

A Healthier Workplace

How employers can reduce
physical inactivity

A Nuffield Health White Paper commissioned by Sport England



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Introduction

Increasing physical activity is one of the most powerful interventions known for improving public health. At present, a third of working-age adults do not meet the Chief Medical Officer's recommendation for 150 weekly minutes of moderate intensity exercise, and over half of those spend less than 30 minutes a week being active.

More than two-thirds of adults spent at least two hours a day watching TV or using a computer.

Physical inactivity is particularly concentrated among lower socioeconomic groups; those in the bottom quintile of the office for National Statistics' Index of Multiple Deprivation (IMD) are twice as likely as those in the top to be inactive. The most disadvantaged suffer a significantly higher incidence of cardiovascular disease, type 2 diabetes and some cancers.

Physical inactivity is related but not equivalent to sedentary behaviour. There is now growing evidence to suggest that sedentary behaviour may be an independent risk factor for health.

In today's knowledge economy, it is estimated that up to 80% of a typical working day can be spent in a seated position.

Equally, standing all day is not the same thing as physical activity, and many retail or manual workers are not meeting the recommended targets for physical exercise.

"Our working world has changed over the past 60 years as the proportion of jobs involving production have more than halved. Car ownership has more than doubled."
- Davina Deniszczyc, Charity Director and Medical Director (primary care), Nuffield Health.

This decline in manual labour and active commuting has had a significant effect on the amount of physical activity performed in our daily routine – and one that is hard to compensate for purely in leisure time. Physical inactivity can have real business and economic consequences. Workplace sickness alone is estimated to cost the economy in England £5.5bn a year.

Physically active employees have lower levels of absenteeism or presenteeism, greater efficiency, and are less likely to suffer from stress or depression.

To provide employers with up-to-date guidance, Sport England commissioned Nuffield Health to produce this white paper, collating the latest evidence and best practice on:

- » Which interventions work to increase physical activity and reduce sedentary behaviour in a workplace context.
- » What interventions work with under-represented groups who are particularly likely to be inactive, such as female workers or lower socioeconomic groups.
- » What are the potential challenges and facilitators when it comes to practically implementing these recommendations.

The following pages outline how we approached this task and our findings. It represents an overview of the interventions that UK employers might wish to consider when looking to support their employees in leading healthier, more active working lives.

Definitions used

Physical activity is defined as activity that requires a significant level of physical energy (eg running or dancing) this raises your heartrate and makes breathing harder.

Sedentary behaviour, is defined as long periods of being fully sedentary (eg sitting or lying down).

By **under-represented groups**, we are referring to groups such as female workers, lower socioeconomic groups or those with lower levels of educational attainment. Many of these are at higher risk of physical inactivity.

Metabolic Equivalent (MET) is the amount of energy required to perform an activity, with being at rest benchmarked at one.

A result is **statistically significant** if it unlikely to have occurred given the null hypothesis, which is designed to represent we would expect from random chance. Statistical significance, however, is not the same thing as clinical significance. It does not tell us about the magnitude of the effect.

Interventions are classified as having **strong evidence** when more than 66% of relevant studies find a statistically significant difference in physical activity or sedentary behaviour associated with the intervention versus a control group.

Interventions are classified as having **moderate evidence** when 50-65% of relevant studies find a statistically significant difference in physical activity or sedentary behaviour associated with the intervention versus control group.

Interventions are classified as having **weak evidence** when less than 50% the of relevant studies find a statistically significant difference in physical activity or sedentary behaviour associated with the intervention versus a control group.

Executive Summary

To better understand the current evidence base on workplace interventions to increase physical activity, Nuffield Health systematically searched the literature, narrowing down a long list of **3809 studies** to 107 relevant, recent evidence-based studies. A full list is available in the appendix.

Out of these **107 studies**, Nuffield Health identified 12 types of intervention that had been studied: 10 individual interventions, as well another **51 studies** that investigated multicomponent interventions, dividing these between those that included an online element and those that were offline only.

Nuffield Health judged interventions to have a strong evidence base where more than 66% of studies found a statistically significant effect, and a moderate evidence base where **50-65% of studies** found a significant effect.

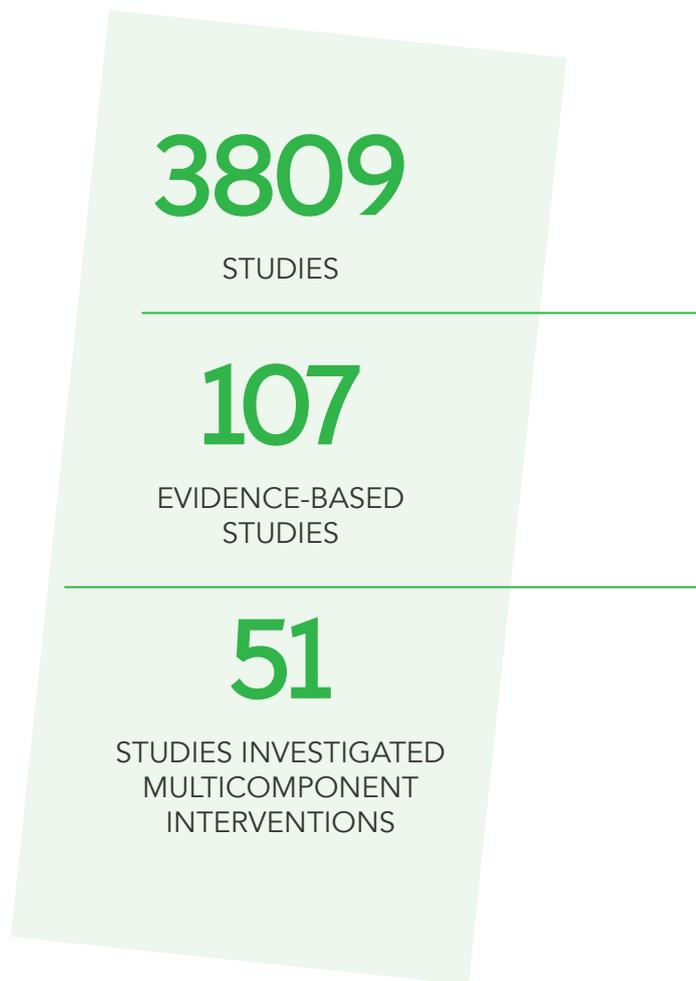
The assessment of these interventions, outlined on page 7, identified four interventions with strong evidence; four with moderate evidence and a further four with weak evidence of efficacy.

In short, there is good evidence that employers can make a difference to the physical activity and sedentary behaviour of their workforce. This review suggests that sedentary behaviour may be easier to influence than physical activity, with both active desks and activity prompts potentially showing effective results.

Nevertheless, there is also good evidence that group support and providing exercise facilities, both on and off the worksite, can be effective. Multicomponent interventions, particularly those that included an online element, also had good evidence for effectiveness.

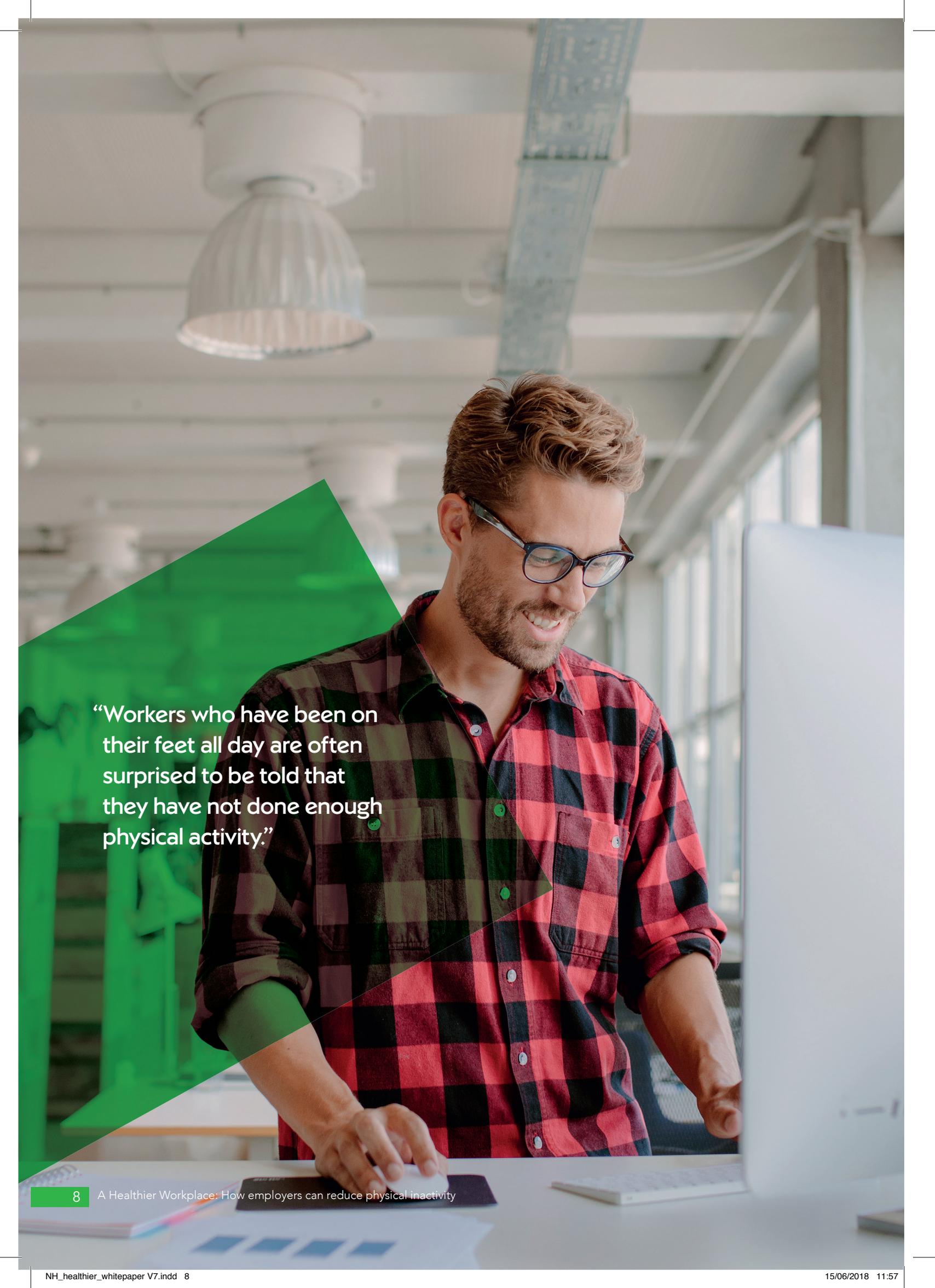
There is weak evidence for the effectiveness of written information when combined with any other intervention.

There is much less specific evidence on the impact of workplace interventions for under-represented groups, such as those with low levels of education or income. Nevertheless, the evidence that is available suggests a similar approach to that followed for employees is likely to work: there is reasonable evidence to suggest that supervised exercise, group support, and multicomponent interventions can be effective.



Interventions aimed at increasing physical activity

- 1) **Unsupervised exercise including walking.** Employees are encouraged or provided resources to take part in unsupervised exercise at onsite facilities, or designated walking routes. **Moderate evidence of effectiveness.**
- 2) **Worksite supervised exercise classes.** A fitness professional delivered exercise class at the worksite. **Strong evidence of effectiveness.**
- 3) **Supervised exercise classes off worksite.** A fitness professional delivered exercise class not at the worksite. **Moderate evidence of effectiveness.**
- 4) **Group support.** Organised group sessions where employees come together for health education, to monitor progress, agree physical activity goals or identify challenges to change. **Strong evidence of effectiveness.**
- 5) **Incentives.** Providing employees with value rewards for behaviour. **Insufficient evidence;**
- 6) **Individual coaching.** Participants receive one-to-one coaching to increase physical activity. **Insufficient evidence.**
- 7) **Activity prompts.** Software, email or other messages encouraging breaks in extended sedentary time. **Moderate evidence of effectiveness.**
- 8) **Active desks.** Sit-stand desks / treadmill desks added to the working environment to encourage reductions in sedentary time. **Strong evidence of effectiveness.**
- 9) **Written health education.** Print-based written content that provides advice on how to achieve reductions in sitting time or increases in physical activity such as posters or booklets. **Weak evidence of effectiveness.**
- 10) **Web based interventions.** Utilising online support such as websites, apps, and or emails to encourage behaviour change. **Moderate evidence of effectiveness.**
- 11) **Offline only multicomponent interventions.** Combining multiple of the above and other offline individual interventions to increase physical activity or reduce sedentary behaviour. **Weak evidence of effectiveness.**
- 12) **Online & Offline Multicomponent Interventions.** Combining both online and offline interventions to increase physical activity or reduce sedentary behaviour. **Strong evidence of effectiveness.**

A man with short brown hair and glasses, wearing a red and black plaid shirt, is smiling and looking at a computer monitor in a modern office. He is standing at a desk, with his hand on a mouse. The office has large windows, a white ceiling with a light fixture, and a blue metal structure. A large green triangle is overlaid on the left side of the image.

