Exposome-wide analysis of human aging mechanisms, age-related diseases, and mortality in a UK population



M. Austin Argentieri
Green Templeton College
University of Oxford

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Declaration

I declare that this thesis is entirely my own work, and except where otherwise stated, describes my own research.

The UK Biobank data resources that have been used in the analyses have all undergone various degrees of central processing before inclusion in my data analyses. Throughout my thesis, I have clearly described any analyses that have been conducted by others. This includes the calculation of several polygenic risk scores by a colleague at the University of Oxford, Jennifer Collister.

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Abstract

Background: Although it has been recognized that environmental exposures may be the major determinants of human aging and mortality, progress in understanding the impact of the exposome (i.e., the totality of all the non-genetic, external exposures that contribute to health and disease for an individual across the lifecourse) on mortality and age-related morbidity is lacking. In this thesis, I aimed to quantify the effect of the exposome on mortality, aging biomarkers, and chronic diseases.

Methods: I conducted a multi-step, exposome-wide analysis in the UK Biobank (n = 492,569). An exposome-wide association study (XWAS) of all-cause mortality was conducted using independent discovery and replication sets including participants recruited in England (median 12.5 follow-up years), with multiple further analyses conducted to evaluated replicated exposures for reverse causation due to prevalent disease and confounding due to exposome correlation. Remaining exposures were tested in relationship to 25 blood biomarkers related to aging mechanisms, 3 cardiometabolic risk factors (obesity, hypertension, dyslipidemia), and incidence of 25 age-related diseases. Finally, I fitted multivariable Cox models for mortality and each of the 25 disease outcomes, which included age and sex, all independent exposures associated with each outcome, polygenic risk scores (PRS), and clinical risk factors. C-index and R^2 for these models were validated in an independent set of participants from Scotland/Wales (median 13.7 follow-up years).

Findings: I found 55 exposures that were associated with mortality after multiple analysis stages, including factors related to smoking, physical activity, early childhood, social networks, mental health, diet and supplements, air pollution, material deprivation, sociodemographics, and sleep. Each of the 55 exposures was associated with an average of 21/25 aging biomarkers, 11/25 diseases, and 3/3 cardiometabolic risk factors. I found that while age and sex explain 43-47% of the variance in mortality, adding these 55 exposures to the model increased the mortality R2 estimate to 61-66%. Further adding PRS for 16 noncommunicable diseases only increased the ability to explain mortality by 0.03-0.6%. Finally, adding clinical risk factors to the model further increased explanation of mortality to 67-70%. Proportions of variance explained by age and sex, the exposome, PRS, and clinical factors for the 25 age-related diseases studied are also reported.

Interpretation: These results provide the first comprehensive map of the environmental architecture of mortality, aging mechanisms, and age-related diseases. I identified many environmental exposures that are strongly associated with mortality in the UK Biobank, which seem to influence mortality through modulation of diverse biological mechanisms, cardiometabolic risk factors, and disease multimorbidity. I further demonstrated that aside from age and sex, the exposome explains the greatest amount of variation in mortality risk even after accounting for polygenic disease risk. Further analysis may be needed to establish causality of identified exposures and to detect residual reverse causation bias in exposures not detected via the methods used in this thesis.

1. Chapter One: Introduction

1.1. Aging across the lifecourse

The past two centuries have seen major increases in human life expectancy worldwide. In the UK, life expectancy has nearly doubled over the past 170 years from roughly 40 years in 1841 to 80 years in 2011 (Fig. 1a). Worldwide, the number of persons 80 years or older is expected to triple between 2020 and 2050.[1] On the population level, aging is characterized by an increasing mortality risk with age, with the rate of increase in mortality risk with age referred to as the rate of aging. Currently in the UK, mortality rates are at their lowest around puberty and continue to increase until 100 years of age (Fig. 1b).

Yet increases in human lifespan across the past 200 years have not always been met with an equal increase in healthy, disease-free lifespan (healthspan).[2] Aging involves a progressive loss of physiological integrity and function over time, which leads to an increased vulnerability to age-related disease and death. Major chronic diseases such as cardiovascular disease, diabetes, cancer, and neurodegenerative disease all show varying rates of increasing morbidity with age (Fig. 2).[3,4] While we all advance in age every year, there is variation across individuals in how quickly age-related phenotypes develop and how steeply mortality risk increases with age. This can be described as variation in rates of aging. How fast we age ultimately shapes the extent of middle and late life morbidity and disability, and determines whether premature mortality or longevity is achieved.

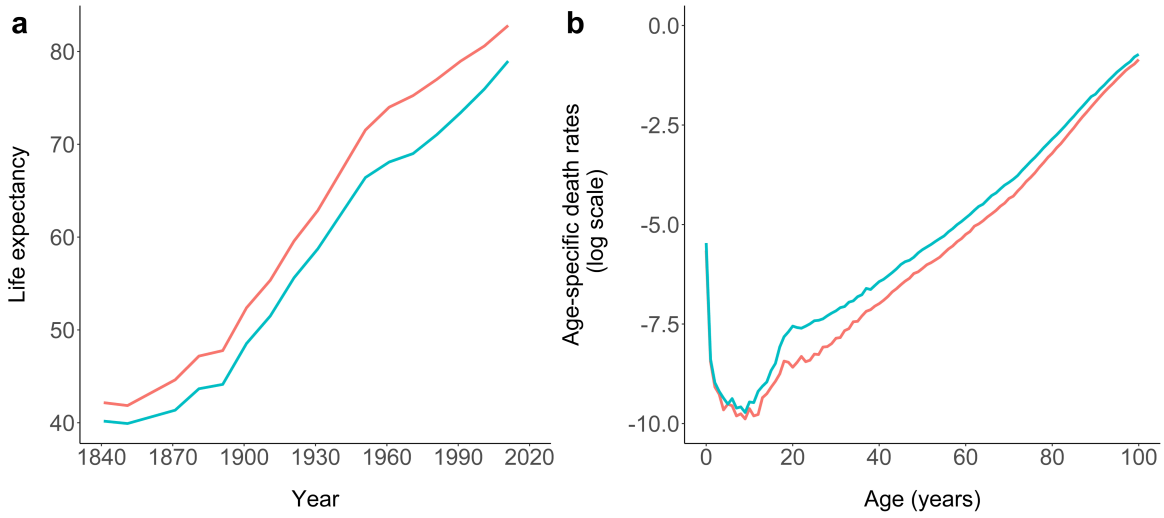


Figure 1. a, Life expectancy at birth from 1841-2011 in England and Wales for women (red) and men (blue). **b**, Mortality rates by age for UK women (red) and men (blue) from 2018-2020. Note that the y-axis of (**b**) is a log scale. Data sources: Decennial life tables for England and Wales (**a**) and National life tables – life expectancy in the UK: 2018 to 2020 (**b**), Office of National Statistics.

Clinically, aging is expressed as multiple interdependent stages across the lifecourse (Fig. 3a). The aging process is initially manifested as sub-clinical and biological changes that begin to accumulate from mid-life onwards and includes loss of bone, cartilage, and muscles mass, as well the accumulation of abdominal fat.[5] Subsequently, systemic changes to the endocrine, immune, and circulatory systems also occur, leading to an increase in blood pressure, dyslipidemia, inflammation, changes in hormone levels, and a decrease in sensitivity to hormones such as insulin.[6] These systemic sub-clinical changes are major drivers of common age-related diseases, which in turn increase the risk of death.

On the cellular level, nine evolutionarily conserved hallmarks of aging have been identified across many animal species, including humans (Box 1).[7] These include altered intracellular communication (including inflammation), telomere shortening, macromolecular damage, epigenetic changes, changes to metabolism and nutrient sensing,

loss of proteostasis, stem cells damage and regeneration, cellular senescence, and mitochondrial dysfunction. While acute stress and inflammatory responses are the first line of defense against pathogens and tissue damage and are essential for life, older organisms fail to shut off this inflammation response.[8] This lingering "sterile" inflammation is characterized by chronic, albeit mild, elevations in serum inflammatory

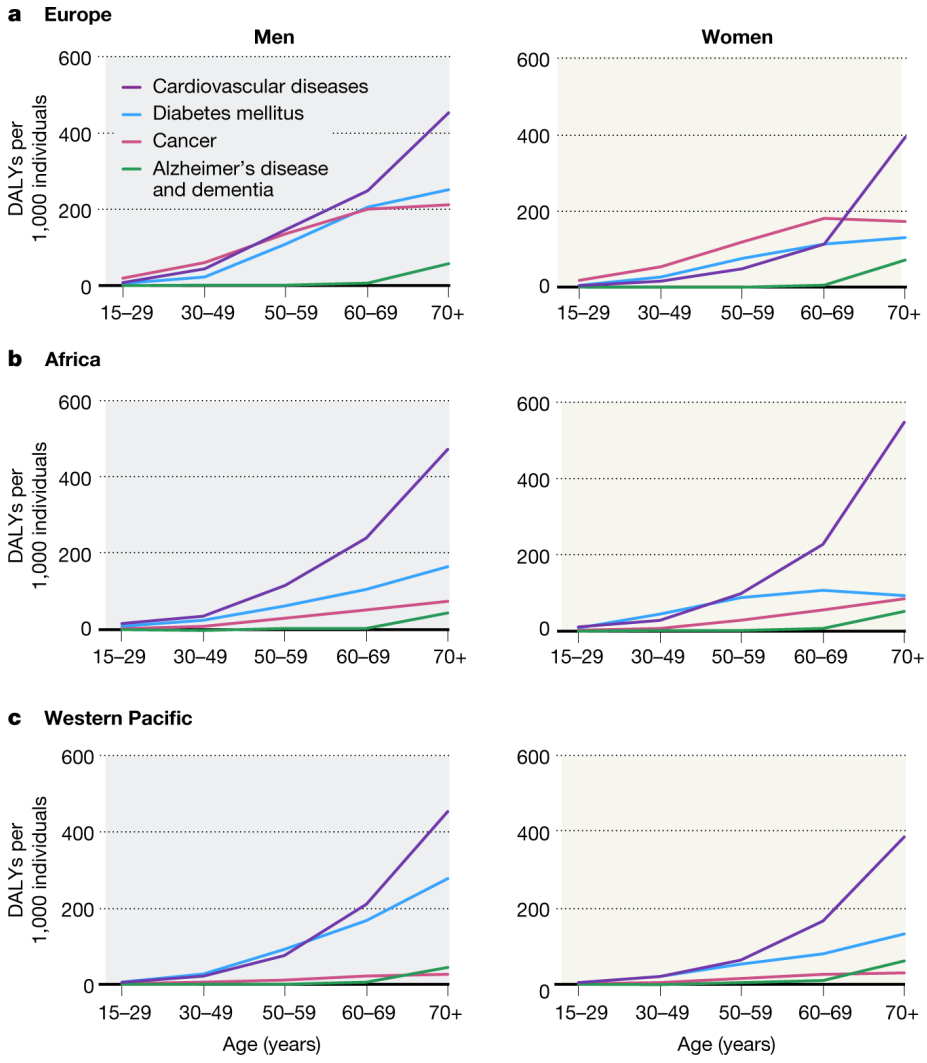


Figure 2. a–c, Disability-adjusted life years (DALYs) per 1,000 individuals are shown for men (left) and women (right). DALYs are shown for malignant neoplasms (red), diabetes mellitus (blue), Alzheimer's disease and other dementias (green), and cardiovascular diseases (purple) in different areas of the world for the year 2015 according to data from the WHO**. a,** Europe**. b,** Africa**. c,** Western Pacific. One DALY represents the loss of one year of health due to mortality or disability caused by the indicated disease. Source: Partridge et al. (2018) *Nature*.

molecules such as interleukin (IL)-6, tumor necrosis factor α (TNF-α) and C-reactive protein (CRP).[9-13] Many of the cellular hallmarks of aging have been shown to lead to chronic activation of these inflammation systems (inflammaging[14,15]).

The nine pillars of biological aging[7] have each been implicated in multiple age related diseases.[16,17] Chronic inflammation has been associated with diabetes, cardiovascular disease, and cancers;[14,15,18-20] telomere shortening has been linked with cardiovascular disease and cancer;[21-23] epigenetic mechanisms have been associated with cancer, diabetes, osteoporosis, coronary heart disease, and neurodegenerative

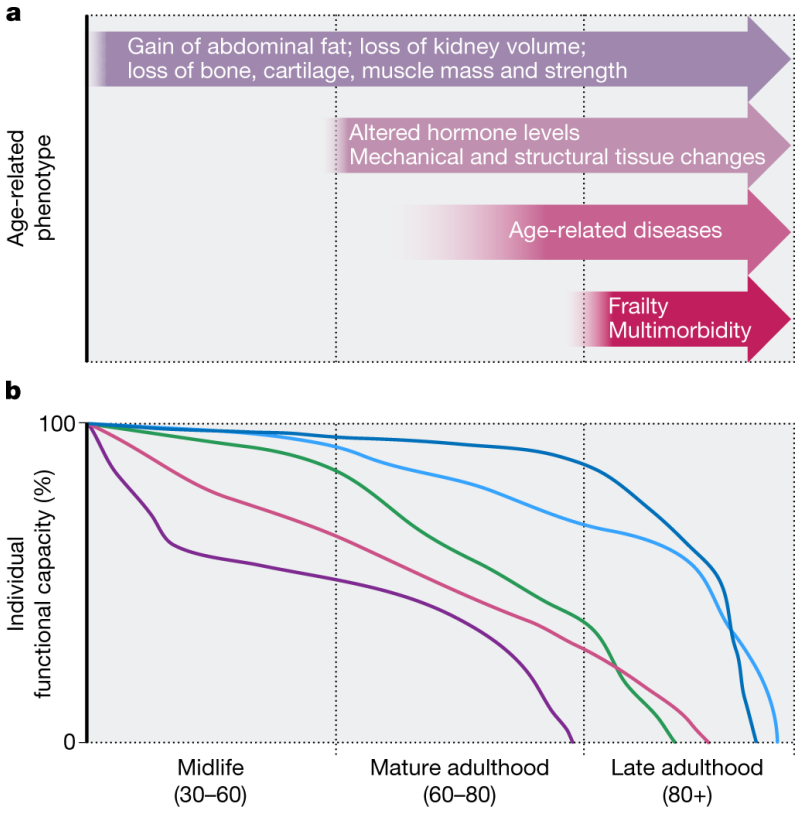


Figure 3. Progression and timing of aging phenotypes. **a**, The progression of aging phenotypes from sub-clinical degradation to disease and frailty across stages of life. **b**, Variation in rates of aging and functional decline over time. Each organ, tissue, cell, or trait can deteriorate over time at different rates in different people, resulting in variation in individual trajectories of functional decline during aging, graphically represented by the different colored lines. Source: Partridge et al. (2018) *Nature*.

disorders;[24,25] metabolic changes have been implicated in diabetes, cardiovascular disease, cancer, and neurodegenerative disorders;[26-28] free radical macromolecular damage and DNA damage are implicated in cancer, autoimmune disorders, rheumatoid arthritis, cardiovascular disease, and neurodegenerative diseases;[29,30] mitochondrial dysfunction is linked to cancer, neurodegenerative and cardiovascular disorders, diabetes, and obesity;[31,32] loss of proteostasis is involved in cancer, diabetes, and neurodegenerative diseases;[33-35] cell senescence has been linked to osteoarthritis, diabetes, cardiovascular disease, and cancer;[36] and stem cell aging has been associated with cancer and neurodegenerative disorders.[37-39] Because these mechanisms are involved in the etiology of most chronic diseases, many will develop two or more diseases (multimorbidity). Alongside multimorbidity, increasing age into later life is also accompanied by frailty, a composite of ill health and functional deficits that further compounds morbidity and mortality risk through organ failure, disability, fractures, and falls.

There is variation across individuals in the rate at which age-related sub-clinical phenotypes and decline from age-related disease occurs (depicted graphically in Fig. 3B). These person-specific variations in rates of aging result in major differences between calendar age and so-called biological age, which refers to the relative age of a person based on (patho)physiological status. Two persons born at the same date may differ substantially in biological age, and it is this accelerated rate of biological aging, rather than calendar age, that ultimately shapes the extent of middle and late life morbidity, disability, and determines age at death. Even within the same individual, different tissues (e.g., heart, brain, immune, metabolic) can age at different rates and through different mechanisms.[40]

Box 1. The nine pillars of biological aging[7]

Altered intracellular communication (incl. inflammation). As the first line of defense against pathogens and tissue damage, the acute inflammatory response is a central mechanism for somatic maintenance. While in most cases older organisms are capable of mounting an inflammatory response when appropriate, it has been shown that older organisms fail to shut off this inflammation response.[8] This lingering "sterile" inflammation is characterized by chronic, albeit mild, elevations in serum inflammatory molecules such as interleukin (IL)-6, tumor necrosis factor α (TNF-α) and C-reactive protein (CRP).[9-13]

Mitochondrial dysfunction. Mitochondrial function has a profound impact on the aging process. According to the revised mitochondrial free radical theory of aging, reactive oxygen species (ROS) are created by mitochondria as a stress-elicited response to combat age-related degradation, but after time ROS accumulation begins to contribute to age-associated mitochondrial damage.[41] Independent of ROS production, mitochondrial degeneration accumulation over time, due to lower biogenesis and clearance (i.e., autophagy) may contribute to the aging process.[7]

Epigenetics. Epigenetics refers to changes in gene expression and function that do not involve a change in the underlying DNA sequence. Key epigenetic mechanisms include DNA methylation, histone modifications, and non-coding RNAs. Aging is associated with profound epigenetic changes across the life course.[42-44] It has been proposed that age-related epigenetic alterations are the result of evolutionarily conserved mechanisms whereby key proteins such as Sirtuins, insulin-like growth factor-1 (IGF-1), mTOR, and AMP-activated kinase (AMPK) all have a trade-off between promoting growth and epigenetic regulation in times of plenty, and relocalizing to other genomic locations to perform DNA repair and recycling of broken-down cell components in times of stress. This Relocalization of Chromatin Modifiers Hypothesis of Aging (RCM; more recently renamed the Information Theory of Aging[45]) has been supported by numerous studies.[43,44]

Metabolism. Many of the genetic pathways known to impact longevity have critical roles in nutrient sensing and the regulation of metabolism or have been shown to interact strongly with cellular metabolism. This includes the insulin and IGF-1,[26,46] mTOR,[47] AMPK,[48] and Sirtuin[49,50] pathways. Mitochondria function, because of its crucial role in cellular energy production, has also been studied extensively in relationship to aging.[15,51,52] Increasing evidence also links remodeling of the gut microbiome with aging and age-related dieases.[15]

Proteostasis. Proteostasis refers to the mechanisms responsible for repairing and maintaining the proteome. This includes protein chaperones, two proteolytic systems, the ubiquitin-proteasome system, and the lysosome-autophagy system.[53] During normal and acute stress conditions, the proteostasis system is able to return the proteome to a point of homeostasis. Under chronic stress, however, proteostasis is difficult to maintain and proteotoxicity occurs.[33] With aging, however, the ability to maintain proteostasis under normal and stress circumstances is gradually compromised.

Cellular senescence. Cell senescence is a permanent cell cycle arrest (cessation of cell division). It likely evolved as a beneficial compensatory response to damage to prevent the propagation of damaged cells that may be oncogenic. Normally, senescent cells are removed by macrophages, but with age senescent cells accumulate through increasing DNA damage and the development of inefficiencies in clearing senescent cells.[7] These senescent cells can cause tissue damage and are implicated in the etiology of many chronic disease.[54]

Box 1. The nine pillars of biological aging (cont'd)

Telomere attrition. Normal aging is accompanied by shortening of telomeres over time in both humans and mice.[55] Pathological telomere dysfunction has been shown to causally lead to cellular senescence and aging in mice,[7] with meta-analyses in human also demonstrating a relationship between shorter telomeres and mortality risk.[56] Furthermore, DNA damage at telomeres has been shown to cause persistent DNA damage that leads to cell senescence and apoptosis.[57]

Macromolecular damage. Free radical macromolecular damage and DNA damage caused by mutations have been associated with accelerated aging in multiple studies. Furthermore, accelerated human aging syndromes (e.g., Hutchinson-Gilford progeria, Werner, Cockayne syndromes) are characterized by mutations in DNA repair genes, including genes that encode nuclear lamins.[58,59]

Stem cells and regeneration. Adult stem cells are characterized by their ability to differentiate into the cell types of the organ in which they reside. Stem cells contribute to the regeneration and homeostasis of almost all tissues. During aging, however, the functionality of adult stem cells declines. This is largely due to accumulation of DNA damage and epigenetic alterations in stem cells over time.[60] Interestingly, many of the pillars of aging contribute to the accumulation of damage in stem cells over time, including proteostasis, metabolisms, epigenetic, macromolecular damage repair, and inflammation pathways.[60]

There has been major progress in estimating biological age by using 'omics data to build aging "clocks," although the correlation between current epigenomic, proteomic, and metabolomic aging clocks is low and these may capture different aging signals.[40]

1.2. Chronic disease and lifespan

The development of chronic diseases and multimorbidity are crucial determinants of age at death. Worldwide, all of the top 10 causes of death in the population over 70 years are chronic non-comunicable diseases.[61] Those with multimorbidity or blood markers of chronic disease risk die up to 20 years younger than those without multimorbidity and/or low levels of disease markers.[62,63] Recent research using UK

Biobank data supports the link between age-related disease morbidity and lifespan.[64] In this study, the authors conducted a phenome-wide association study of longevity (defined as living beyond the 90th and 99th percentile of age using cohort-specific life tables) using Mendelian randomization to evaluate whether the associations between disease phenotypes and lifespan are causal. Mendelian randomization is a method to investigate the causal relationships between exposures and health outcomes in observational data by using genetic variants as instrument variables for the exposure of interest.[65] Using this approach, this study in the UK Biobank found significant evidence for a causal relastionship between longevity and many chronic diseases and aging phenotypes, including heart disease, type 2 diabetes, Alzheimer's disease, hypertension, high cholesterol, venous thromboembolism, and body fat mass.[64]

One of the greatest population health challenges facing today's global world is addressing the quality of life and economic burden of prolonged periods of multimorbidity in aging populations. Indeed, historical evidence from the past several decades in the UK and the Netherlands indicates that populations are spending more time in poor health as they live longer.[66] Consequently, many have claimed that reducing the length and severity of late-life morbidity should be a major aim of global population health.[3] This would result in so-called *healthy aging*, in which the length and severity of late-life morbidity are reduced and occur later in life, leading to an extension of healthy, disease-free life (healthspan) and longevity.[3] For example, those who survive to over 100 or even 110 years show progressively later onset of major disease and shorter duration of morbidity late in life.[67,68] Reducing the length and severity of late-life morbidity will have a

major impact on the burden of age-related diseases on society. In the US alone, the value of slowing aging and increasing life expectancy by 1 year has been estimated to be US$ 38 trillion, whereas the value of slowing aging by 10 years would be US$ 367 trillion.[69]

1.3. Causes of aging

1.3.1. Evolutionary origins of aging

Why we age has been a long standing question for evolutionary biologists. Various theories have been proposed, all resting on the premise that the strength of natural selection decreases following reproduction. In this view, the strength of natural selection declines as a function of age, leading to the so-called "selection shadow" in which natural selection cannot "see" harmful genetic mutations whose effects occur after reproduction.[70] This is because a harmful mutation that has a negative effect only later in life will likely already have been passed on to the individual's offspring when the harmful effects manifest. Natural selection will therefore be inefficient at eliminating such a mutation from the population. This concept is the fundamental basis for evolutionary theories of aging, and may explain why mortality rates in the UK population are at their lowest around puberty, and then continue to increase all the way to 100 years of life (Fig. 1b).

In this evolutionary view of aging, maintenance and repair mechanisms that are selected across generations only need to be efficient enough to keep an organism in healthy condition to reproduce: the maintenance of "health" is then only a means to the

end of reproduction. As human lifespans continue to increase farther beyond reproductive age, we are evolutionarily poorly equipped to repair and deal with the accumulation of damage and degradation over the decades that follow reproduction. This leads to age-related disease, functional decline, and mortality.

1.3.2. Genetic determinants of lifespan

Whether there is a genetic limit to lifespan is still contested.[71] But the remarkable increases seen in human lifespan over the past 200 years (Fig. 1a) have occurred too quickly for changes to the human gene pool to have played a major role.[3] This is because the gene pool is generally expected to be stable across generations according to Hardy-Weinberg equilibrium.[72] Although the role of genetics in recent increases in lifespan is limited, conserved longevity genetic pathways have been identified across diverse eukaryotic species.[26,50,51]

The past decade has seen major progress in elucidating the genetic architecture of age-related disorders, with genome-wide association studies (GWAS) uncovering hundreds of thousands of genomic regions that are associated with complex human diseases.[73] Compared to the progress in understanding the genes involved in age-related diseases, there have been fewer advances in understanding the genes involved in human lifespan in the general population.[3] A very limited number of genes have been found to be associated consistently with long lifespan across human GWAS, including apolipoprotein E *(APOE)*, forkhead box O3 *(FOXO3A)*, and cyclin dependent kinase inhibitor 2A and 2B

(CDKN2A/B).[3] Among candidate gene studies, only *APOE*[74] and *FOXO3A*[75,76] have shown associations with longevity that have been consistently replicated across studies.

Of the variants discovered to date, only *APOE* has been among the strongest associations at the level of genome-wide significance across multiple GWAS publications.[3] The *APOE* gene is involved in a large number of age-related diseases, including Alzheimer's disease, hypercholesterolemia, and ischemic heart disease.[77,78] Although the association of *APOE* to longevity was already reported in the previous century,[74] the underlying mechanisms through which the gene is involved in longevity remain to be elucidated.[79] *APOE* has been linked to cardiovascular disease due to its key role in dyslipidemia,[78] and although its role in dementia may in part be mediated through it function in lipid metabolisms,[78] *APOE* has a major effect on Alzheimer's disease through influencing microglia function, inflammation, and the innate immune system.[80]

Studies have also consistently revealed the *FOXO3* gene as an important determinant of aging and longevity across mammal species.[81,82] FOXO proteins are involved in a wide range of crucial cellular processes related to aging, including regulating stress resistance, metabolism, cell cycle arrest, and apoptosis (programmed cell death).[81] Of note is that the *FOXO3* gene has not been found to be significantly associated with age-related disorders in GWAS conducted date. However, the gene does show genome-wide significant associations with a large number of age-related traits including IGF-1 levels, kidney function (glomerular infiltration), cognitive function and brain measurements at MRI, cognitive function (verbal-numerical reasoning), lung function (FEV/FEVC ratio - forced expiratory volume [FEV] in the first one second over the forced vital capacity [FVC]

of the lungs), blood pressure, lipids, bone mass density, lean body mass, birth weight, and age at menarche (*FOXO3*-related traits retrieved using GeneCards[83]).

The genome-wide association of *CDKN2A* and *CDKN2B* to longevity is consistent and replicated across studies.[84,85] Of interest is that these genes, and the regions between the genes, are involved in cellular senescence and have also been associated with age-related diseases such as coronary artery disease, stroke, diabetes, glaucoma, and melanoma.[86,87]

A recent study using high coverage (90X) whole genome sequencing to study 81 semi-supercentenarians and supercentenarians (105+/110+ years of age) and 36 healthy unrelated geographically matched controls indicated that semi-supercentenarians (those who live to between 105-109 years of age) share a common genetic background that is associated with efficient DNA repair mechanisms.[88] Top variants associated with longevity in this single study were found in the gene *STK17A*, which is involved in several of the cellular hallmarks of aging including DNA damage response and regulation of the apoptotic process.[89] Interestingly, *STK17A* has also been associated in previous GWAS with type 2 diabetes and high density lipoprotein (HDL) cholesterol measurement, as well as with Alzheimer's-related phenotypes such as neurofibrillary tangles and beta-amyloid 1-42 in cerebrospinal fluid (*STK17A*-related traits retrieved using GeneCards[83]). Despite interesting results, this finding remains to be replicated.

Of interest is that several recent studies using whole genome sequencing of family members in long-lived families have also identified functional genetic variants in the IGF-1 receptor (*IGF1R*) that may be important for long life.[90,91] These findings bridge the gap

between genetic research on human longevity and the overwhelming evidence in experimental research in animal models linking IGF-1 to lifespan.[92]

Ultimately, despite the discovery of certain genetic variants associated with longevity, the heritability (i.e., the fraction of phenotypic variance that is due to genetic variance) of lifespan has been shown to be low. Estimates vary across studies, with different studies estimating the genetic heritability of lifespan to be between 12-25%.[93,94]

1.3.3. The environment, health care, and population health

The global health care and population health landscapes have changed dramatically over the past two centuries, as have the physical and social environments in which we live. The greatest contributions to the nearly twofold increase in global human lifespan during the past 200 years have been attributed to changes in human environments – improved water and food quality, hygiene, reductions in malnutrition, better housing and lifestyle, motor-vehicle safety, safer workplaces, immunization against infectious disease, antibiotics, and improved medical care.[95] Indeed, throughout European history over the past several centuries, it has been documented that improvements in population health and longevity have been closely related to improvements in medical care and public health, as well as economic, social, and political environments.[96] Throughout this thesis, I use the term "environment" broadly to refer to the fundamental patterning of physical and socioeconomic environments, as well as individual behaviors (e.g., smoking),

lifestyles (e.g., physical activity), and treatment landscapes (e.g., access to quality health care and medicines) that are shaped by these larger environmental contexts.

Johan Mackenbach's work has documented the historical rise and fall of diseases over the past several centuries in Europe, concluding that many of the major disease epidemics during this period (both in terms of infectious and non-communicable disease) have occurred in a small enough time-scale to rule out spontaneous (i.e., genetically driven) changes within human physiology as the root cause.[96] While there certainly exist diseases that are caused primarily by genetic defects (e.g., Huntington's disease and Down's syndrome), these are relatively rare and are not related to age or rates of aging.[97] Instead, Mackenbach shows that the majority of diseases (both infectious and non-communicable) must arise from the interaction between humans and their environment.[96,98] Drawing from the evolutionary work of Dubos,[99] Mackenbach clarifies that throughout human history disease often stems from a reaction of human biology to, and/or a failure to cope with, our environments.[96,98]

Over the past three decades, public health interventions (e.g., improved water and food quality, hygiene, motor-vehicle safety, safer workplaces) have played a large and decisive role in the decline of many leading causes of morbidity and mortality, including plague, smallpox, typhus, cholera, lung cancer, cirrhosis of the liver, and road traffic injuries.[100] Over the past century, advancement in medical care and medicines, especially antibiotics, have played a further role in the decline in mortality from infectious diseases, stroke, and several other diseases.[101] Declines in mortality from cardiovascular disease over the past 50 years can also largely be attributed to improvements in both public health

and medical treatments.[102] Furthermore, fundamental structural factors such as income and prosperity,[103] as well as effective governments that take measures to protect health, run complex health care systems, and distribute wealth to benefit health,[104] have both been crucial determinants of life expectancy over the past century.

