Health benefits from recreation methodology, natural capital, UK

The methodology used to develop estimates of the health benefits gained from outdoor recreation in the UK.

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1 . Overview

We have developed methodologies to estimate the health benefits gained from outdoor recreation in the UK.

These estimates, reported in the UK recreation health benefits account 2022, are Experimental Statistics. They are in a testing phase and remain under development. We publish them to involve users and stakeholders in their development and to build in quality from an early stage. These estimates should be interpreted in this context.

We welcome feedback on any aspect of the approaches presented in this methodology. Please email natural.capital.team@ons.gov.uk.

2 . Methods used

We have developed two separate methods for estimating the health benefits gained from outdoor recreation. The first, the “Exercise based” method, builds on existing literature on the benefits of vigorous exercise of any form, whether this is performed outdoors or not.

The second, the “Exposure based” method, is developed from an academic paper which looked specifically at time spent outdoors regardless of the level of activity.

Both methods aimed at using existing survey data of time spent and activities outdoors to develop aggregate estimates of health benefits across the UK.

For both methods, we have estimated health benefits in terms of quality adjusted life years (QALYs). A QALY is a measure of the state of health of a person, adjusted to reflect their quality of life. One QALY is equal to one year of life in perfect health.

Outdoor exercise

The methodology for generating health benefits gained from outdoor exercise has been adapted from the report, A study to scope and develop urban natural capital accounts for the UK from the Economics For The Environment Consultancy Ltd (Eftec). This outlines methods to estimate the physical health benefits gained from outdoor recreation in an urban environment. It builds on the work of White et al (2016) in Recreational physical activity in natural environments and implications for health: A population based cross-sectional study in England.

Eftec's methodology first estimates the number of "active visitors" using visitor data from the Monitor of Engagement with the Natural Environment (MENE) survey. MENE is a survey which collects information about use and enjoyment of the natural environment, by English residents. Between March 2009 and February 2019, it sampled around 47,000 respondents each year, containing approximately 20,000 visit takers.

"Active visitors" are survey respondents that undertake 30 minutes of moderate-intense physical activity, five times a week. If respondents do not meet this threshold, but state that they visit nature five times or more for 30 minutes or more a week, and have completed moderate to intense physical activities, they are also considered to be "active visitors".

Activities with intensity thresholds above three Metabolic Equivalence of Task (METs), as outlined in the 2011 Compendium of Physical Activities (Ainsworth et al.), are considered moderate-intense. Examples of these include walking, cycling, and swimming. Activities such as picnicking, sightseeing and wildlife watching are not considered moderate-intense. QALY scores are then applied to these "active visitors".

Analysing Health Survey for England data, Beale et al. (2007) estimated that 30 minutes a week of moderate-intense physical activity, if undertaken 52 weeks a year, would be associated with 0.010677 QALYs per individual, per year. The additional QALYs gained are assumed to be linear over time – five qualifying sessions would result in a QALY increase of 0.053384. The additional QALYs gained represent the improvement to an individual's health through regular exercise.

If an "active visitor" stated they had visited nature once in the last week, they would be assigned a QALY score of 0.010677. This would scale linearly, with two visits to nature being worth 0.021354, and so on, up to five visits a week. The sum of scores for all "active visitors" would then be calculated and multiplied by £12,936 (in 2008 prices), the cost of NHS resources required to add one QALY to the lives of NHS patients (Claxton et al, 2015).

As MENE has a changing weekly sample. Data for individual respondents are captured for a single specific week and may not be representative of an individual's full year. As a result, the number of "active visitors" gaining health benefits is likely to be a shared cumulative figure. For example, 52 individual respondents may gain a single week's worth of benefits, which cumulatively sum to a year's worth. This could be described as the number of people equivalent gaining health benefits.

The MENE survey stopped collecting data in early 2019, and was superseded by the People and Nature Survey (PANS) in early 2020. PANS samples around 25,000 respondents each year, with approximately 14,000 visit takers, annually. PANS data have been used to generate estimates for 2020.

We have used additional survey data to create estimates for the UK. Scotland's People and Nature Survey (SPANS) collects similar data to MENE and PANS for residents of Scotland, in the years 2013 to 2014, 2017 to 2018, and 2019 to 2020. SPANS surveys approximately 11,000 respondents annually. Data from the National Survey for Wales (NSW) are used to gather similar information from residents of Wales. The recreation-based section of the NSW gathered data in 2016 to 2017, and 2018 to 2019.

Eftec's original methodology focused solely on urban areas. This has been expanded to include the seven different habitats featured within the health benefits of recreation publication. These habitats correspond to the broad habitat classifications from the UK National Ecosystem Assessment (PDF, 2.09MB), presented in the Habitat extent and condition bulletin. Additionally, the data have also been generated for six different age bands. More information about the process of generating results by both habitat and age can be found within the Habitats and Age breakdowns section of this methodology report.

