BlueHealth

Linking environment, climate & health

BlueHealth International Survey Methodology and Technical Report

Details on the administration, sampling, content, and management of the BlueHealth International Survey

www.bluehealth2020.eu

@BlueHealthEU

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 666773.

BlueHealth International Survey Methodology and Technical Report

Date last edited: 20200601

Lewis Elliott
Postdoctoral Research Associate
European Centre for Environment and Human Health, University of Exeter, c/o Knowledge Spa, Royal Cornwall Hospital, Truro, Cornwall, TR1 3HT, UK

L.R.Elliott@exeter.ac.uk

Contents

The BlueHealth International Survey was a core deliverable of the Horizon 2020 BlueHealth project[1]. It was envisaged as a way of addressing the lack of coordinated and harmonised data across countries on people's recreational visits to natural environments, in particular blue spaces, and their effects on people's physical and psychological health. This document describe the methodology, management, and content of the survey data in detail and are intended to be a thorough guide for researchers using this data in the future when it becomes an open access resource. The document also contains a codebook (section 8) which describes every variable included in the data file.

1 Setting

BIS was administered in eighteen countries worldwide. Fourteen of these countries were European Union member states, namely the United Kingdom, Ireland, France, Spain, Portugal, Germany, Netherlands, Czech Republic, Italy, Sweden, Finland, Estonia, Greece, and Bulgaria. As past research has typically focused on the health benefits of coastal environments as opposed to other blue space environments[2–6], these countries were chosen in particular to reflect countries whose coastline bordered one of Europe's principal seas, though the Czech Republic also provides a landlocked comparator. The four other countries where the survey was administered were Hong Kong, Canada, Australia (primarily Queensland), and the USA (state of California only).

2 Mode of administration

An online survey format was chosen for ease of reaching a large number of participants internationally and was delivered by YouGov, a UK-based market research company, through their registered panels of participants. While this method can elicit socially desirable responding and thus threaten the construct validity of certain questions[7], participants exhibiting other systematic response biases (e.g. straightlining in Likert-scale questions, or 'careless' responses[8]) are regularly screened and omitted by YouGov. Furthermore, measures are taken to prevent the possibility that surveys could be completed by machines. Online studies also typically tend to attract a more diverse demographic sample than other modes of administration[9]. We also took measures to minimise question-order bias with regards to key subjective wellbeing items[10] (section 4.1). Where YouGov did not have an internal panel of participants in a country, the data collection was outsourced to a similar company who could fulfil requirements related to representativeness (section 3). Nonetheless, the presentation and content of the survey was identical with the only exception being in Ireland where questions were asked of the participant's sex, age, and region of residence to match data automatically logged in all other countries (section 4.7.1).

3 Sampling, design, and recruitment

Representative samples of participants from each country were sought as the availability and quality of blue spaces differs across regions[11] and thus, the health benefits potentially conferred by these environments might also differ, as has been found with green spaces[12]. In the European countries sampled, this was achieved by stratified sampling of geographic region (typically the first or second level of the Nomenclature of Territorial Units for Statistics (NUTS 1/NUTS 2)) and separately by each possible combination of sex (male, female) and age group (18-29, 30-39, 40-49, 50-59, 60+). In Spain, Germany, the Netherlands, Italy, Greece, and Sweden, the NUTS 1 classification was used. In the Czech Republic, Portugal, Bulgaria and Ireland, the NUTS 2 classification was used. In the United Kingdom the NUTS 1 classification was used excluding Northern Ireland. In Finland, the NUTS 2 classification was used excluding the monolingual Swedish Åland islands region as the survey was only offered in Finnish. In France, a simplified NUTS 1 classification was used (North-East, North-West, South-East, South-West, Paris region) which excludes Corsica and the overseas departments and regions of France. In Estonia, where no NUTS1 division exists, it was only feasible to perform the latter stratification.

In Canada, comparable stratifications were performed using provincial regions (though no participants were recruited from the Northwest Territories or Nunavut). In Hong Kong and Queensland, the latter stratification of sex interacted with age group was performed without further regional stratification. In California, due to the demographics of the online panel, it was only feasible to stratify the population on sex and a more coarse age group categorisation (18-29, 30-64, and 65+) separately. As the numbers of participants collected in each stratum do not reflect proportions in the actual population of each country, the data incorporate non-response weights which permit inferences at the national scale.

Due to technical issues, in Bulgaria and Canada, some regions were not recorded. In these cases, we used home location information given by participants during the survey (section 4.7) to manually assign regions. A variable is included in the final data file which indicates whether or not a region was manually assigned (section 8.13). Missing data only exist where a region was not automatically recorded and the participant either (i) did not provide their home location, or (ii) entered a home location outside of the country in which they were a registered panellist.

Sampling was undertaken in seasonal waves across the course of a year as previous research has shown that blue space visits tend to be strongly impacted by season[13]. The survey was therefore administered in four, approximately-monthly waves of data collection. The first wave launched on the 7th June 2017 and closed on the 30th of June. The second wave launched on the 5th of September and closed on the 4th of October. The third wave was launched on the 14th of December and closed on the 15th of January. The fourth wave launched on the 5th of March 2018 and closed on the 16th of April 2018. At the start of each month, YouGov conducted a technical pilot (hence no wave starts on the first day of each month) to ensure the survey would operate correctly in each country. The later start of the December-January wave was in order to capture the so-called ‘Christmas gap’ which has been identified in surveys of leisure visits to natural environments as of particular significance, as visits over this period tend to differ from the norm in terms of characteristics[14]. The longer period of data collection in the March-April wave was in order to supplement countries whose samples had yet to accrue approximately 1,000 responses.

YouGov sent tranches of emails on a daily basis gradually throughout the duration of each wave to participants within each stratum so as not to complete data collection within a particular stratum too quickly and instead have responses which represent the period as a whole. The aim was to recruit approximately 250 responses per country, per wave, so that the total 1,000 could be considered a sample which is representative of that country’s population based on sex, age, and region of residence (see above). Actual recruitment numbers varied

but approximately 1,000 responses has been considered previously as appropriately powerful to make national inferences based on these three strata[15].

Table 1. Number and proportion of participants sampled compared to target proportions by country, sex, and age

Country	Sex*Age	Number recruited	Proportion of country sample	Target proportions
Bulgaria	Female 18-29	100	0.09	0.08
Bulgaria	Female 30-39	98	0.09	0.08
Bulgaria	Female 40-49	113	0.11	0.08
Bulgaria	Female 50-59	108	0.10	0.08
Bulgaria	Female 60 and above	135	0.13	0.19
Bulgaria	Male 18-29	81	0.08	0.09
Bulgaria	Male 30-39	114	0.11	0.09
Bulgaria	Male 40-49	111	0.11	0.09
Bulgaria	Male 50-59	105	0.10	0.08
Bulgaria	Male 60 and above	89	0.08	0.14
California	Female	577	0.54	0.51
California	Male	501	0.46	0.49
California	18-29	209	0.19	0.24
California	30-64	605	0.56	0.61
California	65+	264	0.24	0.16
Canada	Female 18-29	94	0.09	0.08
Canada	Female 30-39	87	0.08	0.08
Canada	Female 40-49	70	0.07	0.08
Canada	Female 50-59	73	0.07	0.08
Canada	Female 60 and above	182	0.18	0.19
Canada	Male 18-29	89	0.09	0.09
Canada	Male 30-39	89	0.09	0.09
Canada	Male 40-49	105	0.10	0.09
Canada	Male 50-59	97	0.09	0.08
Canada	Male 60 and above	144	0.14	0.14
Czech Republic	Female 18-29	117	0.11	0.09
Czech Republic	Female 30-39	90	0.08	0.09
Czech Republic	Female 40-49	81	0.08	0.09
Czech Republic	Female 50-59	84	0.08	0.08
Czech Republic	Female 60 and above	174	0.16	0.17
Czech Republic	Male 18-29	82	0.08	0.09
Czech Republic	Male 30-39	117	0.11	0.10
Czech Republic	Male 40-49	107	0.10	0.09
Czech Republic	Male 50-59	91	0.08	0.08
Czech Republic	Male 60 and above	137	0.13	0.13
Estonia	Female 18-29	94	0.10	0.09
Estonia	Female 30-39	81	0.08	0.08
Estonia	Female 40-49	87	0.09	0.08
Estonia	Female 50-59	107	0.11	0.09
Estonia	Female 60 and above	148	0.15	0.20

Estonia	Male 18-29	96	0.10	0.10
Estonia	Male 30-39	88	0.09	0.09
Estonia	Male 40-49	89	0.09	0.08
Estonia	Male 50-59	80	0.08	0.08
Estonia	Male 60 and above	91	0.09	0.11
Finland	Female 18-29	86	0.08	0.09
Finland	Female 30-39	99	0.09	0.08
Finland	Female 40-49	78	0.07	0.08
Finland	Female 50-59	93	0.09	0.09
Finland	Female 60 and above	159	0.15	0.18
Finland	Male 18-29	114	0.11	0.09
Finland	Male 30-39	90	0.08	0.08
Finland	Male 40-49	78	0.07	0.08
Finland	Male 50-59	90	0.08	0.08
Finland	Male 60 and above	174	0.16	0.15
France	Female 18-29	130	0.12	0.09
France	Female 30-39	102	0.10	0.08
France	Female 40-49	100	0.09	0.09
France	Female 50-59	114	0.11	0.09
France	Female 60 and above	146	0.14	0.18
France	Male 18-29	68	0.06	0.09
France	Male 30-39	48	0.04	0.08
France	Male 40-49	70	0.07	0.09
France	Male 50-59	92	0.09	0.08
France	Male 60 and above	201	0.19	0.14
Germany	Female 18-29	92	0.09	0.08
Germany	Female 30-39	78	0.08	0.07
Germany	Female 40-49	79	0.08	0.09
Germany	Female 50-59	95	0.09	0.09
Germany	Female 60 and above	176	0.17	0.18
Germany	Male 18-29	86	0.08	0.09
Germany	Male 30-39	68	0.07	0.07
Germany	Male 40-49	92	0.09	0.09
Germany	Male 50-59	100	0.10	0.09
Germany	Male 60 and above	159	0.16	0.15
Greece	Female 18-29	105	0.11	0.08
Greece	Female 30-39	95	0.10	0.09
Greece	Female 40-49	99	0.10	0.09
Greece	Female 50-59	100	0.10	0.08
Greece	Female 60 and above	43	0.04	0.18
Greece	Male 18-29	86	0.09	0.08
Greece	Male 30-39	118	0.12	0.09
Greece	Male 40-49	121	0.12	0.09
Greece	Male 50-59	96	0.10	0.08
Greece	Male 60 and above	107	0.11	0.15
Hong Kong	Female 18-29	139	0.14	0.10

Hong Kong	Female 30-39	142	0.14	0.11
Hong Kong	Female 40-49	116	0.12	0.10
Hong Kong	Female 50-59	82	0.08	0.10
Hong Kong	Female 60 and above	54	0.05	0.14
Hong Kong	Male 18-29	119	0.12	0.09
Hong Kong	Male 30-39	100	0.10	0.07
Hong Kong	Male 40-49	93	0.09	0.07
Hong Kong	Male 50-59	88	0.09	0.09
Hong Kong	Male 60 and above	51	0.05	0.12
Ireland	Female 18-29	126	0.12	0.09
Ireland	Female 30-39	115	0.11	0.11
Ireland	Female 40-49	91	0.09	0.10
Ireland	Female 50-59	76	0.07	0.08
Ireland	Female 60 and above	121	0.11	0.13
Ireland	Male 18-29	81	0.08	0.09
Ireland	Male 30-39	113	0.11	0.10
Ireland	Male 40-49	115	0.11	0.10
Ireland	Male 50-59	89	0.08	0.08
Ireland	Male 60 and above	132	0.12	0.11
Italy	Female 18-29	87	0.08	0.07
Italy	Female 30-39	82	0.08	0.08
Italy	Female 40-49	108	0.10	0.10
Italy	Female 50-59	100	0.09	0.09
Italy	Female 60 and above	166	0.16	0.19
Italy	Male 18-29	84	0.08	0.08
Italy	Male 30-39	108	0.10	0.08
Italy	Male 40-49	121	0.11	0.10
Italy	Male 50-59	87	0.08	0.08
Italy	Male 60 and above	123	0.12	0.15
Netherlands	Female 18-29	106	0.10	0.09
Netherlands	Female 30-39	78	0.07	0.07
Netherlands	Female 40-49	92	0.09	0.09
Netherlands	Female 50-59	108	0.10	0.09
Netherlands	Female 60 and above	167	0.16	0.16
Netherlands	Male 18-29	96	0.09	0.09
Netherlands	Male 30-39	72	0.07	0.07
Netherlands	Male 40-49	97	0.09	0.09
Netherlands	Male 50-59	99	0.09	0.09
Netherlands	Male 60 and above	147	0.14	0.14
Portugal	Female 18-29	106	0.11	0.08
Portugal	Female 30-39	94	0.10	0.09
Portugal	Female 40-49	94	0.10	0.09
Portugal	Female 50-59	98	0.10	0.09
Portugal	Female 60 and above	54	0.06	0.18
Portugal	Male 18-29	80	0.08	0.08
Portugal	Male 30-39	98	0.10	0.08

Portugal	Male 40-49	114	0.12	0.09
Portugal	Male 50-59	98	0.10	0.08
Portugal	Male 60 and above	110	0.12	0.14
Queensland, AU	Female 18-29	124	0.12	0.13
Queensland, AU	Female 30-39	95	0.09	0.09
Queensland, AU	Female 40-49	107	0.11	0.09
Queensland, AU	Female 50-59	94	0.09	0.08
Queensland, AU	Female 60 and above	140	0.14	0.13
Queensland, AU	Male 18-29	50	0.05	0.13
Queensland, AU	Male 30-39	66	0.07	0.08
Queensland, AU	Male 40-49	82	0.08	0.09
Queensland, AU	Male 50-59	86	0.09	0.08
Queensland, AU	Male 60 and above	157	0.16	0.12
Spain	Female 18-29	82	0.08	0.08
Spain	Female 30-39	92	0.09	0.09
Spain	Female 40-49	96	0.09	0.10
Spain	Female 50-59	99	0.09	0.08
Spain	Female 60 and above	130	0.12	0.16
Spain	Male 18-29	92	0.09	0.08
Spain	Male 30-39	137	0.13	0.10
Spain	Male 40-49	143	0.14	0.10
Spain	Male 50-59	87	0.08	0.08
Spain	Male 60 and above	96	0.09	0.13
Sweden	Female 18-29	93	0.09	0.10
Sweden	Female 30-39	82	0.08	0.08
Sweden	Female 40-49	92	0.09	0.08
Sweden	Female 50-59	89	0.08	0.08
Sweden	Female 60 and above	161	0.15	0.17
Sweden	Male 18-29	122	0.11	0.10
Sweden	Male 30-39	100	0.09	0.08
Sweden	Male 40-49	98	0.09	0.09
Sweden	Male 50-59	79	0.07	0.08
Sweden	Male 60 and above	153	0.14	0.15
United Kingdom	Female 18-29	121	0.10	0.10
United Kingdom	Female 30-39	103	0.08	0.08
United Kingdom	Female 40-49	114	0.09	0.09
United Kingdom	Female 50-59	111	0.09	0.08
United Kingdom	Female 60 and above	249	0.20	0.16
United Kingdom	Male 18-29	72	0.06	0.10
United Kingdom	Male 30-39	71	0.06	0.08
United Kingdom	Male 40-49	96	0.08	0.09
United Kingdom	Male 50-59	113	0.09	0.08
United Kingdom	Male 60 and above	217	0.17	0.14

N.B Weights in the data file can be applied to adjust estimates towards national norms for age, sex, and region of residence.

4 Content

Participants first read the following information:

> *"Please read this information carefully before deciding whether or not to participate. If you decide to participate, thank you. If you decide not to take part, thank you for considering.*
>
> *What is the aim of the survey?*
>
> *The aim of this survey is to find out how people use outdoor spaces internationally. These can be green spaces such as parks and the countryside, or blue spaces such as the coastline, lakes and rivers (i.e. including water). There is some evidence that using these places may be related to people's health but this is yet to be investigated on a more global scale. This survey is being undertaken as part of a European Commission funded grant to the University of Exeter Medical School.*
>
> *What are participants being asked to do?*
>
> *For some of the questions you may indicate that you "prefer not to answer" if you wish. Please note that this survey will ask you to locate your home location by placing a marker on a map. Only the approximate location of this marker is accessible to the researchers, but in a small number of cases (e.g. where your home is located in a more rural area) this could mean your address is identifiable. However, this information will only be available to researchers at the University of Exeter and will always be stored on a secure, offline server.*
>
> *The survey should take a maximum of 25 minutes to complete, but in many cases it will be considerably shorter.*
>
> *Can participants change their mind and withdraw from the survey?*
>
> *You can withdraw from the survey at any time by closing your browser window.*
>
> *What data or information are collected and what use will be made of it?*
>
> *All of the responses you make to the questions in this survey will be recorded. All responses you provide will be kept anonymous - you won't be personally identifiable in any way. The data will be stored and shared securely and will only be viewed by selected individuals at 9 European academic institutions who are collaborating on the project. Research may be published using this data, but again, you will not be personally identifiable in any research output. After June 2020, the data collected from this survey will be made freely accessible to the public. This means anyone could apply to use the data for their own research or commercial purposes. Your responses will however, remain anonymous - you will not be able to personally identified in this dataset."*

Participants were then supplied with contact details of the lead researcher as well as the chair of the ethics board who approved the research (University of Exeter College of Medicine and Health's Research Ethics Committee) whom they could contact if they had any questions or concerns about the study.

Participants then completed a consent form. If they did not check all boxes, they were redirected to a landing page which informed them that they were ineligible to participate. The terms the participant had to agree to were: "My participation in the project is entirely voluntary", "I am free to withdraw from the survey at any time by closing my browser window", "The data will be retained in secure storage", "The results of the project may be published but my

anonymity will be preserved", "A fully anonymised dataset including my responses will be made publicly accessible after June 2020", "I agree to take part in this survey", and "I am aged 18 or above".

If they agreed to all of these terms, participants progressed through seven main survey modules outlined below. Depending on the route through the survey, its duration could last as little as 10 minutes, or as long as 30. Piloting suggested that on average, participants took 20-25 minutes to complete the survey.

4.1 Subjective wellbeing

The first module of questions comprised the four subjective wellbeing items proposed by the OECD for use in national surveys[10] and also the personal wellbeing index[16]. Participants first reported satisfaction with their life as a whole. As well as being a commonplace measure of evaluative wellbeing in international surveys[17–19], life satisfaction has also been associated with residential coastal proximity previously[20]. The seven-item personal wellbeing index then followed this which queries the participant's satisfaction with their standard of living, health, achievements in life, personal relationships, safety, community connectedness, and future security. These have been shown to account for significant variation in satisfaction with one's life as a whole in Australian and Hong Kong samples[21] (albeit with evidence of some cultural responses biases) and thus could be considered important covariates in any analysis of life satisfaction. Lastly, this module queried participant's eudaimonic wellbeing (how worthwhile they perceived their daily activities to be), as well as their positive (happiness) and negative (anxiety) experiential wellbeing; these are the remaining three items proposed by the OECD for measuring subjective wellbeing. Eudaimonic and experiential wellbeing have been shown to be associated with how often a person visits natural environments, and specific characteristics of a visit to a natural environment, respectively[22]. Following recommendations, all of these items were measured on 11-point scales. These questions were asked at the outset of the survey so as to not be contaminated by responses to other items in the survey[10].

4.2 Frequencies of natural environment visits

The second of the module of the survey which was answered by all participants concerned how often participants made recreational visits to different green and blue spaces in the last four weeks. The last four weeks was chosen as an appropriate recall period for two main reasons. Firstly, regarding recall accuracy, there is at least precedent for the accurate recall of health states in the last "few weeks", as this is the nomenclature used by the 12-item general health questionnaire[23], one of the most widely used screening tools for minor psychiatric disorders worldwide[24]. Secondly, the last four weeks has been used as a recall period in previous leisure visit surveys[25], and as previous research has demonstrated that less than 7% of the population of England visited the coast (a key blue space) in the past week[4], it was considered that the last four weeks would yield a more substantial amount of recreational visit data.

On successive pages, participants were presented with lists (and accompanying visual exemplars) of 'urban' green spaces (local parks/pocket parks, large urban parks, community gardens or allotments, playgrounds or playing fields, cemeteries or churchyards, botanical gardens or zoos), 'rural' green spaces (woodlands or forests, farmland or arable land, meadow or grassland, mountains, moorland or heathland, country parks), 'urban' inland blue spaces (fountains, urban rivers or canals, swimming pools or outdoor spas), 'rural' inland blue spaces (ponds/streams/small water bodies, lakes, rural rivers or canals, waterfalls, wetlands, outdoor ice rinks), 'urban' coastal blue spaces (esplanades/promenades, piers, harbours or marinas), and 'rural' coastal blue spaces (sandy beaches, rocky shores, cliffs and headlands, lagoons, open sea) and asked to report how often in the last four weeks they had visited each space using four categorical response options (not at all in the last four weeks, once or twice in the last four weeks, once a week, several times a week). Of those environments which participants indicated they had visited at least once in the last four weeks, they were also asked if they had

visited that type of environment yesterday. Finally, participants were asked how often they had visited green and blue spaces in the last 12 months (not at all in the last 12 months, a few times in the last 12 months, once or twice a month, once a week, several times a week, every day) reflecting analogous items used for monitoring population-wide rates of recreational visits to natural environments[14]. Visiting green and blue spaces at least once a month in the last 12 months has been shown to be associated with greater eudaimonic wellbeing previously[22].

While the potential for double-counting exists (e.g. a waterfall cannot exist without a stream or river; outdoor ice rinks are often frozen ponds or lakes), this taxonomy of environments was developed both considering internationally-agreed taxonomies of green spaces[26], and with the expert guidance of landscape architects within the BlueHealth consortium who were mindful of the different affordances[27–29] offered by these different environment categories.

4.3 Natural environment perceptions

The third module, also answered by all participants, concerned natural environment perceptions more generally. The first four items concerned autonomous motivations for visiting natural environments and presented participants with four statements against which participants rated how true of them each statement was on 7-point Likert scales. The four statements asked whether participants found visiting green and blue spaces enjoyable, whether the activities they conducted there were important to them, whether they sometimes felt pressured to visit green and blue spaces, and whether they would feel disappointed if they did not visit them. Research has previously theorised that natural environment exposure can bolster personal autonomy[30].

Secondly, participants were administered the one-item inclusion of nature in self scale[31]. This scale, adapted from the inclusion of other in self scale[32], was designed to measure a person's connectedness to nature; a psychological construct that has demonstrated significant associations with experiential and evaluative wellbeing[33]. Concurrent validity with measures of environmental concern have been demonstrated previously[31]. Specifically, the scale asks participants to select one of seven pictures showing two overlapping circles labelled "self" and "nature". These ranged from 1 (touching but not overlapping) to 7 (where circles nearly entirely overlapped). This item was carefully translated so its meaning was maintained (section 6.1 and section 6.2).

Participants were asked whether they had a view of blue space from their home (yes/no) as a residential view of blue space has been associated with lower odds of psychological distress[34] and depression in older adults[5] previously. Participants were also asked what quantity of blue space they perceived that they had within a 10-15 minute walk, and 10-15 minute drive, of their home (none, a little, a lot, not sure). These two questions were adapted from a previous cross-national survey of the health effects of natural environment exposure[35]; the former is considered to represent approximately a 1km walk from the participant's residence[36], the latter is considered to represent a person's 'community[37]' and has been identified as important in identifying environmental supportiveness for physical activity and walking behaviour[38].

A binary (yes/no) choice item asked whether participants regularly commuted by or through blue space when commuting to or from work, school, or other daily activities. Active commuting through natural environments in four European cities has been associated with better mental health previously[39]. Two items queried participant's overall perceptions of the quality and safety of the blue spaces near their home on 5-point scales. Good quality blue spaces (e.g. having appropriate facilities, containing wildlife) have been associated with higher visit frequencies in a Hong Kong sample[40] and perceiving a natural environment as safe has been shown to be crucial to supporting physical activity[41].

Lastly, three items queried the nature of the participant's childhood contact with blue spaces. Specifically, they addressed whether blue spaces were easily accessible to them as a child, whether their parents or guardians were comfortable with them playing in and around blue spaces, and whether they visited blue spaces frequently. Previous research has identified

childhood experiences of natural environments to be predictive of levels of nature-based physical activity during adulthood[42].

4.4 Most recent visit to a blue space

Participants who had indicated earlier in the survey that they had visited a blue space at least once in the last four weeks (section 4.2) were then asked to report on their most recent visit to a blue space in this fourth module. Those that had not were redirected to the 'health' section (section 4.6). Querying the 'most recent visit' may introduce bias as it is a non-random method of selecting a visit to a blue space made in the last four weeks. However, it is an approach used in national surveys of leisure visits to natural environments[25] and considering the scarcity of blue space visits at a population-level identified previously[4] should not overly inflate the frequencies of blue space visits with particular characteristics over those with different characteristics.

The first question asked the participant what the date of the most recent visit was as the amount of physical activity accrued on blue space visits has been found to differ between weekdays and weekend days previously[43]. The date, along with geolocation of the visit (see below), will also permit linkage with data describing meteorological conditions which have been found to affect nature-based physical activity[44], and the stress restoration potential of natural environments[45] previously. The second question asked which of 17 blue space categories best describes the type of environment the participant visited (see section 4.2 for these categories). Visiting different types of blue space has been associated with different stress restoration benefits[46] and physical activity accumulation[43] previously. The next question queried the time of day that the participant arrived at the blue space. Research has demonstrated that even within regions, different blue spaces can afford different rates of recreation dependent on time of day[47]. Responses were permitted in all possible five-minute intervals within 24 hours. Participants were then asked how much time they spent at the blue space with responses permitted in 10-minute intervals up to 4 hours or more. Research has demonstrated that time spent at a natural environment is positively associated with its perceived restorative potential[46]. In contrast to measures used in leisure visit surveys previously[14] this captures only the time spent at the particular blue space and excludes travel time allowing us more precise exposure estimation in terms of visit duration than has been possible previously[48]. Participants were then asked to rate the quality of the water at the blue space they visited (poor, sufficient, good, excellent). These categories are commensurate with the ratings given to designated bathing waters in the European Union[11] and feed in to a later experimental survey module (section 4.5).