Outside of these fundamental improvements to population health and medical treatment, many behavioral, lifestyle, and socioeconomic risk factors for mortality have been consistently identified over the past few decades and replicated across numerous studies, including smoking, physical activity, and socioeconomic inequality.[105-108] In 2013, the World Health Organization (WHO) published a landmark report with a global action plan to reduce premature mortality from non-communicable diseases by 25% by 2025.[109] Drawing from decades of epidemiological evidence, the report identified seven major risk factors that are leading contributors to global chronic disease burden and premature mortality, including alcohol, insufficient physical activity, tobacco use, high blood pressure, intake of salt or sodium, diabetes, and obesity. These are often referred to as the WHO 25 × 25 risk factors. Some of these risk factors represent disease phenotypes that are the result of interactions between the environment and human physiology (e.g., blood pressure, diabetes, obesity). However, taking the broad definition of the environment described above, others could be more appropriately classified as environmental influences or behaviors shaped by environment (e.g., smoking, physical activity, salt intake, alcohol) that then interact with human physiology to produce disease phenotypes. Estimates of the impact of these risk factors on mortality vary across studies, but the most recent and largest large global meta-analysis of mortality risk showed that the number of

years lost due to smoking, high vs. low socioeconomic status (SES), and physical inactivity are on average 4.8, 3.4, and 2.4 years, respectively.[105]

Social support is another environmental influence that is consistently associated with mortality across multiple meta-analyses, with pooled effect estimates across multiple meta-analyses indicating that all-cause mortality is 11-53% more likely in people without social support.[110]Air pollution has a direct impact on cardiovascular disease,[111] and it has also been demonstrated that fine particulate matter ($PM_{2.5}$) exposure can dramatically shorten life expectancy in the US population above 65 years old.[112]

Environmental factors have not only been linked with mortality, but also with the age of onset for age-related morbidity. For example, in a recent analysis of 1.8 million people in Scotland, those living in areas of high socioeconomic deprivation developed multimorbidity 10-15 years earlier than those in the most affluent areas.[93] Lower SES is strongly related to lifestyle (e.g., diet, smoking) but also to homicide, violent crime, death due to traffic accidents, hazardous waste, air pollutants, and unsafe residential and working environments.[113]

The impact of adverse SES on health behaviors also includes constraints that limit individual's capacity for adopting health-promoting behaviors. That is, even if individuals in all SES groups had a similar desire for healthy behavior, those in low SES groups have more difficulty in accumulating the resources to realize these goals. For example, while low SES individuals smoke more often, the desire to quit does not differ greatly according to SES, nor does education about the health risks of smoking.[114]

1.3.4. Gene-environment interactions

Ultimately, the number and combinations of causal factors involved in complex, age-related diseases are simply too great for genetic or environmental information alone to tell the full story.[115] Instead, environmental influences interact with our underlying genetic composition to shape risk of morbidity and mortality across the lifecourse. To begin with, those with a particular genotype may be more sensitive to environmental influence that others. For example, a recent twin study documented that, among those who do not carry risk alleles in the *APOE* or *ESR1* genes, variability in cognitive performance over time was more sensitive to stress factors, social support, and depressive symptoms.[116]

There can also be variation in the relative importance and contribution of genetic and environmental factors to specific traits over the lifecourse. For example, longitudinal research conducted among Swedish twins has shown that the impact of unique environmental variance (i.e., environmental influences that are individual-specific and not shared with siblings) on cognitive measures increases with age between 50-80 years, whereas the impact of additive genetic variance (i.e., the additive effects across all gene variants pertinent to the trait) on most cognitive measures peaks around age 65 and then declines, with the exception of memory tasks.[117]

Another interesting example of gene-environment interactions comes from research on caloric restriction. Caloric restriction, as a form of environmental manipulation related to diet, has been shown to increase lifespan in a number of animal models.[46] Interestingly, several genes associated with lifespan and longevity, including *IGF1R* and

FOXO3, have been shown to modify or cancel out the life extending effect of caloric restriction when mutated in animal models.[118]

Overall, while changes to the gene pool have likely not contributed to changes in human life expectancy over the past 200 years, individual genetic variation throughout human history has certainly been interacting with changing human environments to jointly shape variation in rates of aging and age-related morbidity. A key issue that remains to be answered in better understanding the influence of the environment on aging and life expectancy is not only which environmental exposures cause age-related disease and mortality, but how these influences interrelate with each other and influence these outcomes jointly with the genome.

1.4. Conceptual model of aging used in this thesis

The conceptual model of age-related disease and lifespan that I use for this thesis builds upon and extends the model of Partridge et al.[3] (Fig. 4). This conceptual model imparts the following hypothesized principles: (1) The entire cascade of human aging and lifespan/mortality is first and foremost determined by the interplay between genetic variation and human environments, including behavior, lifestyle, public health and medical treatments, and our physical surroundings. The precise proportion of environment/genetic influence on age-related disease is currently unknown. I hypothesize that environmental factors play an important role in mortality and aging, and I have designed the analyses in this thesis to test this hypothesis. (2) At the cellular level, there

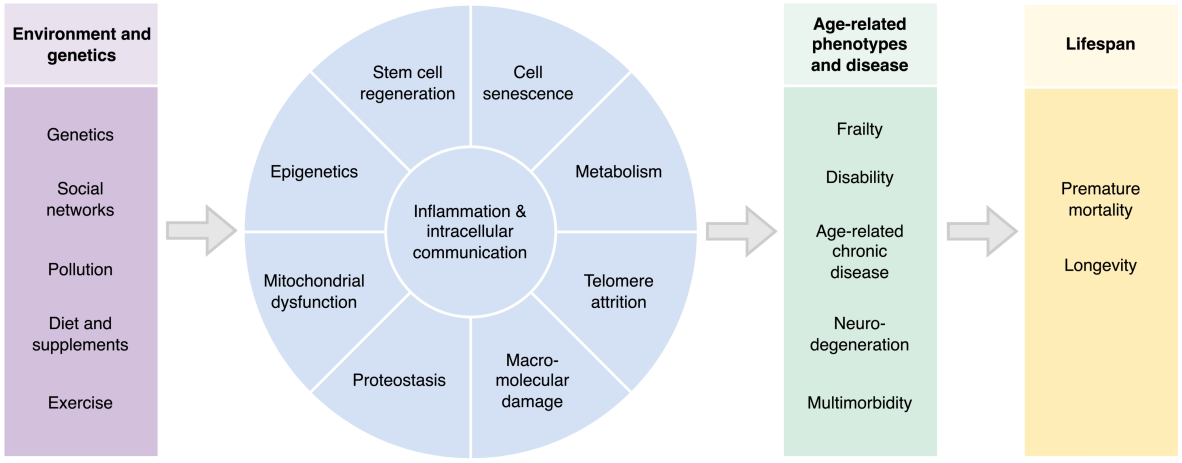


Figure 4. Conceptual model of aging. Blood-based aging biomarkers available in the UK Biobank dataset and investigated in this study are contained within the sections in light blue (metabolism, telomeres, inflammation). Modified from: Partridge et al. (2018) *Nature*.

are various interrelated mechanisms activated during aging (blue circle in Fig 4; described in greater detail in Box 1). These mechanisms are driven by complex interactions between genetic and environmental factors. (3) Alterations to biological aging mechanisms are common features in the etiology of most age-related chronic diseases, and lead to chronic disease multimorbidity, disability, and frailty. (4) These three domains of influences (genome/exposome, biological response, disease multimorbidity) form a causal pathway leading to variation in rates of aging and ultimately mortality.

1.5. Limitations to classical approaches for studying the environment and aging

As described above, environmental influences (including advancements in structural conditions, treatments, and public health) have made major contributions to increases in life expectancy and the decline of numerous diseases over the past two centuries. Given this, understanding the environmental determinants of age-related

disease and mortality risk should be a priority population health concern to not only promote increases in human life expectancy but to also combat age-related disease burden and multimorbidity as populations grow older.

Classical epidemiology approaches to studying environmental influences on mortality or disease examine associations between a single exposure (or group or related exposures) and the outcome of interest. Since many exposures may be correlated, spurious associations (confounding) can occur if an exposure is not causally related to the outcome of interest but is strongly correlated with the true causal factor(s). The approach taken in classical single exposure epidemiology to account for this is to adjust for potential confounders in statistical models. This approach has been extremely successful in identifying environmental factors that are relevant to age-related diseases and mortality (e.g., air pollution, asbestos, physical activity),[119] and has been crucial in developing successful preventative interventions (e.g., research on smoking[120]).

Despite the undeniable successes of this approach over the past 50 years, it has certain limitations as well. Of note, while extensive adjustment for confounding is often undertaken, only effect estimates for the exposure of interest are usually reported. Furthermore, other relevant exposures may not have been tested either because they fell outside the scope of the single exposure study design or were not theorized to be related to the exposures or outcome being studied. These limitations prevent researchers from understanding the relative strength of associations between different types of environmental factors and disease. Furthermore, when single exposures are tested against an outcome one at a time in separate publications, it is more difficult to compare effect

sizes for these individually tested environmental exposures when the datasets, statistical models, covariates, and data treatment methods will differ between papers.

Although not the common approach, there have also been epidemiological studies that have aimed to identify many risk factors for healthy aging and to model their joint effects on survival and healthy aging in single multivariable models.[121,122] While studies such as these overcome some of the limitations discussed above by testing large numbers of exposures together to be able to report the relative contributions of many different exposures to healthy aging, these studies are still more or less hypothesis-based, meaning that exposures chosen to be studied are those that the authors select based on theory or previous epidemiological evidence.

1.6. Exposome science

An alternative approach to the classical epidemiology methods described above is an exposome-wide approach, in which the aim is to conduct a hypothesis-free and comprehensive analysis of human environmental determinants in relation to disease and complex phenotypes. The exposome, as initially conceived of by Wild[123] and subsequently refined by Miller and Jones,[124] refers to a cumulative measure of environmental influences throughout the life course. Exposome science is often defined as all the non-genetic drivers of health and disease for an individual across the lifecourse,[125] including the physical environment (e.g., pollutants, built environment), behavior, lifestyle, diet, culture, medical care and treatment landscapes, socio-economic contexts, but also including the

corresponding biological responses to all of these exposures.[125] Others have described the exposome as documenting the "biography-to-biology transition,"[126] again characterizing the exposome as including both cumulative measures of the environment across the lifecourse and the corresponding biological responses.

As described recently by Vineis and Barouki in their review of the exposome concept, the exposome is composed of multiple stages across the lifecourse.[127] As they say, "the onset of a non-communicable disease can be seen as the endpoint of a life-long trajectory of exposures, that act via multistage mechanisms and express the biography of a person, where socioeconomic position is an overarching determinant of the trajectory."[127] This trajectory reflects each individual's unique history of exposures, which is superimposed on their underlying genetic susceptibilities. Vineis and Barouki further make the distinction between two distinct layers of the exposome, noting that environmental and behavioral determinants of health such as smoking, diet, or pollution are intermediates that are caused and shaped by fundamental socioeconomic determinants. They further note that the links between all these components have not been investigated properly in single exposure epidemiology to date, and that investigating these links is a key strength of exposome science.

Importantly, Vineis and Barouki also describe the distinction between how an exposome versus a traditional epidemiological approach to analyze environmental exposures, where the latter interprets disease as the effect of single exposures that explain different proportions of cases in a population (i.e., population attributable risks). Instead, they propose an exposome approach that operationalizes the environment in terms of

capital, according to Pierre Bourdieu's concept.[128] That is, they propose that health and disease at a certain point in time are the result of social, economic, and cultural capital accumulated across the lifecourse, alongside accumulated biological capital (which is the interplay between inherited genetics and biological/physiological responses to environments across the lifecourse). These accumulations of capital then influence the intermediate stages of environmental influence such as living in a deprived area or adopting unhealthy lifestyles and behaviors (Fig. 6). Overall, this exposome approach takes environmental influences not as single, isolated exposures, but instead as influences that are irrevocably interrelated to each other within a larger web of accumulation across the lifecourse.

1.7. Current state of exposome research on adult health and challenges to overcome

Although exposome science is a nascent field, work is already underway. To gauge the state of the science in the field, I conducted a systematic review to identify all exposome-wide studies of any health outcome in humans (methods are described in section 2.3.7 in Chapter Two). Since the exposome is a relatively recent concept, studies were also included in the review if they described their method as "environment-wide," which from my reading of the literature has been used synonymously with "exposome-wide" to systematically assess environmental exposures in relationship to a given outcome. From this review, 73 published exposome-wide studies were identified. Of the 73 studies identified, only 7 studied actual diagnosis of a chronic, non-communicable

disease that is a leading cause of death worldwide (Table 1). Of these 7 papers, most focused on cardiometabolic diseases, with no exposome studies published on leading global causes of death such as Alzheimer's or dementias, stroke, lung cancer, or chronic obstructive pulmonary disease (COPD). Although one study conducted an exposome-wide analysis of lung cancer mortality, only county-level aggregate data were used from US census or other population databases instead of individual-level data.[129] The remaining of the 70 published exposome studies focused on intermediate clinical risk factors (e.g., blood pressure, lipids, glycemic control) or other outcomes that are rare, acute, perinatal, observed in children, or not major causes of mortality.

Three exposome papers have been published on mortality or longevity to date, with one "environment-wide" analysis of all-cause mortality[130] and another phenome-wide paper on all-cause mortality[131] recently published. Further, one "exposome-wide" paper has been published on longevity.[64] Each of these three papers have suffered from limitations in sample size or definition of the exposome, which are discussed in more detail below.

Table 1. Existing exposome-wide studies on priority chronic health conditions that are major causes of mortality in adults.						
Outcome	**Population**	**Longitudinal**	**Replication**	**Exposome categories**	**Exposome incl. anthropometrics or disease**	**Addressed correlation**
B-cell lymphoma[132]	EPIC cohort (n = 475,426)	Yes	No	Diverse	Yes	Yes – LASSO, PCA
Chronic kidney disease[133]	NHANES (n = 46,748)	No	Yes; same cohort	Chemicals only	No	No
Type 2 diabetes[134]	NHANES (n = 503 to 3,318)	No	Yes; same cohort	Chemicals, dietary nutrients	No	No
Type 2 diabetes[135]	Marshfield Personalized Medicine Research Project Biobank (n = 7,420)	No	Yes; NHANES	Diverse	No	No
Coronary heart disease[136]	Nurses' Health Study (n = 62,811)	Yes	Yes; Nurses' Health Study II	Diet	No	No
Peripheral artery disease[137]	NHANES (n = 6,819)	No	Yes; same cohort	Chemicals, anthropometrics, physical activity, smoking	Yes	No
Cardiovascular disease[138]	NHANES (n = 43,568)	No	Yes; same cohort	Chemicals, anthropometrics, clinical phenotypes	Yes	Yes – random forest

A clear takeaway from this review is that, with few exceptions, exposome study designs are not currently being used to study and better understand the determinants of high-priority population health outcomes that are leading causes of death worldwide. Furthermore, existing studies on these diseases: (1) almost entirely use cross-sectional methods, leading to reverse causation bias where the true direction of effect between exposure and outcome cannot be ascertained; (2) use relatively small sample sizes that are underpowered to detect small and modest effects; (3) are focused on analysis of chemical and toxicological exposures (often exclusively); (4) and usually do not conduct any analyses (beyond a descriptive correlation heatmap) to adjust or account for the correlation between exposures, leading to confounding.

Trying to assess whether exposures are causal determinants of the outcome being studied is a widely discussed issue in exposomics.[126] Yet, as documented above, few exposome studies I reviewed adequately dealt with correlated exposures. This deficit is important to address, since it is well documented that environmental influences on health show strong and widespread correlation between each other.[139,140] This variable correlation is a major source of confounding, and furthermore highly correlated exposures cannot usually be put together in classical linear regression models without creating biased regression coefficients. One reason for the lack of methods to address correlation in existing exposome research may be because other approaches to address causality are more often considered, such as Mendelian Randomization or "multi-layered" approaches,[126] although the review I conducted shows that few studies take these steps. The theory behind the so-called "multi-layered" approach[126] is that if an environmental

exposure is reliably associated with multiple layers of outcomes, each of which has its own unique biases and confounders, then consistency in observed associations across layers reinforces an interpretation of causality. For example, a recent analysis in the Lifepath consortium assessed socioeconomic disadvantage among up to 1.7 million participants on: (a) long-term health outcomes; (b) intermediate physiological phenotypes, such as childhood obesity or walking pace; (c) intermediate circulating biomarkers (e.g., DNA methylation); and (d) immunity. They found a consistent dose-response between socio-economic disadvantage and each layer, despite adjusting for different confounders for each analysis, bolstering the conclusion that socioeconomic disadvantage plays a causal role in health and disease.[141]

Another conclusion from my review on existing exposome science is that in practice there is no clear consensus or consistency across studies on the definition and limit of what constitutes the exposome. First and foremost, while most studies describe the exposome as a holistic concept of all environmental exposures, in practice most empirical exposome studies only analyze chemical or dietary exposures. This approach does not match the current scientific knowledge on the determinants of mortality and lifespan discussed in section 1.3.3 above, where many large population-based meta-analyses and historical analyses have shown the importance of domains of the environment beyond chemical and pollution exposures, such as socioeconomic and psychosocial factors, behaviors (e.g., smoking), and lifestyle (e.g., physical activity). The limitations of this approach are seen in the only existing "environment-wide" analysis of mortality conducted to date using the NHANES cohort (n = 6,008).[130] This study focused on chemical

and toxicological exposures, with limited assessment of other domains of the exposome. Consequently, they could only explain 2.1% of mortality using the exposures identified.

Another area in which there is lack of consensus on the scope of the exposome relates to whether anthropometric measurements, disease diagnoses, and biological responses to the environment are included in the exposome. Operationalizing the exposome as all non-genetic factors (including anthropometrics and biological responses to the environment) in this way is likely too broad and will significantly alter results from discovery analyses. A clear methodological reason for making a division between true environment factors and biological (e.g., changes in blood metabolites, proteins, or epigenetic mechanisms) or physiological (e.g., frailty, disease phenotypes, walking pace, hand strength) responses to the environment is that biological, physiological, and clinical phenotypes are often mediators between the environment and disease endpoints being studied, meaning that adding them in the same model as the upstream exposome influences may diminish, or even remove, the significance of the exposures tested.[142]

This pitfall can be seen concretely in many existing exposome studies. In a previous phenome-wide analysis of mortality in the UK Biobank, environment exposures were tested in discovery analyses alongside blood biomarkers and disease/frailty phenotypes.[131] Consequently, disability, frailty, and other disease indicators were found to be the strongest predictors of mortality risk and none of the true environmental exposures studied (e.g., physical activity, pollution, education) were returned as top hits in the analysis aside from smoking. Furthermore, a recent exposome analysis of lymphoma[132] (Table 1) also included anthropometric and disease diagnosis exposures in its exposome-

wide scan. When running a principal components analysis (PCA) of all replicated exposures and putting the resulting principal components (PCs) into a single multivariable model, only the PC containing anthropometrics and BMI remained significantly associated with lymphoma after FDR. The same phenomenon was seen in the above-mentioned exposome study on longevity,[64] where adding environment and disease phenotypes together as the "exposome" led to only disease phenotypes and cardiometabolic risk factors remaining significantly associated with longevity. Although these disease phenotypes may convey the highest disease risk, they do not provide information about the most fundamental exposures for age-related disease and longevity. Related to this question is whether medication use or medical treatments should be considered as part of the exposome. However, given that these are usually administered to treat those with disease, in statistical models it is likely that these variables would capture the effect of the disease diagnosis itself on the outcome.

Recently, one conceptual review has deliberately argued to limit the definition of exposome to the totality of environmental exposures only, which is distinct from biological and phenotypic responses to these exposures.[143] This approach has been termed "functional exposomics." The authors clarify that a key component of exposomics should be investigating the interaction between exposome and biological and phenotypic responses, but that this distinction allows for clearer multi-omics analysis methodologies where the exposome is one distinct layer among other layers of omics and phenotypic influence (e.g., genomics, metabolomics, disease states).

1.8. Conceptual model of the exposome

Drawing from the arguments above, it seems that a functional exposomics approach provides the most appropriate methods for discovering the environmental determinants of human aging. Within such a framework, it will be important to conceptualize the functional exposome itself as made up of the accumulation of multiple layers across the lifecourse, which then influence intermediate human environments (Fig. 5). These exposome influences form a circular feedback relationship with our internal biological responses and resulting physical phenotypes over time. In this model, individual susceptibility to disease is the product of the interplay between each individual's cumulative history of exposures and biological responses, all of which interact with their underlying genetic susceptibilities. Such an approach is an explicit

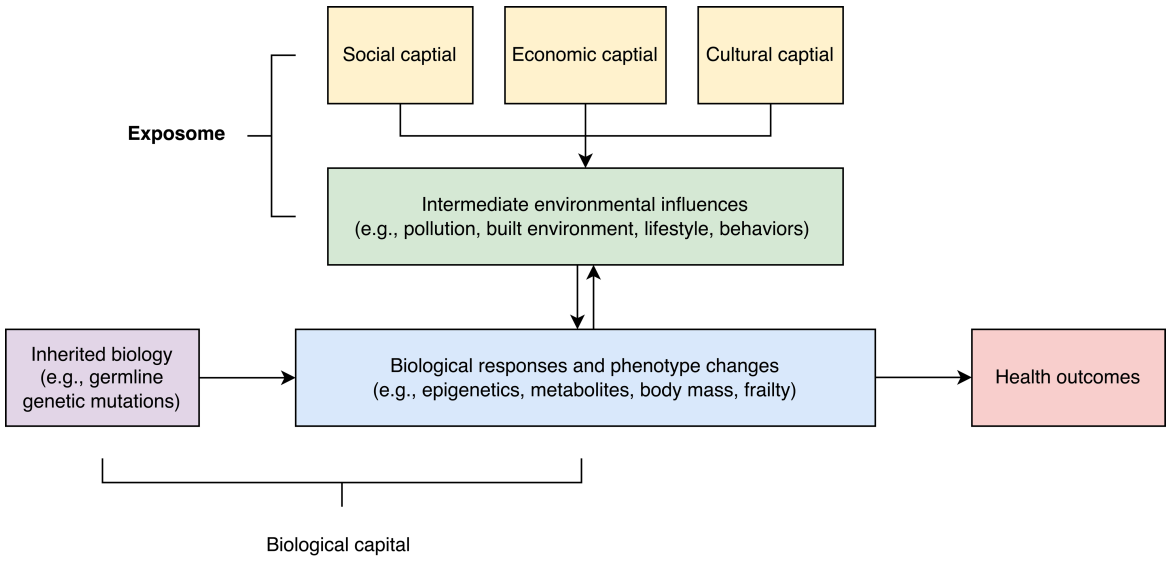


Figure 5. A conceptual model of the exposome in relationship with other influences on health across the lifecourse. Note the multiple layers within the exposome. Each form of capital is accumulated and dynamic across the lifecourse, as are the interplay between the exposome and biological capital. Adapted from: Vineis and Barouki. (2022) *Environ Int.*

endorsement of the idea that environmental exposures do not influence disease one at a time or independently. Rather, in the same way that genetic susceptibility to disease can be added up across all relevant genetic variants to describe total polygenic risk of disease, so too is the effect of the environment on disease the result of an accumulation of many environmental effects to form a total environmental risk greater than the sum of its parts.

1.9. Thesis aims

In this thesis, I attempt to address the gaps in the literatures on aging and exposome science discussed above through taking an integrative approach to studying the environmental determinants of human aging. To achieve this, I have developed new methods for an exposome-wide analysis of mortality and age-related phenotypes using prospective data from the UK Biobank (n = 492,569). Importantly, since accelerated rates of aging entail the development of chronic disease and increased mortality risk even in middle age (e.g., 40-60 years), we can detect and triangulate advanced rates of aging in people of middle age through measuring changes to aging biological mechanisms, chronic disease and multimorbidity burden, and mortality risk. This is the approach that I have taken to triangulate aging in this thesis.

The overall goal of this thesis is to quantify the impact of the environment on mortality and age-related diseases. In doing so, I aim to unravel how various components of the exposome are involved in age-related pathology in mid-life. To achieve this, my thesis work has been focused on three interconnected aims:

(1) Identifying exposures that are associated with all-cause mortality through a novel, multi-step analysis designed to address known biases in the fields of epidemiology and exposome research (Chapter Three). Aging typically entails multimorbidity across numerous diseases, with varying diseases and aging biological pathways affected across individuals. I therefore begin my thesis analyses by identifying exposures that reliably associate with the common outcome of all age-related diseases – mortality. The muti-step study design used in this chapter to identify exposures associated with mortality was designed to address known biases and methodological challenges through: (a) individually testing all exposures available in an exposome-wide association study (XWAS) using independent discovery and replication sets in order to improve the reproducibility of results; (b) testing replicated exposures for susceptibility to reverse causation from prevalent disease (e.g., those with a cardiovascular disease diagnosis may stop smoking); and (c) using a clustering analysis to combine exposures into multivariable models to address confounding due to environmental exposure intercorrelation.

(2) Identifying the age-related biological mechanisms, cardiometabolic risk factors, and chronic diseases through which the exposome influences risk of mortality (Chapter Four). All exposures significantly associated with mortality are tested in relationship to 25 blood biomarkers related to aging, incidence of 25 age-related chronic diseases, and prevalence of three cardiometabolic risk factors (obesity, hypertension, dyslipidemia). All chronic diseases investigated are either in the top 20 causes of death in the UK Biobank or are diseases that are highly prevalent in aging populations. This allows me to broadly test all the chronic diseases that either are significant determinants of mortality and lifespan or

are common aging phenotypes (e.g., macular degeneration, rheumatoid arthritis). Investigating a broad range of biological mechanisms and diseases allows me to measure whether different exposures influence different disease pathways, and to capture variation in multimorbidity patterns.

(3) Using multivariable models to estimate the impact of the exposome on mortality and age-related disease risk (Chapter Five). In this chapter, I create several stages of multivariable exposome models to estimate the total amount of variation (R^2) in mortality and age-related disease that can be explained by: (a) age and sex; (b) polygenic risk scores (PRS); (c) the exposome; (d) the exposome and PRS; and (e) the exposome, PRS, and clinical risk factors. For each disease outcome, all exposures that were associated with the outcome in analyses from Chapter Four are put in the same model to measure the total contribution of the exposome. R^2 values from these exposome multivariable models (a) are then compared with the subsequent models adding in PRS (b) and clinical information (c) to calculate how much of the remaining variation in mortality and age-related diseases can be explained by PRS and clinical risk factors on top of the exposome.

The analyses in this thesis are designed to disentangle the impact of environmental, genetic, and clinical factors on human aging and mortality. Together, results from these analysis stages reveal the environmental architecture of aging in the UK Biobank, which describes the associations between the exposome and each stage of the aging causal pathway that is available to analyze within the UK Biobank dataset.

2. Chapter Two: Approach and study population

To carry out this work outlined above has necessitated new analysis approaches that can deal with highly correlated environment variables and other sources of confounding. I therefore begin in this chapter with a detailed discussion of the methodological issues and challenges related to hypothesis-free analysis designs that I addressed in designing this study. I describe the broader rationale for the methodological approaches that I have taken, discussing the analytical issues encountered. This is followed by a detailed discussion of the general statistical methods, study population, and variable preparation used for analyses in this thesis.

2.1. Rationale for a hypothesis-free, exposome-wide approach

I carried out a hypothesis-free, exposome-wide analysis of all environment variables available in the UK Biobank in relationship to all-cause mortality for three key reasons:

(1) Choosing a limited set of exposures for analysis, based on previous research, would likely mean that I exclude understudied variables that may associate with mortality. A hypothesis-free analysis of all environment variables available in the UK Biobank would undoubtedly confirm and validate the contribution of previously established risk factors for all-cause mortality, but also simultaneously allows for the possibility of understanding new information about certain environmental risk factors that may associate differently with all-cause mortality, or lose their significance altogether,

when assessed alongside all other related exposures available in the UK Biobank. It is worth noting, however, that is unlikely in the context of a data resource like the UK Biobank that completely unstudied exposome influences will be discovered, since variables would have been included in the UK Biobank dataset in the first place because of some hypothesized or known relationship to health outcomes.

(2) Categories of environmental variables collected in the UK Biobank are multidimensional and it is not always possible to select *a priori* the optimal variable that will associate with mortality. The hypothesis-free exposome approach that I've used goes beyond simply adding one key variable from every category of environment variable to the analysis (e.g., just one smoking variable, just one physical activity variable). Instead, I included every environmental variable available for each trait, even if this meant including multiple of the same type of variable. For example, in the analysis I did not just include smoking pack years, but every smoking question available in the dataset that also met the other inclusion criteria (detailed below). In my discovery exposome-wide analyses, I study each of these variables as a single exposure. This is key to decrease measurement biases across variables and maximize information on the exposome.

The imperative for this approach was initially to maintain a unified variable selection decision rule across all variables. Whereas there may be clear previous evidence to guide the selection of an optimal smoking variable in the UK Biobank, previous research does not exist for many other variable categories in the dataset. This is because the measures used to assess many exposures in the UK Biobank don't always match those found in previous studies. For example, the diet variables found in the UK Biobank do not

precisely match the scales and measures used in previous epidemiological research on diet. Because of this, no summary diet score can be derived based on previous literature (e.g., a Healthy Eating Index [HEI], Alternate Healthy Eating Index [AHEI], or Dietary Approaches to Stop Hypertension [DASH] diet score), nor can a best variable be chosen to align my approach with previous research.

Without a clear ability to decide on variable inclusion/exclusion based on previous literature, choosing smaller subsets of variables to analyze for only some variable categories based on varying levels of previous evidence would introduce selection bias into my approach and would impede the ability for discovery. If previous research on well-known risk factors is robust and accurate, then the results from my own analyses should replicate those previous studies and show the strongest associations for the same optimal versions of those variables. But this approach also allows for a more data-driven method for variable selection for categories of variables that are more difficult to align with existing all-cause mortality research.

(3) Despite the many undeniable successes of observational epidemiology in determining important factors that contribute to mortality and disease risk, it is also well documented that published studies in observational epidemiology suffer from a preponderance of false positives and non-replicated associations.[144] Associations are often tested and reported for one variable at a time, or for small groups of variables, leading to 100s or 1,000s of different publications from certain prolific cohort studies. As Ioannidis and colleagues have written, this kind of "fragmentation" does not serve science well.[145] Another roadblock to reproducibility in epidemiology is the use of nominal significance

levels of $p < 0.05$. In the field of genetic epidemiology, it has previously been demonstrated that the positive predictive value of an association (i.e., the probability of a true association and not a spurious one, given a statistically significant finding) is a function of the p-value threshold used (type 1 error), power, and prior probability of the outcome (Fig. 6).[146] As the p-value threshold used decreases, the probability of finding true positives and not false positives improves dramatically. Other issues negatively impacting reproducibility include difficulty to account for confounding or reverse causation because of limited

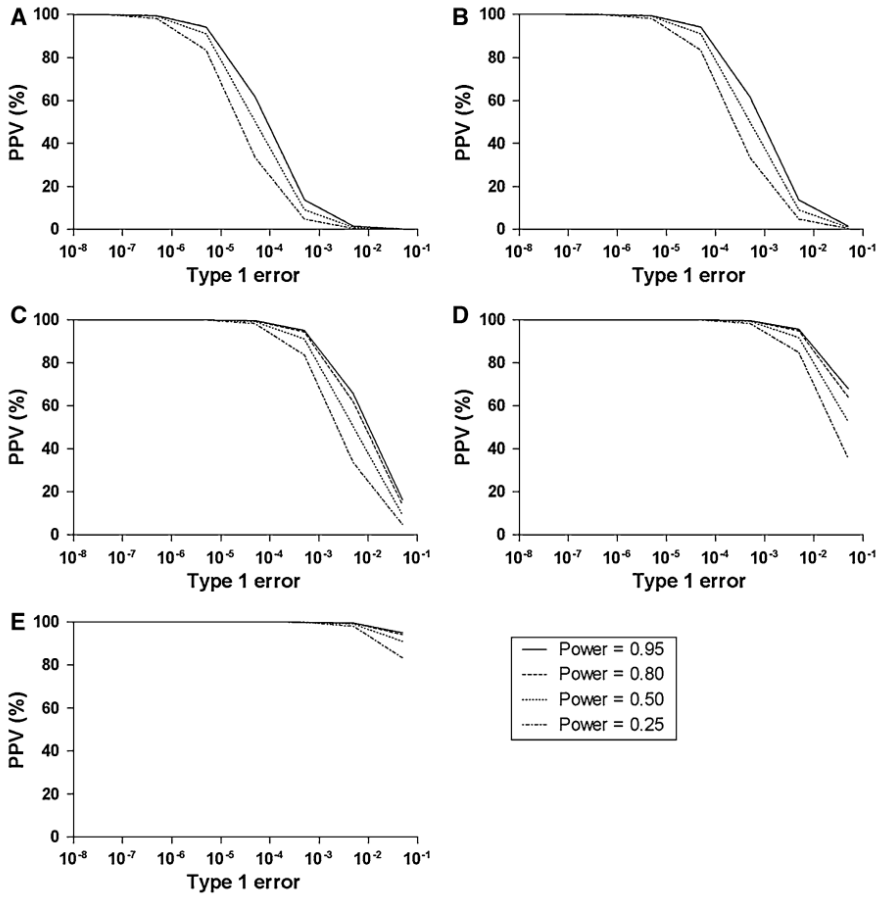


Figure 6. Positive predictive value (PPV) of varying p value thresholds. Solid power is 0.95; short dash power is 0.80; dotted power is 0.50; dot-dashed power is 0.25. **a** PPV of p value with a fixed prior probability of association of 1 × 10−4. **b** PPV of p value with a fixed prior probability of association of 1 × 10−3. **c** PPV of p value with a fixed prior probability of association of 0.01. **d** PPV of p value with a fixed prior probability of association of 0.10. **e** PPV of p value with a fixed prior probability of association of 0.50. Source: Broer et al. (2013) *Eur J Epidemiol.*

variables considered or cross-sectional designs, and the lack of public sharing of complete analysis output for both significant and null results.

