category of PA was linked to a smaller, but still progressive, percentage estimate for lost work productivity; 5.99%, 4.95% and, 4.36% (Table 2).

Higher volumes of PA were also associated with spending less time sitting at work and throughout the working day ($p < 0.05$; Figures 3 and 4). While the least active employees reported higher times of occupational sitting and daily sitting during weekdays, employees engaged in high volumes of PA reported the least time sitting on both domains (Figures 3 and 4). As PA MET minutes/week rose from zero, the average minutes spent sitting at work and during working days reduced. However, the rate of decrease on occupational and total weekday sitting time lessened when PA was high (Figures 3 and 4). Contrarily, higher volumes of PA were significantly associated with spending more time sitting at weekends ($p < 0.05$; Figure 5). As PA increased from zero METs-minute/week, the average of minutes spent sitting at weekends increased more sharply than when PA was higher (Figure 5). Higher volumes of PA were also significantly associated with less time spent sitting while travelling during weekends and weekdays ($p < 0.05$). While low active employees spent an average of 62 minutes/day sitting during weekend travel, the comparable average for moderately and highly active employees was 45 (62.38 to 17.61) minutes/day. Similarly, for weekday travelling low active employees averaged 77 minutes/day sitting compared to 59 (77.03 to 18.38) minutes/day for the moderately active ($p < 0.05$).

Two domains of sitting time showed significant negative linear associations with positive mental well-being ($p < 0.05$; Table 2). Greater levels of sitting in weekend travelling and total weekend sitting time were associated with lower mental well-being; sitting 30 extra minutes a day in each domain was linked to a reduction of 0.6% and 0.4% respectively; 0.36 and 0.20 points in the

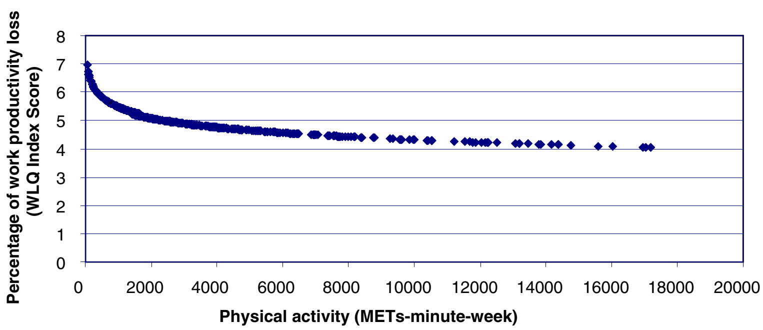

Figure 2 Significant negative non-linear association between physical activity (METs-minute-week) and percentage of work productivity loss (WLQ Index Score). [1]Estimate of the percentage of work loss based on the weighted sum of the scores from the Work Limitations Questionnaire scales.

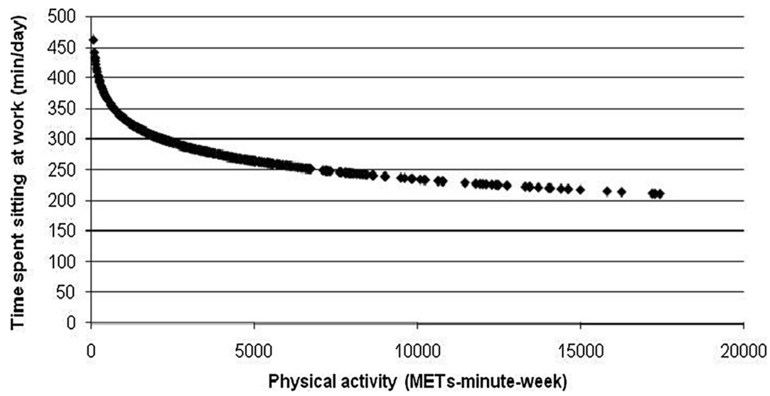

Figure 3 Significant negative non-linear association between physical activity (METs-minute-week) and occupational sitting time.

WEMWBS score respectively ($p < 0.05$; Table 2). No significant associations were found between weekday occupational and total sitting time for mental well-being.

Time spent sitting during weekend travelling also showed an inverse relationship with work productivity ($p < 0.05$; Table 2). More sitting during weekend travelling was related to greater difficulties in meeting job demands (every extra 30 minutes/day was linked with an additional 1.4% difficulty in meeting job scheduling demands, a 1.5% increase in difficulty performing cognitive tasks or tasks that involved interacting with others and a 1.2% increase in the difficulty of meeting demands for quantity, quality and timeless of completed work). Greater levels of sitting while travelling at weekends were also linked to lower overall work productivity (each additional block of 30 minutes/day was linked to a reduction of 0.3% ($p < 0.05$; Table 2). There were no significant associations between productivity and occupational or total sitting time.

In highly active employees, greater levels of sitting at work, throughout the work day and while travelling during weekend was related to lower mental well-being (for each increment of 30 minute/day was related to a reduction of 0.6%, 0.36% and 1.9% respectively (0.34, 0.2 and 1.06 points in the WEMWBS scores; Table 3). This association was not significant for inactive employees (Table 3). Greater levels of sitting in weekend travel was also linked to lower work productivity in the highly active (each additional 30 minutes was associated with a 0.8% reduction). Among inactive employees, no domain of work productivity was linked to higher sitting time.

Discussion

This study examined the associations between sitting time and PA, with mental well-being and work productivity in 557 office employees. Uniquely, the study addresses cross-sectional differences in how indices of sitting, alone or in combination with markers of PA, relate to mental well-being and productivity. Given the need to develop workplace PA interventions that target employees' health related efficiency outcomes, this study provides novel insights of the interactive relationships between sitting time and PA. This evidence contributes to a better understanding of how targeting both behaviors can

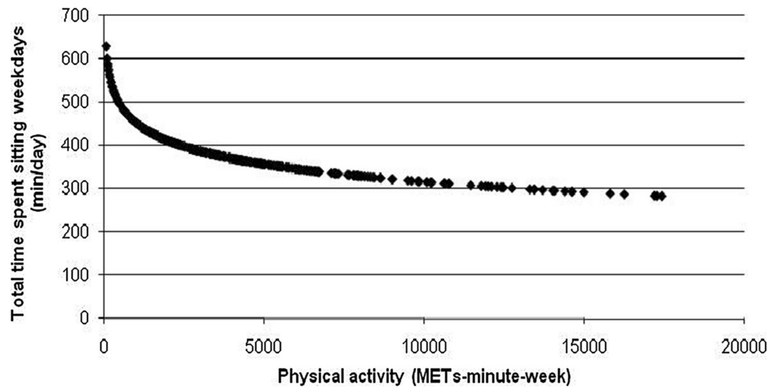

Figure 4 Significant negative non-linear association between physical activity (METs-minute-week) and total time spent sitting during weekdays.

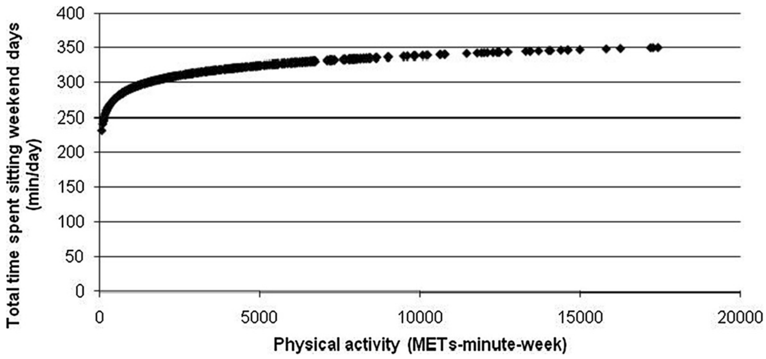

Figure 5 Significant positive non-linear association between physical activity (METs-minute-week) and total time spent sitting on weekend days.

potentially benefit the mental well-being and productivity of office employees.