“Workers who have been on their feet all day are often surprised to be told that they have not done enough physical activity.”

Key recommendations for putting this into practice

To sense check the findings, Nuffield Health organised a series of workshops with leading employers. We wanted to hear their experience of the challenges and opportunities of putting some of these interventions into practice. The employers Nuffield Health spoke to stressed;



The importance of culture

Leadership should come from the top, but often there is a reluctance in leadership to intrude on their workers, personal lives.



Every workplace is different

Activity desks and on-site exercise classes can work for office workers, but factory workers often don't have that flexibility and are already standing for much of the day.



Details matter

Active desks may reduce sedentary behaviour, but without adequate guidance employees may stand for too long, proving counterproductive.



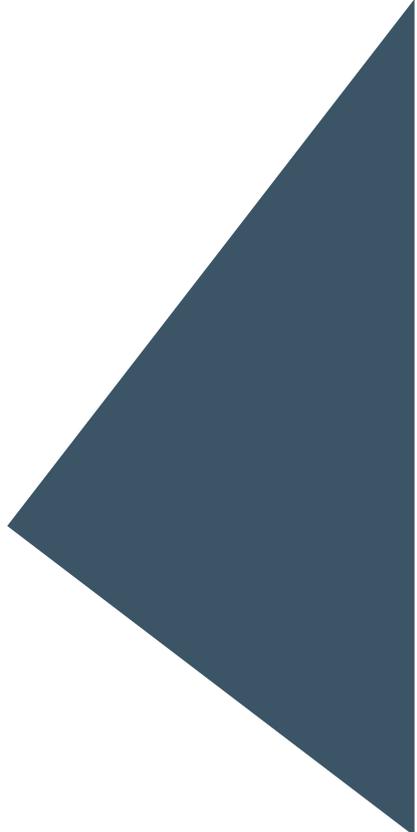
Providing information can be surprisingly powerful

Workers who have stood on their feet all day in a shop or factory, are often surprised to be told that they still have not done enough physical activity.



There is limited understanding of the difference between reducing physical inactivity and sedentary activity

Many of the employers involved in the research had seen strong results from health kiosks providing employees with basic data on blood pressure, body fat and BMI.



The importance of physical activity

Increasing physical activity is one of the most powerful interventions known for improving public health. Low physical activity is one of the top 10 leading causes of disease and disability in England¹ while globally it is estimated to be responsible around **6% of deaths**, the fourth highest risk factor for global mortality.²

While the recommendations from the World Health Organization (WHO) and the UK Chief Medical Officer suggest that adults should be active for at least two and a half hours per week, significant benefits come from even very low levels of exercise. One estimate suggests that if, in the UK, the activity of those currently inactive was increased by that low level it would prevent one in six deaths.⁴

By exercising your cardiovascular, musculoskeletal and motivational systems, regular physical activity causes those systems to become more efficient, and reduces the risk of³

- ☠ All-cause mortality by 30%
- ♥ Cardiovascular disease by up to 35%
- 💧 Type 2 diabetes by up to 40%
- 👤 Breast cancer by 20%
- 📄 Colon cancer by 30%
- 🧠 Depression by up to 30%
- 🦴 Hip fractures by up to 68%
- ⚙️ Dementia by up to 30%

Scientifically, physical activity is defined as “any bodily movement produced by skeletal muscles that requires energy expenditure”, and measured by its Metabolic Equivalent (MET), or the amount of energy required to perform it.

While most attention in public policy has focussed on increasing the quantity of physical activity, there is also growing evidence to suggest that extended periods of being fully sedentary – sitting or lying down – may be an independent risk factor for health. In other words, it is not enough to go to the gym every evening if you spend the rest of the day not moving from your seat.

At present, data from the 2016 Health Survey suggests that a third (33%) of English working-age adults fail to meet the aerobic guidelines for 150 minutes of moderate intensity exercise (see **Figure 1, Page 12**).

Even among those meeting the aerobic guidelines, more than half do not meet the muscle-strengthening guidelines. Overall, just 34% of working-aged men and 27% of working-aged women meet both recommendations (see **Figure 2, Page 12**).

¹ Public Health England, Health matters: getting every adult active every day, 2016, <https://www.gov.uk/government/publications/health-matters-getting-every-adult-active-every-day/health-matters-getting-every-adult-active-every-day>, (accessed 14 February 2018).

² Department of Health, Start Active, Stay Active: A report on physical activity for health from the four home countries' Chief Medical Officers, 2011, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf, (accessed 14 February 2018).

³ Public Health England, Health matters: getting every adult active every day, 2016, <https://www.gov.uk/government/publications/health-matters-getting-every-adult-active-every-day/health-matters-getting-every-adult-active-every-day>, (accessed 14 February 2018).

⁴ Public Health England, Health matters: getting every adult active every day, 2016, <https://www.gov.uk/government/publications/health-matters-getting-every-adult-active-every-day/health-matters-getting-every-adult-active-every-day>, (accessed 14 February 2018).

How physically active are we?

For working aged adults, the UK Chief Medical Officer sets four key recommendations⁵

“Adults should aim to be active daily. Over a week, activity should add up to at least 150 minutes (Two and a half hours) of moderate intensity activity in bouts of ten minutes or more – one way to approach this is to do 30 minutes on at least five days a week.”



“Alternatively, comparable benefits can be achieved through 75 minutes of vigorous intensity activity spread across the week or a combination of moderate and vigorous intensity activity.”



“Adults should also undertake physical activity to improve muscle strength on at least two days a week.”



“All adults should minimise the amount of time spent being sedentary (sitting) for extended periods.”



As a rough guide:

Being at rest is benchmarked as a MET of 1;

Light activities are those such as ironing (2.3), cleaning (2.5) or a stroll (2.5);

Moderate activities are those like painting (3), hoovering (3.5) or playing golf (4.3);

Vigorous activities are those like aerobic dancing (6.5), singles tennis (8) or running a mile in 10 minutes (10).

⁵ Department of Health, Start Active, Stay Active: A report on physical activity for health from the four home countries' Chief Medical Officers, 2011, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf, (accessed 14 February 2018).

Figure 1: Summary of activity by age (%)

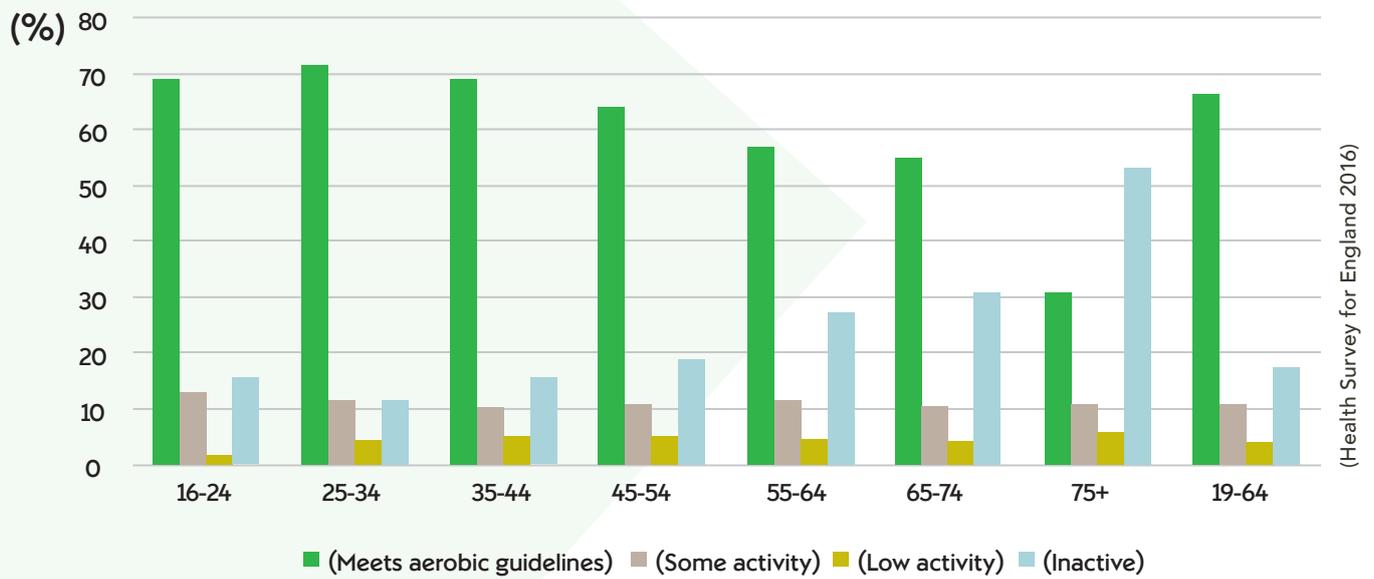
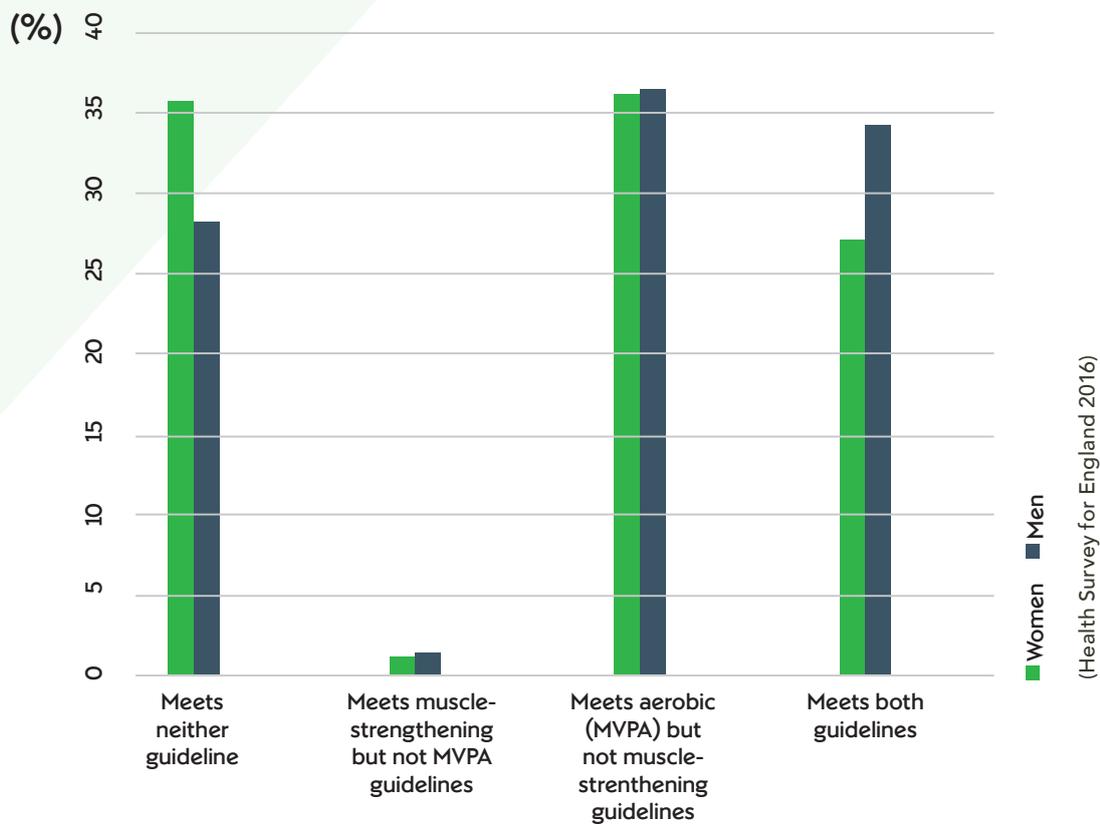


Figure 2: Working age adults aged (19-64) meeting physical activity recommendations (%)





“At present, data from the 2016 Health Survey suggests that a third of working-age adults fail to meet the aerobic guidelines for 150 minutes of moderate intensity exercise.”