Participants were then asked what the main activity was that they undertook when visiting the blue space. Leisure visit surveys have previously asked participants to report either the main activity undertaken[25] or alternatively all the activities undertaken[14] on a particular visit. The former option was selected here so we could better ascribe estimates of activity-related energy expenditure than has been possible previously[43] where assumptions have to be made or participants excluded. Participants could select one from a list of 29 activities (walking with a dog, walking without a dog, Nordic walking, running, cycling, horse riding, golf, adventure sport, informal games and sport, fishing, hunting, conservation, sunbathing, visiting an attraction, quiet activities [e.g. reading], playing with children, appreciating scenery from a car, eating or drinking, socialising, watching wildlife, boating, commercial boat trip, paddling [i.e. splashing in shallow water], swimming, water sport, diving, ice skating, ice fishing, or snow sports) or select "any other activity not in the list". Selection of activity categories was first informed by previous leisure visit surveys[14,25], and then underwent consultation within the project consortium and with public engagement groups in order to form a list that was comprehensive and culturally sensitive. Where the potential for ambiguity existed, exemplar activities were given (i.e. in the survey participants could see, for example, that 'adventure sport' referred to activities such as coasteering, climbing, paragliding, off-road driving, or mountain biking). Participants were then asked how long they spent doing this activity in 10-minute intervals up to 4 hours or more. As with the visit activity, this was so that estimates of

activity-related energy expenditure could be better ascribed than has been possible previously[43]. For example, it allows us to estimate how much the visit itself could contribute to achieving recommended physical activity levels by multiplying it by a standardised measure of energy cost[49].

Participants were then asked about psychological outcomes of their visit. On seven-point Likert scales, participants were first asked the extent to which the visit made them feel happy, anxious, how worthwhile they found the visit, and how satisfied they were with the visit. These were intended to be analogous to the global positive experiential, negative experiential, eudaimonic, and evaluative wellbeing measures (respectively) recommended by the OECD for national wellbeing measurement[10] and used earlier in the survey (section 4.1). The intention was that analyses focused on these visit outcomes could then control for a person's overall subjective wellbeing, meaning that any visit-level finding could not be attributable to general personal dispositions. More recently, these questions have been incorporated into a national leisure visit survey in England[14] and a composite measure of these items has been shown to be positively associated with blue space visit duration and activity intensity in an older-adult sample in Hong Kong[40]. A further three items with 7-point Likert scale responses queried the participant's autonomy on the visit ("I felt free to be who I am"), relatedness during the visit ("I felt closeness or intimacy with others"), and competence on the visit ("I felt a sense of achievement"). These three items were original and were intended to target the autonomy, competence, and relatedness domains of self-determination theory[50]. It has previously been theorised that these intrinsic 'psychological needs' can often be met through affiliating with natural environments[51,52].

Another item with the same response scale asked the extent to which the participant "felt part of nature" during the visit. This item was adapted from the Nature Connection Index[53], a multi-item scale to measure connectedness to nature. Rather than administering the scale as a whole, we selected this item as it had the lowest mean score and most normal distribution of responses during its original pilot[53] in comparison to the other items. It has previously been theorised that nature connectedness might be positively related to eudaimonic wellbeing and mediated through the fostering of intrinsic values[54]; such a hypothesis can be tested with the questions detailed in the preceding paragraphs. A one-item measure ("I was able to rest and recover my ability to focus in that blue space") queried participant's perceptions of the restorative potential[55] of the blue space and was adapted from a previous study[56]. Again, participants could respond on a 7-point Likert scale. Four further items used this response scale to query the participant's perceptions of the blue space's safety ("I felt safe [i.e. protected from danger]"), wildlife presence ("there was wildlife to see and enjoy"), litter ("the area was free from litter/vandalism"), and facilities ("there were good facilities [e.g. parking, footpaths, toilets]"). These four items have recently been adopted into a national leisure visit survey in England[14] and the presence of good facilities and wildlife at urban blue spaces has been shown to be predictive of blue space visit frequency in Hong Kong previously[40].

Two questions asked how many adults, including the participant, were present on the visit (1 up to 10 or more) and how many children were present (0 up to 10 or more). The presence of other adults on leisure visits to natural environments has been positively associated with energy expenditure on that visit previously[43] and visiting only with children has been negatively associated with stress restoration[46]. The participant was also asked how often they had visited that particular blue space in the last four weeks (free numerical response). This was asked to determine whether the environment was an 'everyday' or 'favourite' blue space to visit, as such waterside environments have been shown to be associated with particularly strong restorative benefits previously[57].

To assess some of the health risks associated with recreational visits to blue spaces, participants were then asked whether they had experienced trips, wounds, bites, sunburn, or other accidents on their most recent blue space visit (yes/no); a set of potentially common adverse effects which were decided through consultations with the BlueHealth consortium and general public. Additionally, participants were asked whether they had experienced any

gastrointestinal symptoms (vomiting, diarrhoea, stomach ache, indigestion), ear ailments (ache, discharge), eye ailments (pain, discharge), skin ailments (rash, ulcer, sore, itch), and flu symptoms (fever, headache, joint pain, sore throat, cold, cough), or any other symptom of illness since their most recent visit. These questions were only asked of people who reported partaking in a water-based activity earlier in the survey and were designed to reflect the most common ailments associated with recreational exposure to infectious microorganisms (particularly sewage-related) in natural, and predominantly coastal, waters[58]. Participants were further asked whether anyone else in their household had experienced similar symptoms since the visit to control for the likely possibility that these symptoms were not related to the visit itself.

The next set of visit-related questions queried the participant's journey to the blue space. Firstly, they were asked where their visit started from (home, holiday accommodation, elsewhere, workplace) reflecting a similar categorisation used in comparable surveys[14]. Visits to natural environments beginning from holiday accommodation have previously been shown to result in higher rates of energy expenditure[43]. Next, participants operated an embedded, customised Google Maps application programming interface (API) to indicate the precise location from where their visit began. A marker, whose default position was typically the capital city of the country in which the participant resided, could be moved to anywhere in the world to denote this start point. Instructions were provided on how to use the API and a search box also allowed participants to enter a place name to which the marker would automatically relocate. An event listener silently logged the precise coordinates (World Geodetic System 1984) of this location when the participant proceeded to the following page of the survey. On the next page, participants were asked to use the API again to denote the blue space location that they arrived at. This time the default position of the marker was the position where the participants had indicated their start point. Again, instructions and a search box were provided to assist the participant. These mapping items were used for multiple purposes including but not necessarily limited to: (a) to get a precise home location for participants to which land cover, environmental, and sociodemographic data could be linked (see also section 4.7 and section 5), (b) to objectively measure the distance of the journey, (c) to identify environmental features of the visit location (e.g. whether it is a designated bathing water); and, (d) to corroborate participant's region of residence as logged by the survey company (section 3 and section 4.7.1). Pre-testing this API with a public engagement group (section 6.1) suggested that the API was usable even by those who were more novice computer users, at least through a PC medium (as opposed to mobile device).

Participants were next asked to report an estimate of the one-way travel distance between their start point and blue space they arrived at. A free numerical response was permitted in either kilometres or miles (subsequently converted into kilometres), though unrealistically high answers were prohibited. They were further asked to provide an estimate of how long it took them to travel between their start point and the blue space they arrived at. Again, a free numerical response in hours and minutes was permitted (subsequently converted to minutes) and unrealistically high answers were prohibited. They were then asked to report their principal mode of travel used (personal motorised transport [e.g. car, van, motorbike], walking [including wheelchair use and mobility scooters], bicycle, ran/jogged, bus or tram, train or metro, taxi, hire car, ferry or public boat, other [e.g. horseback]) and, if applicable, how many other people travelled with them in their car/van/motorbike (0 up to 10 or more). Participants were then asked the purpose of their visit (entirely to visit this place, partly to visit this place and partly to do something else, entirely for another reason). These categories aimed to reflect intentional, indirect, and incidental motivations for visiting the blue space; frequencies of similar visit classifications have been associated with nature connectedness previously[59]. Lastly, participants were asked to estimate how much their journey costed. Participants were instructed that this should include travel to the blue space as well as any onward or return travel and were given examples of potential costs (e.g. public transport fares, petrol, or parking). They were also instructed to provide an estimate of only the share of costs related

to themselves, if travelling with other people. A free numerical response in the participant's local currency was permitted.

Ultimately, these six questions were designed to provide a detailed illustration of the participant's travel cost and would facilitate analyses of the potential economic worth of blue spaces. Comparable research with all natural environments has been conducted previously[60] and similar questions have informed the development of online platforms for land use policy decisions[61]. The items can also be used to corroborate distances assigned to the coordinates of the start point and visit location provided by the participants earlier in the survey (see above). Moreover, longer travel distance and more active modes of transport have been shown to be positively related to the amount of physical activity accrued on recreational visits to natural environments previously[43].

4.5 Contingent behaviour experiment

The next module of the survey comprised a contingent behaviour experiment designed to test the effects of bathing water signage on recreational behaviour. Specifically, it tested the effects of the signage that was designed and implemented in the European Union following recommendations made by the European Parliament's revised bathing water quality directive[62]. The directive placed a decree on member states to present, in an easily accessible place in the near vicinity of a designated bathing water, "the current bathing water classification and any bathing prohibition or advice against bathing referred to in this Article by means of a clear and simple sign or symbol". Subsequently, standardised pictograms were developed that all member states could use[63]. For these reasons, this survey module was only administered to participants from European countries.

The experiment was particularly concerned with any effects the signage might have on the hypothetical frequency of visits that the participant would make to the blue space they described in the previous survey module, and how they would make time for additional visits, or what they might do instead of visiting. While previous research has predicted economic benefits through improved public health from the revisions to the bathing water directive[64], other research has revealed that despite people valuing improvements to water quality, designations play an insignificant role in people's motivations to visit coastal locations[65]. Moreover in a more specific contingent behaviour study in south-west Scotland, water quality improvements only resulted in modest changes to hypothetical beach visits[66].

There were two blocks of questions in this module, the order of which was randomised within each participant. One block concerned improvements in water quality and the other concerned deteriorations. Firstly, the participant was reminded of the water quality rating they gave to the blue space they described in the previous module (poor, sufficient, good, excellent; in line with Article 5 of the revised bathing water directive[62]) and presented with the corresponding pictogram[63] that could be displayed at that site. On the next page, they were presented with a pictogram that represented either an improvement (i.e. good to excellent) or a deterioration (i.e. good to sufficient). For the purposes of the experiment, a fictitious 'outstanding' category with corresponding pictogram was invented for those who had rated the water at the blue space as 'excellent' already, and a deterioration from a 'poor' rating was visualised with the additional 'advice against bathing' pictogram that the directive recommends should be used at bathing waters which are classified as 'poor' for five consecutive years[62].

Regardless of whether an improvement or deterioration scenario was viewed first, the participant was asked how it would affect the number of visits they made to that blue space in the last four weeks (no change, fewer visits, more visits). They were reminded of the number of visits they had reported that they took previously (section 4.4). If they answered "more visits", they were asked how many more visits they would make in the next four weeks (free numerical response with unrealistically high answers prohibited), and then how they would make time for these visits (reduce the number of visits you make to other blue spaces, reduce the time you spend doing non-leisure activities, reduce the time you spend doing other leisure activities). If they answered "fewer visits", they were asked how many fewer visits they would

make to the blue space in the next four weeks (free numerical response with unrealistically high answers prohibited) and then what they would do with their time instead (do different leisure activities not in blue spaces, go to a different blue space, something else [participants could state what this might be as free text], stay at home). If they answered "no change", they would proceed to the other block of questions (improvement or deterioration scenario).

4.6 Health

The sixth module of survey questions concerned the participant's health in general and comprised many commonly used and validated metrics of both physical and mental health. Firstly, the World Health Organisation-Five Well-Being Index (WHO-5) was administered. The WHO-5 is a widely used measure of recent psychological wellbeing, has been translated into more than 30 languages, and has adequate validity both as a screening tool for depression and an outcome measure in clinical trials[67]. It is also used in large, multinational, cross-sectional surveys[18]. It asks participants to indicate for each of the five statements which response option comes closest to how they have been feeling over the last two weeks. The five statements are "I have felt cheerful and in good spirits", "I have felt calm and relaxed", "I have felt active and vigorous", "I woke up feeling fresh and rested", and "my daily life has been filled with things that interest me" (at no time, some of the time, less than half of the time, more than half of the time, most of the time, all of the time). These response options are conventionally scored 0 to 5 respectively, summed, and multiplied by 4 to give a score out of 100[67]. Dichotomisations at greater or less than 50 are considered to represent 'high' and 'low' psychological wellbeing, whereas greater or less than 28 are considered indicative of 'high risk' of depression and 'low risk' of depression[68,69]. Previous research has found that socioeconomic inequalities in WHO-5 scores are narrower among Europeans reporting good access to green/recreational areas[12] and residential views of blue space in Hong Kong have been associated with greater odds of 'high' wellbeing[40].

Taken from the European Social Survey[17], the next item queried the participant's overall health in general (very bad, bad, fair, good, very good). Similar overall assessments of health are correlated with mortality[70] and have been associated with the availability of greenspace[71,72] and residential coastal proximity[2] previously. The next question asked whether the participant was experiencing any long-standing illness, disability, infirmity, or mental health problem (no, yes to some extent, yes a lot). The wording was again taken from the European Social Survey[17]. People who report having a long-standing illness or disability tend to undertake recreational visits to natural environments less frequently and report their poor health as a particular barrier to accessing these environments[73]. They also accrue less physical activity in natural environments than their non-disabled counterparts when they do visit them[43].

One item assessed the amount of physical activity the participant achieved in the last seven days. This measure has previously been shown to be as reliable as the World Health Organisation's Global Physical Activity Questionnaire[74] (GPAQ) and have modest concurrent validity with it[75]. Specifically it incorporates moderate-intensity physical activity achieved through recreation and transport but not through housework or occupational physical activity. Participants are asked to "think now about any physical activity you might engage in. 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" and are then asked, "during the last 7 days, 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?" They respond with a number from nought to seven. The wording "raise your breathing rate" is important as it indicates that the physical activity was at least of moderate-intensity and therefore sufficiently intense as to generate potential physical and mental health benefits[76–92] and to contribute towards achievement of physical activity recommendations set out by the World Health Organization[93]. These recommendations require that an adult accrues at least 150 minutes of moderate-intensity aerobic physical activity throughout the week in bouts of at least 10 minutes, or 75 minutes of vigorous-intensity physical activity, or an equivalent combination of moderate- and vigorous-intensity physical activity. The more stringent criteria of continuous

30-minute bouts of moderate-intensity exercise referred to in our question reflect older physical activity guidelines[94], but comparable physical activity items have shown significant relationships with residential coastal proximity previously[4]. We also recognise that a one-item measure is not as sensitive to activity intensities, nor is it as comprehensive of all physical activity domains compared to more common physical activity assessments used internationally such as the GPAQ[74], International Physical Activity Questionnaire[95] (IPAQ), or short questionnaire to assess health-enhancing physical activity[96]. However, since others have suggested that the relationship between environmental exposures (residential or visit-based) is potentially limited to only leisure-time or transport-related physical activity of lower intensities anyway[97], we do not consider this a significant limitation. An additional question queried the number of days in the previous week the participant undertook walking for recreation or transport for at least 10 minutes continuously. This was adapted from IPAQ[95] and is asked because previous research has shown that coastal residents walk more for exercise each week than non-coastal residents[98], and also because rates of walking alone have been shown to mediate associations between coastal proximity and both general and mental health[99]. Due to a technical error, this variable was not recorded for participants in the Czech Republic.

Taken from the European Social Survey[17], the next two questions asked about the participant's alcohol consumption and smoking status. The first asked, "In the last 12 months, how often have you had a drink containing alcohol? This could be wine, beer, spirits, or other drinks containing alcohol" (never, less than once a month, once a month, 2-3 times a month, once a week, several times a week, every day, prefer not to answer). The second asked, "Which of these best describes your smoking behaviour? This includes rolled tobacco but not pipes, cigars or electronic cigarettes" (I have never smoked, I have only smoked a few times, I do not smoke now but I used to, I smoke but not every day, I smoke daily, prefer not to answer). These were asked because previous research has shown that even passive exposure to blue spaces can reduce negative affect and stress[100–102]; constructs which are positively related to the number and strength of cravings for alcohol[103]. Similarly, exposure to blue spaces has been shown to support physical activity[104]; a behaviour which can reduce cravings for cigarettes[92]. Using these heath behaviour items, these proposed pathways can be empirically tested within the scope of the BlueHealth International Survey.

A checkbox item (yes, no) asked participants if they had taken any prescription medicines in the last two weeks for (separately) depression, anxiety, or pain in the neck or back (as well as "none of the above," "don't know," and "prefer not to answer;" a "yes" response to any of these would prevent a response to the former three options). This question was adapted from the European Health Interview Survey[105] and was asked because: (a) views of coastal blue space have been associated with lower rates of depression among older adults in Ireland[5], (b) exposure to blue spaces in controlled settings has been shown to reduce anxiety[106,107]; and, (c) natural environment density in 1km radii of Dutch residences is negatively related to the prevalence of neck and back complaints[108].

The next item queried how often in the past four weeks the participant consulted a general practitioner due to poor health (never, once, more than once, do not know, prefer not to answer). Again this was adapted from the European Health Interview Survey[105] and was asked because previous evidence has shown that residential exposure to natural environments is associated with reductions in the prevalence of a wide range of disease clusters in the Netherlands[108], and in particular coastal and saltwater environments near the home have been associated with rates of good health generally in England[2,109]. A further question asked participants on how many days in the past 12 months they were absent from work due to poor health (never, once, 1 to5 times, 6 to 10 times, more than 10 times, do not know, prefer not to answer). Again, this was adapted from the European Health Interview Survey[105] and was asked for similar reasons to that of the aforementioned question on general practitioner visits; i.e. a secondary outcome of less illness might be less work absence, which has economic

implications[110]. To our knowledge the effects of natural environment exposure (both residential and visit-based) on work absence has not been studied previously.

One item asked participant's about the duration of a typical night's sleep: "About how many hours in each 24-hour day do you usually spend sleeping (including at night and naps)? Please give your answer to the nearest hour" (less than 6 hours,7 hours, 8 hours, 9 hours, 10 hours, over 10 hours). This question's wording and response options were informed by a previous study which found that neighbourhood green space density in 1km radii of Australian's homes was positively associated with healthy durations of sleep (not too short or too long)[111]. Such findings have since been replicated in other settings[112,113] and have important implications for physical health outcomes[114,115]. To our knowledge such findings have not been shown with exposure to blue space although anecdotal evidence for the benefits of coastal walking on sleep duration do exist[116].

The last two questions in this module asked about the participant's height and weight. Firstly, they were asked: "What is your height without shoes? If you don't know, please give your best estimate." Participants could answer in metres and centimetres or in feet and inches. Although the final data only contain centimetres, the response options actually reflected one inch increases from four feet up to eight feet and thus the resultant centimetre data are unevenly spaced. Participants were also allowed to answer "don't know" or "prefer not to answer". For weight, participants were asked: "What is your weight without shoes? If you don't know, please give your best estimate." Again, participants could respond in either kilogrammes, stones and pounds, or just pounds. Although the final data only contain kilogrammes, the response options actually reflected one pound increases from six stones up to 20 stones and thus the resultant kilogramme data are unevenly spaced. Participants were also allowed to answer "less than 6 st / 38k.1kg / 84 lbs," "more than 20st / 127kg / 280lbs," or "prefer not to say". These questions were asked so that participant's body mass index (BMI) could be calculated. Evidence from New Zealand has previously shown that people with better access to beaches also had lower BMI, and another study of middle- to older-age adults from Shanghai, China has found that living closer to a river is associated with lower odds of being overweight or obese[117]; though quantitative evidence for the connections between blue space exposure and adiposity outcomes more generally is considered inconsistent[104].

4.7 Demographics

Participants were asked whether they perceived themselves as a competent swimmer (yes, no). As well as being the most popular in-water activity practised at beach environments in England[13], swimming itself can be particularly therapeutic, especially when practised over time[118]. Informed by consultation with a public engagement group, participants were asked the extent to which they agreed with the statement, "I often feel self-conscious engaging in activities at blue spaces" (strongly disagree, disagree, slightly disagree, neither agree nor disagree, slightly agree, agree, strongly agree, not sure) reflecting research with British and American samples which demonstrates that passive and active exposures to natural environments may positively impact perceived body image[119,120].

Participants were asked whether they had a dog (yes, no). An often cited predictor of regular physical activity[121–130], dog ownership has also been found to moderate associations between area-level green space availability and leisure- and transport-related physical activity[131] and thus could demonstrate similar relationships with blue space availability. Participants were also asked whether they owned or had access to a car because car owners have previously been found to be more physically active[132], and are willing to travel further to other recreational areas for physical activity[133]. Participants were further asked how long it would take for them to walk to their nearest public transport stop (less than one minute, one to five minutes, five to ten minutes, approximately 15 minutes, approximately 30 minutes, more than 30 minutes, don't know). This question was taken from a longitudinal transport survey administered in seven European cities[134].

Participants were then asked about their access to a garden (I don't have access to a private garden or outdoor space, I have access to a private communal garden, I have access to a private outdoor space, but not a garden [balcony, yard, patio area], I have access to a private garden). This was taken from a national survey of leisure visits to natural environments[14] and was asked because previous evidence has demonstrated that people living in areas with a greater availability of natural environments may nonetheless spend more time in their private gardens[135]; thus garden ownership may moderate relationships between blue space availability and health outcomes. Participants were also asked how "green" they perceived their street to be (1=not very green, to 5=very green, or not applicable – I do not live on a street). This item was adapted from a previous study which demonstrated that quantity (and quality) of streetscape greenery was related to perceived general health, acute health-related complaints, and mental health[136].

The next item queried participant's regular social contact by asking: "How often do you meet socially with friends, relatives or work colleagues? 'Meet socially' implies by choice rather than for reasons of either work or pure duty" (never, less than once a month, once a month, several times a month, once a week, several times a week, every day, do not know). Taken from the European Social Survey[17], this item was asked as social contact has been proposed as one of the key potential mechanisms that connects contact with natural environments with a variety of health outcomes[137,138].

Taken from two existing surveys[14,17], the next two questions asked about household composition (number of adults and number of children in household) as this (in particular living with a child) has proved to be an important covariate in previous studies examining the impact of land cover classes on mental health[139]. Participants were also asked their work status in line with categorisations from the European Social Survey[17] (in paid work [or away temporarily] [employee, self-employed, working for your family business]; unemployed and actively looking for a job; unemployed, wanting a job but not actively looking for a job; in education, [not paid for by employer] even if on vacation; doing housework, looking after children, or other persons; retired; permanently sick or disabled; in community or military service; other; do not know). Some countries were not presented with the option of "in community or military service" (see European Social Survey questionnaires for specific details on this[17]) and due to a technical error in the administering of the Bulgarian survey which meant responses to this variable were not recorded, YouGov ascribed the work status to the Bulgarian sample based on employment information those panellists provided upon signing up to the YouGov panel. Previous research has shown that people in education tend to expend more energy on leisure visits to natural environments[43] employment status has been shown to be a crucial predictor of mental health and life satisfaction in longitudinal studies of the impact of residential coastal proximity on these outcomes previously[3].

Educational attainment was measured in four categories (did not complete primary education, completed primary education, completed secondary/further education [up to 18 years of age], completed higher education [e.g. university degree or higher]). Such a categorisation was found to be the most applicable to multiple European countries in a previous survey of the health effects of living near natural environments[35]. Educational deprivation has been a key covariate in analyses of the relationship between area-level green space and poor health outcomes previously[72].

Participant's perceived ethnic minority status was asked with the wording: "Do you belong to a minority ethnic group in [country]? 'Belong' refers to attachment or identification" (no, yes, do not know). While this measure captures only perceived ethnic minority status and not actual ethnicity, it has been seen as the most appropriate measure for capturing ethnicity internationally[17]. Previous research has suggested that ethnicity may be an important moderator of the relationship between time spent outdoors (especially weekend time) and depression[140].

Participants were also asked about their marital status with an item adapted from the European Social Survey[17]: "Which of the following best describes your marital status now?" (Married, in a civil union, or living with your partner [cohabiting]; single, separated/divorced/civil union dissolved or widowed/civil partner died; neither of these; prefer not to answer). Previous research has demonstrated that unmarried adults tend to accrue more physical activity on visits to natural environments[43] while in a longitudinal study of residential coastal proximity and health, married adults also enjoyed better mental health and life satisfaction[3].

One item taken from the European Social Survey[17] asked how they felt about their present household income (finding it very difficult on present income, finding it difficult on present income, coping on present income, living comfortably on present income, do not know). Very similar measures of 'perceived financial strain' have been used in cross-national research previously as a proxy of socioeconomic status to show that inequalities in psychological wellbeing (measured by WHO-5) are narrower among Europeans reporting good access to green and recreational areas[12]. A second item asked about the participant's total annual household income after tax and compulsory deductions from all sources. Taken from the European Social Survey[17], participants could respond by indicating one of ten deciles of household income that were commensurate with the deciles in the most recent wave of the European Social Survey that had been administered in that country. For non-European countries, partners in those countries were consulted on the best system of deciles to use based on other labour surveys in those countries (for example, in Australia deciles were created from collapsed categories in the most recent wave of the Household, Income, and Labour Dynamics in Australia (HILDA) survey). Participants could also answer with "prefer not to answer". Income will be used in travel cost analyses (section 4.4) and will potentially be another socioeconomic status proxy variable to demonstrate associations between environmental exposures, health, and inequalities[12,141].

Lastly, for those participants who had not earlier reported their home location when reporting their visit start point (section 4.4), they were asked to indicate their home location on an embedded, customised Google Maps application programming interface (API). As before, a marker, whose default position was typically the capital city of the country in which the participant resided, could be moved to anywhere in the world to denote this home location. Instructions were provided on how to use the API and a search box also allowed participants to enter a place name to which the marker would automatically relocate. An event listener silently logged the precise coordinates (World Geodetic System 1984) of this location when the participant proceeded to the following page of the survey.

4.7.1 Additional demographic data

As well as the demographic data described above, YouGov automatically appended data concerning the participant's sex (male, female), age (18-29, 30-39, 40-49, 50-59, 60+), and region of residence using information the participant had provided upon sign up (except Ireland; section 2). These variables were used in the stratified sampling of participants and subsequently in the creation of non-response weights (section 3). Data were also automatically appended concerning the wave of data collection (section 3) and the dates and times of survey commencement and completion.