The main finding of the present study indicated that employees' PA levels exerted different influences on the associations between sitting time, mental well-being and work productivity. Previous research has reported adverse associations between prolonged sitting time and well-being in adults [15,26]. However, these studies have focused on leisure-time sitting (i.e. television viewing and screen-based sitting) rather than on investigating how employees' PA levels might interact on the results of occupational sitting time and subsequent effects on mental well-being. While several studies have examined joint associations between PA and sitting time with physical health outcomes [27,28], few have investigated the interactive effects of PA and sitting time relative to mental well-being.

Rosenkranz et al. [29] identified that PA was positively associated with excellent overall health (OR 2.22, 95% CI = 2.20. 2.47) and quality of life (OR = 1.13, 95% CI = 1.09, 1,18), interactions between PA and sitting time were not statistically significant. Similarly, Södergren et al. [30] addressed the relationship between leisure PA and sitting time to examine their associations with good self-reported health. No associations between sitting time and self-rated health were identified using multivariate analysis. However, both of these studies [29,30] measured total daily sitting time by asking participants to report total hours per day usually spent sitting (using IPAQ short and long forms). Neither investigated the joint associations between PA and different domains of sitting time relative to mental well-being.

In our study, spending more time sitting at work and during workdays was linked to lower mental well-being in the highly active employees but not in their inactive counterparts. A possible explanation could be the relationship identified in our sample between PA and both sitting time domains. While highly active employees averaged 3.5 hours sitting at work and 5.4 hours/day sitting from Mondays to Fridays, their low active counterparts averaged 5.15 hours/day and 7.11 hours/day sitting respectively. For highly active employees, increasing sitting time may indicate a decline healthy daily behavior, with negative consequences for their mental well-being. Even though no threshold for sitting time has been linked to diminished mental well-being, previous research has identified that sitting for more than 7 hours/day was associated with an increased likelihood of depressive symptoms in women [31]. Since adopting one healthy lifestyle behavior can facilitate adopting another [32], and similarly for negative behavior, future research should examine how changes to the domains of sitting time relate to mental well-being in highly active employees.

For the same group, higher volumes of time spent sitting travelling at weekends were associated with both poorer work performance and poorer mental well-being. To our knowledge, no previous studies have investigated the joint associations between PA with total and specific domains of sitting time relative to employees' work performance. Our results indicated that time spent sitting while travelling during non-working days influenced employees' work productivity and, that PA levels exerted an influence on this association. Again, this may be explained by the relationship identified in our sample between PA and sitting time while travelling at weekends; with highly active employees sitting 17 minutes/day less while travelling on Saturday and Sundays than their inactive counterparts. While a recent systematic review [33] identified that the most commonly assessed subtypes of sitting domains were TV viewing, total sitting, general screen and occupational sitting time - with each being associated with lower levels of PA – few studies have examined how specific sitting domains during non-working days are influenced by PA levels or vice versa. Even less is known about how this relates to work-related issues such as work productivity or performance. Our results are partly consistent with previous research

Table 3 Interaction between PA levels and sitting time relative to mental well-being, work productivity loss and the scales for presenteeism adjusted for demographics

	Mental Well-Being at work (WEMWBS)[1]	WLQ Index Score[2]% of lost work productivity	Presenteeism (WLQ)[3] Time scale[4]	Presenteeism (WLQ) Mental-Interpersonal scale[5]	Presenteeism (WLQ) Output scale[6]
Time spent sitting at work (min/day)[7]					
Physical activity low level	−0.10 (−0.32, 0.13)	0.004 (−0.12, 0.13)	0.09 (−0.46, 0.63)	−0.02 (−0.61, 0.56)	0.19 (−0.78, 0.41)
Physical activity moderate level	−0.13 (−0.27, 0.01)	0.03 (−0.06, 0.11)	0.03 (−0.39, 0.32)	0.20 (−0.19, 0.58)	0.24 (−0.19, 0.67)
Physical activity high level	−0.17 (−0.31, −0.03)*	0.07 (−0.02, 0.16)	0.32 (−0.06, 0.69)	0.32 (−0.11, 0.75)	0.33 (−0.13, 0.79)
Time spent sitting travelling to and from places on weekdays (min/day)					
Physical activity low level	0.21 (−0.16, 0.59)	−0.17 (−0.41, 0.06)	−0.59 (−1.77, 0.59)	−0.58 (−1.64, 0.48)	−1.00 (−2.24, 0.24)
Physical activity moderate level	0.02 (−0.35, 0.40)	−0.04 (−0.27, 0.18)	−0.28 (−1.17, 0.60)	0.01 (−0.99, 1.01)	−0.07 (−1.18, 1.04)
Physical activity high level	−0.07 (−0.36, 0.21)	0.08 (−0.10, 0.26)	0.63 (−0.16, 1.42)	0.06 (−0.88, 1.00)	−0.11 (−1.17, 0.95)
Time spent sitting travelling to and from places on weekend days (min/day)					
Physical activity low level	0.22 (−0.15, 0.58)	−0.15 (−0.38, 0.07)	−0.73 (−1.88, 0.42)	−0.44 (−1.47, 0.59)	−0.80 (−1.95, 0.35)
Physical activity moderate level	−0.23 (−0.62, 0.15)	−0.05 (−0.28, 0.19)	−0.24 (−1.21, 0.73)	0.22 (−0.81, 1.24)	−0.12 (−1.30, 1.07)
Physical activity high level	−0.53 (−0.84, −0.22)*	0.40 (0.21, 0.59)*	1.83 (0.99, 2.66)*	1.61 (−0.59, 2.63)*	1.47 (0.40, 2.54)*
Total time spent sitting on weekdays (min/day)					
Physical activity low level	−0.02 (−0.14, 0.10)	−0.03 (−0.11, 0.05)	−0.15 (−0.57, 0.27)	−0.04 (−0.38, 0.31)	−0.21 (−0.59, 0.17)
Physical activity moderate level	−0.14 (−0.26, −0.02)*	0.02 (−0.05, 0.09)	0.03 (−0.27, 0.33)	0.16 (−0.15, 0.47)	0.14 (−0.23, 0.50)
Physical activity high level	−0.10 (−0.21, −0.002)*	0.06 (−0.01, 0.12)	0.28 (−0.01, 0.58)	0.19 (−0.16, 0.54)	0.13 (−0.23, 0.50)
Total time spent sitting on weekend days (min/day)					
Physical activity low level	−0.10 (−0.21, 0.001)	−0.01 (−0.07, 0,06)	0.06 (−0.29, 0.41)	0.12 (−0.19, 0.42)	0.06 (−0.26, 0.39)
Physical activity moderate level	−0.03 (−0.15, −0.09)	−0.03 (−0.04, 0.10)	0.16 (−0.13, 0.45)	0.09 (−0.23, 0.41)	0.25 (−0.11, 0.61)
Physical activity high level	−0.03 (−0.15, 0.10)	−0.02 (−0.10, 0.06)	−0.12 (−0.48, 0.24)	0.03 (−0.40, 0.47)	−0.15 (−0.58, 0.27)

*$p < 0.05$.
[1]Warwick-Edinburgh Mental Well-being Scale (WEMWBS): Scores range 14 to 70. Higher scores mean better positive mental well-being.
[2]A percentage estimate of work loss based on the weighted sum of the scores from the Work Limitations Questionnaire (WLQ) scales.
[3]A percentage estimate of time in the previous two weeks spent feeling limited in performing a specific dimension of job tasks (rated from low to high difficulty).
[4]Five items addressing difficulty in scheduling demands.
[5]Six items cover difficulty performing cognitive tasks involving the processing of sensory information and a person's problems interacting with people on-the-job.
[6]Five items address decrements in the ability to meet demands for quantity, quality and timeless of completed work.
[7]The coefficients of the different domains of sitting correspond to an increase of 15 min/day.

that indicates that highly active employees sit less at work and also outside work [34], including commuting, even though the previous study only referenced commuting on weekdays. However, the associations found in our sample between PA and total sitting time during non-working days suggests a different pattern of sedentary and PA behaviors during non-working days. This change in patterns is consistent with a previous study indicating that the time periods of 06:00–07:00 and 17:00–19:00, which are typically outside normal working hours, represent the periods when moderate-to-vigorous PA is significantly higher in work days than non-working days [35]; being at work from 09:00–17:00 clearly influences employees' sedentary and PA patterns during the workdays [35]. Furthermore, previous research has suggested that engaging in sitting behaviors is related to having more leisure time, which mainly happens on the weekends of working adults [36] and that sitting time during non-working days is explained by different correlates (i.e. home and neighborhood factors) than working days [36]. Future research should investigate the effects sedentary patterns on non-working days have on work productivity as well as mental well-being.