A move away from targeted analyses and selective reporting of results towards hypothesis-free analyses and XWAS will contribute greatly to the reproducibility of findings in observational epidemiology. This approach should: (1) be performed in a large, well-characterized study sample with adequate power; (2) use a stringent significance threshold corrected for many simultaneous tests; (3) be performed with concurrent replication analyses in an independent population; (4) undertake an agnostic analysis of all available environment features (i.e., the exposome) in a given dataset; and (5) document and reports all tests across the exposome (both significant and null) without selective reporting. Such an XWAS approach will be crucial in diminishing the reporting of false positives and increasing the reproducibility of significant associations in observational epidemiology. As has been shown elsewhere, a similar transition in the field of genetic epidemiology from candidate gene studies to large genome-wide association studies (GWAS) with stringent significance thresholds and frequent replication brought the ratio of false positives to false negatives from approximately 180:1 (candidate gene) to 1:40 (GWAS),[147] and greatly improved the positive predictive value of findings.[146]

2.2. Addressing methodological challenges in exposome-wide research

There are two interrelated issues specific to working with environmental data that needed to be accounted for within the context of exposome-wide analyses. These are: (1)

possible reverse causation between prevalent disease status at baseline and each environmental variable, and (2) possible residual confounding arising from the dense intercorrelation between environmental variables.

It is conceivable that being in poor health or having a disease at baseline may influence participants' responses to exposures collected at baseline in the UK Biobank (e.g., those who have a lung cancer diagnosis may have stopped smoking and thus would report no current smoking at the baseline assessment). This represents a source of potential reverse causation to which these exposures are susceptible. To address this, I conducted a sensitivity analysis to assess whether having a disease or being in poor health at baseline influenced any of the effect estimates from the mortality XWAS in the general population. Sensitivity analyses to test for this are described in greater detail in section 3.1.3, but reverse causation bias was checked by systematically testing for interactions between replicated exposures and an indicator of baseline poor health. I only carried forward variables that showed no signs of bias in this analysis to the final modeling stages.

As described in Chapter One, most existing exposome-wide analyses do not account for the correlation structure among exposures in their analyses. To be clear, many previous studies have calculated and report the correlation between significant exposures, but fail to account for this correlation in their modeling. This is problematic, as it has been shown previously that exposome-wide association studies suffer from extreme significance inflation.[148] The dense intercorrelation between environmental factors is likely driving this inflated significance, and not accounting for this is somewhat akin to not accounting for linkage disequilibrium in the context of a GWAS. This correlation structure

makes identifying true determinants of mortality much more difficult, as it is difficult to say which exposures are causal factors driving the true association with mortality and which are merely correlated strongly with the causal factors.

To address this, I added a step to my thesis analyses to calculate the hierarchical clustering of all exposures replicated in the mortality XWAS. I then conducted further multivariable mortality modeling, within each cluster and among groups of neighboring clusters, where all variables from the same cluster of correlated variables (and also from neighboring clusters) were added into the same mortality model. This forces variables to adjust out of the model that do not have independent influences on mortality in the presence of the true determinants with which they are correlated.

A single multivariable model containing all validated factors from the XWAS across all clusters was not carried out because certain domains represented in different clusters are mediators of others in the pathway towards mortality. In the previous XWAS of all-cause mortality discussed in Chapter One, all factors replicated in their XWAS were put a single multivariable model in which smoking, one of the strongest known factors affecting disease and mortality, adjusted out of the model.[130] I therefore adopted this cluster modeling approach to avoid this kind of undesirable outcome of upstream exposome influences adjusting out when adding mediators to the model.

And finally, to try to improve confidence in whether exposures studied are true determinants of mortality and age-related disease, I employed the multi-layer approach discussed in Chapter One by testing each exposure in relationship to many different layers, including mortality, a range of diverse chronic diseases, cardiometabolic risk

factors, and diverse biomarkers. When an exposure is associated in consistent directions of effect across these layers, it improves confidence that is a true determinant of aging.

In the following sections, I report the general methods for this thesis related to the study population and data preparation.

2.3. Statistical methods

All statistical analyses were carried out using R version 4.1.0 and RStudio Version 1.4.1717. Polygenic risk scores were calculated using PLINK 2.0.

2.3.1. Study design and participants

The UK Biobank is a prospective cohort study with extensive genetic and phenotype data available for 502,505 individuals resident in the United Kingdom.[149] The full UK Biobank protocol is available online. Fig. 7 shows a flow diagram of participant exclusions and sample sizes for all stages of the study design. After all participant exclusions, a final analytic sample of n = 492,569 participants remained. The sample was then further subdivided into those recruited in England (n = 436,891) for all main analyses and those recruited in Scotland or Wales (n = 56,676) as an independent set used to validate final multivariable models (Chapter Five).

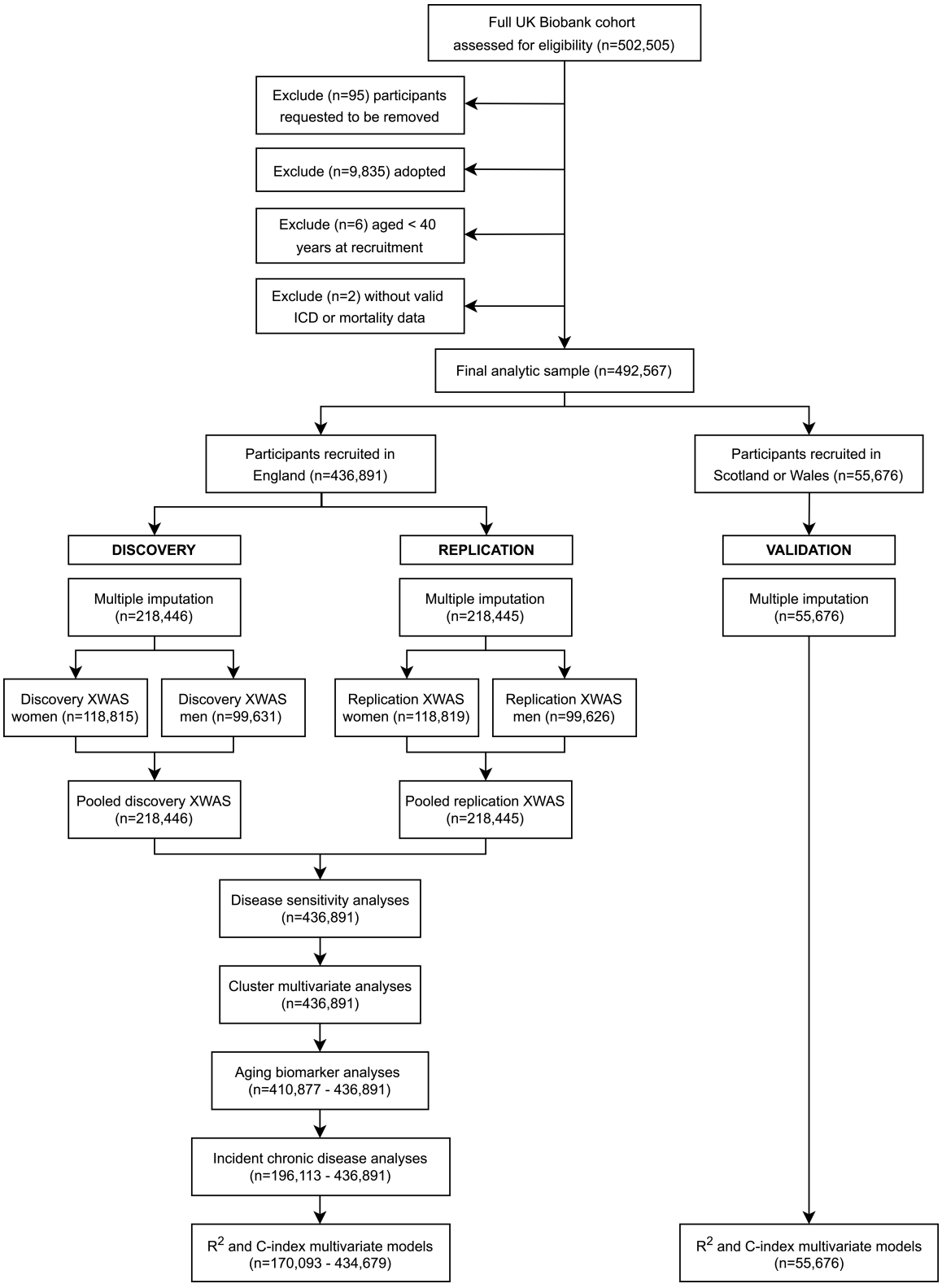


Figure 7. Flow diagram of UK Biobank study participant exclusions and exposome-wide study design steps

2.3.2. Exposome variable selection

A detailed table of all exposures tested in this thesis is given in Appendix Table S1. I considered for study inclusion all non-genetic variables that were collected at baseline in the UK Biobank via the touchscreen questionnaire, verbal interviews, physical measures, cognitive function assessment, blood sample assays, and urine assays that were available as of July 24, 2020 (769 variables). This included measures of the exposome, as well as variables on disease status, physical and biological measures (e.g., BMI, hand grip strength, blood/urine biomarkers), disease treatment (e.g., medications), and disability/frailty (e.g., disability allowances, walking pace). These non-exposome variables are referred to collectively as disease morbidity and aging phenotype variables. Exposome variables were included for use in the mortality XWAS, whereas prevalent and incident diseases, morbidities, and aging phenotypes were retained in the datasets both to improve the precision of the multiple imputation and to use later as covariates for analysis.

For certain physical measures, such as vision and hearing tests and heel bone mineral density, only non-specialist summary variables were considered and the rest were excluded. Similarly, the "best measure" variable for both forced vital capacity (FVC) and forced expiratory volume in 1-second (FEV1) were used and the raw readings for each individual blow attempt were not analyzed. Baseline ECG during fitness variables were excluded because no summary measures are currently available. Responses on hormone replacement therapy or oral contraceptives from field ID 6153 were not considered, as more detailed information on these was available in the female-specific reproduction

variables. Where multiple variables exist for the same trait, the most complete variable with the least amount of missing data was selected for analysis (e.g., standard measures of weight and BMI were used instead of impedance measures). Variables marked as pilot variables, or related to metrics for collecting other variables, device IDs, or other procedural metrics were also excluded.

Further deprivation variables derived from participants' post codes at baseline were also considered for inclusion. Townsend deprivation index is calculated for each participant based on the national census output areas from the national census immediately preceding their recruitment date into the UK Biobank.

Baseline air pollution measures are available at several different time points preceding or concurrent with the baseline recruitment in the UK Biobank. Air pollution estimates for nitrogen oxides (NO), nitrogen dioxide (NO_2), and particulate matter ($PM_{2.5}$, PM_{10}) in the years 2005-2007 were derived from EU-wide air pollution maps (resolution 100m x 100m).[150] Pollution concentration values were mapped to UK Biobank participants by overlaying the x-y geographical coordinates of UK Biobank participants with these maps (projected to British National Grid). The same air pollution measures were also estimated in 2010 for each participant's address using a Land Use Regression (LUR) model developed as part of the European Study of Cohorts for Air Pollution Effects (ESCAPE).[151]

Additionally, several other derived physical environment measures are available at baseline for UK Biobank participants. Traffic variables (e.g., distance to nearest major road, traffic intensity on nearest road) were calculated using LUR based on Eurostreets (vs 3.1) digital road network for the year 2008. Noise pollution for the year 2009 was modelled

using a version of the CNOSSOS-EU noise model.[152] Further information on derivation of the air pollution, noise pollution, and traffic variables is available on the UK Biobank website. Greenspace exposure and distance to the coast was mapped to participants based on home location grid references. Greenspace measures were created using the 2005 Generalised Land Use Database for England.[153] Coastal proximity was calculated for participants as a Euclidean distance raster from the coastline for a small grid cell size (50m), which was then mapped to UK Biobank participant coordinate locations. Further information is available on the UK Biobank website. Finally, urban and rural home area classification were mapped to UK Biobank participants by post code using the classifications created by the Office for National Statistics (ONS) as part of the ONS Postcode Directory (ONSPD).

I also considered for inclusion five items administered in the UK Biobank from the Childhood Trauma Screener (CTS), which was developed as a short form of the Childhood Trauma Questionnaire for large epidemiological populations.[154] CTS variables were collected in 2016-17 through a mental health questionnaire administered to UK Biobank participants via online follow-up. All UK Biobank participants with a valid email address on record were invited to complete the questionnaire, of whom 158,835 completed the questionnaire. Valid responses for CTS questions were received for 157,348 participants. These variables were initially considered for inclusion in the analysis as baseline exposures because they were asked retrospective to childhood, however sensitivity analyses showed significant survival bias evident in associations with all-cause mortality using these variables in the general cohort. Although childhood abuse exposures were

associated with increased risk of all-cause mortality in just the sub-population administered the mental health questionnaire, analyses in the entire cohort study population (after imputing missing values for childhood trauma for the whole cohort) showed these same exposures to be associated with significantly decreased risk of mortality. This is because these variables were only asked to a subset of the cohort that survived all the way from baseline until 2017, and thus represent responses from a healthier and longer living sub-population compared with the full baseline cohort.

After creating binary dummy variables from any "mark all that apply" questions (this process is described below in the "Variable coding" section), I arrived at a total of 769 potential variables to include in the dataset for imputation. From this list of 769 potential variables, I first excluded all variables missing in more than 80% of the final male and female datasets. Furthermore, I also excluded all nested variables (e.g., a question asking respondents to indicate the number of years since diagnosis that was only asked to participants who responded yes to having a previous cancer diagnosis) except for those that could be recoded to avoid improper missing data imputation (see section 2.3.4).

After all variable exclusions, including further variable deletions during the pre-XWAS quality control stage (see section 2.3.5), a final total of 185 and 179 exposures were left in women and men, respectively, to be included in XWAS analyses. A total of 239 variables in both women and men remained representing disease morbidity and aging phenotypes. Exposome variables common to both men and women were 175 in total. Two variables (accommodation type [field ID 670] and diet change over the past 5 years [field ID 1538]) are included in both domains of analysis, as some response levels of these

variables were considered indicative of an exposome association (and only included in the XWAS), whereas other response levels were indicative of illness or disability (e.g., diet change in the past 5 years due to an illness, or reporting living in sheltered accommodation). All continuous exposure variables were centered and standardized before analysis, except for age at recruitment. All ordinal categorical variables were recoded to only test linear associations and other polynomial contrasts (e.g., quadratic or cubic associations) were not assessed. All nominal categorical exposures were analyzed with the most common category set as the reference.

2.3.3. Variable coding

The following variable recoding was carried out before multiple imputation. All variable responses of "Prefer not to answer", "Do not know", and "Not applicable" were recoded to NA. Following multiple imputation, any variable values where the participant responded "Prefer not to answer" in the original dataset were recoded to NA. All nominal categorical variables were coded as unordered factors, with the reference level set as the most frequent response reported in the UK Biobank dataset. Ordered categorical variables were coded with the reference level set as the lowest response (e.g., "Never", "Rarely", or "None"). Dichotomous categorical variables were coded with the reference level set as "No." All variables with "mark all that apply" response categories were converted into multiple dummy variables, with each unique response option used to create a yes/no dichotomous variable.

For all numeric diet intake variables, participants who responded “less than one” were recoded as 0.5. For variables on number of hours spent watching TV, on the computer, and driving, participants who responded “less than one” were recoded as 0.5.

To harmonize responses to the home area population density variable (field ID 20118) across different countries, this variable was recoded with a simpler classification of urban or rural home area population density. Participants who were classified in the original variable as "England/Wales - Urban – sparse," "England/Wales - Urban - less sparse," "Scotland - Large Urban Area," or "Scotland - Other Urban Area" were recoded to “Urban.” All other responses were recoded to “Rural,” with the exception of “Postcode not linkable.” Those with values of “Postcode not linkable” were set as NA after imputation.

All nested variables were excluded from analysis, except for several variables that could be recoded to account for nesting. Two variables were recoded in this way before imputation and then imputed normally. For smoking pack years (field ID 20161) and smoking pack years as a proportion of lifespan exposed to smoking (field ID 20162), missing values were recoded as 0 if the respondent was coded as “No” in response to the derived ever smoked variable available in the UK Biobank (field ID 20160), but otherwise left as NA if respondents had ever smoked.

I also recoded several nested variables after multiple imputation. For bread type, cereal type, and coffee type variables, all participants with a response of 0 for the bread, cereal, and coffee intake questions were coded to “Never eat bread”, “Never eat cereal,” and “Never drink coffee,” respectively. After imputation, I also recoded the number of

people living in your household variable to NA if a respondent reported living in a care home or sheltered accommodation, since that question was not asked to these participants and there were very few of them. I then recoded dummy variables created from field ID 6141 (how are you related to people in your household). Specifically, if the participant reported being the only person living in their household, then each dummy variable was set to "No." Additionally, if the participant reported living in a care home or sheltered accommodation, then each dummy variable was set to NA. For example, for the yes/no dummy variable indicating whether the participant lives at home with parents, the response was recoded to "No" if that same participant reported living as the only person in their household and was set to NA if that same participant reported living in a care home or sheltered accommodation.

Non-exposome response level recoding. For two nominal categorical variables, I removed a specific level as our team deemed that it was capturing disability and not the exposome. The first was Type of accommodation lived in (field ID 670), where I recoded anyone reported living in "sheltered accommodation" to NA and removed that response level from the variable. The second was Major dietary changes in the last 5 years (field ID 1538), where I recoded anyone reported "Yes, because of illness" to NA and removed that response level from the variable.

Diet variable recoding. Following previous research on diet in the UK Biobank,[155] I recoded several diet variables. For processed meat (field ID 1349), poultry (field ID 1359), oily fish (field ID 1329), and non-oily fish (field ID 1339), I combined the top three frequencies to get four categories: never, < 1.0 time per week, 1.0 time per week, and ≥ 2.0

times per week. For cheese intake (field ID 1408), I combined the bottom two frequencies and the top two frequencies to get four categories: < 1.0 time per week, 1.0 time per week, 2.0-4.9 times per week, and ≥ 5.0 times per week. For daily tea intake (field ID 1488), I grouped participants into the following categories: < 2.0 cups per day, 2.0-3.9 cups per day, 4.0-5.9 cups per day, and ≥ 6.0 cups per day. For daily coffee intake (field ID 1498), I grouped participants into the following categories: 0 cups/day, 0.5-1.9 cups per day, 2.0-2.9 cups per day, and ≥ 3.0 cups per day. Cereal (field ID 1458), bread (field ID 1448), and water (field ID 1528) intake were categorized into quartiles based on participants' responses. Cereal was coded as < 2 bowls/week, 2-4.9 bowls/week, 5-6.9 bowls/week, ≥ 7 bowls/week. Bread was coded as <8 slices/week, 8-13.9 slices/week, 14-19.9 slices/week, ≥ 20 slices/week. Water was coded as <1 glass/day, 1-1.9 glass/day, 2-2.9 glass/day, ≥ 3 glass/day. Finally, in line with previous large-scale research on alcohol consumption,[156] I restricted analyses of alcohol intake frequency (field ID 1558) to current drinkers only. For alcohol intake, all participants who responded as "Never" or "Previous" drinkers to the alcohol status variable (field ID 20117) were coded as NA. In addition, I coded participants who responded as drinking on "Special occasions only" as NA. The final variable was coded as a nominal variable with responses for "One to three times a month", "Once or twice a week", "Three or four times a week", and "Daily or almost daily", with "One to three times a month" set as the reference.

2.3.4. Derived variables

Several derived variables were calculated in the UK Biobank dataset used for analysis. All derived variables were calculated after imputation, and the original variables used to create each of the derived variables were then excluded from the XWAS analysis (with the exception of diet variables used to construct the partial fiber score).

Ethnicity. Responses to the baseline UK Biobank self-reported ethnicity question (field ID 21000) were condensed into Black, Asian, white, mixed, and other response categories. This condensation largely follows previous research in the UK Biobank,[157] although further collapses all reported Asian ethnic backgrounds into a single response category. Response categories were re-coded as follows: Black = "Black or Black British", "Caribbean", "African", "Any other Black background"; White = "White", "British", "Irish", "Any other white background"; Mixed = "Mixed", "White and Black Caribbean", "White and Black African", "White and Asian", "Any other mixed background"; Asian = "Asian or Asian British", "Chinese", "Indian", "Pakistani, "Bangladeshi", "Any other Asian background"; Other = "Other ethnic group".

Sleep. I created a categorical variable for hours of sleep using the UK Biobank hours of sleep continuous measure (field ID 1160). In line with recommendations from the American Academy of Sleep Medicine and Sleep Research Society,[158] category levels used for hours of sleep were <7 hours, 7-9 hours, and >9 hours, with the reference set as 7-9 hours.

Education. Following previous research on education in the UK Biobank,[159-161] an education years variable was created by converting the responses from the education qualifications variable (field ID 6138) into the equivalent years of education. Response categories were mapped onto years of education using the International Standard Classification of Education (ISCED) scale as follows: 7 years = "none of the above (no qualifications)"; 10 years = "CSEs or equivalent" or "O levels/GCSEs or equivalent"; 13 years = "A levels/AS levels or equivalent"; 15 years = "other professional qualification"; 19 years = "NVQ or HNC or equivalent"; 20 years = "college or university degree." Where participants marked multiple educational qualifications, the qualification with the highest corresponding years of education was used for that participant.

Standardized lung function. Standardized FEV1 and FVC variables were created by dividing the FEV1 (field ID 20150) and FVC (field ID 20151) best measure variables by standing height squared (field ID 50). This was done to ensure that values for these variables were not strongly determined by body size.[162,163]

Normalized hand grip strength. Hand grip strength variables (field IDs 46-47) were normalized to body mass by dividing by weight.[164,165]

Partial fiber score. Following a method previously reported in the UK Biobank,[166] I created a daily partial fiber score using baseline self-report data on intake of fresh fruit, dried fruit, raw vegetables, and cooked vegetables; bread type and bread intake; and breakfast cereal type and breakfast cereal intake. Intake of fresh fruit, dried fruit, raw vegetables, and cooked vegetables was measured as a numeric response corresponding to portions consumed per day, and these portions were multiplied by the estimated fiber

content per portion for each food group (Table 2). Bread and cereal intake were measured as a numeric response corresponding to portions consumed per week. Bread and cereal intake were divided by 7 to get an estimate of daily intake, and this daily intake was multiplied by the estimated fiber content for the specific type of bread and cereal that each participant reported to mainly eat. Participants who indicated "less than one" in response to the weekly bread and cereal intake questions were recoded as 0.5.

I then summed the fiber intakes from each type of food to get a daily estimated partial fiber intake. I observed a lower average fiber intake in the sample used for my analysis (12.4 g in all participants, 13 g in women, 11.6 g in men) compared with the previous publication on creation of the fiber score (14.3 g in all participants, 14.6 g in women,14.0 g in men), as my analyses were conducted in the full baseline cohort whereas the previous publication was only conducted in a subsample of the UK Biobank population (n = 20,348) who were healthy enough to survive to the follow up assessment of 24-hour recall diet 4 years after recruitment. This sub-population would be a healthier population than the full baseline cohort and understandably would therefore show improved healthy habits and behaviors such as fiber consumption. I converted the continuous fiber score into quintiles and analyzed partial fiber as an ordinal variable. After creating the partial fiber score, consumption of the individual food components of the score were retained in analyses to test whether each of the food groups contributed to mortality beyond their fiber content.

Table 2. Components and calculation of the daily partial fiber score

Food variable (UK Biobank field ID)	**Portion specified in touchscreen question**	**Portion size**	**Estimated fiber content per portion (g)**
Fresh fruit (1309)	Pieces (e.g., 1 apple, 1 banana, 10 grapes)		2.0
Dried fruit (1319)	Pieces (e.g., 1 apricot, 1 prune, 10 raisins)		0.5
Cooked vegetables (1289)	Heaped tablespoons		1.0
Raw vegetables (1299)	Heaped tablespoons		1.0
Bread intake (1438) Bread type (1448)	Slices	White bread: 36 g Brown bread: 36 g Wholemeal bread: 36 g Other type of bread: 36 g	0.68 1.26 1.80 1.25
Breakfast cereal intake (1458) Breakfast cereal type (1468)	Bowls	Bran cereal: 40 g Biscuit cereal: 40 g Oat cereal: 160 g Muesli: 55 g Other (e.g., cornflakes): 30 g	7.16 2.92 1.92 4.18 0.54

Estimated fiber content/portion take from Bradbury et al. (2018).[166]

Total red meat consumption. *I* created a new total red meat consumption variable by summing the frequencies for beef (field ID 1369), pork (field ID 1389), and lamb/mutton (field ID 1379), using the following coding: 'Never' = 0, 'Less than once a week' = 0.5, 'Once a week' = 1, '2-4 times a week' = 3, '5-6 times a week' = 5.5, 'Once or more daily' = 7. These values were then summed across the three variables and participants were coded into 4 categories of total red meat consumption: <1 time per week, 1.0-1.9 times per week, 2.0-2.9 times per week, and ≥3.0 times per week.

Total fruit consumption. Participants were asked to enter the number of pieces of fresh fruit (field ID 1309) and dried fruit (field ID 1319) they eat per day. One piece of fresh

fruit, and two 'pieces' of dried fruit were counted as a serving. I then summed the number of total servings consumed per day and grouped participants into the following categories: < 2.0 servings per day, 2.0-2.9 servings per day, 3.0-3.9 servings per day, and ≥ 4.0 servings per day.

Total vegetable consumption. Participants were asked to enter the number of heaped tablespoons of cooked vegetables (field ID 1289) and salad/raw vegetables (field ID 1299) they eat per day. Two heaped tablespoons of either type of vegetables was counted as a serving. I then summed the number of total servings consumed per day and grouped participants into the following categories: < 2.0 servings per day, 2.0-2.9 servings per day, 3.0-3.9 servings per day, and ≥ 4.0 servings per day.

Total dairy milk intake. *I* derived an estimate of total dairy milk intake using the questions on type of milk (field ID 1418), bowls of breakfast cereal (field ID 1458), cups of tea (field ID 1488), and cups of coffee (field ID 1498). For participants who selected one of 'Full cream', 'Semi-skimmed' or 'Skimmed' milk intake, I calculated their total daily dairy milk consumption by summing 100 mL of milk for each bowl of breakfast cereal, 35 mL of milk for each cup of tea, and 25 mL of milk for each cup of coffee. Participants were then divided into three categories: those that consumed < 150 mL of milk, 150-299 mL of milk, and ≥ 300 mL of milk daily. Participants who answered 'Never/rarely have milk' to the question on type of milk consumed were assigned to the first category. This derivation of totally daily dairy milk intake was previously shown in the UK Biobank to discriminate well between those who had low and high dairy milk intakes according to the more detailed 24-hour dietary assessment variables.[155]

Leisure time physical activity. As has been done previously,[167] I used responses from a mark all that apply question (field ID 6164) asking participants about types of physical activity they have undertaken in the past 4 weeks to create a summary leisure time physical activity (LTPA) score. For each type of activity, if the participant reported undertaking that activity in the past 4 weeks, then they were asked how many times in the past 4 weeks and the how long they spent on the activity each time. Those responses were used to determine the number of days/week for each activity and the number of minutes for each activity. These values were multiplied and divided by 7 to get the mins/day for each activity, which was multiplied by the metabolic equivalent of task (MET) for each activity (Table 3). I then summed these values across all variables to get a total LTPA MET value for each participant. Participants were categorized into three groups of LTPA using the IPAQ scoring system: (1) high activity: 3,000 MET-mins per week or greater; (2) moderate: 600-3,000 MET-mins per week; and (3) low: less than 600 MET-mins per week.

Table 3. Components and calculation of the LTPA and OPA scores

LTPA (field ID)	**METs**
Walking for pleasure (6164, 981, 971)	3.3 METs * mins/week
Strenuous sports (6164, 1001, 991)	8.0 METs * mins/week
Other exercises (6164, 3647, 3637)	4.5 METs * mins/week
Light DIY (6164, 1021, 1011)	2.25 METs * mins/week
Heavy DIY (6164, 2634, 2624)	4.5 METs * mins/week
OPA (field ID)	
Heavy physical work (816, 767)	4.5 METs * mins/week
Walking/standing work (806, 767)	2.25 METs * mins/week

LTPA: leisure-time physical activity; OPA: occupational physical activity; MET: metabolic equivalent of task; DIY: do-it-yourself. METs used for each type of activity were taken from Pearce et al. (2020).[167]

Occupational physical activity. As has been done previously,[167] I used responses on whether participants' work involves heavy manual or physical work (field ID 816) or involves mainly walking or standing (field ID 806) to create a summary occupational physical activity (OPA) score. For both variables, participants reported how often they performed each type of work by choosing from the following categories: "Never/rarely", "Sometimes," "Usually," or "Always." To estimate minutes spent per week in each of these types of work, I first multiplied the hours of employment per week (field ID 767) by 60 to get the total minutes per week that each participant spent at work. Values of mins of employment per week were set to 0 for all participants who did not indicate that they were in paid employment or self-employed (field ID 6142). I then calculated the number of minutes spent specifically in each type of heavy manual and walking/standing work by adjusting the total minutes of work per week according to participants responses to how frequently they engage in heavy manual or walking/standing work. Specifically, for both variables I multiplied the minutes spent working per week by: 0 if the participant replied "Never/rarely"; 1/3 if the participant replied "Sometimes"; 2/3 if the participant replied "Usually"; and 1 if the participant replied "Always." In this way, I calculated the approximate minutes per week that each participant spent in both heavy manual and walking/standing work. The mins per week for both types of work were then multiplied by the metabolic equivalent of task (MET) for each activity (Table 3) and these values were summed across both variables to get a total OPA MET value for each participant. I used the same MET thresholds per week as the LTPA variable to categorize participants into low, moderate, and high OPA.

Total sedentary time. Total sedentary time was measured according to a previously reported method in the UK Biobank,[168] using measures on self-reported hours spent on a typical day watching television (field ID 1070), using the computer (field ID 1080), and driving (field ID 1090). Values for each variable greater than 24 hours per day were excluded, and those reporting over 16 hours were re-coded to 16 hours. Tertiles were used to categorize sedentary time into low (0-4 hours), medium (5-6 hours), and high (>6 hours) levels of sedentary behavior, with 0-4 hours set as the reference and the variable was classed as an unordered factor.

2.3.5. Variable quality control

As a final quality control (QC) step conducted after imputation but before running the sex-specific XWAS, I systematically examined the crosstabs between each potential categorical analysis variable and the mortality binary indicator in both women and men. Any categorical variable with less than 10 mortality cases for a single response level was then flagged for further inspection. Three possible quality control actions were then undertaken:

(1) Binary categorical variables with less than 10 mortality cases for one of the response levels were completely excluded from the XWAS.

(2) I collapsed the "All of the time" and "Often" response levels for the narcolepsy variable, and I also collapsed the "Yes" and "I am completely deaf" response levels for the variable "Do you have any difficulty with your hearing?"

(3) For nominal categorical variables, any response levels with too few mortality cases were set to NA and therefore not analyzed in the XWAS. The only variable that this affected was the “What type of accommodation do you live in?” variable, where the response level indicating that participants were living in a care home was set to NA and not analyzed in the XWAS because too few participants endorsed that response.

In order to improve the interpretability of results, all responses of “none of the above” or “other” for nominal variables were set to NA and not analyzed. The response level of “None of the above” was also set to NA for the usual walking pace variable, and the resulting response levels of "Brisk pace", "Steady average pace", and "Slow pace" were recoded to be an ordinal variable with slow pace as the highest response level.

As a final pre-XWAS coding step, I also set all responses to the alcohol intake frequency variable (field ID 1558) as NA if the participant reported being a previous drinker and not a current or never drinker in a separate alcohol consumption status variable (Field ID 20117). Previous research has shown that including previous drinkers and never drinkers together in measures of current alcohol intake frequency leads to substantial confounding in mortality analyses due to the fact that many previous drinkers are those that stopped drinking due to some health issue or disability.[169,170] With this coding scheme, those who responded “Never” in the alcohol frequency variable are true never drinkers and not those who used to drink but have since stopped.

2.3.6. Multiple imputation

The dataset of participants recruited in England was split into random 50% subsamples for discovery and replication while maintaining the same proportion of mortality cases in each. The average percentages of missing data across all final variables included in the UK Biobank analysis datasets were 11% in women (range: 0 – 79%) and 10.9% in men (range: 0 – 77%). As shown in Fig. 8, the rates of missing data for the final subset of 55 exposures identified as independently associated with mortality (described in Chapter Three) was lower, with the majority of variables missing < 5% of responses and all but one variable missing < 20 % of responses.

Because of the large heterogeneity in number of missing responses across exposure variables initially considered in the analyses, I created multiple imputed datasets instead of producing a single imputed dataset. Creating a single imputed dataset does not account for the uncertainty caused by the missing data and tends to inflate the significance of p-values, artificially shorten confidence intervals, and represent variables as more strongly associated than they really are.[171] Studies using simulation data alongside ALSPAC cohort data have shown that multiple imputation, even when used on datasets with large proportions of missing data (up to 90%), can still produce unbiased regression results so long as the imputation model is properly specified and the data are missing at random.[172] Indeed, it has been shown that multiple imputation is often more efficient than complete case analyses for estimating the coefficient of a regression variable when other model covariates are incomplete (i.e., have missing data).[173,174]



Figure 8. Rates of missing information among the 55 exposures replicated in the mortality XWAS and that survived the disease sensitivity and cluster modeling steps. Derived variables are not shown (they were only created after multiple imputation) and instead all component variables that make up derived variables are shown.