4.8 Additional items for non-European countries

As non-European countries did not partake in the contingent behaviour experiment (section 4.5) as this concerned European bathing water signage, three of these countries (Canada, Queensland [Australia], and California [USA]) instead saw a series of additional questions at the end of the survey. The following sections outline these additional questions, their sources, and why they were asked.

4.8.1 California (USA) additional items

Participants in the California sample were asked to think back to the visit they reported earlier (section 4.4). They were asked the extent to which they agreed with eight items about their

visit: “I felt I was ‘ruminating’ or dwelling over things that have happened to me”, “I was playing back over in my mind how I acted in a previous situation”, “I was re-evaluating what I had done in a previous situation”, “I was reflecting on episodes of my life that I should no longer concern myself with”, “I was spending a great deal of time thinking back over my embarrassing or disappointing moments”, “I was conscious of my inner feelings”, “I was reflective about my life” and, “I was aware of my innermost thoughts” (strongly disagree, disagree, slightly disagree, neither agree nor disagree, slightly agree, agree, strongly agree, do not know). The former five items are derived from a question set that distinguished rumination from reflection[142] and were asked because acute walks in natural environments have been shown to reduce rumination[143,144]. The latter three items were adapted from the situational self-awareness scale[145]. These were asked because previous research has shown that people with higher self-awareness tend to demonstrate less connection to nature[146].

4.8.2 Canada additional items

Participants in the Canadian sample were asked whether they participated or not in nine environmental behaviours: “Visiting nature makes me think about climate change and/or other threats to the environment”, “I often talk with friends about problems related to the environment”, “I am a member (passive or active) in an environmental organization”, “I bring unused medicine back to the pharmacy”, “When possible in nearby areas (around 20 km), I use public transportation or ride a bike”, “I buy organic vegetables and fruits”, “I reuse my shopping bags”, “I consider myself an environmentalist”, and “I eat red meat”. These items were taken from a cross-cultural measure of general ecological behaviour[147]. It has previously been argued that pro-environmental behaviours can be automatically induced by exposure to ‘favourable’ natural environments[148].

4.8.3 Queensland (Australia) additional items

The first additional item asked of the Queensland sample was actually asked directly after the participants had been asked about their travel mode on their most recent blue space visit (section 4.4). It asked participants to indicate the approximate size of the vehicle in which they travelled from a list of fourteen categories with exemplars (and additional “other” and “don’t know” options). It was only asked of participants indicating that they had travelled by personal motorised transport (e.g. car, van, or motorbike). It was asked in order to better estimate the economic[60,61] and environmental costs of the journey.

They were then asked to indicate how true of themselves four items concerning community cohesion were: “I care about other people in my neighbourhood”, “I feel connected to other people in my neighbourhood”, “I feel that people within my neighbourhood are on ‘same team”, and “I would help my neighbours if they required 1 hour of my time” (1=not at all true to 5=very much true with an additional “do not know” option). These items were adapted from a previous study which found that perceived quality of natural environments, views of natural environments, and time spent in natural environments were predictive of higher community cohesion which in turn enhanced subjective wellbeing[149]. Other research in Australia has found that neighbourhood affability (a similar construct) moderates associations between area-level urban green space and physical activity outcomes[150].

Three further items queried the participant’s pro-environmental identity. Participants were asked the extent to which they agree with three statements: “I think of myself as an environmental person”, “To engage in environmental behaviours is an important part of who I am”, and “I am not the type of person who would be involved in environmental behaviours” (1=disagree to 7=agree with an additional “do not know” option). Adapted from a previous study[151], these items were, in a similar way to the Canadian sample, asked because researchers have argued previously that contact with natural environments can automatically induce pro-environmental attitudes and behaviours[148].

The final two items asked the type of dwelling the participant resided in from a list of 16 possible options (with additional “prefer not to say” and “don’t know” options) and whether the

participant was of Aboriginal or Torres Strait Islander origin (no, yes, do not know, prefer not to say). These items were adapted from the Household, Income, and Labour Dynamics in Australia (HILDA) survey[152]. The former question was asked because previous research has found that dwelling type potentially moderates the effects of public green space availability on life satisfaction in an urban Australian sample previously[20]. The latter item was asked as Indigenous Australians share a disproportionately large burden of disease nationally[153].

4.9 Debrief

After completing all questions in the survey, participants were presented with a short debrief which explained the nature of the survey to participants and gave the participants the contact details of the lead researcher and chair of the ethics committee which approved the research in case they wanted to know about the results of the survey or had any concerns about the way in which the research was carried out.

5 Additional data

Data appended to the core content of the BlueHealth International Survey will be added over time. This section describes sources of data which were appended using the participant's home location data (derived from questions detailed in section 4.4 or section 4.7). The precise details of how these home location coordinates were processed and shared to ensure confidentiality and anonymity are described later (section 6.3). These additional data principally concern population density data and natural environment exposure assessments. Home location data was only collected for a subsample of the 18,838 participants recruited. In total, 17,908 had geocodes recorded. The remainder had missing data due to, for example, participants using an older web browser for completing the survey which was unable to display the Google Maps application programming interface correctly.

5.1 Population density

We appended data from the NASA Socioeconomic Data and Applications Centre Gridded Population of the World Version 4 (GPWv4) datasets[154]. This is a minimally modelled dataset which disaggregates national census data into a thirty arc-second (≈1km) global grid to give the number of people living in each ≈1km grid square across the globe. Its accuracy is inconsistent across the world due to differences in the availability of census data and also due to the variability of the shapes and sizes of the minimum areal units used in censuses within and between countries, but nonetheless it comprises highly accurate modelled data which improves greatly upon its predecessors[155].

This data can be used for the purposes of classifying survey participants as living in an urban or rural area (a further variable included in the data file). Despite attempts to create standardised definitions of urban areas or urban populations[156,157], there is no internationally consistent definition of what constitutes an urban area, with countries using minimum population thresholds, minimum population density thresholds, combinations of these, or other criteria to define 'urban' or 'rural' status. A forthcoming dataset from GPWv4 will classify grid squares as 'urban' or 'rural' based on these individual definitions. However, in the absence of these classifications, a simple population density threshold was used which considered anyone living in a grid cell with ≥150 people per km^2 to be living in an urban area, consistent with a threshold used in Germany[158].

In some cases, participants home location geocodes indicated that they lived in the sea, or in practically uninhabited areas; both of which were outside of the scope of the data available within GPWv4. For simplicity, such cases were classified as 'rural' (n=964) but users may wish to consider the utility of these data. More stringent approaches to handling unusual home geocodes were taken when ascribing natural environment exposures (section 5.2).

5.2 Natural environment exposure assessment

A number of both distance-based and coverage-based natural environment exposure assessments were ascribed to BlueHealth International Survey data. In general, they were intended to answer research questions about how residential exposures to blue and green spaces impacted people's health and wellbeing internationally, potentially through the mediating pathway of making direct recreational visits to such environments. The focus is on exposure assessments concerning blue spaces, commensurate with the overarching aims of the BlueHealth project[1], but both green space and built environment exposures are also considered.

Due to rounding of coordinates to three decimal degrees on both the latitude and longitude scale (section 6.3), people's home locations could be, on average, approximately 55m away from where their home was truly located (though with variation across the globe especially on the longitude scale). We therefore further excluded participants whose home locations were recorded as greater than 55m away from the coastline (defined by the Global Self-consistent Hierarchical High-resolution Geography shoreline database from the National Oceanic and

Atmospheric Administration - https://www.ngdc.noaa.gov/mgg/shorelines/gshhs.html)[159]. A total of 17,109 home location geocodes were therefore considered in ascribing natural environment exposures.

Working at a worldwide scale necessitates working within a geographic coordinate system i.e. latitudes and longitudes (WGS84) instead of using a projection (e.g. British National Grid) from which it would be simpler to calculate distances and areas. The open source software PostGIS (https://postgis.net/) was therefore used as its internal engine can take coordinates as input and return GIS results as distances or areas as an output (at the expense of computing time).

5.2.1 Coastal proximity

Living closer to the coast has previously been associated with a number of positive health outcomes[104] such as better self-perceived health[2], greater physical activity attainment[4], and better mental health[3] in English samples. Therefore, coastal proximity was seen as a key natural environment exposure to assess within the BlueHealth International Survey.

Consistent with the above research we opted to assess residential proximity to the coastline with a simple Euclidean (crow-flies) distance metric. We used PostGIS (https://postgis.net/) to calculate the distance from the given home location geocode to the nearest coastline as defined by the highest resolution version of the Global Self-consistent Hierarchical High-resolution Geography (GSHHG) shoreline database from the National Oceanic and Atmospheric Administration - https://www.ngdc.noaa.gov/mgg/shorelines/gshhs.html)[159]. This dataset provides a good balance between refinement in capturing a good representation of the land-sea interface (compared to, say, the Natural Earth coastline shapefile - http://www.naturalearthdata.com/downloads/10m-physical-vectors/10m-coastline/), but enough coarseness that smaller rivers and other inland waterways are rarely mischaracterised as coastline (Figure 1). As this is technically a 'shoreline' database, major lake shores are also included as 'coastline', but such characterisation had little impact on the countries included in the BlueHealth International Survey.

Figure 1. The GSHHG (red line) shoreline shapefile superimposed on the ESRI world topographic map with the Natural Earth coastline shapefile (dark blue line) for comparison.

5.2.2 Proximity to lakes and rivers

Access to inland lakes, rivers, or other waterways has previously been associated with recreational walking in a French sample[160], so we were also interested in the participant's residential proximity to lakes and rivers separately. After thorough searches it was concluded that there was no globally consistent database of lakes and/or rivers that was of a high enough resolution in order to capture proximity to likely recreational lakes and/or rivers. The best available dataset identified was the Global Surface Water layer from the US Geological Survey (https://archive.usgs.gov/archive/sites/landcover.usgs.gov/index.html) provided in the form of a raster file at approximately 30m resolution, but this did not include many smaller elongated features such as narrower rivers or streams and also some such features were discontinuously represented due to coverage by vegetation.

However, finer resolution data that can overcome the above two limitations is available for Europe. A vector representation of rivers and lakes is available from the European Catchments and Rivers Network System (ECRINS) database at 1:250000 scale (https://www.eea.europa.eu/data-and-maps/data/european-catchments-and-rivers-network). We used these data to assign Euclidean (crow-flies) distances from the home geolocation to the nearest, river (or stream, canal, waterway etc.) and lake separately for the 14 European countries sampled. A total of 35 participants were assigned no data concerning distance to lakes as they lived over 500km from any lake (principally due to some participants who resided on islands such as Madeira), and one participant was assigned no data concerning distance to rivers as they lived over 100km from a river (their home was located in autonomous Spanish city of Melilla).

5.2.3 Land cover classes

Despite the popularity of remotely sensed vegetation data for assessing exposures to the natural environment in epidemiological research (section 5.2.4), the BlueHealth project is primarily concerned with the health impacts of exposures to blue spaces[1] and therefore more comprehensive assessments of land cover classes were required to assess exposures not only to green spaces but also to blue spaces. Furthermore, recent research has suggested that environmental determinants of psychological health outcomes depend on diversity of land uses, both natural and artificial, rather than specific land uses[161], and thus we required a land cover map that comprised a multitude of land cover classes.

The global coverage of the BlueHealth International Survey required land cover data that was globally comparable. As such, global sources of land cover data were identified at various resolutions that distinguish between different types of natural environment (i.e. at least green and blue spaces) and built environments. These include 1km resolution maps, including the International Geosphere-Biosphere Programme Data and Information System Cover (IGBP-DISCover) map[162], the map produced by the Global Land Cover 2000 (GLC2000) project[163], and the University of Maryland (UMD) land cover map[164]. The 500m resolution MODIS land cover map[165] and the European Space Agency's 300m resolution GlobCover map[166], until recently, provided the highest resolution global land cover maps.

In 2010, however, a National Geomatics Center of China led collaborative project produced the Global Land Cover (GLC) GlobeLand30 data set, which is a 30m resolution raster data set based on Landsat and Landsat-like image data[167]. The data has been produced using a mixture of automated and semi-automated methods and algorithms. The GlobeLand30 data were produced in 2010 (for the years 2010 and 2000) and feature ten land cover classes, namely: water bodies (i.e. rivers, lakes, reservoirs, ponds), wetlands (i.e. deltas, swamps, marshland, mangrove forests, tidal flats, salt marshes), permanent snow and ice (i.e. glaciers, mountain tops), artificial surfaces (i.e. buildings in urban areas, roads, mines, industrial areas), cultivated land (i.e. farmland, arable land, plantations), forests (i.e. woodlands, forests, rainforests), shrubland (i.e. scrub, heathland, moorland), grassland (i.e. parks, fields, hills, prairies), bareland (i.e. sand, beach, desert, canyon, mountain [without snow], salt flats), and tundra (i.e. plains, either barren or covered by lichen, moss, or hardy perennial herbs and

shrubs in polar regions). These land cover classes were hierarchically classified in this order so as to not misrepresent water (bodies or wetlands) that was covered by vegetation as anything other than water. Satisfactory accuracy of the GlobeLand30 data have been demonstrated in Iran[168], China[169], Germany[170], and Italy[171], with on average 80% congruence with more localised land use maps, though one study noted that in Germany, wetlands were sometimes classed by other Europe-wide land cover databases as a mix of water bodies and agricultural areas[170].

We assessed the proportions of the 2010 versions of these ten land cover classes (and also the sea, represented by areas without data in GlobeLand30) in buffers surrounding participant's home geolocations. Firstly, a 300m radial buffer was selected because it is a commonly used threshold for accessibility[172] that was key to both the Accessible Natural Greenspace Standards developed by Natural England[173] and an indicator developed for the World Health Organisation[174]. Secondly, a 1000m radial buffer was selected as it represents an approximate 10 minute walk from the home; a threshold often used when considering distances in physical activity studies[175] and also implemented in cross-national research on the influences of natural environments in the neighbourhood on a multitude of health outcomes previously[36].

In total, 17,039 of the 17,109 home geolocations (section 5.2) were processed for assigning these land cover classes. The remaining 70 cases were outside of the extent of GlobeLand30 tiles. A total of 133 GlobeLand30 tiles covered these 17,039 geocodes. The programming language Python was used to count the number of pixels in each land cover class that fell inside of, or intersected, the buffer using a customised tool ("raster stats"). The area of each 300m or 1000m radial buffer according to this assignment procedure therefore varies slightly upward from their actual areas (282,743m^2 and 3,141,593m^2, respectively) due to the intersection of rasters that are not wholly encompassed by the buffer. The final data contain 11 variables representing area, one for each GlobeLand30 land cover class as well as the sea, for each buffer size (300m and 1000m).

5.2.4 Surrounding greenness

The Normalised Difference Vegetation Index (NDVI) is one of the most widely-used remotely sensed data sources for assessing the natural environment in epidemiological studies of the effects of natural environments on health outcomes[176–181]. It detects live (i.e. photosynthesising) green plant canopies using multispectral remotely sensed data based on spectral reflectance measurements acquired in the visible (red band) and near-infrared regions, respectively[182]. Resulting data span from -1 to 1 with values of <.01 reflecting areas of bare land, rock, sand, water, snow, or tundra; values of 0.2-0.3 reflecting shrubs and grassland, and values of 0.6-0.8 reflecting temperate and tropical rainforests[183]. Its global coverage, historical data (with certain products dating back to 1981), and continuously updated data, make NDVI a popular choice for epidemiological research.

However, it is not without criticism in population-health research with researchers questioning its utility for predicting health outcomes in smaller buffers[184], how it is aggregated into different areal units[185] (i.e. the modifiable areal unit problem[186]), as well as its potential to misclassify exposure[187] and how well it can inform policy and planning as a sole approach to modelling natural space[187]. It is for these reasons we opted for the GlobeLand30 dataset as our primary means of classifying land cover as while it is globally comparable remotely sensed data (like NDVI), it can identify different types of land cover class, thereby better classifying exposure to natural space (section 5.2.3). Nonetheless, due to its extensive use in epidemiological studies, we appended NDVI data to the home locations of BlueHealth International Survey participants for comparison purposes with previous research.

NDVI data was acquired from MODIS Terra satellite imagery (https://modis.gsfc.nasa.gov/). To ensure approximate consistency with the 300m and 1km radial buffers used for land cover classes (section 5.2.3), we selected two MODIS products: (a) MOD13Q1 vegetation indices 16-day L3 global 250m (hereafter MODIS250), and (b) MOD13A3 vegetation indices monthly

L3 global 1km (hereafter MODIS1000). The finer resolution 30m satellite imagery from Landsat thematic mapper was investigated but was not feasible to use considering restrictions on computing power (especially considering the global scale of the data). Using these data products we need only assign the pixel value at which the home geocode is located and not an average within a buffer.

MODIS imagery is projected into a sinusoidal projection and spatially divided by tiles. A request for the 60 tiles which overlapped home geocodes for the appropriate time period (June 1st 2017 to 31st March 2018 i.e. the approximate duration of survey data collection) was made to the USGS server (https://e4ftl01.cr.usgs.gov). A total of 1,671 MODIS hierarchical data format files were successfully downloaded (1,133 files for MODIS250 and 538 files for MODIS1000). The hierarchical data format files were converted to TIFF image files using the Python programming language. We extracted two of the 16 available layers of data for each file: the NDVI layer and pixel reliability layer (an indicator of the accuracy of the returned NDVI value). A total of 3,342 rasters were processed from the original 1,671 imagery files.

Each participant will have many possible NDVI observations (from across the period of data collection). It is conventional to filter on accuracy and choose the clearest image based on the date (often summer time images), or compute the NDVI for the best imagery found across the period of data collection (less seasonal bias). We therefore chose the latter option to reduce seasonal bias (though often this still exists as most clear images would be taken on days of clement weather). Where no data are found, this indicates that the home location is geocoded as being in the sea. However, geocodes on coastal margins sometimes have data and sometimes do not (Figure 2). In these and other cases, averages were not always possible.

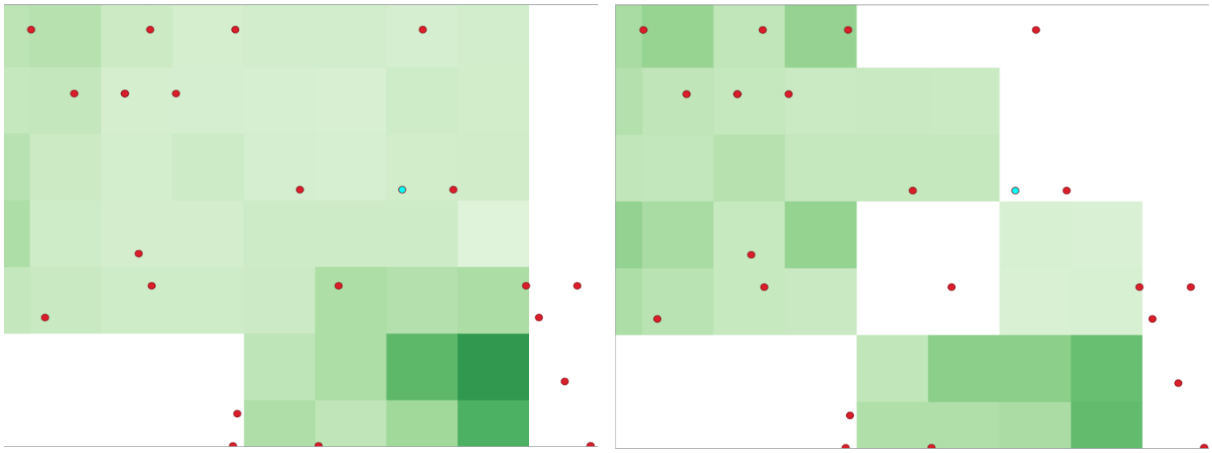

Figure 2. An example coastal margin where the geocode coloured blue has data on the left image (taken on the 29th of August 2017), but not on the right image (taken on the 14th of September 2017).

As a threshold, we only accepted imagery if it was of the highest quality or second-highest quality as defined by the pixel reliability rank. The final data therefore include two sets of two variables; one set for the highest quality at 250m and 1000m resolution, and the other set for the second highest quality at both these resolutions. It is foreseen that the best quality data will be used when available and the second-best quality data when it is not. Four further variables detail that amount of MODIS imagery used to create those NDVI values with higher numbers therefore indicating greater reliability in the estimate.

In the resulting data, 441 participants had no NDVI data as their home was geolocated in the sea; 1,426 did not have the best quality data for NDVI250 imagery, 1,478 did not have the best quality data for NDVI1000 imagery, 37 did not have the second-best quality data for

NDVI250 imagery, but no participants did not have the second-best quality data for NDVI1000 imagery. The final data therefore contain 16,652 participants with at least some NDVI data.

5.3 Air pollution

Given numerous theoretical models and frameworks of nature—health relationships posit air pollution as a direct (or indirect) pathway through which exposure to natural environments can impact health[137,138,188], we included estimates of fine particulate matter ambient pollution at both the participant's home and, if applicable, visit location, to enable analysis of such mechanisms.

We used data from the DIMAQ project[189] to append median modelled estimates of fine airborne particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$) to the given home location and visit location provided by the respondent. The most recent version of these data were modelled across the globe for the year 2016 at a 0.1° x 0.1° spatial resolution which equates to approximately 11km by 11km at the equator. Spatial joins (using the 'sf' R package[190]) were performed to link this raster data to the geolocation point data in the survey.

While more information on the procedure for global modelling is available[189], briefly, ground measurements from 9,690 monitoring locations around the world, satellite remote sensing; population estimates; topography; and information on local monitoring networks and measures of specific contributors of air pollution from chemical transport models were used. This allowed estimation of a concentration even where no direct air pollution monitoring was available.

6 Management

6.1 Development, piloting and public engagement

Ideas for the survey's original content were initially reviewed and refined by members of the BlueHealth consortium at a meeting in April 2016. While there was an appetite among consortium members to include a similar level of detail concerning green space visits as blue space visits, the time constraints of an online survey format precluded this being possible and the decision was taken to focus recalled visits on blue spaces only, commensurate with the overarching aims of the project[1].

Following this initial review of its content, partner institutions in the BlueHealth consortium were invited to make more detailed comments on a draft version of the survey in May and June 2016. This resulted in some important developments such as a working taxonomy of blue spaces which in turn permeated throughout other tasks in the BlueHealth project, the use of imagery in questions concerning visits to different green and blue environments so cultural biases in interpretation of environment names would be less likely, and refining definitions of "blue space", "visit", and "leisure time" so that there was less ambiguity.

In parallel with this, a half-day consultation with the Health and Environment Public Engagement Group (HEPE) at the University of Exeter[191] asked attendees to work through paper copies of the survey making comments on potential oversights and omissions, as well as any instances of ambiguity, verbose or taxing language, or items which participants would find difficult to answer or were unwilling to answer. Useful outcomes of this consultation included additional activities (section 4.4), the inclusion of an item on the accessibility of public transport (section 4.7), and the inclusion of an item on self-consciousness at blue spaces (section 4.7).

In August 2016, the content and proposed methodology of the survey was approved by the University Of Exeter College Of Medicine and Heath's Research Ethics Committee who advised minor changes to the participant information sheet and wording of the consent procedure which participants were presented with at the start of the survey.

After subcontracting YouGov to undertake the administering of the survey in November 2016, they suggested further changes to the survey in December 2016 which included additional "don't know" or "prefer not to answer" options to particular items which would assist the participant in progressing through the survey in a timely fashion and also the shortening of the survey as a whole to avoid participant fatigue. They were additionally responsible for creating feasible target samples and stratified sampling methods (section 3).

After an online version of the English version of the survey was completed by YouGov, a further consultation with HEPE (see above) in March 2017 saw attendees progress through this online platform providing feedback on its usability, flow, and time taken to complete the survey. Attendees paid particular attention, for example, to questions utilising Google Maps APIs which were suspected to be more challenging, but were actually appraised favourably by them, despite some attendees acknowledging that they were more novice computer users. Other feedback from this session included favourable appraisals about the amount of content present on each page of the survey, but also some concerns about the visibility of imagery related to questions about visiting different green and blue spaces in the last four weeks (section 4.2). Such feedback was passed on to YouGov for consideration.

Also in March to April 2017, others at the University of Exeter piloted this online version of the survey on a range of different browsers, operating systems, and devices, to ensure the most comprehensive compatibility. Some issues were raised with unexpected crashes on older versions of browsers, but sometimes these were unavoidable issues as the online platform could only function correctly with more up-to-date browsers. YouGov also piloted this version of the survey internally on different browsers, operating systems, and devices to further quality-check its compatibility.

In March 2017, YouGov also completed translations of the survey (section 5.2) into all languages. These were reviewed by bilingual native speakers of each language within and outside the BlueHealth consortium against the English version to ensure that the meaning of the English version had been appropriately translated. Important refinements at this stage included how the word "nature" was specified in translations of the inclusion of nature in self scale (section 4.3) and how the word "outstanding" was translated in the creation of this category for the purposes of the pictograms used in the contingent behaviour experiment module (section 4.5).

After these issues were resolved with YouGov the survey's development was considered complete. However, in addition to this piloting, at the start of each wave of the survey YouGov also conducted a technical pilot to ensure the survey would operate correctly in each country (section 3).

6.2 Translation

The English version of the survey was translated into only the primary official language of each country in which it was administered (section 1). The only exceptions to this were for Estonia and Canada. For Estonia, the survey was translated into Estonian and Russian due to the high prevalence of Russian speakers in the country as a whole as well as in particular Estonian cities. For Canada, the survey was translated into both English and French due to the high prevalence of both languages in Canada.

For a number of questions included in the surveys including subjective wellbeing items (section 4.1), health items (section 4.6), and demographic items (section 4.7), established translations already existed in a number of languages due to those items being included in other multinational surveys[17–19,105]. Furthermore, for the contingent behaviour experiment module, established translations of "poor", "sufficient", "good" and "excellent" already existed for use with European bathing water signage[11,62–64]. Where these established translations already existed, they were implemented in the BlueHealth International Survey. Many of these translations had been developed through a process of rigorous forward and back translation.

