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Protecting and improving the nation's health

# **10 minutes brisk walking each day in mid-life for health benefits and towards achieving physical activity recommendations**

## Evidence summary

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## Executive summary

International evidence and the UK Chief Medical Officers' (CMOs) guidelines highlight the frequency and type of physical activity required to achieve general health benefits, particularly the benefit of 150 minutes physical activity of at least moderate intensity each week.

The 150 minutes or more per week recommendation in guidance provides the level at which health benefits are achieved across a wide range of conditions for an achievable amount of time over a week. However a reduced level of benefits may be achieved through activity at less than the optimum 150 minutes, with some benefits shown even at levels of 10 minutes or more of at least moderate intensity activity.

'Brisk' walking (at least 3 mph) is a moderate intensity physical activity and evidence-based intervention for promoting physical activity. It is already prevalent, has no skill, facility or equipment requirement and is more accessible and acceptable than other forms of physical activity. This report, based on a rapid review of the evidence, summarises the potential benefits of 10 minute blocks of brisk walking as part of a contribution to the CMO recommended levels of activity.

For currently inactive individuals, evidence shows the following health benefits could be achieved from 10 minutes of brisk walking per day for 7 days:

- increased physical fitness
- greater ease of performance of everyday physical activities
- improved mood
- improved quality of life
- increased body leanness and healthier weight
- 15% reduction in risk of early death

Individuals with an existing health condition would likely achieve greater health benefits due to improvements in management of their condition and reduced risk of developing comorbidities. However further work is needed to explore the equivalent opportunity for some people living with disabilities, especially those with lower limb mobility impairments, which inhibit walking.

An additional 10 minutes brisk walking per day is likely to be seen as achievable by the one in four adults in England who are currently classified as 'inactive' by virtue of doing less than 30 minutes physical activity per week. In addition walking interventions in people active but not achieving CMO's guidelines (low activity) have consistently achieved an additional 30 minutes of walking per week, lifting people out of the 'inactive' category at which the greatest risks to health persist

The accessibility and acceptability of walking has particular potential for a cohort of the population with particular need for increased physical activity and who are currently inactive or doing less than the UK CMO's guidelines, particularly those in mid-life (aged 40-60 years) in lower socioeconomic groups<sup>22</sup>. If one in 10 of the seven million people within this cohort of the English population started to do 10 minutes of walking per day, it is estimated it would prevent 251 deaths per year and achieve an economic saving of £310 million per year.

# Background

International evidence<sup>1</sup> and the UK Chief Medical Officers' guidelines<sup>2</sup> highlight the frequency and type of physical activity required to achieve general health benefits, including 150 minutes physical activity of at least moderate intensity each week.

Central to this evidence is the message that 30 minutes of at least moderate intensity physical activity on at least 5 days a week (or 150 minutes over a week) helps to prevent and manage over 20 chronic conditions. Guidelines also call for activities that increase muscle strength on two or more days per week and breaking up extended periods of sitting (*Figure 1*).

Almost one in four (22.4%) of the English population are defined as 'inactive' by virtue of doing less than 30 minutes of activity per week<sup>3</sup> and have the highest risk of ill health due to insufficient physical activity. For some of these individuals 150 minutes may seem an unrealistic aim. There is a recognition that benefits may be accrued from lower levels of activity, both in terms of improving health and also by moving people from inactivity to low activity (ie 30-149 minutes per week) and to help move them towards achieving 150 minutes.

**Figure 1** Infographic of UK Chief Medical Officers' physical activity guidelines<sup>10</sup>



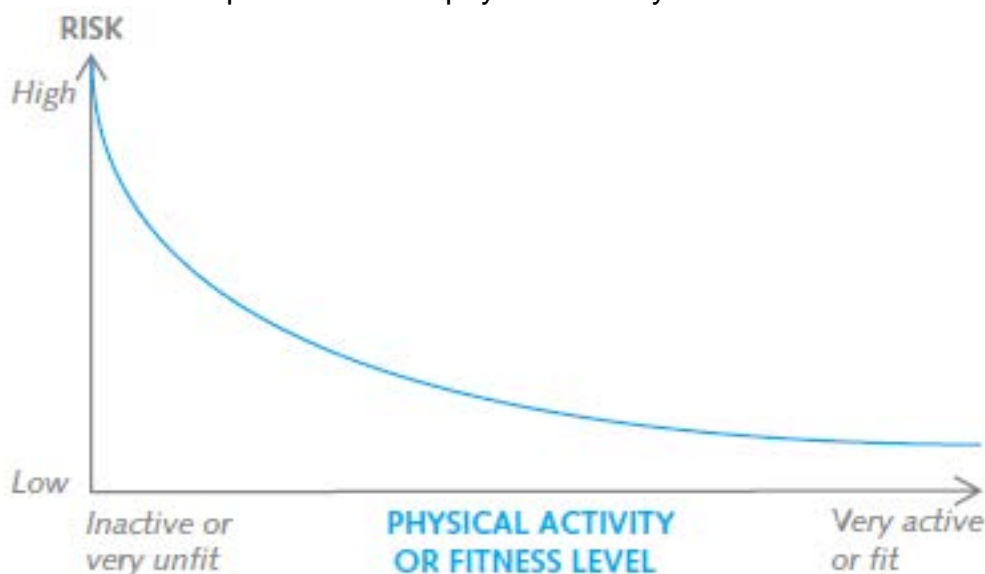
## Dose-response relationship of physical activity and health