From 2009 to 2015, the MENE survey asked respondents how many times a week they undergo 30 minutes of moderate-intense physical activity. A similar question does not feature for years 2016 to 2018 of the MENE survey nor in the Scottish and Welsh equivalent surveys, SPANS and NSW. As a result, the missing data has been imputed. This involves determining the number of respondents considered "active visitors" as a proportion of the total respondents.

For example, on average between 2009 and 2015, 15.1% of respondents that visited built-up areas and gardens once a week were classed "active visitors". These proportions are applied in place of the missing physical activity question for SPANS, NSW, and years 2016 to 2018 of the MENE survey.

Exposure to nature

The methodology used to generate health benefits gained from exposure to nature has been built on the work of White, M.P., Alcock, I., Grellier, J. et al (2016). They reported that individuals who spent at least 120minutes a week in nature had consistently higher levels of both health and well-being than those who reported no exposure. It did not matter how this time was achieved, whether over several short visits or a single long session. These findings were generated by analysing data from the MENE survey.

To operationalise their findings, we sought to generate a quantitative value corresponding to the health benefits gained from exposure to nature. Multinomial logistic regression analysis was chosen to estimate this value to control for other factors that could impact self-reported general health.

The variables used in the model were:

- self-reported general health
- exposure to nature
- age
- sex
- ethnicity
- disability
- working status
- social grade
- dog ownership
- physical activity
- children
- residence area deprivation
- air pollution levels
- access to green space

Some 20,076 participants, drawn from 10 years' worth of MENE survey data, were used to estimate the impact of exposure to nature. Additional datasets were used alongside MENE, including English indices of deprivation, Access to green space, and Modelled background pollution data.

The regression analysis produced coefficients describing the impact all variables had on self-reported general health. The dependent variable of general health was defined by five categories, one being very good health, and five being very bad health. Coefficients were produced for all variables which described each variable's impact on health categories one through four, compared with health category five.

The regression produces four separate models which predict the odds ratio of an individual having a given "self-reported health" score. We could use those models to calculate the probability of an individual reporting each score by using their own reported data, for each of the variables included in the model.

Those who visited nature for 120 minutes or more were given two sets of probabilities. One of these included their exposure to nature, while the other removed it from their model. The difference between the predicted "self-reported health" from each of these calculations gives us the "benefit" of time outdoors.

QALY scores were applied to each of the five general health categories, with very good health assigned one QALY, and very bad health assigned 0.2 QALYs. The remaining categories were assigned QALY values of increasing 0.2 increments up from the lowest of 0.2 QALYs. The probabilities within each set were then multiplied by the assigned QALY value and summed, to create a score out of one QALY. The difference in score between the two sets of probabilities indicated the QALYs gained for a respondent that was exposed to nature for 120 minute or more.

Table 1 provides an example calculation.

Table 1: Example calculation of a predicted self-reported health score

SELF REPORTED HEALTH SCORE	Equivalent QALY	Without Exposure to Nature		With Exposure to Nature	
		Modelled Probability	Weighted QALY	Modelled Probability	Weighted QALY
5	**0.2**	0.042	0.008	0.024	0.005
4	**0.4**	0.174	0.07	0.134	0.054
3	**0.6**	0.514	0.308	0.496	0.298
2	**0.8**	0.236	0.189	0.297	0.238
1	**1**	0.034	0.034	0.049	0.049
	Predicted QALYs		0.609		0.644
	Net benefit of nature				0.035

Source: Natural England - Monitor of Engagement with the Natural Environment Survey

Unfortunately, the questions required to use the model are often asked within MENE on a monthly or quarterly basis, instead of weekly. This means that it is not possible to apply this model directly to determine the QALYs gained from each individual respondent.

Instead, the mean average of the difference in QALY values for 6823 respondents that were sufficiently exposed to nature was calculated to be 0.01995 QALYs. This value indicates the estimated health benefit gained from being in nature for 120 minutes or more, every week, for a year, per person. This is the equal to approximately £260 (2008 prices) using the £12,936 cost of NHS resources required to add one QALY to the lives of NHS patients (Claxton et al, 2015).

The 0.01995 QALY value was created with the intention of applying it to recreation-based surveys, such as the MENE survey. This involves determining the number of respondents that visit nature for 120 minutes or more, each week, annually. The QALY value, and associated cost, is then applied to this figure to estimate the value of health benefits gained from exposure to nature. As with the exercise-based method, the changing weekly sampling of the MENE survey results in the number of respondents being a shared cumulative figure.