Missing data were imputed separately for the discovery, replication, and validation datasets (Fig. 7). I used the R package missRanger[175] to perform multiple imputation, which combines random forest imputation with predictive mean matching. Together, these methods offer a robust approach to imputed missing data in heterogeneous datasets (i.e., datasets containing both continuous and categorical data). Random forest imputation is a non-parametric method that is particularly appropriate when a normal distribution for all variables cannot be assumed, as it will preserve any skewness in the original data, and has also been shown to have the least imputation error and greatest accuracy when compared with other leading methods such as multiple imputation by chained equations (MICE).[176,177] Furthermore, random forest imputation is able to handle collinearity between variables well during imputation, whereas multiple imputation carried out from predictive mean matching alone does not perform well in the presence of collinearity. In fact, early attempts at performing multiple imputation via predictive mean matching using the mice[178] package in R with the dataset would not even run successfully because of the high collinearity present between various index of multiple deprivation variables, as well as among air pollution variables.

I imputed 5 datasets, with a maximum of 10 iterations specified for each imputation. Each imputation was also weighted by degree of missing data for each participant, such that the contribution of data from participants with higher proportions of missingness were weighted down in the imputation. I set the maximum number of trees for the random forest to 200, but left all other random forest hyperparameters at their default. The imputation datasets included all exposures, in addition to all baseline disease

and aging phenotype variables to be used in later analyses. The imputation procedure considered all variables as predictors to impute missing values in all other variables. In addition, the Nelson-Aalen estimate of cumulative hazard and the all-cause mortality event indicator were also used to predict imputation values, as it has been shown that imputation incorporating the Nelson-Aalen estimate of cumulative hazard to the survival time $H_0(T)$ and the event indicator as predictors improves the imputations for survival analyses.[174] The average out-of-bag (OOB) error rate for multiple imputation across all imputed datasets was 0.077 in women (range: 0 – 0.75) and 0.076 in men (range: 0 – 0.68). All subsequent study analyses were run independently in each of the five imputed datasets, and results were pooled using Rubin's rule.[179]

2.3.7. Systematic review of exposome-wide health studies

To better situate the research from this thesis in relation to the landscape of published exposome-wide or environment-wide analyses, I conducted a systematic review to identify all exposome studies published to date on any health outcomes in humans. I searched PubMed on March 28, 2022 using the following search string: Exposom* OR Exposome-wide OR Environment-wide OR "Environment-wide association study" OR "ExWAS" OR "Ex-WAS". Eligibility criteria included peer-reviewed, original research articles containing an exposome- or environment-wide analysis of biological, health, or behavioral outcomes in humans, with no limit for year of publication. Exclusion criteria included duplicates; non-English publications; research not carried out in humans;

reviews, commentaries, or methods articles; corrigendum or response articles; and preprints. Paper abstracts were screened independently for eligibility by two separate reviewers (myself and another PhD student), with any discrepancies in inclusion/exclusion decisions reconciled to arrive at the final list of papers to include. Studies were reviewed for inclusion using Rayyan software.[180] Protocol for the systematic review was pre-registered on the Open Science Framework (OSF) (DOI: 10.17605/OSF.IO/N3DCV; https://osf.io/n3dcv/). 1,472 studies were retrieved via our search, of which 73 were deemed appropriate to include.

3. Chapter Three: Exposome-wide analysis of all-cause mortality

Ultimately, despite individual variation in age-related biological changes and disease, the endpoint is always the same – mortality. This is the common outcome of all age-related diseases, and was therefore the most appropriate outcome to use for my initial exposome-wide analyses to identify exposures that may influence the progression of aging. After initial XWAS modeling, multiple analyses steps were carried out to test identified exposures for their susceptibility to bias from exposome intercorrelation and reverse causation due to prevalent disease. Further sensitivity analyses were also carried out to measure potential bias resulting from using self-reported physical activity measures instead of objectively measured physical activity from an accelerometer. Results from these mortality analyses are described below.

3.1. Methods

3.1.1. Mortality outcome variables

For all-cause mortality analyses, participant follow-up started at recruitment into the UK Biobank study and ended on the censoring date, or death, for all participants, leaving a total of 11-15 years of follow-up. Mortality date and cause of death information was obtained from National Health Service (NHS) Information Centre for participants from England. Detailed information about the linkage procedure with national registries

for mortality and cause of death information is available online. Mortality data were accessed from the UK Biobank data portal on May 4, 2022, with the UK Biobank recommending at that time a censoring date of September 30, 2021 or October 31, 2021 for participants recruited in England/Scotland or Wales, respectively (11-15 years follow-up).

3.1.2. Exposome-wide association study (XWAS) modeling

XWAS of all-cause mortality were initially carried out separately in women and men, and then a final XWAS was calculated in the pooled dataset with both women and men to increase power. Exposome variables in the final pooled XWAS were limited to those asked to both women and men, omitting sex-specific reproductive factors. In each XWAS, I serially assessed associations of each individual exposure with all-cause mortality using Cox proportional hazards models with age as the time scale; stratified by 5-year birth cohorts and sex; and adjusted for assessment center, years of education, and ethnicity. Since it has been shown that UK Biobank participants are likely to misreport alcohol consumption as a function of higher disease burden,[181] self-reported overall health status was added as an additional XWAS covariate for self-reported alcohol intake. P-values in the discovery and replication analyses were corrected using the false discovery rate (FDR; Benjamini-Hochberg method[182]) with a significance threshold of FDR $p < 0.05$. A rationale for each of the covariates in the final XWAS model is given below.

Mortality risk varies significantly with age. To account for this, Cox models in both the discovery and replication XWAS were calculated using age-at-risk as the time scale for

the survival analysis instead of follow-up time in the study (i.e., number of years between date of recruitment into the study and date of censoring). It has been previously shown that using follow-up time in study as the time scale, while merely adding age as a covariate, does not adequately reduce age-related bias in survival analyses for outcomes that are age-related.[183,184] Using age-at-risk as the time scale has been shown to adequately mitigate this bias in survival analysis because it puts similar subjects in a risk set together and allows for a non-parametric age effect. Using age-at-risk as the time scale in a survival model is performed using three variables to calculate the survival outcome: age at recruitment, age at censoring, and the event indicator. The difference between these two approaches is demonstrated in the two R formulas below:

$$coxph(Surv(f,d) \sim e + x, data) \quad (1)$$

$$coxph(Surv(e,a,d) \sim x, data) \quad (2)$$

where formula 1 is a more common survival formula using follow up time in study (f) and the event indicator (d) to calculate the survival outcome, with age at recruitment (e) entered as a covariate (ideally centered to the mean) alongside other exposures and covariates of interest (x). Formula 2 is an age-at-risk survival formula using age at recruitment (e), age at censoring (a), and the event indicator (d) to calculate the survival outcome. Note that age at recruitment and age at censoring are not centered or standardized in the age-at-risk analysis, and a separate covariate for age is not needed in the model.

Geographic location has been shown to significantly influence mortality and life expectancy in the UK, even after accounting for differences in deprivation between areas.[185] Accordingly, UK Biobank assessment center (as a proxy for geographic location) was added to the XWAS model as a covariate. In a meta-analysis of 48 prospective cohort studies (n = 1,700,000), socioeconomic status was shown to associate significantly with mortality, contributing the third highest population attributable fraction for mortality compared with conventional risk factors (behind smoking and physical activity).[105] I therefore used education years as covariate related to socioeconomic status. Ethnicity was also considered as a covariate, as this has also been used in multivariable adjustment from a previous XWAS of all-cause mortality.[130]

Each XWAS model was also stratified by two variables: 5-year birth cohort and sex. Adding strata for 5-year birth cohorts adjusts for cohort effects, as cohort effect patterns have been demonstrated for many age-related diseases and in mortality patterns across multiple European countries (including England) for both sexes and almost all causes of death.[186,187] Participants were assigned to one of seven birth cohort categories (in 5-year intervals from 1935 until 1970) using their year of birth. XWAS models were also stratified by sex since mortality rates were much lower in women compared to men in the dataset (5% vs. 8.7%), and thus I could not assume a common baseline mortality hazard between men and women. When conducting preliminary model selection analyses in the UK Biobank dataset, a model using a strata term for sex resulted in a much better model fit according to AIC compared with an identical model using a fixed effect covariate for sex instead of a strata term.

The Cox proportional hazards model used in the final XWAS was composed with age-at-risk as the time scale; included covariates for UK Biobank assessment center, years of education, household income, and ethnicity; and was stratified by 5-year birth cohorts and sex. XWAS Cox models were analyzed with the survival[188] package in R using the following formula:

$$coxph(Surv(e,a,d) \sim strata(b,s) + t + g + r + x, data) \quad (3)$$

where e is age at recruitment, a is age at censoring, d is the event indicator (mortality = 1, no mortality or censored = 0), b is 5-year birth cohorts, s is sex (female/male), t is UK Biobank assessment center, g is years of education, r is ethnicity, and x is the individual exposures being tested. Adding a stratification variable in a Cox proportional hazards model allows for separate baseline hazard functions to be fitted within each of the strata, while keeping other covariates constant. In the XWAS model, baseline hazards were thus calculated separately within each combination of sex and 5-year birth cohorts (14 total strata), and the resultant regression coefficients returned in the model results are optimized across all strata. Early sex-specific XWAS runs used an identical model, but omitted the strata term for sex.

Exposome variables in the final pooled XWAS were limited to those asked to both women and men, omitting sex-specific reproductive factors. Sex-specific XWAS variables showing significant associations with all-cause mortality included having had a cervical smear test, having gone through menopause, and number of children in women; and puberty timing (relative age of voice breaking and gaining facial hair) in men. These

variables were not tested in further disease sensitivity or correlation-based multivariable analysis, and thus further analysis would be needed to make strong claims about the independent role of these reproduction variables in aging.

The four covariates for assessment center, household income, education, and ethnicity were assumed to be related to mortality based on previous literature and were not tested independently as exposures in the XWAS. Replication XWAS analyses only tested those variables significant in the discovery, and both discovery and replication XWAS results were FDR corrected.

3.1.3. Disease sensitivity

A sensitivity analysis was conducted to test whether exposures replicated in the full cohort XWAS were susceptible to reverse causation due to prevalent disease at baseline. I conducted two analyses. The first was conducted in the full sample of English participants (n = 436,891) where I individually tested every exposure replicated in the pooled mortality XWAS again in relation to mortality using the pooled XWAS formula and covariates, but now adding an interaction term between each exposure and an indicator of baseline disease or poor health (see definition below):

$$coxph(Surv(e,a,d) \sim strata(b,s) + t + g + p + r + x^{*}i, data) \quad (4)$$

where e is age at recruitment, a is age at censoring, d is the event indicator (mortality = 1, no mortality or censored = 0), b is 5-year birth cohorts, s is sex (female/male), t is UK

Biobank assessment center, *g* is years of education, *r* is ethnicity, *x* is the individual exposures being tested, and *i* is the baseline poor health indicator. The interaction terms used returned estimates for the direct effect of the exposure *x* and poor health indicator *i*, as well as the interaction *x*i*. I flagged any exposures that no longer had a significant direct effect in this model ($p < 0.05$) but whose interaction with the baseline poor health indicator was significant ($p < 0.05$). This retrieved 12 variables whose associations with mortality are likely completely explained by poor health status at baseline in this dataset, and these variables were removed from any further analysis.

To further confirm the robustness of the pooled mortality XWAS results to reverse causation, I also performed the pooled XWAS a second time in the subset of participants with no disease at baseline (testing only those exposures that were replicated in the pooled XWAS in the full sample). Betas for each exposure from each of these two XWAS were then plotted against each and the correlation between them was calculated. As shown in Fig. 9, the correlation between the mortality betas in these two populations is extremely strong (Pearson's $R = 0.96$), indicating that the effect estimates from the pooled XWAS in the full sample are largely not biased due to reverse causation. The 12 variables flagged in the interaction analysis described above captures all of the variables whose effect estimates change direction in the two populations or whose point diverges more considerably from the best fit line in Fig. 9.

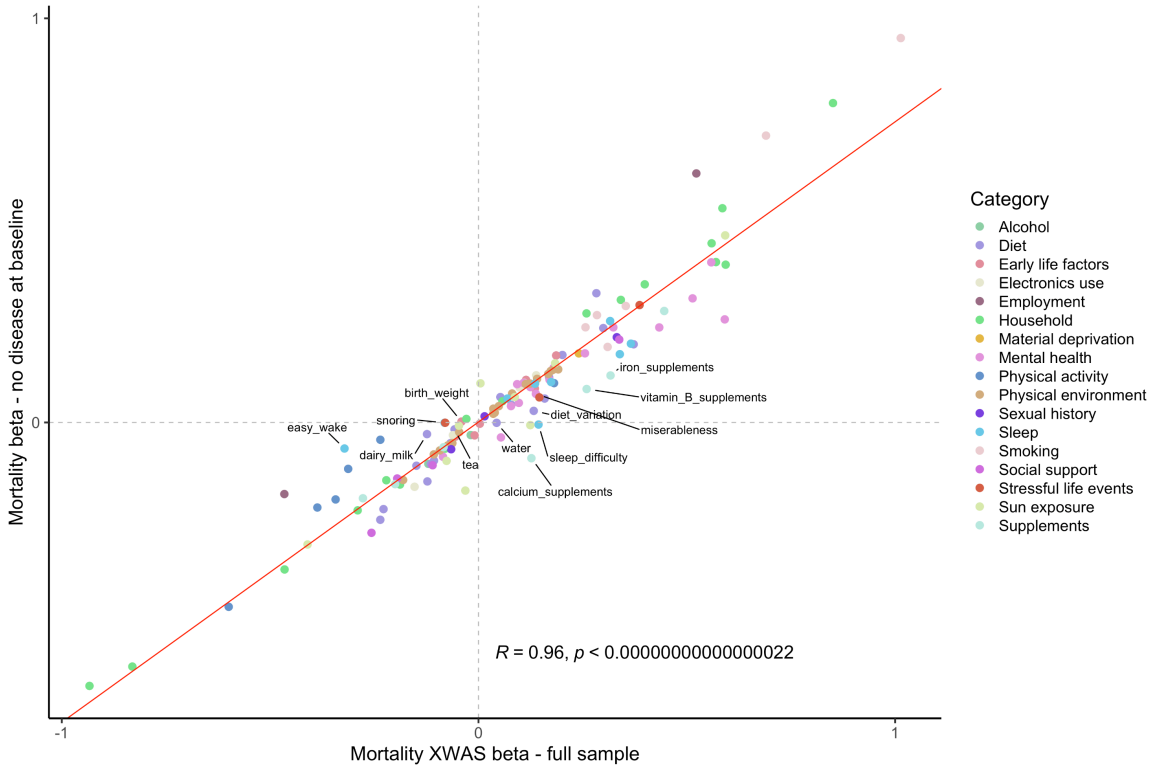


Figure 9. Correlation between mortality XWAS betas calculated in the full pooled sample including women and men (x-axis) and the subset of participants with no disease or poor health (y-axis). Pearson's R for the correlation between betas is shown, as is the p-value for the correlation. A best fit line is fitted by regressing the betas from the y-axis onto the betas from the x-axis. Labelled points are those variables that were flagged during the disease indicator interaction analysis.

In creating the baseline disease/poor health indicator for all participants, participants were coded as having disease or poor health at baseline if they: (1) had a linked hospital inpatient ICD diagnosis for any of the chronic illnesses or clinical intermediates studied in this thesis (including hypertension, dyslipidemia, and obesity) with a diagnosis date before or on their date of recruitment to the UK Biobank; (2) were assigned a diagnosis code for any of the chronic diseases or clinical intermediates studied during the baseline clinical interview (field IDs 20001, 20002; Table 11 – Chapter Four); (3) self-reported a physician diagnosis of heart attack (field ID 6150), angina (field ID 6150),

stroke (field ID 6150), high blood pressure (field ID 6150), bronchitis/emphysema (field ID 6152), diabetes (field ID 2443), or cancer (field ID 2453); (3) self-reported a number of cancer diagnoses ≥ 1 (field ID 134); (4) self-reported taking insulin medication (field ID 6153, 6177), cholesterol lowering medication (field ID 6153, 6177), or blood pressure medication (field ID 6153, 6177); or (5) self-reported their overall health status as "poor" (field ID 2178).

3.1.4. Correlation and cluster analyses

Correlation between all variables was calculated using the pooled XWAS discovery dataset combining women and men using the R package polycor[189] to create a heterogenous correlation matrix for each imputed dataset, consisting of Pearson correlations between continuous variables, polyserial correlations between continuous and ordinal variables, and polychoric correlations between ordinal variables. Correlation coefficients were first calculated within each imputed dataset, then transformed to a normally distributed z-score via Fisher's z transformation, pooled via Rubin's rule, and then re-transformed back to the original r-scale coefficient after pooling. This was done to create a normally distributed sampling distribution for the correlation coefficients, which is required for pooling via Rubin's rule. P-values for the significance of each pooled correlation coefficient were calculated using the pooled z-transformed correlation coefficient and the standard error based on sample size.

Our exposome dataset exhibited a densely intercorrelated structure among variables replicated in the mortality XWAS. As has been observed previously in environment data,[139,140] despite a very low percentage of observed inter-variable correlations with a coefficient of correlation above 0.50 or below -0.50 (4.08%), a very large percentage of inter-variable correlations were significant according to p-values for the correlations. Specifically, 90% of inter-variable correlations between exposures replicated in the mortality XWAS exhibited a significant Bonferroni-corrected correlation p-value below 0.001 (mean absolute value of significant correlation coefficients: 0.09). Only 7.01% of correlation coefficients had an absolute value of 0.30 or above.

Exposome variables replicated in the mortality XWAS and not confounded by prevalent disease status (plus the covariates for education and ethnicity) were considered for clustering analysis, using the correlation coefficients between these variables. I used both k-means and hierarchical clustering using Euclidean distance to determine an adequate cluster structure for the data. To get an initial approximation of the number of clusters that fit the data, I used both AIC and the total within-cluster sum of squares (WSS).

For AIC analyses, I first computed the k-means clustering of the exposures for different numbers of clusters (k) ranging from 1-100. k-means clustering is a machine learning algorithm that determines a pre-specified number of centroids (means) in the correlation coefficient values and then partitions the variables in the dataset into unique clusters based on the distance of their correlation coefficients from the centroids. For each k, I then calculate the AIC of the cluster model as the WSS + 2(k*number of total

variables).[190] I then plotted the AIC as a function of the number of clusters k and examined the plot visually to try to find the elbow in the plot (Fig. 10). An elbow in the plot could not be determined visually, and was thus calculated as the maximum absolute second derivative of the curve of AIC values for k.

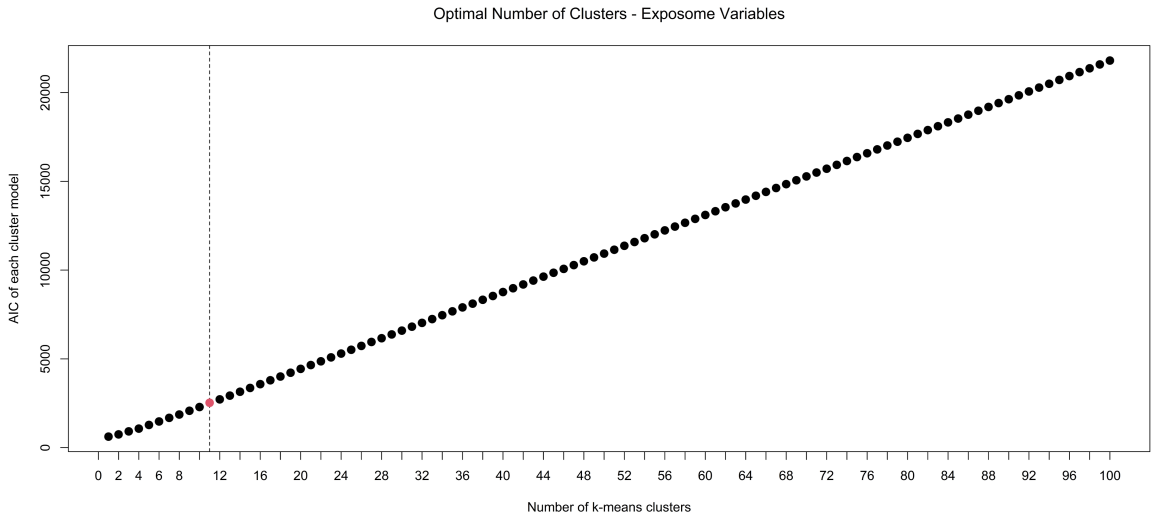


Figure 10. AIC for the cluster model (y-axis) according to the number of k-means clusters (y-axis) for exposures replicated in the pooled mortality XWAS. The black dotted line at 11 shows the number of clusters detected with an optimal AIC according to k-means.

For WSS analyses, I first computed the hierarchical clustering of exposures for different numbers of clusters (k) ranging from 1-100. For each k, I then calculated the WSS, which is a measure of the variability of the observations within each cluster. A cluster with a small WSS is more compact and has lower variability of observations within a cluster than a cluster that has a large WSS. I plotted the WSS as a function of the number of clusters k, and examined the plot visually to find the elbow in the plot (Fig. 11). This point represents the number of clusters k where adding another cluster doesn't greatly improve

(i.e., lower) the total WSS. The WSS plot was created using the fviz_nbclust function in the package factoextra.[191]

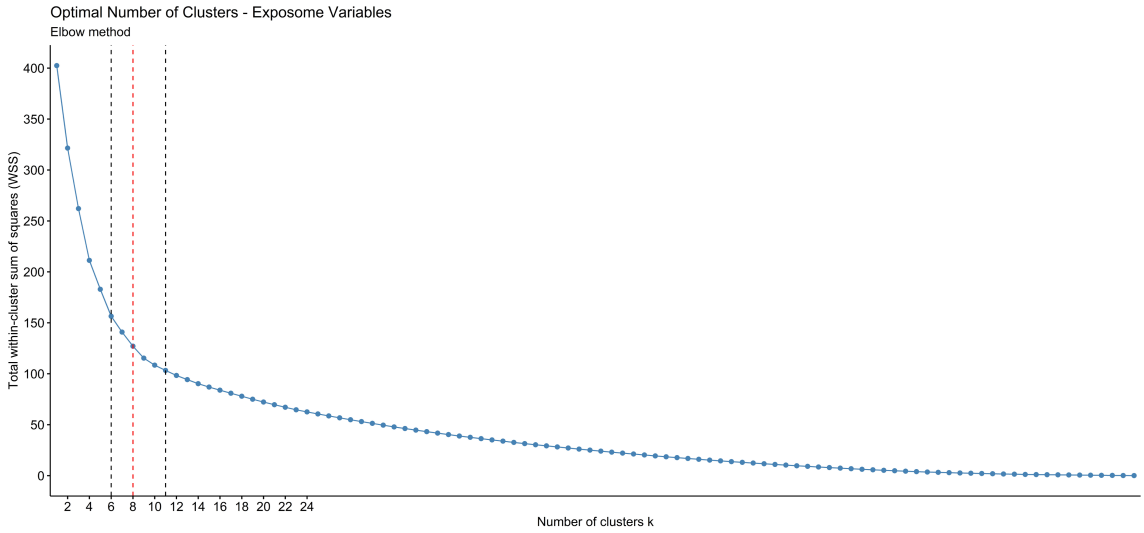


Figure 11. Total within-cluster sum of squares (WSS; y-axis) according to the number of hierarchical clusters (y-axis) for exposures replicated in the pooled mortality XWAS. The black dotted lines at 6 and 11 shows the number of clusters detected via k-means clustering according to principal components plots and AIC, respectively. The red dotted line at 8 shows the number of clusters actually chosen.

AIC analysis using k-means clustering initially returned 11 clusters as the optimal solution, however when plotting the k-means clustering according to 11 clusters, this cluster solution did not adequately break up clusters into discrete groupings. I therefore iteratively plotted lower numbers of k-means clusters starting from 10 until the variables were grouped discretely. This brought us to a total of 6 k-means clusters (Fig. 12). A cluster solution of 6 and 11 clusters were plotted on the WSS elbow plot, but both did not quite match the elbow in the plot. I determined that an 8-cluster solution was a better approximation of the elbow in the WSS curve, preferentially using the WSS plot information since the final cluster structure would be based on hierarchical clustering.

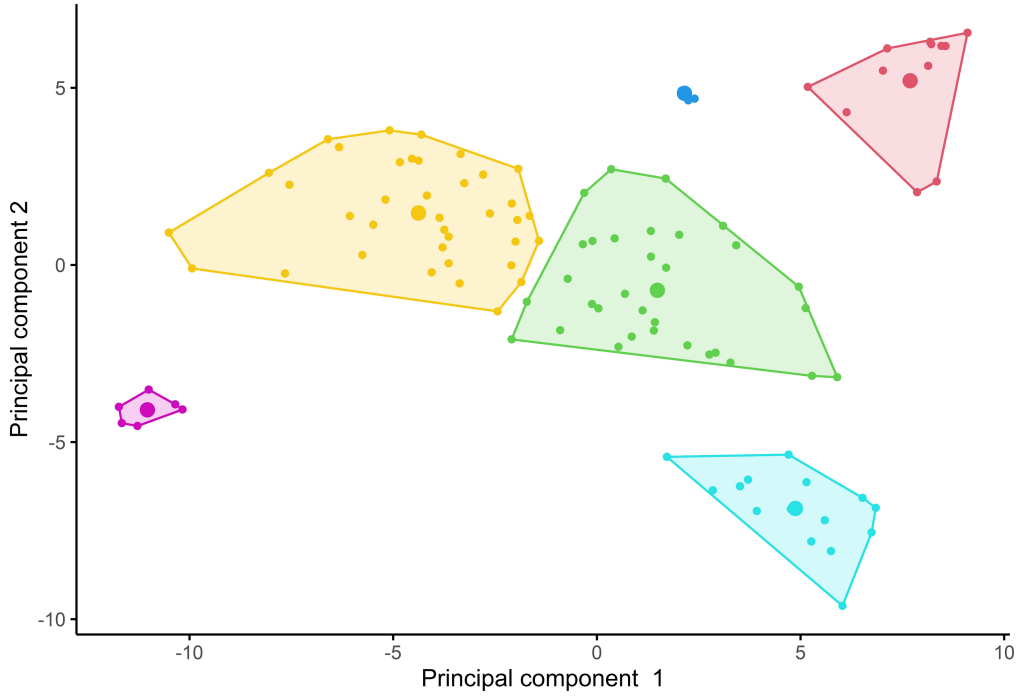


Figure 12. K-means clustering of exposures replicated in the pooled mortality XWAS using a 6-cluster solution. Each dot represents an individual exposure, with the larger dot being the centroid of each k-means cluster. X- and y-axes are the first two principal components taking the correlation matrix of all the exposures as an input.

When visually inspecting the dendrogram of hierarchical correlation, 8 clusters separate the variables very well in terms of breaking variables into discrete groups with large distances/heights between clusters (Fig. 13).

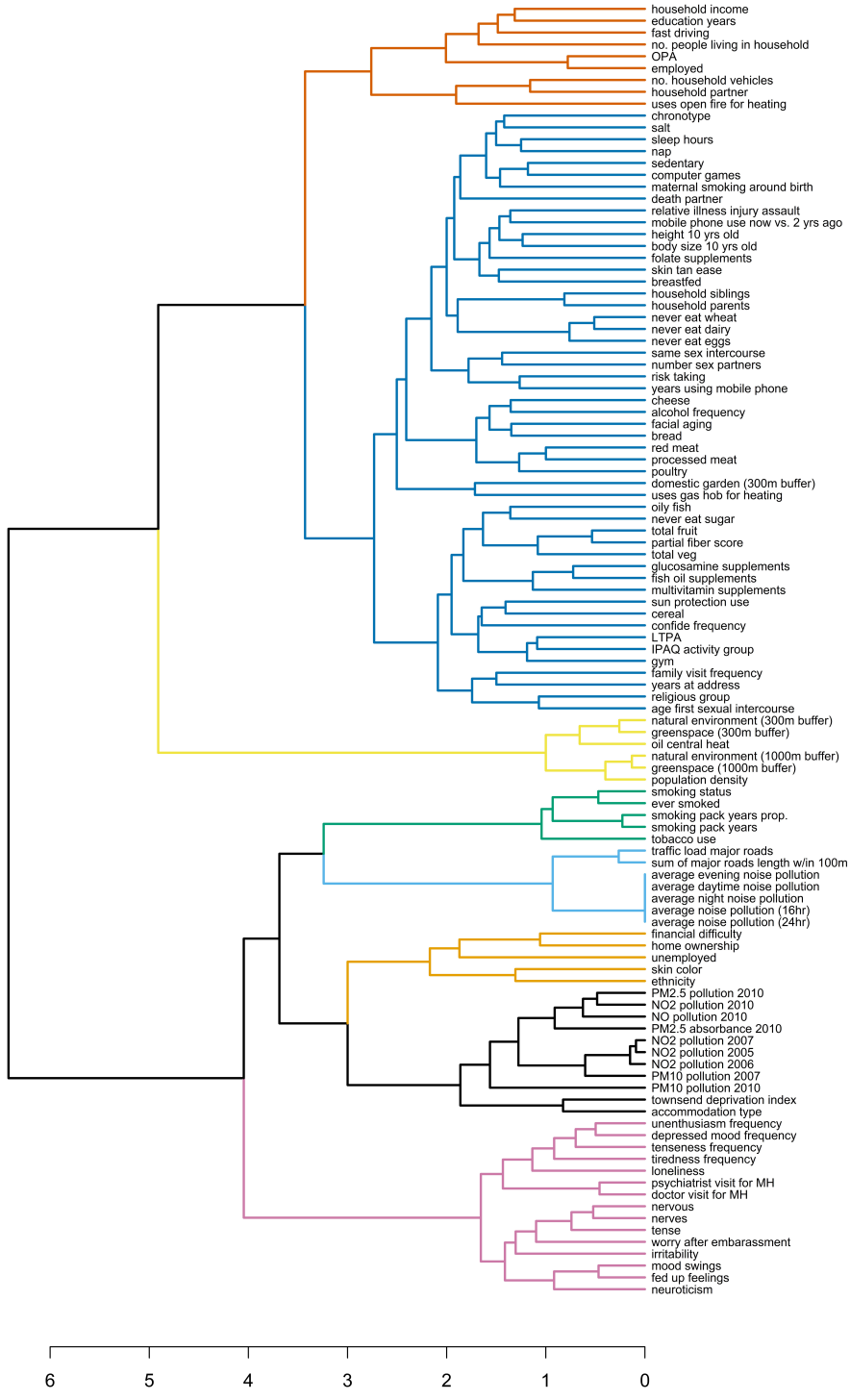


Figure 13. Hierarchical clustering of exposures replicated in the pooled mortality XWAS using an 8-cluster solution. Each color represents a separate cluster. X-axis shows the height between clusters in terms of complete linkage.

3.1.5. Cluster multivariable modeling procedures

Because discovery and replication had already been carried out in the XWAS to identify robust exposures associated with mortality, I re-merged the discovery and replication datasets to increase power and improve precision of the estimates in the cluster multivariable models. As described above, clustering analysis retrieved 8 independent clusters of exposures replicated in the mortality XWAS. I further conducted multivariable modeling within each of these 8 clusters using the following procedure: (1) All variables in the cluster were run in a single multivariable mortality Cox model to check for multicollinearity using the variance inflation factor (VIF). VIF analysis was carried out using the car package in R.[192] Variables with a GVIF^(1/(2*Df)) > 1.6 were flagged for collinearity and removed. GVIF^(1/(2*Df)) is similar to GVIF, but takes into account degrees of freedom for categorical variables. (2) After any collinear variables are removed, all remaining exposures in the cluster were tested together in a single multivariable mortality Cox model using age as the timescale, stratified by 5-year birth cohorts and sex, and adjusted for UK Biobank assessment center, household income, education, and ethnicity (if those variables were not already in the cluster). As in the XWAS, additional adjustment for self-reported overall health status was made in the cluster with self-reported alcohol intake. This process led to a number of variables adjusting out that were confounded by short-range correlation between other similar exposures.

