

Extended Abstract for European Population Conference (EPC)

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Title: Socioeconomic, Lifestyle, and Environmental Determinants of Life Satisfaction in the United Kingdom: Evidence from the UK Household Longitudinal Study (2009–2019)

Short Abstract

Life satisfaction is an important measure of people's well-being and health, influenced by socioeconomic, environmental, and lifestyle factors shaping daily life. This paper investigates socioeconomic (e.g., ethnicity, marital status, number of children, income, occupation, sex, age, education, housing tenure), lifestyle (e.g., body mass index, exercise, alcohol consumption, eating habits, smoking), and environmental (e.g., air pollution, weather, urban-rural, access to green spaces) determinants of life satisfaction in the UK. We use the UK Household Longitudinal Study data for waves 1–10 (N = 75,891; 2009–2019) and apply ordinal multilevel mixed-effects modelling. Higher life satisfaction was associated with being married or in a couple, higher income satisfaction, retirement, having children, good physical and mental health, and being non-smokers. Income satisfaction was the strongest predictor. Ethnic minorities—particularly Indian and mixed ethnic groups—and individuals in management and professional occupations reported lower life satisfaction. Environmentally, exposure to NO₂ pollution above EU limits and higher temperatures were linked to lower life satisfaction, while rural residence, increased sunshine, and greater park availability related to higher satisfaction. Life satisfaction declined significantly over time, reaching its lowest point in 2019. Lifestyle factors, including physical activity and vegetable consumption, showed positive associations. These findings highlight that whilst socioeconomic and health factors remain dominant determinants, environmental quality and lifestyle behaviours provide complementary pathways to enhancing population well-being and life satisfaction, with implications for public health and urban planning.

Keywords: Life Satisfaction, socioeconomic, environment, lifestyle, UK.

Extended abstract:

1. Introduction

Life satisfaction (LS) is an important measure of peoples' well-being, which is studied extensively by researchers in the fields of environmental health, economics, and impact assessments (1-3). LS is affected by several factors related to the individuals' age, gender, income, education, ethnicity, marital status, socioeconomic position, type of occupation, general health, lifestyle arrangements, and the quality of the surrounding physical environment (4-8). Recently, more emphasis is being placed on the effects of the physical environment (e.g., air quality and pollution, climatic factors, noise, green spaces, and neighbourhood and housing conditions) on well-being related factors such as LS, happiness, subjective well-being, and self-reported mental health (1, 4, 9-15). Despite the availability of literature regarding life satisfaction and well-being, the integration of social, economic, lifestyle and environmental determinants within the same study design is still lacking. Additionally, research that incorporates both subjective and objective determinants of life satisfaction is also limited. For example, perceived income satisfaction might impact life satisfaction differently than the more objective measure of net income.

In this study, we aim to gain a holistic overview of the individual's life satisfaction by assessing the socioeconomic (e.g., ethnicity, marital status, number of children, income, occupation, sex, age, education, and housing tenure), lifestyle (e.g., body mass index, exercise, alcohol consumption, eating habits, and smoking), and environmental (e.g., air pollution, weather factors, urban-rural, and access/availability of green spaces) determinants of life satisfaction in the UK. The study follows the conceptual framework presented in Figure 1 below.

2. Methods

We utilise data from the UK Household Longitudinal Study (UKHLS) for waves 1 to 10, covering the years of 2009 up to 2019. The UKHLS data comprises approximately 40,000 households from the UK and includes variables on the individuals' socio-demographic attributes like gender, age, marital status, education, occupation, socioeconomic classification, perceived financial situation, income, housing tenure, ethnicity, and country of birth. It also includes information on the individual's general health, well-being, life satisfaction, smoking status, alcohol consumption, exercise, body mass index, and eating habits. The UKHLS data also includes geography variables such as the census lower super output areas (LSOAs) of residence, which allow for the linkages of area-level variables including air pollution, weather variables, and accessibility/availability of green spaces.

The original sample of UKHLS for waves 1 to 10 included a total of 444,181 yearly observations. After dropping some observations due to missing data (Figure 2), we were left with a total of 373,431 yearly observations from 75,891 individuals.

Figure 1. A conceptual framework for the socioeconomic, lifestyle, and environmental determinants of life satisfaction

