Estimates of the number of people in England who attain or exceed vigorous intensity exercise by walking at 3 mph

PAUL KELLY[1], MARIE MURPHY[2], PEKKA OJA[3], ELAINE M. MURTAGH[4], & CHARLIE FOSTER[1]

[1]*BHF Health Promotion Research Group, University of Oxford, Oxford, UK,* [2]*University of Ulster, Sport and Exercise Science Research Institute, Jordanstown, UK,* [3]*UKK Institute for Health Promotion Research, Tampare, Finland, and* [4]*Mary Immaculate College, Arts Education and Physical Education, South Circular Road, Limerick, Co. Limerick, Ireland*

Abstract

Walking is a safe, accessible and low cost activity, amenable to change and known to have great potential to increase physical activity levels in sedentary individuals. The objective of this study is to estimate the proportion of the 2009 adult population of England who would attain or exceed vigorous intensity activity (>70% maximum heart rate [HR_{max}]) by walking at 3 mph. We conducted predictive impact modelling using participants' ($n = 1741$, aged 25–64 years) cardiovascular fitness data from treadmill walking tests. We combined this data with English population estimates adjusted for age and sex to estimate the numbers of individuals that would exceed 70% HR_{max} (an intensity considered sufficient for fitness gains) when walking at 3 mph (4.8 km $\cdot$ h^{-1}). We estimate 1.5 million men (95% confidence interval [CI] 0.9–2.2 million) (from 13.4 million corresponding to 11.6% (95% CI 7.0–16.2%)) and 3.9 million women (95% CI 3.0–4.8 million) (from 13.6 million corresponding to 28.6% (95% CI 22.0–35.1%)) in England aged 25–64 years would benefit from regularly walking at 3 mph. In total, a projected 5.4 million individuals (95% CI 3.9–6.9 million) aged 25–64 (from 26.97 million corresponding to 20.1% (95% CI 14.6–25.7%)) could benefit from walking at 3 mph. Our estimates suggest a considerable number of individuals in the English population could receive fitness and health benefits by walking regularly at 3 mph. Physical activity messages that promote walking at this speed may therefore have the potential to significantly impact national fitness levels and health in England.

Keywords: *Walking, fitness, public health*

Introduction

Walking has been described as the safest, most convenient form of physical activity. It is low-impact, low cost and readily accessible, requiring no special skills or equipment (Albright, 2000; Ogilvie et al., 2007). It can be readily assimilated into daily life through active transportation and can be continued into old age (Ogilvie et al., 2007). It is an important form of activity to many individuals due to an unwillingness or inability of a large proportion of the population to participate in more vigorous activities (Hamer & Steptoe, 2008). Systematic review of exercise interventions has shown walking to have the greatest potential for increasing activity levels in sedentary individuals (Hillsdon, Foster, & Thorogood, 2005; Hillsdon & Thorogood, 1996). As many adults in England are not meeting physical activity recommendations (Department of Health, 2006, 2008), walking may be a suitable activity to address this issue.

Despite the potential benefits of walking current levels are relatively low; the 2008 Health Survey for England found that only 41% of men and 34% of women reported any walking in the previous four weeks (Department of Health, 2008). Other studies have shown that this walking is socially patterned and the pattern varies by walking purpose; walks over 30 minutes at a fast or brisk pace are more common among affluent groups, whereas walking for transport reveals an opposite trend (Department of Health, 2006, 2008; Scottish Executive Health Department, 2005; Transport Statistics, 2006).

Attaining moderate levels of fitness through physical activities such as walking is related to significantly lower death rates, and has protective

effects against the influences of smoking, raised blood pressure, elevated cholesterol and general poor health (Blair et al., 1996). Low levels of physical fitness have been shown to be an independent risk factor for cardiovascular disease (CVD) (Haskell, Blair, & Hill, 2009). From a public health perspective, small improvements in exercise capacity and fitness can translate into clinically significant alterations in health risk and all-cause mortality (Myers et al., 2002).