Levels of physical inactivity may be even higher than this. While official statistics are largely based on self-reported data, individuals tend to overestimate their levels of physical activity. More objective measures, based on technological or accelerometry data suggests that only 6% of men and 4% of women may meet the target levels of activity.⁶

There is not yet enough scientific data to set quantitative thresholds for unsafe levels of sedentary behaviour. It is known that both genders spend on average between three to six hours per day performing sedentary activities where they are sat or lying down (see Figure 3). More than two-thirds of adults spent at least two hours a day watching TV or using a computer.⁷

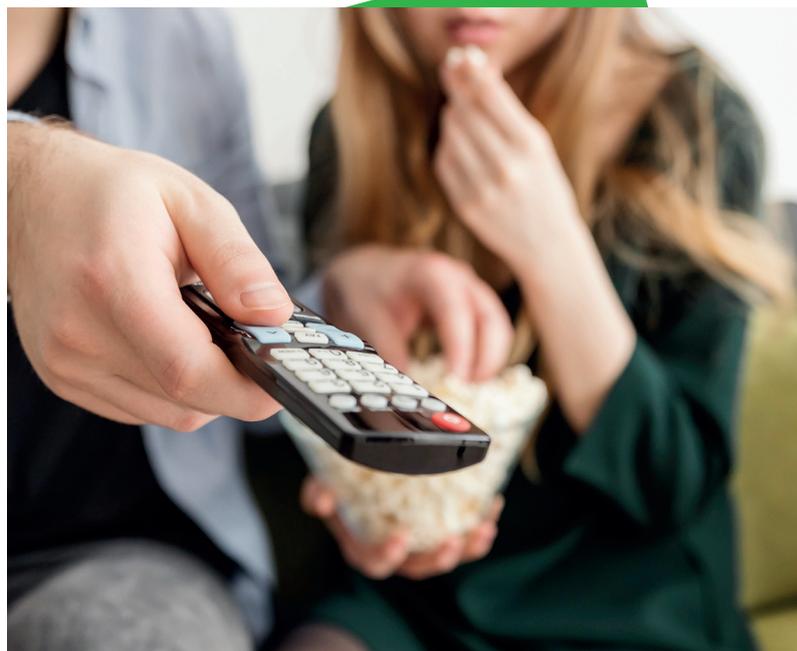


Figure 3: Median sedentary time per day broken down by working week and gender (%)

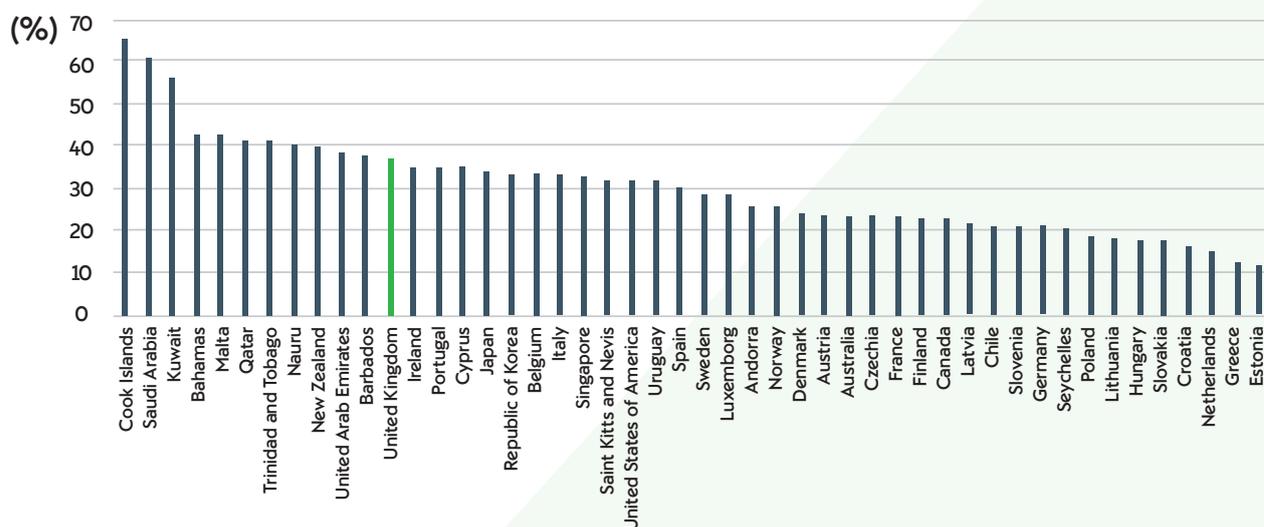


⁶ Department of Health, Start Active, Stay Active: A report on physical activity for health from the four home countries' Chief Medical Officers, 2011, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf, (accessed 14 February 2018).

⁷ Department of Health, Start Active, Stay Active: A report on physical activity for health from the four home countries' Chief Medical Officers, 2011, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf, (accessed 14 February 2018).

Compared to other higher-income countries, WHO data (shown in figure 4) suggests that a relatively high proportion of the UK population is insufficiently active.

Figure 4: Comparative national index of insufficiently active (%)
Age-standardised estimate, 2010, WHO

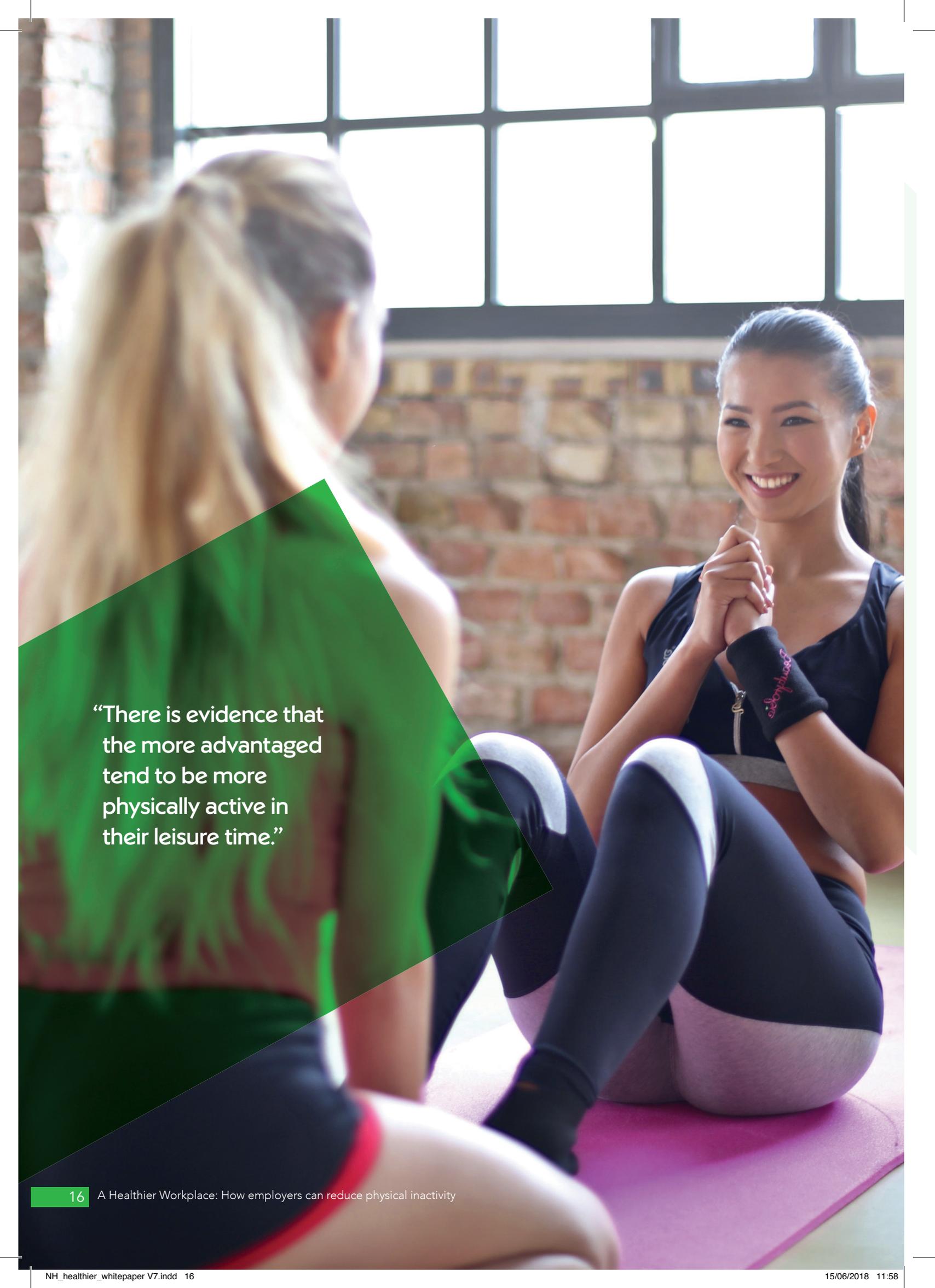


Physical inactivity is particularly concentrated among lower socioeconomic groups. Those in the bottom quintile of the Office for National Statistics' (ONS) Index of Multiple Deprivation are twice as likely as those in the top to be inactive (see Figure 7, Page 17).

While the relationship between workplace activity and socio-economic status is complicated – many blue collar workers spend much of their work standing up, and there does not seem to be a significant differences in the likelihood of active commuting – there is evidence that the more advantaged tend to be more physically active in their leisure time.

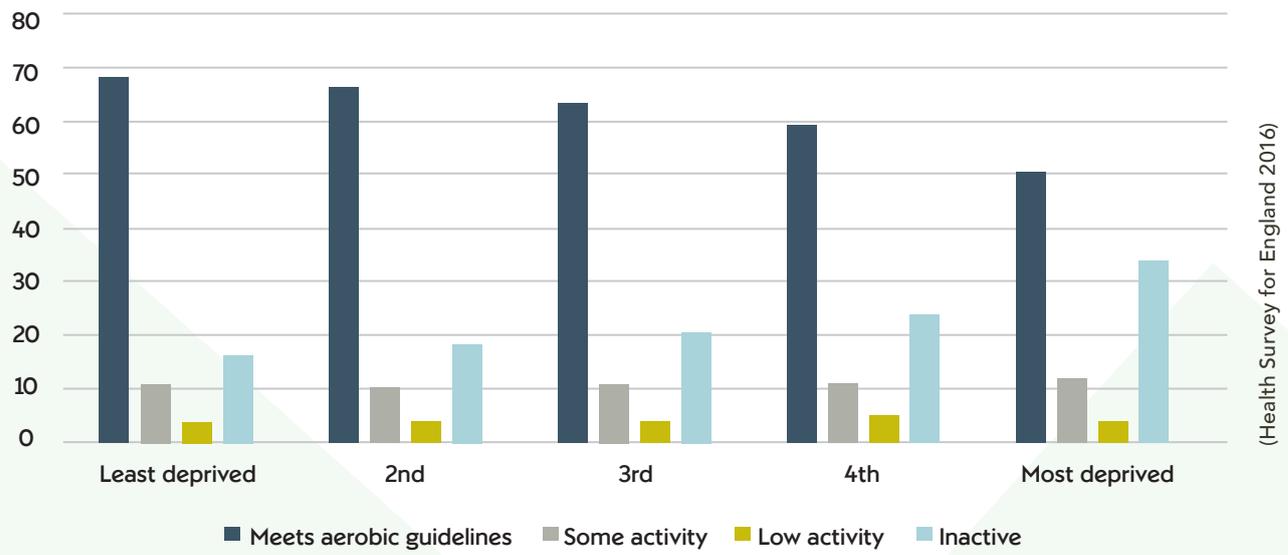
This is one significant driver behind the sharp distinctions in healthy living expectancy experienced by different socio-economic groups. Men living in the bottom 10% of areas ranked by deprivation live 9 fewer years than those who live in the top 10%, while women live 7 fewer years.⁸ The most disadvantaged suffer a significantly higher incidence of cardiovascular disease, type 2 diabetes and some cancers.

⁸ Public Health England, Health profile for England, 2017, <https://www.gov.uk/government/publications/health-profile-for-england/chapter-5-inequality-in-health>, (accessed 14 February 2018).



“There is evidence that the more advantaged tend to be more physically active in their leisure time.”

Figure 5: Summary of activity level by ONS Index of multiple deprivation (%)





⁹ HM Government, Saving Lives: Our Healthier Nation, 1999, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265576/4386.pdf, (accessed 14 February 2018).

¹⁰ HM Government, A Sporting Future for All, 2000, <http://www.lrsersa.org/old/modernisation/sportfutureforall.pdf>, (accessed 14 February 2018).

¹¹ HM Government, Moving More, Living More: The Physical Activity Olympic and Paralympic Legacy for the Nation, 2014, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/279657/moving_living_more_inspired_2012.pdf, (accessed 14 February 2018).

¹² HM Government, Sporting Future: A New Strategy for an Active Nation, 2015, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486622/Sporting_Future_ACCESSIBLE.pdf, (accessed 14 February 2018).

¹³ Sport England, Sport England: Towards an Active Nation, 2016, <https://www.sportengland.org/media/10629/sport-england-towards-an-active-nation.pdf>, (accessed 14 February 2018).



The evolution of government policy on physical activity

While the importance of physical activity for health has been understood for some times, the current threshold of 150 weekly minutes of moderate-intensity activity was not specified until a joint publication by the Centers for Disease Control (CDC) and American College of Sports Medicine (ACSM) in 1995.⁹

These guidelines were rapidly adopted by the WHO and other countries, with the UK matching suit in the 1996 Strategy Statement on Physical Activity and the 1999 White Paper Saving Lives: Our Healthier Nation.

This was followed by a new sports strategy in 2000 with A Sporting Future for All¹⁰ and by the 2004 Game Plan, which broadened out the focus from improving elite performance to tackling the health and economic burden created by the UK's relatively low level of physical activity.

Game Plan's headline target was an ambition for 70% of the population to achieve 150 minutes of moderate activity by 2020. The current self-reported rate for over 16-year-old adults meeting this is 62%, suggesting this goal is unlikely to be met.