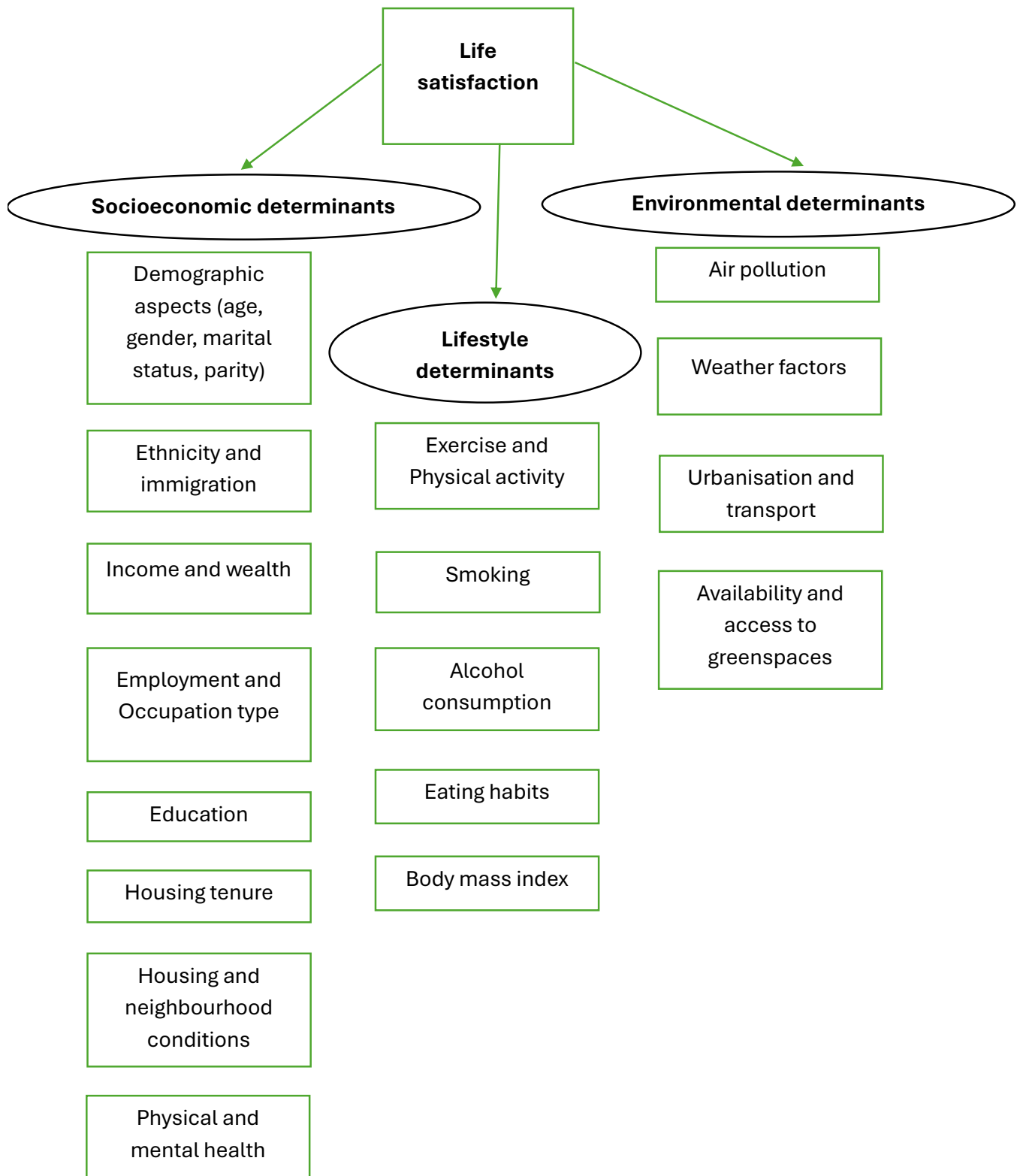
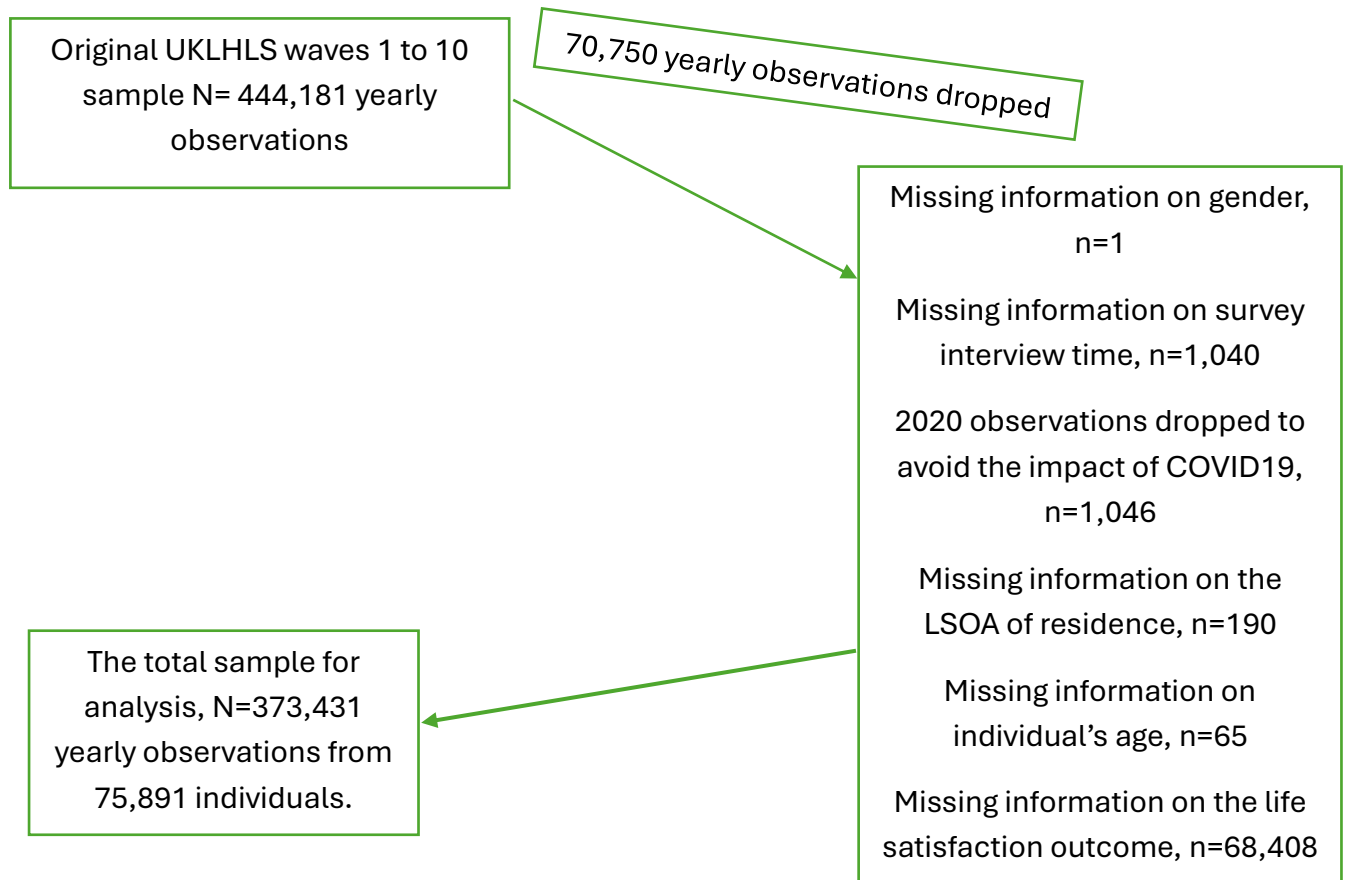


Figure 2. Dropping observations from the UKHLS waves 1 to 10 dataset due to missing information



2.1. Study variables

The main outcome in this study is individual's reported self-satisfaction that is measured on a 7-point Likert scale ranging from completely dissatisfied to completely satisfied. Our study also included several socioeconomic, lifestyle and environmental factors.

The socioeconomic variables included sex, age, calendar year dummies representing the year of the survey interviews, country of residence (i.e., England, WALES, Scotland, and Northern Ireland), marital status, number of children, ethnicity, country of birth (i.e., being born in the UK versus not), net income, income satisfaction, occupation type, highest educational level, housing tenure, how is the external condition of the address relative to other residences, whether trash or litter is observed on the street/road near the place of residence, limiting long-term illness, self-reported general health, and self-reported mental health via the General Health Questionnaire (GHQ12) scale. For the GHQ12 scales, it is composed of 12 questions about the individuals' experience of 12 symptoms related to mental well-being in the past few weeks preceding data collection date. The 12 questions are: 1) Ability to concentrate; 2) Losing much sleep; 3) Playing a useful part; 4)

Capability of taking decisions; 5) Being under stress; 6) Inability to overcome difficulties; 7) Enjoying normal activities; 8) Being able to face up problems; 9) Feeling unhappy and depressed; 10) Losing confidence; 11) Thinking of self as worthless; and 12) Feeling reasonably happy. Individuals are then asked to rate the negative questions as 0 = 'not at all', 1 = 'no more than usual', 2 = 'rather more than usual', 3 = 'much more than usual' and the positive questions as 0 = 'better than usual', 1 = 'same as usual', 2 = 'less than usual', and 3 = 'much less than usual'. Then a Likert scale summative score is constructed by adding up all the 12 items of the GHQ12 scale resulting in a total mental well-being score ranging from 0 to 36 with higher scores indicating poorer mental well-being. For this study, and following relevant literature, we further dichotomised the GHQ12 scale based on one cut off point of greater than or equal to 12 as an indication of poor mental well-being.

The lifestyle variables included smoking and alcohol consumption as well as eating habits (waves 2, 5, 7, and 9), sports activity (waves 2 and 5), and body mass index (BMI; wave 1) but only for specific waves of the UKHLS data.