To account for confounding due to longer-range confounding between exposures, I also combined variables from neighboring clusters. This was done according to the

dendrogram structure shown in Fig. 12, where I refer to each cluster from top to bottom as 1-8, with the top cluster in orange as cluster 1 and the bottom cluster in pink as cluster 8. First, multivariable models were conducted within each of clusters 1-8. I then took all variables significant in clusters 1-3 and put them in the same multivariable mortality Cox model. Separately, I took all variables significant in clusters 4-8 and put them in the same multivariable mortality Cox model. Self-reported overall health was not added as a covariate in the combined multivariable Cox models containing clusters 1-3, as I observed that adding in these greater covariates to the model showed the greatest level of alcohol intake to now correctly associate with increased mortality risk. Variables from clusters 1-3 and 4-8 were not put together into a single model for the reasons described above.

At the end of this process, I was left with 55 exposures that I am confident are not susceptible to confounding from other correlated exposures. Significance in all the cluster multivariable models was determined by a nominal $p < 0.05$, and each model was stratified by birth cohort and sex and adjusted for UK Biobank assessment center, years of education, and ethnicity (if one of the covariates was already in the cluster itself, then it was not added twice).

Air pollution, greenspace, noise pollution, and traffic variables contained multiple, redundant variables that were too correlated and collinear to be used in conjunction with one another in the same model (correlation coefficient > 0.97). This would have required arbitrarily selecting a single air pollution variable to test while discarding the rest, which was undesirable. Instead, I ran separate principal component analyses (PCA) among the nine air pollution variables (NO [2010], NO2 [2005, 2006 ,2007, 2010], PM2.5 [2010], PM2.5

absorbance [2010], and PM10 [2007, 2010]), four greenspace variables (greenspace buffer 1000m, greenspace buffer 300m, natural environment buffer 1000m, natural environment buffer 300m), four noise pollution variables (average daytime noise pollution, average evening noise pollution, average night noise pollution, average 16 hour noise pollution, and average 24 hour noise pollution), and two traffic variables (sum of road length of major roads within 100m, total traffic load on major roads) that were all significant after the pooled XWAS and disease sensitivity analysis. Three PCs were retrieved that captured >90% of the variation in the air pollution variables, two PCs captured >96% of the variation in greenspace variables, one PC captured >99% of the variation in noise pollution variables, and one PC captured > 91% of the variation in traffic variables. These PCs were used in all cluster models described above instead of the individual variables. Plots of principal component loadings are shown in Fig. 14 (English participants) and Fig. 15 (Scottish/Welsh participants).

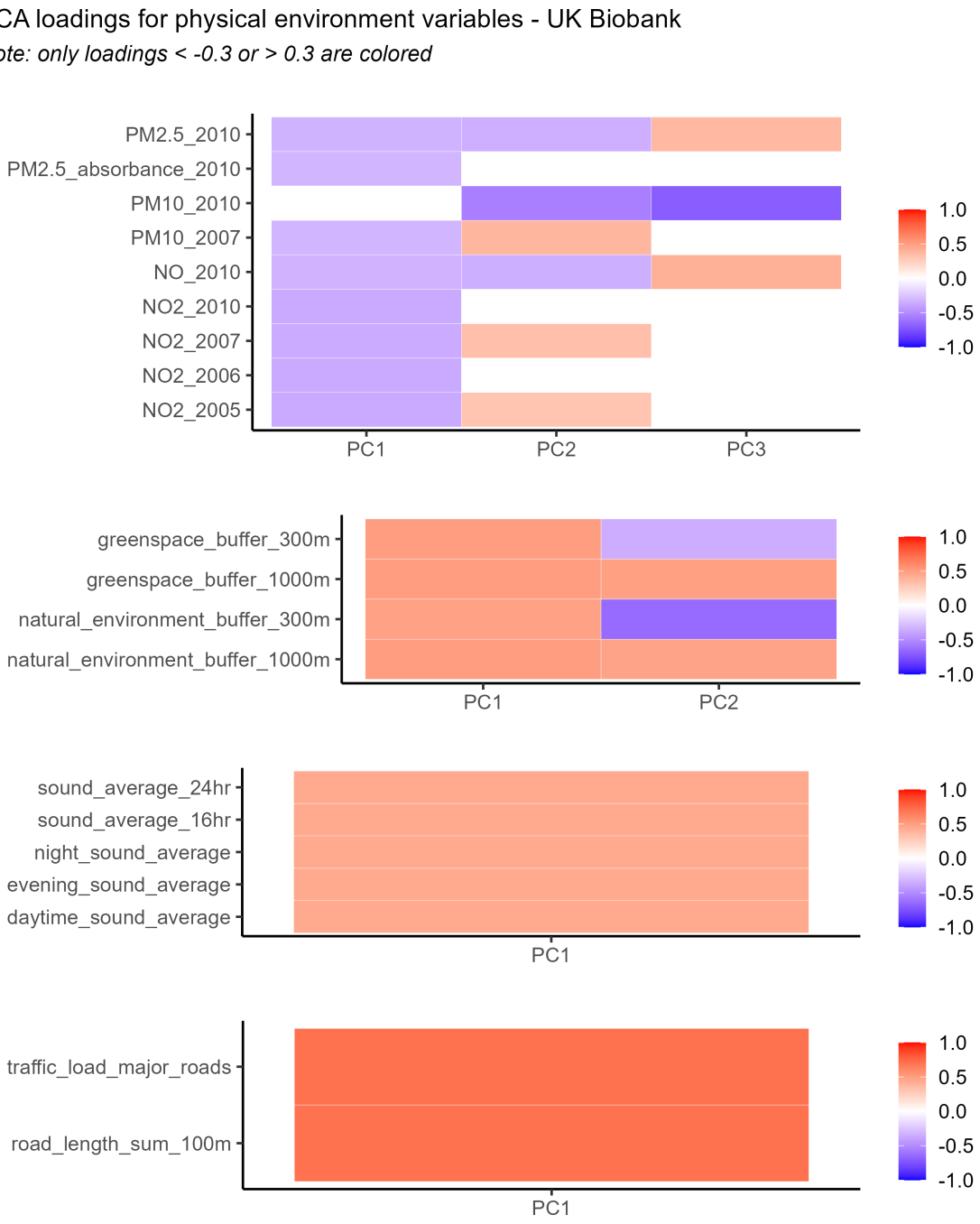


Figure 14. Principal component (PC) loadings for highly correlated physical environment variables among English UK Biobank participants (n = 436,891). Since all air pollution levels loaded inversely onto the first air pollution PC, the first PC was multiplied by -1 before analysis in order to reflect increasing levels of air pollution in line with the original direction of the component variables.

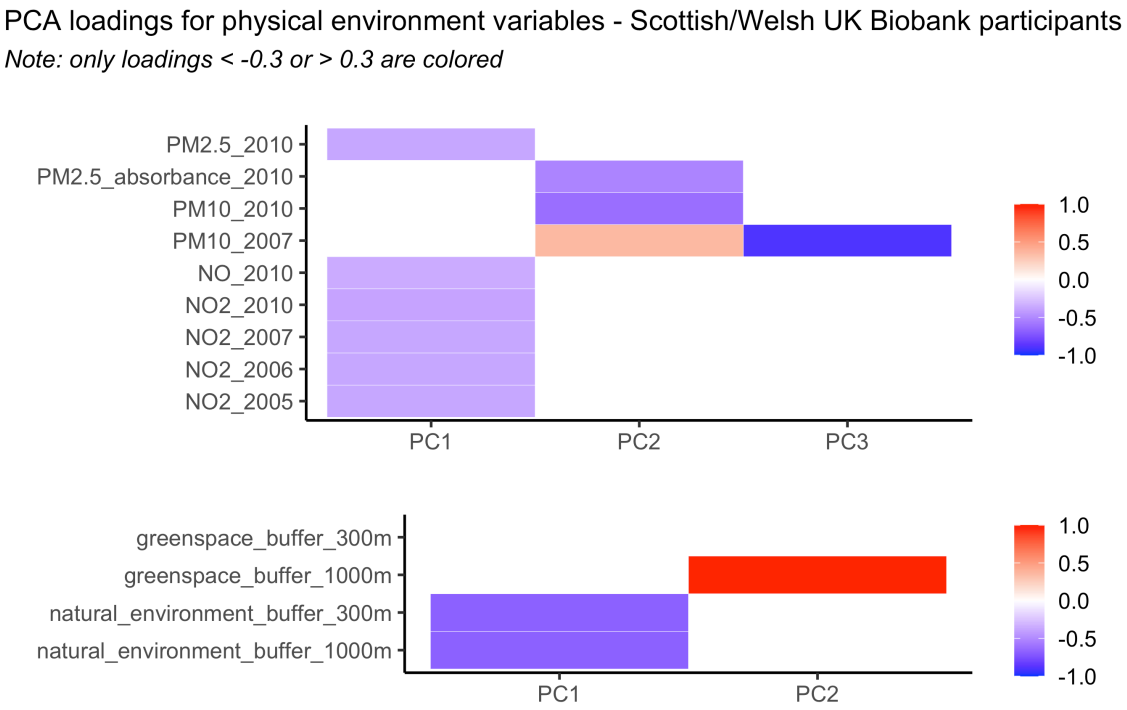


Figure 15. Principal component loadings for highly correlated physical environment variables among Scottish/Welsh UK Biobank participants (n = 55,676). Principal components were only made for categories of variables that were significant in the cluster multivariable modeling carried out in English participants (n = 436,891). Since all air pollution levels loaded inversely onto the first air pollution PC, the first PC was multiplied by -1 before analysis in order to reflect increasing levels of air pollution in line with the original direction of the component variables.

3.2. Results

3.2.1. Characteristics of the study population

The study sample (n = 492,569) for analysis included all UK Biobank study participants who were not adopted and were at least 40 years old at baseline (Fig. 7). XWAS analyses (as well as aging biomarker and chronic disease analyses in Chapter Four) were carried out using UK Biobank participants recruited in England (n = 436,891), among whom there were 31,716 deaths from all causes after a median 12.5 years of follow up (Table 4). Women had a lower rate of all-cause mortality compared with men (5.4% in women vs 9.4% in men). As expected, the mortality rate among participants with no prevalent disease at baseline (n = 301,320) was lower than the total cohort population (4.6% vs. 7.3%; Table 5). Among the validation set of Scottish/Welsh participants (n = 55,676), there were 5,267 deaths from all causes after a median 13.7 years of follow up (Table 6). Mortality by cause of death information for both English participants and those recruited in Scotland/Wales is given in Tables 7-8.

Table 4. Baseline descriptive statistics - UK Biobank participants recruited in England

	Female (N=237,634)	Male (N=199,257)	Total (N=436,891)
Age			
Mean (SD)	56 (8.0)	57 (8.2)	57 (8.1)
Household income			
Less than 18,000	52,139 (21.9%)	38,416 (19.3%)	90,555 (20.7%)
18,000 to 30,999	58,496 (24.6%)	45,827 (23.0%)	104,323 (23.9%)
31,000 to 51,999	52,229 (22.0%)	48,178 (24.2%)	100,407 (23.0%)
52,000 to 100,000	37,443 (15.8%)	39,514 (19.8%)	76,957 (17.6%)
Greater than 100,000	9,742 (4.1%)	10,884 (5.5%)	20,626 (4.7%)
Education years			
7 years	39,642 (16.7%)	33,716 (16.9%)	73,358 (16.8%)
10 years	46,951 (19.8%)	27,632 (13.9%)	74,583 (17.1%)
13 years	13,922 (5.9%)	10,134 (5.1%)	24,056 (5.5%)
15 years	31,779 (13.4%)	20,463 (10.3%)	52,242 (12.0%)
19 years	30,058 (12.6%)	38,388 (19.3%)	68,446 (15.7%)
20 years	72,867 (30.7%)	66,742 (33.5%)	139,609 (32.0%)
Ethnicity			
White	223,428 (94.0%)	187,256 (94.0%)	410,684 (94.0%)
Asian	5,172 (2.2%)	5,344 (2.7%)	10,516 (2.4%)
Black	4,452 (1.9%)	3,210 (1.6%)	7,662 (1.8%)
Mixed	1,610 (0.7%)	938 (0.5%)	2,548 (0.6%)
Other	2,388 (1.0%)	1,737 (0.9%)	4,125 (0.9%)
BMI			
Mean (SD)	27 (5.2)	28 (4.2)	27 (4.8)
Smoking status			
Never	141,414 (59.5%)	97,119 (48.7%)	238,533 (54.6%)
Previous	74,753 (31.5%)	77,122 (38.7%)	151,875 (34.8%)
Current	20,591 (8.7%)	24,223 (12.2%)	44,814 (10.3%)
Home area population density			
Urban	203,583 (85.7%)	171,299 (86.0%)	374,882 (85.8%)
Rural	34,051 (14.3%)	27,958 (14.0%)	62,009 (14.2%)
Mortality			
Alive	224,740 (94.6%)	180,435 (90.6%)	405,175 (92.7%)
Dead	12,894 (5.4%)	18,822 (9.4%)	31,716 (7.3%)

Mortality rates are for the 11-15 year study follow up period. Descriptive statistics are from the first imputed dataset and are not pooled. BMI: body mass index; SD: standard deviation.

Table 5. Baseline descriptive statistics - UK Biobank participants with no prevalent disease

	Female (N=163,415)	Male (N=137,905)	Total (N=301,320)
Age			
Mean (SD)	55 (8.0)	55 (8.2)	55 (8.1)
Household income			
Less than 18,000	29,254 (17.9%)	20,104 (14.6%)	49,358 (16.4%)
18,000 to 30,999	39,009 (23.9%)	30,209 (21.9%)	69,218 (23.0%)
31,000 to 51,999	39,122 (23.9%)	36,101 (26.2%)	75,223 (25.0%)
52,000 to 100,000	30,113 (18.4%)	31,891 (23.1%)	62,004 (20.6%)
Greater than 100,000	7,984 (4.9%)	9,057 (6.6%)	17,041 (5.7%)
Education years			
7 years	21,857 (13.4%)	18,072 (13.1%)	39,929 (13.3%)
10 years	32,872 (20.1%)	19,198 (13.9%)	52,070 (17.3%)
13 years	10,116 (6.2%)	7,321 (5.3%)	17,437 (5.8%)
15 years	21,435 (13.1%)	13,934 (10.1%)	35,369 (11.7%)
19 years	21,210 (13.0%)	27,055 (19.6%)	48,265 (16.0%)
20 years	54,466 (33.3%)	51,046 (37.0%)	105,512 (35.0%)
Ethnicity			
White	153,607 (94.0%)	129,698 (94.0%)	283,305 (94.0%)
Asian	3,481 (2.1%)	3,416 (2.5%)	6,897 (2.3%)
Black	3,095 (1.9%)	2,343 (1.7%)	5,438 (1.8%)
Mixed	1,185 (0.7%)	696 (0.5%)	1,881 (0.6%)
Other	1,647 (1.0%)	1,245 (0.9%)	2,892 (1.0%)
BMI			
Mean (SD)	26 (4.8)	27 (3.9)	27 (4.4)
Smoking status			
Never	100,764 (61.7%)	72,787 (52.8%)	173,551 (57.6%)
Previous	48,831 (29.9%)	48,644 (35.3%)	97,475 (32.3%)
Current	13,300 (8.1%)	16,046 (11.6%)	29,346 (9.7%)
Home area population density			
Urban	139,489 (85.4%)	117,969 (85.5%)	257,458 (85.4%)
Rural	23,926 (14.6%)	19,936 (14.5%)	43,862 (14.6%)
Mortality			
Alive	157,783 (96.6%)	129,820 (94.1%)	287,603 (95.4%)
Dead	5,632 (3.4%)	8,085 (5.9%)	13,717 (4.6%)

Baseline descriptive statistics for the subsample of UK Biobank participants with no disease at baseline (used for disease sensitivity analyses). Mortality rates are for the 11-15 year study follow up period. Descriptive statistics are from the first imputed dataset and are not pooled. SD: standard deviation.

Table 6. Baseline descriptive statistics - UK Biobank participants recruited in Scotland/Wales

	Female (N=30,707)	Male (N=24,969)	Total (N=55,676)
Age			
Mean (SD)	56 (8.0)	57 (8.1)	56 (8.0)
Household income			
Less than 18,000	7,454 (24.3%)	4,843 (19.4%)	12,297 (22.1%)
18,000 to 30,999	7,060 (23.0%)	5,571 (22.3%)	12,631 (22.7%)
31,000 to 51,999	7,018 (22.9%)	6,370 (25.5%)	13,388 (24.0%)
52,000 to 100,000	5,037 (16.4%)	5,258 (21.1%)	10,295 (18.5%)
Greater than 100,000	1,127 (3.7%)	1,307 (5.2%)	2,434 (4.4%)
Education years			
7 years	5,571 (18.1%)	4,669 (18.7%)	10,240 (18.4%)
10 years	5,000 (16.3%)	2,828 (11.3%)	7,828 (14.1%)
13 years	1,893 (6.2%)	1,391 (5.6%)	3,284 (5.9%)
15 years	3,520 (11.5%)	2,453 (9.8%)	5,973 (10.7%)
19 years	3,466 (11.3%)	4,289 (17.2%)	7,755 (13.9%)
20 years	10,966 (35.7%)	9,104 (36.5%)	20,070 (36.0%)
Ethnicity			
White	30,101 (98.0%)	24,383 (97.7%)	54,484 (97.9%)
Asian	247 (0.8%)	266 (1.1%)	513 (0.9%)
Black	73 (0.2%)	72 (0.3%)	145 (0.3%)
Mixed	125 (0.4%)	86 (0.3%)	211 (0.4%)
Other	114 (0.4%)	104 (0.4%)	218 (0.4%)
BMI			
Mean (SD)	27 (5.3)	28 (4.3)	28 (4.9)
Smoking status			
Never	18,264 (59.5%)	12,575 (50.4%)	30,839 (55.4%)
Previous	9,221 (30.0%)	8,845 (35.4%)	18,066 (32.4%)
Current	3,128 (10.2%)	3,476 (13.9%)	6,604 (11.9%)
Home area population density			
Urban	27,481 (89.5%)	22,310 (89.4%)	49,791 (89.4%)
Rural	3,219 (10.5%)	2,648 (10.6%)	5,867 (10.5%)
Mortality			
Alive	28,518 (92.9%)	21,891 (87.7%)	50,409 (90.5%)
Dead	2,189 (7.1%)	3,078 (12.3%)	5,267 (9.5%)

Mortality rates are for the 11-15 year study follow up period. Descriptive statistics are calculated using the first imputed analysis dataset and are not pooled across imputed datasets. SD: standard deviation.

Table 7. Mortality by cause of death - UK Biobank participants recruited in England

	Total deaths (N=31,716)
All diseases*	22,166 (69.9%)
Ischemic heart disease	5,320 (16.8%)
Lung cancer	2,845 (9.0%)
Cerebrovascular diseases	2,349 (7.4%)
Emphysema, COPD	2,266 (7.1%)
Colorectal cancer	1,624 (5.1%)
Breast cancer	1,404 (4.4%)
Type II diabetes	1,394 (4.4%)
All-cause dementia	1,281 (4.0%)
Pancreatic cancer	1,228 (3.9%)
Prostate cancer	1,216 (3.8%)
Chronic kidney diseases	1,160 (3.7%)
Esophageal cancer	816 (2.6%)
Lymphoma	764 (2.4%)
Parkinson's disease	722 (2.3%)
Chronic liver diseases	689 (2.2%)
Alzheimer's disease	661 (2.1%)
Leukemia	656 (2.1%)
Ovarian cancer	590 (1.9%)
Liver cancer	580 (1.8%)
Vascular dementia	362 (1.1%)
Rheumatoid arthritis	193 (0.6%)
Osteoporosis	63 (0.2%)
Osteoarthritis	36 (0.1%)
Macular degeneration	1 (0.0%)

Table 8. Mortality by cause of death - UK Biobank participants recruited in Scotland/Wales

	Total deaths (N=5,267)
All diseases*	3,757 (71.3%)
Ischemic heart disease	936 (17.8%)
Lung cancer	558 (10.6%)
Cerebrovascular diseases	434 (8.2%)
Emphysema, COPD	400 (7.6%)
Type II diabetes	323 (6.1%)
Colorectal cancer	276 (5.2%)
All-cause dementia	251 (4.8%)
Breast cancer	216 (4.1%)
Pancreatic cancer	195 (3.7%)
Alzheimer's disease	181 (3.4%)
Chronic kidney diseases	178 (3.4%)
Prostate cancer	163 (3.1%)
Esophageal cancer	122 (2.3%)
Chronic liver diseases	116 (2.2%)
Lymphoma	112 (2.1%)
Parkinson's disease	106 (2.0%)
Liver cancer	103 (2.0%)
Ovarian cancer	97 (1.8%)
Vascular dementia	94 (1.8%)
Leukemia	91 (1.7%)
Rheumatoid arthritis	46 (0.9%)
Osteoporosis	12 (0.2%)
Osteoarthritis	3 (0.1%)
Macular degeneration	0 (0%)

Numbers and percentages represent the number of deaths for which each disease was listed as either the primary or contributory cause of death. Only diseases that were associated with at least one exposure are listed. *"All diseases" encompasses only those diseases listed in this table and is an indicator of the number of participants with any of the diseases in this table listed as a primary or contributory cause of death.

3.2.2. Exposome-wide analysis of all-cause mortality

I first completed two sex-specific XWAS of all-cause mortality by individually testing all exposures in relation to all-cause mortality via Cox proportional hazards models using discovery and replication sets. Summary statistics for sex-specific XWAS are shown in Appendix Tables S2-S3. XWAS regression betas were very strongly correlated between women and men and showed little divergence in effect (Pearson's $R = 0.95$, $p < 2.2 \times 10^{-16}$; Fig. 16). The female and male datasets were therefore pooled to conduct a single XWAS including both women and men to improve power.

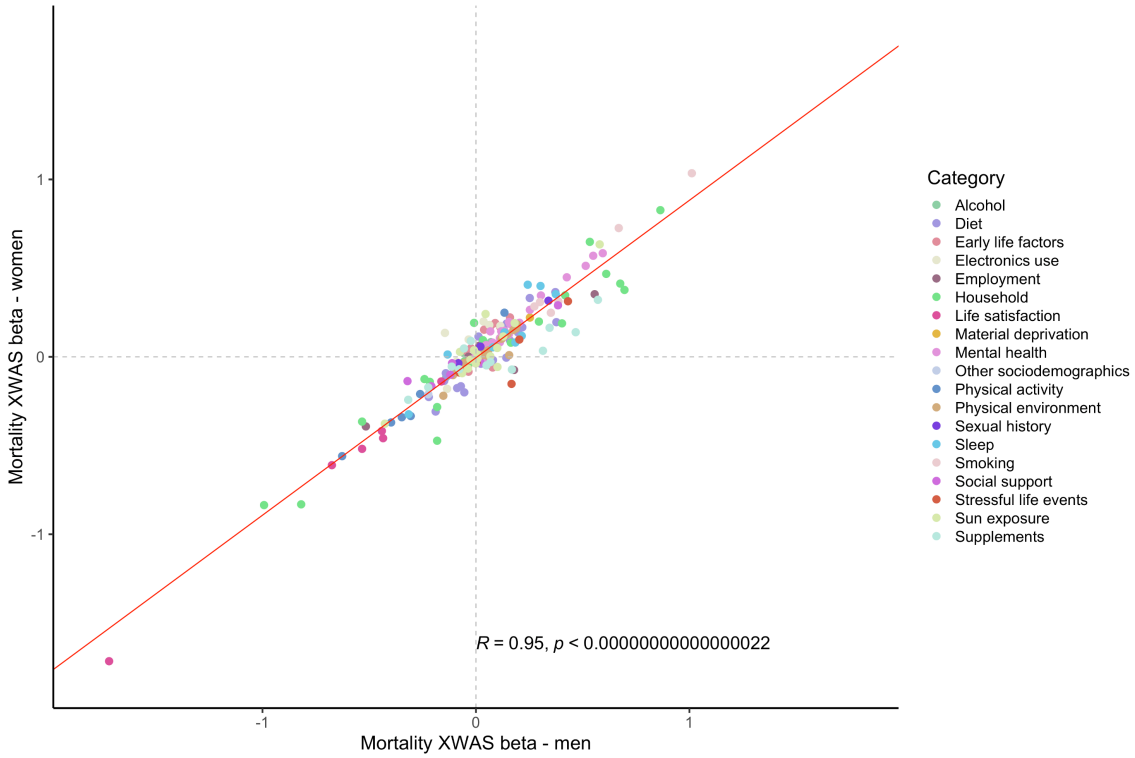


Figure 16. Correlation between mortality XWAS betas calculated separately in women (y-axis) and men (x-axis). Pearson's R for the correlation between betas is shown, as is the p-value for the correlation. A best fit line is fitted by regressing the betas from the y-axis onto the betas from the x-axis.

In a final mortality XWAS using pooled data from both women and men, 119/176 exposures (67.6%) were significantly replicated (Fig. 16). Summary statistics for the final pooled XWAS are shown in Appendix Table S4. Overall, I observed very strong correlation between betas from the pooled mortality XWAS and betas for the same exposures among participants with no prevalent disease at baseline ($R = 0.96$, $p < 2.2 \times 10^{-16}$; Fig. 17), suggesting there is no strong statistical evidence for reverse causation bias in the XWAS results. Interaction analyses between replicated exposures and a baseline poor health indicator revealed 12 exposures whose associations with mortality were likely completely explained by prevalent disease status, leaving 107/119 (89.9%) exposures whose associations with mortality were not likely explained by pre-existing morbidity.

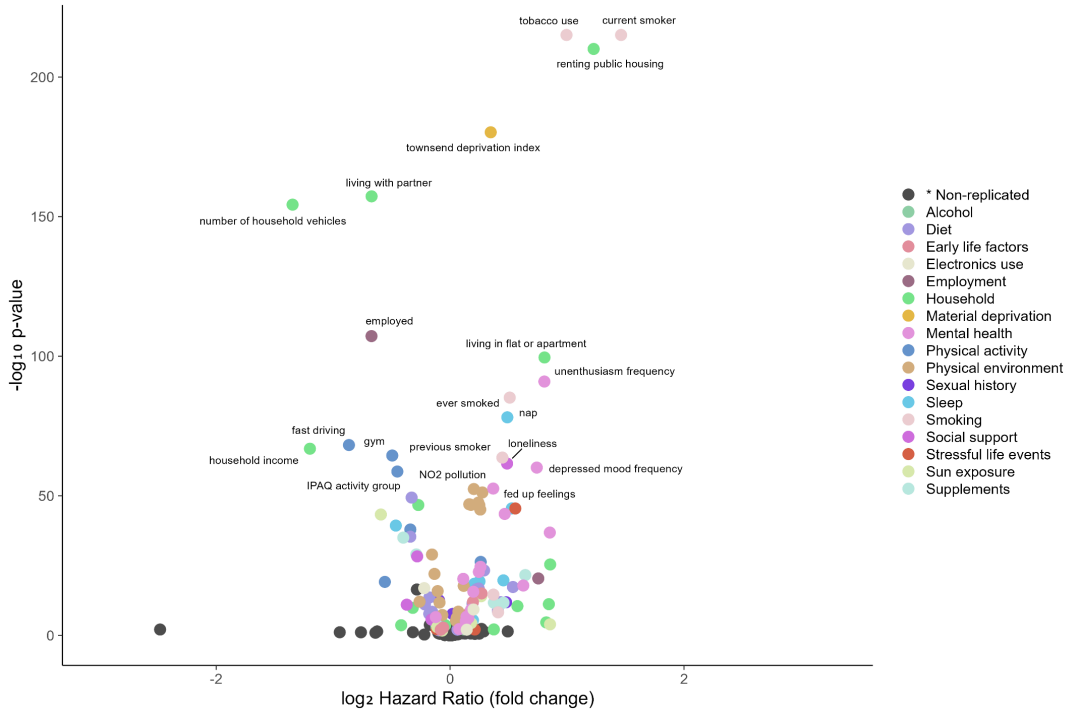


Fig. 17. Volcano plot of log-transformed p-values and fold change (log_2 of the hazard ratio) for all mortality XWAS associations in the final pooled analysis. Each point represents the association between a single exposure and all-cause mortality from the XWAS discovery analysis (n=218,483). Exposures that were not replicated are colored dark grey and labelled with the category "* Non-replicated." The top 20 points according to strongest p-value are labelled.

3.2.3. Architecture of the exposome

I observed high degrees of correlation between exposures replicated in the XWAS (90% of variable pairs had a significant Bonferroni-corrected correlation p-value below 0.001), indicating that some mortality associations observed in the XWAS may be confounded due to this correlation structure. To address this, I used hierarchical clustering to organize replicated exposures that are not confounded by prevalent disease status into 8 unique clusters (Fig. 13) and conducted multivariable mortality Cox models within each cluster and neighboring clusters. Using this method, I identified 55 exposures that remained significant in these cluster multivariable models (Fig. 17a-b), and which I conclude are independently associated with all-cause mortality and likely not confounded by exposures intercorrelation.

Mortality cluster models returned many independent mortality associations for similar types of variables, demonstrating that the environmental architecture of human aging is comprised of a complex network of independent yet interrelated exposures, and that basic categorizations of exposures (e.g., physical activity, social integration) cannot be reduced to the effect of a single variable. I found that multiple dimensions of physical activity (general physical activity: IPAQ; leisure time physical activity: LTPA; total sedentary time) all exhibit significant effects on mortality, even when included in the same model and adjusted for a wide number of other correlated variables. I also observed that total fruit and vegetable intake no longer exhibit a significant effect on mortality when assessed in a model together with dietary fiber and other diet intake variables.

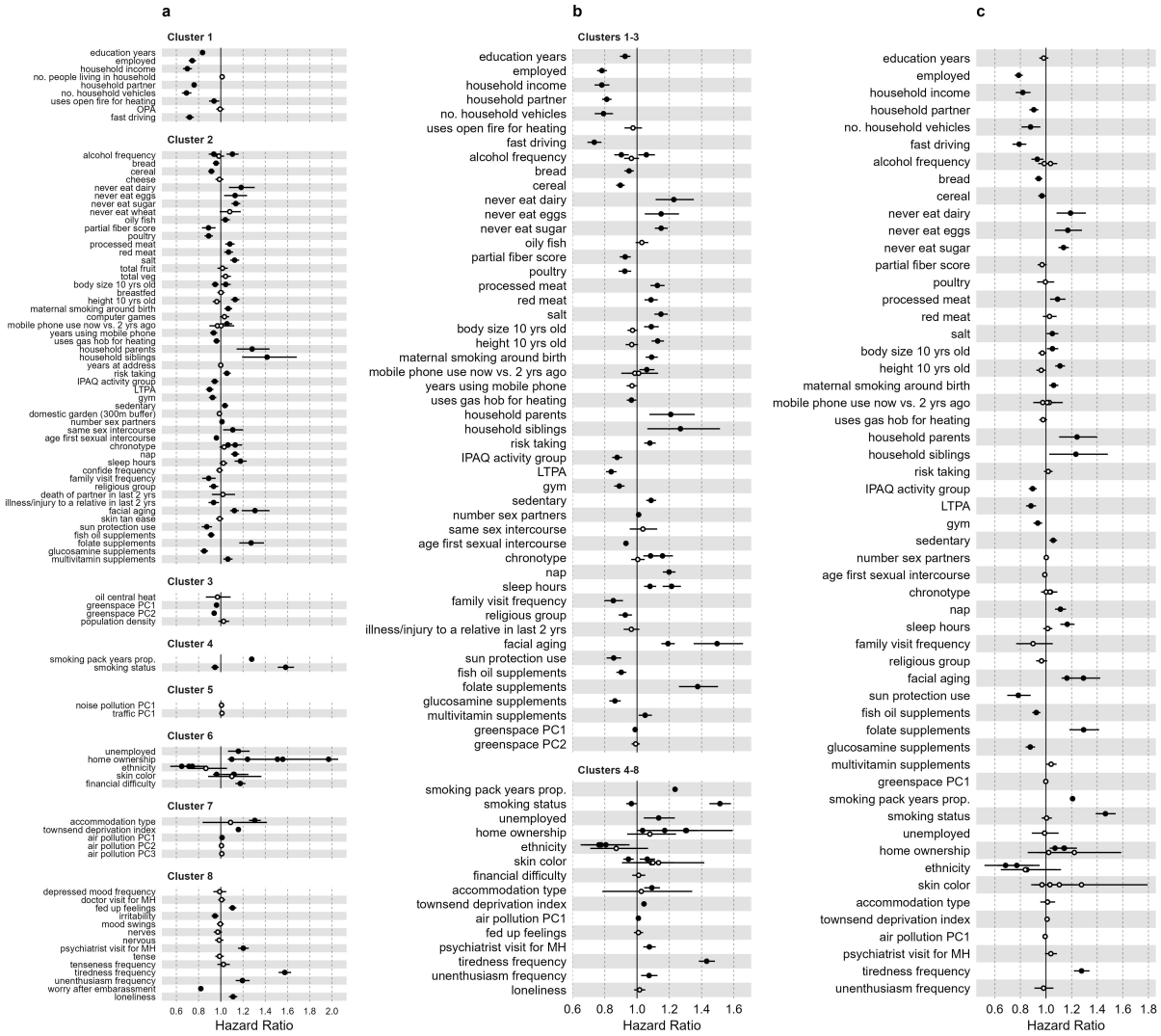


Figure 17. Forest plot of exposures associations with all-cause mortality (n= 436,891) in (**a**) multivariable models within each individual cluster, (**b**) multivariable models within grouped neighboring clusters, and (**c**) final exposome model used for C-index and R^2 calculations. Only variables significant at $p < 0.05$ were carried forward to the next model. Cluster models in (**a**) and (**b**) were calculated using age as the timescale, stratified by 5-year birth cohorts and sex, and adjusted for UK Biobank assessment center, years of education, household income, and ethnicity (only if the covariate was not already in the cluster model). The full exposome R^2 model (**c**) uses a single Cox model with mortality survival time as the timescale and adding age (scaled) and sex as fixed covariates. Multiple estimates are shown for nominal categorical variables, with estimate points for each response level in the same row. Estimates not significant at $p < 0.05$ are shown as hollow points. LTPA: leisure time physical activity; MH: mental health; OPA: occupational physical activity; PC: principal component

3.2.4. Sensitivity analyses

I conducted a sensitivity analysis to compare the explanatory power of the baseline self-reported physical activity variables available in the UK Biobank versus an objective measure of physical activity. Data collection for accelerometer data occurred from 2013-2015 in a subsample of 103,672 UK Biobank participants. Mortality survival times were re-calculated using the date from the start time of the accelerometer wear period (field ID 90010) as the start date of follow up for each participant. I used the overall acceleration average variable (field ID 90012) as the measure of objective physical activity. Description of the development of this variable has been described previously.[193] Before analysis, I carried out several quality control steps to refine the overall acceleration average variable by excluding participants: (1) whose data could not be calibrated (field ID 90016); (2) who did not wear the device long enough to get a stable measure of their physical activity status (field ID 90015); (3) with >1% clipped values before or after calibration (field IDs 90183, 90185) out of the total data readings (field ID 90187); or (4) who had an unrealistically high overall acceleration average of 100mg or greater. This process excluded 6,189 participants, leaving a total sample of n = 85,520 for accelerometer analyses.