Over the last decade, increasing physical activity has grown in prominence in the public health policy agenda. As part of the legacy of the 2012 Olympics, the Government pledged to create "a much more physically active nation", setting out a new goal in 2012 to "have a year-on-year increase in the number of adults doing 150 minutes of exercise per week (in bouts of 10 minutes or more) and a year-on-year decrease in those who are inactive."¹²

In 2015, the Government published a new sporting strategy Sporting Future: **A New Strategy for an Active Nation**, which introduced a new outcomes-based framework and a broadened focus on all physical activity, rather than just participation in sport.

Responding to this, Sport England's current five-year strategy Sport England: Towards an Active Nation has allocated 25% of its resources to tackling physical inactivity, stressing the need to ensure that everyone feels comfortable taking part in part in physical activity, "regardless of age, background or level of ability."¹³

This includes a new focus on under-represented groups such as women, the elderly, disabled people and lower socio-economic groups.

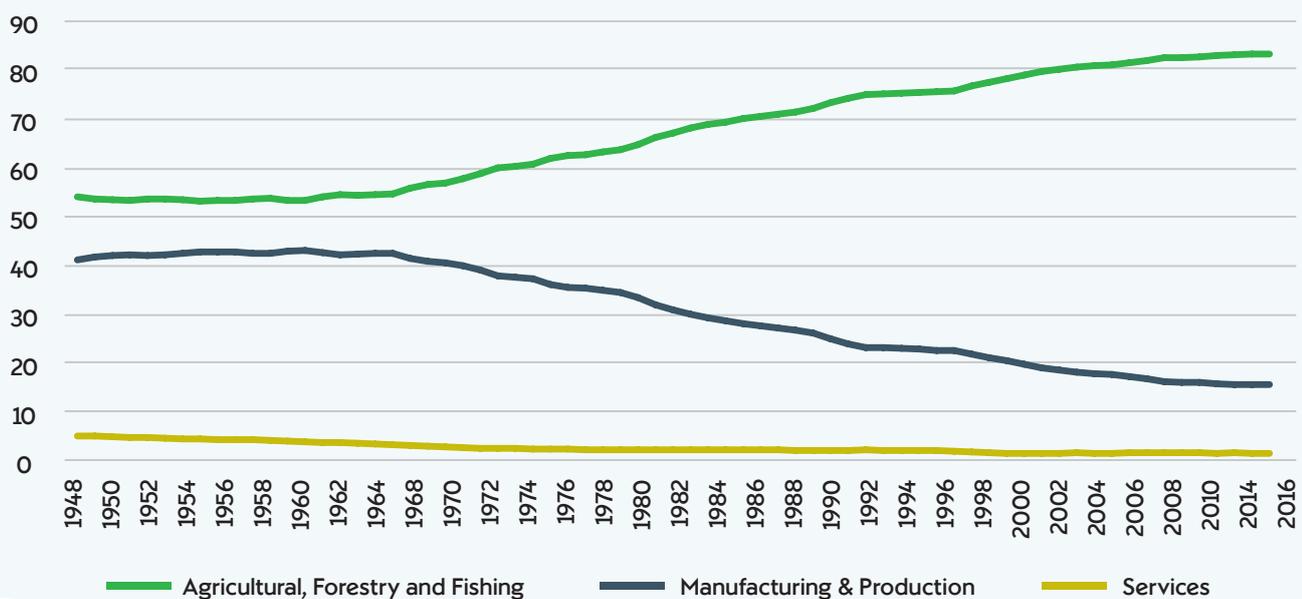
The role of employers

Over the past 60 years, production jobs have decreased from 42% to 15%.¹⁴ While car ownership has more than doubled from 31% to 75%.¹⁵ In today's knowledge economy, it is estimated that up to 80% of a typical workday can be spent in a seated position, with the average European employee spending around five hours per day sedentary at work.

The decline in manual labour and active commuting has had a significant effect on the amount of physical activity someone undertakes in their daily routine – and one that is hard to compensate for purely in leisure time. Compared to the 1960s, a UK citizen is now fifth less active, and on current trends are estimated to be a third less active again by 2030.¹⁶

Physical inactivity can have real business and economic consequences. Physically active employees have lower levels of absenteeism or presenteeism, lower efficiency, and are less likely to suffer from stress or depression. Workplace sickness alone is estimated to cost the economy in England £5.5bn a year.¹⁸

Figure 6: Employment share by industry (%)¹⁷



(Health Survey for England 2016)

¹⁴ Thomas, R and Dimsdale, N, A Millennium of UK Data, Bank of England OBRA dataset, <http://www.bankofengland.co.uk/research/Pages/onebank/threecenturies.aspx>, (accessed 14 February 2018).

¹⁵ Public Health England, Health matters: getting every adult active every day, 2016, <https://www.gov.uk/government/publications/health-matters-getting-every-adult-active-every-day/health-matters-getting-every-adult-active-every-day> (accessed 14 February 2018).

¹⁶ Public Health England, Health matters: getting every adult active every day, 2016, <https://www.gov.uk/government/publications/health-matters-getting-every-adult-active-every-day/health-matters-getting-every-adult-active-every-day> (accessed 14 February 2018).

¹⁷ Thomas, R and Dimsdale, N, A Millennium of UK Data, Bank of England OBRA dataset, <http://www.bankofengland.co.uk/research/Pages/onebank/threecenturies.aspx>, (accessed 14 February 2018).

¹⁸ Department of Health, Start Active, Stay Active: A report on physical activity for health from the four home countries' Chief Medical Officers, 2011, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf, (accessed 14 February 2018).

¹⁹ NICE, Physical activity in the workplace, 2008, <https://www.nice.org.uk/guidance/ph13/chapter/1-Recommendations>, (accessed 14 February 2018).



“ Workplace sickness alone is estimated to cost the economy in England £5.5bn a year. “

To provide employers with up to date guidance, Sport England commissioned Nuffield Health to collate evidence, collating the latest and best practice on improving workplace wellbeing:



1) Which interventions work to increase physical activity and reduce sedentary behaviour in a workplace context?

Nuffield Health compiled an up to date systematic review of the scientific literature on workplace interventions to reduce physical inactivity and sedentary behaviour;



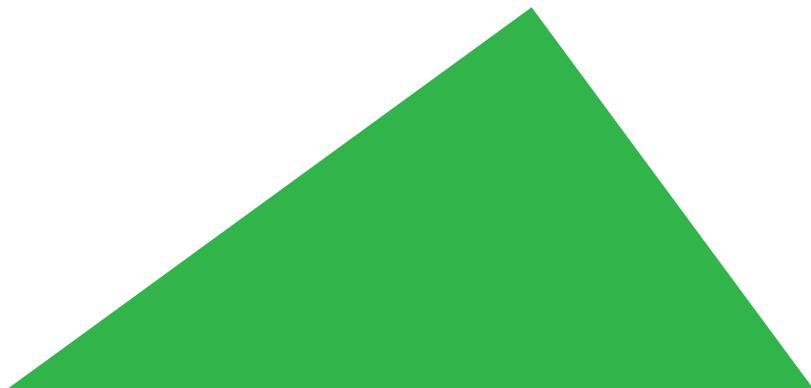
2) What interventions work with underserved groups who are particularly likely to be inactive, such as female workers or lower socio-economic groups?

While previous evidence reviews exist for increasing physical activity in the workplace none have focussed specifically on the needs of underserved groups;



3) What are the potential challenges and facilitators when it comes to practically implementing these recommendations?

After developing our short list of interventions, Nuffield Health ran a series of workshops consulting with leading employers on their own experiences of trying to encourage greater employee physical activity.



NICE recommendations on physical activity in the workplace

The National Institute for Health and Care Excellence (NICE), the Government's agency responsible for collating scientific evidence and developing official public health guidance, has set out its own recommendations for how employers can increase physical activity in the workplace.¹⁹

This outlines:

- 1) Policy and planning.** Develop an organisation-wide plan or policy to encourage and support employees to be more physically active. This should:
 - » include measures to maximise the opportunity for all employees to participate;
 - » be based on consultation with staff and should ensure they are involved in planning and design, as well as monitoring activities, on an ongoing basis;
 - » be supported by management and have dedicated resources;
 - » set organisational goals and be linked to other relevant internal policies (for example, on alcohol, smoking, occupational health and safety, flexible working or travel);
 - » link to relevant national and local policies (for example, on health or transport).

2) Implementing a physical activity programme.

Introduce and monitor an organisation-wide, multi-component programme to encourage and support employees to be physically active. This could be part of a broader programme to improve health. It could include:

- » flexible working policies and incentive schemes;
- » policies to encourage employees to walk, cycle or use other modes of transport involving physical activity (to travel to and from work and as part of their working day);
- » the dissemination of information (including written information) on how to be more physically active and on the health benefits of such activity. This could include information on local opportunities to be physically active (both within and outside the workplace) tailored to meet specific needs, for example, the needs of shift workers;
- » ongoing advice and support to help people plan how they are going to increase their levels of physical activity;
- » the offer of a confidential, independent health check administered by a suitably qualified practitioner and focused on physical activity.

3) Components of the physical activity.

Encourage employees to walk, cycle or use another mode of transport involving physical activity to travel part or all the way to and from work (for example, by developing a travel plan). Help employees to be physically active during the working day by:

- » where possible, encouraging them to move around more at work (for example, by walking to external meetings);
- » putting up signs at strategic points and distributing written information to encourage them to use the stairs rather than lifts if they can;
- » providing information about walking and cycling routes and encouraging them to take short walks during work breaks; encouraging them to set goals on how far they walk and cycle and to monitor the distances they cover.

Employers should take account of the nature of the work and any health and safety issues. For example, many people already walk long distances during the working day, while those involved in shift work may be vulnerable if walking home alone at night.

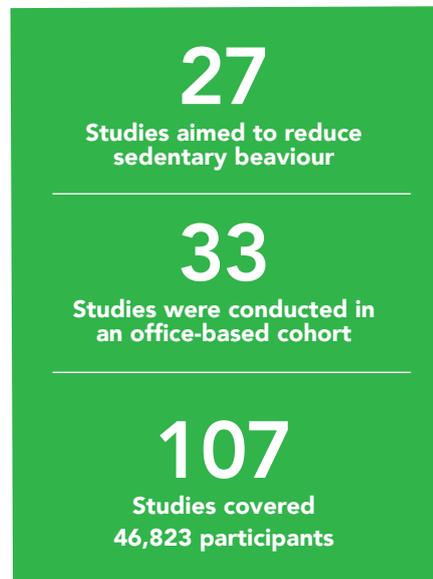


Review method and findings

What is the evidence base?

To better understand the current evidence base on workplace interventions to increase physical activity, Nuffield Health systematically searched six electronic databases (Medline, Embase, AMED, The Cochrane Library, The King’s Fund and DH-Data) for eligible studies, narrowing down a long list of 3809 studies to 107 that met the full eligibility criteria.

The full methodology and criteria are set out in Appendix A.



In aggregate, the final list of **107 relevant studies** covered:

<p>Focus. 27 studies aimed to reduce sedentary behaviour specifically and the remaining 80 studies focussed on promoting physical activity;</p>	<p>Country. 38 studies conducted in the USA; 12 in the UK; 10 in Australia; six each in Denmark and the Netherlands; four in Belgium; three each in Canada, Finland, Germany and Japan; two each in Spain, Taiwan and Sweden; and one study in Brazil, France, Iran, New Zealand, Norway, Portugal, Singapore, South Africa and Switzerland. Four studies included data from more than one country;</p>
<p>Type of work. 33 studies were conducted in an office-based cohort and a further 22 based in an education setting (eg school or university). Sixteen studies were conducted in healthcare staff, six in factory-based staff, three in manual workers (eg construction) and one in retail or service staff;²⁰</p>	<p>Methodology. 69 randomised-controlled trials, 17 quasi-experimental studies, 14 cluster randomised controlled trials, four randomised crossover trials and three controlled trials;</p>
<p>Size. In total, the 107 studies covered 46,823 participants, with sample sizes ranging from 10 to 9,786 participants;</p>	<p>Reporting. 53 studies using self-report methods (eg questionnaires), while 54 used objective measures (eg physical activity monitors or physiological tests).</p>



On which interventions does evidence exist?

Out of these 107 studies, 10 types of individual intervention that had been studied were identified, and another 51 studies that looked at multicomponent interventions:

Interventions aimed at increasing physical activity:

<p>1) Unsupervised exercise including walking. Employees are encouraged or provided resources to take part in unsupervised exercise at onsite facilities, or designated walking routes;</p>	<p>4) Group support. Organised group sessions where employees come together for health education, to monitor progress, agree physical activity goals or identify Challenges to change;</p>
<p>2) Worksite supervised exercise classes. A fitness professional delivered exercise class at the worksite;</p>	<p>5) Incentives. Providing employees with valued rewards for behaviour;</p>
<p>3) Supervised exercise classes off worksite. A fitness professional delivered exercise class not at the worksite;</p>	<p>6) Individual Coaching. Participants receive one-to-one coaching to increase physical activity.</p>

²⁰ Nuffield Health could not classify the setting in 26 studies as the samples included participants with varying occupations, for example, a trial based in a large, distributed organisation containing multiple functions.

