Natural England Research Report NERR062

# Investigating the potential increase in health costs due to a decline in access to greenspace: an exploratory study

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# Executive Summary

Having pleasant and accessible places to exercise is known to be related to the quantity of physical exercise that people undertake. Greenspaces such as parks and woodlands can be key places where exercise occurs, and they are likely to play a role in encouraging physical activity.

This exploratory study examines the people most likely to reduce their exercise levels as a result of a decline in greenspace quality and accessibility. We find that there are around 4.7 million regular walkers in English greenspace, and of these, there are over 700,000 people who are unlikely to substitute their current level of greenspace exercise for exercise elsewhere, should greenspace access or quality decline.

These people undertake on average over 3 hours of walking in greenspace each week, and are motivated to do so by a desire to relax, unwind and enjoy fresh air. If they were to lose access to convenient, quality greenspaces, the health implications are potentially significant.

Using the World Health Organization's Health Economic Assessment Tool, the loss of physical activity is estimated to lead to an additional 374 deaths per year, with an economic cost of £434 million per year.

A complementary analysis using the University of East Anglia's MOVES model suggests that there would be over 2,300 additional cases of life-limiting disease annually. The additional cost to the English healthcare system is estimated at £23.6 million per year.

This illustrative analysis demonstrates that, even when calculated with conservative parameters, greenspaces are making a significant contribution to increasing national health and wellbeing. These figures are produced focussing only on the direct link between health and exercise, and do not include the wider mental health benefits of time spent in the natural environment, or indeed other benefits offered by greenspace such as flood control, temperature regulation and air quality improvements, which also have direct and distal health benefits. It is important that these multiple benefits are considered when planning for greenspace provision.

# Contents

# 1 Introduction

The natural environment offers a range of pleasant places for people to walk and be physically active. For this analysis we are particularly interested in accessible greenspaces near to where people live, in and around towns and cities, and the terms ‘greenspace’ and ‘natural environment’ are used interchangeably.

An ongoing decline in the quality and accessibility of urban greenspaces (Davies et al. 2011) may have a negative effect on those individuals who use these places regularly and obtain health benefits from doing so. In this exploratory study we examine the greenspace users most at risk of reducing their exercise levels due to a decline in greenspace quality or accessibility. We use the Health Economic Assessment Tool (HEAT) for walking to estimate the economic cost of their increased mortality, and the Model for Estimating the Outcomes and Values in the Economics of Sport (MOVES) model to understand the additional costs this loss of exercise may impose on the English healthcare system due to increasing levels of morbidity.

This analysis adds to our understanding of the potential scale of the health effects associated with losses in urban greenspace, particularly in relation to those users who are currently active. It also highlights many of the key gaps in our knowledge of greenspace users.

# 2 Background

In 2011, over 17.5 million people in the UK aged 16 and over did not meet the UK Chief Medical Officer's minimum recommendations for physical activity[1] (Health and Social Care Information Centre 2013). This has significant implications for population health and medical expenditure. Scarborough and colleagues estimate that that in 2006-07, £0.9 billion was spent by the NHS on physical inactivity related ill-health. This includes costs associated with increased prevalence of ischaemic heart disease, stroke, breast cancer, colorectal cancer and diabetes mellitus (Scarborough et al 2011). Increasing the level of physical activity in the UK population is a key objective of the Department of Health, working in conjunction with other government departments (Public Health Policy and Strategy Unit 2013).

For both children and adults, parks and other greenspaces can be important locations for physical activity. In a study of users of Birchwood Forest Park in Warrington, UK, 47 per cent of park users were observed walking/cycling through the park, 17 per cent were undertaking sport or exercise activities, 9 per cent of users were dog walking, 8 per cent were walking for leisure, and 6 per cent were playing (children only) (Tzoulas and James 2010). A study in urban Bristol, UK, by Lachowycz et al (2012) found that 26.4 per cent of children's after school moderate-vigorous activity, and 17.8 per cent of their weekend moderate-vigorous activity, occurred outdoors. However, the vast majority of moderate-vigorous activity actually occurred indoors (72.6 per cent of moderate-vigorous activity after school, and 78.7 per cent on weekends), suggesting that whilst parks and shared greenspaces are important, they are not the only environments contributing to physical activity. Furthermore, it is unclear to what extent people are willing to substitute greenspaces for other locations suitable for physical activity.

