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Recreational physical activity in natural environments and implications for health: A population based cross-sectional study in England

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ABSTRACT

Background. Building on evidence that natural environments (e.g. parks, woodlands, beaches) are key locations for physical activity, we estimated the total annual amount of adult recreational physical activity in England's natural environments, and assessed implications for population health.

Methods. A cross-sectional analysis of six waves (2009/10–2014/5) of the nationally representative, Monitor of Engagement with the Natural Environment survey ($n = 280{,}790$). The survey uses a weekly quota sample, and population weights, to estimate nature visit frequency across England, and provides details on a single, randomly selected visit ($n = 112{,}422$), including: a) duration; b) activity; and c) environment type.

Results. Approximately 8.23 million (95% CIs: 7.93, 8.54) adults (19.5% of the population) made at least one 'active visit' (i.e. ≥30 min, ≥3 METs) to natural environments in the previous week, resulting in 1.23 billion (1.14, 1.32) 'active visits' annually. An estimated 3.20 million (3.05, 3.35) of these also reported meeting recommended physical activity guidelines (i.e. ≥5 × 30 min a week) fully, or in part, through such visits. Active visits by this group were associated with an estimated 109,164 (101,736, 116,592) Quality Adjusted Life Years (QALYs) annually. Assuming the social value of a QALY to be £20,000, the annual value of these visits was approximately £2.18 billion (£2.03, £2.33). Results for walking were replicated using WHO's Health Economic Assessment Tool.

Conclusions. Natural environments provide the context for a large proportion of England's recreational physical activity and highlight the need to protect and manage such environments for health purposes.

1. Introduction

Regular physical activity is associated with a decreased risk of obesity, coronary heart disease, diabetes, some cancers, mental ill health, and mortality (National Institute for Health Care Excellence, 2008; World Health Organization, 2009). Nevertheless, in England only 34% of adults report meeting the minimum recommended weekly levels of activity (i.e. 5 × 30 min) (Bélanger et al., 2011), and inactivity is estimated to cost the healthcare system more than £1 billion annually (Scarborough et al., 2011). Consequently, there is great interest in understanding the barriers to, and enablers of, physical activity, including the role of environmental factors (Ding et al., 2012; National Institute for Health Care Excellence, 2012; Ogilvie et al., 2007). Although explicitly linked to health promotion for centuries (Thompson, 2011), the potential of 'natural environments', such as parks, woodlands and beaches, to support and encourage regular outdoor physical activity has only been investigated systematically, relatively recently (Hunter et al., 2015). Crucially, natural environments offer opportunities for informal or incidental physical activity among those who, for lack of time, money or confidence, are reluctant to participate in organised sports or gym-related activities (Schutzer and Graves, 2004; Withall et al., 2011).

To date, however, most studies have examined the relationship between a person's self-reported physical activity level *in general* and their proximity to natural environments *in general* without exploring how much activity occurs in outdoor natural settings (Hunter et al., 2015). Although several studies have monitored physical activity in adults and children using accelerometers and GPS trackers, these studies tend to involve few individuals making it hard to generalise to an entire population (Evenson et al., 2013; Wheeler et al., 2010). We know of no previous attempt to estimate either the total amount of physical activity that takes place in an entire country's varied natural environments, or the potential benefits to population health of such activities. The aim of the current research was to address these gaps.

Specifically, we estimated annual adult levels of physical activity occurring in natural environments across England, using data from the

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Monitor of Engagement with the Natural Environment (MENE) Survey (Natural England, 2015a). The MENE is a nationally representative survey investigating visits to natural environments for recreational purposes, and survey weights allow population estimates of visit type and frequency. As physical activity needs to be both regular and sustained to benefit health (Haskell et al., 2007), our assessment of the health implications of nature visits focused on those individuals who met recommended physical activity guidelines either fully, or partly, in natural environments. The potential health effects associated with this cumulative level of activity were considered in terms of Quality Adjusted Life Years (QALYs) (Beale et al., 2012), and a monetary estimate of the social value of these QALYs made. (National Institute of Health and Care Excellence, 2013) Finally, a robustness check of this estimate (focused on walking) was conducted using the World Health Organisation's, Health Economic Assessment Tool (HEAT).

2. Methods

2.1. Study design and sample

Data were from Waves 1–6 (years 2009/10–2014/5) of the MENE survey. The MENE is a repeat cross-sectional survey of over 40,000 adults annually (total $n = 280{,}790$). It is commissioned by Natural England and is part of a face-to-face nationally representative omnibus survey conducted throughout the year to reduce seasonal biases. Data are collected via in-home interviews using Computer Assisted Personal Interviewing (CAPI) (Natural England, 2015a). Respondents are asked about occasions in the last week when they spent leisure time "out of doors", defined as, "*open spaces in and around towns and cities, including parks, canals and nature areas; the coast and beaches; and the countryside including farmland, woodland, hills and rivers. This could be anything from a few minutes to all day. It may include time spent close to your home or workplace, further afield or while on holiday in England. However, this does not include routine shopping trips or time spent in your own garden*" (p.35) (Natural England, 2015a). Approximately 40% of respondents report at least one visit in the last week. General information is collected about all visits, and detailed data are collected for a single visit ($n =$ 112,422), randomly selected (via CAPI) from those taken in the last week.