Interventions aimed at reducing sedentary behaviour;

<p>7) Activity prompts. Software, email or other messages encouraging breaks in extended sedentary time.</p>	<p>9) Written health education. Print-based written content that provides on how to achieve reductions in sitting time or increases in physical activity such as posters or booklets.</p>
<p>8) Active desks. Sit-stand desks / treadmill desks added to the working environment to encourage reductions in sedentary time.</p>	<p>10) Web based interventions. Utilising online support such as websites, apps, and or emails to encourage behaviour change.</p>

Multicomponent interventions

<p>7) Activity prompts. Software, email or other messages encouraging breaks in extended sedentary time.</p>	<p>9) Written health education. Print-based written content that provides on how to achieve reductions in sitting time or increases in physical activity such as posters or booklets.</p>
<p>11) Offline Only Multicomponent Interventions. Combining multiple of the above and other offline individual interventions to increase physical activity or reduce sedentary behaviour.</p>	<p>12) Online + Offline Multicomponent Interventions. Combining both online and offline interventions to increase physical activity or reduce sedentary behaviour.</p>

Which interventions work?

Nuffield Health judged an intervention to have strong evidence if more than **66%** of relevant studies found a statistically significant effect compared to a control group where no intervention was used.

Nuffield Health classify studies where a significant effect is found as 'Association +', and other studies as 'Association -'. If between 50% and 66% of studies found a significant effect, the study assessed the intervention to have moderate evidence, and anything below was classified as weak evidence. The complete list of studies, classified by intervention is included in **Appendix 2**, and they have been graphically summarised the findings in **Figure 7, Page 29**.

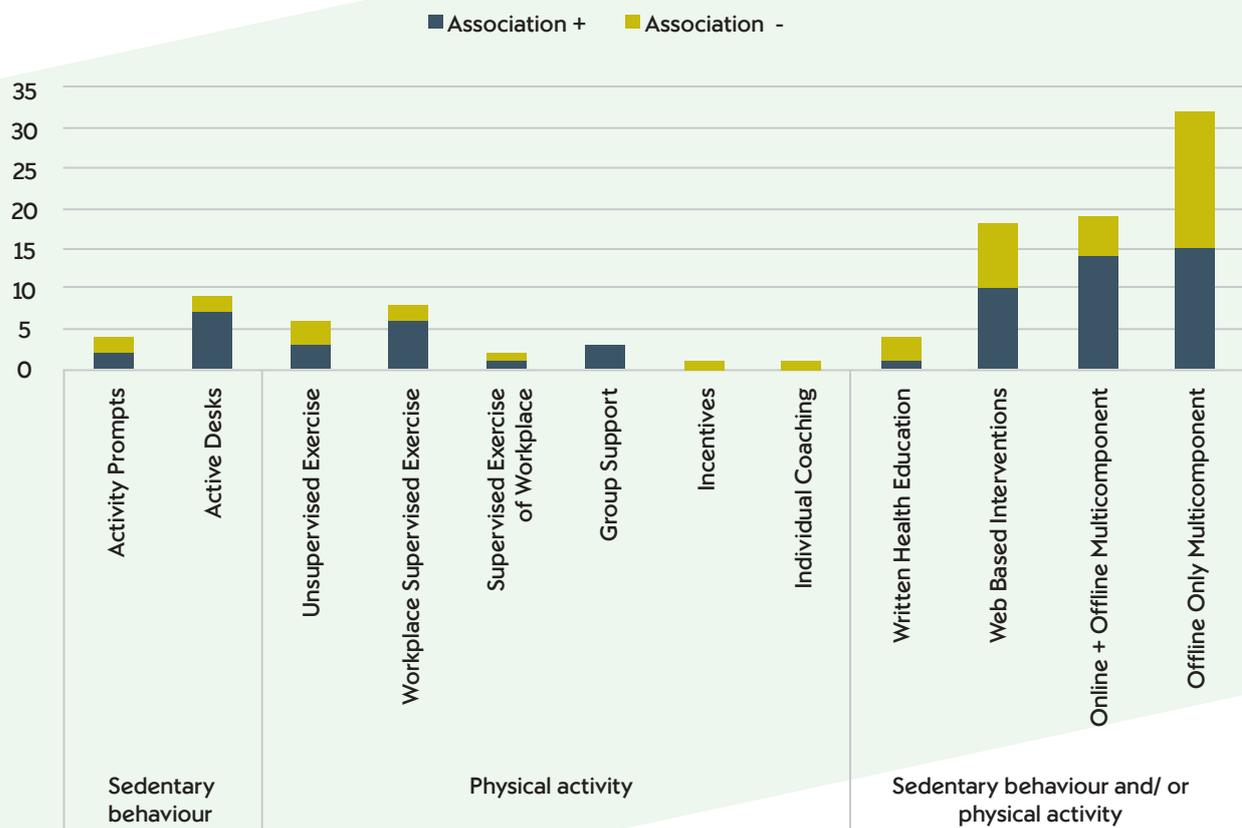
Criteria for judging the strength of the evidence base

<p>Strong</p>	<p>Over 66% (two thirds) of studies find a statistically significant positive difference ('Association +') between control and intervention groups</p>
<p>Moderate</p>	<p>Between 50-66% find a significant effect, or there is just one study and it is judged significant</p>
<p>Weak</p>	<p>Under 50% of studies find a significant effect</p>

Using this methodology, it was found that:

- » there is **strong evidence** that supervised workplace exercise and group support can increase physical activity, while active desks can reduce sedentary behaviour;
- » there is **moderate evidence** that supervised exercise outside the workplace and unsupervised exercise increases physical activity, activity prompts reduce sedentary behaviour and that web-based interventions can improve both;
- » there is **weak evidence** that written health education is effective, although this was based only on a small number of studies;
- » there is **insufficient evidence** to judge the effectiveness of incentives and individual coaching for increasing physical activity, which only had 1 study each.

Figure 7: Effective versus ineffective intervention types, total number of studies



Analysis

For the multicomponent interventions, the study found that there was strong evidence (74%) of effectiveness for interventions that combined both online and offline components, while interventions that made use of only offline interventions had relatively weak evidence (47%).

Beyond web-based support, the most popular utilised components were written education (30 studies), unsupervised exercise (22 studies), group support (26 studies), incentives (12 studies) individual coaching (10 studies) and environmental changes to the workplace (10 studies), such as the provision of cycle shelters or the creation of spaces to exercise.

Care should be taken when drawing conclusions from this data. The lack of evidence from a study in relation to an intervention's efficiency does not necessarily mean an intervention was ineffective. Many of the studies had poor designs, with many otherwise promising interventions failing to display significant statistical differences between the intervention and control conditions as both saw significant improvements in physical activity.

Equally, the literature review only looked at statistical significance rather than effect size, showing how large a difference an intervention could be expected to make.

It was not attempted to calculate the cost effectiveness of any intervention.

There is a clear tension between our finding both that multicomponent offline only interventions were ineffective, and also that multiple specific offline interventions that did work.

In aggregate however, there is good evidence that employers can make a difference to the physical activity and sedentary behaviour of their workforce. This review suggests that sedentary behaviour may be easier to influence than physical activity, with both active desks and activity prompts potentially effective.

Nevertheless, there is also good evidence that group support and providing exercise facilities, both on and off the worksite, can be effective. By contrast, there is only weak evidence for the effectiveness of written information when not combined with any other intervention.



What works for under-represented groups?

There is a relatively small evidence base looking at the effectiveness of interventions targeted specifically at under-represented groups, with the research screening process identifying 21 relevant studies:

- » 14 studies explored interventions targeted at female employees. The most common intervention trialled was supervised worksite exercise (four studies), followed by a combination of online and offline multicomponent interventions (three studies);
- » Seven studies looked at employees in routine or semi-routine occupations, with six of those focussed on online and offline multicomponent interventions;
- » One study looked at a web-based intervention for a low educated group;
- » One study looked at using activity prompts to reduce sedentary behaviour in female office workers. This study found no effect, but it would require a larger evidence base to make a definitive judgement.

Aggregating this data, it was found that:

- » there is **strong evidence** that supervised worksite exercise can increase physical exercise in underserved groups, and that a combined offline and online multicomponent approach can improve both physical activity and reduce sedentary behaviour;

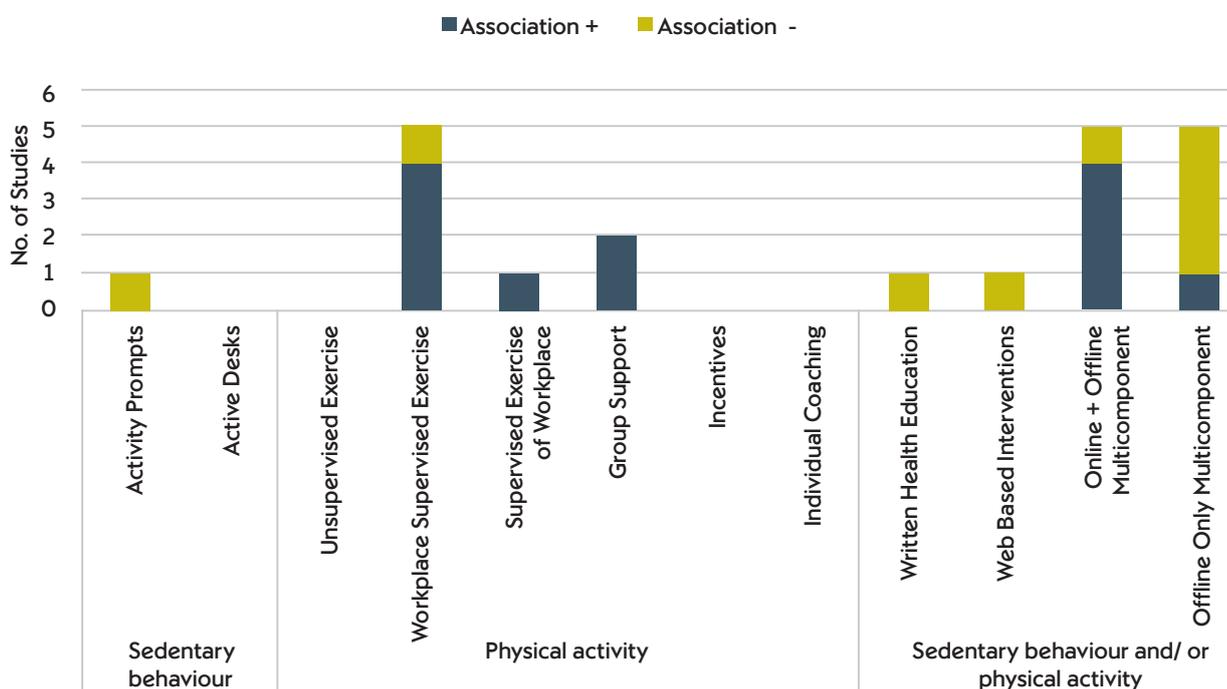
- » there is **moderate evidence** that group support can increase physical activity;
- » there is **weak evidence** that offline only interventions are effective, with just one in five studies finding a significant effect;
- » there is **inconclusive evidence** of the impact of supervised off-worksite exercise, activity prompts, web-based interventions or written health education. (All of these only had one study);

there is **no evidence** on the effectiveness of active desks, unsupervised exercise, incentives and individual coaching.

In short, there is much less specific evidence on the impact of workplace interventions for under-represented groups. Nevertheless, the evidence available suggests a similar approach to that followed for all employees is likely to work: there is reasonable evidence that supervised exercise, group support, and multicomponent interventions can be effective.

A full description of the 21 studies is contained in Appendix C, and is graphically summarised in Figure 8, Page 32.

Figure 8: Effective versus ineffective intervention types, for under-represented groups



How to put this into practice

While there is good evidence that employers can increase physical activity among their employees, there is much less evidence looking at how this advice varies by workplace or demographic:

- » Active desks and activity prompts may reduce sedentary behaviour among office workers, for example, but they have much less relevance for other occupations in retail or manual labour. These types of professions are exactly where many of the under-served groups where relatively bad health outcomes are more likely to be found;

- » Not every employer will be able to afford or have the physical space to implement every type of intervention. Worksite supervised exercise, for example, requires an employer to not only provide suitable professionals to run sessions, but also sufficient onsite facilities, including a space for exercise and changing areas. Activity prompts may not have quite as good an evidence base as active desks but are likely to be significant cheaper to implement;
- » The specific details of how an intervention is implemented can make a real difference. Active desks may reduce sedentary behaviour – but without adequate guidance, employees may seek to stand with them all the time, which is not necessarily healthy either.

The employer's perspective

To sense check the findings of this research, a series of workshops were organised with leading employers to learn from their experience in the challenges and opportunities from trying to put some of these interventions into practice.