The National Ecosystem Assessment identified that there was a decline in the condition and accessibility of UK urban greenspace between 1970 and 2000. Key issues have been reductions in funding for public parks, land management skills shortages, and the sale of sporting facilities for development (Davies et al 2011). A study of 11 wards in Merseyside, UK, found that between 1975 and 2000, the amount of vegetated land cover declined by 6 per cent, and there was a corresponding increase in built infrastructure (Pauleit, Ennos and Golding 2005). The recent report, *State of UK Public Parks 2014*, found that 86 per cent of parks managers reported budget cuts since 2010, and 81 per cent of local authorities had reduced park management staff. Liverpool City Council's parks department budget will be cut by 50 per cent in the next three years. Additionally, 45 per cent of councils are reported to be considering selling or disposing of some of their greenspace assets (Heritage Lottery Fund 2014).

It is not known if this decline in greenspaces will be offset by an increase in alternative exercise facilities such as gyms or swimming pools, however given the pay-per-use nature of such facilities, it is unlikely that these can entirely fill the niche held by urban greenspaces, particularly for disadvantaged groups in society. It is therefore possible that the ongoing decline in urban greenspace may be contributing to reductions in the amount of physical activity undertaken by the UK population.

Bauman and Bull (2007) conducted a systematic review of existing literature reviews examining the different variables associated with physical activity. They found that access to physical activity facilities, convenient destinations, land use and urban 'walkability' were all correlated with physical activity. Perceived aesthetics was also found to be significantly associated with physical activity. However, all of these studies are cross-sectional, and therefore can only demonstrate that

[1] At least 150 minutes of moderate, 75 minutes of vigorous activity, or an equivalent combination of these per week.

environmental attributes are correlated with a higher level of walking, not that environmental attributes caused an increase in walking activity.

The RESIDE study in Perth, Australia was a longitudinal study of individuals before and after moving into a new housing development. Participants were monitored using a pedometer for a week, before the move and one year after the move. The study found that an increase in access to recreational facilities (an additional park within 1.6 km, or beach within 800m) was associated with an increase in recreational walking time by between 17.6 and 22.1 minutes per week, above a baseline average of 69 minutes per week (Giles-Corti et al 2013). This represents around a 27 per cent increase in recreational walking. There are reasons why this research is of limited applicability to England. Firstly, the study examined new homes which were largely in greenfield sites; and secondly, Perth has a dry Mediterranean climate with an average monthly temperature of around 25°C during the hottest summer months[2]. However it does offer useful evidence that changes in access to greenspace may lead to changes in walking levels.

Current research is suggestive of a link between the natural environment and physical activity, although both longitudinal research and UK-based research is rare. In a context of declining greenspace access, it is important to understand the potential contribution that the greenspace could make to maintaining regular physical activity and avoiding the costs associated with sedentary lifestyles.

[2] Whilst English winter weather may not be conducive to outdoor exercise, extreme heat in the Perth summer time can have a similar effect!

# 3 Methodology

## Data sources and models

The Monitor of Engagement with the Natural Environment (MENE) is an ongoing survey of English adults, carried out by Natural England. It uses quotas to obtain a balanced sample of respondents, who are asked about recent visits to the natural environment. Further information on MENE survey design and sampling is available in Natural England (2013).

Data on walking behaviour from this survey was analysed using two complementary tools- the Health Economic Assessment Tool (HEAT) for Walking, developed by the World Health Organization, and the Model for Estimating the Outcomes and Values in the Economics of Sport (MOVES) model developed by the University of East Anglia Medical School. Both of these models examine the health effects of a change in physical activity. Mental health is included only where the physical activity is linked to a specific mental health effect (for instance, effects of physical activity on depression or dementia). This analysis therefore does not include the general mental health benefits of being near to greenspace (see Rolls and Sunderland 2014 for an overview of the evidence).

HEAT values reductions in mortality attributed to increased physical activity, using Value of a Statistical Life (VSL). Estimates of the dose-response relationship between physical activity and life expectancy were obtained from a review of epidemiological studies. Further detailed information on the HEAT tool methodology can be found in World Health Organization (2011).

The MOVES model was developed for Sport England to estimate the economic benefits of participating in physical activities[3]. The model estimates changes associated with reductions in disease risk (reduced morbidity) as a result of physical activity. Key information on the dose-response relationship of physical activity on disease risk was obtained from Woodcock et al. (2011). The MOVES model presents results in terms of the number of disease cases averted, change in Quality Adjusted Life Years (QALYs), and effects on treatment costs. Treatment cost estimates were obtained from Allender et al. (2007). Treatment costs are based on average costs per QALY, and not the marginal cost for each additional case. This may be higher or lower depending on the extent to which each additional case affects fixed and variable costs of treatment. A hospital, for instance might be able to treat the case within its current capacity, so the cost of treatment is medication only, or it might be already at capacity and treating the additional case requires investment in additional doctors or facilities. In the absence of this very specific information, average treatment costs have been used.