Where questions did not have an existing translation, they were forward translated by bilingual native speakers internal to YouGov who were trained in survey translation before being reviewed by other bilingual native speakers of each language both within and outside the BlueHealth consortium (section 5.1). Efforts were made to ease this translation process by, for example, using simple sentence syntax, avoiding the use of pronouns in favour of repeated nouns, avoiding colloquialisms and metaphor, avoiding the use of English passive tense, and avoiding hypothetical wording or subjunctive mood[192]. However, this was not always possible. For example, the contingent behaviour experiment module (section 4.5) necessitates the use of hypothetical phrasing.

Back translation was not used for this survey. While back translation has long been an important convention in cross-cultural psychological research[193], it cannot always overcome issues of conceptual equivalence[194], that is, the correct semantic translation of more abstract, or in this case potentially Anglo-centric, terms or psychological constructs. Along with the added expense of back translation, it was preferred therefore to review forward-translated versions of the survey by people within and outside the BlueHealth consortium who were familiar with the aims of this research and who therefore could judge the semantic content of these translations accurately.

6.3 Data management and protection

Throughout data collection, data were held on YouGov's secure servers in London, UK. After each wave of data collection, data were sent to the University of Exeter via a secure file transfer protocol in .sav (IBM SPSS Statistics) format. The exact content and format of the data files were iteratively revised between YouGov and the University of Exeter until final data delivery in July 2018. Once at the University of Exeter, data were stored on offline, password-protected, firewalled server.

In some circumstances where YouGov did not have registered panels of participants, they outsourced data collection to other online survey companies. As this sometimes resulted in inconsistent formatting of the returned data, we used R v3.5.1[195] and in particular the 'tidyverse' suite of packages[196], to clean and process this data into a harmonised format and then exported this to .sav and .csv files.

Very little personal data were collected from participants. However, with the recording of home location coordinates (section 4.4 and section 4.7), anonymity of individuals could be compromised. It was agreed that YouGov would only transfer to us home location coordinates whose latitudes and longitudes were rounded to three decimal degrees to preserve anonymity. Nonetheless, we recognise that in particularly rural areas, this could still identify single individuals which is why the participant information sheet informed participants that their home could potentially be identifiable (section 4) and why data are always password-protected and stored offline. Such rounding of coordinates resulted in non-uniform error in home locations across the globe which was a challenge when assigning area-level environmental exposures (section 5.2).

6.4 Legacy

BlueHealth is participating in the Horizon 2020 Open Data pilot which encourages consortia to make data generated from Horizon 2020 projects free to use, reuse, and redistribute. It advises placing research data in a trusted digital repository (e.g. the UK Data Service) and make sure third parties can freely access, mine, exploit, reproduce and disseminate it.

The BlueHealth International Survey is intended to be released in this way after the termination of the project in June 2020. The exact date will be dependent on how long it creates to complete accompanying documentation and details on metadata. However, completed datasets (with data in addition to what has been described here) will be made publicly accessible through such a repository. Potentially, this will be accompanied by guidance on analysis (e.g. analysis scripts) which the user will be encouraged to consult for a range of basic data preparation tasks. These supplementary materials are intended to be a starting point for users of this forthcoming open data.

7 References

1. Grellier, J. *et al.* BlueHealth: a study programme protocol for mapping and quantifying the potential benefits to public health and well-being from Europe's blue spaces. *BMJ open* **7**, e016188 (2017).
2. Wheeler, B. W., White, M., Stahl-Timmins, W. & Depledge, M. H. Does living by the coast improve health and wellbeing? *Health & Place* **18**, 1198–1201 (2012).
3. White, M. P., Alcock, I., Wheeler, B. W. & Depledge, M. H. Coastal proximity, health and well-being: Results from a longitudinal panel survey. *Health & Place* **23**, 97–103 (2013).
4. White, M. P., Wheeler, B. W., Herbert, S., Alcock, I. & Depledge, M. H. Coastal proximity and physical activity: Is the coast an under-appreciated public health resource? *Preventive Medicine* **69**, 135–140 (2014).
5. Dempsey, S., Devine, M. T., Gillespie, T., Lyons, S. & Nolan, A. Coastal blue space and depression in older adults. *Health & Place* **54**, 110–117 (2018).
6. Bauman, A., Smith, B., Stoker, L., Bellew, B. & Booth, M. Geographical influences upon physical activity participation: evidence of a 'coastal effect'. *Australian and New Zealand Journal of Public Health* **23**, 322–324 (1999).
7. Behrend, T. S., Sharek, D. J., Meade, A. W. & Wiebe, E. N. The viability of crowdsourcing for survey research. *Behavior Research Methods* **43**, 800–813 (2011).
8. Meade, A. W. & Craig, S. B. Identifying careless responses in survey data. *Psychological Methods* **17**, 437–455 (2012).
9. Gosling, S. D., Vazire, S., Srivastava, S. & John, O. P. Should We Trust Web-Based Studies? A Comparative Analysis of Six Preconceptions About Internet Questionnaires. *American Psychologist* **59**, 93–104 (2004).
10. OECD. *OECD Guidelines on Measuring Subjective Well-being*. (OECD Publishing, 2013).
11. European Environment Agency. *European bathing water quality in 2017*. (2018).

12. Mitchell, R. J., Richardson, E. A., Shortt, N. K. & Pearce, J. R. Neighborhood Environments and Socioeconomic Inequalities in Mental Well-Being. *American Journal of Preventive Medicine* **49**, 80–84 (2015).
13. Elliott, L. R. *et al.* Recreational visits to marine and coastal environments in England: Where, what, who, why, and when? *Marine Policy* (2018) doi:10.1016/j.marpol.2018.03.013.
14. Natural England. *Monitor of Engagement with the Natural Environment: Technical Report to the 2009-16 surveys*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/612705/mene-technical-report-2015-16.pdf (2017).
15. Gelcich, S. *et al.* Public awareness, concerns, and priorities about anthropogenic impacts on marine environments. *Proceedings of the National Academy of Sciences* **111**, 15042–15047 (2014).
16. International Wellbeing Group. *Personal Wellbeing Index: 5th Edition*. http://www.acqol.com.au/uploads/pwi-a/pwi-a-english.pdf (2013).
17. European Social Survey (ESS). https://www.europeansocialsurvey.org/.
18. Anderson, R., Mikuliç, B., Vermeylen, G., Lyly-Yrjanainen, M. & Zigante, V. *Second European Quality of Life Survey - overview*. http://eurofound.europa.eu/ (2009).
19. Inglehart, R., Puranen, B., Pettersson, T., Nicolas, J. & Esmer, Y. The World Values Survey.
20. Ambrey, C. & Fleming, C. Public Greenspace and Life Satisfaction in Urban Australia. *Urban Studies* **51**, 1290–1321 (2014).
21. Lau, A. L. D., Cummins, R. A. & Mcpherson, W. An Investigation into the Cross-Cultural Equivalence of the Personal Wellbeing Index. *Social Indicators Research* **72**, 403–430 (2005).
22. White, M. P., Pahl, S., Wheeler, B. W., Depledge, M. H. & Fleming, L. E. Natural environments and subjective wellbeing: Different types of exposure are associated with different aspects of wellbeing. *Health & Place* **45**, 77–84 (2017).

23. Goldberg, D. P. & Williams, P. *A user's guide to the General Health Questionnaire: GHQ.* (GL Assessment, 1988).
24. Werneke, U., Goldberg, D. P., Yalcin, I. & Üstün, B. T. The stability of the factor structure of the General Health Questionnaire. *Psychological Medicine* **30**, 823–829 (2000).
25. Natural Resources Wales. *Wales Outdoor Recreation Survey 2014 Technical Report*. https://cdn.naturalresources.wales/media/4753/wales-outdoor-recreation-survey-2014-technical-report.pdf (2015).
26. Cvejić, R. *et al. A typology of urban green spaces, ecosystem provisioning services and demands*. https://greensurge.eu/working-packages/wp3/files/D3.1_Typology_of_urban_green_spaces_1_.pdf/D3.1_Typology_of_urban_green_spaces_v2_.pdf (2015).
27. Gibson, E. J. Where Is the Information for Affordances? *Ecological Psychology* **12**, 53–56 (2000).
28. Heft, H. Affordances, Dynamic Experience, and the Challenge of Reification. *Ecological Psychology* **15**, 149–180 (2003).
29. Thompson, C. W. & Travlou, P. *A critical review of research in landscape and woodland perceptions, aesthetics, affordances and experience.* http://www.academia.edu/download/5288124/forcom_litreview.pdf (2009).
30. Weinstein, N., Przybylski, A. K. & Ryan, R. M. Can Nature Make Us More Caring? Effects of Immersion in Nature on Intrinsic Aspirations and Generosity. *Personality and Social Psychology Bulletin* **35**, 1315–1329 (2009).
31. Schultz, P. W. The structure of environmental concern: concern for self, other people, and the biosphere. *Journal of Environmental Psychology* **21**, 327–339 (2001).
32. Aron, A., Aron, E. N. & Smollan, D. Inclusion of Other in the Self Scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology* **63**, 596–612 (1992).

33. Howell, A. J., Dopko, R. L., Passmore, H.-A. & Buro, K. Nature connectedness: Associations with well-being and mindfulness. *Personality and Individual Differences* **51**, 166–171 (2011).

34. Nutsford, D., Pearson, A. L., Kingham, S. & Reitsma, F. Residential exposure to visible blue space (but not green space) associated with lower psychological distress in a capital city. *Health & Place* **39**, 70–78 (2016).

35. Nieuwenhuijsen, M. J. *et al.* Positive health effects of the natural outdoor environment in typical populations in different regions in Europe (PHENOTYPE): a study programme protocol. *BMJ open* **4**, e004951 (2014).

36. Smith, G. *et al.* Characterisation of the natural environment: quantitative indicators across Europe. *International Journal of Health Geographics* **16**, (2017).

37. Kirtland, K. A. *et al.* Environmental measures of physical activity supports: Perception versus reality. *American Journal of Preventive Medicine* **24**, 323–331 (2003).

38. Addy, C. L. *et al.* Associations of Perceived Social and Physical Environmental Supports With Physical Activity and Walking Behavior. *Am J Public Health* **94**, 440–443 (2004).

39. Zijlema, W. L. *et al.* Active commuting through natural environments is associated with better mental health: Results from the PHENOTYPE project. *Environment International* **121**, 721–727 (2018).

40. Garrett, J. K. *et al.* Urban blue space and health and wellbeing in Hong Kong: Results from a survey of older adults. *Health & Place* (2018) doi:10.1016/j.healthplace.2018.11.003.

41. Weimann, H. *et al.* Perception of safety is a prerequisite for the association between neighbourhood green qualities and physical activity: Results from a cross-sectional study in Sweden. *Health & Place* **45**, 124–130 (2017).

42. Calogiuri, G. Natural Environments and Childhood Experiences Promoting Physical Activity, Examining the Mediational Effects of Feelings about Nature and Social Networks. *International Journal of Environmental Research and Public Health* **13**, 439 (2016).

43. Elliott, L. R., White, M. P., Taylor, A. H. & Herbert, S. Energy expenditure on recreational visits to different natural environments. *Social Science & Medicine* **139**, 53–60 (2015).

44. Chan, C. B., Ryan, D. A. & Tudor-Locke, C. Relationship between objective measures of physical activity and weather: a longitudinal study. *International Journal of Behavioral Nutrition and Physical Activity* **3**, 21 (2006).

45. Hartig, T., Catalano, R. & Ong, M. Cold summer weather, constrained restoration, and the use of antidepressants in Sweden. *Journal of Environmental Psychology* **27**, 107–116 (2007).

46. White, M. P., Pahl, S., Ashbullby, K., Herbert, S. & Depledge, M. H. Feelings of restoration from recent nature visits. *Journal of Environmental Psychology* **35**, 40–51 (2013).

47. Völker, S. & Kistemann, T. “I’m always entirely happy when I’m here!” Urban blue enhancing human health and well-being in Cologne and Düsseldorf, Germany. *Social Science & Medicine* **78**, 113–124 (2013).

48. White, M. P. *et al.* Spending at least 120 minutes a week in nature is associated with good health and wellbeing. *Scientific Reports* **9**, 7730 (2019).

49. Ainsworth, B. E. *et al.* 2011 Compendium of Physical Activities: A Second Update of Codes and MET Values. *Medicine & Science in Sports & Exercise* **43**, 1575–1581 (2011).

50. Deci, E. & Ryan, R. M. *Intrinsic Motivation and Self-Determination in Human Behavior*. (Springer Science & Business Media, 1985).

51. Kellert, S. R. & Wilson, E. O. *The Biophilia Hypothesis*. (Island Press, 1995).

52. Kellert, S. R. *Kinship to Mastery: Biophilia In Human Evolution And Development*. (Island Press, 2003).

53. Hunt, A. *et al. Monitor of Engagement with the Natural Environment: developing a method to measure nature connection across the English population (adults and children)*. (2017).

54. Cleary, A., Fielding, K. S., Bell, S. L., Murray, Z. & Roiko, A. Exploring potential mechanisms involved in the relationship between eudaimonic wellbeing and nature connection. *Landscape and Urban Planning* **158**, 119–128 (2017).

55. Hartig, T., Mang, M. & Evans, G. W. Restorative Effects of Natural Environment Experiences. *Environment and Behavior* **23**, 3–26 (1991).

56. Nordh, H., Hartig, T., Hagerhall, C. M. & Fry, G. Components of small urban parks that predict the possibility for restoration. *Urban Forestry & Urban Greening* **8**, 225–235 (2009).

57. Korpela, K. M., Ylén, M., Tyrväinen, L. & Silvennoinen, H. Determinants of restorative experiences in everyday favorite places. *Health & Place* **14**, 636–652 (2008).

58. Leonard, A. F. C., Singer, A., Ukoumunne, O. C., Gaze, W. H. & Garside, R. Is it safe to go back into the water? A systematic review and meta-analysis of the risk of acquiring infections from recreational exposure to seawater. *Int J Epidemiol* **47**, 572–586 (2018).

59. Cox, D. T. C., Hudson, H. L., Shanahan, D. F., Fuller, R. A. & Gaston, K. J. The rarity of direct experiences of nature in an urban population. *Landscape and Urban Planning* **160**, 79–84 (2017).

60. Sen, A. *et al.* Economic Assessment of the Recreational Value of Ecosystems: Methodological Development and National and Local Application. *Environ Resource Econ* **57**, 233–249 (2014).

61. Day, B. & Smith, G. *Outdoor Recreation Valuation ORVal User Guide*. 27 http://leep.exeter.ac.uk/orval (2016).

62. Official Journal of the European Union. *Directive 2006/7/EC of the European Parliament and of the Council of 15 February (2006) concerning the management of bathing water quality and repealing Directive 76/160/EEC.* (2006).

63. Official Journal of the European Union. *Commission Implementing Decision of 27 May 2011 establishing, pursuant to Directive 2006/7/EC of the European Parliament and of the Council, a symbol for information to the public on bathing water classification and any bathing prohibition or advice against bathing*. 3 (2011).

64. Georgiou, S. & Bateman, I. J. Revision of the EU Bathing Water Directive: economic costs and benefits. *Marine Pollution Bulletin* **50**, 430–438 (2005).

65. McKenna, J., Williams, A. T. & Cooper, J. A. G. Blue Flag or Red Herring: Do beach awards encourage the public to visit beaches? *Tourism Management* **32**, 576–588 (2011).

66. Hanley, N., Bell, D. & Alvarez-Farizo, B. Valuing the Benefits of Coastal Water Quality Improvements Using Contingent and Real Behaviour. *Environmental and Resource Economics* **24**, 273–285 (2003).

67. Topp, C. W., Østergaard, S. D., Søndergaard, S. & Bech, P. The WHO-5 Well-Being Index: A Systematic Review of the Literature. *Psychotherapy and Psychosomatics* **84**, 167–176 (2015).

68. Löwe, B. *et al.* Comparative validity of three screening questionnaires for DSM-IV depressive disorders and physicians' diagnoses. *Journal of Affective Disorders* **78**, 131–140 (2004).

69. Nicolucci, A. *et al.* Benchmarking network for clinical and humanistic outcomes in diabetes (BENCH-D) study: protocol, tools, and population. *SpringerPlus* **3**, 83 (2014).

70. Kyffin, R. G. E., Goldacre, M. J. & Gill, M. Mortality rates and self reported health: database analysis by English local authority area. *BMJ* **329**, 887–888 (2004).

71. Maas, J. Green space, urbanity, and health: how strong is the relation? *Journal of Epidemiology & Community Health* **60**, 587–592 (2006).

72. Mitchell, R. & Popham, F. Greenspace, urbanity and health: relationships in England. *Journal of Epidemiology & Community Health* **61**, 681–683 (2007).

73. Boyd, F., White, M. P., Bell, S. L. & Burt, J. Who doesn't visit natural environments for recreation and why: A population representative analysis of spatial, individual and temporal factors among adults in England. *Landscape and Urban Planning* **175**, 102–113 (2018).

74. Armstrong, T. & Bull, F. Development of the World Health Organization Global Physical Activity Questionnaire (GPAQ). *J Public Health* **14**, 66–70 (2006).

75. Milton, K., Bull, F. C. & Bauman, A. Reliability and validity testing of a single-item physical activity measure. *British Journal of Sports Medicine* **45**, 203–208 (2011).

76. Warburton, D. E. R., Nicol, C. W. & Bredin, S. S. D. Health benefits of physical activity: the evidence. *Canadian Medical Association Journal* **174**, 801–809 (2006).

77. Nocon, M. *et al.* Association of physical activity with all-cause and cardiovascular mortality: a systematic review and meta-analysis. *European Journal of Cardiovascular Prevention & Rehabilitation* **15**, 239–246 (2008).

78. Li, J. & Siegrist, J. Physical Activity and Risk of Cardiovascular Disease—A Meta-Analysis of Prospective Cohort Studies. *International Journal of Environmental Research and Public Health* **9**, 391–407 (2012).

79. Jeon, C. Y., Lokken, R. P., Hu, F. B. & van Dam, R. M. Physical Activity of Moderate Intensity and Risk of Type 2 Diabetes: A systematic review. *Diabetes Care* **30**, 744–752 (2007).

80. Monninkhof, E. M. *et al.* Physical Activity and Breast Cancer: A Systematic Review. *Epidemiology* **18**, 137–157 (2007).

81. Harriss, D. J. *et al.* Lifestyle factors and colorectal cancer risk (2): a systematic review and meta-analysis of associations with leisure-time physical activity. *Colorectal Disease* **11**, 689–701 (2009).

82. Wendel-Vos, G. Physical activity and stroke. A meta-analysis of observational data. *International Journal of Epidemiology* **33**, 787–798 (2004).

83. Whelton, S. P., Chin, A., Xin, X. & He, J. Effect of aerobic exercise on blood pressurea meta-analysis of randomized, controlled trials. *Annals of internal medicine* **136**, 493–503 (2002).

84. Moayyeri, A. The Association Between Physical Activity and Osteoporotic Fractures: A Review of the Evidence and Implications for Future Research. *Annals of Epidemiology* **18**, 827–835 (2008).

85. Tardon, A. *et al.* Leisure-time physical activity and lung cancer: a meta-analysis. *Cancer Causes & Control* **16**, 389–397 (2005).

86. Hamer, M. & Chida, Y. Physical activity and risk of neurodegenerative disease: a systematic review of prospective evidence. *Psychological Medicine* **39**, 3 (2009).

87. Bize, R., Johnson, J. A. & Plotnikoff, R. C. Physical activity level and health-related quality of life in the general adult population: A systematic review. *Preventive Medicine* **45**, 401–415 (2007).

88. Mammen, G. & Faulkner, G. Physical Activity and the Prevention of Depression. *American Journal of Preventive Medicine* **45**, 649–657 (2013).

89. Ekkekakis, P. Honey, I shrunk the pooled SMD! Guide to critical appraisal of systematic reviews and meta-analyses using the Cochrane review on exercise for depression as example. *Mental Health and Physical Activity* **8**, 21–36 (2015).

90. Holley, J., Crone, D., Tyson, P. & Lovell, G. The effects of physical activity on psychological well-being for those with schizophrenia: A systematic review. *British Journal of Clinical Psychology* **50**, 84–105 (2011).

91. Wang, D., Wang, Y., Wang, Y., Li, R. & Zhou, C. Impact of physical exercise on substance use disorders: a meta-analysis. *PloS one* **9**, e110728 (2014).

92. Haasova, M. *et al.* The acute effects of physical activity on cigarette cravings: systematic review and meta-analysis with individual participant data: IPD meta-analysis: PA and cigarette cravings. *Addiction* **108**, 26–37 (2013).

93. World Health Organization. *Global recommendations on physical activity for health.* (2010).

94. Haskell, W. L. *et al.* Physical Activity and Public Health: Updated Recommendation for Adults from the American College of Sports Medicine and the American Heart Association. *Medicine & Science in Sports & Exercise* **39**, 1423–1434 (2007).

95. Craig, C. L. *et al.* International physical activity questionnaire: 12-country reliability and validity. *Medicine and science in sports and exercise* **35**, 1381–1395 (2003).

96. Wendel-Vos, G. C. W., Schuit, A. J., Saris, W. H. M. & Kromhout, D. Reproducibility and relative validity of the short questionnaire to assess health-enhancing physical activity. *Journal of Clinical Epidemiology* **56**, 1163–1169 (2003).

97. Hillsdon, M., Panter, J., Foster, C. & Jones, A. The relationship between access and quality of urban green space with population physical activity. *Public Health* **120**, 1127–1132 (2006).

98. Humpel, N., Owen, N., Iverson, D., Leslie, E. & Bauman, A. Perceived environment attributes, residential location, and walking for particular purposes. *American Journal of Preventive Medicine* **26**, 119–125 (2004).

99. Pasanen, T. P., White, M. P., Wheeler, B. W., Garrett, J. K. & Elliott, L. R. Neighbourhood blue space, health and wellbeing: The mediating role of different types of physical activity. *Environment International* **131**, 105016 (2019).

100. McMahan, E. A. & Estes, D. The effect of contact with natural environments on positive and negative affect: A meta-analysis. *The Journal of Positive Psychology* **10**, 507–519 (2015).

101. White, M. P. *et al.* Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology* **30**, 482–493 (2010).

102. Ulrich, R. S. *et al.* Stress recovery during exposure to natural and urban environments. *Journal of environmental psychology* **11**, 201–230 (1991).

103. Kavanagh, D. J., May, J. & Andrade, J. Tests of the elaborated intrusion theory of craving and desire: Features of alcohol craving during treatment for an alcohol disorder. *British Journal of Clinical Psychology* **48**, 241–254 (2009).

104. Gascon, M., Zijlema, W., Vert, C., White, M. P. & Nieuwenhuijsen, M. J. Outdoor blue spaces, human health and well-being: A systematic review of quantitative studies. *International Journal of Hygiene and Environmental Health* **220**, 1207–1221 (2017).

105. European Commission. *Eurostat : European Health Interview Survey (EHIS wave 2) Methodological manual.* https://scholar.google.com/scholar_lookup?title=Eurostat%3A%20European%20health%20interview%20survey%20%28EHIS%20wave%202%29.%20Methodological%20manual&publication_year=2013 (2013).

106. Tanja-Dijkstra, K. *et al.* Improving Dental Experiences by Using Virtual Reality Distraction: A Simulation Study. *PLoS ONE* **9**, e91276 (2014).

107. Tanja-Dijkstra, K. *et al.* The Soothing Sea: A Virtual Coastal Walk Can Reduce Experienced and Recollected Pain. *Environment and Behavior* 0013916517710077 (2017).

108. Maas, J. *et al.* Morbidity is related to a green living environment. *Journal of Epidemiology & Community Health* **63**, 967–973 (2009).

109. Wheeler, B. W. *et al.* Beyond greenspace: an ecological study of population general health and indicators of natural environment type and quality. *International Journal of Health Geographics* **14**, (2015).

110. Brown, S. & Sessions, J. G. The Economics of Absence: Theory and Evidence. *Journal of Economic Surveys* **10**, 23–53 (1996).

111. Astell-Burt, T., Feng, X. & Kolt, G. S. Does access to neighbourhood green space promote a healthy duration of sleep? Novel findings from a cross-sectional study of 259 319 Australians. *BMJ open* **3**, e003094 (2013).

112. Grigsby-Toussaint, D. S. *et al.* Sleep insufficiency and the natural environment: Results from the US Behavioral Risk Factor Surveillance System survey. *Preventive Medicine* **78**, 78–84 (2015).

113. Johnson, B. S., Malecki, K. M., Peppard, P. E. & Beyer, K. M. M. Exposure to neighborhood green space and sleep: evidence from the Survey of the Health of Wisconsin. *Sleep Health* (2018) doi:10.1016/j.sleh.2018.08.001.

114. Cappuccio, F. P., Cooper, D., D'Elia, L., Strazzullo, P. & Miller, M. A. Sleep duration predicts cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. *European Heart Journal* **32**, 1484–1492 (2011).

115. Cappuccio, F. P., D'Elia, L., Strazzullo, P. & Miller, M. A. Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. *Sleep* **33**, 585–592 (2010).

116. Ratcliffe, E. *Sleep, mood, and coastal walking*. 23 (2015).

117. Ying, Z., Ning, L. D. & Xin, L. Relationship Between Built Environment, Physical Activity, Adiposity, and Health in Adults Aged 46–80 in Shanghai, China. *Journal of Physical Activity and Health* **12**, 569–578 (2015).
118. Foley, R. Swimming as an accretive practice in healthy blue space. *Emotion, Space and Society* **22**, 43–51 (2017).
119. Swami, V., Barron, D., Weis, L. & Furnham, A. Bodies in nature: Associations between exposure to nature, connectedness to nature, and body image in U.S. adults. *Body Image* **18**, 153–161 (2016).
120. Swami, V., Barron, D. & Furnham, A. Exposure to natural environments, and photographs of natural environments, promotes more positive body image. *Body Image* **24**, 82–94 (2018).
121. Wu, Y.-T., Luben, R. & Jones, A. Dog ownership supports the maintenance of physical activity during poor weather in older English adults: cross-sectional results from the EPIC Norfolk cohort. *Journal of Epidemiology and Community Health* **71**, 905–911 (2017).
122. Bauman, A. E., Russell, S. J., Furber, S. E. & Dobson, A. J. The epidemiology of dog walking: an unmet need for human and canine health. *The Medical Journal of Australia* **175**, 632–634 (2001).
123. Christian, H. E. *et al.* Dog Ownership and Physical Activity: A Review of the Evidence. *Journal of Physical Activity and Health* **10**, 750–759 (2013).
124. Cutt, H., Giles-Corti, B., Knuiman, M. & Burke, V. Dog ownership, health and physical activity: A critical review of the literature. *Health & Place* **13**, 261–272 (2007).
125. Lail, P., McCormack, G. R. & Rock, M. Does dog-ownership influence seasonal patterns of neighbourhood-based walking among adults? A longitudinal study. *BMC Public Health* **11**, 148 (2011).
126. McCormack, G. R., Graham, T. M., Swanson, K., Massolo, A. & Rock, M. J. Changes in visitor profiles and activity patterns following dog supportive modifications to parks: A natural experiment on the health impact of an urban policy. *SSM - Population Health* **2**, 237–243 (2016).