There is a non-linear dose-response relationship between physical activity and health and disease; meaning that health benefits tend to increase with increased activity, with the rate of benefit (and reduction in health risks) per minute of activity reducing as activity increases (Figure 2). This relationship appears the same irrespective of individual characteristics, such as age, gender and ethnicity<sup>48</sup>.

The 150 minutes or more per week recommendation in guidance provides the level at which health benefits are achieved across a wide range of conditions for an achievable amount of time over a week. While 150 minutes or more is required to achieve the breadth of health benefits with emerging evidence of potential benefits associated with more than 100 conditions, such as prevention of Parkinson's disease<sup>4</sup> and management of severe mental illness<sup>5</sup>, a reduced level of health benefits can be achieved through sessions of 10 minutes or more of at least moderate intensity activity. The UK CMOs suggested that this may be a level "sufficient to improve cardiovascular fitness and lessen some risk factors for heart disease and type 2 diabetes"<sup>2</sup>. Accumulating physical activity through bouts of at least 10 minutes also provides similar health benefits to the same amount performed in longer continuous sessions<sup>6,7,8,9</sup>.

The UK CMOs have stressed that "While increasing the activity levels of all adults who are not meeting the recommendations is important, targeting those adults who are significantly inactive (ie engaging in less than 30 minutes of activity per week) will produce the greatest reduction in chronic disease"<sup>2</sup>. Whilst promoting the core message of the 150 minutes as the key for optimising health benefits, the UK CMO's infographic recognises the benefits of 30-149 minutes per week of moderate intensity physical activity for adults<sup>10</sup> and children and young people<sup>11</sup>. In particular, they advise that: "Something is better than nothing" and "Start small and build up gradually: just 10 minutes at a time provides benefit".

**Figure 2** Dose-response curve of physical activity and reduction in health risks<sup>12</sup>

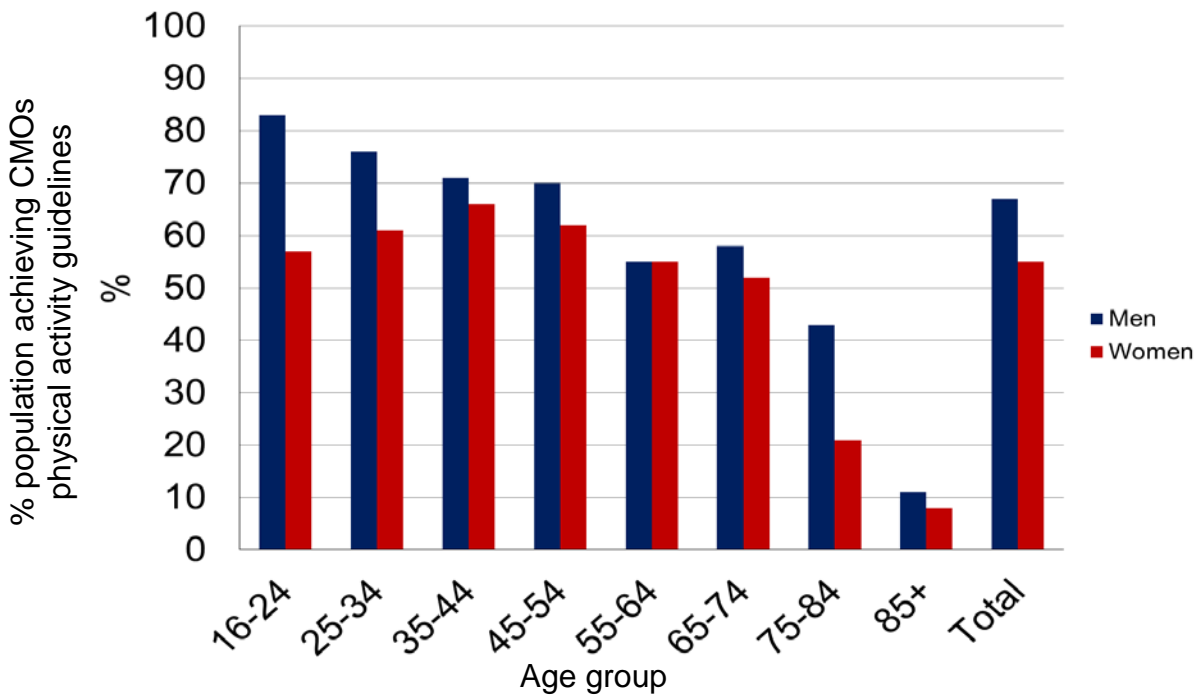


## Physical activity in ‘mid-life’

Physical activity levels and the prevalence of ill-health vary across age groups. One in five (19.7%) of 40-60 year olds (3 million adults) are physically inactive (completing less than 30 mins of moderate physical activity a week)<sup>24</sup>. Adults aged 40-60 years (ie ‘mid-life’) are being targeted as it has benefits across a range of dynamics by:

- enabling the development of positive habits as physical activity starts to decline (*Figure 3*)
- helping prevent and manage health conditions at a period of high risk (ie around 1 in 4 (25%) people aged 30-39 report having a long-lasting health condition compared to over 1 in 2 (55%) by ages 60-65<sup>13</sup>)
- for those who are parents, influencing the physical activity of children through parental role modelling, particularly in infancy and early childhood<sup>14,15</sup>

**Figure 3** Physical activity at recommended levels in England across age groups<sup>16</sup>



Inequalities in physical activity also exist within the 40-60 year old age group, including for the 7 million people with a lower income (ie socioeconomic category C2DE). Low income is associated with inactivity (eg 33% of women in the lowest income quartile are inactive compared to 18% in the highest<sup>17</sup>) and the following factors associated with lower levels of activity are more common in low income 40-60 year olds:

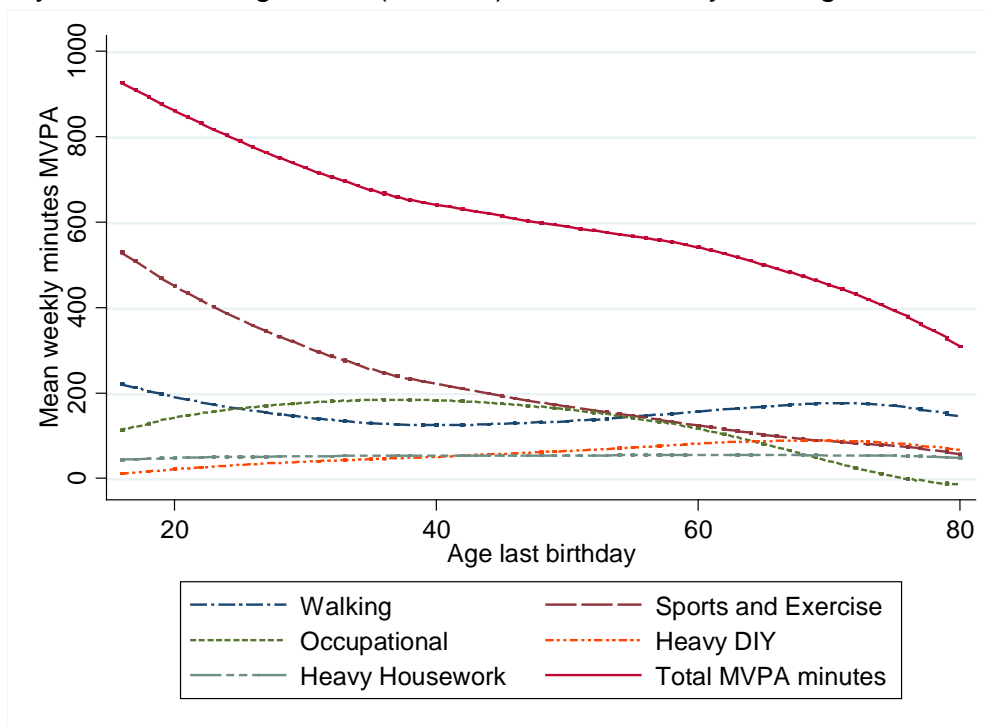
- greater likelihood of having a disability
- greater likelihood of having a long-term condition
- higher proportion from an Black or Minority Ethnic (BME) background

## Walking as a physical activity intervention

Brisk walking at 3 mph is a physical activity of ‘moderate intensity’, ie it has a rating of 3.3 metabolic equivalents (METS; a measure of how much energy is expended)<sup>18</sup>. An individual can tell if they are walking briskly or other activity is of moderate intensity because they will breathe faster, experience an increase in heart rate and feel warmer. Walking has also been highlighted by the UK CMOs as one of *“the easiest and most acceptable forms of physical activity....that can be incorporated into everyday life”*<sup>2</sup>. Walking therefore provides one of the greatest opportunities for those who are sufficiently mobile to be physically active.