## Identification of regular walkers

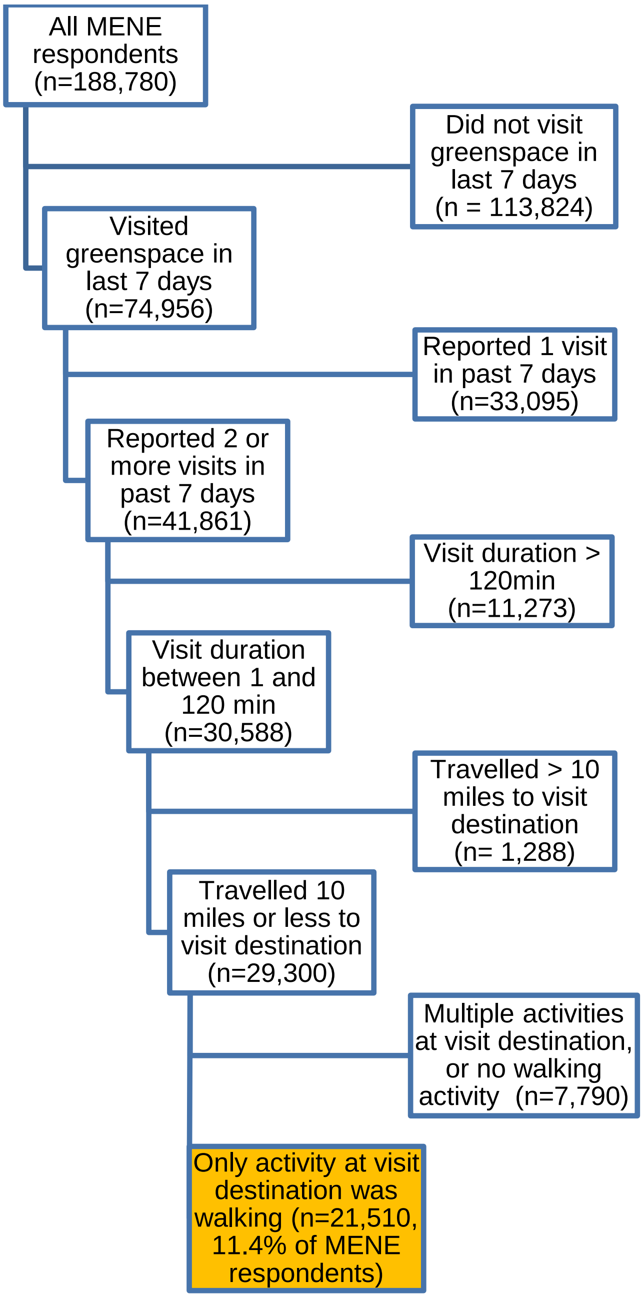
The MENE survey interviewed 188,780 people between March 2009 and February 2013 (Natural England 2013). Of these people, 74,956 (39.7 percent) had visited the natural environment within the past seven days. These people were interviewed further about one specific visit selected at random[4].

As the health benefits of exercise are primarily associated with habitual behaviour, occasional visitors were excluded from the analysis. Regular visitors to the natural environment were defined as those people visiting the natural environment twice or more in the past week, whose selected visit

[3] Further detail on the MOVES model can be obtained from the model developers, Health Economics Consulting, at the University of East Anglia.
[4] As detailed information was only collected about this one visit, it was assumed that this visit was representative of the individual's other visits, where more than one was taken.

examined was 2 hours or less in duration, and who travelled 10 miles or less to reach their visit destination (29,300 people). This is because both only one visit in the last week and visits of more than 2 hours duration or more than 10 miles away were thought to have a higher probability of being a one-off occurrence rather than a regular event. The HEAT tool is focussed on regular walking behaviour but excludes other physical activities and so only those individuals whose only activity on the specified visit was either ‘walking without a dog’ or ‘walking with a dog’ were included (21,510 individuals). This excludes individuals who participated in multiple activities during the same visit, as it was not possible to estimate the amount of time spent walking or doing other activities. The process of elimination produces a highly conservative estimate of regular walkers and is summarised in Figure 1.