The most frequently recurring themes of that exercise were that:



Culture change is as important as 'harder' interventions studied in the evidence review. Facilitators should work hard to be as friendly and approachable as possible. Leadership must come from the top, but often those in senior management are relatively unhealthy. While few would dispute the importance of employee health, there is often a reluctance to intrude on their workers' personal lives or be seen as overly interfering.



Providing information can be surprisingly powerful. One intervention with no systematic data available, but that the participants found highly effective, was the use of health kiosks. These are places that provide basic data on blood pressure, body fat and BMI. This not only catalysed initial behaviour change, but allowed employees to monitor their progress a few months down the line.



Employers and employees only have a limited understanding of the difference between reducing physical inactivity and sedentary activity. If you have stood on your feet all day in a shop or factory, it can come as an unpleasant surprise to be told that you still have not done enough physical activity for the day.



The intervention must be adapted to the type of workplace. On site exercise classes can work for office workers, but factory workers don't have that kind of flexibility to fit in physical activity around the rest of their schedule.

Employer View

"We still find it's a culture thing. If your team are active, you'll go. If you're in a team where your leader isn't interested, you won't. It's senior leader and culture-driven."

- Health and wellbeing lead, financial services company

Employer View

"I think any senior person you speak to about employee health they'll say of course it isn't unimportant, it's more what it means in personal terms which is, do we want to intrude? Are we pushing the boundaries too far if we're asking them not only to do the job, but also to eat more apples. It can be seen as very patronising."

- Wellbeing lead, UK retailer

Employer View

"We found an interesting incentive was health kiosks. It's very simple. Just a contraption that measures blood pressure, body fat and your BMI. Very basic indicators. What was surprising was the number of people who made changes after that. I had a lot of people say they looked at it and thought, 'Oh...'"

- Wellbeing lead, UK retailer

In the rest of this review, the challenges and facilitators extracted from the 107 studies in the literature review have been aggregated, giving guidance on how the ten individual interventions or a multicomponent intervention can be implemented in practice:

Overall evidence base:

Moderate evidence of effectiveness

Evidence base for under-represented groups:

No evidence

Physical activity:

1) Unsupervised exercise

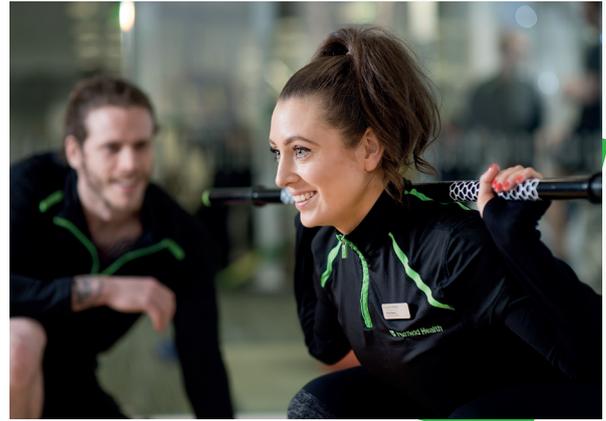
Employees are encouraged or provided resources to take part in unsupervised exercise at onsite facilities, or designated walking routes.

Facilitators

- » Reduce the barriers to participation by recommending a type of activity with low dedicated time requirements (e.g. active commuting, increased step counts);
- » Gives the freedom to choose when and how to engage in physical activity;
- » Activity can be completed at a time when is most convenient for the employee.

Challenges

- » Can be expensive to supply employees with membership to sports facilities or provide those facilities on site;
- » Employees cite a range of barriers to participating in unsupervised exercise, including 'no time', 'too tired', 'not accessible', and 'no partner to exercise with';
- » Employees may lack the knowledge or confidence to engage in unsupervised exercise programmes;
- » Increased risk of injury from unsupervised sessions.



Overall evidence base:

Strong evidence of effectiveness

Evidence base for under-represented groups:

Strong evidence of effectiveness

2) Workspace supervised exercise

A fitness professional delivered exercise class at the worksite.

Facilitators

- » Classes offered during lunch breaks and before or after work hours can ensure that exercise time does not encroach on work tasks;
- » Exercise level and type can be tailored to the needs of the workforce, including health outcomes beyond physical activity, such as yoga classes for stress reduction or postural alignment classes for back pain;
- » Supervision ensures that all exercises are performed safely and correctly;
- » Supervision can help to motivate employees and allow them to build their confidence in performing exercises;
- » A sense of accountability to class supervisors may enhance participation rates;
- » Worksite classes may help to build rapport between employees taking part.

Challenges

- » Exercises classes during working hours may require alternative cover staff to be arranged;
- » Workplaces must have suitable facilities to run exercise classes/facilities (e.g. exercise space, equipment, shower and changing facilities);
- » Not easily scalable to reach employees across distributed workforces;
- » Supervised exercise classes may not result in lasting changes to exercise levels after termination of a programme;
- » Requires a trained exercise professional to organise and run sessions, in addition to suitable health and safety policies;
- » Low participations rates are likely, particularly for high intensity exercise sessions;
- » Compensation effects may result, such as a reduction in physical activity outside of class time;
- » Intensive exercise classes may not be appropriate for all employee groups, such as those who are very inactive.

Overall evidence base:

Moderate evidence of effectiveness

Evidence base for under-represented groups:

Inconclusive

3) Supervised exercise off workplace

A fitness professional delivered exercise class not at the worksite.

Facilitators

- » Classes offered out of work hours can ensure that exercise time does not encroach on work tasks;
- » High quality/fun classes (e.g. football, rugby, dance) can boost participation rates;
- » Supervision ensures that all exercises are performed safely and correctly;
- » Participation rates are usually high for offsite exercise classes;
- » Supervision can help to motivate employees and allow them to build their confidence in performing exercise;
- » A sense of accountability to class supervisors may increase participation.

Challenges

- » Supervised exercise classes may not result in lasting changes after the termination of a programme;
- » Requires a trained exercise professional and exercise facilities to organise and run sessions;
- » May require significant time to set up and a supportive infrastructure for delivery;
- » Barriers to off-worksite class attendance include time, transport and other priorities.

Overall evidence base:

Strong evidence of effectiveness

Evidence base for under-represented groups:

Moderate evidence of effectiveness

4) Group support

Organised group sessions where employees come together for health education, to monitor progress, agree physical activity goals or identify challenges to change.

Facilitators

- » Offers employees an opportunity to voice and share their experiences with workplace support for behaviour change;
- » Relatively low burden for delivering staff;
- » Group session may help to build rapport between the employees taking part;
- » Relatively low attrition rates.

Challenges

- » Group support sessions delivered during work hours require that employees are granted time away from work tasks;
- » May require a suitable facilitator to organise and run group sessions;
- » Sessions may be available to a limited few only;
- » Requires suitable numbers of willing employees to participate in group sessions;
- » Group based support may be more appealing to types of employee. (Previous research has found participation has been found to be low among male employees);
- » Employees may not wish for their health behaviours to be discussed with fellow colleagues.

Overall evidence base:	Insufficient evidence
Evidence base for under-represented groups:	No evidence

5) Incentives

Providing employees with valued rewards for behaviour.

Facilitators

- » Likely to work best as part of a multi-component intervention, alongside other behaviour change support such as goal setting and action plans.

Challenges

- » Incentives may not result in lasting changes to behaviour after the direct incentive is taken away;
- » If using financial incentives, employers may desire evidence of cost-effectiveness;
- » Incentives need to be appropriate so that they motivate physical activity for all, ensuring that those who are already active are not demotivated;
- » May be perceived as coercive.

Overall evidence base:	Insufficient evidence
Evidence base for under-represented groups:	No evidence

6) Individual coaching

Participants receive one-to-one coaching to increase physical activity.

Facilitators

- » Facilitators can easily tailor content to suit the unique needs of a workforce;
- » Face-to-face education sessions may be more effective if delivered as part of a multi-component intervention, with additional environmental and organisation support for behaviour change;
- » A sense of accountability to session facilitators can enhance participation rates;
- » Very high adherence rate when taking place during working hours.

Challenges

- » Individual coaching sessions delivered during work hours will require that employees are granted time away from work tasks;
- » Not easily scalable to reach employees across distributed workforces;
- » May prove to be high cost depending on the provider;
- » Lack of management support can increase attrition rates as employees cite 'lack of time' when missing meetings;
- » Difficult to engage employees who do not wish to take part.

Employer View

“What we’re really clear on is there’s certain groups will be more prone to sedentary behaviour, whereas warehouse workers don’t need to worry about the number of steps, whereas office workers there’s a role where sedentary behaviour – its more from an occupational angle. So when we talk about focus areas, where physical activity and a healthy body is more important, actually their job means they’re sitting around all day.”

- Employee experience lead, UK supermarket

Employer View

“What about standing? In terms of our workforce, there’s a lot of time on the shop floor, but you don’t move around much.”

- Wellbeing lead, UK retailer

Overall evidence base:

Moderate evidence of effectiveness

Evidence base for under-represented groups:

Inconclusive evidence

7) Activity prompts

Software, email or other messages encouraging breaks in extended sedentary time.

Facilitators

- » Low cost;
- » Software may be relatively easy to install depending on existing IT support;
- » Potentially scalable to reach large numbers of employees;
- » Message content can be modified to suit the recipient;
- » Can be easily turned off if required;
- » Prompts can be set to momentarily ‘lock’ access for a given period of minutes, essentially making the employee leave their desk;
- » Prompts likely to work best in combination with environmental support as part of a multicomponent intervention (e.g. provision of active desks, restructuring workplace layout);
- » Witnessing other employees adhering to active prompts can act as a visual cue, encouraging others to follow suit;
- » May provide welcome breaks from stressful work.

Challenges

- » Optimal frequency of prompts is unknown: too infrequent may be ineffective, too frequent may irritate employees;
- » Not a relevant approach for workplaces in which employees already spend a large amount of time standing/walking;
- » The effectiveness of activity prompts may wear off over time due to habituation;
- » Increased standing time may lead to complaints of back pain or fatigue;
- » May incur cost in licensing costs and instalment depending on size of organisation;
- » Extended time standing at work may lead to compensation effects during out-of-work hours (e.g. increased sitting in the evenings), leading to no overall health benefit;
- » Extended time spent standing may lead to increased tiredness.

Employer View

"We have the active desks, but we don't allow them to have it straight away. They have to have training for that desk mechanism. They have to flag and then they can move up and down on their desks. We didn't want people having it, or it just went negative. There was a double intervention. This years results was a great climb on last year – and we've just put activity desks and just started with wobbling stools and all sorts of bits, workout spaces and activity desks, chairs, apples – I can't see balls being on the trade floor. They'll get kicked at people."

- Health and wellbeing lead, financial services company

Employer View

"We tried standing desks, and that's why it's an interesting one – people just stand there. They will stand for 20 hours. We found there were other issues with upper back issues and blood flow."

- Health and wellbeing lead, financial services company

Overall evidence base:

Moderate evidence of effectiveness

Evidence base for under-represented groups:

Inconclusive evidence

8) Active desks

Sit-stand desks / treadmill desks added to the working environment to encourage reductions in sedentary time.

Facilitators

- » To boost adherence, active desks may need to be combined with other support as part of a multicomponent intervention;
- » Providing training can facilitate uptake and adherence among employees;
- » Use may be higher in employees already motivated to be physically active.

Challenges

- » Expensive to install companywide;
- » Not necessarily feasible to install or use at scale in certain workplaces;
- » Not a relevant approach for workplaces in which employees already spend a large amount of standing or walking;
- » Increased standing time may lead to complaints of back pain, fatigue or musculoskeletal conditions;
- » Extended time standing at work may lead to compensation effects during out-of-work hours (e.g. increased sitting in the evenings);
- » May interfere with work tasks and be unacceptable for some employees.

Employer View

"I was quite taken by – you were talking about people measuring themselves against 5 a day. Whether you do it or not, you know where you stand. You've done two, you've done three. When it comes to exercise, all of the jargon is hard to understand. Where – the perfect is 150, but actually doing 30 mins is where you get an initial health saving. So there's something about helping people understand what to do. What should we be doing?"

- Health and wellbeing lead, financial services company

Overall evidence base:

Moderate evidence of effectiveness

Evidence base for under-represented groups:

Inconclusive evidence

9) Written health education

Print-based written content that provides advice on how to achieve reductions in sitting time or increases in physical activity such as posters or booklets.

Facilitators

- » Low cost compared to other types of intervention;
- » Easily scalable to reach large numbers of employees;
- » Visually appealing content with images may increase employee engagement;
- » Utilising written materials such as posters around the worksite, in canteens and other high use areas, can assist in engaging unmotivated employees;
- » For those who do read, levels of satisfaction and interest in content is usually high;
- » Employees discuss and share written content with colleagues, encouraging others to become more active;
- » Employees tend to prefer delivery via electronic mediums but are more likely to read print-based materials.

Challenges

- » Written materials may not be read, or read only after a significant delay;
- » Effectiveness may be limited to already motivated employees;
- » Numerous "booster" materials may be required to support longer-term behaviour change;
- » Low engagement rates are likely if employees are required to seek out and access written materials;
- » May be perceived as the employer offering limited or low value support for behaviour change;
- » Provides no opportunities to discuss or verify information or advice, allowing for misinterpretation.