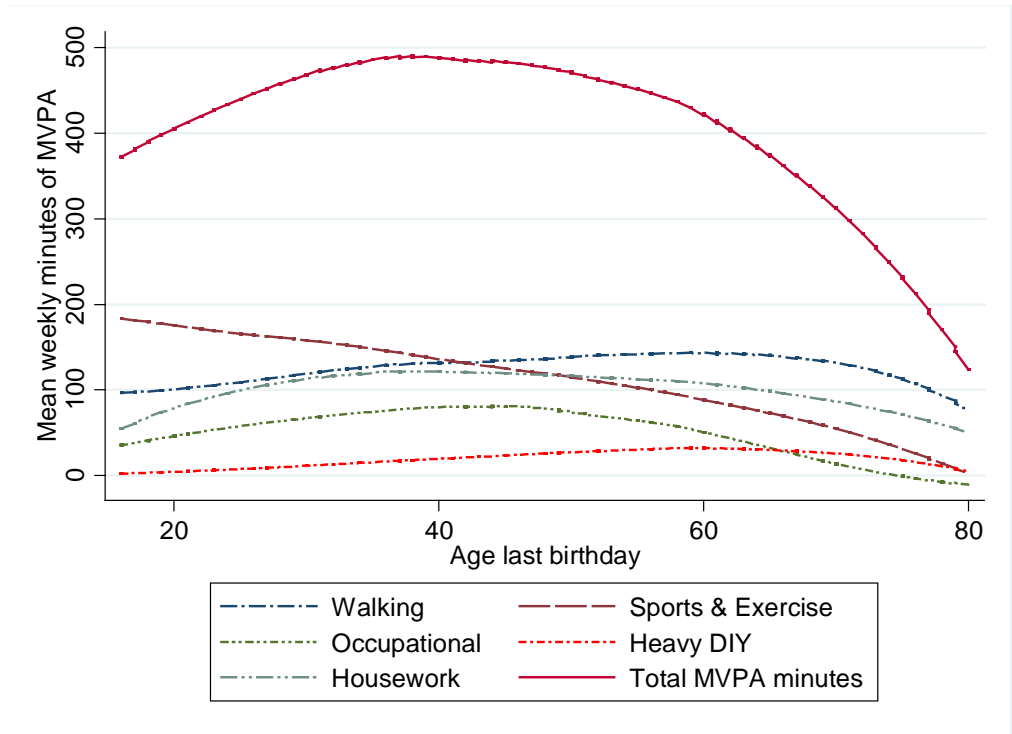
Physical activity is carried out in ‘domains’, ie performed in specific contexts such as travel, sport, occupational and domestic. For those who achieve the recommended physical activity levels there is significant variation in the types and domains of activity when one considers social, economic and demographic characteristics<sup>19,20,21</sup>. For adults who are less active, the relative contribution of walking is similar across genders and has limited age-related decline compared to exercise, cycling or swimming. An analysis of the 2012 Health Survey for England found that younger adults gained most of their activity through sports (53% in men and 43% in women), with the contribution declining in both genders differentially. In women the percentage of sport minutes dropped quickly with older age as housework and walking became more common sources of activity<sup>22</sup>. In men, occupational activity became increasingly important with advancing age, until 65-74 where it dropped dramatically. A similar but less pronounced occupational physical activity pattern was seen among women (*Figures 4 and 5*).

**Figure 4** Mean weekly minutes of domain-specific and total moderate-to-vigorous (MVPA) physical activity in 2012 amongst men (n=3621), Health Survey for England, 2012.





**Figure 5** Mean weekly minutes of domain-specific and total moderate-to-vigorous (MVPA) physical activity in 2012 amongst women (n=4537). Health Survey for England, 2012.



In addition to being accessible and acceptable, walking offers the potential to increase activity in adults compared to other forms of activity given its prevalence and enduring popularity with age. Adults aged 40-60 years in England spend more time walking per week than any other physical activity — 2 hours for men and 2.25 hours for women<sup>24</sup> — and 79% of adults do at least some walking every month<sup>24</sup>. In 2002, a third of adults said that walking for more than 10 minutes was their only form of exercise in a typical month<sup>23</sup>.

However, approximately four in 10 (41.3%) adults aged 40-60 years in England report not having walked at a brisk or fast pace for 10 minutes or more in the previous month<sup>24</sup>. Walking — including walking for everyday transport — has notably declined over recent decades overall. The average distance (miles per person per year) walked has fallen 15 miles between 1995/97 and 2015<sup>25</sup>. Walking trips as a percentage of overall trips in England declined from 27% to 22% between 1995/97 and 2015<sup>25</sup>.

Therefore there is a need to both encourage people who are walking to ensure that they are walking at a brisk pace and increase their regularity of walking, and to support those not walking regularly to develop the walking habit.

Further work is needed to explore the alternative opportunities for people with disabilities, especially lower limb impairment, that prohibit brisk walking as an everyday form of physical activity.