**Figure 1** Identification of regular walkers

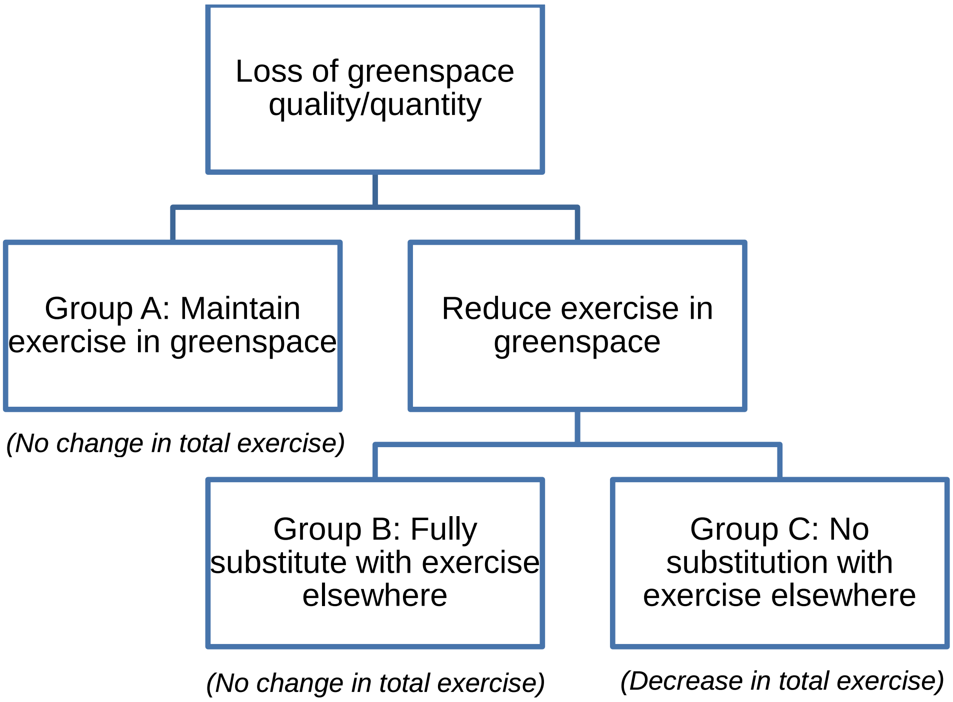


## Hypothesised change in exercise behaviour

If an individual was not able to visit the greenspace regularly, for instance if their local greenspace was no longer accessible, they face a sequence of decisions. These are illustrated by the decision tree in Figure 2. This decision tree is highly simplified, but encompasses the range of possibilities available to individuals.

All three groups experience a welfare loss as a result of them having to change to a less preferred option than their current situation, however only Group C experiences a decline of total exercise and subsequent physical health benefits.

**Figure 2** Exercise in greenspace decision tree




When greenspace quality or quantity declines, the individual must decide whether or not to continue exercising in greenspace. Group A maintains its normal exercise in greenspace (by continuing to use the existing location, or moving to alternative greenspaces). The remaining individuals reduce their amount of exercise in greenspace, and faces a subsequent decision – to increase their exercise elsewhere instead (in the gym or other non-greenspace locations), or not. To simplify the analysis, we have not considered that individuals might partially substitute with exercise elsewhere, however this is examined later in sensitivity analysis.

Group B fully substitutes their exercise in greenspace with exercise elsewhere. Group C however, does not. Group C is the only group to experience a decrease in total exercise and related health benefits.

We can therefore focus on Group C as being most of interest to this study. However, in reality we know very little about this group. To estimate the health loss associated with this group's exercise decisions, we need to know both the number of individuals in this group, and the change in the total amount of exercise they do.

We do not know the proportion of Group C within the regular walker population of 16,033 individuals, however we can speculate that the people most likely to be in this group are those people who are motivated to visit greenspace for reasons other than health and exercise. These people we assume will not substitute their walking in greenspace for alternative exercise elsewhere. Instead they may choose alternative activities that do not involve exercise. A subset of MENE respondents was asked about their different motivations for visiting greenspace, so we are able to use these results to estimate the number of regular walkers in Group C. A total of 6,201 regular walkers were asked the visit motivations question, of which 3,307 (53.3 per cent) did not select 'health and exercise' as a motivation for their visit to greenspace. However, the majority of this group (2,384 respondents) did select 'walking the dog' as a motivation for their visit to greenspace. This highlights the potential role of pet ownership in promoting incidental exercise. The 2,384 dog walkers were subtracted from the 3,307 people in Group C as it was felt that they were likely to continue walking their dog regardless of the change in greenspace access. In the longer term however, the quality and accessibility of local greenspaces may affect the number of people who choose to own a dog. We were now left with 1,267 regular walkers who were not motivated to walk for either their own or their pet's heath.

The MENE survey asks about the number of exercise sessions undertaken in the last week[5], however does not identify which of these sessions actually occur in the natural environment. We therefore assume that the lower of the number of exercise sessions or the number of greenspace visits, is the number of greenspace exercise sessions undertaken by the individual. We exclude those individuals who report no exercise sessions (344 respondents), as there is no identifiable health benefit associated with their walking. This leaves 923 individuals in Group C, representing 14.9 per cent of the regular walker subset asked the visit motivations question.