127. Temple, V., Rhodes, R. & Higgins, J. W. Unleashing physical activity: an observational study of park use, dog walking, and physical activity. *Journal of Physical Activity and Health* **8**, 766–774 (2011).

128. Toohey, A. M. & Rock, M. J. Unleashing their potential: a critical realist scoping review of the influence of dogs on physical activity for dog-owners and non-owners. *International Journal of Behavioral Nutrition and Physical Activity* **8**, 46 (2011).

129. Toohey, A. M., McCormack, G. R., Doyle-Baker, P. K., Adams, C. L. & Rock, M. J. Dog-walking and sense of community in neighborhoods: Implications for promoting regular physical activity in adults 50 years and older. *Health & Place* **22**, 75–81 (2013).

130. Westgarth, C., Christley, R. M. & Christian, H. E. How might we increase physical activity through dog walking?: A comprehensive review of dog walking correlates. *International Journal of Behavioral Nutrition and Physical Activity* **11**, 83 (2014).

131. White, M. P., Elliott, L. R., Wheeler, B. W. & Fleming, L. E. Neighbourhood greenspace is related to physical activity in England, but only for dog owners. *Landscape and Urban Planning* **174**, 18–23 (2018).

132. Solomon, E., Rees, T., Ukoumunne, O. C., Metcalf, B. & Hillsdon, M. Personal, social, and environmental correlates of physical activity in adults living in rural south-west England: a cross-sectional analysis. *International journal of behavioral nutrition and physical activity* **10**, 129 (2013).

133. Hillsdon, M., Coombes, E., Griew, P. & Jones, A. An assessment of the relevance of the home neighbourhood for understanding environmental influences on physical activity: how far from home do people roam? *International Journal of Behavioral Nutrition and Physical Activity* **12**, (2015).

134. Gerike, R. *et al.* Physical Activity through Sustainable Transport Approaches (PASTA): a study protocol for a multicentre project. *BMJ Open* **6**, e009924 (2016).

135. Lin, B. B., Fuller, R. A., Bush, R., Gaston, K. J. & Shanahan, D. F. Opportunity or orientation? Who uses urban parks and why. *PLoS one* **9**, e87422 (2014).

136. de Vries, S., van Dillen, S. M. E., Groenewegen, P. P. & Spreeuwenberg, P. Streetscape greenery and health: Stress, social cohesion and physical activity as mediators. *Social Science & Medicine* **94**, 26–33 (2013).

137. Hartig, T., Mitchell, R., de Vries, S. & Frumkin, H. Nature and Health. *Annual Review of Public Health* **35**, 207–228 (2014).

138. Markevych, I. *et al.* Exploring pathways linking greenspace to health: Theoretical and methodological guidance. *Environmental Research* **158**, 301–317 (2017).

139. Alcock, I. *et al.* What accounts for 'England's green and pleasant land'? A panel data analysis of mental health and land cover types in rural England. *Landscape and Urban Planning* **142**, 38–46 (2015).

140. Beyer, K. M. M., Szabo, A. & Nattinger, A. B. Time Spent Outdoors, Depressive Symptoms, and Variation by Race and Ethnicity. *American Journal of Preventive Medicine* **51**, 281–290 (2016).

141. Mitchell, R. & Popham, F. Effect of exposure to natural environment on health inequalities: an observational population study. *The Lancet* **372**, 1655–1660 (2008).

142. Trapnell, P. D. & Campbell, J. D. Private self-consciousness and the five-factor model of personality: distinguishing rumination from reflection. *Journal of personality and social psychology* **76**, 284 (1999).

143. Bratman, G. N., Hamilton, J. P., Hahn, K. S., Daily, G. C. & Gross, J. J. Nature experience reduces rumination and subgenual prefrontal cortex activation. *Proceedings of the National Academy of Sciences* **112**, 8567–8572 (2015).

144. Bratman, G. N., Daily, G. C., Levy, B. J. & Gross, J. J. The benefits of nature experience: Improved affect and cognition. *Landscape and Urban Planning* **138**, 41–50 (2015).

145. Govern, J. M. & Marsch, L. A. Development and Validation of the Situational Self-Awareness Scale. *Consciousness and Cognition* **10**, 366–378 (2001).

146. Frantz, C., Mayer, F. S., Norton, C. & Rock, M. There is no "I" in nature: The influence of self-awareness on connectedness to nature. *Journal of Environmental Psychology* **25**, 427–436 (2005).

147. Kaiser, F. G. & Wilson, M. Assessing People's General Ecological Behavior: A Cross-Cultural Measure. *Journal of Applied Social Psychology* **30**, 952–978 (2000).

148. van den Bosch, M. A. & Depledge, M. H. Healthy people with nature in mind. *BMC Public Health* **15**, (2015).

149. Weinstein, N. *et al.* Seeing Community for the Trees: The Links among Contact with Natural Environments, Community Cohesion, and Crime. *BioScience* **65**, 1141–1153 (2015).

150. Ambrey, C. L. Urban greenspace, physical activity and wellbeing: The moderating role of perceptions of neighbourhood affability and incivility. *Land Use Policy* **57**, 638–644 (2016).

151. Fielding, K. S., McDonald, R. & Louis, W. R. Theory of planned behaviour, identity and intentions to engage in environmental activism. *Journal of Environmental Psychology* **28**, 318–326 (2008).

152. Wilkins, R. & Lass, I. *The Household, Income and Labour Dynamics in Australia Survey: Selected Findings from Waves 1 to 16*. 150 https://melbourneinstitute.unimelb.edu.au/hilda/publications/hilda-statistical-reports (2018).

153. Vos, T., Barker, B., Begg, S., Stanley, L. & Lopez, A. D. Burden of disease and injury in Aboriginal and Torres Strait Islander Peoples: the Indigenous health gap. *Int J Epidemiol* **38**, 470–477 (2009).

154. Center For International Earth Science Information Network-CIESIN-Columbia University. Documentation for the Gridded Population of the World, Version 4 (GPWv4), Revision 10 Data Sets. (2017) doi:10.7927/h4b56gpt.

155. Doxsey-Whitfield, E. *et al.* Taking Advantage of the Improved Availability of Census Data: A First Look at the Gridded Population of the World, Version 4. *Papers in Applied Geography* **1**, 226–234 (2015).

156. Chomitz, K. M., Buys, P. & Thomas, T. S. *Quantifying the rural-urban gradient in Latin America and the Caribbean*. vol. 3634 (World Bank Publications, 2005).

157. Uchida, H. & Nelson, A. Agglomeration index: towards a new measure of urban concentration. (2009).

158. Dijkstra, L. & Poelman, H. *A harmonised definition of cities and rural areas: the new degree of urbanisation*. 28 https://ec.europa.eu/regional_policy/sources/docgener/work/2014_01_new_urban.pdf (2014).

159. Wessel, P. al & Smith, W. H. A global, self-consistent, hierarchical, high-resolution shoreline database. *Journal of Geophysical Research: Solid Earth* **101**, 8741–8743 (1996).

160. Perchoux, C., Kestens, Y., Brondeel, R. & Chaix, B. Accounting for the daily locations visited in the study of the built environment correlates of recreational walking (the RECORD Cohort Study). *Preventive Medicine* **81**, 142–149 (2015).

161. Olsen, J. R., Nicholls, N. & Mitchell, R. P1 Urban landscapes, city diversity and quality of life: an objective cross-sectional study of 66 european cities. *J Epidemiol Community Health* **72**, A61–A61 (2018).

162. Loveland, T. R. *et al.* Development of a global land cover characteristics database and IGBP DISCover from 1 km AVHRR data. *International Journal of Remote Sensing* **21**, 1303–1330 (2000).

163. Bartholomé, E. & Belward, A. S. GLC2000: a new approach to global land cover mapping from Earth observation data. *International Journal of Remote Sensing* **26**, 1959–1977 (2005).

164. Hansen, M. C., DeFries, R. S., Townshend, J. R. & Sohlberg, R. Global land cover classification at 1 km spatial resolution using a classification tree approach. *International journal of remote sensing* **21**, 1331–1364 (2000).

165. Friedl, M. A. *et al.* Global land cover mapping from MODIS: algorithms and early results. *Remote sensing of Environment* **83**, 287–302 (2002).

166. Arino, O. *et al.* GlobCover: The most detailed portrait of Earth. *Eur. Space Agency* **136**, 25–31 (2008).

167. Chen, J. *et al.* Global land cover mapping at 30m resolution: A POK-based operational approach. *ISPRS Journal of Photogrammetry and Remote Sensing* **103**, 7–27 (2015).

168. Jokar Arsanjani, J., Tayyebi, A. & Vaz, E. GlobeLand30 as an alternative fine-scale global land cover map: Challenges, possibilities, and implications for developing countries. *Habitat International* **55**, 25–31 (2016).

169. Wang, Y., Zhang, J., Liu, D., Yang, W. & Zhang, W. Accuracy Assessment of GlobeLand30 2010 Land Cover over China Based on Geographically and Categorically Stratified Validation Sample Data. *Remote Sensing* **10**, 1213 (2018).

170. Jokar Arsanjani, J., See, L. & Tayyebi, A. Assessing the suitability of GlobeLand30 for mapping land cover in Germany. *International Journal of Digital Earth* **9**, 873–891 (2016).

171. Brovelli, M., Molinari, M., Hussein, E., Chen, J. & Li, R. The First Comprehensive Accuracy Assessment of GlobeLand30 at a National Level: Methodology and Results. *Remote Sensing* **7**, 4191–4212 (2015).

172. Higgs, G., Fry, R. & Langford, M. Investigating the implications of using alternative GIS-based techniques to measure accessibility to green space. *Environment and Planning B: Planning and Design* **39**, 326–343 (2012).

173. Handley, J. *et al. Providing Accessible Natural Greenspace in Towns and Cities: A Practical Guide to Assessing the Resource and Implementing Local Standards for Provision*. 39 http://publications.naturalengland.org.uk/publication/65021 (2011).

174. Annerstedt van den Bosch, M. *et al.* Development of an urban green space indicator and the public health rationale. *Scandinavian journal of public health* **44**, 159–167 (2016).

175. Smith, G., Gidlow, C., Davey, R. & Foster, C. What is my walking neighbourhood? A pilot study of English adults' definitions of their local walking neighbourhoods. *International Journal of behavioral nutrition and physical activity* **7**, 34 (2010).

176. Amoly, E. *et al.* Green and Blue Spaces and Behavioral Development in Barcelona Schoolchildren: The BREATHE Project. *Environmental Health Perspectives* **122**, 1351–1358 (2014).

177. Bloemsma, L. D. *et al.* Green Space Visits among Adolescents: Frequency and Predictors in the PIAMA Birth Cohort Study. *Environmental Health Perspectives* **126**, (2018).

178. Burkart, K. *et al.* Modification of Heat-Related Mortality in an Elderly Urban Population by Vegetation (Urban Green) and Proximity to Water (Urban Blue): Evidence from Lisbon, Portugal. *Environmental Health Perspectives* **124**, (2015).

179. Crouse, D. L. *et al.* Urban greenness and mortality in Canada's largest cities: a national cohort study. *The Lancet Planetary Health* **1**, e289–e297 (2017).

180. Dzhambov, A. M. *et al.* Multiple pathways link urban green- and bluespace to mental health in young adults. *Environmental Research* **166**, 223–233 (2018).

181. Gascon, M. *et al.* Mental Health Benefits of Long-Term Exposure to Residential Green and Blue Spaces: A Systematic Review. *International Journal of Environmental Research and Public Health* **12**, 4354–4379 (2015).

182. James, P., Banay, R. F., Hart, J. E. & Laden, F. A Review of the Health Benefits of Greenness. *Current Epidemiology Reports* **2**, 131–142 (2015).

183. Weier, J. & Herring, D. Measuring Vegetation (NDVI & EVI). https://earthobservatory.nasa.gov/features/MeasuringVegetation (2000).

184. Gascon, M. *et al.* Normalized difference vegetation index (NDVI) as a marker of surrounding greenness in epidemiological studies: The case of Barcelona city. *Urban Forestry & Urban Greening* **19**, 88–94 (2016).

185. Reid, C. E., Kubzansky, L. D., Li, J., Shmool, J. L. & Clougherty, J. E. It's not easy assessing greenness: A comparison of NDVI datasets and neighborhood types and their associations with self-rated health in New York City. *Health & Place* **54**, 92–101 (2018).

186. Kwan, M.-P. From place-based to people-based exposure measures. *Social Science & Medicine* **69**, 1311–1313 (2009).

187. Rugel, E. J., Henderson, S. B., Carpiano, R. M. & Brauer, M. Beyond the Normalized Difference Vegetation Index (NDVI): Developing a Natural Space Index for population-level health research. *Environmental Research* **159**, 474–483 (2017).

188. Dzhambov, A. M., Browning, M. H. E. M., Markevych, I., Hartig, T. & Lercher, P. Analytical approaches to testing pathways linking greenspace to health: A scoping review of the empirical literature. *Environmental Research* **186**, 109613 (2020).

189. Shaddick, G. *et al.* Data integration model for air quality: a hierarchical approach to the global estimation of exposures to ambient air pollution. *Journal of the Royal Statistical Society: Series C (Applied Statistics)* **67**, 231–253 (2018).

190. Pebesma, E. Simple features for R: standardized support for spatial vector data. *The R Journal* **10**, 439–446 (2018).

191. Maguire, K. *et al.* Public involvement in research about environmental change and health: a case study. *Health* (2018).

192. Werner, O. & Campbell, D. T. Translating, working through interpreters, and the problem of decentering. in *A handbook of method in cultural anthropology* vol. 398 420 (American Museum of Natural History, 1970).

193. Brislin, R. W. Back-Translation for Cross-Cultural Research. *Journal of Cross-Cultural Psychology* **1**, 185–216 (1970).

194. Douglas, S. P. & Craig, C. S. Collaborative and Iterative Translation: An Alternative Approach to Back Translation. *Journal of International Marketing* **15**, 30–43 (2007).

195. R Core Team. *R: A language and environment for statistical computing*. (2019).

196. Wickham, H. & Grolemund, G. *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. (O'Reilly Media, 2017).

8 Codebook for BlueHealth International Survey Data File

This document contains a table which pertains to every variable included in the cleaned data files provided by Lewis Elliott on the Croust server at the University of Exeter and also to the data files provided to external collaborators. Regardless of file format (.csv, .sav), the variable names are consistently in the same order.

This document does not contain the full content of the BlueHealth International Survey (i.e. it does not include the participant information sheets, consent forms, debriefs, some of the explanatory text etc.), but it does contain the exact wording of every question, exact wording of response options (which are sometimes abbreviated for parsimony in the data files) as well as introductory text to questions where it is necessary in order to understand the question's meaning. Furthermore, it contains details on the countries (or states, territories) which were asked a particular question, whether the variable is included in external collaborator's data files, references or links to where the question was taken or derived from (if applicable), and additional notes, for example on who provided the questions.

The following list is an explanation of the column names of the tables.

- **Variable name:** The name of the variable as it appears in the data files.
- **Variable class:** The 'class' or 'type' of variable it is (e.g. numeric, categorical, date-time, string etc.).
- **Short description:** A short description of what the variable concerns.
- **Wording:** The exact wording (in English) of the question, as it originally appeared in the online surveys.
- **Response options:** The response options available to the respondent. These can include the categories and their value labels in the data file, or can otherwise be identified as, for example, free text, 1 to 7 etc.
- **Reference:** A citation, description, or other reference to the source of the question, or where it was derived from.
- **Excluded countries:** Countries (or states, territories) where the question was <u>not</u> asked.
- **Inclusion in collaborators' data files:** Whether the variable is included in data files provided to external collaborators in Portugal, Finland, Ireland, Hong Kong, California, Canada, and Queensland.
- **Notes:** Any additional notes on the variable.

The column header names differ slightly for the last three sections but information is comparable. All natural environment exposure metrics were constructed by Marta Cirach at ISGlobal who should be included as a named author on any published output which uses these data.

8.1 Introductory variables

Variable name	Variable class/type	Short description	Wording	Response options		Reference	Excluded countries	Inclusion in collaborators' data files	Notes
id	Numeric	Participant ID	n/a	n/a		n/a	None	Yes	-
survey_duration	Numeric	Time (in minutes) it took for the respondent to complete the survey	n/a	n/a		n/a	None	Yes	-
survey_start	Date-time	Date and time at which the respondent began the survey	n/a	n/a		n/a	None	Yes	-
survey_end	Date-time	Date and time at which the respondent finished the survey	n/a	n/a		n/a	None	Yes	-
country	Categorical	Country of residence	n/a	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	Australia Bulgaria California Canada Czech Republic Estonia Finland France Germany Greece Hong Kong Ireland Italy Netherlands Portugal Spain Sweden United Kingdom	n/a	None	No	-
language	Categorical	Language that respondent	n/a	1 2 3	Bulgarian Czech Dutch	n/a	None	Yes	-

		completed the survey in		4 5 6 7 8 9 10 11 12 13 14 15 16	English Estonian Finnish French French Canadian German Greek Italian Portuguese Russian (EST) Spanish Swedish Traditional Chinese				
wave	Categorical	The wave of the survey the respondent participated in	n/a	1 2 3 4	Jun-17 Sep-17 Dec-17 Mar-18	n/a	None	Yes	-
weight_var	Numeric	Sample weight	n/a	n/a		n/a	None	Yes	-
cluster	Categorical	Cluster variable used to produce svywght_a and svywght_b	n/a	Combinations of age, sex, and region variable strings		n/a	None	Yes	This variable was primarily used for rescaling weights (see svywght_a and svywght_b), but can also be used for setting up the survey as a complex survey design object (e.g. using the 'survey' package in R, or the complex samples module in SPSS) depending on the researcher's objective.
svywght_a	Numeric	Rescaled sample weight	n/a	n/a		n/a	None	Yes	The sample weights in weight_var are rescaled by adjusted by a factor that represents the proportion of cluster size divided by the sum of sampling weights within each cluster. Suitable for use in "weights=" argument of typical regression modelling runctions in the R statistical software package. Most useful for cluster-robust point estimates. Recommended when low cluster size is a concern. See https://www.rdocumentation.org/packages/sjstats/versions/0.17.5/topics/scale_weights
svywght_b	Numeric	Rescaled sample weight	n/a	n/a		n/a	None	Yes	The sample weights in weight_var are adjusted by a factor which is the sum of sample weights within each cluster divided by the sum of squared sample weights within each cluster. Suitable for use in "weights=" argument of typical regression modelling runctions in the R statistical software package. Most useful for residual between-cluster variance. See https://www.rdocumentation.org/packages/sjstats/versions/0.17.5/topics/scale_weights
sex	Categorical	Sex of the respondent	n/a (coded from panel	1 2	Female Male	n/a	None	Yes	-

			registration information)						
age	Categorical	Age group	n/a (coded from panel registration information in most cases)	1 2 3 4 5	18-29 30-39 40-49 50-59 60+	n/a	None	Yes	-
region	Categorical	Consolidated region of residence	n/a (coded from panel registration information)	See individual region variables below for information on how regions in countries were categorised. See flag_manual_region for cases where regions were manually assigned.		n/a	None	Yes	NAs represent cases where (a) no region was automatically assigned, and (b) the given home location in subsequent variables was either (i) not recorded or (ii) outside of the country in which the respondent was a registered panellist.
reg_FRA	Categorical	Modified NUTS 1 French region of residence	n/a (coded from panel registration information)	1 2 3 4 5	Nord-Est Nord-Ouest Region Parisienne Sud-Est Sud-Ouest	n/a	Only France	No	-
reg_DEU	Categorical	NUTS 1 German region of residence	n/a (coded from panel registration information)	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	Baden-Württemberg Bayern Berlin Brandenburg Bremen Hamburg Hessen Mecklenburg-Vorpommern Niedersachsen Nordrhein-Westfalen Rheinland-Pfalz Saarland Sachsen Sachsen-Anhalt Schleswig-Holstein Thüringen	n/a	Only Germany	No	NUTS 1 regions are equal to German states

reg_ESP	Categorical	NUTS 1 Spanish region of residence	n/a (coded from panel registration information)	1 2 3 4 5 6 7	Canarias Centro Comunidad de Madrid Este Noreste Noroeste Sur	n/a	Only Spain	No	-
reg_NLD	Categorical	NUTS 1 Dutch region of residence	n/a (coded from panel registration information)	1 2 3 4	Noord-Nederland Oost-Nederland West-Nederland Zuid-Nederland	n/a	Only Netherlands	No	-
reg_ITA	CategoricaL	NUTS 1 Italian region of residence	n/a (coded from panel registration information)	1 2 3 4 5	Centro Isole Nord-Est Nord-Ovest Sud	n/a	Only Italy	No	-
reg_CZE	Categorical	NUTS 2 Czech region of residence	n/a (coded from panel registration information)	1 2 3 4 5 6 7 8	Jihovýchod Jihozápad Moravskoslezsko Praha Severovýchod Severozápad Střední Cechy Střední Morava	n/a	Only Czech Republic	No	-
reg_SWE	Categorical	NUTS 1 Swedish region of residence	n/a (coded from panel registration information)	1 2 3	Norra Sverige Östra Sverige Södra Sverige	n/a	Only Sweden	No	-
reg_GRC	Categorical	NUTS 1 Greek region of residence	n/a (coded from panel registration information)	1 2 3 4	Attiki Kentriki Ellada Nisia Aigaiou, Kriti Voreia Ellada	n/a	Only Greece	No	-

reg_FIN	Categorical	NUTS 2 Finnish region of residence (exc. Åland Islands)	n/a (coded from panel registration information)	1 2 3 4	Etelä-Suomi Helsinki - Uusimaa Länsi-Suomi Pohjois- ja Itä-Suomi	n/a	Only Finland	Only Finland	-
reg_PRT	Categorical	NUTS 2 Portuguese region of residence	n/a (coded from panel registration information)	1 2 3 4 5 6 7	Alentejo Algarve Área Metropolitana de Lisboa Centro Norte Região Autónoma da Madeira Região Autónoma dos Açores	n/a	Only Portugal	Only Portugal	-
reg_BGR	Categorical	NUTS 2 Bulgarian region of residence	n/a (coded from panel registration information)	1 2 3 4 5 6	Severen tsentralen Severoiztochen Severozapaden Yugoiztochen Yugozapaden Yuzhen tsentralen	n/a	Only Bulgaria	No	-
reg_CAN	Categorical	Canadian province/territory of residence	n/a (coded from panel registration information)	1 2 3 4 5 6 7 8 9 10 11	Alberta British Columbia Manitoba New Brunswick Newfoundland and Labrador Nova Scotia Ontario Prince Edward Island Quebec Saskatchewan Yukon	n/a	Only Canada	Only Canada	-
reg_IRL	Categorical	NUTS 2 Irish region of residence	n/a (coded from panel registration information)	1 2	Border, Midland and Western Southern and Eastern	n/a	Only Ireland	Only Ireland	-
reg_GBR	Categorical	NUTS 1 British region	n/a (coded	1 2	East Midlands East of England	n/a	Only UK	No	-

	of residence (exc. Northern Ireland)	from panel registration information)	3 4 5 6 7 8 9 10 11	London North East North West Scotland South East South West Wales West Midlands Yorkshire and the Humber

8.2 OECD wellbeing items and personal wellbeing index

Variable name	Variable class/type	Short description	Wording	Response options	Reference	Excluded countries	Inclusion in collaborators' data files	Notes
lifesat	Numeric	Global life satisfaction	All things considered, how satisfied are you with your life as a whole nowadays?	0=Extremely dissatisfied to 10=Extremely satisfied (recoded to continuous in data files)	European Social Survey and OECD wellbeing measurement guidelines	None	Yes	-
livingsat	Numeric	Satisfaction with living standard	How satisfied are you with your standard of living?	0=Not at all satisfied to 10=Completely satisfied (recoded to continuous in data files)	Personal wellbeing index	None	Yes	-
healthsat	Numeric	Satisfaction with health	How satisfied are your with your health?	0=Not at all satisfied to 10=Completely satisfied (recoded to continuous in data files)	Personal wellbeing index	None	Yes	-
achievesat	Numeric	Satisfaction with what you achieve	How satisfied are you with what you are achieving in life?	0=Not at all satisfied to 10=Completely satisfied (recoded to continuous in data files)	Personal wellbeing index	None	Yes	-
relationsat	Numeric	Satisfaction with relationships	How satisfied are you with your personal relationships?	0=Not at all satisfied to 10=Completely satisfied (recoded to continuous in data files)	Personal wellbeing index	None	Yes	-
safesat	Numeric	Satisfaction with safety	How satisfied are you with how safe you feel?	0=Not at all satisfied to 10=Completely satisfied (recoded to continuous in data files)	Personal wellbeing index	None	Yes	-
communitysat	Numeric	Satisfaction with community	How satisfied are you with feeling part of your community?	0=Not at all satisfied to 10=Completely satisfied (recoded to continuous in data files)	Personal wellbeing index	None	Yes	-
securitysat	Numeric	Satisfaction with security	How satisfied are you with your future security?	0=Not at all satisfied to 10=Completely satisfied	Personal wellbeing index	None	Yes	-

				(recoded to continuous in data files)				
worthwhile	Numeric	Worthwhileness of daily activities	Overall, to what extent do you feel the things you do in your life are worthwhile?	0=Not at all worthwhile to 10=Completely worthwhile (recoded to continuous in data files)	OECD wellbeing measurement guidelines	None	Yes	-
happy_yday	Numeric	Happiness yesterday	Overall, how happy did you feel yesterday?	0=Not at all to 10=Completely (recoded to continuous in data files)	OECD wellbeing measurement guidelines	None	Yes	-
anxious_yday	Numeric	Anxiety yesterday	Overall, how anxious did you feel yesterday?	0=Not at all to 10=Completely (recoded to continuous in data files)	OECD wellbeing measurement guidelines	None	Yes	-