Two models were tested: the first included the self-reported baseline physical activity measures (IPAQ, LTPA, OPA, sedentary time) in the full sample of UK Biobank participants recruited in England (n = 436,891), the second only included overall acceleration average in the subsample of participants with accelerometer data (n = 85,520). Both models were run as Cox proportional hazards models with mortality survival time as

the timescale with additional covariates for age at time of activity measurement, sex, UK Biobank assessment center, years of education, household income, ethnicity, smoking status, and Townsend deprivation index. All polynomial contrasts were allowed for all ordinal variables. When putting all self-reported baseline physical activity measures in the same model, there was no collinearity according to VIF. The pooled R^2 from the all-cause mortality model using overall acceleration average was 0.59, whereas the pooled R^2 from the model using self-reported baseline physical activity measures was 0.56 (Table 9). Objective physical activity explained a greater amount of the mortality variation in the UK Biobank sample by 3%, indicating that mortality variation explained by baseline self-reported physical activity measures underrepresents the total influence of the objectively measured physical activity on mortality by only approximately 3%.

Table 9. Accelerometer vs. self-reported physical activity measures in relation to mortality

	Hazard Ratio [95% CI]	**p-value**	**Hazard Ratio [95% CI]**	**p-value**
Overall acceleration average	0.95 [0.94, 0.95]	< 0.001		
IPAQ physical activity group			0.82 [0.80, 0.84]	< 0.001
Leisure time physical activity (LTPA)			0.85 [0.82, 0.88]	< 0.001
Occupational physical activity (OPA)			0.87 [0.84, 0.90]	< 0.001
Total sedentary time			1.10 [1.08, 1.13]	< 0.001
R^2	0.59		0.56	

Both models include covariates for age, sex, UK Biobank assessment center, household income, years of education, ethnicity, smoking status, and Townsend deprivation index.

3.3. Discussion

Cluster multivariable models returned robust, significant associations for many exposures that are unstudied or understudied in the context of mortality, including several aspects of physical activity (pleasure walks; light and heavy DIY activities like watering the lawn, digging, carpentry; swimming; and strenuous sport activity), type of accommodation lived in (apartment vs. house), and certain measures of household composition such as number of people living within your household and living with parents or siblings. Although frequency of confiding in others has previously been associated with all-cause mortality in the UK Biobank as part of a composite measure including loneliness,[194] I also demonstrate that it has explanatory power for mortality on its own.

The cluster multivariable analyses I conducted also returned some results that contradict previous mortality research. For example, I observed no associations between fruit and vegetable intake and mortality, despite previous evidence that fruit and vegetable intake matter for cardiovascular health and mortality.[195] This may indicate that the primary benefit of fruit and vegetable intake on mortality is through increasing dietary fiber intake, and that the effect of fruit and vegetable intake on mortality is made redundant when assessed in a model that already captures fiber intake. Previous large studies showing an effect of fruit and vegetable intake on mortality have not accounted for total dietary fiber consumption in their models, only total calorie consumption.[195]

In line with previous research,[156] I observed that frequency of alcohol intake showed a U-shaped association with mortality unless modelled in current drinkers only. When modeling using current drinkers, I found a J-shaped association between alcohol intake and mortality, where only the highest amount of alcohol intake was associated with increased risk of mortality compared with the lowest intake level. Previous large meta-analyses[170] and a Mendelian randomization study[196] in the UK Biobank have demonstrated increasing risk of mortality with each increase in alcohol consumption, however I could not replicate this linear dose-response association. Of note, I also only observed an increase in mortality risk for the highest level of alcohol intake in the XWAS model when adding further adjustment for self-reported overall health status. This lends further support to the idea that self-reported alcohol status can be severely biased by health status at recruitment, supported by recent research from the UK Biobank that found participants are likely to misreport behavioral traits such as alcohol consumption, often as a function of higher disease burden.[181] It may be that the true direction of the association between self-reported alcohol intake and mortality may only be possible to detect via Mendelian Randomization. I also observed the same associations between alcohol intake and mortality in the unimputed data (results not shown), and am therefore confident that the observed association is not somehow an artefact of multiple imputation.

Furthermore, the analyses in this thesis replicate a previous finding from the Million Women Study showing that despite many previously reported associations between happiness and mortality, happiness has no effect on all-cause mortality when proper covariate adjustment is made.[197]

Interestingly, analysis results indicate that risk of mortality is lower for Black, Asian, and "Other" ethnicities compared with whites in the UK Biobank, even after adjustment for a large suite of sociodemographic and deprivation factors (Fig. 17). This mirrors previous research using national UK census and death registration data, which shows that life expectancy is lower for whites compared with all other ethnic groups in the UK.[198] However, these same non-white ethnic groups also tend to live in higher deprivation areas, report poorer self-rated health, and report poorer experiences of using health services in the UK.[199] More research is required to understand how these opposite forces interact in different ways to produce lower mortality risk for UK minorities. While the relationship between geographic location, area disadvantage, and mortality is well established in the UK,[185] further research is also needed on how this relationship applies across ethnic groups.

Overall, cluster multivariable analyses showed robust associations across multiple, similar exposures that all have a concurrent effect on mortality while in the same model (e.g., multiple measures of physical activity: walking for pleasure, swimming and cycling, home DIY, general activity levels). This demonstrates that the environmental architecture of human aging is comprised of a complex network of interrelated factors that cannot be reduced to the effect of a single variable for entire conceptual categories like social integration, physical activity, and diet/lifestyle. Analyses that focus on a single measure for any of these domains may fail to capture their total effect on aging.

4. Chapter Four: Age-related mechanisms and chronic disease analyses

In the previous chapter, I conducted multiple analysis steps to identify exposures that are independently associated with mortality. After an initial XWAS scan, replicated variables were tested for their susceptibility to reverse causation by prevalent disease status and were further tested in multivariable models according to their correlation structure. This multi-step screening process returned a list of 55 exposures that have independent associations with all-cause mortality that are robust to exposome intercorrelation and reverse causation bias.

The aim of the analyses in this thesis chapter was to then test the age-related biological mechanisms and disease pathways with which each of these 55 exposures is associated. These analyses begin to paint a picture of the biological and disease pathways through which the 55 identified exposures influence mortality, and also reveals the patterns of multimorbidity associated with each of these exposures.

4.1. Methods

4.1.1. Aging biomarker analyses

Aging biomarkers (Table 10) were measured using baseline non-fasting blood serum samples as previously described.[200] Data on leukocyte telomere length (LTL) was only available in a slightly smaller sample (n = 410,877) than other biomarkers and was not imputed. Biomarkers were previously adjusted for technical variation by the UK Biobank, with sample processing and quality control procedures described on the UK Biobank website.

Table 10. Variables used for biomarker analyses

Biomarker	UK Biobank field ID
Alanine aminotransferase	30620
Albumin	30600
Alkaline phosphatase	30610
Apolipoprotein A	30630
Apolipoprotein B	30640
Aspartate aminotransferase	30650
High sensitivity C-reactive protein	30710
Cholesterol	30690
Creatinine	30700
Cystatin C	30720
Direct bilirubin	30660
Total bilirubin	30840
Gamma glutamyltransferase	30730
Glucose	30740
Glycated hemoglobin (hbA1c)	30750
HDL cholesterol	30760
Insulin-like growth factor 1 (IGF-1)	30770
LDL direct	30780
Lipoprotein(a)	30790
Phosphate	30810

Triglycerides	30870
Urate	30880
Urea	30670
Vitamin D	30890
Leukocyte telomere length (LTL)	22192

All exposures replicated in the mortality XWAS that survived the disease sensitivity and cluster modeling states were tested in relation to these 25 age-related blood biomarkers. Aging biomarker analyses were cross-sectional, with analyses of leukocyte telomere length (LTL) in a smaller sample since it was only released for a subset of participants (n = 410,877). Serum biomarker variables were log transformed and then age-adjusted by regressing each onto recruitment age separately in women and men. All aging mechanisms were tested in linear regression models with covariates for sex, 5-year birth cohort, assessment center, years of education, ethnicity, number of medications, smoking status, and IPAQ physical activity level. IGF-1, LTL, and vitamin D models included additional covariates for standing height, leukocyte count, and month of biomarker assessment (to control for seasonality of vitamin D sun exposure), respectively.

4.1.2. Incident chronic disease analyses

Incidence of 25 chronic diseases and prevalence three cardiometabolic risk factors (hypertension, obesity, dyslipidemia) was assessed in the full population studied in the mortality XWAS analyses (n = 436,891). ICD codes used to define each disease are given in Table 11. For all incident chronic disease and clinical risk factor analyses, participant follow-up started at recruitment into the UK Biobank study and ended on the censoring

date or date of first disease diagnosis, for all participants, leaving a total of 8-15 years of total follow-up. I also searched death register data for participants with one of the diseases listed as a primary or contributory cause of death but no hospital inpatient diagnosis was listed. In this case, the participant was listed as a case and the date of diagnosis used was the date of death. If any participants with no relevant diagnosis died before the censoring date, then date of death was used as the censoring date.

All exposures replicated in the mortality XWAS that survived the disease sensitivity and cluster modeling states were tested in relation to 8-15 year incidence of these 25 chronic diseases and prevalent risk of the three cardiometabolic risk factors. This included all diseases in the top 20 causes of death in the UK Biobank as of July 28, 2022 (except for causes related to accidents/external injury and infectious disease) as well as other conditions that are highly prevalent in aging populations. I serially assessed each exposure and disease pair using Cox models that used age-at-risk as the timescale, were stratified by 5-year birth cohort and sex, and were adjusted for the following covariates: UK Biobank assessment center, years of education, ethnicity, smoking status, and IPAQ physical activity level. For cardiometabolic risk factors, I serially assessed each exposure and disease pair using cross-sectional logistic regression models adjusted for age, sex, assessment center, household income, years of education, ethnicity, smoking status, and IPAQ physical activity level. P-values were corrected using FDR separately for each biomarker and disease. Each set of biomarker and disease analyses was corrected separately for multiple testing using FDR. Heatmaps and annotation tracks for biomarker and incident disease analyses were created using the ComplexHeatmap package in R.[201]

Table 11. Variables used to calculate prevalence and incidence of chronic diseases and clinical risk factors

Chronic diseases	Baseline measures (field ID)	Baseline verbal interview diagnosis codes	ICD-10 codes	ICD-9 codes
Colorectal cancer	-	1022, 1023	C18-C20	153, 154
Lung cancer	-	1001, 1027, 1028, 1080	C33, C34	162
Esophageal cancer	-	1017	C15	150
Liver cancer	-	1024	C22	155
Pancreatic cancer	-	1026	C25	157
Brain cancer	-	1032	C71	191
Leukemia	-	1048	C91-C95	204-208
Lymphoma	-	1047	C81-C86, C88	201-203
Breast cancer	-	1002	C50	174-175
Ovarian cancer	-	1039	C56	183
Prostate cancer	-	1044	C61	185
Type 2 diabetes	Taking insulin medication (6153, 6177) Diabetes diagnosed by physician (2443) Non-fasting blood hbA1c ³ 48 mmol/mol (30750) Non-fasting blood glucose ³ 11.1 mmol/L (30740)	1223	E11	250
Ischemic heart disease	Heart attack diagnosis by physician (6150) Angina diagnosis by physician (6150)	1074, 1075	I20-I25	410-414
Cerebrovascular diseases	Stroke diagnosis by physician (6150)	1081, 1086, 1491, 1583	I60-I69	430-438

Emphysema, COPD	Bronchitis/emphysema diagnosis by physician (6152)	1112, 1472	J43-J44	492
Chronic liver diseases	-	1157, 1158	K70, K73-K74	571
Chronic kidney diseases	-	1192, 1193, 1194	N18	585
All-cause dementia	-	1263	A81.0, F00-F03, F05.1, F10.6, G30-G31, I67.3	331.0, 290.4, 331.1, 290.2, 290.3, 291.2, 294.1, 331.2, 331.5
Vascular dementia	-	1263	F01, I67.3	290.4
Alzheimer's disease	-	1263	F00, G30	331.0
Parkinson's disease and parkinsonism	-	1262	G20-G22	332
Rheumatoid arthritis	-	1464	M05-M06	714
Macular degeneration	-	1528	H35.3	362.5
Osteoporosis	-	1309	M80-M81	733.0
Osteoarthritis	-	1465	M15-M19	715
Cardiometabolic risk factors	**Baseline measures (field ID)**	**Baseline verbal interview diagnosis codes**	**ICD-10 codes**	**ICD-9 codes**
Hypertension	High blood pressure diagnosis by physician (6150) Taking medication for high blood pressure (6153, 6177) Blood pressure SBP/DBP ≥ 140/90 mmHg (4079, 4080)	1065, 1072	I10-I15	401-405
Obesity	BMI ≥ 30 kg/m^2 (21001)	-	E66	278.0
Dyslipidemia	Taking cholesterol lowering medication (6153, 6177)	-	E78	272

	Blood cholesterol ≥ 240 / 38.67 (30690)
	Blood LDL ≥ 160 / 38.67 (30780)
	Blood HDL < 40 / 38.67 (30760)
	Blood triglycerides [3] 200 / 88.57 (30870)

4.2. Results

4.2.1. Aging biomarker and cardiometabolic risk factor analyses

Descriptive statistics for all 25 baseline biomarkers in this population are given in Table 12. Each of the 55 independent exposures was associated with a wide range of aging biomarkers that span different organ systems and mechanisms (Fig. 18a). On average, each exposure was associated with 21/25 biomarkers. Five exposures were associated with all 25 biomarkers: Townsend deprivation index, partial fiber score, smoking status, hours of sleep, and ethnicity. Number of sexual partners was associated with the fewest biological mechanisms (8/25). Summary statistics from all biomarker analyses are given in Appendix Tables S5-S29.

Lipoprotein(a) (a biomarker related to cardiovascular disease) was associated with the least number of exposures (23 total) but was strongly associated with ethnicity, consistent with previous research on the influence of genetic ancestry on lipoprotein(a).[202] Leukocyte telomere length (LTL) returned the second fewest associations with exposures (28), which may be due to the relatively larger genetic heritability of LTL.[203] While I found no association between a general measure of physical activity (IPAQ activity group) and LTL, I did find significant evidence for an association between leisure time physical activity (LTPA) and LTL. This suggests that telomere length, as an aging mechanism, may only be modulated by certain types of physical activity in this population.

Table 12. Biomarker summary statistics by sex - UK Biobank participants recruited in England

	Female (N=237,634)	Male (N=199,257)	Total (N=436,891)
Alanine Aminotransferase (U/L)	20 (12)	27 (15)	23 (14)
Albumin (g/L)	45 (2.6)	46 (2.6)	45 (2.6)
Alkaline phosphatase (U/L)	85 (27)	82 (25)	84 (26)
Apolipoprotein A (g/L)	1.6 (0.27)	1.4 (0.23)	1.5 (0.28)
Apolipoprotein B (g/L)	1.0 (0.24)	1.0 (0.24)	1.0 (0.24)
Aspartate aminotransferase (U/L)	24 (9.4)	28 (12)	26 (11)
C-reactive protein (mg/L)	2.7 (4.4)	2.5 (4.4)	2.6 (4.4)
Cholesterol (mmol/L)	5.9 (1.1)	5.5 (1.1)	5.7 (1.1)
Creatinine (umol/L)	64 (14)	82 (19)	72 (19)
Cystatin C (mg/L)	0.88 (0.16)	0.94 (0.18)	0.91 (0.18)
Direct bilirubin (umol/L)	1.5 (0.64)	2.0 (0.93)	1.7 (0.82)
Gamma glutamyltransferase (U/L)	30 (34)	46 (50)	37 (42)
Glucose (mmol/L)	5.1 (1.1)	5.2 (1.4)	5.1 (1.2)
Glycated hemoglobin (HbA1c) (mmol/mol)	36 (5.9)	37 (7.6)	36 (6.7)
HDL cholesterol	1.6 (0.38)	1.3 (0.31)	1.5 (0.39)
Insulin-like growth factor 1 (IGF-1) (nmol/L)	21 (5.8)	22 (5.6)	21 (5.7)
LDL direct (mmol/L)	3.6 (0.87)	3.5 (0.86)	3.6 (0.87)
Leukocyte telomere length (T/S ratio)	0.84 (0.13)	0.82 (0.13)	0.83 (0.13)
Lipoprotein(a) (nmol/L)	45 (50)	44 (49)	45 (49)
Phosphate (mmol/L)	1.2 (0.15)	1.1 (0.16)	1.2 (0.16)
Total bilirubin (umol/L)	8.1 (3.7)	10 (4.9)	9.1 (4.4)
Triglycerides (mmol/L)	1.5 (0.85)	2.0 (1.2)	1.7 (1.0)
Urate (umol/L)	270 (66)	360 (72)	310 (81)
Urea (mmol/L)	5.2 (1.3)	5.6 (1.5)	5.4 (1.4)
Vitamin D (nmol/L)	49 (21)	49 (21)	49 (21)

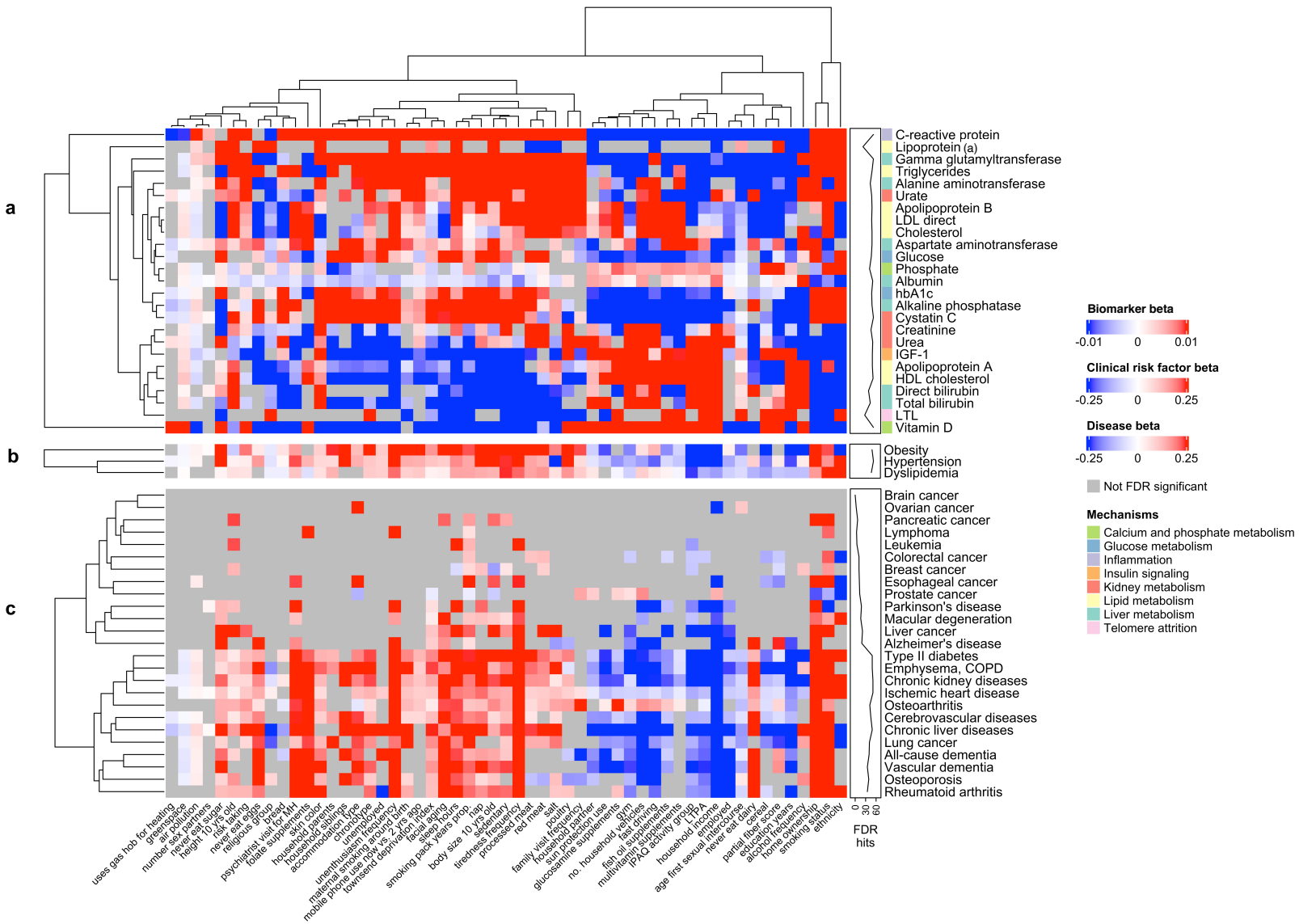

a
b
c
C-reactive protein
Lipoprotein (a)
Gamma glutamyltransferase
Triglycerides
Alanine aminotransferase
Urate
Apolipoprotein B
LDL direct
Cholesterol
Aspartate aminotransferase
Glucose
Phosphate
Albumin
hbA1c
Alkaline phosphatase
Cystatin C
Creatinine
Urea
IGF-1
Apolipoprotein A
HDL cholesterol
Direct bilirubin
Total bilirubin
LTL
Vitamin D
Obesity
Hypertension
Dyslipidemia
Brain cancer
Ovarian cancer
Pancreatic cancer
Lymphoma
Leukemia
Colorectal cancer
Breast cancer
Esophageal cancer
Prostate cancer
Parkinson's disease
Macular degeneration
Liver cancer
Alzheimer's disease
Type II diabetes
Emphysema, COPD
Chronic kidney diseases
Ischemic heart disease
Osteoarthritis
Cerebrovascular diseases
Chronic liver diseases
Lung cancer
All-cause dementia
Vascular dementia
Osteoporosis
Rheumatoid arthritis
0
30
60
FDR hits
uses gas hob for heating
green space
air pollution
number sex partners
never eat sugar
height 10 yrs old
risk taking
never eat eggs
religious group
psychiatrist visit for MH
folate supplements
bread
household parents
skin color
household siblings
accommodation type
chronotype
unemployed
unenthusiasm frequency
maternal smoking around birth
mobile phone use now vs 2 yrs ago
townsend deprivation index
facial aging
sleep hours
smoking pack years prop
nap
body size 10 yrs old
sedentary
tiredness frequency
processed meat
red meat
salt
poultry
family visit frequency
household partner
sun protection use
glucosamine supplements
gym
no. household vehicles
fast driving
fish oil supplements
multivitamin supplements
IPAQ activity group
LTPA
household income
employed
age first sexual intercourse
never eat dairy
partial fiber score
cereal
education years
alcohol frequency
home ownership
smoking status
ethnicity
Biomarker beta
-0.01
0
0.01
Clinical risk factor beta
-0.25
0
0.25
Disease beta
-0.25
0
0.25
Not FDR significant
Mechanisms
Calcium and phosphate metabolism
Glucose metabolism
Inflammation
Insulin signaling
Kidney metabolism
Lipid metabolism
Liver metabolism
Telomere attrition

Figure 18. Exposome-wide analysis of (**a**) aging biomarkers, (**b**) cardiometabolic risk factors, and (**c**) age-related chronic diseases. Colors in the heatmaps represent betas for associations between exposures and biomarkers/diseases. A line annotation track is shown that counts the total number of FDR significant associations for each outcome. For heatmap (**a**), an addition annotation track shows the primary biological mechanism associated with each aging biomarker. Air pollution and greenspace are the first principal components combining all air pollution and greenspace variables, respectively. For nominal categorical variables with more than one response level, the association for the level with the strongest p-value is reported in this figure. COPD: chronic obstructive pulmonary diseases; IGF-1: insulin-like growth factor 1; LTL: leucocyte telomere length; LTPA: leisure time physical activity.

Cardiometabolic risk factors studied (obesity, hypertension, and dyslipidemia) were cross-sectionally associated with nearly every exposure studied (Fig. 18b). Obesity, hypertension, and dyslipidemia were each associated with 50, 54, and 48 exposures, respectively. Number of sexual partners and using a gas hob for heating were the only two exposures associated with only 1/3 cardiometabolic risk factors, showing a weak positive association with obesity and negative association with hypertension, respectively.

4.2.2. Incident chronic diseases analyses

Prevalence and incidence rates for chronic diseases and cardiometabolic risk factors studied in English participants are shown in Table 13. Each of the 55 independent exposures also associated prospectively with concurrent incidence of multiple chronic diseases (Fig. 18c), indicating that each of these exposures is a likely catalyst of multimorbidity. On average, each exposure was associated with 11/25 chronic diseases. Smoking variables were associated with the greatest number of diseases (21-22). Household income and home ownership were associated with the second highest number of diseases (19), followed by tiredness frequency (18), Townsend deprivation index (18), and IPAQ activity group (18). Notably, I observed several major blocks of related exposures that were associated in consistent directions with concurrent diagnosis of at least half the diseases studied, including groups of mental health, diet and supplements, sleep, smoking, physical activity, income, and socioeconomic status exposures (Fig. 19c). Number of sexual partners was only associated with three diseases: chronic liver diseases,

ischemic heart disease, and Parkinson's disease. Summary statistics from all biomarker analyses are given in Appendix Tables S30-S57.

Chronic kidney diseases and ischemic heart disease were associated with the greatest number of exposures (51), followed by emphysema and chronic obstructive pulmonary disease (COPD; 50). As a group, cardiometabolic diseases (chronic liver diseases, chronic kidney diseases, cerebrovascular diseases, ischemic heart disease, and type II diabetes) were associated with the largest number of factors, with all cardiometabolic conditions associated with an average of 49 exposures. Dementia outcomes were associated with an average of 32 exposures, with Alzheimer's disease being associated with fewer exposures (19) than all-cause dementia (42) and vascular dementia (36). Cancers were associated with the fewest overall exposures, with the exception of lung cancer (41 exposures). Of note, I also found no associations between any exposure and incidence of brain cancer.