Exercising at 60% $\dot{V}O_{2max}$, corresponding to approximately 70% maximum heart rate (HR_{max}), is considered greater than moderate intensity (Pollock et al., 1998) and can lead to substantial increases in $\dot{V}O_{2max}$ with associated health benefits (Asikainen et al., 2002). Walking is traditionally considered a low–moderate intensity activity, unlike activities such as running, cycling, swimming and other sports. However, previous research has identified the proportions of a population representative sample that exceed 70% HR_{max} when walking for 1 mile at 3 mph (Morris & Hardman, 1997; Sports Council and Health Education Authority [SCHEA], 1992) demonstrating that walking is not a low–moderate intensity activity for everyone. Until now these data have not been extrapolated to population estimates, or the results converted into public health messages or policy guidance on walking.

There are approximately 27 million adults aged 25–64 in England (UK National Statistics, 2009) and this investigation is an attempt to estimate the number of these individuals that would attain or exceed a level of exercise intensity sufficient for significant improvements in fitness ($>70\%$ HR_{max}) and receive the associated health benefits by walking at 3 mph. While the outcome of walking at 3 mph is affected by relative intensity when people perform a given volume of physical activity (Shephard, 2001), the results may be instructive regarding the potential impact of increasing walking on population fitness and health. The purpose of this study was therefore to estimate the proportion of the 2009 adult population of England who would attain or exceed vigorous intensity activity ($>70\%$ HR_{max}) by walking at 3 mph.

Method

The Allied Dunbar National Fitness Survey (ADNFS) conducted in 1992 required participants ($n = 1741$) to walk for 1 mile (1.6 km) on a motor driven treadmill at 3 mph (4.8 km $\cdot$ h^{-1}) (SCHEA, 1992). This represented 53% of the base sample. The cardiovascular response to this was observed with a continuous recording of the participants' electrocardiogram to measure heart rate. Maximum heart rate was predicted by 220 minus age in years, allowing percentage maximum heart rate to be calculated (SCHEA, 1992). Probability sampling at three stages of selection (area, address and respondent) was used to yield a representative sample of the residential adult population in England. The response rate to the treadmill testing was 53% (SCHEA, 1992).

In their influential 1997 paper, *Walking to Health*, Morris and Hardman represented these data as proportions of the sample that did not exceed 70% HR_{max} when completing this exercise prescription (Morris & Hardman, 1997). The proportion of men and women aged 25–34, 35–44, 45–54 and 55–64 who exceeded 70% of HR_{max} when walking at 3 mph is shown in Table I. We applied these proportions to the 2009 English population estimates by age and sex (UK National Statistics, 2009) to estimate by 10 year age band the numbers of individuals in England aged 26–64 that would exceed 70% HR_{max} and therefore

Table I. Estimated numbers of individuals in England who would attain vigorous intensity activity by walking 1 mile at 3 mph.

	Age	Number in English population ($\times 1000$)[a]	% exceeding 70% HR_{max} walking @ 3 mph (4.8 km $\cdot$ h^{-1})[b] (with 95% CI)	Number getting training effect ($\times 1000$) (with 95% CI)	% of population getting training effect (with 95% CI)
Men	25–35	3352.7	2 (0–4.4)	67.1 (0–147.5)	
	35–44	3875.1	8 (4.2–11.8)	310.0 (162.8–457.3)	
	45–54	3230.6	9 (5.0–13.0)	290.8 (161.5–420.0)	
	55–64	2928.6	30 (21.1–38.9)	878.6 (617.9–1139.2)	
		13387.0		**1546.5** (942.2–2164.0)	**11.6** (7.0–16.2)
Women	25–35	3355.5	12 (7.6–16.4)	402.7 (255.0–550.3)	
	35–44	3917.5	19 (13.7–24.3)	754.6 (536.7–952.0)	
	45–54	3285.7	38 (31.3–45.7)	1248.6 (995.6–1501.6)	
	55–64	3028.8	49 (39.7–58.3)	1484.1 (1202.4–1765.8)	
		13587.5		**3890.0** (2989.7–4769.7)	**28.6** (22.0–35.1)

[a]Population estimates sourced http://www.statistics.gov.uk.