## Health benefits of 10 minutes brisk walking per day

Although the evidence for 10 minute bouts of walking is limited, it is clear that 70-90 minutes per week of *brisk* walking can improve fitness. A meta-analysis of available studies showed a significant weighted mean treatment effect (TE) of  $3.04 \text{ ml.kg}^{-1} \cdot \text{min}^{-1}$  of oxygen uptake (a measure of the uptake and utilisation of oxygen as an indicator of cardiovascular fitness)<sup>26</sup>. The benefits of such an improvement in aerobic capacity include greater ease of performance of everyday physical activities and improved quality of life for the individual<sup>27</sup>. From a population perspective, an improvement of this magnitude (approximately 10%) is likely to result in a 15% reduction in mortality<sup>28</sup>, irrespective of the baseline fitness level<sup>29</sup>. The daily dose of walking in these studies included 1-3 session(s) of ten minutes bouts of brisk walking. The authors reflected the importance of intensity of this walking, so promotion of walking for health benefits must stress intensity of at least 'moderate intensity' (64–76% Maximum Heart Rate)<sup>30</sup>; which equates to 'brisk' walking at a pace of 3 mph or more.

Brisk walking for 10 minutes has been demonstrated to help with low back pain<sup>31</sup>. Recreational physical activity has actually been demonstrated to be better than specific exercises for reducing lower back pain<sup>32</sup>.

In UK adults, self-reported brisk walking for personal transport was strongly associated with body leanness, with a greater association than other moderate intensity physical activities such as playing sport<sup>33</sup>. This is in line with a review of international surveys, which noted an inverse association between active transportation and obesity<sup>34</sup>.

The short term benefits of brisk walking are quickly noticed by low active / low fitness adults and can therefore be a motivator. It is likely that many of the health benefits associated with regular walking are derived from the 'last bout' or immediate effects from a single walk, including transitory changes in resting blood pressure<sup>35</sup>, increased insulin sensitivity<sup>36</sup> and improvements in the way in which the body handles dietary fat<sup>37</sup>.

Modelling suggests a considerable number of people in the English population could receive fitness and health benefits by walking regularly at 3 mph<sup>38</sup>. Therefore physical activity promotion focussing on brisk walking to achieve moderate intensity physical activity has the potential to significantly improve national levels of health in England.

Almost two-thirds (62.5%) of people with long-term conditions are inactive<sup>39</sup>, twice the rate in the population as a whole. Long-term conditions become more common in mid-life, with 42% of people aged 45-64 years having a long-term condition<sup>40</sup> and over a third (36.1%) having a limiting disability<sup>41</sup>. Addressing physical inactivity could disproportionately benefit those with long-term conditions, as it can improve management of some conditions (eg type 2 diabetes<sup>42</sup>) and people with long-term conditions are also more likely to develop many of the conditions that could be prevented by being active (including many cancers<sup>43</sup>).

Particular conditions and risks factors where benefits could be gained include:

- *high blood pressure* – Through a reduction in resting blood pressure associated with a reduced risk of death from stroke and coronary heart disease
- *diabetes* – Due to increased insulin sensitivity
- *being over-weight or obese* – By increased energy expenditure and increased metabolism
- *with mild to moderate depression or anxiety* – Through improved mood<sup>49</sup>
- *with musculoskeletal issues, such as lower back pain* – By a reduction in inflammation and pain

Disabled people are also at greater risk of many long-term conditions that could be prevented through physical activity, as well as other health and wellbeing issues that activity can help address (eg social isolation). Despite this greater potential for benefit, disabled people are twice as likely to be physically inactive<sup>44</sup>, with particularly low participation rates for some disabilities only (eg only one in four people with learning difficulties take part in physical activity each month compared to over half of those without a disability<sup>45</sup>).

Promotion of walking for health benefits has equal resonance for the two-thirds (64%) of disabled people with no mobility issues as for the general population, but there is a risk of inequalities for the one in three (36%) disabled people who are mobility impaired<sup>41</sup>. Mobility impaired adults unable to walk could still be encouraged to do 10 minute bursts of moderate intensity physical activity each day. For those in a wheelchair, wheeling a chair is classified as 'vigorous' rather than 'moderate' intensity activity (ie it achieves greater than 6.0 METs<sup>18</sup>), therefore 10 minutes of activity would accrue greater health benefits for the same period of time.

The aim of achieving even 70 - 90 minutes of walking per week, even in 10 minute blocks, may appear ambitious for some people. The most effective interventions that result in inactive people walking achieve an additional 30 minutes of walking per week for those individuals<sup>46</sup>. This may seem a small shift and improvement against a recommendation of 150 minutes per week, but fits the best randomised controlled trial evidence on the potential scale of change possible for inactive adults who start walking and moves this group out of the inactive category. In addition it is likely to be seen as achievable and aligns with the ambition of the UK physical activity guidance to target inactive adults to produce the greatest reduction in chronic disease

The WHO Health Economic Assessment Tool estimates that if the 7 million lower income (socioeconomic groups C2DE) 40-60 year olds in England walked briskly for 10 minutes per day, there is the potential to prevent 2,515 deaths per year and an economic saving of £3.1 billion per year. Therefore getting 1 in 10 of this cohort to walk briskly for 10 minutes per day could potentially prevent 251 deaths per year and save £310 million per year<sup>47</sup>.