The 923 individuals undertook on average 3.6 walking visits to the greenspace each week, of which we count 2.9 as greenspace exercise sessions. These have an average duration of 73 minutes per session, or 212 minutes per week. We assume that these individuals walk at average pace (3 miles per hour), as HEAT identifies this as the minimum speed required to achieve health benefits.

## Descriptive statistics

This section describes the characteristics of the 923 individuals who were asked the visit motivations question and determined to be in Group C. However, given that not all regular walkers were asked this question, if we assume that the regular walkers who were not asked the motivations question would have responded similarly as those who were, we find that there are actually 3,202 individuals in Group C (1.7 per cent of the MENE sample).

From an analysis of the characteristics of Group C, it is clear that they are somewhat younger than the wider English population, and more likely to be professionals or managers. There are also slightly more females in Group C.

[5] The specific question asked was 'In the past week, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?'

**Table 1** Group C, age, sex, and socioeconomic classification

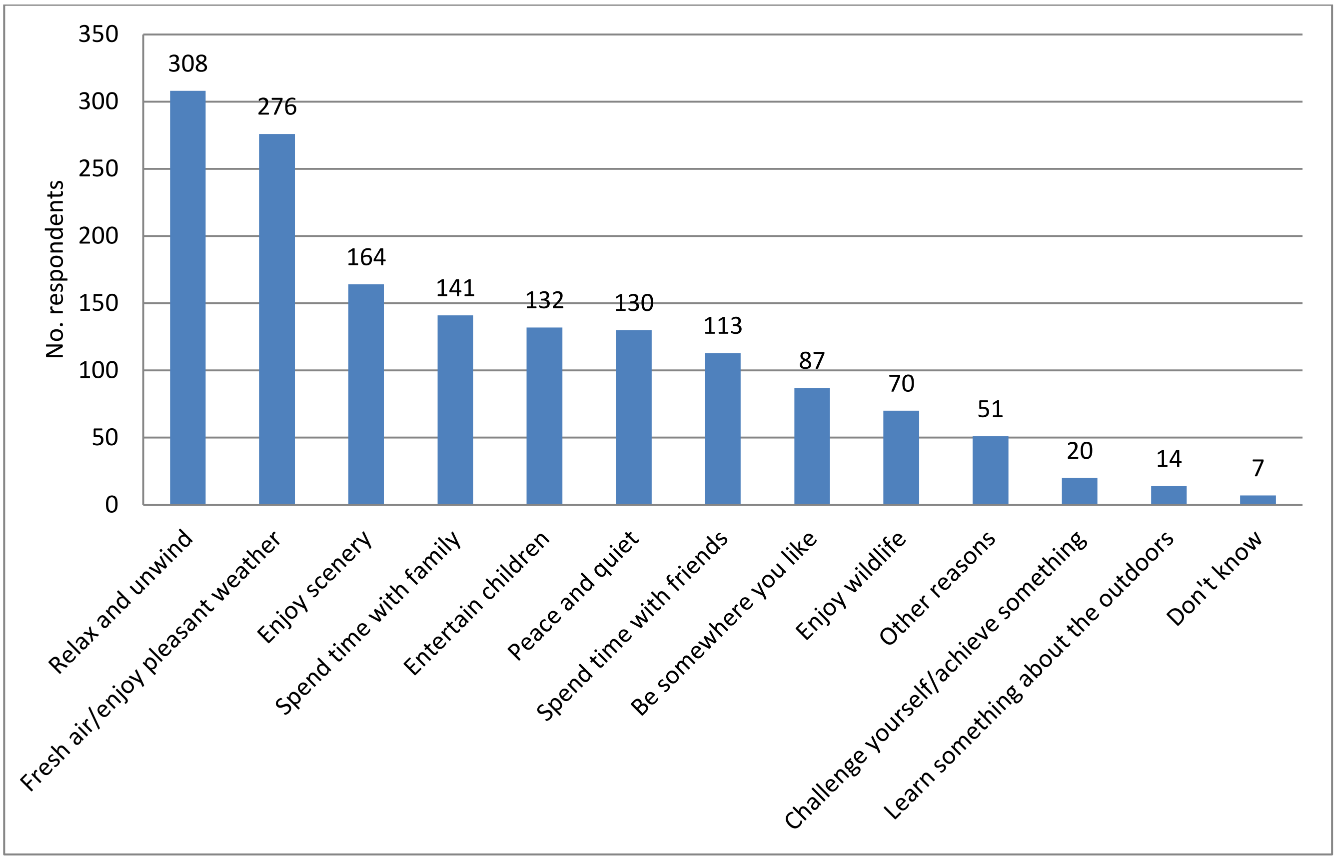
| Category | Male, Group C | Female, Group C | Total, Group C | Percentage of total[a] | English population[b] | Percentage of total[a] |
|---|---|---|---|---|---|---|
| Female | | | 503 | 54% | 21,261,000 | 51% |
| Male | | | 420 | 46% | 20,102,000 | 49% |
| Age | | | | | | |
| 16-24 | 98 | 56 | 154 | 17% | 6,222,000 | 15% |
| 25-34 | 53 | 99 | 152 | 16% | 7,063,000 | 17% |
| 35-44 | 68 | 98 | 166 | 18% | 7,536,000 | 18% |
| 45-54 | 62 | 94 | 156 | 17% | 7,163,000 | 17% |
| 55-64 | 58 | 73 | 131 | 14% | 6,134,000 | 15% |
| 65+ | 81 | 83 | 164 | 18% | 8,564,000 | 21% |
| **Socioeconomic classification[c]** | | | | | | |
| AB: Professionals, middle management | | | 256 | 28% | | 21% |
| C1: Junior management, small business owners | | | 286 | 31% | | 27% |
| C2: Skilled manual workers | | | 132 | 14% | | 24% |
| DE: Casual workers, long term unemployed | | | 249 | 27% | | 28% |
| **Total** | | | **923** | | **41,363,000** | |