8.3 Frequencies of natural environment visits

Variable name	Variable class/type	Short description	Wording	Response options		Reference	Excluded countries	Inclusion in collaborators' data files	Notes
local_park_4wk	Categorical	Frequency of visits to local parks in the last four weeks	*Introduced as:* Firstly, have a look at these green spaces in towns or cities below and indicate which, if any, you have visited at least once in the last four weeks in your leisure time: Local neighbourhood park	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
large_park_4wk	Categorical	Frequency of visits to large urban parks in the last four weeks	*Introduced as above* Large urban park	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
community_garden_4wk	Categorical	Frequency of visits to allotments or community gardens	*Introduced as above*	1	Not at all in the last four weeks	Based on Monitor of Engagement	None	Yes	-

		in the last four weeks	Allotment or community garden	2 3 4	Once or twice in the last four weeks Once a week Several times a week	with the Natural Environment Survey and Welsh Outdoor Recreational Survey			
playground_4wk	Categorical	Frequency of visits to playgrounds/playing fields in the last four weeks	*Introduced as above* Playground or playing field	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
cemetery_4wk	Categorical	Frequency of visits to cemeteries in the last four weeks	*Introduced as above* Cemetery or churchyard	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
botanic_zoo_4wk	Categorical	Frequency of visits to botanical gardens/zoos in the last four weeks	*Introduced as above* Botanical garden or zoo	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
woodland_4wk	Categorical	Frequency of visits to in the last four weeks	*Introduced as:* Next, have a look at these green spaces in rural areas below and indicate which, if any, you have visited at least once in the last four weeks in your leisure time:	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-

			Woodland or forest						
farmland_4wk	Categorical	Frequency of visits to farmland in the last four weeks	*Introduced as above:* Arable farmland	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
meadow_4wk	Categorical	Frequency of visits to meadows in the last four weeks	*Introduced as above:* Meadow or grassland	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
mountain_4wk	Categorical	Frequency of visits to mountains in the last four weeks	*Introduced as above:* Mountain	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
moorland_4wk	Categorical	Frequency of visits to moorland in the last four weeks	*Introduced as above:* Hill, moorland or heathland	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
country_park_4wk	Categorical	Frequency of visits to country parks in the last four weeks	*Introduced as above:* Country park	1 2 3	Not at all in the last four weeks Once or twice in the last four weeks Once a week	Based on Monitor of Engagement with the Natural	None	Yes	-

				4	Several times a week	Environment Survey and Welsh Outdoor Recreational Survey			
lake_4wk	Categorical	Frequency of visits to lakes in the last four weeks	*Introduced as:* Next, have a look at these inland blue spaces below and indicate which, if any, you have visited at least once in the last four weeks in your leisure time: Natural or artificial lake or reservoir	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
urban_river_4wk	Categorical	Frequency of visits to urban rivers in the last four weeks	*Introduced as above:* Urban river/canal (surrounded by buildings)	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
rural_river_4wk	Categorical	Frequency of visits to rural rivers in the last four weeks	*Introduced as above:* Rural river/canal (with vegetated banks)	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
waterfall_4wk	Categorical	Frequency of visits to waterfalls in the last four weeks	*Introduced as above:* Waterfall or rapids	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor	None	Yes	-

						Recreational Survey			
pond_4wk	Categorical	Frequency of visits to small water bodies in the last four weeks	*Introduced as above:* Small water bodies (e.g. streams and ponds)	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
wetland_4wk	Categorical	Frequency of visits to wetlands in the last four weeks	*Introduced as above:* Fen, marsh or bog	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
pool_spa_4wk	Categorical	Frequency of visits to pools/spas in the last four weeks	*Introduced as above:* Outdoor public pool, lido, or thermal spa	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
fountain_4wk	Categorical	Frequency of visits to fountains in the last four weeks	*Introduced as above:* Ornamental water feature or fountain	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
rink_4wk	Categorical	Frequency of visits to outdoor skating rinks in the last four weeks	*Introduced as above:* Outdoor skating or ice hockey rink	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment	None	Yes	-

						Survey and Welsh Outdoor Recreational Survey			
esplanade_4wk	Categorical	Frequency of visits to esplanades or promenades in the last four weeks	*Introduced as:* Next, have a look at these coastal blue spaces in towns or cities below and indicate which, if any, you have visited at least once in the last four weeks in your leisure time: Seaside promenade	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
pier_4wk	Categorical	Frequency of visits to piers in the last four weeks	*Introduced as above:* Pier	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
harbour_4wk	Categorical	Frequency of visits to harbours in the last four weeks	*Introduced as above:* Harbour or marina	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
beach_4wk	Categorical	Frequency of visits to sandy beaches in the last four weeks	*Introduced as:* Lastly, have a look at these other coastal blue spaces below and indicate which, if any, you have visited at least	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor	None	Yes	-

			once in the last four weeks in your leisure time: Sandy beach or dunes			Recreational Survey			
rocky_shore_4wk	Categorical	Frequency of visits to rocky shores in the last four weeks	*Introduced as above:* Rocky or stony shore	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
cliff_4wk	Categorical	Frequency of visits to cliffs in the last four weeks	*Introduced as above:* Sea cliffs	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
lagoon_4wk	Categorical	Frequency of visits to lagoons in the last four weeks	*Introduced as above:* Salt marsh, estuary or lagoon	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
sea_4wk	Categorical	Frequency of visits to the open sea in the last four weeks	*Introduced as above:* Open sea	1 2 3 4	Not at all in the last four weeks Once or twice in the last four weeks Once a week Several times a week	Based on Monitor of Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey	None	Yes	-
local_park_yday large_park_yday	Categorical	Whether the respondent visited	Did you make a visit in your	Respondent selects which, if any, they visited yesterday.		Based on Monitor of	None	Yes	-

community_garden_yday playground_yday cemetery_yday botanic_zoo_yday woodland_yday farmland_yday meadow_yday mountain_yday moorland_yday country_park_yday lake_yday urban_river_yday rural_river_yday waterfall_yday pond_yday wetland_yday pool_spa_yday fountain_yday rink_yday esplanade_yday pier_yday harbour_yday beach_yday rocky_shore_yday cliff_yday lagoon_yday sea_yday none_yday		the environment yesterday (environment names were as above).	leisure time to any of these spaces yesterday?	Recoded as 1=No and 2=Yes for all variables. Respondent could also select "none of the above".		Engagement with the Natural Environment Survey and Welsh Outdoor Recreational Survey			
visit_12m	Categorical	How often the respondent visits green/blue spaces in the last 12 months	In the last 12 months, how often, on average, have you spent your leisure time at green and blue spaces?	1 2 3 4 5 6	Not in the last 12 months A few times in the last 12 months Once or twice a month Once a week Several times a week Every day	Based on Monitor of Engagement with the Natural Environment Survey	None	Yes	-

8.4 Self-determination, connectedness, local blue spaces, and childhood exposure

Variable name	Variable class/type	Short description	Wording	Response options		Reference	Excluded countries	Inclusion in collaborators' data files	Notes
sdt_enjoy	Categorical	Whether respondent enjoys natural environments	*Introduced as:* And how true of you are each of these statements:	1 2 3 4 5	1= Not at all 2 3 4= Somewhat true 5	Related to self-determination theory	None	Yes	Designed by Netta Weinstein (Cardiff University)

			"I find visiting green and blue spaces enjoyable or fun"	6 7 8	6 7= Very true Not sure				
sdt_important	Categorical	Whether respondent finds natural environment activities important	*Introduced as:* And how true of you are each of these statements: "The things I do in green and blue spaces (e.g. exercise, relaxation) are important to me"	1 2 3 4 5 6 7 8	1= Not at all 2 3 4= Somewhat true 5 6 7= Very true Not sure	Related to self-determination theory	None	Yes	Designed by Netta Weinstein (Cardiff University)
sdt_pressure	Categorical	Whether respondent feels pressured to visit natural environments	*Introduced as:* And how true of you are each of these statements: "I sometimes feel pressured by others (e.g. partner, friends) to visit green and blue spaces"	1 2 3 4 5 6 7 8	1= Not at all 2 3 4= Somewhat true 5 6 7= Very true Not sure	Related to self-determination theory	None	Yes	Designed by Netta Weinstein (Cardiff University)
sdt_disappointed	Categorical	Whether respondent would feel disappointed spending time indoors	*Introduced as:* And how true of you are each of these statements: "I would feel disappointed in myself if I spent all of my time indoors"	1 2 3 4 5 6 7 8	1= Not at all 2 3 4= Somewhat true 5 6 7= Very true Not sure	Related to self-determination theory	None	Yes	Designed by Netta Weinstein (Cardiff University)
ins	Categorical	Nature connectedness measured by the inclusion of nature in self scale	"Please select the picture that best describes your relationship with the natural environment. How interconnected are you with nature? ('Self' = you; 'Nature' = the environment)."	1 2 3 4 5 6 7 8	Least connected 2 3 4 5 6 Most connected Don't know	Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of environmental psychology*, *21*(4), 327-339.	None	Yes	-
view	Categorical	Whether respondent has a view of blue	"Do you have a view of blue space from your home?"	1 2	No Yes	n/a though based on evidence e.g.	None	Yes	-

		space from home				Nutsford, D., Pearson, A. L., Kingham, S., & Reitsma, F. (2016). Residential exposure to visible blue space (but not green space) associated with lower psychological distress in a capital city. *Health & place*, *39*, 70-78.			
blue_walk	Categorical	Amount of blue space within a short walk of respondent's home	"How much blue space is within a 10-15 minute walk from your home?"	1 2 3 4	Not sure None A little A lot	Adapted from PHENOTYPE survey	None	Yes	-
blue_drive	Categorical	Amount of blue space within a short drive of respondent's home	"How much blue space is within a 10-15 minute drive from your home?"	1 2 3 4	Not sure None A little A lot	Adapted from the PHENOTYPE survey and informed by public engagement group	None	Yes	-
commute	Categorical	Whether respondent commuted through blue space	"Do you usually pass by/through blue space when commuting to or from work/school/other daily activities?"	1 2	No Yes	Adapted from the PHENOTYPE survey	None	Yes	-
quality	Categorical	Perceived quality of local blue spaces	*Introduced as:* Overall, how satisfied are you with the following aspects? "The quality of blue spaces near your home? (including how well they are maintained, the water quality, wildlife etc.)"	1 2 3 4 5 6	Don't know Very dissatisfied Dissatisfied Neutral Satisfied Very satisfied	Adapted from the PHENOTYPE survey	None	Yes	-

safety	Categorical	Perceived safety of local blue spaces	*Introduced as:* Overall, how satisfied are you with the following aspects? "The safety of blue spaces near your home? (i.e. hazards, people in the open space)"	1 2 3 4 5 6	Don't know Very dissatisfied Dissatisfied Neutral Satisfied Very satisfied	Adapted from the PHENOTYPE survey	None	Yes	-
child_access	Categorical	Accessibility of blue space as a child	*Introduced as:* How strongly do you agree with each of these statements regarding your childhood experiences of blue space (aged 0 to 16 years of age). "As a child (aged 0-16), there was easily accessible blue space near my home(s)"	1 2 3 4 5 6 7 8	Don't know Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	n/a	None	Yes	Designed by Kayleigh Wyles (University of Surrey) based on previous research
child_allowed	Categorical	How comfortable parents were with respondent playing in blue space as a child	*Introduced as:* How strongly do you agree with each of these statements regarding your childhood experiences of blue space (aged 0 to 16 years of age). "As a child, my parents/guardians were comfortable with me playing in and around blue spaces"	1 2 3 4 5 6 7 8	Don't know Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	n/a	None	Yes	Designed by Kayleigh Wyles (University of Surrey) based on previous research
child_visit	Categorical	Childhood blue space visits	*Introduced as:* How strongly do you agree with each of these statements regarding your childhood experiences of blue space (aged 0 to 16 years of age). "As a child, I often visited blue spaces"	1 2 3 4 5 6 7 8	Don't know Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	n/a	None	Yes	Designed by Kayleigh Wyles (University of Surrey) based on previous research

8.5 Visit-based questions

Variable name	Variable class/type	Short description	Wording	Response options	Reference	Excluded countries	Inclusion in collaborators' data files	Notes
v_date	Date-time	Date of most recent blue space visit	What date did this visit take place?	Calendar tool with "don't know" option (recoded as missing)	Weekend/weekday important covariate in many comparable previous studies	None	Yes	Many dates recorded ambiguously were recoded as missing
v_environment	Categorical	The type of blue space that was visited	Which of the following best describes the type of blue space that you visited? Please only select one option which best describes the place you visited for the majority of your time.	1 Fen, marsh or bog 2 Harbour or marina 3 Natural or artificial lake or reservoir 4 Open sea 5 Ornamental water feature or fountain 6 Outdoor public pool, lido, or thermal spa 7 Outdoor skating or ice hockey rink 8 Pier 9 Rocky or stony shore 10 Rural river/canal (with vegetated banks) 11 Salt marsh, estuary or lagoon 12 Sandy beach or dunes 13 Sea cliffs 14 Seaside promenade 15 Small water bodies (e.g. streams and ponds) 16 Urban river/canal (surrounded by buildings) 17 Waterfall or rapids	Adapted from Monitor of Engagement with the Natural Environment survey	None	Yes	Respondents only saw the options that were possible given their responses to earlier questions
v_time	Categorical	Time of day the respondent arrived at the blue space	At what time of day did you arrive at the blue space?	All possible 5 minute intervals in 24-hour clock format (e.g. 0025, 1435, 2100)	None	None	Yes	Numeric in .sav format due to too many categories upon export; could recode as date-time

									type if necessary
v_duration	Categorical	Duration of time spent in blue space	And approximately how much time did you spend at that blue space?	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	10 minutes 20 minutes 30 minutes 40 minutes 50 minutes 1 hour 1 hour 10 minutes 1 hour 20 minutes 1 hour 30 minutes 1 hour 40 minutes 1 hour 50 minutes 2 hours 2 hours 10 minutes 2 hours 20 minutes 2 hours 30 minutes 2 hours 40 minutes 2 hours 50 minutes 3 hours 3 hours 10 minutes 3 hours 20 minutes 3 hours 30 minutes 3 hours 40 minutes 3 hours 50 minutes 4 hours or more	Adapted from Monitor of Engagement with the Natural Environment survey	None	Yes	-
v_water_quality	Categorical	Perceived quality of water at blue space	How would you rate the quality of the water at the blue space you visited? Think about the colour, smell, any litter that was in the water etc.	1 2 3 4	Poor Sufficient Good Excellent	Derived from EU's latest bathing water quality classifications	None	Yes	Feeds into later contingent behaviour experiment
v_activity	Categorical	Main activity undertaken at the blue space	On this visit which of these activities, if any, was the main activity you did?	1 2 3 4 5 6 7 8 9	Walking with a dog Walking without a dog Nordic walking (i.e. with poles) Running Cycling Horse riding Golf Adventure sport (e.g. coasteering, climbing, paragliding, off-road driving, mountain biking) Informal games and sport (e.g. Frisbee, bat and ball, beach ball)	Adapted from Monitor of Engagement with the Natural Environment survey with greater input from public engagement groups	None	Yes	In the data files, these categories are abbreviated for parsimony to the following: 1 Walking w 2 Walking w 3 Nordic wa 4 Running 5 Cycling 6 Horse ridi 7 Golf 8 Adventure 9 Informal g sport

				10	Fishing (including angling, crabbing)				10	Fishing
				11	Hunting or shooting				11	Hunting
				12	Conservation activity (e.g. litter-picking)				12	Conservation
				13	Sunbathing				13	Sunbathing
				14	Visiting an attraction				14	Visiting an attraction
				15	Quiet activities (e.g. reading meditating)				15	Quiet activities
				16	Playing with children				16	Playing with children
				17	Appreciating scenery from a car				17	Appreciating scenery from a car
				18	Eating or drinking				18	Eating or drinking
				19	Socialising with friends				19	Socialising
				20	Watching wildlife				20	Watching wildlife
				21	Boating (e.g. yachting, canoeing, kayaking, pedalo/paddle boat)				21	Boating
				22	Commercial boat trip (e.g. organised fishing trip, marine wildlife trip)				22	Commercial boat trip
				23	Paddling (i.e. walking in shallow water)				23	Paddling (splashing)
				24	Swimming				24	Swimming
				25	Watersport (e.g. surfing, windsurfing, kitesurfing, Jet Ski)				25	Watersport
				26	Diving (e.g. Scuba diving, snorkelling)				26	Diving
				27	Ice skating				27	Ice skating
				28	Ice fishing				28	Ice fishing
				29	Snow sports (e.g. skiing, snowboarding, cross-country skiing, sledding)				29	Snow sports
				30	Any other activity not in the list				30	Other
v_activity_duration	Categorical	Length of time the main activity was engaged with	And how long did you spend doing this activity?	1	10 minutes	Derived from Welsh Outdoor Recreation Survey	None	Yes	-	
				2	20 minutes					
				3	30 minutes					
				4	40 minutes					
				5	50 minutes					
				6	1 hour					
				7	1 hour 10 minutes					
				8	1 hour 20 minutes					
				9	1 hour 30 minutes					
				10	1 hour 40 minutes					
				11	1 hour 50 minutes					

				12 13 14 15 16 17 18 19 20 21 22 23 24	2 hours 2 hours 10 minutes 2 hours 20 minutes 2 hours 30 minutes 2 hours 40 minutes 2 hours 50 minutes 3 hours 3 hours 10 minutes 3 hours 20 minutes 3 hours 30 minutes 3 hours 40 minutes 3 hours 50 minutes 4 hours or more				
v_happy	Categorical	Recalled happiness	*Introduced as:* How much do you agree with the statements below about your visit? "It made me feel happy"	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Related to OECD wellbeing measurement items	None	Yes	-
v_anxious	Categorical	Recalled anxiety	*Introduced as:* How much do you agree with the statements below about your visit? "It made me feel anxious"	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Related to OECD wellbeing measurement items	None	Yes	-
v_worthwhile	Categorical	Recalled worthwhilenes ss	*Introduced as:* How much do you agree with the statements below about your visit? "I found the visit worthwhile"	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Related to OECD wellbeing measurement items	None	Yes	-
v_satisfied	Categorical	Recalled satisfaction	*Introduced as:* How much do you agree with the statements below about your visit? "I was satisfied with the visit"	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Related to OECD wellbeing measurement items	None	Yes	-
v_autonomy	Categorical	Recalled autonomy	*Introduced as:* How much do you agree with the	1 2 3	Strongly disagree Disagree Slightly disagree	Related to self-determination theory	None	Yes	Designed by Netta Weinstein

			statements below about your visit? "I felt free to be who I am"	4 5 6 7	Neither agree nor disagree Slightly agree Agree Strongly agree				(Cardiff University)
v_related	Categorical	Recalled relatedness	*Introduced as:* How much do you agree with the statements below about your visit? "I felt closeness or intimacy with others"	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Related to self-determination theory	None	Yes	Designed by Netta Weinstein (Cardiff University)
v_connected	Categorical	Recalled connectedness to nature	*Introduced as:* How much do you agree with the statements below about your visit? “I felt part of nature”	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Related to self-determination theory but derived from a measure of nature connectedness designed by Natural England for use in the Monitor of Engagement with the Natural Environment survey.	None	Yes	-
v_competence	Categorical	Recalled competence	*Introduced as:* How much do you agree with the statements below about your visit? “I felt a sense of achievement”	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Related to self-determination theory	None	Yes	Designed by Netta Weinstein (Cardiff University)
v_restored	Categorical	Recalled restoration	*Introduced as:* How much do you agree with the statements below about your visit? “I was able to rest and recover my ability to focus in that blue space”	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Based on a well-used single item measure of perceived restorativeness (e.g. Nordh, H., Hartig, T., Hagerhall, C. M., & Fry, G. (2009). Components of small urban parks that	None	Yes	-

						predict the possibility for restoration. Urban Forestry & Urban Greening, 8, 225-235).			
v_safe	Categorical	Perceived safety of blue space	*Introduced as:* How much do you agree with the statements below about your visit? "I felt safe" (i.e. protected from danger)	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Used in the most recent waves of Monitor of Engagement with the Natural Environment survey	None	Yes	-
v_wildlife	Categorical	Perceived wildlife at the blue space	*Introduced as:* How much do you agree with the statements below about your visit? "There was wildlife to see and enjoy"	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Used in the most recent waves of Monitor of Engagement with the Natural Environment survey	None	Yes	-
v_litter	Categorical	Perceived litter/vandalism at the blue space	*Introduced as:* How much do you agree with the statements below about your visit? "The area was free from litter/vandalism"	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Used in the most recent waves of Monitor of Engagement with the Natural Environment survey	None	Yes	-
v_facilities	Categorical	Perceived quality of facilities at the blue space	*Introduced as:* How much do you agree with the statements below about your visit? "There were good facilities (e.g. parking, footpaths, toilets)"	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Used in the most recent waves of Monitor of Engagement with the Natural Environment survey	None	Yes	-
v_adults	Categorical	Number of adults (inc. self) on the visit	How many adults aged 16 and over, including yourself, were on this visit?	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	Adapted from Monitor of Engagement with the Natural Environment survey	None	Yes	-

				10 10 or more				
v_children	Categorical	Number of children on the visit	How many children aged under 16 were on this visit?	1 0 2 1 3 2 4 3 5 4 6 5 7 6 8 7 9 8 10 9 11 10 or more	Adapted from Monitor of Engagement with the Natural Environment survey	None	Yes	-
v_visits4wk	Numeric	Number of visits to this blue space in the last 4 weeks	In the last 4 weeks, approximately how many times have you visited this blue space?	Free numeric text response	n/a	None	Yes	Feeds into contingent behaviour experiment
v_tripped v_wound v_bitten v_accident v_sunburn v_no_injuries	Categorical	Checkbox item for accidents/injuries on the visit	Did any of the following happen to you while you were at the blue space? Please select all that apply. I tripped over or fell over I got a cut or wound I got stung or bitten (i.e. by an insect or other animal) I had another accidental injury I got sunburn or sunstroke/dehydration None of the above	1 No 2 Yes (response options were the options to the left, but in the data files they are coded as yes/no)	Recommendation of BlueHealth external advisory board	None	Yes	Respondents could select as many as applicable. If “none of the above” selected, respondents could not select any other response option.
v_vomit v_flu v_ears v_eyes v_rash v_other_ills v_no_illness	Categorical	Checkbox item for illnesses suffered after the blue space visit	Have you experienced any of the following symptoms since your most recent visit to the blue space? Please select all that apply. Vomiting, diarrhoea, stomach ache or indigestion Flu symptoms (e.g. fever, headache, joint and muscle aches, sore throat, runny nose, cough)	1 No 2 Yes (response options were the options to the left, but in the data files they are coded as yes/no)	Adapted from the “Beach Bums” survey	None	Yes	Only asked of participants who indicated that they went into/on the water through their visit activity. Respondents could select as many as applicable. If “none of the above” selected, respondents

			Earache or discharge from ears Red, painful eyes or discharge from eyes Skin rash, ulcer, sore, or itch Any other symptom of illness None of the above						could not select any other response option.
v_household_ills	Categorical	Whether anyone in respondent's household has had similar symptoms	Has anyone else in your house been unwell with similar symptoms since your most recent visit to a blue space?	1 2 3	No Not sure Yes	Control variable for above (also based on "Beach Bums" survey)	None	Yes	-
v_start_point	Categorical	Where the visit began from	Where did your journey start from?	1 2 3 4	Your home Holiday accommodation Elsewhere Your place of work	Adapted from Monitor of Engagement with the Natural Environment survey	None	Yes	-
v_start_lat	Numeric	Latitude of start point	Please locate this start point on the map below. You can drag the marker to a position on the map, or you can use the search box below to pin a location. Please keep in mind that only the approximate position of the marker will be saved, not the address.	Respondent selected start point via an embedded Google Maps API		Inspired by mapping technique used in the PASTA project survey	None	Yes (securely shared)	-
v_start_lon	Numeric	Longitude of start point	Please locate this start point on the map below. You can drag the marker to a position on the map, or you can use the search box below to pin a location. Please keep in mind that only the approximate position of the marker will be saved, not the address.	Respondent selected start point via an embedded Google Maps API		Inspired by mapping technique used in the PASTA project survey	None	Yes (securely shared)	-
v_visit_lat	Numeric	Latitude of blue space the	Now think about the blue space that you arrived at. Please locate this blue space on the map below.	Respondent selected start point via an embedded Google Maps API		Inspired by mapping technique used	None	Yes	-

		respondent arrived at	Again, you can drag the marker to a position on the map, or you can use the search box below to pin a location.		in the PASTA project survey			
v_visit_lon	Numeric	Longitude of blue space the respondent arrived at	Now think about the blue space that you arrived at. Please locate this blue space on the map below. Again, you can drag the marker to a position on the map, or you can use the search box below to pin a location.	Respondent selected start point via an embedded Google Maps API	Inspired by mapping technique used in the PASTA project survey	None	Yes	-
v_distance_km	Numeric	Distance travelled in kilometres	Approximately how far in miles/kilometres did you travel to reach this place? By that we mean the one-way distance from your start point to the blue space you visited.	Free numeric response box with options both for miles and kilometres (converted into kilometres during data processing)	Adapted from the Monitor of Engagement with the Natural Environment survey	None	Yes	Unrealistic answers were prohibited
v_travel_time_mins	Numeric	Duration of travel time in minutes	Approximately how long was your total journey time from your start point to the blue space you visited?	Free numeric response box with boxes for hours and minutes separately	Adapted from the Monitor of Engagement with the Natural Environment survey	None	Yes	Unrealistic answers were prohibited
v_network_distance_km	Numeric	Network distance between start point and visit location	n/a	n/a	n/a	None	Yes	Road network distance calculate via calls to an OpenStreetMap route API (involve Jo Garrett if using this variable)
v_network_duration_minutes	Numeric	Driving time between start point and visit location	n/a	n/a	n/a	None	Yes	Average driving time in minutes along the road network. Calculated via calls to an OpenStreetMap API (involve Jo Garrett if using this variable)

v_straight_line_distance_m	Numeric	Crow-flies distance between start point and visit location	n/a	n/a		n/a	None	Yes	Calculated using the Vicenty (ellipsoid) method (involve Jo Garrett if using this variable)
v_nearest_neighbour_id	Numeric	ID of another respondent whose visit location was nearest this visit location	n/a	n/a		n/a	None	Yes	Calculated using the 'Near' function in ArcGIS (involve Jo Garett if using this variable)
v_nearest_neighbour_lon	Numeric	Longitude of visit taken by the respondent whose ID is referred to in v_nearest_neighbour_id	n/a	n/a		n/a	None	Yes	Calculated using the 'Near' function in ArcGIS (involve Jo Garett if using this variable)
v_nearest_neighbour_lat	Numeric	Latitude of visit taken by the respondent whose ID is referred to in v_nearest_neighbour_id	n/a	n/a		n/a	None	Yes	Calculated using the 'Near' function in ArcGIS (involve Jo Garett if using this variable)
v_nearest_neighbour_straight_line_distance_m	Numeric	Crow-flies distance between visit location and nearest neighbour visit location referred to in the two previous variables	n/a	n/a		n/a	None	Yes	Calculated using the Vicenty (ellipsoid) method (involve Jo Garrett if using this variable)
v_mode	Categorical	Mode of transport used on journey	What form of transport did you use on this journey for the majority of the distance?	1 2	Personal motorised transport (e.g. car, van, motorbike) Walking (including wheelchair use and mobility scooters)	Adapted from the Monitor of Engagement with the Natural Environment survey	None	Yes	-