[b]Direct measure of heart rate for adults taken from Morris and Hardman Walking to Health paper, p324, British Journal of Sports Medicine, May 1997. They referenced Allied Dunbar National Fitness Survey data.

attain vigorous intensity activity by walking at 3 mph. 95% confidence intervals (CIs) on the proportions were calculated from the ADNSF age band sample sizes.

Results

We estimate 1.5 million men (95% CI 0.9–2.2 million) (from 13.4 million corresponding to 11.6% (95% CI 7.0–16.2%)) and 3.9 million women (95% CI 3.0–4.8 million) (from 13.6 million corresponding to 28.6% (95% CI 22.0–35.1%)) in England aged 25–64 years would achieve vigorous intensity activity by walking at 3 mph. In total, a projected 5.4 million individuals (95% CI 3.9–6.9 million) aged 25–64 (from 26.97 million corresponding to 20.1% (95% CI 14.6–25.7%)) would achieve vigorous intensity activity by walking at 3 mph (see Table I). This means that potentially over one in four women and one in ten men are likely to improve fitness and other CVD risk factors by regularly walking at just 3 mph.

In men, the numbers who would achieve vigorous intensity by walking at 3mph increase from 25–34 to 35–44 years, appear relatively stable from 35–44 to 45–54 years and increase sharply from 45–54 to 55–64 years (see Figure 1). In women, the numbers who would achieve vigorous intensity by walking at 3 mph rise with increasing age in an apparently linear fashion (see Figure 2).

Discussion

We estimated the number of adults in England that could attain vigorous intensity by walking at 3 mph. Our estimates show that a projected total of 5.4 million individuals (95% CI 3.9–6.9 million) or almost one fifth of all individuals aged 25–64 could

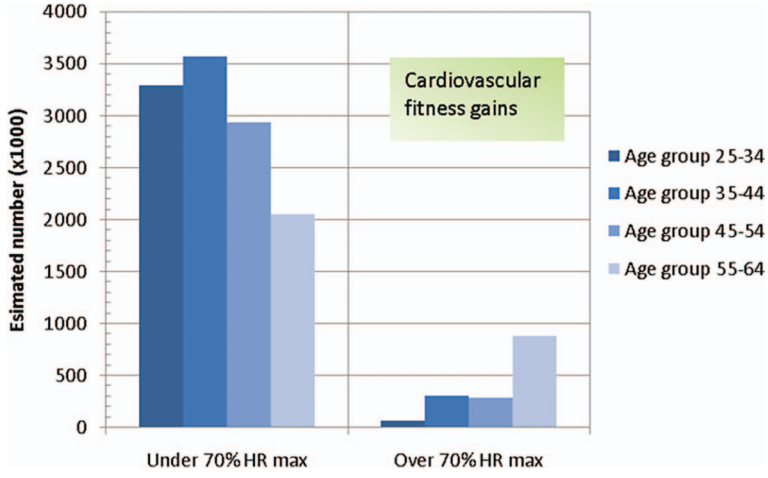

Figure 1. Estimated numbers of each age group for men who are over or under 70% HR_{max} when walking for 1 mile at 3 mph.