## Conclusion

International evidence and the UK Chief Medical Officers' guidelines, *Start Active Stay Active*, highlight the frequency and type of physical activity required to achieve general health benefits, including 150 minutes physical activity of at least moderate intensity each week.

The 150 minutes or more per week recommendation in guidance provides the level at which health benefits are achieved across a wide range of conditions for an achievable amount of time over a week. While 150 minutes or more is required to achieve the breadth of health benefits, a level of benefits can be achieved through sessions of 10 minutes or more of at least moderate intensity activity.

The UK Chief Medical Officers' highlighted walking as one of *"the easiest and most acceptable forms of physical activity....that can be incorporated into everyday life"*. 'Brisk' walking (ie at least 3 mph) is an evidence-based choice for a promoting physical activity across the inactive population. It is already prevalent, has no skill, facility or equipment requirement and is more accessible and acceptable than other forms of physical activity for most people.

For the one in four adults who are chronically inactive a recommended 'dose' of an additional 10 minutes per day may seem ambitious, but is likely to be seen as achievable. Previous walking interventions have consistently demonstrated achieving an additional 30 minutes of walking per week, therefore lifting people out of the 'inactive' category (ie less than 30 minutes of moderate intensity physical activity per week) at which the greatest risks to health persist. It thereby aligns with the ambition of the UK physical activity guidance to target inactive adults to produce the greatest reduction in chronic disease.

Evidence has demonstrated the following health benefits from 10 minutes per day or 70- 90 minutes per week of brisk walking (or moderate intensity physical activity):

- increased physical fitness
- greater ease of performance of everyday physical activities
- improved mood
- improved quality of life
- increased body leanness and healthier weight
- 15% reduction in risk of early death

Individuals with an existing health condition would likely achieve greater health benefits due to improvements in management of their condition and reduced risk of developing comorbidities. This includes people: with or at risk of high blood pressure; with or at risk of diabetes – due to increased insulin sensitivity; who are over-weight or obese ; with mild to moderate depression or anxiety; or with musculoskeletal issues, such as lower back pain.

The accessibility and acceptability of walking has particular potential for a cohort of the population with particular need for increased physical activity, those in mid-life (aged 40-60 years) in lower socioeconomic groups. If 1 in 10 of the 7 million people within this section of the English population started to do 10 minutes of walking per day, it is estimated it would prevent 251 deaths per year and achieve an economic saving of £310 million per year<sup>47</sup>.

## Methodology Note

This report summarises the evidence collated through a rapid review of the evidence relating to 10 minutes of brisk walking conducted by Dr Mike Brannan, Dr Charlie Foster and Prof Marie Murphy.

## References

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- <sup>1</sup> World Health Organization (2010) *Global Recommendations on Physical Activity for Health*. [http://apps.who.int/iris/bitstream/10665/44399/1/9789241599979\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/44399/1/9789241599979_eng.pdf)
- <sup>2</sup> Department of Health (2011) *Start Active Stay Active*. <https://www.gov.uk/government/publications/start-active-stay-active-a-report-on-physical-activity-from-the-four-home-countries-chief-medical-officers>
- <sup>3</sup> Public Health England (based on Health Survey for England 2012, NHS Digital). Accessed: NatCen Social Research, University College London. Department of Epidemiology and Public Health. (2014). Health Survey for England, 2012. [data collection]. UK Data Service. SN: 7480, <http://doi.org/10.5255/UKDA-SN-7480-1>. [Unpublished]
- <sup>4</sup> Yang F, Trolle Lagerros Y, Belloc R, Adami HO, Pederson NL, Wirdefeldt K (2015) Physical activity and risk of Parkinson's disease in the Swedish National March Cohort. *Brain* 138: 269-75
- <sup>5</sup> Bredin SD, Warburton DE, Lang DJ (2013) The Health Benefits and Challenges of Exercise Training in Persons Living with Schizophrenia: A Pilot Study. *Brain Sciences* 3: 821-48
- <sup>6</sup> US Department of Health and Human Services (2008) *Physical activity guidelines for Americans*. <https://health.gov/paguidelines/pdf/paguide.pdf>
- <sup>7</sup> Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS (2010) A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. *International Journal of Behavioural Nutrition and Physical Activity* 7: 39
- <sup>8</sup> O'Donovan G, Blazeovich AJ, Boreham C, Cooper AR, Crank H, Ekelund U, Fox KR, Gately P, Giles-Corti B, Gill JM, Hamer M, McDermott I, Murphy M, Mutrie N, Reilly JJ, Saxton JM, Stamatakis E (2010) The ABC of physical activity for health: a consensus statement from the British Association of Sport and Exercise Sciences. *Journal of Sports Sciences* 28: 573–591.
- <sup>9</sup> Murphy MH, Blair SN, Murtagh EM (2009) Accumulated versus continuous exercise for health benefit: a review of empirical studies. *Sports Medicine* 39: 29–43.
- <sup>10</sup> UK Chief Medical Officers (2015) *Physical activity benefits for adults and older adults*. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/469457/Physical\\_activity\\_infographic.PDF](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/469457/Physical_activity_infographic.PDF)