				3	Bicycle				
				4	Ran/jogged				
				5	Bus				
				6	Train				
				7	Taxi				
				8	Hire car				
				9	Ferry or other public boat				
				10	Other (e.g. horseback)				
v_passengers	Categorical	Number of passengers in the car/van/motor bike	How many people travelled with you in the car/van/motorbike?	1	0	Used for economic analyses	None	Yes	Only asked if "Personal motorised transport" was selected
				2	1				
				3	2				
				4	3				
				5	4				
				6	5				
				7	6				
				8	7				
				9	8				
				10	9				
				11	10 or more				
v_purpose	Categorical	Purpose of visit	Was the main purpose of your journey visiting this place or did you make the journey for other reasons? Please select the option which best applies.	1	The purpose of my journey was entirely to visit this place	Reflective of: (a) intentional; (b) indirect, and; (c) incidental reasons for visiting blue spaces.	None	Yes	-
				2	The purpose of my journey was partly to visit this place and partly to do something else				
				3	The purpose of my journey was entirely for another reason (e.g. to visit a relative)				
v_spend	Numeric	Amount spent on visit	Approximately how much did your journey cost? This includes travel from the start point to the blue space you visited as well	Free numeric response box		None, but used in other surveys like Monitor of Engagement with the Natural	None	Yes	Responses given in the local currency of the country and have not

		as any onward or return travel after you left that place e.g. return train/bus/taxi fares, petrol, parking etc. If you travelled with other people, please give the amount that relates just to your own share of the costs.			Environment survey			been converted in the data files

8.6 Contingent behaviour experiment

Variable name	Variable class/type	Short description	Wording	Response options	Reference	Excluded countries	Inclusion in collaborators' data files	Notes
v_improve_change	Categorical	If water quality improved, would visit frequency change?	*Introduced as:* Suppose that the water quality at this blue space improved and the blue space were given a sign saying the water quality is now [XXXX]. You would now see this sign: [DISPLAY SIGN]. How would this affect the number of visits you will make to this blue space in the next four weeks? Please keep in mind that you said you made [XXXX] visits to this blue space in the last 4 weeks.	1 No change 2 Fewer visits 3 More visits	-	Queensland, California, Canada, Hong Kong	No	-
v_improve_more_visits	Numeric	How many more visits would respondent make?	How many more visits would you make to this blue space in the next 4 weeks?	Free numeric response box	-	Queensland, California, Canada, Hong Kong	No	Only asked if "more visits" selected above. Unrealistic responses

									prohibited.
v_improve_more_substitute	Categorical	How would respondent substitute time for these extra visits	To allow you to make these visits, would you…?	1 2 3	Reduce the number of visits you make to other blue spaces Reduce the time you spend doing non-leisure activities Reduce the time you spend doing other leisure activities	-	Queensland, California, Canada, Hong Kong	No	Only asked if "more visits" selected above.
v_improve_less_visits	Numeric	How many fewer visits would respondent make?	How many fewer visits would you make to this blue space in the next 4 weeks?	Free numeric response box		-	Queensland, California, Canada, Hong Kong	No	Only asked if "less visits" selected above
v_improve_less_substitute	Categorical	What respondent would do differently with their time	What would you do instead? Would you:	1 2 3 4	Do different leisure activities not in blue spaces Go to a different blue space Something else Stay at home	-	Queensland, California, Canada, Hong Kong	No	Only asked if "less visits" selected above
v_improve_less_substitute_open	String	What respondent would do differently with their time (if "something else" was selected)	n/a (free text box at end of last question)	Free text		-	Queensland, California, Canada, Hong Kong	No	Only asked if "something else" selected above
v_deteriorate_change	Categorical	If water quality deteriorated, would visit frequency change?	*Introduced as:* Suppose that the water quality at this blue space deteriorated and the blue space were given a sign saying the water quality is now [XXXX]. You would now see this sign: [DISPLAY SIGN]. How would this affect the number of visits you will make to this blue space in the next four weeks? Please keep in mind that you said you made [XXXX] visits to this blue space in the last 4 weeks.	1 2 3	No change Fewer visits More visits	-	Queensland, California, Canada, Hong Kong	No	-

v_deteriorate_more_visits	Numeric	How many more visits would respondent make?	How many more visits would you make to this blue space in the next 4 weeks?	Free numeric response box	-	Queensland, California, Canada, Hong Kong	No	Only asked if "more visits" selected above. Unrealistic responses prohibited.
v_deteriorate_more_substitute	Categorical	How would respondent substitute time for these extra visits	To allow you to make these visits, would you…?	1 Reduce the number of visits you make to other blue spaces 2 Reduce the time you spend doing non-leisure activities 3 Reduce the time you spend doing other leisure activities	-	Queensland, California, Canada, Hong Kong	No	Only asked if "more visits" selected above.
v_deteriorate_less_visits	Numeric	How many fewer visits would respondent make?	How many fewer visits would you make to this blue space in the next 4 weeks?	Free numeric response box	-	Queensland, California, Canada, Hong Kong	No	Only asked if "less visits" selected above
v_deteriorate_less_substitute	Categorical	What respondent would do differently with their time	What would you do instead? Would you:	1 Do different leisure activities not in blue spaces 2 Go to a different blue space 3 Something else 4 Stay at home	-	Queensland, California, Canada, Hong Kong	No	Only asked if "less visits" selected above
v_deteriorate_less_substitute_open	String	What respondent would do differently with their time (if "something else" was selected)	n/a (free text box at end of last question)	Free text	-	Queensland, California, Canada, Hong Kong	No	Only asked if "something else" selected above

8.7 Health and wellbeing items

Variable name	Variable class/type	Short description	Wording	Response options	Reference	Excluded countries	Inclusion in collaborators' data files	Notes

who5_cheerful	Categorical	Cheerful in last two weeks	*Introduced as:* Please indicate for each of the five statements which is closest to how you have been feeling over the last two weeks. "I have felt cheerful and in good spirits"	1 2 3 4 5 6	At no time Some of the time Less than half of the time More than half of the time Most of the time All of the time	WHO-5 wellbeing index	None	Yes	-
who5_calm	Categorical	Calmness in last two weeks	*Introduced as:* Please indicate for each of the five statements which is closest to how you have been feeling over the last two weeks. "I have felt calm and relaxed"	1 2 3 4 5 6	At no time Some of the time Less than half of the time More than half of the time Most of the time All of the time	WHO-5 wellbeing index	None	Yes	-
who5_active	Categorical	Active in last two weeks	*Introduced as:* Please indicate for each of the five statements which is closest to how you have been feeling over the last two weeks. "I have felt active and vigorous"	1 2 3 4 5 6	At no time Some of the time Less than half of the time More than half of the time Most of the time All of the time	WHO-5 wellbeing index	None	Yes	-
who5_fresh	Categorical	Rested in last two weeks	*Introduced as:* Please indicate for each of the five statements which is closest to how you have been feeling over the last two weeks. "I woke up feeling fresh and rested"	1 2 3 4 5 6	At no time Some of the time Less than half of the time More than half of the time Most of the time All of the time	WHO-5 wellbeing index	None	Yes	-
who5_interest	Categorical	Interested in last two weeks	*Introduced as:* Please indicate for each of the five statements which is closest to how you have been feeling over the last two weeks. "My daily life has been filled with things that interest me"	1 2 3 4 5 6	At no time Some of the time Less than half of the time More than half of the time Most of the time All of the time	WHO-5 wellbeing index	None	Yes	-

general_health	Categorical	Self-reported general health	How is your health in general? Would you say it is...	1 2 3 4 5	Very bad Bad Fair Good Very good	European Social Survey	None	Yes	-
disability	Categorical	Presence of long-standing illness or disability	Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem?	1 2 3	No Yes to some extent Yes a lot	European Social Survey	None	Yes	-
physical_activity	Numeric	Physical activity in the last seven days	*Introduced as:* Think now about any physical activity you might engage in. 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. During the last 7 days, 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?	0 to 7		Milton, K., Bull, F. C., & Bauman, A. (2010). Reliability and validity testing of a single-item physical activity measure. *British Journal of Sports Medicine*, *45*(3), 203-208.	None	Yes	-
walking	Numeric	Walking in the last seven days	*Introduced as:* Now think about walking in particular, which can include walking for recreation or to get to and from places, but should not include housework or walking that may be part of your job. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?	0 to 7		Adapted from IPAQ	Czech Republic (due to technical error)	Yes	-

alcohol	Categorical	Alcohol consumption in last 12 months	In the last 12 months, how often have you had a drink containing alcohol? This could be wine, beer, spirits, or other drinks containing alcohol.	1 2 3 4 5 6 7 8	Never Less than once a month Once a month 2-3 times a month Once a week Several times a week Every day Prefer not to answer	European Social Survey	None	Yes	-
smoking	Categorical	General smoking status/behaviour	Which of these best describes your smoking behaviour? This includes rolled tobacco but not pipes, cigars or electronic cigarettes.	1 2 3 4 5 6	I have never smoked I have only smoked a few times I do not smoke now but I used to I smoke but not every day I smoke daily Prefer not to answer	European Social Survey	None	Yes	-
medication_high_blood_pressure medication_depression medication_anxiety medication_neck_back_pain medication_none medication_do_not_know medication_prefer_not_to_answer	Categorical	Checkbox item for medications currently taken	During the past two weeks, have you used any medicines for any of the following conditions that were prescribed for you by a doctor? Please select all that apply. Depression Tension or anxiety Pain in the neck or back None of the above Don't know Prefer not to answer	1 2 (Response options were the medications on the left, but in the data file each variable is coded yes/no)	No Yes	Adapted from the European Health Interview Survey	None	Yes	If "none of the above," "don't know," or "prefer not to answer" were selected, no other option could be selected.
gp_visits_4wk	Categorical	Visits to general practitioner in the last four weeks	During the past four weeks, how many times did you consult a GP (general practitioner) due to poor health?	1 2 3 4 5	Never Once More than once Do not know Prefer not to answer	Adapted from the European Health Interview Survey	None	Yes	-
work_absence_12m	Categorical	Work absence in the last 12 months	In the past 12 months, how many days in total were you absent from work due to poor health?	1 2 3 4 5 6 7	Never Once 1 to 5 times 6 to 10 times More than 10 times Do not know Prefer not to answer	Adapted from the European Health Interview Survey	None	Yes	-
sleep	Categorical	Sleep duration	About how many hours in each 24-hour day do	1 2	Less than 6 hours 7 hours	Adapted from Astell-Burt, T.,	None	Yes	-

			you usually spend sleeping (including at night and naps)? Please give your answer to the nearest hour.	3 8 hours 4 9 hours 5 10 hours 6 Over 10 hours	Feng, X., & Kolt, G. S. (2013). Does access to neighbourhood green space promote a healthy duration of sleep? Novel findings from a cross-sectional study of 259 319 Australians. BMJ open, 3(8), e003094.			
height_cm	Categorical	Self-reported height in cm	What is your height without shoes? If you don't know, please give your best estimate.	1 122 2 124 3 127 4 130 5 132 6 135 7 137 8 140 9 142 10 145 11 147 12 150 13 152 14 155 15 157 16 160 17 163 18 165 19 168 20 170 21 173 22 175 23 178 24 180 25 183 26 185 27 188 28 191 29 193 30 196 31 198	European Social Survey	None	Yes	Respondents had option to answer in feet and inches or metres and centimetre. Response intervals were actually increasing in inches from 4 foot to 8 foot, hence the unevenly spaced centimetres.

				32 201 33 203 34 206 35 208 36 211 37 213 38 216 39 221 40 224 41 231 42 236 43 239 44 241 45 Don'tknow 46 Prefer not to answer				
weight_kg	Categorical	Weight in kilogrammes	What is your weight without shoes? If you don't know, please give your best estimate.	197 categories from 38kg up to 127kg with options for more or less than the highest or lowest amounts (respectively) as well as a "prefer not to say" option	European Social Survey	None	Yes	Respondents could answer in stones and pounds or kilogrammes. Response intervals increased in pounds from 6 stones to 20 stones, hence the unevenly spaces kilogrammes.

8.8 Demographic items

Variable name	Variable class/type	Short description	Wording	Response options	Reference	Excluded countries	Inclusion in collaborators' data files	Notes

swimmer	Categorical	Whether the respondent is a competent swimmer	Do you consider yourself to be a competent swimmer?	1 2	No Yes	n/a	None	Yes	-
self_conscious	Categorical	Whether the respondent is self-conscious engaging in activities at blue spaces	How much do you agree with the statement: “I often feel self-conscious engaging in activities at blue spaces”	1 2 3 4 5 6 7 8	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree Not sure	Suggested by pubic engagement group	None	Yes	-
dog	Categorical	Dog ownership	Do you have a dog?	1 2	No Yes	Monitor of Engagement with the Natural Environment survey	None	Yes	-
car	Categorical	Car access	Do you own or have access to a car?	1 2	No Yes	Monitor of Engagement with the Natural Environment survey	None	Yes	-
public_transport	Categorical	Nearest public transport stop	From your home, how long would it take you to walk to the nearest public transport station or stop? This could be bus, train, tram, metro etc.	1 2 3 4 5 6 7	Less than 1 minute 1 to 5 minutes 5 to 10 minutes Approximately 15 minutes Approximately 30 minutes More than 30 minutes Don't know	PASTA project survey	None	Yes	-
garden	Categorical	Garden access	Which of the following best applies to you?	1 2 3 4	I don’t have access to a private garden or outdoor space I have access to a private communal garden I have access to a private outdoor space, but not a garden (balcony, yard, patio area) I have access to a private garden	Monitor of Engagement with the Natural Environment survey	None	Yes	Recoded in data files to: 1 No acce 2 Commu 3 Private (not a g 4 Private g
street_green	Categorical	Level of street greenery	How ‘green’ is the street where you live? Consider all types of vegetation including	1 2 3 4	1 - Not very green 2 3 4	Adapted from de Vries, S., van Dillen, S. M., Groenewegen, P.	None	Yes	-

			trees, flower boxes, front gardens and bushes.	5 6	5 - Very green Not applicable, I do not live on a street	P., & Spreeuwenberg, P. (2013). Streetscape greenery and health: Stress, social cohesion and physical activity as mediators. Social Science & Medicine, 94, 26-33.			
social	Categorical	Social contact	How often do you meet socially with friends, relatives or work colleagues? 'Meet socially' implies by choice rather than for reasons of either work or pure duty.	1 2 3 4 5 6 7 8	Never Less than once a month Once a month Several times a month Once a week Several times a week Every day Do not know	European Social Survey	None	Yes	-
household_comp	Categorical	Household composition (no. of adults and children)	Including yourself, how many people – including children – live in your house regularly as members of the household?	1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10 or more	European Social Survey	None	Yes	-
children_in_household	Categorical	No. of children in household	And how many of these are children aged under 16?	1 2 3 4 5 6 7 8 9 10 11	0 1 2 3 4 5 6 7 8 9 10 or more	Monitor of Engagement with the Natural Environment survey	None	Yes	-
work_status	Categorical	Work status in past week	Which of these descriptions best describes your situation (in the last seven days)? Please select only one.	1 2	In paid work (or away temporarily) (employee, self-employed, working for your family business) Unemployed and actively looking for a job	European Social Survey	None	Yes	Some countries not shown community or military service

				3	Unemployed, wanting a job but not actively looking for a job				option (in line with European Social Survey guidance). Bulgaria's work status was imputed by YouGov following a technical error so may be less reliable.
				4	In education, (not paid for by employer) even if on vacation				
				5	Doing housework, looking after children, or other persons				
				6	Retired				
				7	Permanently sick or disabled				
				8	In community or military service				
				9	Other				
				10	Do not know				
education	Categorical	Educational attainment	Which of the following best describes your highest educational achievement?	1	Did not complete primary education	PHENOTYPE survey	None	Yes	-
				2	Completed primary education				
				3	Completed secondary/further education (up to 18 years of age)				
				4	Completed higher education (e.g. university degree or higher)				
ethnicity	Categorical	Perceived minority status	Do you belong to a minority ethnic group in the [COUNTRY]? "Belong" refers to attachment or identification.	1	No	European Social Survey	None	Yes	-
				2	Yes				
				3	Do not know				
marital	Categorical	Marital status	Which of the following best describes your marital status now?	1	Married, in a civil union, or living with your partner (cohabiting)	European Social Survey	None	Yes	-
				2	Single, separated/divorced/civil union dissolved or widowed/civil partner died				
				3	Neither of these				
				4	Prefer not to answer				
income_perceived	Categorical	Satisfaction with income	Which of these descriptions comes closest to how you feel about your household's income nowadays?	1	Finding it very difficult on present income	European Social Survey	None	Yes	-
				2	Finding it difficult on present income				
				3	Coping on present income				

				4 Living comfortably on present income 5 Do not know				
household_income	Categorical	Household income after tax	Which of the following describes your household's total annual income after tax and compulsory deductions, from all sources? If you don't know the exact figure, please give an estimate.	1 Lowest decile 2 2nd decile 3 3rd decile 4 4th decile 5 5th decile 6 6th decile 7 7th decile 8 8th decile 9 9th decile 10 Highest decile 11 Prefer not to answer	European Social Survey	None	Yes	In the survey deciles were in line with the deciles put forward by the European Social Survey for each individual currency.
home_latitude	Numeric	Latitude of home location	Finally, can you locate your home on the map below? You can drag the marker to a position on the map, or you can use the search box below to pin a location. Please keep in mind that only the approximate position of the marker will be saved, not the address.	Respondent pinned their home location via a Google Maps API (this was subsequently rounded to three decimal places).	Method used in the PASTA project survey	None	Yes (secure sharing)	Only asked of people who had not reported a home location earlier as the start point of their visit
home_longitude	Numeric	Longitude of home location	Finally, can you locate your home on the map below? You can drag the marker to a position on the map, or you can use the search box below to pin a location. Please keep in mind that only the approximate position of the marker will be saved, not the address.	Respondent pinned their home location via a Google Maps API (this was subsequently rounded to three decimal places).	Method used in the PASTA project survey	None	Yes (secure sharing)	Only asked of people who had not reported a home location earlier as the start point of their visit
age_sex	Categorical	The combination of age and sex of the respondent	n/a (coded from panellist sign-up information).	1 Female 18-29 2 Female 30-39 3 Female 40-49 4 Female 50-59 5 Female 60 and above 6 Male 18-29 7 Male 30-39 8 Male 40-49 9 Male 50-59	n/a	None	Yes	-

				10	Male 60 and above		

8.9 Additional items for Queensland

Variable name	Variable class/type	Short description	Wording	Response options		Reference	Notes
AUS_car_type	Categorical	Type of car/van/motorbike used for the journey to the blue space	Please indicate the approximate size of the vehicle in which you travelled?	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	Motor bike Micro car (e.g. Holden Spark, Kia Picanto) Light car (e.g. Mazda 2, Volkswagen Polo) Small car (e.g. Mazda 3, Toyota Corolla) Medium car (e.g. Mazda 6, Toyota Camry) Large car (e.g. Ford Falcon, Holden Commodore) People mover (e.g. Kia Carnival, Toyota Tarago) Small SUV (e.g. Mazda CX3, Volkswagen Tiguan) Medium SUV (e.g. Mazda CX5, Toyota Rav4) Large SUV (e.g. Ford Territory, Nissan Pathfinder) All terrain SUV (e.g. Mitsubishi Pajero, Toyota Landcruiser) 2WD Ute (e.g. Ford Ranger 2WD, Mitsubishi Triton 2WD) 4WD Ute (e.g. Ford Ranger 4WD, Toyota Hilux 4WD) Electric car (e.g. BMW i3, Nissan Leaf) Other Don't know	-	Asked after v_mode to only people who had indicated they travelled by car, van, or motorbike
AUS_nieghbourhood_care	Categorical	Care for the community	“I care about other people in my neighbourhood”	1 2 3 4 5 6	1=Not at all true 2 3 4 5=Very much true Do not know	Weinstein, N., Balmford, A., DeHaan, C. R., Gladwell, V., Bradbury, R. B., & Amano, T. (2015). Seeing community for the trees: the links among contact with natural environments, community cohesion, and crime. BioScience, 65(12), 1141-1153.	-
AUS_neighbourhood_connected	Categorical	Connected to the community	“I feel connected to other people in	1 2 3	1=Not at all true 2 3	Weinstein, N., Balmford, A., DeHaan, C. R.,	-

			my neighbourhood"	4 5 6	4 5=Very much true Do not know	Gladwell, V., Bradbury, R. B., & Amano, T. (2015). Seeing community for the trees: the links among contact with natural environments, community cohesion, and crime. BioScience, 65(12), 1141-1153.	
AUS_neighbourhood_team	Categorical	People in neighbourhood on the same team	"I feel that people within my neighbourhood are on 'same team"	1 2 3 4 5 6	1=Not at all true 2 3 4 5=Very much true Do not know	Weinstein, N., Balmford, A., DeHaan, C. R., Gladwell, V., Bradbury, R. B., & Amano, T. (2015). Seeing community for the trees: the links among contact with natural environments, community cohesion, and crime. BioScience, 65(12), 1141-1153.	-
AUS_neighbourhood_time	Categorical	Helping neighbours	"I would help my neighbours if they required 1 hour of my time"	1 2 3 4 5 6	1=Not at all true 2 3 4 5=Very much true Do not know	Weinstein, N., Balmford, A., DeHaan, C. R., Gladwell, V., Bradbury, R. B., & Amano, T. (2015). Seeing community for the trees: the links among contact with natural environments,	-

						community cohesion, and crime. BioScience, 65(12), 1141-1153.	
AUS_env_person	Categorical	Environmental person	"I think of myself as an environmental person"	1 2 3 4 5 6 7 8	1=Disagree 2 3 4 5 6 7=Agree Do not know	Adapted from: Fielding, K. S., McDonald, R., & Louis, W. R. (2008). Theory of planned behaviour, identity and intentions to engage in environmental activism. Journal of environmental psychology, 28(4), 318-326.	-
AUS_env_behaviour	Categorical	Environmental behaviour	"To engage in environmental behaviours is an important part of who I am"	1 2 3 4 5 6 7 8	1=Disagree 2 3 4 5 6 7=Agree Do not know	Adapted from: Fielding, K. S., McDonald, R., & Louis, W. R. (2008). Theory of planned behaviour, identity and intentions to engage in environmental activism. Journal of environmental psychology, 28(4), 318-326.	-
AUS_not_env_person	Categorical	Non-environmental behaviour	"I am not the type of person who would be involved in environmental behaviours"	1 2 3 4 5 6 7 8	1=Disagree 2 3 4 5 6 7=Agree Do not know	Adapted from: Fielding, K. S., McDonald, R., & Louis, W. R. (2008). Theory of planned behaviour, identity and intentions to engage in environmental activism. Journal	-

						of environmental psychology, 28(4), 318-326.	
AUS_dwelling	Categorical	Housing type	What type of dwelling do you live in? Is it a separate house, a semi-detached house, a flat or home unit, or something else?	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	Separate house Separate house with attached shop, office, etc. Semi-detached house / row or terrace house / townhouse, etc. with one storey Semi-detached house / row or terrace house / townhouse, etc. with 2 or more storeys Semi-detached house / row or terrace house / townhouse, etc. attached to a shop, office, etc. Flat / unit / apartment: in a one-storey block Flat / unit / apartment: in a two-storey block Flat / unit / apartment: in a three-storey block Flat / unit / apartment: in a four to nine-storey block Flat / unit / apartment: in a 10 or more storey block Flat / unit / apartment: attached to a house (e.g., granny flat) Flat / unit / apartment: attached to a shop, office, etc. Caravan / Tent / Cabin / Houseboat Other private dwelling Nursing home Other non private (e.g., boarding house, hostel) Prefer not to say Don't know	HILDA survey	-
AUS_origin	Categorical	Aboriginal origin	Are you of Aboriginal or Torres Strait Islander Origin?	1 2 3 4	No Yes Do not know Prefer not to say	n/a	-

8.10 Additional items for California

Variable name	Variable class/type	Short description	Wording	Response options	Reference	Notes
v_Cal_ruminate	Categorical	Rumination on visit	I felt I was "ruminating" or dwelling over things that have happened to me	1 Strongly disagree 2 Disagree 3 Slightly disagree 4 Neither agree nor disagree	Trapnell, P. D. & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality:	-

				5 6 7 8	Slightly agree Agree Strongly agree Do not know	distinguishing rumination from reflection. J. Pers. Soc. Psychol. 76, 284–304.	
v_Cal_playback	Categorical	Playing back previous situations	I was playing back over in my mind how I acted in a previous situation	1 2 3 4 5 6 7 8	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree Do not know	Trapnell, P. D. & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality: distinguishing rumination from reflection. J. Pers. Soc. Psychol. 76, 284–304.	-
v_Cal_reevalute	Categorical	Reevaluating previous situations	I was reevaluating what I had done in a previous situation	1 2 3 4 5 6 7 8	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree Do not know	Trapnell, P. D. & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality: distinguishing rumination from reflection. J. Pers. Soc. Psychol. 76, 284–304.	-
v_Cal_reflect	Categorical	Reflecting on previous situations	I was reflecting on episodes of my life that I should no longer concern myself with	1 2 3 4 5 6 7 8	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree Do not know	Trapnell, P. D. & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality: distinguishing rumination from reflection. J. Pers. Soc. Psychol. 76, 284–304.	-
v_Cal_think	Categorical	Thinking back on situations negatively	I was spending a great deal of time thinking back over my embarrassing or disappointing moments	1 2 3 4 5 6 7 8	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree Do not know	Trapnell, P. D. & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality: distinguishing rumination from reflection. J. Pers. Soc. Psychol. 76, 284–304.	-
v_Cal_feeling	Categorical	Conscious of inner feelings	I was conscious of my inner feelings	1 2 3 4 5 6 7	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree	Govern, J. M., & Marsch, L. A. (2001). Development and validation of the situational self-awareness scale. Consciousness and cognition, 10(3), 366-378.	-