Finally, the environmental factors included air pollution (nitrogen dioxide NO₂, and particulate matter with a diameter of less than or equal to 5 µm PM_{2.5} at a 1 km spatial resolution from the Department for Environment, Food and Rural Affairs), weather conditions (annual mean temperature in °c, annual mean of hours with bright sunshine, annual mean wind speed at 10 m above ground level in m/s, and annual mean of rainfall in mm at a 5 km spatial resolution from the MetOffice), the presence of heavy traffic on street/road near the place of residence, living in rural versus urban area, and the 2020 availability/accessibility to green spaces in England, Wales, and Scotland in terms of the average distance to the nearest park in meters, average number of public parks within 1000 m radius, and average combined size of parks within 1000 m radius in meter squared. The environmental variables of air pollution, weather conditions, and availability/accessibility to green spaces were linked to the individual-level UKHLS survey for each year between 2009 and 2019 using the LSOA of residence for each individual.

2.2. Data analysis

Life satisfaction and the socioeconomic, lifestyle and environmental determinants of life satisfaction were described using frequencies and percentages for each wave of the UKHLS data. Multilevel mixed-effects ordinal logistic regression was applied to examine the determinants of life satisfaction in a stepwise manner. Model 1 is a simple model including only age, gender, country of residence, and calendar year dummies. Model 2 includes additionally marital status, number of children, ethnicity, country of birth, net income, income satisfaction, occupation type, education, housing tenure, the situation of the house compared to the neighbourhood, presence of trash and litter on the streets, limiting long-term illness, self-reported general health, and mental well-being GHQ12. Model 3 includes additionally the lifestyle variables of smoking and alcohol and in a

sensitivity analysis for only waves 2 and 5 we include sports activity, for waves 2, 5, 7, and 9 we include fruits and vegetables eating habits, and for wave 1 we include BMI. Finally, model 4 includes the environmental factors of air pollution, weather conditions, presence of heavy traffic on the street next to the place of residence, rural-urban indicator, and the accessibility/availability of green spaces. Model 5 is the same as model 4 but it excludes the variables of accessibility/availability of green spaces for broader geographical coverage because the greenspace variables are only available for England, Wales and Scotland but not for Northern Ireland.

STATA software was used for statistical analysis and R studio was used for the spatial pre-processing of air pollution, weather conditions, and green space data, so that this data is linked to the LSOAs in the UK for each year between 2009 and 2019. Odd ratios (ORs) and 95% confidence (CIs) were used to report the study findings. Statistical significance was considered at a P-value of less than 0.05.

3. Results

Appendix Table 1 shows the descriptive statistics of the life satisfaction outcome and its socioeconomic, lifestyle and environmental determinants for a total of 373,431 yearly observations from 75,891 individuals for each of the 10 waves of the UKHLS data. Most of individuals were somewhat or mostly satisfied with their life. For the socioeconomic factors in all the 10 waves, the majority were females, belonged to the middle age groups, resided in England, were married, had zero children, were British white, born in the UK, somewhat or mostly satisfied with their income, earned on average £1500 of net income, worked in management and professional occupations, had a university or high school education, owned their house with mortgage, had no street litter, their house was of similar conditions to the neighbourhood houses, did not have limiting long-term illness, reported very good or good health, and had good mental well-being GHQ12 score. For the lifestyle factors, in all the 10 waves, the majority were non-smokers, occasionally had an alcoholic drink, had no to little sports activity, consumed fruits and vegetables every day, and were in the healthy or overweight BMI category. As for the environmental factors, in all the 10 waves, most of the individuals were exposed to NO₂ pollution levels below the European commission standard of 20 µg/m³ while they were exposed to PM2.5 pollution levels above the European commission standard of 10 µg/m³. Most of the individuals did not report heavy road traffic next to their house, lived in an urban area, were exposed to about 10 °c of average annual temperature, 1,560 hours of average sunshine, 4 m/s of annual wind speed, and 900 mm of average annual rainfall. The distance to the nearest park was about 400 m, the number of parks/public spaces within 1000 m radius was about 4, and the combined size of parks within 1000 m radius was about 380,000 m².

Table 1 shows the results of the socioeconomic, lifestyle, and environmental determinants of life satisfaction.

Socioeconomic Determinants: The baseline model (Model 1), adjusted for age, sex, interview calendar year dummies, and country, revealed significant demographic patterns in life satisfaction. Compared to those aged 16-20, younger and middle-aged adults (21-60 years) reported significantly lower odds of higher life satisfaction, with the strongest negative association observed among those aged 41-45 (OR: 0.45, 95% CI: 0.43-0.47). However, adults over 70 showed higher odds of life satisfaction (OR: 1.11, 95% CI: 1.06-1.17) – meaning they were more satisfied with life. Life satisfaction declined significantly over time, with each subsequent year from 2010 onwards showing lower odds compared to 2009, reaching the lowest point in 2019 (OR: 0.62, 95% CI: 0.59-0.64). When socioeconomic variables were introduced in Model 2, several key determinants emerged. Being married (OR: 1.52, 95% CI: 1.48-1.57) or living as a couple (OR: 1.42, 95% CI: 1.37-1.47) was strongly associated with higher life satisfaction compared to being single. Income satisfaction showed the strongest association with life satisfaction, with those completely satisfied with their income having substantially higher odds (OR: 1.69, 95% CI: 1.61-1.78) compared to those completely dissatisfied. Retired individuals reported higher life satisfaction than those in intermediate occupations (OR: 1.36, 95% CI: 1.30-1.42), while those in management and professional roles had lower odds of life satisfaction (OR: 0.90, 95% CI: 0.87-0.92). Health emerged as a critical determinant, with those reporting poor general health having dramatically lower odds of life satisfaction (OR: 0.17, 95% CI: 0.16-0.18) compared to those in excellent health, and poor mental wellbeing was strongly associated with lower life satisfaction (OR: 0.30, 95% CI: 0.29-0.30). Ethnic minorities, particularly those of Indian (OR: 0.89, 95% CI: 0.83-0.94) and mixed ethnicities (OR: 0.86, 95% CI: 0.79-0.93), reported lower odds of life satisfaction compared to British white individuals.

Lifestyle Factors: Model 3 incorporated lifestyle behaviours, revealing modest but significant associations with life satisfaction. Current smokers had 8% lower odds of higher life satisfaction compared to non-smokers (OR: 0.92, 95% CI: 0.90-0.94). Alcohol consumption showed no significant association with life satisfaction across different frequency categories, suggesting that drinking patterns—whether occasional, 1-2 days per week, or 3+ days per week—did not substantially differ from never drinking in their relationship with life satisfaction. The introduction of lifestyle factors had minimal impact on the effect sizes of socioeconomic variables from Model 2, with most odds ratios remaining stable. Income satisfaction continued to demonstrate the strongest association with life satisfaction, and the protective effects of being married or in a couple relationship persisted. Health variables maintained their strong associations, with both physical and mental health remaining critical determinants.