([a] numbers may not sum to 100 due to rounding, [b] data sourced from Office for National Statistics 2012, [c] socioeconomic classification percentages for English population obtained from Natural England and other parties 2013)

In order to reach their greenspace destinations, 657 (71.2 per cent) of Group C came by foot, and 223 (24.2 per cent) used a car or van. The remainder used public transport or other forms of transportation. This highlights the importance of local and easily accessible greenspace.

So why did Group C go walking in the natural environment? As Figure 3 shows, two very important motivations were to relax and unwind, and to enjoy fresh air or pleasant weather. Environmental attributes such as scenery and peace and quiet were also prominent, as were opportunities to entertain children and to be with family and friends.

**Figure 3** Group C walking motivations



# 4 Results

The adult population of England in 2010 was estimated to be 41.4 million people (ONS 2012). Assuming that the quotas used in MENE mean that it is broadly representative of the wider English population, this suggests that there are around 4.7 million regular walkers in greenspace in England (11.4 per cent of the total population). Within this group, there are an estimated 0.7 million individuals (1.7 per cent of the total population) who could be classed within Group C. These people experience health benefits from regular walking that can be attributed to access to greenspace, and whose health may be affected if access to these places is reduced.

## Economic cost of increased mortality

HEAT defines health benefits in terms of the value of reduced mortality, i.e. in any given year, the number of adults dying is lower than might be expected if they did not undertake the given level of exercise. It then values the number of deaths avoided.

HEAT is only recommended for application to populations of adults aged between 20 and 74. The age brackets for the MENE survey (as shown in Table 1) do not correspond to this age range, and a conversion was undertaken, in which we assumed that 60 per cent of 16-24 year olds were aged between 20 and 24, and 60 per cent of people within the 65+ age bracket were aged 65-74[6]. For Group C in MENE, 2,760 individuals were found to be aged between 20 and 74 (1 per cent of the MENE sample).

**Table 2** HEAT data inputs

| **Key data inputs** | **Figure used** |
|---|---|
| Estimated number of Group C regular outdoor walkers in England aged between 20 and 74 (2010) | 621,000 (1.5 per cent of the adult English population) |
| Reduction in walking time (minutes per week) | 212 |
| Time period of analysis (years) | 20 |
| Discount rate[7] (percentage) | 3.5 |
| UK crude mortality rate (deaths per 100,000 per year) (given by HEAT) | 434.1 |
| Value of a Statistical Life (£,2010) | 1,632,892 |

A key input required to use HEAT is the value of a statistical life (VSL). This reflects society's willingness to pay to reduce the risk of premature death, and is commonly used in health, workplace safety and transport policy. The VSL used was that recommended by the UK Department for Transport for road accidents. The Department recommends a VSL of £1,632,892 (2010) per fatal casualty (Department for Transport 2014). It should be noted that the VSL for road accidents (causing instant death) may not be completely comparable with the VSL of prolonged fatal illnesses

[6] These percentages are based on data from the Office for National Statistics UK Population Pyramid, 2010, available at: **http://www.ons.gov.uk/ons/interactive/uk-population-pyramid---dvc1/index.html**
[7] People generally prefer to receive benefits now rather than later. The discount rate is used to convert benefits realised in future time periods to benefits today. 3.5 per cent is the rate recommended by UK Treasury for benefits realised up to 25 years into the future.

caused by inactivity, such as cancer. People's preferences and values for death avoidance are related to the manner of death (Chilton et al 2006). Alberini and Scasny (2013) for instance find that VSL for cancer risk reduction is €5.28 million, compared with €2.87 million for road traffic risk reductions. By using a VSL for road traffic accidents, it is possible that we are significantly underestimating the value of the health benefits lost due to reductions in greenspace access.