Table 13. Chronic disease and cardiometabolic risk factor diagnosis rates - UK Biobank English participants

	Female (N=237,634)	Male (N=199,257)	Total (N=436,891)
Colorectal cancer			
No diagnosis	233,700 (98.3%)	194,334 (97.5%)	428,034 (98.0%)
Incident diagnosis	2,834 (1.2%)	3,516 (1.8%)	6,350 (1.5%)
Prevalent diagnosis	1,100 (0.5%)	1,407 (0.7%)	2,507 (0.6%)
Lung cancer			
No diagnosis	235,068 (98.9%)	196,424 (98.6%)	431,492 (98.8%)
Incident diagnosis	2,305 (1.0%)	2,423 (1.2%)	4,728 (1.1%)
Prevalent diagnosis	261 (0.1%)	410 (0.2%)	671 (0.2%)
Esophageal cancer			
No diagnosis	237,210 (99.8%)	198,099 (99.4%)	435,309 (99.6%)
Incident diagnosis	373 (0.2%)	986 (0.5%)	1,359 (0.3%)
Prevalent diagnosis	51 (0.0%)	172 (0.1%)	223 (0.1%)
Liver cancer			
No diagnosis	237,178 (99.8%)	198,576 (99.7%)	435,754 (99.7%)
Incident diagnosis	382 (0.2%)	570 (0.3%)	952 (0.2%)
Prevalent diagnosis	74 (0.0%)	111 (0.1%)	185 (0.0%)
Pancreatic cancer			
No diagnosis	236,855 (99.7%)	198,358 (99.5%)	435,213 (99.6%)
Incident diagnosis	736 (0.3%)	843 (0.4%)	1,579 (0.4%)
Prevalent diagnosis	43 (0.0%)	56 (0.0%)	99 (0.0%)
Brain cancer			
No diagnosis	237,133 (99.8%)	198,668 (99.7%)	435,801 (99.8%)
Incident diagnosis	379 (0.2%)	477 (0.2%)	856 (0.2%)
Prevalent diagnosis	122 (0.1%)	112 (0.1%)	234 (0.1%)
Leukemia			
No diagnosis	236,728 (99.6%)	197,946 (99.3%)	434,674 (99.5%)
Incident diagnosis	692 (0.3%)	1,020 (0.5%)	1,712 (0.4%)
Prevalent diagnosis	214 (0.1%)	291 (0.1%)	505 (0.1%)
Lymphoma			
No diagnosis	235,985 (99.3%)	197,254 (99.0%)	433,239 (99.2%)
Incident diagnosis	1,201 (0.5%)	1,429 (0.7%)	2,630 (0.6%)
Prevalent diagnosis	448 (0.2%)	574 (0.3%)	1,022 (0.2%)

Table 13. Chronic disease and cardiometabolic risk factor diagnosis rates - UK Biobank English participants

	Female (N=237,634)	Male (N=199,257)	Total (N=436,891)
Breast cancer			
No diagnosis	218,845 (92.1%)	199,105 (99.9%)	417,950 (95.7%)
Incident diagnosis	8,843 (3.7%)	90 (0.0%)	8,933 (2.0%)
Prevalent diagnosis	9,946 (4.2%)	62 (0.0%)	10,008 (2.3%)
Ovarian cancer			
No diagnosis	235,622 (99.2%)	199,254 (100.0%)	434,876 (99.5%)
Incident diagnosis	1,190 (0.5%)	3 (0.0%)	1,193 (0.3%)
Prevalent diagnosis	822 (0.3%)	0 (0%)	822 (0.2%)
Prostate cancer			
No diagnosis	237,626 (100.0%)	186,308 (93.5%)	423,934 (97.0%)
Incident diagnosis	5 (0.0%)	9,805 (4.9%)	9,810 (2.2%)
Prevalent diagnosis	3 (0.0%)	3,144 (1.6%)	3,147 (0.7%)
Type II diabetes			
No diagnosis	220,224 (92.7%)	174,531 (87.6%)	394,755 (90.4%)
Incident diagnosis	6,843 (2.9%)	8,592 (4.3%)	15,435 (3.5%)
Prevalent diagnosis	10,567 (4.4%)	16,134 (8.1%)	26,701 (6.1%)
Ischemic heart disease			
No diagnosis	218,285 (91.9%)	163,606 (82.1%)	381,891 (87.4%)
Incident diagnosis	11,852 (5.0%)	19,369 (9.7%)	31,221 (7.1%)
Prevalent diagnosis	7,497 (3.2%)	16,282 (8.2%)	23,779 (5.4%)
Cerebrovascular diseases			
No diagnosis	227,488 (95.7%)	186,034 (93.4%)	413,522 (94.7%)
Incident diagnosis	6,765 (2.8%)	8,640 (4.3%)	15,405 (3.5%)
Prevalent diagnosis	3,381 (1.4%)	4,583 (2.3%)	7,964 (1.8%)
Emphysema, COPD			
No diagnosis	226,215 (95.2%)	186,023 (93.4%)	412,238 (94.4%)
Incident diagnosis	6,970 (2.9%)	8,485 (4.3%)	15,455 (3.5%)
Prevalent diagnosis	4,449 (1.9%)	4,749 (2.4%)	9,198 (2.1%)
Chronic liver diseases			
No diagnosis	236,132 (99.4%)	196,869 (98.8%)	433,001 (99.1%)
Incident diagnosis	922 (0.4%)	1,621 (0.8%)	2,543 (0.6%)
Prevalent diagnosis	580 (0.2%)	767 (0.4%)	1,347 (0.3%)

Table 13. Chronic disease and cardiometabolic risk factor diagnosis rates - UK Biobank English participants

	Female (N=237,634)	Male (N=199,257)	Total (N=436,891)
Chronic kidney diseases			
No diagnosis	228,299 (96.1%)	189,208 (95.0%)	417,507 (95.6%)
Incident diagnosis	8,858 (3.7%)	9,381 (4.7%)	18,239 (4.2%)
Prevalent diagnosis	477 (0.2%)	668 (0.3%)	1,145 (0.3%)
All-cause dementia			
No diagnosis	234,741 (98.8%)	195,953 (98.3%)	430,694 (98.6%)
Incident diagnosis	2,819 (1.2%)	3,214 (1.6%)	6,033 (1.4%)
Prevalent diagnosis	74 (0.0%)	90 (0.0%)	164 (0.0%)
Vascular dementia			
No diagnosis	236,967 (99.7%)	198,308 (99.5%)	435,275 (99.6%)
Incident diagnosis	614 (0.3%)	884 (0.4%)	1,498 (0.3%)
Prevalent diagnosis	53 (0.0%)	65 (0.0%)	118 (0.0%)
Alzheimer's			
No diagnosis	236,139 (99.4%)	197,823 (99.3%)	433,962 (99.3%)
Incident diagnosis	1,441 (0.6%)	1,368 (0.7%)	2,809 (0.6%)
Prevalent diagnosis	54 (0.0%)	66 (0.0%)	120 (0.0%)
Parkinson's			
No diagnosis	236,302 (99.4%)	197,026 (98.9%)	433,328 (99.2%)
Incident diagnosis	1,035 (0.4%)	1,719 (0.9%)	2,754 (0.6%)
Prevalent diagnosis	297 (0.1%)	512 (0.3%)	809 (0.2%)
Rheumatoid arthritis			
No diagnosis	231,489 (97.4%)	196,363 (98.5%)	427,852 (97.9%)
Incident diagnosis	2,668 (1.1%)	1,362 (0.7%)	4,030 (0.9%)
Prevalent diagnosis	3,477 (1.5%)	1,532 (0.8%)	5,009 (1.1%)
Macular degeneration			
No diagnosis	232,478 (97.8%)	195,968 (98.3%)	428,446 (98.1%)
Incident diagnosis	4,625 (1.9%)	2,973 (1.5%)	7,598 (1.7%)
Prevalent diagnosis	531 (0.2%)	316 (0.2%)	847 (0.2%)
Osteoporosis			
No diagnosis	222,980 (93.8%)	196,689 (98.7%)	419,669 (96.1%)
Incident diagnosis	8,307 (3.5%)	1,686 (0.8%)	9,993 (2.3%)
Prevalent diagnosis	6,347 (2.7%)	882 (0.4%)	7,229 (1.7%)

Table 13. Chronic disease and cardiometabolic risk factor diagnosis rates - UK Biobank English participants

	Female (N=237,634)	Male (N=199,257)	Total (N=436,891)
Osteoarthritis			
No diagnosis	183,497 (77.2%)	162,615 (81.6%)	346,112 (79.2%)
Incident diagnosis	26,469 (11.1%)	19,410 (9.7%)	45,879 (10.5%)
Prevalent diagnosis	27,668 (11.6%)	17,232 (8.6%)	44,900 (10.3%)
Hypertension			
No diagnosis	46,256 (19.5%)	28,391 (14.2%)	74,647 (17.1%)
Prevalent diagnosis	191,378 (80.5%)	170,866 (85.8%)	362,244 (82.9%)
Obesity			
No diagnosis	181,877 (76.5%)	148,720 (74.6%)	330,597 (75.7%)
Prevalent diagnosis	55,757 (23.5%)	50,537 (25.4%)	106,294 (24.3%)
Dyslipidemia			
No diagnosis	125,446 (52.8%)	67,006 (33.6%)	192,452 (44.1%)
Prevalent diagnosis	112,188 (47.2%)	132,251 (66.4%)	244,439 (55.9%)

Prevalent chronic disease rates are calculated as those with a corresponding ICD diagnosis date before or on the date of recruitment into the UK Biobank cohort. Additionally, those who self-reported a physician diagnosis of cancer, diabetes, heart attack, stroke, or bronchitis/emphysema during the baseline verbal interview were also used to count prevalent cases for cancer, diabetes, heart disease, cerebrovascular disease, and chronic lower respiratory diseases, respectively. Incident disease rates are for the 11-14 year study follow up period and exclude those with prevalent disease at baseline. Descriptive statistics are calculated using the first imputed analysis dataset and are not pooled across imputed datasets.

4.2.3. Sensitivity analyses

After conducting analyses between all exposures and incident prostate cancer, I observed that many significant associations were in the opposite direction as expected. Notably, I observed all smoking variables showed an association with decreased risk of incident prostate cancer. This inverse association has been well documented in previous

studies.[204-206] It has been posited that those who do not smoke may be more likely to undergo a prostate specific antigen (PSA) test and receive a diagnosis whereas those who smoke may be less likely to undergo testing and therefore would be undiagnosed or not diagnosed until a much later stage. I attempted to test this by stratifying the sample population by those who had ever received a PSA test (field ID 2365), as well as conducting a model in the full sample with PSA test as a fixed covariate. All Cox models included age as the timescale, were stratified by 5-year birth cohorts, and were adjusted for UK Biobank assessment center, household income, ethnicity, years of education, and IPAQ activity group. All polynomial contrasts were allowed for all ordinal variables.

The inverse association between smoking and incident prostate cancer remained in both those who had and had not received a PSA test (Table 14). Furthermore, adding in ever having taken a PSA test as a covariate to the model in the full sample also did not alter the inverse association observed between smoking and prostate cancer. Together, these results seem to rule out any PSA test detection bias explaining the associations between smoking and prostate cancer. Previous research has also demonstrated that IGF-1 levels are associated with increased risk of prostate cancer[207] and it has been posited that smoking may reduce the risk of prostate cancer through decreasing IGF-1.[206] Biomarker analysis did show a significant association between smoking and decreased IGF-1 levels (Fig. 19a), which may support this hypothesis.

Table 14. Smoking associations with prostate cancer according to PSA test

	No PSA test		**Has PSA test**		**PSA test as covariate**	
	Hazard Ratio [95% CI]	**p-value**	**Hazard Ratio [95% CI]**	**p-value**	**Hazard Ratio [95% CI]**	**p-value**
Never smoker (reference)	-	-	-	-	-	-
Previous smoker	0.97 [0.91, 1.03]	0.31	0.93 [0.87, 1.00]	0.04	0.95 [0.91, 1.00]	0.04
Current smoker	0.90 [0.81, 0.99]	0.02	0.86 [0.75, 0.98]	0.02	0.88 [0.81, 0.95]	< 0.001

All models are Cox models with age as the timescale, stratified by 5-year birth cohorts, and with covariates for UK Biobank assessment center, household income, years of education, ethnicity, and IPAQ activity level. Sample sizes are n = 137,598 for those with no PSA test, n = 58,425 for those with a PSA test, and n = 196,113 for final model not stratified by PSA test but including PSA test as a covariate.

4.3. Discussion

Taken together, the results from the mortality analyses in Chapter Three, alongside the aging biomarker, cardiometabolic risk factor, and incident chronic disease analyses from this chapter reveal a picture of the environmental architecture of human aging (Fig. 19), which shows the correlations and interrelationships between exposures and the many biological mechanisms, cardiometabolic risk factors, and disease pathways that each works through to ultimately determine mortality. The clear story that emerges from these analyses is that the aging exposome is a major driver of chronic disease multimorbidity, with all exposures that are independently associated with mortality also being associated

concurrently with a wide range of incident chronic disease diagnoses and alterations to numerous and diverse biological mechanisms.

In general, I found remarkable consistency in the direction of effect when comparing associations between each exposure and mortality, biomarkers, and diseases. For example, most of the factors associated with decreased mortality are generally associated with decreased risk of disease, increased levels of healthy biomarkers, and decreased levels of detrimental biomarkers. As discussed in the literature introduced in Chapter One on multi-layer analysis approaches,[126] this consistency in regression beta directions when testing exposures across several different layers (morality, biomarkers, diseases) gives greater plausibility to the associations and improves our confidence that those exposures are deterministic factors if they associate in a consistent and plausible direction with all these different layers.

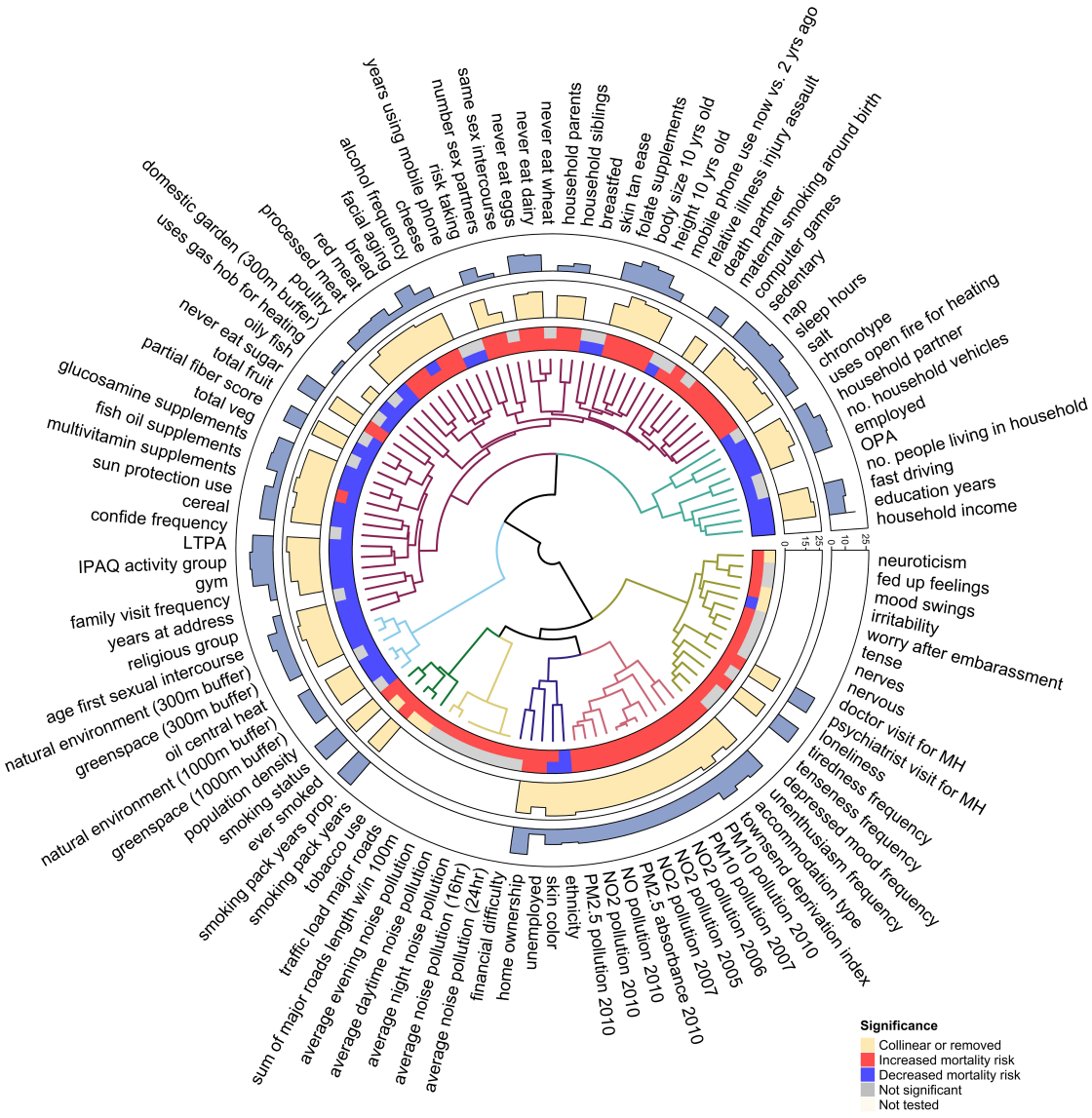


Figure 19. The environmental architecture of human aging in the UK Biobank. Tracks shown from inner to outer are: (a) dendrogram representing the hierarchical clustering of exposures replicated in the all-cause mortality pooled XWAS, with separate clusters represented by alternating colors (k = 8); (b) heatmap of exposome associations with mortality in the pooled XWAS; (c) heatmap of exposome associations with mortality in the cluster multivariable analyses; (d) the number of aging biomarkers each variable was cross-sectionally associated with after FDR correction; and (e) the number of incident chronic diseases each variable was associated with after FDR correction. Peach colored cells in the cluster multivariable track represent variables filtered out due to collinearity. For nominal categorical variables with more than one response level, the association for the level with the strongest p-value is reported in this figure. For XWAS covariates not tested separately as exposures in the pooled XWAS and disease sensitivity analysis (household income, education, ethnicity, UK Biobank assessment center), the most significant p-value for these covariates across all tests was chosen. LTPA: leisure time physical activity; MH: mental health; OPA: occupational physical activity; UKB: UK Biobank.

In particular, several blocks of exposures can be identified that show particularly strong concordance in associations across the different layers tested. When examining Fig. 18, the rightmost 3/4 of the figure shows three distinct blocks of exposures associated with increased, decreased, and increased risk mortality, respectively. These blocks show strong associations across the majority of diseases, cardiometabolic risk factors, and biological mechanisms tested. Variables in these blocks include those related to smoking, socioeconomic status (income, deprivation, home ownership, education), physical activity, sleep, and mental health.

Protective exposures strongly associated with reduced risk of mortality (total physical activity, leisure physical activity, going to the gym, income, education, living with a partner) were consistently associated with decreased risk of nearly two thirds of all diseases studied, and with decreased risk of obesity, dyslipidemia, and hypertension. On the biological level, these were consistently associated with increased levels of markers that have been previously associated with slower biological aging (telomere length, IGF-1), as well as increased levels of mechanisms that are known to have protective influences on cardiometabolic and other chronic diseases, including markers related to calcium balance (vitamin D, phosphate), lipid metabolism (HDL cholesterol, apolipoprotein A), liver metabolism (bilirubin, albumin) and kidney metabolism (creatinine, phosphate). These same protective exposures were also consistently associated with decreased levels of known mechanisms that increase risk of cardiometabolic and other chronic diseases, including markers related to glucose metabolism (glucose, hbA1c), lipid metabolism (triglycerides, LDL, and total cholesterol), inflammation (C-reactive protein), liver

metabolism (gamma glutamyltransferase, alkaline phosphatase), and kidney metabolism (cystatin C).

Detrimental exposures strongly associated with increased mortality risk (smoking, lack of home ownership, deprivation, sedentary behavior, mental health difficulties, poor sleep) consistently showed effects on the above mentioned biological mechanisms, cardiometabolic risk factors, and incident diseases in the opposite directions as protective exposures, providing a clear picture of the interrelated layers of biological mechanisms, clinical risk phenotypes, and disease pathways through which these exposome influences ultimately affect risk of mortality.

In general, the leftmost 1/4 of Fig. 18 shows exposures with more variable consistencies in association directions between chronic diseases cardiometabolic risk factors, and biological mechanisms. These results demonstrate the complicated and sometimes multifaceted effects that some exposures can have, even leading to contradictory short vs. long term effects on biological responses compared with long-term disease and mortality risk. For example, while never eating sugar was associated with increased risk of all cardiometabolic diseases and risk factors, it was also associated with improved, beneficial levels of HDL, bilirubin, LDL, total cholesterol, and triglycerides. Recent meta-analyses and large cohort studies have shown that both diets with extremely low sugar (< 5%) and overall low carbohydrate diets are associated with greater mortality risk,[208,209] but also show that low amounts of dietary sugar are associated with improved triglycerides and cholesterol.[210] These are consistent with the findings described in this thesis, showing a complicated picture in which extreme dietary sugar or carbohydrate

restriction in the short-term has positive benefits on cholesterol and triglycerides, but over the long term leads to a detrimental effect on mortality. I also found that another dietary extreme variable, never eating dairy, was associated with increased risk of mortality and all cardiometabolic diseases while cross-sectionally associated with lowered risk of dyslipidemia and lower levels of HDL, LDL, triglycerides, and total cholesterol. This is consistent with a recent large meta-analysis and Mendelian randomization study indicating a relationship between milk intake and lower HDL and LDL.[211] However, the evidence to date on the relationship between milk or dairy intake and mortality is extremely heterogenous and no clear conclusion has emerged, likely due to the variation in the reference diet compared with diary intake.[212,213]

Among diet variables, intakes of meat, bread, and cereal were associated with the greatest number of biological mechanisms, whereas dietary extreme variables such as never eating eggs, dairy, or sugar were associated with greater numbers of incident diseases. Psychosocial variables such as frequency of visiting family and friends, being part of a religious group, and living with a partner, parents, or siblings, were associated with slightly fewer diseases and biological mechanisms than other categories of variables. Overall, I found the most inconsistency in effect directions across diseases for alcohol intake, likely reflecting the well documented difficulties and biases in measuring self-reported alcohol intake discussed in Chapters 2-3.

Across the diseases studied, the major outlier in terms of direction of effect between exposome and the diseases was prostate cancer, which tended to show the opposite direction of association compared with other diseases for nearly every exposure

with which it was associated. This is well documented for exposures like smoking, which is discussed and tested further in the sensitivity analysis section above.

5. Chapter Five: Multivariable exposome modelling

In the previous chapter, I demonstrated that each of the 55 unique exposures associated with all-cause mortality in the UK Biobank is associated with a wide range of age-related biological mechanisms, cardiometabolic risk factors, and age-related diseases. The clear takeaway is that each exposure seems to be a major driver of multimorbidity. Since each of the unique exposures that were associated with mortality also associated with a large number of biological mechanisms and diseases, this further confirmed that no further reduction in exposures needed to be completed and that all 55 exposures influence, to varying extents, associate with all stages of the aging causal pathway I was able to test using UK Biobank data.

In this final analysis chapter, I attempt to estimate the total impact of this aging exposome on all-cause mortality, as well as each of the 25 age-related chronic diseases studied. This allows me to test, for the first time in a single dataset, whether the exposome is truly the primary driver of mortality. Final multivariable models were then fitted combining all exposures associated with each outcome, along with PRS and clinical information. In this context, I call these models multi-omic due to the models including both exposomic and genomic information.

5.1. Methods

5.1.1. Final multivariable exposome modeling

As a final analysis step, all exposures independently associated with mortality and surviving the disease sensitivity and cluster modeling steps were assessed in a single model with mortality as the outcome. The aim was to determine the amount of variation in mortality that the entire aging exposome explains. Similar multivariable models were calculated for each of the chronic disease outcomes studied, with the subset of exposures used in these models that were individually associated with that disease in previous analysis steps. For sex-specific diseases (breast, ovarian, and prostate cancers), I also included all sex-specific exposures that were replicated in the female- and male-only mortality XWAS. Ordinal categorical variables were allowed all polynomial contrasts for these final multivariable models. The Cox proportional hazards models used for these multivariable models different slightly from those used in previous analyses, instead using mortality survival time as the timescale, using recruitment age sex as fixed covariates, and removing birth cohort from the model given its collinearity with age. This is represented in the below R formula:

$$coxph(Surv(f,d) \sim e + s + x, data) \quad (5)$$

where *f* is survival time for the outcome, *d* is the event indicator, *e* is age at recruitment (scaled), *s* is sex, and *x* is a vector of all exposures associated with the outcome in previous analysis steps.

Because different variables in the dataset had small amounts of NA values after recoding (see section 2.3.3), adding more and more variables to a single model increases the number of participants that are dropped from regression due to an NA response across any variable. To ensure that model performance would not be affected by this and to avoid overfitting, I systematically calculated crosstabs between each categorical exposure and the event indicator for each outcome. Datasets used for this crosstab procedure included only the subsets of participants with no missing values across any exposures or PRS variables for that outcome, as well as excluding any prevalent outcome cases. Any categorical exposures with less than 10 outcome cases for one of the response levels was completely excluded from all exposome models for that specific outcome. The only exception was the variable on type of accommodation lived in, where instead I recoded all responses of "Mobile or temporary structure (i.e., caravan)" to NA and removed that as a response level from the variable (since only a few hundred people endorsed this response level in the subset of participants in the multivariable models).

For each outcome, five versions of the model were calculated. The first only includes age (scaled) and sex in the model (model 1). Model 2 includes age, sex, and the polygenic risk score (PRS) for the outcome, if available (see below for more detail). Model 3 is the full exposome model (shown in formula 5, above). Model 4 takes all variables from model 3 and also includes PRS (if available). Finally, model 5 was calculated including all

variables from model 4 plus additional known clinical risk factors for each outcome (Table 15). If a PRS was not available for a particular outcome, then model 4 was not calculated for that outcome and model 5 was calculated excluding any PRS information. Each model was validated in the independent Scottish/Welsh dataset (n = 55,676) by obtaining the linear predicted values from the models in the English dataset and measuring the C-index and R^2 for these values in relation to the outcome rates in the Scottish/Welsh population.

For each Cox model, the proportional hazards assumption was tested by examining the Schoenfeld residuals using the cox.zph function in the Survival package. For each model, if any variable showed a p-value lower than 0.0001 in the cox.zph output, then the Schoenfeld residuals were plotted to inspect the residuals distribution. Variables were deemed to violate the proportional hazards assumption based on visual inspection of the Schoenfeld residuals to detect non-conformity of the residuals over time. For these variables, a new model was calculated with an interaction with time. Survival time splitting to use for time interactions in these models was performed using the timeSplitter function from the Greg R package,[214] using two years as the interval for time splitting.

Table 15. Clinical risk factors used in prediction modeling

Outcome	UK Biobank measure(s) used (field ID)
All-cause mortality	Self-rated overall health (2178), usual walking pace (924), taking blood pressure medication (6153, 6177), taking cholesterol medication (6153, 6177), self-reported cancer diagnosis (2453), body mass index (BMI, 21001), systolic blood pressure (4080), major depression status (20216), blue badge recipient (6146), attendance allowance recipient (6146), disability living allowance recipient (6146), baseline type 2 diabetes, baseline ischemic heart disease, baseline cerebrovascular disease, baseline dyslipidemia.

Colorectal cancer	BMI (21001), baseline type 2 diabetes.
Lung cancer	FEV1 best measure (20150) standardized by standing height squared (50), BMI (21001), baseline emphysema/COPD.
Esophageal cancer	BMI (21001), omeprazole intake (6154), ranitidine intake (6154), hot drink temperature (1518).
Liver cancer	BMI (21001), leukocyte count (30000), baseline type 2 diabetes, baseline chronic liver disease.
Pancreatic cancer	BMI (21001), systolic blood pressure (4080), taking blood pressure medication (6153, 6177), baseline type 2 diabetes, baseline ischemic heart disease, baseline dyslipidemia.
Brain cancer	-
Leukemia	BMI (21001), leukocyte count (30000), baseline type 2 diabetes.
Lymphoma	BMI (21001), leukocyte count (30000).
Breast cancer	IGF-1 (30770), BMI (21001), oral contraceptive use (2784), hormone replacement therapy (2814), age when periods started (2714), number of live births (2734), ever had stillbirth (2774), self-reported cancer diagnosis (2453), standing height (50), testosterone (30850).
Ovarian cancer	BMI (21001), hormone replacement therapy (2814), ever had hysterectomy (3591), self-reported cancer diagnosis (2453).
Prostate cancer	IGF-1 (30770), BMI (21001), standing height (50).
Type 2 diabetes	Taking blood pressure medication (6153, 6177), systolic blood pressure (4080), major depression status (20216), baseline dyslipidemia, BMI (21001).
Ischemic heart disease	Taking blood pressure medication (6153, 6177), BMI (21001), systolic blood pressure (4080), major depression status (20216), baseline type 2 diabetes, baseline dyslipidemia.
Cerebrovascular diseases	Taking blood pressure medication (6153, 6177), BMI (21001), systolic blood pressure (4080), baseline ischemic heart disease, baseline type 2 diabetes, baseline dyslipidemia.
Emphysema, COPD	FEV1 best measure (20150) standardized by standing height squared (50), BMI (21001),
Chronic liver diseases	BMI (21001), baseline type 2 diabetes, self-reported cancer diagnosis (2453), leukocyte count (30000).
Chronic kidney diseases	BMI (21001), baseline type 2 diabetes, baseline ischemic heart disease, taking blood pressure medication (6153, 6177), systolic blood pressure (4080).
All-cause dementia	Taking blood pressure medication (6153, 6177), BMI (21001), systolic blood pressure (4080), major depression status (20216),

	baseline type 2 diabetes, hearing difficulty (2247), reaction time (20023), fluid intelligence (20016), prospective memory (20018).
Vascular dementia	Taking blood pressure medication (6153, 6177), BMI (21001), systolic blood pressure (4080), major depression status (20216), baseline type 2 diabetes, hearing difficulty (2247), reaction time (20023), fluid intelligence (20016), prospective memory (20018).
Alzheimer's disease	Taking blood pressure medication (6153, 6177), BMI (21001), systolic blood pressure (4080), major depression status (20216), baseline type 2 diabetes, hearing difficulty (2247), reaction time (20023), fluid intelligence (20016), prospective memory (20018).
Parkinson's disease and parkinsonism	Baseline cerebrovascular disease.
Rheumatoid arthritis	BMI (21001), maternal smoking at birth (1787).
Macular degeneration	Taking blood pressure medication (6153, 6177), BMI (21001), systolic blood pressure (4080), baseline ischemic heart disease.
Osteoporosis	Heel bone mineral density (3148), testosterone (30850), BMI (21001), omeprazole intake (6154), ranitidine intake (6154), self-reported cancer diagnosis (2453), fractured/broken bones in last 5 years (2463), baseline rheumatoid arthritis, baseline chronic kidney disease, baseline chronic liver disease.
Osteoarthritis	Heel bone mineral density (3148), BMI (21001), doing strenuous sports in the past 4 weeks (6164), doing heavy DIY in the past 4 weeks (6164).

All baseline diagnosis indicators were derived using all baseline measures and verbal interview codes listed in Table 11 + any ICD diagnoses from Table 11 with a diagnosis date before the UK Biobank recruitment date.

5.1.2. Calculating polygenic risk scores

Where possible, I used multi-ancestry PRS that were previously made available by the UK Biobank (Table 16). Methods for deriving these PRS are described elsewhere.[215] For cancer outcomes where no PRS were provided by the UK Biobank, I identified recent PRS from the PGS Catalog,[216] selecting scores derived in predominantly European populations

that did not overlap with the UK Biobank cohort (as no multi-ancestry scores were available). These PRS were calculated for me by a colleague at Oxford, Jennifer Collister, as weighted sums in the UK Biobank v3 imputed genotype data using the formula ∑(no. risk alleles*effect size). The scores for leukemia, lung and pancreas cancer (PGS000077, PGS000078, PGS000083, respectively) were derived by Graff et al. (2021)[217] and the esophageal cancer score (PGS002298) by Choi et al. (2020).[218] All variants in these scores met our quality control criteria of imputation information > 0.4 and minor allele frequency (MAF) > 0.005 in the UK Biobank data. Although these scores for leukemia as well as lung, pancreas, and esophageal cancer were derived in European populations, we calculated PRS for the full multi-ancestry sample used in this thesis and accepted the limitation that the PRS may be slightly mis-specified in non-European participants. Nonetheless, initial testing of the PRS in the full sample showed that they performed well, with a strong, dose-response association across quintiles of genetic risk for all PRS except esophageal cancer, which showed weaker associations between the PRS and cancer outcome. This is consistent with the association results obtained from the original publication on the creation of this PRS.[218]

All PRS were coded as quintiles for use in multivariable models. In all multivariable models including PRS variables, I also added an additional covariate for genotype array batch (BiLEVE vs. Axiom; field ID 22000) as well as the first four genetic principal components published by the UK Biobank (field ID 22009).

Table 16. Variables used for calculation of polygenic risk scores (PRS).

Outcome	UK Biobank derived PRS measure(s) used (field ID)
All-cause mortality	Bowel cancer (26218); breast cancer (26220); ovarian cancer (26232); prostate cancer (26267); type 2 diabetes (26285); cardiovascular disease (26223); coronary artery disease (26227); ischemic stroke (26248); Alzheimer's disease (26206); Parkinson's (26260); rheumatoid arthritis (26273); macular degeneration (26204); osteoporosis (26258); lung cancer; esophageal cancer; pancreatic cancer; leukemia
Colorectal cancer	Bowel cancer (26218)
Lung cancer	Calculated ourselves (see Methods)
Esophageal cancer	Calculated ourselves (see Methods)
Liver cancer	None
Pancreatic cancer	Calculated ourselves (see Methods)
Brain cancer	None
Leukemia	Calculated ourselves (see Methods)
Lymphoma	None
Breast cancer	Breast cancer (26220)
Ovarian cancer	Ovarian cancer (26232)
Prostate cancer	Prostate cancer (26267)
Type 2 diabetes	Type 2 diabetes (26285)
Ischemic heart disease	Cardiovascular disease (26223); coronary artery disease (26227)
Cerebrovascular diseases	Ischemic stroke (26248)
Emphysema, COPD	None
Chronic liver diseases	None
Chronic kidney diseases	None
All-cause dementia	Alzheimer's disease (26206)
Vascular dementia	Alzheimer's disease (26206)
Alzheimer's disease	Alzheimer's disease (26206)
Parkinson's disease	Parkinson's (26260)
Rheumatoid arthritis	Rheumatoid arthritis (26273)
Macular degeneration	Macular degeneration (26204)
Osteoporosis	Osteoporosis (26258)
Osteoarthritis	None

5.1.3. Pooling R^2, C-index, and Chi-squared values across imputed datasets

R^2 values for each model were calculated using the CoxR2 package[219] as a measure of explained randomness based on the partial likelihood ratio statistic under the Cox Proportional Hazard model,[220] which has been shown in simulation studies to perform better for survival analysis than traditional or pseudo R^2 metrics.[221] Following previous guidance,[222] R^2 values were first calculated separately within each imputed dataset. To pool R^2 values, I converted to r-scale coefficients by taking the square root, and then converted these to the z-scale using Fisher's z transformation. Z-transformed R^2 values were then averaged across all five imputed datasets. These averaged values were then re-transformed back to the r-scale using inverse z transformation and then squared to return a pooled R^2 value. C-index values were also pooled using the same method. To obtain the pooled proportion of the total model X^2 that each variable and variable category explained, the sum of X^2 values for the same variable/category across all imputed dataset was divided by the sum of the total model X^2 values across all imputed datasets.

5.2. Results

5.2.1. Explaining variation in mortality and key chronic disease outcomes

To quantify the total effect of the aging exposome on mortality, I added all 55 exposures together in a single Cox mortality model. Individually, most exposures only

explained a small proportion of the total model variation (Fig. 20), however when added together alongside age and sex in the same model, the combined additive effects of the exposome explain a large proportion of the variation in all-cause mortality (61-66%; Tables 17-18). Effect estimates for all 55 exposures in this single multivariable model are shown in Fig. 17c. Examining the cause-specific numbers of deaths in the UK Biobank for all 24 chronic diseases associated with at least one exposure, I observed that together these diseases are listed as a cause of death for 69-71% of all deaths among study participants (Tables 7-8). The similarity between these percentages and the exposome mortality model R^2 estimates further corroborates that it is through these diseases that the identified exposures influence mortality. Exposome model variable importance for other key diseases studied are shown in Fig. S1-S9. Effect estimates from the full exposome multivariable model for all chronic diseases studied are shown in Fig. S10-34.

Adding polygenic risk scores (PRS) for 16 chronic diseases to the exposome multivariable mortality model did not increase the ability to explain mortality. In both the main sample and validation set, I observed an increase in R^2 of only 0.0003-0.0061 when comparing the exposome model with the exposome + PRS model (Tables 17-18). To further interrogate this, I conducted a separate multivariable mortality model including only age, sex, and the PRS for 16 chronic diseases (Tables 17-18, model 2). This model barely improved the mortality R^2 compared with a model including just age and sex (increase in R^2 of only 0.0197 and 0.0202 in the validation set and main sample, respectively). This further demonstrates that, on top of a model including age, sex, and polygenic risk for all major noncommunicable disease causes of death in the UK Biobank, the addition of

exposome information leads to a 16-18% improvement in explained variation in mortality. Conversely, inclusion of this polygenic risk information in a model already containing age, sex, and the exposome does not appreciably change mortality R^2 estimates.