This QALY value has been determined from an unweighted sample. The sample from MENE used to produce the regression analysis was chosen since respondents had answered all the required questions. This could lead to a sample featuring natural biases. Additional work is required to create a bespoke set of weight which ensure the sample is representative of the nation.

Identical methods are applied to other recreation-based surveys, including the PANS, SPANS and NSW. As with the previous section of this report, the data have also been generated to feature breakdowns of both habitat and age. An explanation of methodology behind this can be found within the Habitats and Age breakdowns sections of this methodology report.

Habitats

The four recreation-based surveys used within this methodology ask respondents about the type of outdoor place visited. These responses are grouped into the seven broad habitat classes using the classifications described below. Health benefits gained are assigned to broad habitats based on survey responses. Respondents that have visited multiple habitats have their value apportioned, with equal values being attributed to each habitat.

England survey habitats

From MENE and PANS habitats.

Built-up areas and gardens:

- village
- path, cycleway or bridleway
- country park
- park in a town or city
- allotment or community garden
- children’s playground
- playing field or other recreation area
- another open space in a town or city
- urban green space

Coastal margins:

- beach
- other coastline
- nature or wildlife reserve

Woodland:

- woodland or forest
- nature or wildlife reserve

Farmland:

- farmland
- another open space in the countryside
- nature or wildlife reserve

Mountain, moorland and hill:

- mountain, hill or moorland
- nature or wildlife reserve

Freshwater:

- river, lake or canal
- nature or wildlife reserve

Other:

- other places not in the list
- don’t know

Scotland survey habitats

SPANS habitats.

Built-up areas and gardens:

- village
- local park or open space

Coastal margins:

- sea or sea loch
- beach or cliff
- wildlife area or nature reserve

Woodland:

- woodland or forest
- wildlife area or nature reserve

Farmland:

- farmland
- another open space in the countryside
- fields, farmland or countryside
- wildlife area or nature reserve

Mountain, moorland and hill:

- mountain, hill or moorland
- wildlife area or nature reserve

Freshwater:

- river, lake or canal
- loch
- wildlife area or nature reserve

Other:

- other places not in the list
- don’t know

Wales survey habitats

NSW habitats.

Built-up areas and gardens:

- local park or other local space
- roadside pavement or track

Coastal margins:

- beach, sea or coastline

Woodland:

- woodland or forest

Farmland:

- farmland

Mountain, moorland and hill:

- hills, mountains and moorland

Freshwater:

- river, lake or canal

Other:

- other

Age breakdown

The four recreation-based surveys used within this methodology also ask respondents about their age band. The MENE survey features the following six age bands:

- 16 to 24 years
- 25 to 34 years
- 35 to 44 years
- 45 to 54 years
- 55 to 64 years
- 65 years and over

For both MENE and the NSW, the health benefits gained from each respondent are assigned directly to one of these six categories based on their response. However, the PANS and SPANS feature alternative age bands.

PANS asks respondents to select one of five age bands, three of which remain the same as within MENE. The differing two bands are split into three based on the proportion of years across each band. For example, the PANS age band 25 to 39 years would see two-thirds of its value assigned to 25 to 34 years, and one-third to 35 to 44 years. The same can be said of the second differing age band, 40 to 54 years, one-third of which is assigned to 35 to 44 years, and the remaining two-thirds to 45 to 54 years.

SPANS on the other hand features three age bands, each one incorporating the equivalent of two MENE bands. Like PANS, these are split based on the proportion of years. The age band 35 to 54 years is split in half, with an equal proportion being assigned to 35 to 44 years and 45 to 54 years. Currently this causes the Scottish health benefits age time series to feature pairs of matching values.

3 . Data gaps

The use of the Monitor of Engagement with the Natural Environment (MENE) and People and Nature Surveys (PANS) has created a mostly complete time series for England, missing only a single year of data in 2019. However, because both the Scotland's People and Nature Survey and the National Survey for Wales are not run annually, a complete time series for Scotland and Wales cannot be generated through survey data alone. Furthermore, we currently have no recreation-based survey equivalent for Northern Ireland.

Missing England data for 2019 has been imputed using a forecast from 2018. This has been achieved at the individual habitat level. Data from 2019 are more likely to reflect 2018 than 2020, because 2020 data was heavily affected by the coronavirus (COVID-19) pandemic.

Data for Scotland and Wales have been interpolated using the England time series. Year-on-year growth rates for the habitats within England have been used to backdate each time series from the earliest data point for each survey and fill in gaps in between data points.