Table 3 illustrates the HEAT estimates for health benefits potentially lost by the approximately 621,000 Group C regular walkers in England aged between 20 and 74 (the age range used by HEAT) if they cease their current average 212 minutes of walking exercise per week in the natural environment.

These results indicate that this decrease in exercise would be expected to lead to around 374 additional deaths per year, with a lost economic benefit of approximately £434 million, discounted to 2014.

**Table 3** HEAT outputs

| | |
|---|---|
| Number of additional deaths per year | 374 |
| Discounted value of the increased mortality per year, averaged over 10 years | £434 million |

A sensitivity analysis was also conducted, in which we assumed that Group C substituted 50 per cent of their walking exercise with exercise elsewhere. Their lost walking time would be 106 minutes per week. HEAT estimates that this would result in 187 additional deaths per year, with a discounted value of increased mortality of £217 million per year.

## Health care cost of increased morbidity

The MOVES model estimates changes in the number of different disease cases that can be attributed to changes in the amount of regular walking in a population. The model takes into account the starting level of physical activity, as this has implications for the risk of acquiring potential disease. It was assumed that the regular walker cohort was moderately active and walked at a slow pace. The duration of exercise examined was one hour, three times per week (180 minutes). This is slightly inconsistent with the exercise levels able to be examined using HEAT. The time horizon examined was 20 years, with results divided by 20 to obtain an average for one year.

As the age cohorts used by the MOVES model are not consistent with MENE age cohorts, a conversion was required. To do this we assumed that the proportion of each age and sex within the Group C identified in MENE (as shown in Table 1) was consistent in the wider Group C in the English population. We know, for instance, that there are 28 females aged 16-24 in MENE Group C (0.069 per cent of the MENE sample). Scaling this up to the English population gives us 28,590 women aged 16-24. We assume that these women are evenly spread within their age cohort (for example we estimate that one ninth of the group, or 3,177 women, is aged 16). Then we simply sum together all the 16 year olds, 17 year olds, 18 year olds, and so on to obtain the 16-30 year old female cohort as shown in Table 4. Again, this is slightly inconsistent with the HEAT inputs, as MOVES includes all people aged 16+.

**Table 4** MOVES age cohorts used

| Age | Estimated female regular walkers in English population | Estimated male regular walkers in English population |
|---|---|---|
| 16-30 | 87,795 | 98,750 |
| 31-45 | 111,836 | 72,579 |
| 46-60 | 97,685 | 68,927 |
| 60+ | 85,360 | 79,274 |

Results from the MOVES model show that if Group C were to completely stop walking in greenspace, this is likely to have an impact on disease incidence, particularly for breast cancer, colorectal cancer and dementia. Over 2,300 additional cases of disease are estimated to occur each year.

**Table 5** Estimated increase in disease cases amongst Group C, over 20 years

| Disease | No. cases pre-greenspace reduction per year | No. cases post-greenspace reduction per year | No. of additional cases per year | Percentage increase in cases |
|---|---|---|---|---|
| Type 2 Diabetes | 2,441 | 2,994 | 553 | 23% |
| Coronary Heart Disease | 1,241 | 1,386 | 145 | 12% |
| Cerebrovascular disease (Stroke) | 3,673 | 4,154 | 482 | 13% |
| Breast Cancer | 12 | 13 | 1 | 5% |
| Colorectal Cancer | 39 | 45 | 7 | 18% |
| Dementia | 279 | 332 | 53 | 19% |
| Depression | 5,212 | 6,299 | 1,086 | 21% |
| **Total** | **12,896** | **15,224** | **2,328** | **18%** |

Additionally, the model estimates the number of Quality Adjusted Life Years (QALYs) associated with the increase in the number of cases of different diseases. A QALY is a measure of the number of additional years of reasonable quality life that an individual may gain (or lose) as a result of an intervention, in this case a change in use of the natural environment. This allows for comparison between different interventions with differing effects on both life expectancy and quality of life. One year of full health is equal to one QALY. Table 6 also shows the additional treatment costs as a result of the increased disease burden.