Employer View

“Staircases are not the most exciting places, but if you put these posters, it makes it a bit fun, and a bit more competitive – and it’s so simple in terms of this simple, effective thing to do.”

- Wellbeing lead, UK retailer

Overall evidence base:

Moderate evidence of effectiveness

Evidence base for under-represented groups:

Inconclusive evidence

10) Web-based interventions

Utilising online support such as websites, apps, and or emails to encourage behaviour change.

Facilitators

- » Scalable solution with potential to reach a distributed workforce;
- » Easy to update content and meet the changing needs of the employees;
- » Delivery of an intervention via email can ensure company-wide reach;
- » Relatively simple and low cost;
- » Internet delivered exercise recommendations can lead to significant improvements independent of structured/non-structured delivery;
- » Easily accessible information;
- » Low commitment requirement likely to improve outcome potential.

Challenges

- » Content needs to be regularly reviewed and updated to ensure it meets the needs of employees;
- » Costs may be prohibitive if employers consider third party applications/solutions;
- » Usage rates may decline over time;
- » Access may be limited where employees do not routinely have access to computers at work.

Overall evidence base:

Weak evidence of effectiveness

Evidence base for under-represented groups:

Weak evidence of effectiveness

Multicomponent interventions

11) Offline only multicomponent interventions

Print-based written content that provides advice on how to achieve reductions in sitting time or increases in physical activity such as posters or booklets.

Facilitators

- » Defining clear goals of the multicomponent intervention may assist in selection of elements and assist in measuring impact;
- » Multicomponent approaches provide the opportunity for virtually all employees to access some sort of intervention

Challenges

- » Costs of multicomponent interventions may be prohibitive;
- » Difficult to assess effectiveness of individual components as part of a multicomponent strategy;
- » To continually engage employees, employers may have to continually adapt, add, remove, and alter intervention types;
- » Environmental changes to the workplace may be too expensive and complex to organise;

Overall evidence base:

Strong evidence of effectiveness

Evidence base for under-represented groups:

Strong evidence of effectiveness

12) Online and offline multicomponent interventions

Utilising online support such as websites, apps, and or emails to encourage behaviour change.

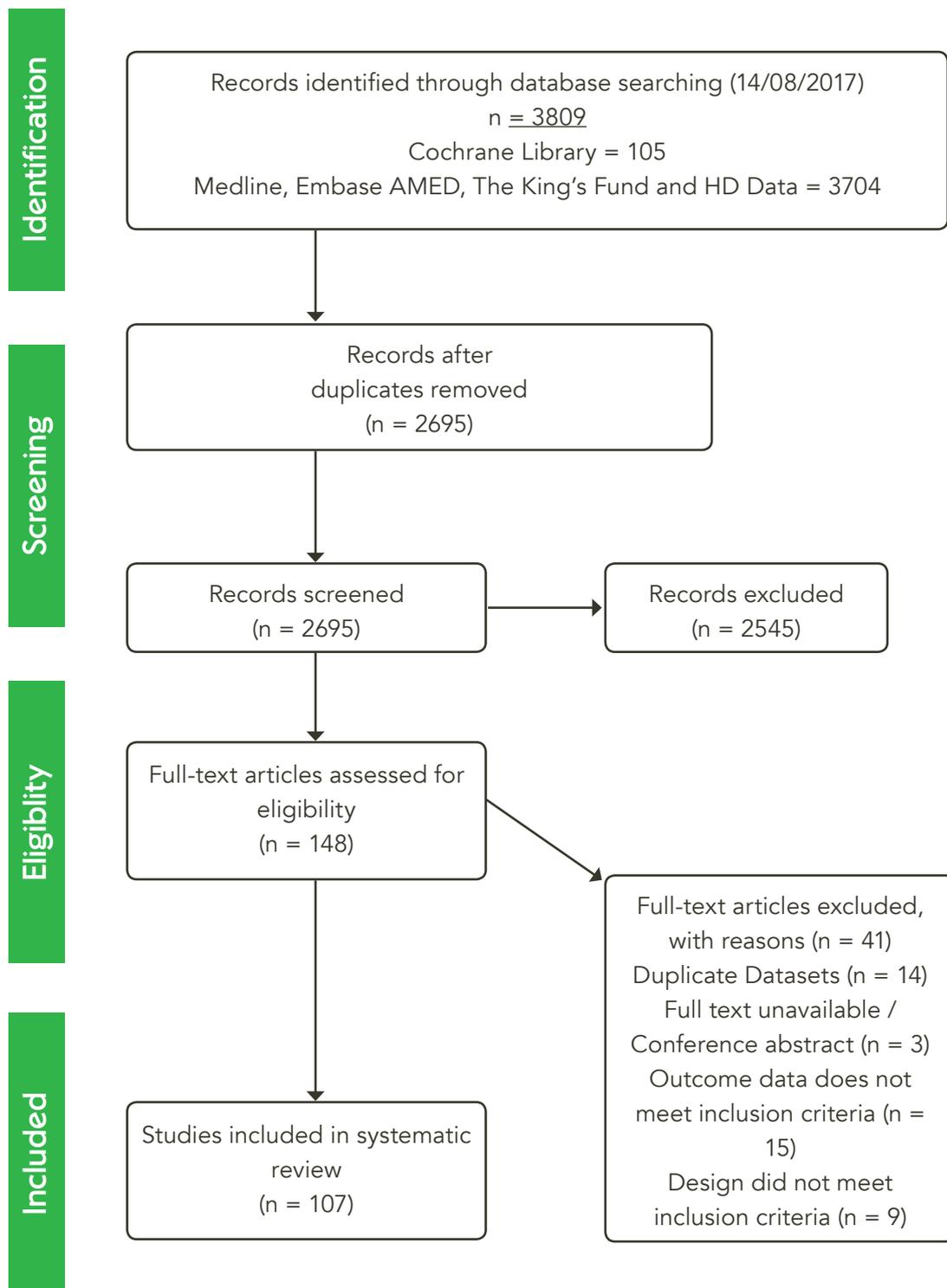
Facilitators

- » Scalable solution with potential to reach a distributed workforce;
- » Easy to update content and meet the changing needs of the employees;
- » Delivery of an intervention via email can ensure company-wide reach;
- » Relatively simple and low cost;
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Challenges

- » Content needs to be regularly reviewed and updated to ensure it meets the needs of employees;
- » Costs may be prohibitive if employers consider third party applications/solutions;
- » Usage rates may decline over time;
- » Access may be limited where employees do not routinely have access to computers at work.

Figure 9: PRISMA flow diagram of search strategy



Data extraction

Authors SA and AI developed data extraction forms to identify and pull relevant information from eligible studies to summarise in this review. This included information on study aims, setting, location, participants, type of intervention and comparison group, primary and secondary outcome measures, indicators of socio-economic disadvantage, main findings and Opportunities and Challenges to conducting the intervention.

One author each (SA, AI, BK, JD, MC) extracted data from all eligible studies with a 5% subset (e.g. N = 6 papers) first checked by all authors at the start of this process to ensure accuracy and standardisation, and to resolve queries and discrepancies prior data extraction on all remaining full texts.

Data summary

To summarise the findings from all studies included in this review, conclusions were drawn on the effectiveness of each intervention based on the criteria below:

An intervention is judged as “**Association +**” if there is a significant difference in physical activity or sedentary behaviour between intervention and control groups at follow-up, favouring the intervention.

An intervention is judged as “**Association -**” if there is an improvement in physical activity or a reduction in sedentary behaviour from baseline in the intervention group, but no significant difference in this change between intervention and control group. Also judged as “Association -” are studies that showed no improvement from baseline in the intervention group, or if the intervention group significantly reduced their physical activity or increased their sedentary behaviour relative to the control group over the follow-up period.

Where multiple physical activity or sedentary behaviour outcomes are presented for a single intervention, Nuffield Health judge effectiveness on the following prioritisation:

- » the primary physical activity/sedentary behaviour outcome measure are preferentially selected, as specified by the author;
- » Where the primary outcome is not specified or is not a physical activity/sedentary behaviour outcome measure, Nuffield Health preferentially select objective measures of physical activity/sedentary behaviour over self-report measures. Where multiple objective measures are present, the indicator that best aligns to the primary aims of the study are chosen;
- » Where data for multiple follow-up points are reported, Nuffield Health preferentially select the latest available, in order to judge the enduring effectiveness of an intervention.

Next, the overall strength of evidence for different categories of physical activity/sedentary behaviour intervention is summarised. For this process, Nuffield Health follow the method adopted by van Stralen et al., (2009)

(see box 3 over).

In detail, Nuffield Health conclude that the evidence supporting a category of intervention is **STRONG** if more than two-thirds of relevant studies were identified as “Association +”.



It is concluded that evidence to support a intervention is **MODERATE** if between half and two-thirds of relevant studies are “**Association +**”.

If there are only two papers, the evidence base is classified moderate if at least one (50%) is effective.

Box 3: criteria for judging the strength of the evidence base

Strong	>66% (two thirds) of studies are effective
Moderate	>66% (two thirds) of studies are effective
Weak	Between 50-66% are effective or there is just one study and it is judged as effective

Lastly, if less than half of relevant studies are “**Association +**”, the strength of evidence is classified for the intervention as **WEAK**.

If there are only two studies, they are classified as weak if neither is effective.

Where only one study is available for a intervention, the evidence-base is considered inconclusive.

Next, Nuffield Health identified studies that explored physical activity/sedentary behaviour interventions in under-represented groups. For this, papers were located that either targeted an socio-economically disadvantaged group directly, or studies that present analyses comparing the effect of an intervention according to the

Finally, Nuffield Health extracted and summarised the information from individual studies on challenges and opportunities to implementing physical activity and sedentary behaviour interventions in the workplace. This included challenges and opportunities for both employers and employees.

Appendices:

Appendix A: Methodology

To compile the evidence base behind this report, Nuffield Health systematically searched electronic databases (Medline, Embase, AMED, The Cochrane Library, The King's Fund and DH-Data) for eligible primary studies from their inception dates to August 2017.

Eligibility is based on six primary inclusion criteria:

- » **Setting:** Studies that recruit participants into a physical activity/sedentary behaviour intervention conducted in a workplace setting;
- » **Intervention:** Studies that include an intervention involving a physical activity or sedentary behaviour change component, either alone or as part of a multi-factorial program (e.g. includes a focus on diet, activity, wellbeing etc.). Interventions that focus on physical rehabilitation or symptom management/treatment (e.g. physiotherapy for back pain) are excluded;
- » **Outcome:** Studies that report a post-intervention physical activity, physical fitness or sedentary behaviour outcome measure;
- » **Population:** Studies that recruit adult employees only (> 16 years);
- » **Study Design:** Studies that report a post-intervention comparison between interventions versus control group(s). This includes controlled trials, randomised controlled trials, cluster randomised controlled trials and quasi-experimental studies with concurrent control;
- » **Date:** For relevance, Nuffield Health subsequently limited its search to recent studies only, published within the last 15 years (e.g. on or after 2002).

Screening

The database searches located 3809 studies. Two authors (Sophie Attwood (SA), Aidan Innes (AI)) independently reviewed all titles and abstracts against inclusion criteria, removing duplicates and excluding ineligible studies.

Full text copies of remaining studies (N = 148) were next located. Three authors (SA, AI and Ben Kelly (BK)) reviewed this shortlist against inclusion criteria, with each full text read and assessed by at least two authors.

Nuffield Health retained studies that both authors considered met all inclusion criteria.

Where two authors disagreed on eligibility status, a final decision was made via group discussions with author BK.

A summary of the search process is available in figure 9 below. The review included a final total of 107 eligible studies.