Environmental Determinants: The fully adjusted environmental model (Model 4) and the model excluding greenspace variables for broader geographic coverage (Model 5) revealed that environmental factors made modest but meaningful contributions to life satisfaction. Air quality showed a small but significant association, with exposure to NO₂

levels above EU limits being associated with 4% lower odds of higher life satisfaction (OR: 0.96, 95% CI: 0.94-0.99 in Model 4; OR: 0.97, 95% CI: 0.94-0.99 in Model 5). PM2.5 pollution showed no significant association. Weather conditions had small effects, with higher temperatures being associated with slightly lower life satisfaction (OR: 0.97, 95% CI: 0.95-0.99) and increased sunshine marginally associated with higher life satisfaction (OR: 1.00, 95% CI: 1.00-1.00). Living in rural areas was associated with 5% higher odds of life satisfaction compared to urban areas in Model 4 (OR: 1.05, 95% CI: 1.02-1.08) and 4% higher in Model 5 (OR: 1.04, 95% CI: 1.01-1.06). The number of parks and public spaces showed a small positive association (OR: 1.01, 95% CI: 1.00-1.01), though distance to parks and combined park size were not significant. Importantly, the addition of environmental variables did not substantially alter the strong associations observed for socioeconomic and health factors in earlier models. Income satisfaction, marital status, health status, and mental wellbeing remained the dominant predictors of life satisfaction, while the temporal decline in life satisfaction across years persisted, suggesting that environmental factors operate alongside rather than through these established socioeconomic and health pathways.

Sensitivity analysis: Adjusting the models further for sports activity for waves 2 and 5 revealed a strong significant association between more physical activity and higher level of life satisfaction (OR=1.08; 95% CI=1.04-1.12 for moderate compared to no/low sports activity and OR=1.20; 95%CI=1.15-1.26 for high compared to no/low sports activity). Adding eating habits such as the frequency of eating fruits and vegetables for waves 2, 5, 7, and 9 also showed a strong association between the frequency of eating vegetables and life satisfaction but not between the frequency of eating fruits and life satisfaction. Specifically, never eating compared to eating one to 3 days of the week vegetables was associated with lower odds of life satisfaction (OR=0.88; 95%CI=0.81-0.95) whereas eating vegetables every day of the week was associated with higher odds of life satisfaction (OR=1.08; 95%CI=1.04-1.11). Finally, the addition of BMI for wave 1 showed that those who are underweight are less satisfied with life compared to those with a healthy weight range (OR=0.84; 95%CI=0.75-0.95) and that those who have overweight (OR=1.05; 95%CI=1.01-1.10) or obese (OR=1.08; 95%CI=1.02-1.14) BMI are more satisfied with life than those with a healthy weight.

4. Concluding discussion

In this study, we investigated comprehensively the socioeconomic, lifestyle, and environmental determinants of life satisfaction in the UK by utilising the UKHLS data for waves 1 to 10, covering the time range between 2009 and 2019. Our findings demonstrated that while socioeconomic and health factors remain the dominant predictors of life satisfaction, lifestyle factors and environmental conditions can also contribute to the individual's life satisfaction. Among the socioeconomic determinants, the strongest association was found between income satisfaction and life satisfaction,

which highlights the importance of perceived financial security, rather than absolute income levels with respect to life satisfaction and well-being. Similarly, the protective effects of being married or in a couple relationship, along with the critical importance of both physical and mental health, highlight that life satisfaction is fundamentally rooted in social connectedness and health. The temporal decline in life satisfaction across the study period, with odds ratios decreasing progressively between 2009 and 2019, raises important questions about societal changes during this decade, potentially reflecting the impacts of economic austerity, political uncertainty (e.g., Brexit), and evolving social conditions in the UK. Our lifestyle findings reveal that health behaviours such as smoking, physical activity, and vegetable consumption are significantly associated with life satisfaction, suggesting that public health interventions promoting healthy lifestyles may yield wellbeing benefits beyond physical health. The environmental determinants, though modest in magnitude, are nonetheless significant and policy-relevant: exposure to NO₂ pollution above EU limits, higher temperatures, and urban residence were associated with lower life satisfaction, while increased sunshine, rural living, and proximity to parks showed positive associations. These findings suggest that environmental quality and urban planning decisions have tangible implications for population wellbeing. The persistence of strong socioeconomic and health associations even after accounting for environmental factors indicates that addressing health inequalities and financial insecurity should remain policy priorities, while environmental improvements may offer complementary pathways to enhancing population life satisfaction. Future research should explore the mechanisms through which environmental factors influence wellbeing, examine potential effect modifications by socioeconomic status, and investigate whether the observed temporal decline in life satisfaction has continued beyond 2019, specifically, comparing it to post-COVID19 pandemic era.

Table 1. Multilevel ordinal logistic regression for the association between life satisfaction and socioeconomic, lifestyle, and environmental factors

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	OR [95%CI]	OR [95%CI]	OR [95%CI]	OR [95%CI]	OR [95%CI]
Gender (ref: Male)					
Female	1.01 [0.98, 1.04]	1.14 [1.11, 1.17]**	1.13 [1.11, 1.16]**	1.13 [1.11, 1.16]**	1.13 [1.11, 1.16]**
Age (ref: 16-20)					
21-25	0.60 [0.57, 0.62]**	0.88 [0.84, 0.92]**	0.89 [0.85, 0.93]**	0.89 [0.85, 0.93]**	0.89 [0.85, 0.93]**
26-30	0.57 [0.54, 0.60]**	0.84 [0.80, 0.89]**	0.85 [0.81, 0.89]**	0.85 [0.81, 0.90]**	0.85 [0.81, 0.90]**
31-35	0.55 [0.52, 0.57]**	0.79 [0.74, 0.83]**	0.80 [0.75, 0.84]**	0.80 [0.76, 0.84]**	0.80 [0.76, 0.84]**
36-40	0.48 [0.46, 0.50]**	0.70 [0.66, 0.74]**	0.71 [0.67, 0.75]**	0.71 [0.67, 0.75]**	0.71 [0.67, 0.75]**
41-45	0.45 [0.43, 0.47]**	0.68 [0.65, 0.72]**	0.69 [0.65, 0.73]**	0.69 [0.65, 0.73]**	0.69 [0.65, 0.73]**
46-50	0.44 [0.42, 0.46]**	0.68 [0.64, 0.71]**	0.68 [0.65, 0.72]**	0.69 [0.65, 0.73]**	0.69 [0.65, 0.73]**
51-55	0.47 [0.45, 0.49]**	0.72 [0.68, 0.76]**	0.73 [0.69, 0.77]**	0.73 [0.69, 0.77]**	0.73 [0.69, 0.77]**
56-60	0.56 [0.53, 0.58]**	0.79 [0.75, 0.84]**	0.80 [0.75, 0.85]**	0.80 [0.75, 0.85]**	0.80 [0.76, 0.85]**
61-65	0.82 [0.78, 0.87]**	0.90 [0.85, 0.96]**	0.91 [0.85, 0.97]**	0.91 [0.86, 0.97]**	0.91 [0.86, 0.97]**
66-70	1.07 [1.02, 1.13]**	0.96 [0.89, 1.03]	0.96 [0.90, 1.03]	0.97 [0.90, 1.03]	0.97 [0.90, 1.03]
>70	1.11 [1.06, 1.17]**	0.97 [0.90, 1.04]	0.97 [0.91, 1.04]	0.97 [0.91, 1.05]	0.97 [0.91, 1.05]
Interview Year (ref: 2009)					
2010	0.90 [0.87, 0.93]**	0.91 [0.88, 0.94]**	0.90 [0.87, 0.93]**	0.88 [0.84, 0.91]**	0.88 [0.84, 0.92]**