				8	Do not know		
v_Cal_life	Categorical	Reflecting on life	I was reflective about my life	1 2 3 4 5 6 7 8	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree Do not know	Govern, J. M., & Marsch, L. A. (2001). Development and validation of the situational self-awareness scale. Consciousness and cognition, 10(3), 366-378.	-
v_Cal_thoughts	Categorical	Aware of inner thoughts	I was aware of my innermost thoughts	1 2 3 4 5 6 7 8	Strongly disagree Disagree Slightly disagree Neither agree nor disagree Slightly agree Agree Strongly agree Do not know	Govern, J. M., & Marsch, L. A. (2001). Development and validation of the situational self-awareness scale. Consciousness and cognition, 10(3), 366-378.	-

8.11 Additional items for Canada

Variable name	Variable class/type	Short description	Wording	Response options		Reference	Notes
CAN_env_change	Categorical	Visiting nature and thinking about climate change	Visiting nature makes me think about climate change and/or other threats to the environment	1 2	No, it does not Yes, it does	n/a	-
CAN_env_problems	Categorical	Talking with friends about environmental problems	I often talk with friends about problems related to the environment	1 2	No, I do not Yes, I do	Kaiser, F. G., & Wilson, M. (2000). Assessing People's General Ecological Behavior: A Cross-Cultural Measure. Journal of Applied Social Psychology, 30(5), 952-978	-
CAN_env_organization	Categorical	Membership of environmental organisation	I am a member (passive or active) in an environmental organization	1 2	No, I am not Yes, I am	Kaiser, F. G., & Wilson, M. (2000). Assessing People's General Ecological Behavior: A Cross-Cultural Measure. Journal of Applied Social Psychology, 30(5), 952-978	-
CAN_medicine	Categorical	Reuse of medicines	I bring unused medicine back to the pharmacy	1 2	No, I do not Yes, I do	Kaiser, F. G., & Wilson, M. (2000). Assessing People's General Ecological Behavior: A Cross-Cultural Measure. Journal of Applied Social Psychology, 30(5), 952-978	-
CAN_transport	Categorical	Public or active transport participation	When possible in nearby areas (around 20 km), I use public transportation or ride a bike	1 2	No, I do not Yes, I do	Kaiser, F. G., & Wilson, M. (2000). Assessing People's General Ecological Behavior: A Cross-Cultural Measure. Journal of Applied Social Psychology, 30(5), 952-978	-

CAN_organics	Categorical	Purchase of organic food	I buy organic vegetables and fruits	1 2	No, I do not Yes, I do	Kaiser, F. G., & Wilson, M. (2000). Assessing People's General Ecological Behavior: A Cross-Cultural Measure. Journal of Applied Social Psychology, 30(5), 952-978	-
CAN_shopping_bags	Categorical	Reusing shopping bags	I reuse my shopping bags	1 2	No, I do not Yes, I do	Kaiser, F. G., & Wilson, M. (2000). Assessing People's General Ecological Behavior: A Cross-Cultural Measure. Journal of Applied Social Psychology, 30(5), 952-978	-
CAN_environmentalist	Categorical	Environmentalist identity	I consider myself an environmentalist	1 2	No, I do not Yes, I do	Kaiser, F. G., & Wilson, M. (2000). Assessing People's General Ecological Behavior: A Cross-Cultural Measure. Journal of Applied Social Psychology, 30(5), 952-978	-
CAN_red_meat	Categorical	Red meat consumption	I eat red meat	1 2	No, I do not Yes, I do	Adapted from Kaiser, F. G., & Wilson, M. (2000). Assessing People's General Ecological Behavior: A Cross-Cultural Measure. Journal of Applied Social Psychology, 30(5), 952-978	-

8.12 Natural environment exposures

Variable name	Variable class/type	Short description	Detailed description	Reference	Notes
dist_coast_km	Numeric	Residential distance to nearest coastline	Euclidean (crow-flies) distance in decimal kilometres from the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) to the nearest coastline as defined by the Global Self-consistent Hierarchical High-resolution Geography shoreline database from the National Oceanic and Atmospheric Administration (https://www.ngdc.noaa.gov/mgg/shorelines/gshhs.html).	Wessel, P., and W. H. F. Smith (1996), A global, self-consistent, hierarchical, high-resolution shoreline database, J. Geophys. Res., 101(B4), 8741–8743, doi:10.1029/96JB00104.	Included for all participants in all countries with valid coordinates for home location. See the note at the foot of this table regarding excluded cases.
dist_river_km	Numeric	Residential distance to nearest river	Euclidean (crow-flies) distance in decimal kilometres from the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) to the nearest river as defined by the European catchments and Rivers network system (Ecrins) from the European Environment Agency.	European Environment Agency. 2012. European Catchments and Rivers Network System (ECRINS).	Included for all EU countries. See the note at the foot of this table regarding excluded cases.
dist_lake_km	Numeric	Residential distance to nearest lake	Euclidean (crow-flies) distance in decimal kilometres from the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) to the nearest lake as defined by the European catchments and Rivers network system (Ecrins) from the European Environment Agency.	European Environment Agency. 2012. European Catchments and Rivers Network System (ECRINS).	Included for all EU countries. See the note at the foot of this table regarding excluded cases.
tundra_300	Numeric	Amount of tundra in	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and	Jun, C., Ban, Y., & Li, S. (2014). China: Open	Included for all countries. In addition to the exclusions stated at the foot of this table, an

		300m residential radial buffer	"home_longitude" variables earlier) that can be classified as "tundra" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
cultivated_land_300	Numeric	Amount of cultivated land in 300m residential radial buffer	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "cultivated land" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
artificial_surfaces_300	Numeric	Amount of artificial surfaces in 300m residential radial buffer	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "artificial surfaces" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
forest_300	Numeric	Amount of forest in 300m residential radial buffer	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "forest" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
bareland_300	Numeric	Amount of bareland in 300m residential radial buffer	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "bareland" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
grassland_300	Numeric	Amount of grassland in 300m residential radial buffer	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "grassland" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
permanent_snow_and_ice_300	Numeric	Amount of permanent snow and ice in 300m residential radial buffer	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "permanent snow and ice" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.

shrubland_300	Numeric	Amount of shrubland in 300m residential radial buffer	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "shrubland" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
wetland_300	Numeric	Amount of wetland in 300m residential radial buffer	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "wetland" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
water_bodies_300	Numeric	Amount of water bodies in 300m residential radial buffer	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "water bodies" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
sea_300	Numeric	Amount of sea in 300m residential radial buffer	Square-kilometre coverage of 300m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "sea" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution. Sea was defined as any area of the buffer that did not contain data i.e. no land cover class.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
tundra_1000	Numeric	Amount of tundra in 1000m residential radial buffer	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "tundra" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
cultivated_land_1000	Numeric	Amount of cultivated land in 1000m residential radial buffer	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "cultivated land" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
artificial_surfaces_1000	Numeric	Amount of artificial surfaces in 1000m	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "artificial surfaces" as defined by GlobeLand30 database from	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514,	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the

		residential radial buffer	the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	434. https://doi.org/10.1038/514434c	GlobeLand30 tiles that were requested and thus do not have data for this variable.
forest_1000	Numeric	Amount of forest in 1000m residential radial buffer	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "forest" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
bareland_1000	Numeric	Amount of bareland in 1000m residential radial buffer	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "bareland" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
grassland_1000	Numeric	Amount of grassland in 1000m residential radial buffer	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "grassland" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
permanent_snow_and_ice_1000	Numeric	Amount of permanent snow and ice in 1000m residential radial buffer	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "permanent snow and ice" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
shrubland_1000	Numeric	Amount of shrubland in 1000m residential radial buffer	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "shrubland" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
wetland_1000	Numeric	Amount of wetland in 1000m residential radial buffer	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "wetland" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
water_bodies_1000	Numeric	Amount of water bodies in 1000m	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the

		residential radial buffer	"water bodies" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution.	cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	GlobeLand30 tiles that were requested and thus do not have data for this variable.
sea_1000	Numeric	Amount of sea in 1000m residential radial buffer	Square-kilometre coverage of 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) that can be classified as "sea" as defined by GlobeLand30 database from the National Geomatics Centre of China (http://www.globallandcover.com/GLC30Download/index.aspx). The data are in raster format at a 30m resolution. Sea was defined as any area of the buffer that did not contain data i.e. no land cover class.	Jun, C., Ban, Y., & Li, S. (2014). China: Open access to Earth land-cover map. Nature, 514, 434. https://doi.org/10.1038/514434c	Included for all countries. In addition to the exclusions stated at the foot of this table, an additional 70 cases fell outside of the GlobeLand30 tiles that were requested and thus do not have data for this variable.
ndvi_250_0	Numeric	Greenness in 250m residential radial buffer (highest accuracy)	Amount of photosynthesised vegetation in 250m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) as defined by the Normalised Difference Vegetation Index taken from MODIS Terra satellite imagery (https://modis.gsfc.nasa.gov/). This variable represents the highest accuracy images available under the study period (if NA, consider using the second-highest accuracy "ndvi_250_1"). Values range from -1 to 1. In general terms, very low values of NDVI (0.1 and below) correspond to barren areas of rock, sand, water or snow. Moderate values (0.2–0.3) represent shrubs and grassland, while high values (0.6–0.8) indicate temperate and tropical rainforests (https://earthobservatory.nasa.gov/features/MeasuringVegetation).	Didan, K. (2015). MOD13Q1 MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid V006 [Data set]. NASA EOSDIS LP DAAC. doi: 10.5067/MODIS/MOD13Q1.006	Included for all countries. See the note at the foot of this table regarding excluded cases. A further 1,426 respondents did not have good enough quality imagery (see "ndvi_250_1").
ndvi_250_1	Numeric	Greenness in 250m residential radial buffer (second-highest accuracy)	Amount of photosynthesised vegetation in 250m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) as defined by the Normalised Difference Vegetation Index taken from MODIS Terra satellite imagery (https://modis.gsfc.nasa.gov/). This variable represents the second-highest accuracy images available under the study period (but highest accuracy ("ndvi_250_0") should always be used when available). Values range from -1 to 1. In general terms, very low values of NDVI (0.1 and below) correspond to barren areas of rock, sand, water or snow. Moderate values (0.2–0.3) represent shrubs and grassland, while high values (0.6–0.8) indicate temperate and tropical rainforests (https://earthobservatory.nasa.gov/features/MeasuringVegetation).	Didan, K. (2015). MOD13Q1 MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid V006 [Data set]. NASA EOSDIS LP DAAC. doi: 10.5067/MODIS/MOD13Q1.006	Included for all countries. See the note at the foot of this table regarding excluded cases. A further 37 respondents did not have good enough quality imagery (and thus do not have a value for either ndvi_250_0 or this variable).
ndvi_1000_0	Numeric	Greenness in 1000m residential	Amount of photosynthesised vegetation in 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) as	Didan, K. (2015). MOD13Q1 MODIS/Terra Vegetation Indices 16-Day	Included for all countries. See the note at the foot of this table regarding excluded cases. A further 1,478 respondents did not

		radial buffer (highest accuracy)	defined by the Normalised Difference Vegetation Index taken from MODIS Terra satellite imagery (https://modis.gsfc.nasa.gov/). This variable represents the highest accuracy images available under the study period (if NA, consider using the second-highest accuracy "ndvi_1000_1"). Values range from -1 to 1. In general terms, very low values of NDVI (0.1 and below) correspond to barren areas of rock, sand, water or snow. Moderate values (0.2–0.3) represent shrubs and grassland, while high values (0.6–0.8) indicate temperate and tropical rainforests (https://earthobservatory.nasa.gov/features/MeasuringVegetation).	L3 Global 250m SIN Grid V006 [Data set]. NASA EOSDIS LP DAAC. doi: 10.5067/MODIS/MOD13Q1.006	have good enough quality imagery (see "ndvi_1000_1").
ndvi_1000_1	Numeric	Greenness in 1000m residential radial buffer (second-highest accuracy)	Amount of photosynthesised vegetation in 1000m radial buffer of the respondent's home location (as stated in "home_latitude" and "home_longitude" variables earlier) as defined by the Normalised Difference Vegetation Index taken from MODIS Terra satellite imagery (https://modis.gsfc.nasa.gov/). This variable represents the second-highest accuracy images available under the study period (but highest accuracy ("ndvi_1000_0") should always be used when available). Values range from -1 to 1. In general terms, very low values of NDVI (0.1 and below) correspond to barren areas of rock, sand, water or snow. Moderate values (0.2–0.3) represent shrubs and grassland, while high values (0.6–0.8) indicate temperate and tropical rainforests (https://earthobservatory.nasa.gov/features/MeasuringVegetation).	Didan, K. (2015). MOD13Q1 MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid V006 [Data set]. NASA EOSDIS LP DAAC. doi: 10.5067/MODIS/MOD13Q1.006	Included for all countries. See the note at the foot of this table regarding excluded cases. All remaining respondents had good enough quality imagery for this variable.
nmodis_250_0	Numeric	Number of images used to produce ndvi_250_0	Amount of MODIS imagery used to compute the metric in "ndvi_250_0"	-	See "ndvi_250_0".
nmodis_250_1	Numeric	Number of images used to produce ndvi_250_1	Amount of MODIS imagery used to compute the metric in "ndvi_250_1"	-	See "ndvi_250_1".
nmodis_1000_0	Numeric	Number of images used to produce ndvi_1000_0	Amount of MODIS imagery used to compute the metric in "ndvi_1000_0"	-	See "ndvi_1000_0".
nmodis_1000_1	Numeric	Number of images used to produce ndvi_1000_1	Amount of MODIS imagery used to compute the metric in "ndvi_1000_1"	-	See "ndvi_1000_1".
pop_dens_1km	Numeric	Population density	Estimated population density taken from the Gridded Population of the World, Version 4 (GPWv4). Units are number of people per square kilometre based on counts	Center for International Earth Science Information Network - CIESIN -	Note NAs are people with missing home geolocations. Values which equal -9999 indicate people whose home geolocations

	consistent with national censuses and population registers with respect to relative spatial distribution, but adjusted to match the 2015 Revision of the United Nation's World Population Prospects (UN WPP) country totals. A proportional allocation gridding algorithm, utilising approximately 13.5 million national and sub-national administrative units (for the whole world, not just the countries herein), was used to assign UN WPP-adjusted population counts to 30 arc-second grid cells. The density rasters were created by dividing the UN WPP-adjusted population count raster for a given target year by the land area raster. The data files were produced as global rasters at 30 arc-second (~1 km at the equator) resolution. Assigned using "home_latitude" and "home_longitude" variables earlier.	Columbia University. 2017. Gridded Population of the World, Version 4 (GPWv4): Population Density Adjusted to Match 2015 Revision UN WPP Country Totals, Revision 10. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H4 9884ZR.	fall outside of the GPWv4 dataset (e.g. because they indicated they lived in the sea or in an exceedingly sparsely populated or uninhabited area; such cases could be considered "rural" in an urban/rural classification). Forthcoming GPWv4 datasets will include urban/rural classifications based on national definitions which will be considered for inclusion here in the future.

N.B Respondents stating that their home location was further than 55m from the coastline (defined by this same data source) were excluded from all of the above natural environment exposure assessment variables. Home location coordinates were rounded to three decimal places for confidentiality reasons and thus there is a margin for error, for example, where a respondent marked a home location on land but due to rounding it appears their home is in the sea. Investigation of how much error this rounding could cause was conducted for Spain, United Kingdom, Hong Kong, and Australia by drawing a 0.0005 degree buffer around the coastline. This equated to approximately 55m latitudinal distance but varied more considerably for longitudinal distance (32 to 52m). A 55m buffer was therefore chosen as it could include most cases where rounding had caused a misclassification of a home location that was originally indicated to be on land.

8.13 Flag variables

Variable name	Variable class/type	Description	Response options	Notes
flag_visitor	Categorical	Indicates whether respondent made a visit or not. Specifically, whether the respondent gave any response to any question represented by variables prefixed with "v_" (section 2.5, section 2.6, or section 2.10).	1=Visitor 2=Non-visitor	
flag_homes	Categorical	Indicates whether a respondent moved the marker from its default location when selecting their home location (from "home_latitude" and "home_longitude" variables). "Reliable" indicates those that did and "unreliable" indicates those that did not.	1=Reliable 2=Unreliable	NAs are people who had no geolocated home location. "Unreliable" also includes those with home coordinates marked as 0.000,0.000.
flag_start_point	Categorical	Indicates whether a respondent moved the marker from its default location when selecting the location of the start point of their visit (from "v_visit_lat" and "v_visit_lon" variables). "Reliable" indicates those that did and "unreliable" indicates those that did not.	1=Reliable 2=Unreliable	NAs are people who had no geolocated start point location. "Unreliable" also includes those with start point coordinates marked as 0.000,0.000.
flag_visit_geolocation	Categorical	Indicates whether a respondent moved the marker from its default location when	1=Reliable 2=Unreliable	NAs are people who had no geolocated visit location.

		selecting their visit location (from "v_visit_lat" and "v_visit_lon" variables). "Reliable" indicates those that did and "unreliable" indicates those who did not move it from the default location *and* those who did not move it from the location selected as their start point (from "v_start_lat" and "v_start_lon").		"Unreliable" also includes those with visit coordinates marked as 0.000,0.000.
flag_times	Categorical	Indicates whether the respondent's survey duration was inordinately quick/slow or not. Specifically the top and bottom 1% of responses (inclusive) were marked as too quick/slow ("exclude") and everyone else was marked as "include".	1=Include 2=Exclude	Exclusions were based on the whole sample and not individual countries. Mean/standard deviation-based (e.g. Malhotra, N. (2008). Completion Time and Response Order Effects in Web Surveys. Public Opinion Quarterly, 72(5), 914–934. https://doi.org/10.1093/poq/nfn050) or more robust median-based (Leys, C., Ley, C., Klein, O., Bernard, P., & Licata, L. (2013). Detecting outliers: Do not use standard deviation around the mean, use absolute deviation around the median. Journal of Experimental Social Psychology, 49(4), 764–766. https://doi.org/10.1016/j.jesp.2013.03.013) statistical methods of excluding people based on response times are also possible but users should note that these could result in considerable data loss which may nevertheless be reliable data. In addition a median absolute deviation method, dependent on rejection criteria (i.e. how many absolute deviations you select as a cutoff), may not detect anyone who was "too quick".
flag_straightliner	Categorical	Indicates "straightliners" and therefore potentially inattentive respondents. More specifically, we assumed that where respondents answered 10 and 10 or 0 and 0 to the questions "happy_yday" and "anxiety_yday", since these were asked so early on in the survey and should yield very different responses, these people could be considered "straightliners".	1=Include 2=Exclude	NAs indicate people who did not answer either or both of these questions (Hong Kong respondents could skip these questions if they wished).
flag_bareland	Categorical	The GlobeLand30 class "bareland" was designed to capture areas dominated by rock or desert. As a consequence of this, many beach areas are classified as "bareland". Using coastal proximity data, this variable was created to identify cases where "bareland" surrounding the respondent's home location is most likely beach rather than rock, desert, or another land cover.	1=Bareland Coastal	All other cases are marked NA.
flag_manual_region	Categorical	Some cases were not automatically assigned a region of residence based on panellist sign-up information. With such	1=Not manual 2=Manual	Where NAs still exist for the variable "region" this indicates that (a) a region was not automatically assigned, and (b) the given home location was either (i) not recorded, or (ii) outside of the country in

		cases, their given home locations were checked manually and assigned a region of residence. This variable distinguishes regions that were checked manually from those which were not.		which the panellist was registered. Human error is of course still possible
flag_homes_incongruent	Categorical	This variable indicates cases where the home location provided by the respondent falls outside of the country in which they are a registered panellist.	1=Congruent 2=Incongruent	This variable was manually made by checking the IDs of cases on a country-by-country basis. Care was taken to ensure the home location could not have been assigned beyond the border of a country due to coordinate rounding in earlier variables (see v_start_lat, v_start_lon, home_latitude, and home_longitude variables). Human error is of course still possible.

8.14 Summary variables of objective and subjective natural environment, population density, and air pollution exposures

Variable name	Variable class/type	Category levels	Detailed description	Notes
green_space_300_pct	Numeric	n/a	Percentage of 300m radial residential buffer occupied by the GlobeLand30 land cover classes cultivated land, forest, shrubland, and grassland	See section 2.12
green_space_1000_pct	Numeric	n/a	Percentage of 1000m radial residential buffer occupied by the GlobeLand30 land cover classes cultivated land, forest, shrubland, and grassland	See section 2.12
green_space_300_3cats	Categorical	1=0% 2=0% to <25% 3=≥25% to 100%	The variable green_space_300_pct categorised into potentially useful groupings.	See section 2.12
green_space_1000_3cats	Categorical	1=0% 2=0% to <25% 3=≥25% to 100%	The variable green_space_1000_pct categorised into potentially useful groupings.	See section 2.12
freshwater_300_pct	Numeric	n/a	Percentage of 300m radial residential buffer occupied by the GlobeLand30 land cover classes water bodies and wetlands.	See section 2.12
freshwater_1000_pct	Numeric	n/a	Percentage of 1000m radial residential buffer occupied by the GlobeLand30 land cover classes water bodies and wetlands.	See section 2.12
freshwater_300_2cats	Numeric	1=None 2=Some	The variable freshwater_300_pct categorised into potentially useful groupings (dichotomised like this due to high number of zeros).	See section 2.12
freshwater_1000_2cats	Numeric	1=None 2=Some	The variable freshwater_1000_pct categorised into potentially useful groupings (dichotomised like this due to high number of zeros).	See section 2.12
coast_prox_cats	Categorical	1=0-1km 2=>1-5km 3=>5-25km 4=>25-50km 5=>50ikm	The variable dist_coast_km categorised into potentially useful groupings (based on distance-decay effects which are the subject of a manuscript in preparation using these data).	See section 2.12

lake_prox_cats	Categorical	1=0-1km 2=>1-5km 3=>5km	The variable dist_lake_km categorised into potentially useful groupings (based on distance-decay effects which are the subject of a manuscript in preparation using these data).	See section 2.12
river_prox_cats	Categorical	1=0-1km 2=>1-2.5km 3=>2.5km	The variable dist_river_km categorised into potentially useful groupings groupings (based on distance-decay effects which are the subject of a manuscript in preparation using these data).	See section 2.12
blue_weekly	Categorical	1=No 2=Yes	Whether the respondent indicated that they had visited a blue space at least weekly during the last four weeks	Constructed by dichotomising responses to all blue space items in section 2.3
coast_weekly	Categorical	1=No 2=Yes	Whether the respondent indicated that they had visited a coastal blue space at least weekly during the last four weeks	Constructed by dichotomising responses to all coastal blue space items (esplanade, pier, harbour, beach, rocky shore, cliff, lagoon, open sea) in section 2.3
inland_weekly	Categorical	1=No 2=Yes	Whether the respondent indicated that they had visited an inland blue space at least weekly during the last four weeks	Constructed by dichotomising responses to all inland blue space items (fountain, urban river, pool, ice rink, pond, lake, rural river, waterfall, wetland) in section 2.3
green_weekly	Categorical	1=No 2=Yes	Whether the respondent indicated that they had visited a green space at least weekly during the last four weeks	Constructed by dichotomising responses to all green space items (local park, large park, community garden, playground, cemetery, botanical garden or zoo, woodland, farmland, meadow, mountain, moorland, country park) in section 2.3
blue_monthly	Categorical	1=No 2=Yes	Whether the respondent indicated that they had visited a blue space at least once during the last four weeks	Constructed by dichotomising responses to all blue space items in section 2.3
coast_monthly	Categorical	1=No 2=Yes	Whether the respondent indicated that they had visited a coastal blue space at least once during the last four weeks	Constructed by dichotomising responses to all coastal blue space items (esplanade, pier, harbour, beach, rocky shore, cliff, lagoon, open sea) in section 2.3
inland_monthly	Categorical	1=No 2=Yes	Whether the respondent indicated that they had visited an inland blue space at least once during the last four weeks	Constructed by dichotomising responses to all inland blue space items (fountain, urban river, pool, ice rink, pond, lake, rural river, waterfall, wetland) in section 2.3
green_monthly	Categorical	1=No 2=Yes	Whether the respondent indicated that they had visited a green space at least once during the last four weeks	Constructed by dichotomising responses to all green space items (local park, large park, community garden, playground, cemetery, botanical garden or zoo, woodland, farmland, meadow, mountain, moorland, country park) in section 2.3
urban	Categorical	1=Urban 2=Rural	Whether the respondent lives in an urban or rural area based on a cut-off of whether their home location was in an area of greater than 150 people per km^2 (see pop_dens_1km for the origin of these data). This threshold is consistent with a threshold used in Germany (Dijkstra, L., & Poelman, H. (2014). A harmonised definition of cities and rural areas: The new degree of urbanisation (No. WP 01/2014; p. 28). Retrieved from European Commission website: https://ec.europa.eu/regional_policy/sources/docgener/work/2014_01_new_urban.pdf)	See pop_dens_1km variable

home_pm2.5	Numeric	n/a	Modelled median concentration of airborne particulate matter with a diameter of 2.5 micrometres or less at the given home location of the respondent. Estimates are modelled at ground level at a resolution of 0.1° x 0.1° (approximately 11km x 11km at the equator) for the year 2016.	Taken from the DIMAQ project - https://www.who.int/airpollution/data/modelled-estimates/en/
v_pm2.5	Numeric	n/a	Modelled median concentration of airborne particulate matter with a diameter of 2.5 micrometres or less at the given visit location of the respondent. Estimates are modelled at ground level at a resolution of 0.1° x 0.1° (approximately 11km x 11km at the equator) for the year 2016.	Taken from the DIMAQ project - https://www.who.int/airpollution/data/modelled-estimates/en/