Finally, it should be pointed out that more sitting time domains were related to mental well-being than to work productivity. Nonetheless, mental well-being has been associated with work productivity and other work-related outcomes (i.e. job stress), indicating that specific domains of sitting time could also indirectly influence work productivity. A recent longitudinal study identified that employees in the low well-being segment reported over 3 times the level of work productivity loss than those in the high well-being segment [37]. Over a year, changes in well-being were significantly associated with positive changes in employees' productivity [37]. Additionally, levels of positive mental well-being reduce as work stress increases [38]; work stress is one of the most commonly reported causes of work-related illness and loss of work performance [38].

This study has several important limitations. As a cross-sectional study, it is not possible to establish cause-effect relationships between sitting time, PA, mental well-being and productivity. Furthermore, the data can only indicate associations; studies are needed to address the directionality of these associations. More PA and less sitting may be result of better mental health and performance. However, descriptive analyses are essential for documenting the potential benefits of health promotion initiatives [39] for employees. This descriptive study provides a valuable baseline for developing workplace interventions aimed at improving employees' well-being and work productivity through sitting behavior *and* PA. It is also important to recognize that our findings are specific to office employees (highly educated middle-age men and women) who showed an interest to participate in a workplace PA program (Walk@WorkSpain). Ongoing research should focus on more heterogonous samples of office employees. In addition, sitting time and PA were measured by self-report. Estimates of workplace sitting are generally higher when measured using objective devices than when measured by self-report [40]. Furthermore, self-report estimates of work performance/productivity and mental well-being have the potential to contain error. However, in the current study these domains were measured by using two scales with high validity and reliability. Objective measures of sitting time are needed to generate deeper insights into the relationship between total and specific sitting domains with employee's well-being and productivity.

Conclusion

Our findings present a strong rationale, based on consistent associations, for combining sitting time reduction strategies with efforts to increase PA in interventions aimed at improving office employees' well-being and productivity. The study identified distinctive associations depending on pre-existing PA levels. In highly active employees, less total sitting time and occupational sitting on work days was associated with better mental well-being and work performance. In inactive employees, higher levels of PA were related to better mental health and higher performance estimates. This study also suggests that workplace PA programs promoting "sitting less" in different domains –including weekends - may beneficially impact work productivity and mental well-being. Future research should investigate the impact of workplace sitting time reduction strategies on work productivity and mental well-being among employees engaged in different levels of pre-existing PA.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

AP and NG contributed to the research design. AP, IM, MG, AG and JF led data collection at the universities, with support from JB. LM performed the statistical analyses. AP drafted the manuscript. JM and NG edited and revised the manuscript. All authors commented on drafts, and read and approved the final manuscript.

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APPENDIX IV: Abstracts accepted in scientific conferences

Walk@WorkSpain: Predictors of sitting time reductions in office employees

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Introduction: Sedentary office workers sit for around 9-11 hours a day (Tudor-Locke et al., 2011) and prolonged periods of sitting have been associated with an increased risk of all-cause mortality (Chau et al., 2013). This study investigated the predictors of reducing sitting time after enrolling in a web-based "sit less and move more at work" program.

Methods: Predictors of reducing sitting time were identified from a quasi-experimental study (Walk@WorkSpain Project) with intervention group employees (n=129; 67% women). Following demographic, physical and behavioural baseline measures, the intervention consisted of a (i) ramping phase to progressively increase baseline counts to 10,000 steps/day through active work tasks, and short/long walking routes at work and; (ii) maintenance phase to sustain the increased volume of step counts through researcher support. Employees self-reported sitting time throughout the intervention. A logistic regression model examined relationships between baseline measures and change in sitting time post intervention.

Results: Sixty percent of employees reduced their daily sitting time after completing the intervention. The strongest predictor of sitting time reduction was high waist circumference (OR= 1.02, 95%CI: 1.00-1.05). Employees who reported more hours/ day sitting at baseline were more likely to change than those who sat less (OR= 1.00, 95%CI: 1.00-1.00). Women were less likely to reduce sitting time after intervention than men (OR= 0.36, 95%CI: 0.18-0.69). This model correctly classified 66% of intervention group employees.

Discussion: High waist circumference, long periods of sitting time and sex predicted sitting time reductions in this Spanish sample of office employees. The findings provide insights into the characteristics of employees for whom Walk@WorkSpain may be most effective.

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18th annual Congress of the
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Hosted by the National Institute of Physical Education of Catalonia (INEFC)

Walk@WorkSpain: Effectiveness on increasing physical activity levels in office employees.

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Introduction: Physical inactivity is the fourth leading risk factor for global mortality (WHO, 2010). However, 50% of the Spanish population does not achieve physical activity (PA) recommendations for health. As most adults spend half of their waking day at work (Tudor-Locke et al., 2011), the workplace has become a convenient setting for delivering PA promotion interventions. This study investigated the impact of a web-based “sit less and move more at work” program had on employee´s PA levels.

Methods: Office employees from four Spanish universities engaged in the program over 19 weeks (n=264; age 42±10 years; 171 women). The intervention group (IG, n=129) used a pedometer, a diary and a website which provided strategies, motivational materials and interactive features to increase step counts and reduce sitting time at work. Following baseline measures, the intervention consisted of a (i) ramping phase to progressively increase baseline step counts to 10,000 by integrating active working tasks, short and long walking routes at work, (ii) a maintenance phase to sustain the increased volume of step counts through researcher support. An additional campus in each university acted as a control group (CG, n=135). Employees completed a PA questionnaire (IPAQ short version) at baseline, post-intervention, and two months follow-up. PA status changes (MET·h·wk^{-1}) were analysed using ANOVA between and within groups.

Results: The IG significantly increased PA levels at post-intervention (+205MET·h·wk^{-1}; $p<.05$), and two months follow-up (+590MET·h·wk^{-1}; $p<.05$). No statistically significant differences between groups were observed. When data from the IG were analysed relative to baseline activity status, inactive employees (n=17, 13%; <600MET·h·wk^{-1}) increased PA levels the most at post-intervention (+1,330MET·h·wk^{-1}; $p<.05$) and follow-up (+1,366MET·h·wk^{-1}; $p<.001$). Active employees (n=70, 54%; 600-3,000 MET·h·wk^{-1}) also showed significant increases at post-intervention (+991MET·h·wk^{-1}; $p<.001$) and at follow up (+1,237MET·h·wk^{-1}; $p<.001$), whereas highly active employees (n=42, 32%; >3,000MET·h·wk^{-1}) decreased their PA levels (-809MET·h·wk^{-1}; $p>.05$).

Discussion: Office employees that engaged the program increased their overall PA levels. Increases were most evident for the least active. Walk@WorkSpain may be effective to achieve PA recommendations for health in Spanish population.

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Walk@WorkSpain: Impact of "sitting less and move more at work" on employees´ cardiovascular risk factors

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Introduction: Sedentary behavior (sitting time) represents an independent preventable risk factor for cardiovascular disease (CVD), even among individuals who meet physical activity recommendations. However, approximately 80% of adults work in sedentary and light activity occupations.This study investigated the impact a "sit less and move more" program had on employees' major CVD risk factors.

Methods: Office employees from four Spanish universities engaged in the program over 19 weeks (n=264; age 42±10 years; 171 women). The intervention group (IG, n=129) used a pedometer, a diary and a website which provided strategies, motivational materials and interactive features to increase step counts and reduce sitting time at work. Following baseline measures, the intervention consisted of a (i) ramping phase to progressively increase baseline step counts to 10,000 by integrating active working tasks, short and long walking routes at work, (ii) a maintenance phase to sustain the increased volume of step counts through researcher support. An additional campus in each university acted as a control group (CG, n=135). Outcome measures were completed at baseline, post-intervention and two months follow-up. Measures included waist circumference, body mass index (BMI) and, systolic and diastolic blood pressure. ANOVA was used to analyse differences within and between groups.