2011	0.79 [0.76, 0.82]**	0.86 [0.83, 0.89]**	0.84 [0.81, 0.87]**	0.86 [0.83, 0.89]**	0.86 [0.83, 0.89]**
2012	0.71 [0.68, 0.73]**	0.76 [0.73, 0.79]**	0.75 [0.72, 0.78]**	0.74 [0.72, 0.77]**	0.74 [0.72, 0.77]**
2013	0.64 [0.62, 0.66]**	0.70 [0.67, 0.73]**	0.69 [0.66, 0.72]**	0.68 [0.65, 0.71]**	0.68 [0.65, 0.71]**
2014	0.75 [0.72, 0.78]**	0.74 [0.71, 0.77]**	0.72 [0.70, 0.75]**	0.74 [0.70, 0.77]**	0.73 [0.70, 0.76]**
2015	0.88 [0.85, 0.91]**	0.74 [0.72, 0.77]**	0.73 [0.70, 0.75]**	0.73 [0.70, 0.76]**	0.73 [0.70, 0.76]**
2016	0.85 [0.82, 0.88]**	0.73 [0.71, 0.76]**	0.72 [0.69, 0.74]**	0.72 [0.69, 0.75]**	0.72 [0.69, 0.75]**
2017	0.75 [0.73, 0.78]**	0.72 [0.69, 0.74]**	0.70 [0.67, 0.73]**	0.71 [0.68, 0.74]**	0.71 [0.68, 0.74]**
2018	0.68 [0.65, 0.70]**	0.67 [0.64, 0.70]**	0.65 [0.63, 0.68]**	0.65 [0.63, 0.68]**	0.65 [0.63, 0.68]**
2019	0.62 [0.59, 0.64]**	0.63 [0.60, 0.66]**	0.62 [0.59, 0.65]**	0.62 [0.59, 0.65]**	0.62 [0.59, 0.65]**
Country (ref: England)					
Wales	0.99 [0.94, 1.05]	1.09 [1.05, 1.14]**	1.09 [1.05, 1.14]**	1.07 [1.02, 1.12]**	1.07 [1.02, 1.12]**
Scotland	1.07 [1.02, 1.13]**	0.97 [0.93, 1.01]	0.97 [0.93, 1.01]	0.93 [0.88, 0.97]**	0.93 [0.89, 0.98]**
Northern Ireland	1.22 [1.15, 1.30]**	1.16 [1.11, 1.22]**	1.16 [1.11, 1.22]**	1.12 [1.06, 1.18]**	1.12 [1.07, 1.18]**
Marital Status (ref: Single, never married)					
Married	-	1.52 [1.48, 1.57]**	1.51 [1.46, 1.56]**	1.50 [1.46, 1.55]**	1.50 [1.46, 1.55]**
Living as a couple	-	1.42 [1.37, 1.47]**	1.42 [1.37, 1.47]**	1.41 [1.37, 1.46]**	1.41 [1.37, 1.46]**
Widowed	-	1.15 [1.09, 1.22]**	1.15 [1.09, 1.21]**	1.14 [1.08, 1.21]**	1.14 [1.08, 1.21]**
Divorced/separated	-	1.15 [1.10, 1.20]**	1.15 [1.10, 1.20]**	1.14 [1.09, 1.19]**	1.14 [1.09, 1.19]**

Number of Children (ref: Zero children)					
One to two children	-	1.14 [1.11, 1.18]**	1.14 [1.11, 1.18]**	1.14 [1.11, 1.18]**	1.14 [1.11, 1.18]**
More than two children	-	1.14 [1.07, 1.21]**	1.13 [1.07, 1.20]**	1.13 [1.07, 1.20]**	1.13 [1.07, 1.20]**
Ethnicity (ref: British white)					
Other white	-	0.93 [0.88, 0.98]*	0.93 [0.88, 0.99]*	0.94 [0.89, 1.00]*	0.94 [0.89, 1.00]*
Indian	-	0.89 [0.83, 0.94]**	0.88 [0.83, 0.94]**	0.91 [0.85, 0.97]**	0.91 [0.85, 0.97]**
Pakistani/Bangladeshi	-	0.93 [0.88, 0.98]**	0.93 [0.87, 0.98]**	0.94 [0.89, 1.00]	0.95 [0.90, 1.01]
Black/Caribbean/African	-	1.04 [0.98, 1.10]	1.03 [0.97, 1.10]	1.07 [1.01, 1.14]*	1.08 [1.01, 1.14]*
Mixed ethnicities	-	0.86 [0.79, 0.93]**	0.86 [0.79, 0.93]**	0.88 [0.81, 0.96]**	0.88 [0.81, 0.96]**
Other ethnicities	-	0.93 [0.87, 0.99]*	0.93 [0.87, 0.99]*	0.95 [0.89, 1.01]	0.95 [0.89, 1.01]
Country of Birth (ref: Born in UK)					
Not born in UK	-	1.00 [0.96, 1.04]	1.00 [0.96, 1.04]	1.00 [0.96, 1.05]	1.00 [0.96, 1.05]
Missing	-	0.91 [0.87, 0.95]**	0.90 [0.86, 0.94]**	0.90 [0.86, 0.94]**	0.90 [0.86, 0.94]**
Net Income (continuous)	-	1.00 [1.00, 1.00]**	1.00 [1.00, 1.00]**	1.00 [1.00, 1.00]**	1.00 [1.00, 1.00]**
Income Satisfaction (ref: Completely dissatisfied)					
Mostly dissatisfied	-	1.74 [1.67, 1.81]**	1.74 [1.67, 1.81]**	1.74 [1.67, 1.81]**	1.74 [1.67, 1.81]**
Somewhat dissatisfied	-	4.77 [4.59, 4.95]**	4.76 [4.58, 4.94]**	4.76 [4.58, 4.94]**	4.76 [4.58, 4.94]**
Neutral	-	6.93 [6.67, 7.21]**	6.92 [6.65, 7.19]**	6.92 [6.65, 7.19]**	6.92 [6.65, 7.19]**

Somewhat satisfied	-	15.6 [15.0, 16.2]**	15.6 [14.9, 16.2]**	15.6 [14.9, 16.2]**	15.6 [14.9, 16.2]**
Mostly satisfied	-	42.1 [40.4, 43.8]**	41.9 [40.3, 43.6]**	41.9 [40.3, 43.6]**	41.9 [40.3, 43.6]**
Completely satisfied	-	169 [161, 178]**	169 [161, 177]**	169 [161, 177]**	169 [161, 177]**
Occupation type (ref: Intermediate)					
Management & professional	-	0.90 [0.87, 0.92]**	0.90 [0.87, 0.92]**	0.90 [0.87, 0.93]**	0.90 [0.87, 0.93]**
Routine	-	1.01 [0.98, 1.04]	1.01 [0.98, 1.04]	1.01 [0.98, 1.04]	1.01 [0.98, 1.04]
Not working (retired)	-	1.36 [1.30, 1.42]**	1.36 [1.30, 1.42]**	1.36 [1.30, 1.42]**	1.36 [1.30, 1.42]**
Not working (student)	-	1.10 [1.03, 1.18]**	1.10 [1.03, 1.18]**	1.11 [1.03, 1.18]**	1.11 [1.03, 1.18]**
Not working (other)	-	0.99 [0.96, 1.02]	1.00 [0.96, 1.03]	1.00 [0.96, 1.03]	1.00 [0.96, 1.03]
Missing	-	0.89 [0.82, 0.97]**	0.89 [0.82, 0.97]**	0.89 [0.82, 0.97]**	0.89 [0.82, 0.97]**
Education (ref: High school degree)					
University degree	-	0.96 [0.94, 0.99]**	0.96 [0.93, 0.99]**	0.96 [0.93, 0.99]**	0.96 [0.93, 0.99]**
Lower educational level	-	1.01 [0.91, 1.11]	1.01 [0.91, 1.11]	1.01 [0.91, 1.12]	1.01 [0.91, 1.12]
Other qualifications	-	1.12 [1.09, 1.16]**	1.12 [1.09, 1.16]**	1.13 [1.09, 1.16]**	1.13 [1.09, 1.16]**
Still a student	-	1.30 [1.22, 1.38]**	1.29 [1.21, 1.37]**	1.29 [1.21, 1.37]**	1.29 [1.21, 1.37]**
Missing	-	1.03 [0.98, 1.09]	1.03 [0.98, 1.09]	1.03 [0.98, 1.09]	1.03 [0.98, 1.09]
Housing Tenure (ref: Owned with mortgage)					
Owned outright	-	1.01 [0.98, 1.03]	1.01 [0.98, 1.03]	1.01 [0.98, 1.03]	1.01 [0.98, 1.03]