- <sup>11</sup> UK Chief Medical Officers (2016) *Physical activity for children and young people (5-18 years)*.  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/507158/CYP\\_infographic.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507158/CYP_infographic.pdf)
- <sup>12</sup> Department of Health (2004) *At least five a week: Evidence on the impact of physical activity and its relationship to health*. A report from the Chief Medical Officer
- <sup>13</sup> Public Health England (based on Health Survey for England 2014, NHS Digital). Accessed: NatCen Social Research, University College London. Department of Epidemiology and Public Health. (2016). Health Survey for England, 2014. [data collection]. 2nd Edition. UK Data Service. SN: 7919, <http://doi.org/10.5255/UKDA-SN-7919-2>. [Unpublished]
- <sup>14</sup> Neshteruk CD, Nezami BT, Nino-Tapias G, Davison KK, Ward DS (2017) The influence of fathers on children's physical activity: A review of the literature from 2009 to 2015. *Preventive Medicine* 102:12-19.
- <sup>15</sup> Trost SG, Loprinzi PD (2011) Parental influences on physical activity behavior in children and adolescents: a brief review. *American Journal of Lifestyle Medicine* 5: 171-181
- <sup>16</sup> Health and Social Care Information Centre (2013) *Health Survey For England 2012. Volume 1: Health, social care and lifestyles*.  
<http://content.digital.nhs.uk/catalogue/PUB13218/HSE2012-Ch1-Intro.pdf>
- <sup>17</sup> British Heart Foundation (2015) Physical Activity Statistics 2015.  
<https://www.bhf.org.uk/publications/statistics/physical-activity-statistics-2015>
- <sup>18</sup> Ainsworth BE, Haskell WL, Leon AS, Jacobs DR Jr, Montoye HJ, Sallis JF, Paffenbarger RS Jr (1993) Compendium of physical activities: classification of energy costs of human physical activities. *Medicine and Science in Sports and Exercise* 25: 71-80.
- <sup>19</sup> Bélanger M, Townsend N, Foster C (2011) Age-related differences in physical activity profiles of English adults. *Preventive Medicine* 52: 247-9
- <sup>20</sup> Strain T, Fitzsimons C, Foster C, Mutrie N, Townsend N, Kelly P (2016) Age-related comparisons by sex in the domains of aerobic physical activity for adults in Scotland. *Preventive Medicine Reports* 3: 90-97.
- <sup>21</sup> Bhatnagar P, Townsend N, Shaw A, Foster C (2015) The physical activity profiles of South Asian ethnic groups in England. *Journal of Epidemiology & Community Health* 0: 1-7
- <sup>22</sup> Roberts D, Townsend N, Foster C (2016) Use of new guidance to profile 'equivalent minutes' of aerobic physical activity for adults in England reveals gender, geographical, and socio-economic inequalities in meeting public health guidance: A cross-sectional study. *Preventive Medicine Reports* 4: 50-60.
- <sup>23</sup> Office for National Statistics (2002) *Social Trends* No. 32  
<http://www.ons.gov.uk/ons/rel/social-trends-rd/social-trends/no--32--2002-edition/index.html>
- <sup>24</sup> Unpublished analysis of Active Lives Survey 2015-16 data.