Results: The IG significantly decreased waist circumference at post-intervention (-1.7cms, $p<.05$) and two months follow-up (-2.1cms, p<.05). When compared to controls, the IG showed a significant higher decrease on waist circumference post intervention and at follow up (-1.0cms, $p<.05$; -0.7cms, $p<.01$ respectively). There were no significant changes for blood pressure and BMI, but average BMI values did decrease relative to the controls at post intervention, with these decreases maintained at follow-up (-0.09 kg/m^2).

Discussion: A workplace program aiming to reduce sitting time and increase step counts successfully reduced abdominal fat and showed a trend towards reducing BMI. Walk@WorkSpain may be an effective intervention strategy for improving some CVD risk factors in office workers.

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Walk@WorkSpain: Does it improve job productivity in office employees?

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Introduction. Presenteeism (time of impaired performance while at work due to health reasons) is highly prevalent due to increasing chronic health problems (Goetzel et al, 2004). Lack of physical activity (PA) is a risk factor for presenteeism (Cancelliere et al, 2011) but evidence on the effectiveness of workplace PA programs to decrease health-related productivity losses is scarce. We evaluated the impact a 'sit less and move more' program (Work@WorkSpain) had on employees´ job productivity.

Methods. A sample of 264 employees (age 42±10 years; 171 women) from four universities engaged the program (19 weeks). The intervention group (IG, n=129) used a pedometer, a diary and a website that provided strategies, motivational materials and interactive features to increase step counts and reduce sitting time at work. An additional Campus in each University acted as a control group (CG, n=135), maintaining normal behaviour. Measures of work performance (Work Limitations Questionnaire, WLQ) were completed at baseline, post-intervention and two months follow-up. The WLQ identified three subscales, reflecting ability to meet job demands for (i) output, (ii) time management and (iii) mental-interpersonal skills. Resulting scale scores were transformed to a 0-100 continuum that represented the rate of difficulty in performing job demands (from low to high). An estimated percent of productivity loss (WLQ Index) was calculated. Paired and independent samples t-tests evaluated differences within and between groups at pre, post-intervention and follow-up.

Results. Job productivity significantly decreased in both groups, but the IG showed a less rate of decline ($p<0.05$). The IG perceived less difficulty than controls ($p<0.05$) in performing (i) job's time and scheduling demands (-10;95%CI:[-17; -2]), (ii) cognitive and interpersonal tasks (-9;95%CI:[-16; -2]) and, (iii) meeting demands for quantity, quality and timeless of completed work (-6;95%CI:[-11;-1]). This effect significantly increased at two months (-11; 95%CI:[-19; -3];-10;95%CI:[-17; -3];-8;95%CI:[-14;-2] respectively). As a result, the IG enhanced job productivity at post-intervention and follow-up by 1.7% and 2% when compared to controls ($p<0.05$).

Conclusion. Office employees engaging in Walk@WorkSpain showed less health-related productivity losses than controls. Workplace programs to reduce sedentary behaviour may be effective at decreasing presenteeism costs.

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Rev Esp Cardiol. 2013;66 Supl 1:121

REVISTA ESPAÑOLA DE CARDIOLOGIA

4014-5 - WALK@WORKSPAIN: FACTORES ASOCIADOS A LA REDUCCIÓN DE GRASA ABDOMINAL DESPUÉS DE PARTICIPAR EN UN PROGRAMA DE "SENTARSE MENOS Y MOVERSE MÁS" EN EMPLEADOS DE OFICINA

Judit Bort Roig[1], Anna M. Puig Ribera[1], Ángel M González Suárez[2], Iván Martínez Lemos[3], María Giné Garriga[4], Jesús Fortuño[4], Joan C. Martori[1] y Nicholas D. Gilson[5] de la [1]Universitat de Vic, Barcelona, [2]Universidad del País Vasco, Bilbao (Vizcaya), [3]Universidad de Vigo, Pontevedra, [4]Universitat Ramon Llull-Blanquerna, Barcelona y [5]The University of Queensland, Australia.

Resumen

Introducción: Prolongados periodos de tiempo sentado son un factor de riesgo cardiovascular (RCV). Debido a que aproximadamente el 80% de la población activa trabaja en ocupaciones sedentarias y que la circunferencia de cintura (CC) es un marcador clave de RCV; el objetivo de este estudio es identificar los factores asociados a la reducción de la CC en empleados de oficina que han participado en un programa laboral para "sentarse menos y andar más".

Métodos: Cuatro universidades españolas participaron en el programa W@WS durante 19 semanas (n = 264; 42 ± 10 años, 171 mujeres). Se utilizó un diseño pre/post con grupo control (GC, n = 135). El grupo intervención (GI, n = 129) utilizó un podómetro y una página web, a partir de la cual se proporcionaban estrategias de trabajo activas y caminatas en el entorno laboral, materiales motivacionales y gráficos de seguimiento. Los datos recolectados fueron: demográficos, antropométricos, biomédicos, AF y comportamiento sedentario. Las variables indicadoras del cambio en la CC fueron identificadas mediante un análisis de regresión lineal multivariante a partir de las características basales de la muestra.

Resultados: La participación en el programa (GI) se asoció a una reducción de 1,089 cm (p = 0,004) en la CC en comparación al GC, las mujeres mostraron una reducción mayor (2,702 cm, p = 0,000). Los participantes del GI alcanzaron las recomendaciones saludables de CC con 93,49 cm en hombres y 79,06 cm en mujeres, a diferencia del GC. Respeto a los indicadores de salud basal, el cambio en la CC fue asociado al IMC y la CC. Cada centímetro extra en la CC al inicio del programa se asoció a una reducción de 0,17 cm (p = 0,000) y por cada kg/m^2 se mostró una reducción de 0,67 cm (p = 0,000) en la CC al finalizar el programa. No se encontró relación entre la cantidad de número de pasos y el tiempo sentado basal.

Conclusiones: Un programa web centrado en reducir el tiempo sentado y aumentar la cantidad de pasos caminando en el lugar de trabajo fue efectivo en la reducción de la adiposidad abdominal especialmente entre mujeres y con una CC y valores de IMC basales mayores; independientemente de los niveles de AF y comportamiento sedentario previos. Debido a que la adiposidad abdominal es un indicador clave en el RCV, W@WS podría ser una intervención efectiva en los lugares de trabajo sedentarios en la reducción del RCV.

ticipants wore the activPAL™ for 7 days again followed by an extensive health examination, similar to the baseline examination. The study is registered at ClinicalTrials.gov (ID NCT00289247).

Results: Data collection was terminated march 2012, with the last follow-up examination taking place on March 5th 2012. Data have not been processed yet and final results can therefore not be reported, but will be presented at the ICPAPH conference. Data will be analysed using intention to treat analyses.

Discussion: Result from the present study may help elucidate whether it is possible to reduce sitting time and improve cardio metabolic biomarkers in a group of adult sedentary men and women, recruited from a population-based study and using an individual approach.

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Building healthy communities: What can we learn from systematic reviews to increase population levels of physical activity?

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WITHDRAWN

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Walk&WorkSpain: Participants' perspectives and experiences on reducing occupational sitting time

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Introduction: Emerging evidence suggests that sedentary behaviour is negatively associated with health. Workplaces are convenient settings for delivering health promotion interventions and reduce occupational sitting time. However, most studies have focused on quantitative analyses to understand the impact of workplace physical activity interventions on reducing occupational sedentary time rather than employees' experiences. We assessed employees' perspectives who undertook a 20-week pedometer-based programme (Walk&WorkSpain)–based on Web technology–that aimed at reducing daily sitting time and increasing daily step counts at work.