Rented from local authority	-	1.08 [1.04, 1.11]**	1.09 [1.05, 1.12]**	1.09 [1.06, 1.12]**	1.09 [1.06, 1.13]**
Privately rented	-	1.12 [1.09, 1.15]**	1.13 [1.10, 1.16]**	1.13 [1.10, 1.17]**	1.13 [1.10, 1.17]**
Other	-	0.98 [0.96, 1.01]	0.99 [0.96, 1.01]	0.99 [0.96, 1.02]	0.99 [0.96, 1.02]
External Condition of the place of residence (ref: About the same as other houses)					
Better	-	0.98 [0.96, 1.01]	0.98 [0.96, 1.01]	0.98 [0.96, 1.01]	0.98 [0.96, 1.01]
Worse	-	0.97 [0.94, 1.01]	0.98 [0.94, 1.02]	0.98 [0.94, 1.01]	0.98 [0.94, 1.01]
Missing	-	0.95 [0.88, 1.03]	0.95 [0.88, 1.03]	0.96 [0.89, 1.04]	0.96 [0.89, 1.05]
Street Litter (ref: Not mentioned)					
Mentioned	-	0.99 [0.96, 1.03]	1.00 [0.96, 1.03]	1.00 [0.96, 1.04]	1.00 [0.96, 1.04]
Missing	-	0.98 [0.91, 1.06]	0.98 [0.90, 1.06]	1.13 [0.89, 1.44]	1.13 [0.89, 1.45]
Limiting long-term illness (ref: No)					
Yes	-	0.91 [0.89, 0.93]**	0.91 [0.89, 0.93]**	0.91 [0.89, 0.92]**	0.91 [0.89, 0.92]**
Missing	-	0.83 [0.66, 1.04]	0.83 [0.67, 1.04]	0.83 [0.66, 1.04]	0.83 [0.67, 1.04]
General Health (ref: Excellent)					
Very good	-	0.71 [0.69, 0.73]**	0.71 [0.69, 0.73]**	0.71 [0.70, 0.73]**	0.71 [0.70, 0.73]**
Good	-	0.52 [0.51, 0.53]**	0.52 [0.51, 0.54]**	0.52 [0.51, 0.54]**	0.52 [0.51, 0.54]**
Fair	-	0.35 [0.34, 0.36]**	0.36 [0.34, 0.37]**	0.36 [0.34, 0.37]**	0.36 [0.34, 0.37]**
Poor	-	0.17 [0.16, 0.18]**	0.17 [0.16, 0.18]**	0.17 [0.16, 0.18]**	0.17 [0.16, 0.18]**

Mental Wellbeing (ref: Good)					
Poor mental wellbeing	-	0.30 [0.29, 0.30]**	0.30 [0.29, 0.30]**	0.30 [0.29, 0.30]**	0.30 [0.29, 0.30]**
Missing	-	0.50 [0.46, 0.54]**	0.50 [0.46, 0.54]**	0.50 [0.46, 0.54]**	0.50 [0.46, 0.54]**
Smoking Status (ref: Non-smoker)					
Smoker	-	-	0.92 [0.90, 0.94]**	0.92 [0.90, 0.95]**	0.92 [0.90, 0.95]**
Missing	-	-	0.89 [0.81, 0.98]*	0.89 [0.81, 0.97]*	0.89 [0.81, 0.97]*
Alcohol Consumption (ref: Never had alcoholic drink)					
Occasionally had alcohol	-	-	1.01 [0.98, 1.04]	1.01 [0.98, 1.04]	1.01 [0.98, 1.04]
1-2 days/week	-	-	1.03 [0.99, 1.06]	1.03 [0.99, 1.06]	1.03 [0.99, 1.06]
3+ days/week	-	-	0.97 [0.94, 1.01]	0.97 [0.93, 1.00]	0.97 [0.93, 1.00]
Missing	-	-	0.99 [0.91, 1.07]	0.99 [0.92, 1.08]	0.99 [0.92, 1.08]
NO2 Air Quality (ref: Below EU limit)					
Above EU limit	-	-	-	0.96 [0.94, 0.99]**	0.97 [0.94, 0.99]**
PM2.5 Air Quality (ref: Below EU limit)					
Above EU limit	-	-	-	1.02 [1.00, 1.04]	1.02 [0.99, 1.04]
Sunshine (Annual average in hours, continuous)	-	-	-	1.00 [1.00, 1.00]*	1.00 [1.00, 1.00]*
Temperature (Annual average in °c, continuous)	-	-	-	0.97 [0.95, 0.99]**	0.97 [0.95, 0.99]**

Wind Speed (Annual average in m/s, continuous)	-	-	-	1.00 [0.99, 1.02]	1.00 [0.99, 1.02]
Rainfall (Annual average in mm, continuous)	-	-	-	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]
Heavy Traffic (ref: Not mentioned)					
Mentioned	-	-	-	0.99 [0.96, 1.01]	0.99 [0.96, 1.01]
Missing	-	-	-	0.86 [0.67, 1.10]	0.85 [0.66, 1.10]
Urban/Rural (ref: Urban area)					
Rural area	-	-	-	1.05 [1.02, 1.08]**	1.04 [1.01, 1.06]**
Distance to Nearest Park (continuous)	-	-	-	1.00 [1.00, 1.00]	-
Number of Parks (continuous)	-	-	-	1.01 [1.00, 1.01]**	-
Combined Size of Parks (continuous)	-	-	-	1.00 [1.00, 1.00]	-

*p < 0.05; **p < 0.01

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Appendix: Table 1. Descriptive Statistics for the study variables by Wave in terms of percentages for categorical variables and mean for continuous variables (N= 75,891 individuals; 373,431 yearly observations)