- <sup>25</sup> Department of Transport (2015) *National Travel Survey: England 2015*.  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/551437/national-travel-survey-2015.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/551437/national-travel-survey-2015.pdf)
- <sup>26</sup> Mutagh EM, Nichols L, Mohammed MA, Holder R, Nevill AM, Murphy MH (2015) The effect of walking on risk factors for cardiovascular disease: An updated systematic review and meta-analysis of randomised control trials. *Preventive Medicine* 72: 34-43
- <sup>27</sup> Murphy MH, Nevill AM, Murtagh EM, Holder RL (2007) The effect of walking on fitness, fatness and resting blood pressure: a meta-analysis of randomised, controlled trials. *Preventive Medicine* 44: 377–385
- <sup>28</sup> Dunn AL, Marcus BH, Kampert JB, Garcia ME, Kohl HW, Blair SN (1999) Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness — a randomized trial. *Journal of American Medical Association* 281: 327–334
- <sup>29</sup> Blair SN, Kohl HW, Barlow CE, Paffenbarger RS, Gibbons LW, Macera CA (1995) Changes in physical-fitness and all-cause mortality — a prospective-study of healthy and unhealthy men. *Journal of American Medical Association* 273: 1093–1098
- <sup>30</sup> American College of Sports Medicine (2017) *ACSM's Guidelines for Exercise Testing and Prescription*. 10th ed. Philadelphia: Wolters Kluwer
- <sup>31</sup> Taylor NF, Evans OM, Goldie PA (2003) The effect of walking faster on people with acute low back pain. *European Spine Journal* 12:166–172.
- <sup>32</sup> Hurwitz EL, Morgenstern H, Chiao C (2005) Effects of recreational physical activity and back exercises on low back pain and psychological distress: findings from the UCLA Low Back Pain Study. *American Journal of Public Health* 95:1817–1824
- <sup>33</sup> Murphy MR, Donnelly P, Shibli S, Foster C, Nevill AM (2012) Physical activity, walking and leanness: An analysis of the Northern Ireland Sport and Physical Activity Survey (SAPAS). *Preventive Medicine* 54:140–144
- <sup>34</sup> Bassett DR, Pucher J, Buehler R, Thompson DL, Crouter SE (2008) Walking, cycling and obesity rates in Europe, North America and Australia. *Journal of Physical Activity and Health* 5: 795–814
- <sup>35</sup> Park S, Rink LD, Wallace JP (2008) Accumulation of physical activity: blood pressure reduction between 10-min walking sessions. *Journal of Human Hypertension* 22: 475–482

- <sup>36</sup> Yap MC, Balasekaran G, Burns SF (2015) Acute effect of 30 min of accumulated versus continuous brisk walking on insulin sensitivity in young Asian adults. *European Journal of Applied Physiology* 115: 1867-1875
- <sup>37</sup> Maraki MI, Sidossis LS (2013) The latest on the Effect of Prior Exercise on Postprandial Lipaemia. *Sports Medicine* 43: 463-481
- <sup>38</sup> Kelly P, Murphy M, Oja P, Murtagh E M, & Foster C (2011) Estimates of the number of people in England who attain or exceed vigorous intensity exercise by walking at 3 mph. *Journal of Sports Sciences* 29: 1629-1634
- <sup>39</sup> Public Health England (based on Health Survey for England 2012, NHS Digital). Accessed: NatCen Social Research, University College London. Department of Epidemiology and Public Health. (2014). Health Survey for England, 2012. [data collection]. UK Data Service. SN: 7480, <http://doi.org/10.5255/UKDA-SN-7480-1>. [Unpublished]
- <sup>40</sup> Steadman K, Woods M, Silvester H (2015) Health and wellbeing at work: a survey of employees. <https://www.gov.uk/government/publications/health-and-wellbeing-at-work-survey-of-employee>
- <sup>41</sup> Office of National Statistics (2013) *Life Opportunities Survey 2009-2012*. London: Office of National Statistics.
- <sup>42</sup> Boule NG, Haddad E, Kenny GP, Wells GA, Sigal RJ (2001) Effects of exercise on glycemic control and body mass in Type 2 Diabetes mellitus. A meta-analysis of controlled clinical trials. *Journal of the American Medical Association* 286:1218–1227
- <sup>43</sup> Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT (2012) Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet* 380:219-29
- <sup>44</sup> Public Health England Physical Activity Tool. Accessed 12 February 2017. <http://fingertips.phe.org.uk/profile/physical-activity/>
- <sup>45</sup> Sport England Active People Survey December 2013 (sport once a month, any sport, any duration)
- <sup>46</sup> Ogilvie D, Foster CE, Rothnie H, Cavill N, Hamilton V, Fitzsimons CF, Mutrie N. (2007) Interventions to promote walking: systematic review. *British Medical Journal* 334:1204–1207.
- <sup>47</sup> Analysis using the WHO/Europe Health Economic Assessment Tool (<http://www.heatwalkingcycling.org/>) with the UK Department of Transport's £1.6m value of a statistical life. Accessed on 13 February 2017.
- <sup>48</sup> US Department of Health and Human Services (2008) *Physical activity guidelines for Americans*. <https://health.gov/paguidelines/pdf/paguide.pdf>
- <sup>49</sup> Baker G, Gray S, Wright A, Fitzsimons C, Nimmo M, Lowry R, Mutrie N and the Scottish Physical Activity Research Collaboration (2008) The effect of a pedometer-based community walking intervention “Walking for Wellbeing in the West” on physical activity levels and health



10 minutes brisk walking each day in mid-life for health benefits and towards achieving physical activity recommendations

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outcomes: A 12-week randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity* 5: 44–49