Method: Two-hundred and sixty-four inactive employees from 4 Spanish universities engaged in Walk&WorkSpain. The intervention group (n = 129) accessed gradually to different strategies through a Webpage: "incidental walking" (active work tasks, i.e. walk talk meetings), "short and long Campus walking routes" (10 minutes, i.e. parking the car a bit far; 20 minutes, i.e. walking at lunch time respectively). Semi-structured interviews were conducted with 8 employees from the intervention to gather qualitative data on personal experiences. The most inactive employees who volunteered were recruited. Participants were evenly divided between men/women and job roles; academic-male (n = 2), academic-female (n = 2), administrative-male (n = 2) and administrative-female (n = 2). Each participant was interviewed three times at the beginning (baseline), middle (8 weeks) and two months after completing the intervention. Interviews were transcribed verbatim and subjected to inductive coding within the major themes of opinions on sitting reduction strategies and experiences of success when implementing them.

Results: At baseline, participants had little awareness about the need of reducing sitting time. Most employees were on the contemplation stage for changing this behavior. Eight weeks later, most participants perceived to implement the different strategies successfully, being incidental walking the mostly widely used followed but short walking routes. However, they could not implement them as regularly as they wanted. At this stage, participants were on preparation for reducing sedentary behavior. The long walks around the Campus could not be implemented successfully at work but most employees put these into practice outside work by the end of the program (i.e. walking to school to pick up their children). At this point, all participants reached the "action stage".

Discussion: Walk@WorkSpain was perceived to be a feasible program to promote sustained reductions on sitting time and increases on physical activity both inside and outside work. The program was perceived to be successful not only in improving participants' awareness but also in gradually introducing changes to reduce sitting time in employees' lives.

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Objectively measured sedentary behaviour and physical activity in office employees: Relationships with presenteeism

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Introduction: Results of previous studies suggest there may be an association between presenteeism (or loss of 'on the job' productivity) and sedentary behaviour and physical activity (PA). Studies have explored these relationships using self-reported measures of activity, which may result in inaccurate or incomplete data. This study examined associations between presenteeism and objectively measured sedentary behaviour and PA in office employees.

Methods: 157 full time office employees were recruited from 9 workplaces in urban South East Queensland. Daily time spent sedentary (≤150 counts), and in light (151–1689 counts), and moderate-to-vigorous (MVPA; 1690–6166 counts), and total PA (>150 counts) was measured over seven days using ActiGraph GT3X accelerometers. Data were included if accelerometer wear time was >10 hours per day, on at least 3 work days and 1 weekend day. Presenteeism was measured using the Work Limitations Questionnaire (WLQ) to give an overall WLQ Index, and four subscale scores: time management, physical demands, mental-interpersonal demands and output, each with a Likert scale of 1–5. Pearson's Product Moment correlation coefficients were used to analyse relationships between sedentary behaviour, time spent in each activity category and WLQ variables.

Results: Data from 75 employees (48%) were included in this analysis (mean age 42.7 SD 11.3y; mean BMI 27.0 SD 4.55; 50 women). Median accelerometer data indicated that employees spent 71.1% of their total day sedentary (664 mins, IQR 96.7), and 26.0% in light activity (242 mins, IQR 73.0), 2.9% in MVPA (15 mins, IQR 39.7), and 28.9% in total PA (267 mins, IQR 81.4). Overall, WLQ

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Efficacy of an integrated approach to reduce sitting time in office workers

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Introduction: There is now substantial evidence linking prolonged sitting time with adverse health outcomes. Desk-based office workers accumulate high amounts of sitting time, often in prolonged bouts, making them an important target for workplace strategies to reduce prolonged sitting. Recent frameworks recommend an integrated approach to workplace health promotion that includes both individual behavior and organizational-level change elements. The advent of sit-stand workstations provides an opportunity to add environmental change to such an integrated approach. To date, no workplace intervention studies have addressed all these elements to target reductions in workplace sitting time. In a controlled workplace trial, we evaluated such an intervention to reduce sitting time.

Methods: Participants were between 26–62 years of age (mean age: 44 ± 11years; 50% female) and were recruited from a single workplace, with intervention participants (n = 18) working on a separate floor from comparison participants (n = 18). The four-week intervention communicated three key messages: "stand up, sit less, move more," and comprised organizational (management consultation; worker information session; management support emails), environmental (sit-stand workstation: Ergotron WorkFit-S), and, individual (30 minute face-to-face consultation; weekly telephone calls; email summaries after each contact) elements. Sitting time was measured using activPAL3^{TM} activity monitors over seven days. Primary outcomes were changes in minutes/day spent sitting (including time accumulated in prolonged sitting bouts ≥30 minutes), standing, and stepping at the workplace and during all waking hours from baseline to four weeks. Analyses were by linear regression adjusted for baseline values (ANCOVA); significance level = 0.05, two-tailed.

Results: At baseline, the overall mean for workplace sitting was 317 [SD 61] minutes/day, with much of this sitting time (110 [69] minutes/day) accrued in prolonged bouts. The intervention group (relative to the comparison group) significantly reduced sitting time at both the workplace (mean change [95% CI]: -128 [-162, -94] minutes/day) and across all waking hours (-78 [-120, -36] minutes/day). Reductions in workplace sitting were primarily driven by a reduction in sitting time accrued in prolonged bouts (-70 [-103, -37] minutes/day). Workplace sitting was almost exclusively replaced by standing (+129 [+96, + 162] minutes/day) with minimal changes to stepping time (-1 [-7, + 5] minutes/day).

Discussion: This integrated intervention, combining organizational, environmental, and individual elements, contributed to a significant reduction in objectively-measured sitting time in office workers. Cluster-randomized trials with larger, more representative samples and longer-term follow-ups are needed to determine the health and work-related benefits of reduced workplace sitting.

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A 5-months workplace pedometer-based intervention: Did it change employees' sedentary behaviour 2 months after removal?

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Introduction: Higher levels of daily sitting time are associated with an elevated risk for type 2 diabetes, all-cause and cardiovascular disease mortality. As a typical work day represents one-half of waking hours and because people spent an average of 10 hours sitting a day, workplace interventions aimed at reducing sitting time are needed. Currently, evidence on the effectiveness of workplace interventions for reducing sedentary behaviour is scarce. We evaluated the impact of a pedometer-based programme–based on Web technology–on employees' sitting time two months after removing the intervention.

Methods: Inactive white-collar employees (n = 264; age 42 ± 10 years; 171 women) undertook a 20-week programme at four Spanish Universities. A quasi-experimental design was used, with an additional Campus in each University acting as a control. Employees at these additional sites undertook key measures for comparative analyses (n = 135; control group; maintain normal behaviour) with the intervention group (n = 129). The intervention consisted of: a) a ramping phase (8 weeks) to progressively increase baseline step counts to 10.000 steps/workday by integrating active working tasks, short (10′) and long (20′) campus walking routes at low and moderate intensities, b) a maintenance phase (12 weeks) of the increased volume of step counts, with intensive researcher guidance (weekly emails). Adherence to behaviour change was assessed two months after completing the intervention. Employees used a pedometer and a Website that provided strategies, motivational materials and interactive features. Employees completed baseline and intervention measures at three points (after ramping, maintenance and adherence phase) of sitting time (domain and day-specific sitting time questionnaire). T Student tests analysed significant differences between groups.

Results: Significant differences between groups ($p < 0.05$) were identified for a) TV sitting time at weekend with mean differences indicating a decrease of 27 and 25 minutes on the maintenance and adherence phase respectively, b) transport sitting time during work days with mean differences indicating a 10 minutes decrease on the adherence phase, (c) total sitting time during work days with mean differences indicating a 38 minutes decrease on the ramping phase. Small, non-significant changes were found for occupational sitting time.

Conclusion: Our workplace pedometer-based programme decreased employee sitting times but not at work, which was our main purpose. This data suggests that employees could not integrate the strategies into their working routines but integrated them outside work instead, facilitating meaningful behaviour change in some specific sitting domains.