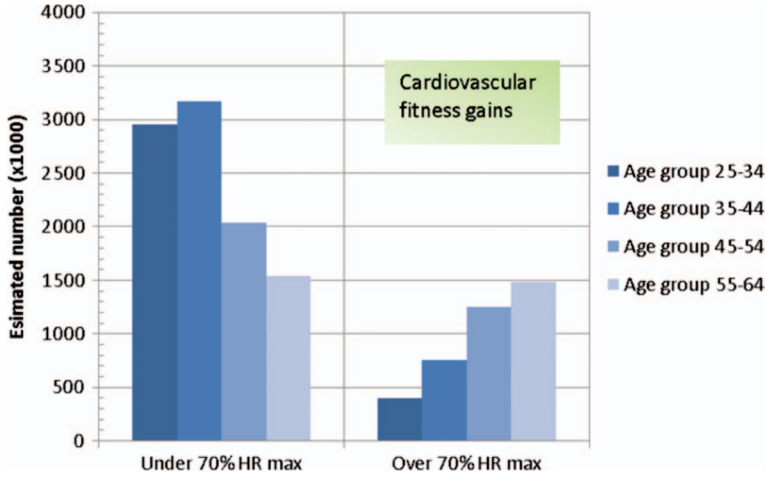

Figure 2. Estimated numbers of each age group for women who are over or under 70% HR_{max} when walking for 1 mile at 3 mph.

achieve the intensity considered necessary to improve fitness and other CVD risk factors from this speed of walking (see Table I).

Strengths and limitations

Our estimate builds on the original ADNFS data (SCHEA, 1992) and proportions by age group shown by Morris and Hardman (1997) as it takes into account that in England the relative sizes of the age groups are different; there are more individuals in the 25–35 years group than 55–65 years. We have de-normalised the proportions to get estimated population numbers and show the potential for attaining vigorous intensity in a significant portion of the population of England by walking at 3 mph.

We use 70% HR_{max} as it is the accepted threshold for attaining the health benefits and corresponds well to the lower limit of vigorous intensity physical activity (Mazzeo et al., 1998). If we had chosen 55% HR_{max} as the cut-off, corresponding to the lower limit of moderate intensity activity, the fitness gains would not have been as substantial, but the numbers receiving these gains would have been much higher. Our estimates can therefore be considered conservative as they include only the numbers attaining $\geq$70% HR_{max} (vigorous intensity) who therefore have the potential to achieve substantial fitness and associated health gains.

The selection of walking at 3 mph for our estimate is supported by other research. When walking for recreation or leisure one study of 82 participants, aged 21 to 74 years found that self-selected walking speeds were 3.48 ± 0.39 mph (Murtagh, Boreham, & Murphy, 2002). This suggests that a speed of 3 mph may be a reasonable target for a public health message. It has been shown that faster walking has substantially greater effects on health (Schnohr, Scharling, & Jensen, 2007) so the selection of 3 mph is again likely to lead to a conservative estimate of the effect of walking on population fitness and health.

Limitations of the present study should also be acknowledged. The ADNFS data were collected in 1992 and show population fitness levels of the time. It is known that population activity behaviour has changed in the intervening period, with occupational activity declining and sports participation increasing (Stamatakis, Ekelund, & Wareham, 2007). The documented increase in health inequalities (Department of Health, 2009; Graham & Kelly, 2004) indicate that there may be more unfit individuals in the population today, and our results may be an underestimate of the number who stand to benefit from walking at 3 mph.

Our estimates show that a considerable number of unfit or de-conditioned individuals could benefit from walking at 3 mph. It is not clear what impact faster paces of walking could have for the more active sections of the population.

Predicted HR_{max} was calculated by 220 minus age, and though the error on this is likely to cancel out over a population sample this is less accurate than other methods. The estimate of intensity level as a function of $\dot{V}O_{2max}$ is derived from % HR_{max}, a method used previously (Oja, 1973), as only HR_{max} data was available. The heart rate data is not adjusted for bodyweight, so may underestimate fitness of overweight participants.

The original fitness data may be subject to selection bias as participants had to agree to various fitness testing regimes, some strenuous. The response rate to the treadmill testing was 53% (SCHEA, 1992). It is possible that this selected a fitter sample, unrepresentative of real population fitness levels, which may in fact be somewhat lower. This would again suggest our results could be an underestimate of the numbers who stand to benefit.

Furthermore, this model does not specify the dose or frequency of walking at 3 mph required; just that walking at 3 mph is intense enough for almost one quarter of the population to achieve vigorous activity. Our assumption is that individuals would meet current physical activity recommendations through walking at 3 mph. However it should be acknowledged that for some unfit/inactive individuals walking at 3mph may not equate to $>$ 70% HR_{max}. It is recognised that in a heterogeneous sample, outcome is affected by relative intensity of physical activity (Shephard, 2001).