Variable	Category	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8	Wave 9	Wave 10
Sample Size	N	39,558	43,354	40,613	38,824	37,128	35,746	37,578	36,074	33,410	31,146
Life Satisfaction	Completely dissatisfied	2.6	2.7	2.7	2.8	2.6	1.9	2.2	2.3	2.5	2.2
	Mostly dissatisfied	4.3	4.9	6.6	6.6	6.5	5.3	4.6	4.9	5.5	4.4
	Somewhat dissatisfied	7.2	7.9	8.0	9.1	8.7	7.4	7.0	7.6	7.4	8.9
	Neither satisfied nor dissatisfied	9.9	9.1	8.7	9.9	10.4	8.8	9.7	10.1	11.0	11.6
	Somewhat satisfied	17.8	16.8	17.8	17.2	18.0	17.6	17.8	17.3	18.1	18.9
	Mostly satisfied	44.1	45.3	45.5	44.2	43.5	46.9	44.6	44.0	43.3	43.6
	Completely satisfied	14.1	13.3	10.8	10.3	10.2	12.0	14.1	13.7	12.2	10.4
Gender	Male	43.8	44.1	44.0	44.1	44.4	44.5	44.5	44.6	44.3	44.3
	Female	56.2	55.9	56.0	55.9	55.6	55.5	55.5	55.4	55.7	55.7
Age	16-20	8.0	8.1	8.0	8.0	8.1	7.5	7.5	7.2	7.1	6.9
	21-25	7.4	6.3	6.6	6.3	6.5	6.4	6.8	6.6	6.4	6.3
	26-30	8.4	7.3	7.1	6.7	6.4	6.0	6.2	6.0	6.0	5.8
	31-35	8.6	7.9	8.1	8.1	7.8	7.4	7.7	7.1	6.5	6.3

	36-40	9.8	9.2	9.1	8.6	8.2	7.8	8.1	8.2	8.0	7.6
	41-45	9.8	9.8	10.0	9.9	9.6	9.2	9.1	8.5	8.2	8.1
	46-50	9.1	9.2	9.5	9.4	9.5	9.7	9.7	9.6	9.3	9.3
	51-55	7.9	8.2	8.6	8.8	9.0	9.1	9.0	9.1	9.3	9.3
	56-60	7.2	7.5	7.5	7.6	8.0	8.1	8.1	8.4	8.9	9.1
	61-65	7.8	8.1	7.9	7.8	7.5	7.6	7.3	7.7	7.8	8.1
	66-70	5.9	6.5	6.4	7.0	7.4	7.9	7.6	7.7	7.8	7.6
	>70	10.3	11.8	11.0	11.8	12.0	13.3	13.0	13.8	14.6	15.5
Country	England	83.3	75.4	75.9	76.4	77.0	77.2	79.0	78.9	78.4	78.5
	Wales	4.9	7.9	7.9	7.7	7.4	7.1	6.4	6.5	6.6	6.5
	Scotland	7.6	9.6	9.5	9.2	9.5	9.1	8.5	8.4	8.6	8.7
	Northern Ireland	4.2	7.2	6.7	6.7	6.0	6.7	6.1	6.2	6.4	6.4
Marital Status	Married	51.1	52.8	52.1	51.6	51.3	52.6	52.4	52.9	53.5	53.9
	Living as a couple	11.7	11.6	11.7	11.9	11.7	11.3	10.8	10.6	10.0	9.8
	Widowed	5.5	5.9	5.6	5.8	5.8	6.0	5.7	5.7	5.8	5.8
	Divorced/separated	8.8	8.2	8.4	8.6	8.5	8.1	7.9	7.8	7.9	7.9
	Single (never married)	22.9	21.5	22.3	22.1	22.8	22.0	23.2	23.1	22.8	22.5

Number of Children	Zero children	81.0	82.1	81.9	82.2	83.1	83.7	83.5	84.1	84.9	85.2
	One to two children	16.0	15.1	15.3	15.0	14.1	13.7	13.8	13.5	12.9	12.6
	More than two children	2.9	2.8	2.8	2.8	2.7	2.6	2.6	2.5	2.2	2.1
Ethnicity	British white	79.1	81.9	81.3	81.6	81.7	81.5	75.7	76.3	77.5	78.3
	Other white	4.4	4.9	4.7	4.6	4.4	4.6	5.6	5.5	5.3	5.1
	Indian	3.5	2.5	2.6	2.6	2.7	2.8	4.1	4.0	3.9	3.8
	Pakistani/Bangladeshi	3.9	2.8	3.2	3.2	3.2	3.4	5.0	4.9	5.0	4.9
	Black/Caribbean/African	4.6	3.1	3.5	3.4	3.3	3.2	4.5	4.1	3.7	3.4
	Mixed ethnicities	1.8	1.3	1.5	1.6	1.7	1.6	1.8	1.9	1.8	1.8
	Other ethnicities	2.8	3.4	3.2	3.1	3.0	2.9	3.2	3.2	2.8	2.8
Country of Birth	Born in UK	84.3	66.5	66.9	68.2	68.7	68.8	66.5	67.2	68.2	68.8
	Not born in UK	15.6	10.8	10.9	10.7	10.4	10.7	15.0	14.2	13.0	12.3
	Missing	0.0	22.6	22.3	21.1	20.9	20.6	18.5	18.7	18.9	18.9
Income Satisfaction	Completely dissatisfied	6.2	5.5	6.3	6.7	5.8	4.5	3.6	3.8	3.8	3.8
	Mostly dissatisfied	8.4	8.2	11.9	11.3	10.8	8.8	6.9	6.8	7.3	6.5
	Somewhat dissatisfied	15.0	14.9	16.4	15.6	15.3	13.1	12.2	11.8	12.4	12.6
	Neutral	14.6	14.1	13.2	13.4	14.3	12.2	12.4	12.7	13.2	13.6

	Somewhat satisfied	19.9	19.7	19.0	17.2	17.6	19.4	20.4	20.1	20.7	19.7
	Mostly satisfied	27.8	28.7	26.4	27.5	27.7	31.2	32.6	32.2	31.8	32.4
	Completely satisfied	8.1	8.9	6.7	8.3	8.6	10.9	12.0	12.6	10.7	11.3
Occupation type	Management & professional	23.4	23.2	23.9	24.1	24.8	24.6	24.6	24.5	24.2	23.7
	Intermediate	13.3	13.3	13.4	13.5	13.6	13.4	13.6	13.5	13.1	12.8
	Routine	20.0	20.2	20.4	19.9	20.2	19.9	19.9	19.0	18.5	17.6
	Not working (retired)	19.9	22.2	21.4	22.5	22.5	24.1	23.2	24.1	24.6	25.2
	Not working (student)	5.6	5.0	5.1	5.0	5.1	4.5	4.9	4.5	4.3	4.2
	Not working (other)	17.5	15.8	15.2	14.6	13.4	13.0	13.2	13.4	13.3	13.9
	Missing	0.3	0.2	0.6	0.4	0.3	0.5	0.6	0.9	2.0	2.6
Education	University degree	31.1	25.0	27.1	28.1	29.3	29.9	30.7	31.6	32.6	33.6
	High school degree	32.5	25.4	26.2	26.5	26.7	27.0	26.3	26.7	26.9	26.7
	Lower educational level	1.5	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0
	Other qualifications	27.5	22.7	21.4	21.4	20.8	21.4	20.1	19.8	19.4	19.2
	Still a student	7.3	7.2	7.0	6.9	6.9	6.2	6.8	6.3	6.1	5.9
	Missing	0.1	18.6	17.2	16.0	15.1	14.5	15.1	14.6	14.0	13.5
Housing Tenure	Owned outright	28.6	31.5	30.9	31.6	0.0	33.7	33.3	34.0	35.1	35.7