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play, respectively. Supervision during break was associated with a significantly lower proportion of learners engaged in vigorous play ($P < 0.04$, 24% vs 28%) and a greater number of learners eating their lunch (17% vs 11%). Finally, learner density (number of learners per area scanned) was significantly and inversely associated with physical activity. Only 17.6% of learners in low density areas were sedentary compared to 49.6% of those in high density areas; conversely 28.2% of learners engaged in vigorous play in low density areas, compared to only 13.5% in high density areas ($P < 0.001$).

Conclusions: Physical activity during break-time in these South African primary schools was adversely affected by over-crowding and teacher supervision. The results suggest that educators were more involved in 'crowd control' than the promotion of physical activity during break-time, and that interventions may be targeted at the school policy environment to reduce these barriers to physical activity.

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Contribution of primary school physical education class to daily moderate-vigorous physical activity

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Introduction: The link between regular physical activity (PA) in childhood and good health is firmly established. However the majority of children do not perform enough PA to maintain good health. There is limited data on the degree to which primary school physical education class (PE) allows children to accumulate moderate-vigorous physical activity. The purpose of the study was to assess the contribution of primary school PE to daily MVPA in 9-year old Irish children.

Methods: 112 (70 F) children had their PA assessed on two school-days using a tri-axial accelerometer. On one day the children had PE, while on the other they did not. The order of the PE day and non-PE day was randomised. Accelerometer PA data was converted to minutes MVPA using the methods of Mattocks et al. (2007). Written informed consent was obtained from the parent/guardian of each child. The study was approved by the relevant institutional review board. T-tests were used to identify differences between PE and non-PE days.

Results: All results are mean, 95% CI. There was a significant difference in minutes of MVPA on PE days (31.1, 29.2–33.1) compared to non-PE days (20.8, 18.9–22.8) ($P < 0.05$). Boys accumulated significantly more minutes MVPA than girls on PE days (33.7, 31.1–36.3, versus 29.6, 26.9–32.3) ($P < 0.05$) but not on non-PE days (21.9, 17.8–26.1, versus 20.2, 18.1–22.3) ($P > 0.05$). The difference in MVPA on PE days compared to non-PE days was greater for boys than girls (11.7, 7.0–16.4, versus 9.4, 7.0–11.8) though not significant ($P > 0.05$). None of the children studied fulfilled current PA recommendations of 60 minutes MVPA per day.

Discussion: Participation in PE class significantly increased the amount of MVPA accumulated by the children in this sample. However the children did not undertake sufficient MVPA to meet current recommended levels for health and therefore warrant intervention.

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After school hours activities of young Australian school children: Low levels of outdoor play and peer interaction

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Introduction: This research was part of a larger study known as the Sydney Playground Project (SPP), which aims to increase physical activity and social skills in primary school children by means of a low-cost innovative playground intervention. The aim of this part of the project was to investigate what children aged 5–7 years in Sydney do after school hours. Our focus was on whether children spent time indoors or outdoors, who they were with, and the parents' perceptions of the children's levels of physical movement, intensity and involvement.

Methods: Experience sampling method (ESM) was used to obtain the data. We asked parents/carers of 221 children, (119 boys, 102 girls; mean age 6.0 years) to keep a palm pilot close by for four week days. On those days, the palm pilot delivered three brief surveys at random times between 1530–1900. The intention of the survey was to find out 'What your child is doing now' and the details of these activities (full details of the protocol can be found at http://www.biomedcentral.com/1471-2458/11/680).

Results: Baseline survey data relating to after school activities indicated 55% of the time was spent indoors in pastimes involving low levels of physical activity. Children were engaged in higher levels of physical activity when outdoors and/or with peers, but these respectively accounted for < 20% and < 10% of survey occasions. The major contributor to children's pastimes was screen time (television or computer, 22%).

Discussion: Our findings are considered in the context of opportunities for children to play outdoors with peers after school hours. We examine some of the pressures on parents and others to keep children safe, which may, paradoxically, lead to children engaging in sedentary pastimes with limited peer interaction, hence increasing the risk of later physical and mental health problems.

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State of the art reviews: The measurement of physical activity using mobile phones

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Introduction: More and more companies are designing technologies that promote healthy lifestyles. In particular, the mobile phone is becoming an increasingly important platform for the delivery of content promoting physical activity. Despite this, little research concerning physical activity assessments via mobile phones providing objective measurements has been carried out. The purpose of this review is to provide an overview of the methods and technology currently being used to measure physical activity patterns.

Methods: The review is based on a full search of the literature identified through a search of PubMed, Web of Science, and IEEE explore between the years 2007–2012. The search was restricted to articles involving the general population containing the following keywords: mobile phone, smartphone, application and exercise or physical activity. Studies selected by the keyword search were considered appropriate for final inclusion if they met the following criteria: Studies with mobile phone applications to promote healthy lifestyle (increase physical activity or decrease sedentary behaviour), specifically measured physical activity as a primary or secondary outcome. Of the initial 33 articles identified by the keyword search, 23 met all the inclusion criteria and were retained for the final review.

Results: The studies analyzed were quite varied; we thus attempted to group and summarize them according to their most salient features. Only 17 studies relied upon internal features of the mobile phone to assess the levels of physical activity. The other 6 studies were focussed on an external sensor device. These 6 studies evaluated the efficacy of this external sensor device that included a self-monitoring component such as a physical activity log or pedometer. The studies evaluated physical activity that included advice or physical activity prescriptions, offered as the sole method. The majority of studies included outcome assessments between 3–12 months, and many of them included some kind of follow-up contact.

Discussion: Newer technologies and approaches being used to promote physical activity include global positioning system, interactive games and the use of camera phones. However, accurate measurement of physical activity involves the use of accelerometers. The availability of these sensors in mass-marketed communication devices creates new opportunities to promote physical activity, a task easier and cheaper in comparison with external sensors. A wide range of applications is also possible. This includes automatic customization of the mobile device's behaviour based upon user activity and generating a daily activity profile to determine if a user is following a healthy activity programme.

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Raw tri-axial acceleration data improves the recognition of physical activity type in children and adolescents

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Introduction: Pattern recognition approaches to accelerometer data reduction have emerged as a viable alternative to conventional regression-based methods. We have previously demonstrated that artificial neural networks (ANNs) can be used to predict children's physical activity type in using processed single axis data (1 Hz) (ActiGraph GT1 M). In the present study, we sought to determine if using features in the raw acceleration signal, from 1 or 3 axes, could improve the performance of our activity type ANN.

Methods: 52 children and adolescents (mean age 13.7 ± 3.1 y, 28 boys, 24 girls) completed 12 activity trials that were categorized into 8 activity classes: lying down, sitting, standing, household chores, walking, running, basketball, and dancing. During each trial, participants wore an ActiGraph GT3X + tri-axial accelerometer on the right hip. We evaluated 4 ANN models: 1) single axis processed data (1 Hz) (ANN_P1); 2) tri-axial processed data (1 Hz) (ANN_P3); 3) single axis raw acceleration signal (30 Hz) (ANN_R1); and 4) tri-axial raw acceleration signal (30 Hz) (ANN_P3). Each ANN model was trained on the following features: 10th, 25th, 50th, 75th, and 90th percentiles and the lag-one autocorrelation. Features were extracted over 10 sec data segments. ANNs were trained, tuned, and tested using a variant of the k-fold cross-validation approach. The nnet library in R was used to implement the ANNs. Accuracy was evaluated by calculating the percentage of time segments correctly classified.

Results: Classification accuracy, averaged over all 8 activity classes, for the ANN_P1, ANN_P3, ANN_R1, and ANN_R3 was 68.6%, 79.3%, 85.1%, and 85.2%, respectively. The ANN_P1 model exhibited acceptable accuracy (>80%) for sitting, walking, running, and basketball, but poor accuracy for lying down (0%), standing (0.1%), household chores (62.4%) and dancing (50.1%). Of note, 85% of the standing time segments were misclassified as sitting. The use of tri-axial processed data (ANN_P3) improved accuracy for standing (57.8%), household chores (79.1%) and dance (81.4%), but had little impact on lying down (0.2%). The ANN_R1 model provided a high level of accuracy for all activity classes (75.9% (household)–96.7% (running)) with the exception of standing (55.1%) and dancing (72.9%). The use of raw tri-axial acceleration signal (ANN_R3) improved the accuracy of these two classes to 58.5% and 76.2%; and only 5% of the standing time segments were misclassified as sitting.