Based on participant demographic profiles and frequency of visits, Natural England developed two weighting variables relevant here: a) 'weekweight', and b) 'weekVweight'. The use of these weights was necessary to make extrapolations from the current sample of individuals and visits per year, to the entire adult population. Details of the derivation and testing of these weights are provided elsewhere, [Appendix *A*1 and ref Natural England, 2015b]. Current analyses estimating population totals and demographic sub-groups making active visits to natural environments in the last week were weighted using 'weekweight'. Analysis of the total annual number of visits, as well as activities undertaken and environment types visited, used the 'weekVweight'. Our institutional ethics board did not require a formal ethics application for the current analysis of this secondary, publically available, anonymised data.

2.2. Data and variables

The main visit variables of interest were: a) duration; b) activity; and c) environment type. For estimating health-related implications, we were also interested in physical activity in general.

Visit duration was estimated by asking, *"How long did this visit last altogether –that is from the time you left to when you returned?"*. Estimates for time spent in the natural environment were derived after subtracting estimated travel time; the latter based on: a) distance travelled; and b) mode of transport (Appendix A2, and ref (Elliott et al., 2015)). To avoid suggesting over precise duration estimates, duration was dichotomised as being either <30 or ≥30 min, a meaningful threshold in terms of meeting the recommended physical activity guidelines.

Although respondents could select multiple activities from a list of 19, our main analyses only included visits involving a single activity as it was impossible to estimate duration for each activity on multi-activity visits. Based on the Compendium of Physical Activities (Ainsworth et al., 2011), Metabolic Equivalence of Task (MET), rates for each MENE activity have been developed (Appendix A3, (Elliott et al., 2015)). One MET is equivalent to a standard resting metabolic rate of 3.5 ml of oxygen consumption per kg of body weight, per minute engaged in an activity. METs are thus a ratio of the metabolic rate associated with an activity compared to this resting rate. Our main analyses focused on those activities categorised as either 'moderate' (i.e. 3–5.9 METs) or 'vigorous' (i.e. ≥6 METs) in intensity, i.e. those most linked to health (Ainsworth et al., 2011; US Department of Health, 2008).

Regarding environment type, respondents could select from one or more categories: 'a park in a town or city' (*town park*), 'a children's playground' (*play area*), 'a playing field or other recreation area' (*play area*), 'another open space in a town or city' (*open space*), 'an allotment or community garden (*allotment*)', 'a country park' (*country park*), a 'woodland or forest' (*woods*), 'farmland' (*farmland*), 'a river lake or canal' (*waterway*), 'a mountain, hill or moorland' (*uplands*), 'a village', 'a path, cycleway or bridleway' (*path*), 'open space in the countryside' (*open country*), 'a beach' (*beach*), 'other coastline' (*coast*); and 'Other'. Visits involving multiple environments were classified as 'Mixed' (Appendix A4). As the chosen visit was randomly selected from all visits in the last week, we assumed it was representative in terms of duration, activity and environment.

The following socio-demographic factors were considered in terms of who constituted 'active visitors': gender, age, socioeconomic status (Social Grades AB (Highest), C1, C2 and DE (Lowest); Appendix A5), urbanity of residence (Appendix A6), region of residence (9 Government Office Regions), and dog ownership.

Frequency of recreational and active travel-related physical activity was measured using the item: '*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? This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job'*. For current purposes, respondents were dichotomised as either 'sufficiently active individuals' (i.e. ≥5 days) or 'insufficiently active individuals' (i.e. <5 days). Although health gains may still be made with $<5 \times 30$ min a week, (Wen et al., 2011) we adopted the more conservative threshold.

2.3. Estimating potential health gains

Building on an estimation of the benefits to health associated with a scheme to promote walking in natural environments, (Natural England, 2009) the current study estimated the potential value to health associated with a wider range of physical activities undertaken during recreational visits to natural environments across England, using a much larger and more representative sample, and calculated the Quality Adjusted Life Years (QALYs) associated with these visits. QALYs are a metric used to compare the health benefits associated with different health-related interventions, where one QALY is equivalent to one year lived in full health. In the current analysis, we used QALY estimates derived by (Beale et al. (2012); Beale et al., 2007) which aimed to estimate the potential health benefits of "*environmental interventions to promote physical activity*" (20, p.26). Based on analysis of Health Survey for England data, (Beale et al. (2007)) estimated that 30 min a week of moderate-intense physical activity, if undertaken 52 weeks a year, would be associated with 0.010677 QALYs per individual, per year. Beale et al. (2007) also assumed that the relationship between physical activity and QALYs is both cumulative and linear (e.g. 2×30 min $\times$ 52 weeks $=$ 0.021354 QALY, Appendix A7).