	Owned with mortgage	38.6	39.6	40.4	39.6	0.0	38.1	36.7	36.7	36.7	37.1
	Rented from local authority	17.1	16.4	16.2	16.2	0.0	15.4	16.1	15.4	14.2	14.1
	Privately rented	15.1	12.2	12.1	11.6	0.0	11.5	12.5	11.7	10.7	10.3
	Other	0.6	0.4	0.4	1.1	100.0	1.2	1.5	2.2	3.3	2.7
External Condition of the place of residence	Better	10.1	9.8	9.8	9.3	9.0	6.9	6.5	4.3	3.3	2.8
	About the same	83.8	85.1	85.6	84.1	85.7	77.2	77.8	56.5	35.9	29.2
	Worse	5.2	4.6	4.2	4.4	4.1	3.9	3.2	2.1	1.7	1.5
	Missing	0.9	0.5	0.4	2.3	1.2	12.1	12.6	37.2	59.0	66.5
Street Litter at the place of residence	Not mentioned	95.2	94.1	95.1	95.1	96.6	83.0	81.5	58.0	38.3	31.2
	Mentioned	4.2	3.5	3.2	2.8	2.5	6.1	6.4	5.1	2.9	2.5
	Missing	0.6	2.4	1.7	2.1	0.9	10.9	12.2	36.9	58.9	66.4
Limiting long-term Illness/Disability	Yes	35.4	35.0	34.0	34.2	33.1	35.3	33.2	34.5	35.8	35.4
	No	64.5	65.0	65.9	65.8	66.9	64.6	66.6	65.4	64.1	64.4
	Missing	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2
General Health	Excellent	18.2	13.1	19.2	19.0	16.9	17.6	14.5	13.4	11.4	10.6
	Very good	32.6	34.1	35.1	36.0	35.0	35.5	35.2	34.0	33.5	34.4
	Good	28.3	33.3	27.0	25.5	28.6	27.5	30.6	32.1	33.9	33.2

	Fair	14.4	14.5	13.8	13.8	14.2	13.8	14.4	14.7	15.5	16.1
	Poor	6.5	5.0	5.0	5.6	5.4	5.6	5.3	5.8	5.7	5.7
Mental Wellbeing (GHQ-12)	Good mental wellbeing	62.4	61.8	63.6	64.4	63.2	65.5	64.5	62.8	61.4	60.4
	Poor mental wellbeing	36.0	36.9	36.2	35.5	36.7	33.9	35.0	36.7	37.9	38.8
	Missing	1.6	1.3	0.2	0.2	0.1	0.6	0.5	0.5	0.7	0.8
Smoking Status	Non-smoker	64.0	78.9	76.2	77.2	82.0	83.0	84.4	85.3	86.6	87.1
	Smoker	17.0	21.1	20.5	20.8	18.0	17.0	15.6	14.7	13.4	12.9
	Missing	19.0	0.0	3.3	2.0	0.0	0.0	0.0	0.0	0.0	0.0
Alcohol Consumption	Never had an alcoholic drink	5.3	5.2	6.8	7.3	14.2	13.3	23.0	20.7	22.4	20.7
	Occasionally had alcohol	32.5	42.6	39.6	40.3	37.5	38.3	44.8	43.5	43.7	42.8
	Have alcoholic drink 1-2 days/week	20.4	27.0	25.7	25.9	24.6	24.3	20.7	21.9	21.2	22.0
	Have alcoholic drink 3+ days/week	19.5	25.0	23.4	23.7	23.7	22.8	11.5	12.2	12.7	12.7
	Missing	22.2	0.3	4.4	2.8	0.0	1.3	0.0	1.7	0.0	1.8
NO2 Air Quality	Below EU limit	59.2	66.6	70.1	71.5	74.3	78.7	77.0	78.9	84.8	86.7
	Above EU limit	40.8	33.4	29.9	28.5	25.7	21.4	23.0	21.1	15.2	13.3

PM2.5 Air Quality	Below EU limit	32.3	36.0	37.1	39.7	38.1	55.5	66.0	63.4	70.2	70.7
	Above EU limit	67.7	64.0	62.9	60.3	61.9	44.5	34.0	36.6	29.8	29.3
Heavy Traffic on Street next to the place of residence	Not mentioned	86.7	86.7	87.5	87.8	88.7	79.3	77.9	55.6	36.3	30.1
	Mentioned	12.7	11.1	11.0	10.2	10.4	9.7	9.9	7.5	4.8	3.5
	Missing	0.6	2.1	1.6	2.1	0.9	10.9	12.2	36.9	58.9	66.4
Urban/Rural residential area	Urban area	78.1	74.4	74.9	74.4	74.7	74.6	76.5	76.1	75.3	75.1
	Rural area	21.9	25.6	25.1	25.6	25.3	25.5	23.5	23.9	24.7	24.9
Sports Activity	No to little sports activity	-	43.4	-	-	44.5	-	-	-	-	-
	Moderate sports activity	-	38.4	-	-	37.2	-	-	-	-	-
	High sports activity	-	18.2	-	-	18.2	-	-	-	-	-
Fruit Consumption	Never	-	6.9	-	-	6.7	-	7.5	-	7.3	-
	1-3 Days	-	28.9	-	-	27.9	-	27.7	-	30.1	-
	4-6 Days	-	18.4	-	-	18.5	-	19.7	-	22.3	-
	Every day	-	45.7	-	-	46.9	-	45.1	-	40.2	-
Vegetable Consumption	Never	-	2.0	-	-	1.9	-	2.2	-	2.5	-
	1-3 Days	-	20.3	-	-	19.2	-	20.8	-	23.0	-
	4-6 Days	-	27.0	-	-	27.2	-	28.0	-	30.8	-

	Every day	-	50.8	-	-	51.7	-	49.1	-	43.7	-
BMI Category	Underweight	2.6	-	-	-	-	-	-	-	-	-
	Healthy weight	41.1	-	-	-	-	-	-	-	-	-
	Overweight	39.1	-	-	-	-	-	-	-	-	-
	Obese	17.2	-	-	-	-	-	-	-	-	-
Net Income (£)		1,249	1,309	1,378	1,404	1,435	1,569	1,540	1,560	1,584	1,613
Distance to Nearest Park (m)		395	408	407	409	411	411	399	401	405	406
Number of Parks/Public Spaces within 1000 m radius		4.5	4.3	4.3	4.3	4.2	4.2	4.4	4.3	4.3	4.3
Combined Size of Parks (m²) within 1000 m radius		398,830	380,609	381,567	370,631	368,194	366,888	374,043	372,564	363,487	365,720
Temperature (°C)		9.83	9.77	10.41	9.86	10.33	10.79	10.46	10.59	10.73	10.62
Sunshine (hours)		1,553	1,539	1,496	1,474	1,546	1,562	1,550	1,520	1,572	1,633
Wind Speed (m/s)		3.9	3.9	4.2	4.1	4.2	4.2	4.1	3.9	3.9	3.9
Rainfall (mm)		762	732	881	959	862	908	832	798	793	843