Conclusion: The use of raw tri-axial acceleration data significantly improves the recognition of sitting time and other physical activity types in children.

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Using SenseCam to categorise type and context of accelerometer-identified episodes

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[2] *Auckland University of Technology*
[3] *University of Melbourne*
[4] *University of California San Diego*

Introduction: To investigate the feasibility of wearable cameras to objectively categorise the type and context of participants' accelerometry-identified episodes of activity.

Methods: Adults were given an Actical hip-mounted accelerometer and a SenseCam image capturing device (worn via lanyard). The onboard clocks on both devices were time-synchronised. Participants engaged in free-living activities for 3 days. Accelerometer data were cleaned and exemplar episodes of sedentary, lifestyle-light, lifestyle-moderate, and moderate-to-vigorous physical activity (MVPA) were identified. Using associated SenseCam images, each accelerometer episode was categorised according to its context and Physical Activity (PA) compendium code.

Results: There were 212 days considered from 49 participants from whom SenseCam images and associated accelerometer data were captured. Using SenseCam images, context attributes were coded for 386 randomly selected episodes. Across the exemplar episodes, 12 categories that aligned with the PA Compendium were identified, and 114 subcategory types were identified. 21% of episodes could not be categorized; 59% were outdoors versus 39% indoors; 33% of episodes were recorded as leisure time activities, with 33% transport, 18% domestic, and 15% occupational. 33% of the exemplar episodes contained direct social interaction and 22% were in social situations where the participant wasn't involved in direct engagement.

Conclusions: SenseCam images offer an objective method to capture a spectrum of activity types and context across 79% of accelerometer-identified episodes of activity. Wearable image capture represents the best objective method currently available to and vigorous physical activities. The results are presented in percentage and chi square test was used to indicate association.

RESULTS: Of 535 students evaluated for nutritional status [324 (60.5%) girls and 211 boys (39.5%)], we observed that 23 girls (7.1%) were OW and 11 (3.4%) OB. For boys, 19 (9.0%) were OW and 9 (4.26%) OB. Of 610 students surveyed for physical activity [382 (62.6%) girls and 228 boys (37.4%)], 169 (44%) girls and 69 (30%) boys were considered inactive. The percentages of OW and OB tended to be higher on boys compared to girls ($p<0.05$), although more girls were considered physically inactive than boys ($p<0.05$).

CONCLUSION: Our results demonstrate a small prevalence of overweight, obesity and physical inactivity in the studied population compared to other national and worldwide studies. We speculate that the lifestyle in small cities and town is favorable to healthy habits.

Supported by FAPEMIG.

2093 *Board #288* **June 2** **9:00 AM - 10:30 AM**

Differences in Waist Circumference Among Adults with Varying Inactivity Patterns Stratified by Frequency and Duration

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(No relationships reported)

INTRODUCTION: There is emerging literature that suggests large amounts of inactivity (sitting) time is associated with increased waist circumference (WC) and higher mortality in adults. In 2008, Healy et al. reported the frequency of breaks in inactivity periods was associated with a lower WC in adults. Little is known about differences in waist circumference between adults with varied patterns of inactivity time or periods.

PURPOSE: To compare the WC of adults with varied frequencies of accelerometer determined periods of inactivity, after adjusting for moderate-to-vigorous physical activity (MVPA).

METHODS: Thirty nine adults (**n**=33 women, **n**=6 men), ages 40.5 + 11.8 yrs were randomly selected from 142 participants enrolled in a six month walking study. An ActiGraph GT1M was worn for 7-days at baseline. All participants had 650 to 750 min of total inactivity (cts < 100) on 2-5 days separated into ≥ 5, ≥ 15, ≥ 30, ≥ 45, and ≥ 60 minute periods. The frequency of inactivity periods was stratified as low- or high using a median split. The levels were compared using t-tests, adjusted for moderate-vigorous PA (1952-5724 cts/min).

RESULTS: The mean WC was 87.6 + 14.1cm with no differences observed by frequency of inactivity periods ($p > .05$) for each duration.

CONCLUSIONS: Participants in the study were enrolled in a walking intervention to accumulate > 10,000 steps/day, which may have influenced their inactivity patterns. Also, each inactivity period was not mutually exclusive - shorter inactivity periods also contained longer inactivity periods and participants were represented in each inactivity period. Additional studies are needed to refine inactivity assessment methods and to identify the impact of inactivity on health outcomes in populations with diverse physical activity patterns.

2094 *Board #289* **June 2** **9:00 AM - 10:30 AM**

One-year Changes in Activity and in Inactivity Objectively Measured Among Overweight and Obese Children

Christel Galvani[1], Donatella Magnoni[2], Daniela Ciprandi[1], Serena Turconi[1], Marcello Faina[3]. [1]*Catholic University, Milan, Italy.* [2]*ASL N1[4], Varese, Italy.* [3]*Italian National Olympic Committee, Rome, Italy.*
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(No relationships reported)

Participation in physical activity (PA) during childhood can help to reduce the onset of risk factors associated with ill health. Seasonal influences play a large role in determining PA behaviors. Lack of information about overweight (OW) and obese (OB) children PA and sedentary (SED) behaviors, evaluated during a whole year, has made it difficult to assess appropriate interventions.

PURPOSE: The aim of this study was to objectively measure PA behavior in a sample of 6 to 14 yr-old children in order to investigate seasonal and weekly differences in PA and SED habits.

METHODS: 18 OW and OB children (OW (n=8): age 10,8±1,2 yr; BMI, 21,9±1,4 kg/m²; OB (n=10): age 10±2,1 yr; BMI 25,6±3,2 kg/m²) were monitored during a whole week 4 times in a year with a Actiheart (AH) monitor (Cambridge Neurotechnology, UK), inferring time spent in sedentary (SED, <1.5 METs) or moderate to vigorous (MVPA, >3 METs) intensity. Data presented provide a minimum of four days of 10-h valid recording per week (at least 1 weekend day is included). A Repeated measure ANOVA was used to analyse data and significance was set at $p<0,05$.

RESULTS: A non significant seasonal difference was detected for time spent in MVPA (spring 129,7±82,4; summer 106,7±76,9; fall 93,5±72; winter 82,7±60,3 min/day) causing, on the contrary, a significant seasonal difference in activity energy expenditure (AEE: spring 660,5±188,3; summer 540,8±132,1; fall 538,9±152,5; winter 482,2±136,2 kcal/day; $p<0,05$). A significant seasonal difference was found in SED behavior (spring 436,9±95,6; summer 389,7±81,2; fall 479,2±93,3; winter 473,8±80,1 min/day; $p<0,05$). No significant differences appeared between weekly and weekend days (MVPA: weekdays 100,7±70,1; weekend 110,1±87,8; SED: weekdays 460,6±94,8; weekend 431,6±118,9 min/day). Besides, OW appeared to be more active than OB children (MVPA: OW 122,8±86,2; OB 87,3±60,8 min/day, $p<0,05$).

CONCLUSIONS: The main finding of this study is that AH data, taking activity into account (without loosing water sports or activity), indicate that for OW and OB children activity levels are highest in spring, drop in summer and reach the lowest point in winter. Besides, children do not result to be more active on weekly days than during the weekends as reported by some authors.

Kristensen PL et al. Scand J Med Sci Sports. 2008 Jun;18(3):298-308.

2095 *Board #290* **June 2** **9:00 AM - 10:30 AM**

Occupational Sitting Time, Job Productivity and Related Work Loss in Spanish University Employees

Anna M. Puig-Ribera[1], Iván Martínez-Lemos[2], Maria Giné-Garriga[3], Jesús Fortuño[3], Ángel Manuel González-Suarez[4], Judit Bort-Roig[1], Nick Gilson[5]. [1]*Universitat de Vic, Vic, Barcelona, Spain.* [2]*Universidad de Vigo, Vigo, Spain.* [3]*FPCEE Blanquerna-Universitat Ramon Llull, Barcelona, Spain.* [4]*Universidad del País Basco, Vitoria, Spain.* [5]*University of Queensland, Brisbane, Australia, Australia.*
Email: annam.puig@uvic.cat
(No relationships reported)

PURPOSE: While evidence highlights the negative impact of physical inactivity on job productivity, relationships between sedentary behavior at work and job performance remains unclear. Prior to the beginning of an intervention study to reduce occupational sitting, this study examined associations between sitting at work, job productivity and related work loss.