Comparison to literature

We think this is the first population estimate of the number of individuals who could attain vigorous intensity activity by walking at 3 mph and therefore have the potential to achieve substantial improvement in fitness and other CVD risk factors.

Meaning, possible explanation, implications

These findings indicate that a considerable number of individuals in England may achieve vigorous intensity activity from a seemingly mild exercise target of regularly walking at 3 mph. A possible explanation for this is that a large number of individuals in the English population have low cardiovascular fitness as a result of physical inactivity and high levels of sedentary behaviours (Department of Health, 2006, 2008). Therefore, the training stimulus required is low for these individuals. Several intervention studies have demonstrated that walking at $\geq$70% HR_{max} results in fitness improvements in adults (Morton, West, & Stephens, 2010; Nicklas

et al., 2009) highlighting the potential for walking regularly at our target walking speed to improve the cardio-respiratory health of 20% of the population of England.

The data show that increasing age is related to lower fitness levels (see Figures 1 and 2). Therefore, walking as an activity for health may be most important to older members of the English population who find other modes of exercise daunting or unmanageable due to low existing fitness levels and age associated physical difficulties.

Our results show that the potential impact is much greater in women than men (see Figures 1 and 2); possibly as their fitness levels are lower. This suggests that walking speed related messages could be a particularly relevant physical activity target for improving fitness and health in women. The differences in the way the numbers who stand to benefit rise with age by gender (see Figures 1 and 2) may in some part be explained by higher occupational activity in men of less than 55 years acting to maintain fitness levels.

Potential public health message

We would like to open a debate with our fellow academics and physical activity practitioners on the possible merit of applying our findings in creating a public health message to promote walking. This message is not intended to replace existing recommendations for adult levels of physical activity (Pollock et al., 1998; US Department of Health and Human Services, 2008) but to reflect and translate the guidelines. We suggest the following example message might be considered for health promoters:

'Regularly walking at just 3 mph can confer substantial health benefits to unfit, sedentary and inactive individuals'.

We acknowledge that the practicality of asking adults to walk at 3mph with or without feedback on their walking speed warrants further investigation and encourage health promoters to find suitable examples and messages that can be used to promote walking at this speed. Pedometer-based strategies involving a 'stepping rate' recommendation have the potential to assist in formulating an appropriate message (Johnson et al., 2006). Emerging research using music to dictate walking pace in patient populations is encouraging (Conklyn et al., 2010; De Bruin et al., 2010). Walking pace messages may need to be tailored for specific subsets of the population. For example, it has previously been demonstrated that a freely-selected pace consistent with 'walking for pleasure' evoked a relative exercise intensity of 70% HR_{max} in obese adults (Hills, Byrne, Wearing, & Armstrong, 2006). A caveat worth noting is that the physical activity message must be directed to inactive adults only, so that already active adults do not assume that walking speeds lower that they are currently engaging in are preferable.

Future research

We think future research should be directed to how this message can be communicated to the relevant individuals or demographics. Furthermore, does it have the potential to actually get the most unfit and physically inactive walking at 3 mph?

Research should be conducted to explore the potential impact of walking at 3 mph in age ranges over 65 (not included in this study) where fitness is likely to be lower, the numbers standing to benefit higher and where walking is the most accessible and often only form of physical activity. Investigation into the benefits of walking at faster paces for fitter, more active individuals of all ages would also be instructive.

Finally, similar modelling in other countries would provide an interesting comparison of international 'un-fitness' levels and provide information about where walking physical activity recommendations could be most effective.

Conclusion

A considerable number of the English population is so physically de-conditioned that walking, even at a relatively slow pace of 3 mph, is sufficient for fitness and health gains, based on heart rate thresholds. Physical activity messages that increase walking at this speed in the most unfit may therefore have the potential to significantly impact national fitness levels and health in England.

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