Appendix B: Overview of the strength of the evidence for categories of workplace-based physical activity intervention

Intervention	Brief Description	¹ Association +	Association -	Total number of studies	*Strength of evidence
Sedentary Behaviour					
Activity prompts	Software, email or other messages encouraging breaks in extended sedentary time	Judice et al 2015, Taylor et al 2016	Swatz et al 2015, Urda et al 2016	4	Moderate (50% +)
Active desks	Sit-stand desks / treadmill desks added to the working environment to encourage reductions in sedentary time	Alkhajah et al 2012, Shuna et al 2014, Dutta et al 2014, Chau et al 2014, Graves et al 2015, Miyachi et al 2015, MacEwan et al 2017	Chau et al, 2015, Donath et al 2015	9	Strong (78% +)
Physical Activity					
Unsupervised exercise including walking	Employees are encouraged or provided resources to take part in unsupervised exercise at onsite facilities, or designated walking routes	Hewitt et al 2008, Yuan et al 2008, Gilson et al 2009	Murphy et al 2006, Puig-Ribera et al 2008, Brown et al 2014	6	Moderate (50% +)
Worksite supervised exercise classes	A fitness professional delivered exercise class at the worksite	2012, Sertel et al 2016, Korshoj et al 2016, Dalager et al 2016, Matsugaki et al 2017, Con Thiele et al 2017	Pedersen et al 2009, Ribeiro et al 2014	8	Strong (75% +)
Supervised exercise classes off worksite	A fitness professional delivered exercise class not at the worksite	Barene et al 2013	Brand et al 2005	2	Moderate (50% +, only two papers)
Group support	Organised group sessions where employees come together for health education, to monitor progress, agree physical activity goals or identify Challenges to change	Barham et al 2010, Purath et al 2004 Tan et al, 2016		3	STRONG (100% +, only 3 studies)
Incentives	Providing employees with valued rewards for behaviour		Dallat et al 2013	1	Inconclusive (1 study only)
Individual Coaching	Participants receive one-to-one coaching to increase physical activity		Schopp et al 2017	1	Inconclusive (1 study only)

Intervention	Brief Description	[†] Association +	Association -	Total number of studies	*Strength of evidence
Sedentary Behaviour and/or Physical Activity					
Written health education	Print-based written content that provides on how to achieve reductions in sitting time or increases in physical activity such as posters or booklets	Mutrie et al 2007	Griffin-Blake et al 2006, Plotnikoff et al 2007, Eves et al 2012	4	Weak (25% +)
Web based interventions	Utilising online support such as websites, apps, and or emails to encourage behaviour change	Plotnikoff et al 2005, Sternfield et al 2009, Touger-Decker et al 2010, Irvine et al 2011, Deitz et al 2014, Blake et al 2015, Lippke et al 2015, Puig-Ribera et al 2015, Poirier et al 2016, De Cocker et al 2016	Marshall et al 2003, Cook et al 2007, Spittaels et al 2007, Slootmaker et al 2009, Bennett et al 2011, Thorndike et al 2012, Robroek et al 2012, Suggs et al 2013	18	Moderate (56% +)
Multicomponent (Online & Offline) interventions	Utilising multiple techniques to target individual level and or environmental level and or organisational level factors or two or more interventions comprising both online and offline modalities, to encourage behaviour change	Naito et al 2008, Musto et al 2010, Morgan et al 2011, Hughes et al 2011, Evans et al 2012, Andersen et al 2013, Carr et al 2013, Gazarian et al 2013, Neuhaus et al 2014, Mansi et al 2015, Carr et al 2016, Shefieinia et al 2016, Smith-McClallen et al 2016, Arrogi et al 2017	Pressler et al 2010, De Cocker et al 2010, Aittasalo et al 2012, Reijonsaari et al 2012, Low et al 2015	19	Strong (74% +)
Multicomponent (Offline Only) interventions	Utilising multiple techniques to target individual level and or environmental level and or organisational level factors or two or more interventions comprising of offline modalities only, to encourage behaviour change	Atlanti et al 2006, Prochaska et al 2008, Mackinnon et al 2010, Christensen et al 2011, Prestwich et al 2012, Verweij et al 2012, Healy et al 2013, Graham et al 2013, Coffeng et al 2014, Sorensen et al 2015, Tucker et al 2016, Brackenridge et al 2016, Belicha et al 2016, Lin et al 2017, Danquah et al 2017	Aittasalo et al 2004, Aldana et al 2005, Racette et al 2009, French et al 2010, Siegal et al 2010, McEachan et al 2011, Strijk et al 2012, Edries et al 2013, Parry et al 2013, Ferraro et al 2013, Karlqvist et al 2013, Kramer et al 2015, Anthony et al 2015, Miller et al 2015, Lacalle et al 2016, Wilson et al 2016, Viester et al 2017	32	Weak (47% +)

Appendix C: Summary of studies for under-represented employee groups

Study	Design	Location	Underserved Group	Intervention	Outcome measure & findings	Association +/-
Physical Activity						
Barene et al, 2013	cluster RCT	Norway	GENDER: 107 female healthcare employees	12-week off worksite supervised exercise classes, performed out-of work hours, including supervised soccer and zumba classes 2-3 times per week. Control condition was no intervention.	Significantly greater improvements in objectively measured fitness (VO2 peak) were found in the intervention group compared to the control group over the follow-up period	Association +
Matsugaki et al, 2017	RCT	Japan	GENDER: 30 female shift working nurses	12-weeks of twice weekly worksite supervised exercise classes focussing on resistance and aerobic training. The control condition received written guidance on resistance and aerobic exercise training only.	No significant difference between intervention and control group in change in maximal oxygen uptake (VO2 max) over the follow-up period.	Association -
Sertel et al, 2016	RCT	Turkey	GENDER: 68 female factory workers	8-week worksite supervised group exercise classes. Group 1 attended classes targeting strength training. Group 2 attended classes targeting endurance training. The control condition received no intervention.	Significantly greater improvements in objectively measured maximal oxygen uptake (VO2 max) were found in the intervention groups 1 and 2 compared to the control group over the follow-up period.	Association +
von Thiele et al, 2017	cluster RCT	Sweden	GENDER: 177 female healthcare employees	12-month intervention. Group 1 were assigned to mandatory worksite-based exercise during work hours. Group 2 were allocated reduction work hours in order to perform exercise. The control condition received no intervention.	Significantly greater improvements in self-reported physical activity (author designed questionnaire assessing frequency and type of physical activity) were found in intervention group 1 compared to group 2 and the control group over the follow-up period.	Association +
Sedentary Behaviour and/or Physical Activity						
Christensen et al, 2011	cluster RCT	Denmark	GENDER: 98 overweight, female healthcare employees	12-month offline multicomponent intervention targeting multiple health behaviours. The focus was on increasing leisure time physical activity and muscle strengthening exercises to facilitate weight loss. The control group received monthly face-to-face education sessions.	The authors report a significant difference in objectively measured aerobic fitness between the intervention and reference groups at 3 months.	Association +
Edries et al, 2013	RCT	South Africa	OCCUPATION: 80 factory workers	6-week offline multicomponent intervention targeting employee wellness. Approaches included group education sessions, goal setting and cognitive behavioural therapy, written health education and weekly supervised aerobic exercise classes. The control condition received one health promotion talk and various educational pamphlets.	No significant difference between intervention and control group in change in self-reported physical activity (Stamford Exercise Behaviour Scale; SEBS) over the follow-up period.	Association -

French et al, 2010	RCT	USA	OCCUPATION: 2225 bus garage employees	18-month offline multicomponent intervention targeting multiple health behaviours. Intervention approaches we selected by participations, and included amongst them; purchasing fitness equipment, fitness programme, walking challenges, supervised exercise classes, health education event and peer monitoring of behaviour change. Control condition was no intervention.	No significant difference between intervention and control group in change in self-reported physical activity (Godin Leisure Time Physical Activity Questionnaire; GLTPA) over the follow-up period	Association -
Lippke et al, 2015	RCT	Germany	OCCUPATION: 384 manual shift workers	4-week web based support. Content of materials was individually matched to theory based stages of behaviour change (non-intenders, intenders, and actors). Control condition received non-matched written general health education, delivered online.	The stag-matched intervention group outperformed the active control condition for selfreported physical activity.	Association +
Low et al, 2015	RCT	USA	GENDER: 57 female healthcare employees	6-month online & offline multicomponent intervention targeting multiple health behaviours. Approaches included motivational counselling via email, organised walks and access to fitness classes and on-site facilities. Control condition received organised walks and access to fitness classes and on-site facilities only.	No significant difference between intervention and control group in terms of change in self-reported physical activity (author designed questionnaire assessing exercise days per week, minutes per session, and intensity [no, leisurely, moderate, or vigorous exercise) over the follow-up period.	Association -
Mansi et al, 2015	RCT	New Zealand	OCCUPATION: 53 factory workers: 53 factory workers	12-week online & offline multicomponent intervention targeting walking. Approaches included pedometer, plus an emailed materials based on self-regulation theory. Control condition received the pedometer plus generic (e.g. non-theory-based) written materials.	The authors report three relevant outcome measures. The intervention group showed a significantly greater improvement in objectively measured step counts (Yamax Digi-walker SW-200) and self-reported physical activity (IPAQ) than the control group over the follow-up period. There was no significant difference in objectively measured functional exercise capacity (6-minute walk test) between intervention and control group at follow-up.	Association +
Morgan et al, 2011	RCT	Australia	OCCUPATION: 110 factory workers	12-week online & offline multicomponent intervention. Approaches involved face-to-face education sessions focussing on weight loss, online materials, handbook and a financial incentive. The control condition received no intervention.	Significantly greater improvements in self-reported physical activity (GLTPA, plus an author designed questionnaire assessing workday physical activity and physical activity habits) were found in the intervention compared to the control group over the follow-up period.	Association +
Musto et al, 2010	quasi-experimental study	USA	GENDER: 77 female university employees	12-week online & offline multicomponent intervention. Approaches included a pedometer plus step log and written materials as well as email support. Control group consisted of participants who had not increased their physical activity over the follow-up period.	Significantly greater improvements in objectively measured step count (pedometer) and self-reported physical activity (Stanford Usual Activity Questionnaire; SUAQ) were found in the intervention compared to the control group over the follow-up period.	Association +

Plotnikoff et al, 2007	RCT	Canada	GENDER: 507 female employees in a large organization	12-month written education intervention, including five printed booklets containing information matched to participant's stage-of-change (Trans theoretical Model). The control condition received generic written health education materials.	No significant differences between intervention groups and control group in change in self-reported physical activity (GLTPA) over the follow-up period.	Association -
Purath et al, 2004	cluster RCT	USA	GENDER: 271 female university employees	6-week counselling based intervention. Control condition received screening and brief intervention only.	Significantly greater improvements in self-reported physical activity (Paffenbarger Physical Activity; PPAQ) were found in the intervention compared to the control group over the follow-up period.	Association +
Ribeiro et al, 2014	RCT	Brazil	GENDER: 195 female healthcare employees	12-week offline multicomponent intervention. Three different interventions were trialled. Group 1 received a pedometer plus individual face-to-face counselling and written materials. Group 2 received a pedometer plus 8 group-based face-to-face counselling sessions. Group 3 participated in twice-weekly supervised aerobic exercise training. Control condition three brief counselling sessions plus written health education materials.	No significant differences between intervention groups and control group in change in objectively measured physical activity (step counts) at final follow-up period (6-months).	Association -
Slootmaker et al, 2009	RCT	Netherlands	EDUCATION: 102 office based employees, analysis comparing employee with different education levels (higher vocational education/ university degree versus other)	12-week web-based intervention Approaches included a pedometer plus web-based tailored written materials. Control condition received generic written health education materials	For the whole sample, there were no significant differences between intervention groups and control group in change in self-reported physical activity (Activity Questionnaire for Adolescents and Adults; AQuAA) or in change in maximal oxygen uptake (VO2 max) over the follow-up period. Authors conducted further analysis comparing differences in effect between higher versus lower educated participants. There was no significant differential intervention effect by education level at final follow-up (8 months).	Association -
Tan et al, 2016	Cluster RCT	Singapore	GENDER: 598 female office based employees	Three face-to-face group health education workshops, with content based on Social Cognitive theory. Main focus was building self-efficacy, goal-setting and problem-solving. Control condition received generic health education written materials.	Significantly greater improvements in self-reported physical activity (EPIC Norfolk Physical Activity Questionnaire 2; EPAQ-2) were found in the intervention compared to the control group over the follow-up period.	Association +
Viestter et al, 2017	RCT	Netherlands	OCCUPATION: 327 construction workers	6-month Multicomponent intervention. Approaches included face-to-face and telephone health coaching sessions during work hours, plus written education materials and personalized feedback. Control condition received usual care.	No significant differences between intervention group and control group in change in self-reported physical activity (Health Enhancing Physical Activity Questionnaire (SQUASH)) and author developed questionnaire assessing meeting physical activity guidelines) at final follow-up (12 months)	Association -

Wilson et al, 2016	Quasi-experimental study	USA	OCCUPATION: 916 overweight transport maintenance employees	6-month offline multicomponent intervention included written education materials, peer-led face to face health coaching sessions and changes to the work environment to promote physical activity. Control condition received no intervention.	There was a decrease in self-reported walking (IPAQ) in both intervention and control conditions over the follow-up period. Significantly greater reduction in self-reported sitting time (IPAQ) were found in the intervention compared to the control group over the follow-up period.	Association -
Shafieinia et al, 2016	Quasi-experimental study Shafieinia et al, 2016	Iran	GENDER: 95 female office workers	12 week Online & Offline Multicomponent intervention including: Email education and group sessions. Control condition received no intervention.	A significant increase in IPAQ reported physical activity was found in the intervention group compared to the control group.	Association +
Urda et al. 2016	RCT	USA	GENDER: 44 Female university staff	Intervention: week 1, maintain normal behaviour; week 2, receive hourly prompts on their computer during work hours to stand up. Control group repeated week 1 during week 2 as opposed to undergoing an intervention	Thigh-worn activity tracker reported no significant change within groups or between groups for sitting time, or sit-to-stand transitions.	Association -

Appendix D: Full list of 107 papers used in review

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