**Table 6** Estimated QALYs lost and additional treatment cost per year

| Disease | QALYs lost per year | Additional treatment cost per year (£, millions) |
|---|---|---|
| Type 2 Diabetes | 53 | 7.3 |
| Coronary Heart Disease | 672 | 1.6 |
| Cerebrovascular disease (Stroke) | 1,233 | 3.1 |
| Breast Cancer | 1 | 0.1 |
| Colorectal Cancer | 10 | 0.2 |
| Dementia | 257 | 3.5 |
| Depression | 2,585 | 7.7 |
| **Total** | **4,812** | **23.6** |

This analysis demonstrates that the bulk of the disease burden is due to increases in the incidence of diabetes and depression. The additional treatment cost due to the increase in all diseases examined is estimated at around £23.6 million per year.

A sensitivity analysis examining the change in Group C's walking exercise found that these results are sensitive to the amount of exercise Group C stops doing. If Group C were to reduce their walking in greenspace by 50 per cent and undertake 1.5 hours of walking per week instead of 3, this would increase the number of disease cases by an estimated 1,255 cases per year. This is a difference of 1,073 cases compared with if they ceased all of their walking exercise.

# 5 Limitations and future evidence needs

This study has explored the extent to which existing information can be used to identify the magnitude of health benefits at risk if access to the greenspace declines. The limited information available means that study does have some limitations.

In particular, it has relied on people's self-reported physical activity to identify health benefits. Self-reporting is known to be less reliable than objective forms of physical activity monitoring such as accelerometers (for a review of the literature, see Prince, Adamo et al. 2008).

The analysis has been limited by the lack of evidence on activity substitution. This makes it very difficult to accurately quantify the net health effects of a reduction in access to greenspaces. Further investigations are needed to understand how people's total physical activity changes in response to a change in access, and who specifically is most affected.

The analysis would also be enhanced by evidence on what types of specific changes to greenspace quality and accessibility directly affect people's exercise levels, and to what extent. For instance, people may continue exercising in a greenspace even as its quality declines, but may stop once its quality falls below a certain threshold. Similarly, they may be willing to travel a certain distance to exercise in greenspaces, but no further.

Given the current evidence limitations, this study is very much exploratory. The estimates produced should be taken as indicative only, due to the assumptions required in order to complete the analysis. However the potential scale of the health impacts found makes the subject worthy of further investigation.

# 6 Conclusions

This exploratory analysis takes a conservative approach to estimating health benefits associated with the natural environment. Unlike other approaches which focus on the potential gains associated with increases in physical activity, ours examines the scenario of a decline in physical activity amongst the approximately 700,000 English people whose primary motivation for walking in the greenspace is not exercise, but rather to relax and enjoy the outdoors. These people are most at risk of reducing their exercise levels if greenspace access and quality continues to decline.

This analysis focuses only on the health gains caused by increases in physical activity. This ignores the other important health benefits of the natural environment. The natural environment plays a valuable role in directly contributing to improvements in people's mental health, reducing air pollution and regulating local temperatures, and these benefits have not been quantified here.

However, just examining the physical activity-related benefits of the natural environment, it is clear that these have the potential to be significant. If regular walkers not motivated by health were to lose access to convenient, high quality greenspaces, the loss of this space could feasibly lead to an additional 374 deaths per year, and over 2,300 additional cases of life-limiting disease. The increase in mortality is valued at £434 million per year, and the increase in morbidity at £23.6 million per year in additional treatment costs. Note that the effect of this increased morbidity is more than just an increase in treatment costs – there are likely to be significant impacts on people's wellbeing and productivity as well which are not assessed here.

Our assessment is based on a hypothetical loss in greenspace quality and/or access to greenspace, which is not quantified. This is assumed to be due to either reductions in funding to maintain greenspaces, or the sale of greenspace land for development. However, although hypothetical, the scenario presented is realistic in that greenspace budgets are under pressure due to the general squeeze in public funding. There is a danger that greenspace funding is reduced disproportionately on the grounds that it is not seen as providing essential services. Our assessment suggests that this may be inefficient from the perspective of cross-government health targets and welfare maximisation.

We have looked at only the physical health aspect of greenspace, and found a potentially high level of benefit. Many more of the benefits of greenspace remain to be quantified but are also potentially high, both in terms of the positive effects on people's welfare and the direct costs associated with replacing their services. This makes a strong case for the quantity and strategic direction of investment in greenspaces to be influenced across the different departments of local government. Given that local authorities now have responsibility for both public health and greenspaces, there is a great opportunity for better links to be made between enhancing the natural environment and improving the health and wellbeing of people nearby.

# 7 References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