The year 2020 for both Wales and Scotland has been interpolated using year-on-year growth rates of England total values. This avoids the drastic changes in individual habitats seen between the last year of the MENE survey (2018) and the earliest year of the PANS survey (2020). The total is currently the best indication of how recreation levels changed because of the global coronavirus pandemic. However, these estimates will be revised when new survey data are available.

The ratio of population sizes between England and Northern Ireland have been applied to England data to generate proportional data for Northern Ireland. This creates a time series for Northern Ireland which mirrors the trend of England. We will continue to look for recreation-based surveys to improve our estimates for Northern Ireland.

4 . Wider implementation

We need to undertake further work to integrate these new estimates into our existing recreation and tourism account. This would expand the account to incorporate the health benefits gained from outdoor recreation.

Firstly, we currently have two methods for generating estimates for the health benefits gained from outdoor recreation. Each estimate features advantages and disadvantages, both in terms of the literature used within the methodology and the use of the recreation-based surveys. However, only one of these estimates can be included within the wider recreation account. We propose to use the exposure to nature approach to estimate the health benefits of recreation in the short term. This provides cautious estimates that directly assess the benefits of the outdoors, capture a wider range of these benefits, and represent a broader set of the public.

Our existing account estimates expenditure by considering the amount spent travelling to and accessing nature. The account also estimates the additional value of a house gained from its proximity to blue and green spaces. To integrate estimates of health benefits successfully care must be taken to avoid double counting all benefits gained from recreation.

For example, those who have spent money to access nature may then also gain health benefits, through exercise or exposure, from their visit. It could be considered that people pay to access nature with the intention of gaining health benefits. In this case, both estimates would capture the same value. In National Accounting terms this may not be an issue since both transactions take place. However, those hoping to use these figures for other purposes would need to take care as it may confuse some users of the data.

Furthermore, health benefits are gained from regular access to nature. Houses in close proximity to nature give people better access to green spaces, raising the likelihood they will access nature regularly and therefore gain health benefits. This benefit may therefore already be included within the additional value of house prices. We will consider these two cases further before our new estimates are integrated into the wider account.

5 . Literature review

Natural environments can be both salutogenic (health promoting) and therapeutic (health restoring or healing). Green and blue spaces can also positively influence physical, mental and social well-being. Beneficial effects stem from a broad range of experiences including viewing images of natural environments, listening to bird sounds, forest-air bathing, and horticultural activities.

A review of green care and nature-based interventions by Natural England (2016), stated the evidence base is convincing and shows that engaging with nature can have a positive impact on physical and mental health. It concluded that the evidence consistently highlights the restorative effect nature can have on humans and its beneficial contribution to well-being.

Indirect exposure to nature may contribute to patients' recovery following surgery. Hospital patients recovering from surgery who had a view of trees from their hospital bed showed greater positive affect (mood and emotion), took fewer moderate and strong painkillers, and spent less time in hospital, than those with windows facing a brick wall. This is according to View through a window may influence recovery from surgery, Ulrich R S (1984).

Natural environments can encourage and accommodate physical activity. A recent study, Spending at least 120 minutes a week in nature is associated with good health and wellbeing, examined relationships between recreational time spent in nature and self-reported health and well-being. It showed that the likelihood of reporting good health or high well-being increased significantly for those who spent at least 120 minutes in nature, compared with those who had no nature contact.

The authors suggested that physical activity may be influencing the relationship between nature and health. However, a systematic review by Thompson Coon and others (2011) found that compared with exercising indoors, exercising in natural settings was associated with increased feelings of revitalisation and positive engagement, decreases in tension, confusion, anger and depression, and increased energy.

Engaging with nature can relieve some of the symptoms of common mental health conditions, for example, anxiety and depression. Maund and others (2019) conducted a pilot study of a six-week nature-based intervention , during which individuals diagnosed with anxiety and/or depression engaged with wetland nature for two hours per week. A range of indicators relating to mental health were measured before and after the intervention. Results showed significant improvements in mental well-being, anxiety, stress and emotional well-being. Additional benefits recorded were improved physical health and reduced social isolation. A recent systematic review and meta-analyses reported that for randomised controlled trials, nature-based interventions were effective in reducing anxiety, improving depression, reducing negative affect and increasing positive affect.

This literature underpins the usefulness of our exposure to nature method since it captures outdoor recreation regardless of level of activity. On the other hand, the outdoor exercise approach shows the higher benefits per visit of more vigorous exercise. We cannot simply add these different measures given the significant double counting this would lead to. However, it is clear that both capture different aspects of the benefits and only relying on one of them may produce a conservative estimate.

6 . Related links

Health benefits from recreation, natural capital, UK: 2022
Bulletin | Released 27 May 2022
Further development of the UK recreation natural capital ecosystem service accounts, including specific methods used to estimate the health benefits gained from nature-based recreational activities.