METHODS: Participants were recruited from four Spanish universities (n=557; 42±16 years old, BMI 24.07±3.7 kg/m², 62% women, 73% working full time, 58% academic). These employees completed a survey measuring time spent sitting at work (domain-specific sitting questionnaire), work performance (Work Limitations Questionnaire, WLQ) and an estimation of work productivity loss based on WLQ data (WLQ Index score). Work performance was identified using three subscales, reflecting ability to meet that day's demands for (i) output (ii) time management and (iii) mental and interpersonal skills. Differences in these subscales and the WLQ index score were compared across sitting time tertiles using ANOVA.

RESULTS: Employees classified in the lower sitting time tertile (113±50 min/day, n=184) showed significantly better skills in dealing with time and scheduling demands at work ($F= 6.9, p=0.001$) compared to employees classified in the upper sitting time tertile (462±69 min/day, n=172). Scores in the WLQ Index indicated that those who sat more at work (462±69 min/day) tended to have a 2% higher productivity loss compared to those who sat less (113±50 min/day; $p=0.061$).

CONCLUSIONS: Preliminary data indicate that levels of sitting at work were associated with the ability to perform specific job demands in our sample. On going work will assess the impact sitting interventions have on employee work performance and job productivity loss.

2096 *Board #291* **June 2** **9:00 AM - 10:30 AM**

Evaluation of the Joint Association of Screen Time and Junk Food Consumption on Childhood Adiposity

Alexander H. Montoye, Heather Hayes, Karin A. Pfeiffer, FACSM, Joe Carlson, Joe C. Eisenmann, Katherine Alaimo, Hye-Jin Paek. *Michigan State University, East Lansing, MI.*
Email: montoyea@msu.edu
(No relationships reported)

Both screen time (ST) and high caloric, low nutrient dense foods (e.g., junk food) are risk factors for obesity. Although several studies have examined the independent associations between these risk factors and obesity, the joint association of ST and junk food consumption (JFC) with adiposity is unknown.

PURPOSE: To determine the joint association of ST and JFC on measures of adiposity in children.

METHODS: 300 (n= 127 males, 173 females) 3rd-5th-grade students (7.3% Caucasian, 32.7% African American, 53.3% Hispanic) from five urban elementary schools in Grand Rapids, MI were analyzed. Body mass index percentiles (BMIPCT) were determined from CDC growth charts. Percent body fat (BF) was assessed by bioelectrical impedance. Television, computer, and video game use were self-reported and summed to obtain ST. A junk food index (JFI) was created based on self-reported consumption frequency of punch, regular and diet soda, frozen desserts, baked desserts, and chocolate candy. Subjects were classified as meeting ST recommendations (≤2 hr/day) or not (> 2hr/day) and as having high or low JFC based on a median split of JFI. Subjects were cross-tabulated into four groups: (G1) met ST recommendations / low JFC (n=51), (G2) met ST recommendations / high JFC (n=32), (G3) did not meet ST recommendations / low JFC (n=124), and (G4) did not meet ST recommendations / high JFC (n=93).

FREE COMMUNICATION/POSTER

APPENDIX V: Training research program grants

- A four years training research program grant, from the Spanish Ministry of Science and Innovation.

- A sub-grant, for conducting a six months internship to the School of Human Movement Studies at the University of Queensland (Australia).

MINISTERIO
DE CIENCIA
E INNOVACIÓN

DIRECCIÓN GENERAL DE INVESTIGACIÓN Y
GESTIÓN DEL PLAN NACIONAL DE I+D+I

SUBDIRECCIÓN GENERAL DE FORMACIÓN E
INCORPORACIÓN DE INVESTIGADORES

REF. PROYECTO: DEP2009-11472
REF. AYUDA: BES-2010-033252
MODALIDAD: TITULADOS

JUDIT BORT ROIG
CALLE BALMES, NUM 4,
43530 ALCANAR
TARRAGONA

Revisada la documentación de su solicitud al Programa de Ayudas FPI convocado por Resolución de 4 de Febrero de 2010 (BOE de 6 de Febrero de 2010), y una vez realizado el proceso de revisión administrativa, le informo que la misma se ha presentado CORRECTAMENTE.

Les ruego a partir de ahora, cite la referencia de la Ayuda arriba indicada en toda comunicación que desee hacernos llegar.

Atentamente,

Madrid a 08 de abril de 2010

Fdo: Israel Marqués Martín
Subdirector General de Formación e
Incorporación de Investigadores

MINISTERIO
DE ECONOMÍA Y
COMPETITIVIDAD

SECRETARÍA DE ESTADO
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DESARROLLO E INNOVACIÓN

SECRETARÍA GENERAL
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CIENTÍFICA Y TÉCNICA

SUBDIRECCIÓN GENERAL
DE RECURSOS HUMANOS PARA LA
INVESTIGACIÓN

TO WHOM IT MAY CONCERN

Since 2010, BORT ROIG, JUDIT has been granted a fellowship of the Spanish Personnel Research Training Programme, whose monthly gross income rises to 1142 € (1501,50 USD)

He/She has applied for an aid for a 180 days stay in AUSTRALIA during the year 2012, and this application has been favourably informed.

The grant for that aid is 10200 € (13410,96 USD) for travel and other expenses, being this aid compatible with the reception of the monthly income provided by his/her fellowship.

During his stay in AUSTRALIA, the fellow will be covered by the insurance policy for accidents and medical assistance signed by the Ministry of Economy and Competitiveness of Spain.

Madrid, April 17 Th 2012

MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD
SUBDIRECCIÓN GENERAL DE RECURSOS HUMANOS PARA LA INVESTIGACIÓN
DIRECCIÓN GENERAL DE INVESTIGACIÓN CIENTÍFICA Y TÉCNICA

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SUBDIRECCIÓN GENERAL DE RECURSOS HUMANOS PARA LA INVESTIGACIÓN

18 ABR. 2012

~~ENTRADA~~
SALIDA Nº 636

Gemma Espinosa Expósito

The Technical Advisor

CORREO ELECTRONICO
becasfpi@mineco.es

Ramirez de Arellano, nº 29.
28043-Madrid
TEL.: 915837400

APPENDIX VI: Internship justification

MINISTERIO
DE ECONOMÍA Y
COMPETITIVIDAD

SUBDIRECCION GENERAL DE
RECURSOS HUMANOS PARA LA
INVESTIGACION

CERTIFICADO DE REALIZACIÓN DE ESTANCIA BREVE

Apellidos, nombre: Bort Roig, Judit	NIF/NIE: 78583093 H
Referencia de la ayuda: EEBB-	Referencia del proyecto:

ORGANISMO: UNIVERSITY OF QUEENSLAND
CENTRO: HUMAN MOVEMENT STUDIES
DEPARTAMENTO: PHYSICAL ACTIVITY AND HEALTH
PAÍS: AUSTRALIA

El abajo firmante certifica que el/la investigador/a en formación a quien se refiere el presente documento ha permanecido en el centro de trabajo desde el día 28 de junio de 2012 hasta el día 23 de dic de 2012 (*)

Nombre y apellidos del firmante; DR NICHOLAS GILSON

Cargo: SENIOR LECTURER.

Fecha: 29.11.12.

Firma y sello

THE UNIVERSITY OF QUEENSLAND
School of Human Movement Studies
Level 5, Building 26
University of Queensland
Brisbane Qld 4072 Australia

(*) TO BE COMPLETED BY THE HOST RESEARCH DIRECTOR
The undersigned certifies that the scholar has remained in this centre from (day) of (month) of 201- until (day) of (month) of 201-

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