Partial R^2 analyses in the Scottish/Welsh validation set (Fig. 21c) indicate that adding PRS only explains an addition 0.09% of the remaining mortality variance on top of the exposome model. Adding PRS for specific disease outcomes did, however, lead to a large improvement in R^2 (20-23%) for breast cancer, and modest (5-10%) improvements in R^2 for diseases such as ovarian, colorectal, pancreatic, and prostate cancers; rheumatoid arthritis; osteoporosis; ischemic heart disease; type 2 diabetes; and Alzheimer's disease (AD). Compared with a model including age, sex, and PRS (model 2), a model using age, sex, and exposome information (model 3, without PRS) explained a greater variation (R^2) in age-related outcomes and mortality for all outcomes except AD, macular degeneration, pancreatic cancer, leukemia, prostate cancer, colorectal cancer, and breast cancer in the English sample. In the Scottish/Welsh validation set, Parkinson's disease, osteoporosis, and ovarian cancer also showed higher R^2 values in model 2 vs. model 3.

Adding known clinical risk factors (model 5) to the exposome + PRS models (model 4) returned varying levels of improvement to R^2 measures. Osteoporosis, leukemia, and type 2 diabetes showed over a 10% increase in R^2 in the validation set (ΔR^2 0.1925, 0.1749, and 0.1045, respectively), while other diseases remained relatively unchanged (Tables 17-18). While adding PRS to the exposome mortality model did not improve mortality explanation, adding clinical risk factors yielded a 4% improvement in R^2 for mortality in the main sample and validation set.

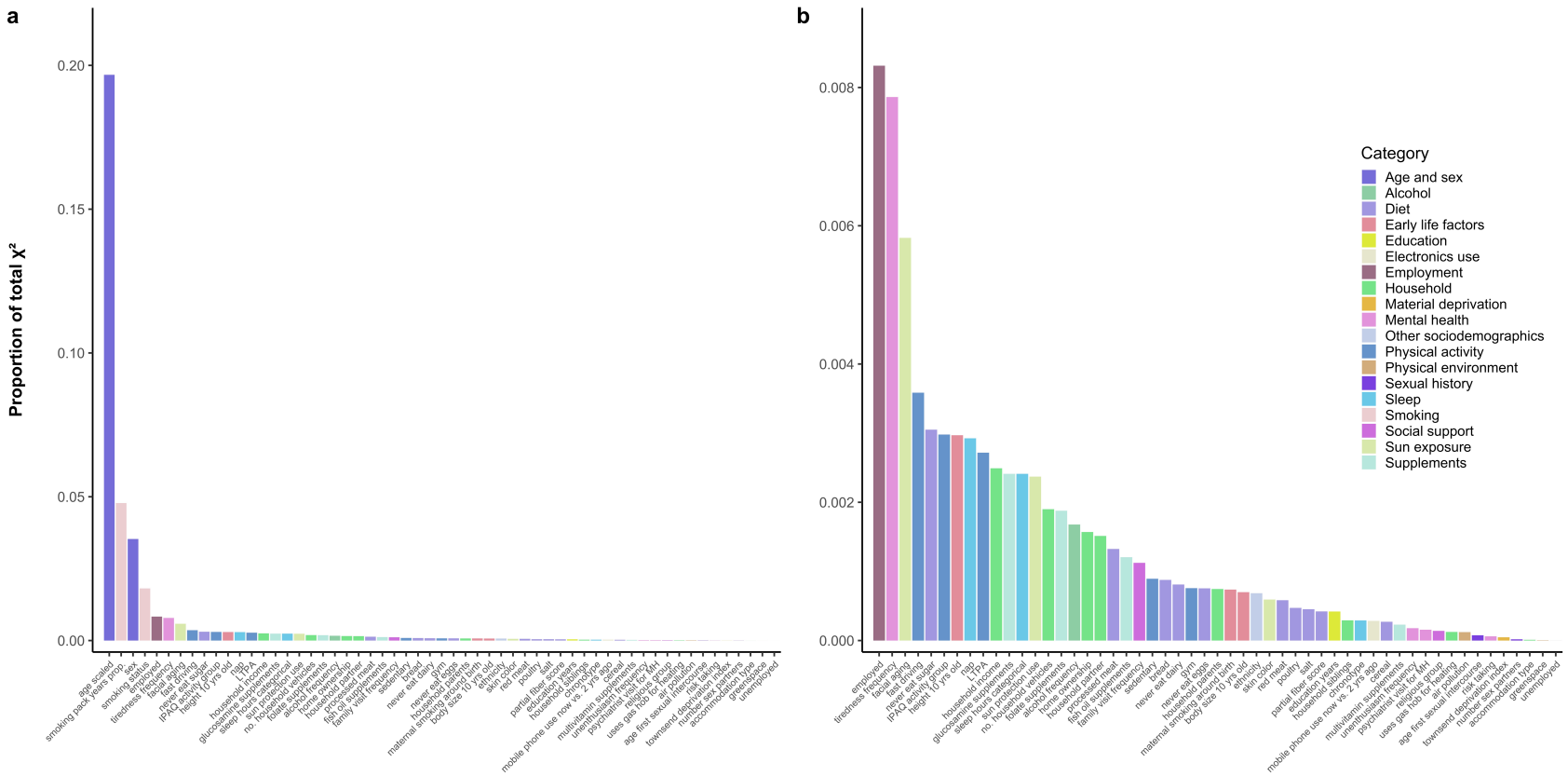


Figure 20. Individual exposures importance from a mortality multivariable model (n = 436,891) including age, sex, and all 55 exposures identified in cluster modeling. All exposure variables from the model are shown in (**a**), whereas (**b**) excludes age, sex, and smoking to show greater resolution on the y-axis for the rest of the exposures. Variable importance was calculated using a Wald test from ANOVA, where the importance of each variable is the proportion of that variable's Wald chi-squared (X^2) relative to the total model X^2.

Table 17. Explained variation and C-index across multivariable models in English UK Biobank participants

Outcome	C-index model 1	C-index model 2	C-index model 3	C-index model 4	C-index model 5	R^2 model 1	R^2 model 2	R^2 model 3	R^2 model 4	R^2 model 5	Cases	Sample
Vascular dementia	0.8288	0.8472	0.8718	0.8828	0.8937	0.7890	0.8371	0.8849	0.9092	0.9273	1,060 - 1,498	351,532 - 436,773
Emphysema, COPD	0.6841	-	0.8444	-	0.8688	0.3469	-	0.8491	-	0.9022	9,634 - 16,722	292,549 - 428,960
All-cause dementia	0.8095	0.8334	0.8415	0.8590	0.8644	0.7386	0.8097	0.8224	0.8693	0.8800	3,175 - 6,033	288,244 - 436,727
Alzheimer's disease	0.8191	0.8578	0.8406	0.8729	0.8784	0.7620	0.8643	0.8178	0.8964	0.9059	2,124 - 2,809	365,380 - 436,771
Lung cancer	0.6959	0.7173	0.8315	0.8327	0.8361	0.3885	0.4609	0.8334	0.8386	0.8518	2,784 - 4,728	288,334 - 436,220
Chronic liver diseases	0.6210	-	0.8039	-	0.8181	0.1640	-	0.7809	-	0.8131	1,596 - 2,543	289,371 - 435,544
Parkinson's disease	0.7638	0.7759	0.7856	0.7978	0.7981	0.6054	0.6435	0.6772	0.7110	0.7124	2,143 - 2,754	349,837 - 436,082
Osteoporosis	0.7536	0.7662	0.7834	0.7945	0.8212	0.5713	0.6134	0.6642	0.6972	0.7788	5,544 - 9,993	287,413 - 429,662
Chronic kidney diseases	0.7301	-	0.7801	-	0.8020	0.4954	-	0.6655	-	0.7403	10,190 - 18,239	296,467 - 435,746
Esophageal cancer	0.7311	0.7390	0.7673	0.7706	0.7749	0.4898	0.5199	0.6181	0.6323	0.6438	1,158 - 1,359	375,001 - 436,668
Macular degeneration	0.7521	0.7658	0.7624	0.7734	0.7738	0.5703	0.6217	0.6012	0.6475	0.6487	6,314 - 7,598	371,516 - 436,044
All-cause mortality	0.7070	0.7128	0.7584	0.7603	0.7751	0.4300	0.4502	0.6142	0.6203	0.6684	18,610 - 31,716	287,858 - 436,891
Type II diabetes	0.6244	0.7044	0.7539	0.7842	0.8305	0.1717	0.4126	0.5717	0.6670	0.7896	8,310 - 17,474	274,289 - 413,331
Liver cancer	0.6943	-	0.7462	-	0.7671	0.3798	-	0.5753	-	0.7020	835 - 952	385,100 - 436,706
Cerebrovascular diseases	0.7096	0.7175	0.7423	0.7458	0.7527	0.4319	0.4583	0.5426	0.5543	0.5780	11,865 - 15,405	345,419 - 428,927
Ischemic heart disease	0.6837	0.7046	0.7238	0.7396	0.7506	0.3431	0.4118	0.4712	0.5215	0.5566	20,864 - 35,125	270,260 - 417,016
Rheumatoid arthritis	0.6356	0.6590	0.7229	0.7344	0.7395	0.2057	0.2721	0.4871	0.5240	0.5402	3,126 - 4,030	352,976 - 431,882
Pancreatic cancer	0.6931	0.7106	0.7097	0.7256	0.7290	0.3798	0.4395	0.4383	0.4900	0.5047	1,514 - 1,579	421,234 - 436,792
Leukemia	0.6897	0.7010	0.6998	0.7093	0.7343	0.3651	0.3997	0.3985	0.4294	0.5559	1,658 - 1,712	422,047 - 436,386
Prostate cancer	0.6774	0.7572	0.6836	0.7609	0.7615	0.3307	0.5719	0.3482	0.5857	0.5874	8,524 - 9,805	172,071 - 196,113
Osteoarthritis	0.6410	-	0.6831	-	0.7004	0.2206	-	0.3458	-	0.4001	37,392 - 45,879	328,327 - 391,991
Colorectal cancer	0.6677	0.6981	0.6760	0.7035	0.7044	0.2927	0.3927	0.3222	0.4133	0.4158	5,973 - 6,350	410,795 - 434,384
Lymphoma	0.6547	-	0.6600	-	0.6815	0.2520	-	0.2666	-	0.3406	2,160 - 2,630	363,233 - 435,869
Ovarian cancer	0.6061	0.6331	0.6435	0.6652	0.6677	0.1246	0.1993	0.2346	0.3111	0.3167	971 - 1,190	196,615 - 236,812
Breast cancer	0.5416	0.6552	0.5672	0.6629	0.6685	0.0202	0.2604	0.0542	0.2862	0.3042	6,472 - 8,843	163,202 - 227,688

Model 1: age, sex. Model 2: age, sex, polygenic risk scores (PRS; including genetic principal components, and genotyping batch). Model 3: age, sex, exposome. Model 4: age, sex, exposome, PRS. Model 5: age, sex, exposome, PRS (if available), known clinical risk factors specific to each outcome. For diseases, the PRS for that specific disease was added. For all-cause mortality, all PRS for all other diseases in this table were added. If a PRS was not available for a particular outcome, then model 4 was not calculated for that outcome (and a dash is shown) but model 5 was still calculated excluding any PRS information. Cases and sample sizes are shown as ranges due to varying levels of missing data across variables used in the different models.

Table 18. Explained variation and C-index across multivariable models in Scottish/Welsh UK Biobank participants

Outcome	C-index model 1	C-index model 2	C-index model 3	C-index model 4	C-index model 5	R^2 model 1	R^2 model 2	R^2 model 3	R^2 model 4	R^2 model 5	Cases	Sample
Vascular dementia	0.8619	0.8749	0.9070	0.9095	0.9148	0.8467	0.8691	0.9241	0.9317	0.9389	193	55,668
Emphysema, COPD	0.7008	-	0.8884	-	0.9068	0.3839	-	0.9150	-	0.9474	1,281	54,556
All-cause dementia	0.8243	0.8527	0.8691	0.8828	0.8852	0.7738	0.8423	0.8767	0.9072	0.9081	643	55,660
Lung cancer	0.7036	0.7236	0.8477	0.8500	0.8523	0.4090	0.4812	0.8599	0.8667	0.8736	710	55,570
Alzheimer's disease	0.8194	0.8581	0.8407	0.8695	0.8705	0.7572	0.8531	0.8129	0.8817	0.8819	329	55,666
Chronic liver diseases	0.6748	-	0.8251	-	0.8426	0.3123	-	0.7962	-	0.8567	272	55,460
Chronic kidney diseases	0.7306	-	0.8134	-	0.8434	0.5041	-	0.7727	-	0.8594	966	55,505
Parkinson's disease	0.7789	0.7982	0.7899	0.8078	0.8090	0.6596	0.7154	0.6873	0.7324	0.7334	197	55,580
Esophageal cancer	0.7450	0.7545	0.7882	0.7928	0.7993	0.5316	0.5695	0.6930	0.7065	0.7197	186	55,650
All-cause mortality	0.7190	0.7250	0.7759	0.7755	0.7880	0.4653	0.4849	0.6625	0.6628	0.7004	5,267	55,676
Type II diabetes	0.6480	0.7132	0.7742	0.8106	0.8531	0.2273	0.4222	0.6267	0.7135	0.8162	1,150	52,806
Osteoporosis	0.7457	0.7572	0.7582	0.7603	0.8136	0.5557	0.5880	0.5670	0.5769	0.7580	112	54,629
Macular degeneration	0.7420	0.7496	0.7549	0.7591	0.7596	0.5398	0.5653	0.5820	0.6017	0.6030	414	55,614
Cerebrovascular diseases	0.7114	0.7216	0.7503	0.7547	0.7592	0.4466	0.4782	0.5691	0.5799	0.5916	1,549	54,508
Liver cancer	0.7196	-	0.7472	-	0.7735	0.4365	-	0.5637	-	0.6868	143	55,648
Ischemic heart disease	0.6980	0.7258	0.7390	0.7615	0.7701	0.3891	0.4831	0.5167	0.5917	0.6134	3,428	52,827
Leukemia	0.7141	0.7075	0.7201	0.7130	0.7486	0.4500	0.4448	0.4637	0.4545	0.6522	176	55,609
Rheumatoid arthritis	0.5751	0.6426	0.7093	0.7452	0.7502	0.0855	0.2309	0.4108	0.5247	0.5613	53	54,888
Prostate cancer	0.6985	0.7734	0.6993	0.7747	0.7756	0.3827	0.6161	0.3857	0.6207	0.6224	874	24,570
Pancreatic cancer	0.6859	0.7071	0.6946	0.7163	0.7236	0.3390	0.3864	0.3649	0.4135	0.4487	226	55,657
Osteoarthritis	0.6380	-	0.6817	-	0.7035	0.2050	-	0.3227	-	0.3960	2,941	50,525
Colorectal cancer	0.6705	0.7015	0.6781	0.7066	0.7081	0.2962	0.4038	0.3198	0.4178	0.4237	760	55,315
Lymphoma	0.6544	-	0.6498	-	0.6491	0.2554	-	0.2511	-	0.2568	288	55,528
Ovarian cancer	0.6214	0.6757	0.6480	0.6877	0.6850	0.1523	0.3037	0.2393	0.3595	0.3531	154	30,590
Breast cancer	0.5434	0.6447	0.5396	0.6446	0.6496	0.0185	0.2232	0.0156	0.2222	0.2370	1,042	29,447

Model 1: age, sex. Model 2: age, sex, polygenic risk scores (PRS; including genetic principal components, and genotyping batch). Model 3: age, sex, exposome. Model 4: age, sex, exposome, PRS. Model 5: age, sex, exposome, PRS, known clinical risk factors specific to each outcome. For diseases, the PRS for that specific disease was added. For all-cause mortality, all PRS for all other diseases in this table were added. If a PRS was not available for a particular outcome, then model 4 was not calculated for that outcome (and a dash is shown) but model 5 was still calculated excluding any PRS information. Results were calculated using linear predicted values based on model results from the English participants and outcome rates from the independent validation Scottish/Welsh sample.

Table 19. Explained variation across multivariable models in English UK Biobank participants (sex-specific)

	R^2 model 1		R^2 model 3		R^2 model 4		R^2 model 5		Cases		Sample	
Outcome	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Vascular dementia	0.8119	0.7410	0.9047	0.8644	0.9277	0.8919	0.9404	0.9167	405 - 614	655 - 884	186,996 - 237,581	164,536 - 199,192
Lung cancer	0.3377	0.4190	0.8228	0.8482	0.8326	0.8502	0.8456	0.8632	1,212 - 2,305	1,572 - 2,423	144,337 - 237,373	143,997 - 198,847
Emphysema, COPD	0.2979	0.3383	0.8576	0.8365	-	-	0.9051	0.8959	3,778 - 7,530	5,856 - 9,192	147,252 - 233,745	145,297 - 195,215
Alzheimer's disease	0.7717	0.7482	0.8374	0.8023	0.9174	0.8765	0.9281	0.8856	1,044 - 1,441	1,080 - 1,368	194,044 - 237,580	171,336 - 199,191
All-cause dementia	0.7454	0.7182	0.8488	0.7992	0.9017	0.8433	0.9114	0.8560	1,258 - 2,819	1,917 - 3,214	144,214 - 237,560	144,030 - 199,167
Chronic liver diseases	0.0316	0.0411	0.7123	0.7748	-	-	0.7431	0.8116	483 - 922	1,113 - 1,621	144,640 - 237,054	144,731 - 198,490
Chronic kidney diseases	0.4665	0.5056	0.6470	0.6629	-	-	0.7026	0.7552	4,181 - 8,858	6,007 - 9,381	148,932 - 237,157	147,487 - 198,589
Parkinson's disease	0.5322	0.5673	0.6251	0.6512	0.6642	0.6868	0.6643	0.6896	766 - 1,035	1,377 - 1,719	185,200 - 237,337	164,637 - 198,745
Osteoporosis	0.3829	0.3384	0.4812	0.6391	0.5327	0.6749	0.6545	0.7697	4,439 - 8,307	1,105 - 1,686	142,205 - 231,287	145,208 - 198,375
Macular degeneration	0.5545	0.5786	0.5903	0.6077	0.6421	0.6498	0.6438	0.6512	3,781 - 4,625	2,533 - 2,973	197,973 - 237,103	173,543 - 198,941
Liver cancer	0.3022	0.3374	0.4962	0.5969	-	-	0.5603	0.7561	319 - 382	516 - 570	205,463 - 237,560	179,637 - 199,146
All-cause mortality	0.3589	0.3968	0.5357	0.5958	0.5502	0.6025	0.6123	0.6495	6,127 - 12,894	11,689 - 18,822	138,977 - 237,634	139,734 - 199,257
Type II diabetes	0.1285	0.1146	0.5888	0.4998	0.6905	0.6040	0.8053	0.7487	2,902 - 6,843	5,408 - 8,592	140,061 - 227,067	134,228 - 183,123
Rheumatoid arthritis	0.1299	0.2288	0.4622	0.5076	0.4987	0.5515	0.5151	0.5660	2,025 - 2,668	1,101 - 1,362	187,057 - 234,157	165,919 - 197,725
Esophageal cancer	0.3032	0.3051	0.5136	0.4935	0.5303	0.5204	0.5684	0.5488	315 - 373	843 - 986	199,797 - 237,583	175,204 - 199,085
Cerebrovascular diseases	0.4191	0.3879	0.5566	0.4932	0.5645	0.5090	0.5862	0.5392	4,977 - 6,765	6,888 - 8,640	184,484 - 234,253	160,935 - 194,674
Pancreatic cancer	0.3571	0.3672	0.4189	0.4330	0.4760	0.4842	0.4929	0.4978	700 - 736	814 - 843	228,338 - 237,591	192,896 - 199,201
Osteoarthritis	0.2202	0.2099	0.3480	0.3548	-	-	0.4077	0.3985	20,996 - 26,469	16,396 - 19,410	172,708 - 209,966	155,619 - 182,025
Leukemia	0.3031	0.3138	0.3463	0.3522	0.3948	0.3836	0.5139	0.5344	669 - 692	989 - 1,020	228,731 - 237,420	193,316 - 198,966
Ischemic heart disease	0.2971	0.2283	0.4689	0.3372	0.5131	0.4053	0.5504	0.4516	6,596 - 13,628	14,268 - 21,497	137,786 - 231,913	132,474 - 185,103
Colorectal cancer	0.2211	0.2954	0.2414	0.3364	0.3326	0.4309	0.3338	0.4358	2,628 - 2,834	3,345 - 3,516	222,508 - 236,534	188,287 - 197,850
Lymphoma	0.2046	0.2446	0.2456	0.2540	-	-	0.3582	0.3680	965 - 1,201	1,195 - 1,429	193,926 - 237,186	169,307 - 198,683
Breast cancer	0.0202	-	0.0542	-	0.2862	-	0.3042	-	6,472 - 8,843	-	163,202 - 227,688	-
Ovarian cancer	0.1246	-	0.2346	-	0.3111	-	0.3167	-	971 - 1,190	-	196,615 - 236,812	-
Prostate cancer	-	0.3307	-	0.3482	-	0.5857	-	0.5874	-	8,524 - 9,805	-	172,071 - 196,113

Model 1: age, sex. Model 3: age, sex, exposome. Model 4: age, sex, exposome, polygenic risk scores (PRS; including genetic principal components, and genotyping batch). Model 5: age, sex, exposome, PRS, known clinical risk factors specific to each outcome. Model 2 was not run in the sex-specific models. For diseases, the PRS for that specific disease was added. For all-cause mortality, all PRS for all other diseases in this table were added. If a PRS was not available for a particular outcome, then model 4 was not calculated for that outcome (and a dash is shown) but model 5 was still calculated excluding any PRS information. Cases and sample sizes are shown as ranges due to varying levels of missing data across variables used in the different models.

Table 20. Explained variation across multivariable models in Scottish/Welsh UK Biobank participants (sex-specific)

	R^2 model 1		R^2 model 3		R^2 model 4		R^2 model 5		Cases		Sample	
Outcome	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Emphysema, COPD	0.3225	0.3908	0.9346	0.8926	-	-	0.9552	0.9339	591	690	30,135	24,421
Vascular dementia	0.8677	0.8083	0.9543	0.8723	0.9574	0.8832	0.9621	0.8991	84	109	30,705	24,963
Lung cancer	0.3049	0.4815	0.8382	0.8560	0.8348	0.8619	0.8418	0.8697	342	368	30,663	24,907
All-cause dementia	0.7927	0.7441	0.8728	0.8407	0.9174	0.8724	0.9144	0.8798	316	327	30,702	24,958
Alzheimer's disease	0.7821	0.7256	0.8550	0.7528	0.9037	0.8496	0.9066	0.8482	184	145	30,704	24,962
Chronic liver diseases	0.1638	0.0904	0.6832	0.7468	-	-	0.7379	0.8319	84	188	30,599	24,861
Chronic kidney diseases	0.4795	0.4997	0.7494	0.7555	-	-	0.8341	0.8587	459	507	30,639	24,866
Osteoporosis	0.3580	0.3286	0.3789	0.5693	0.4114	0.5364	0.6300	0.7955	94	18	29,810	24,819
Parkinson's disease	0.5917	0.6292	0.6580	0.6431	0.6956	0.7037	0.6977	0.7000	76	121	30,663	24,917
All-cause mortality	0.4186	0.4193	0.5991	0.6309	0.5959	0.6309	0.6472	0.6681	2,189	3,078	30,707	24,969
Macular degeneration	0.5124	0.5673	0.5542	0.6129	0.5733	0.6266	0.5783	0.6262	256	158	30,669	24,945
Esophageal cancer	0.3431	0.3837	0.5178	0.5979	0.5292	0.6209	0.4741	0.6231	54	132	30,701	24,949
Cerebrovascular diseases	0.4350	0.4009	0.5614	0.5251	0.5728	0.5381	0.5787	0.5567	694	855	30,209	24,299
Type II diabetes	0.1424	0.1510	0.6704	0.5050	0.7578	0.6145	0.8475	0.7521	408	557	29,411	22,994
Liver cancer	0.3539	0.3329	0.3496	0.5144	-	-	0.5717	0.6311	50	93	30,700	24,948
Rheumatoid arthritis	0.0029	0.3027	0.4729	0.3736	0.5854	0.4873	0.6607	0.4239	34	19	30,141	24,747
Ischemic heart disease	0.3006	0.2398	0.5210	0.3364	0.5853	0.4436	0.6118	0.4755	1,215	2,213	29,762	23,065
Pancreatic cancer	0.3244	0.2886	0.3656	0.3062	0.4531	0.3276	0.4894	0.3588	98	128	30,700	24,957
Osteoarthritis	0.2445	0.1574	0.3496	0.3050	-	-	0.4279	0.3627	1,669	1,272	27,504	23,021
Lymphoma	0.1824	0.3076	0.1370	0.2941	-	-	0.0567	0.2566	141	147	30,632	24,896
Leukemia	0.4885	0.2859	0.5143	0.3040	0.5134	0.2830	0.7057	0.5171	63	113	30,677	24,932
Colorectal cancer	0.2699	0.2410	0.2746	0.2816	0.3753	0.3848	0.3801	0.3973	332	428	30,549	24,766
Breast cancer	0.0185	-	0.0156	-	0.2222	-	0.2370	-	1,042	-	29,447	-
Ovarian cancer	0.1523	-	0.2393	-	0.3595	-	0.3531	-	154	-	30,590	-
Prostate cancer	-	0.3827	-	0.3857	-	0.6207	-	0.6224	-	874	-	24,570

Model 1: age, sex. Model 3: age, sex, exposome. Model 4: age, sex, exposome, polygenic risk scores (PRS; including genetic principal components, and genotyping batch). Model 5: age, sex, exposome, PRS, known clinical risk factors specific to each outcome. Model 2 was not run in the sex-specific models. For diseases, the PRS for that specific disease was added. For all-cause mortality, all PRS for all other diseases in this table were added. If a PRS was not available for a particular outcome, then model 4 was not calculated for that outcome (and a dash is shown) but model 5 was still calculated excluding any PRS information. Results were calculated using linear predicted values based on model results from the English participants and outcome rates from the independent validation Scottish/Welsh sample.

As shown in Tables 19-20, I observed sex differences in R^2 estimates for each outcome studied. Modestly higher R^2 estimates (ΔR^2 ~0.03-0.10) were observed in women compared with men for emphysema and COPD, dementias, rheumatoid arthritis, cerebrovascular diseases, osteoarthritis, and pancreatic cancer, whereas considerably higher R^2 estimates (ΔR^2 ~0.19-0.20) were observed in women for type II diabetes, ischemic heart disease, and leukemia compared with men. Modestly higher R^2 estimates (ΔR^2 ~0.03-0.12) were observed in men compared with women for chronic liver disease, osteoporosis, all-cause mortality, macular degeneration, esophageal cancer, and liver cancer, whereas considerably higher R^2 estimates (ΔR^2 ~0.20) were observed in men for lymphoma compared with women.

Since age-related disease cases in this study were defined using hospital inpatient data, it is possible that participants may have already had the disease for multiple years before actual hospital diagnosis occurred. This could potentially bias exposure variable responses if diagnosis occurred within several years after recruitment but the disease was already present at baseline. To address this additional source of potential reverse causation bias, I also re-calculated all multivariable analyses after excluding any cases occurring within the first 5 years after recruitment (Tables S58-S59). All R^2 estimates remained relatively unchanged. For the age, sex, and exposome model (model 3), no outcome saw a drop in R^2 of more than 3% with the exception of rheumatoid arthritis (3.8% decrease in R^2).

5.2.2. Risk prediction using multivariable exposome models

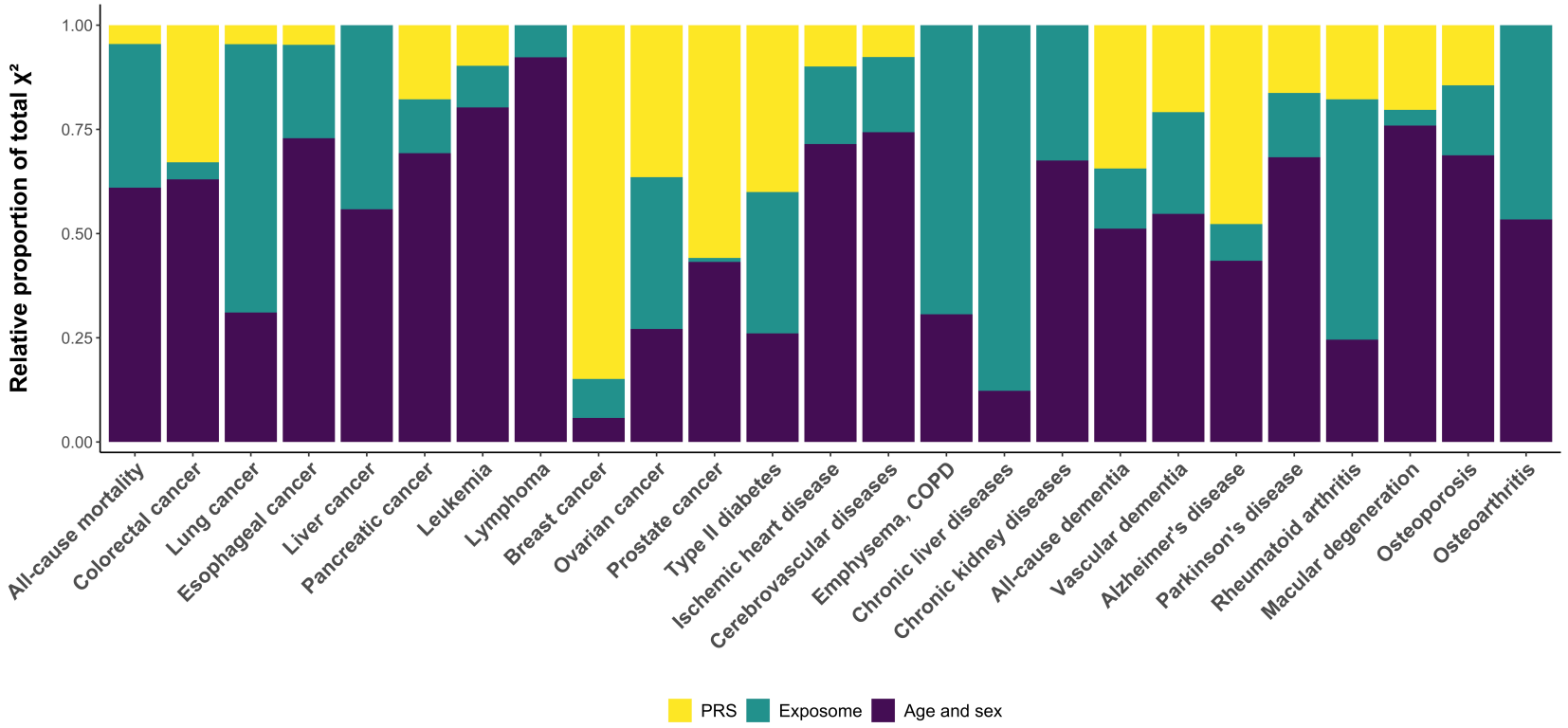
Importantly, I found that models including age, sex, and the exposome were also able to predict incident diagnosis of several age-related diseases with extreme accuracy in the main sample and validation set, including vascular dementia (C-index: 0.87-0.91), all-cause dementia (C-index: 0.84-0.87), AD (C-index 0.84), emphysema/COPD (C-index 0.84-0.89), and lung cancer (C-index 0.83-0.85). Modeling the additive effects of all exposome influences combined led to a substantial increase in prediction compared with a simple age + sex model for emphysema/COPD and lung cancer (ΔC-index: 0.16-0.19 and 0.14, respectively). The additive exposome model for dementias provided a significant, yet smaller, increase of in C-index compared with the age + sex model (ΔC-index 0.04-0.05, 0.03-0.05, 0.02 for vascular dementia, all-cause dementia, AD, respectively). Adding PRS to the dementia models improved C-index even further beyond the full exposome model, but did not appreciably increase prediction for lung cancer. Furthermore, adding known clinical risk factors to the exposome + PRS model modestly improved prediction of emphysema/COPD slightly (C-index 0.87-0.91), but did not substantially improve prediction for dementias or lung cancer.

In total, I found 9 chronic diseases for which I could predict incident diagnosis with C-index > 0.80 in both the main sample and validation sets using exposome, PRS, and clinical information: lung cancer, emphysema/COPD, all-cause dementia, vascular dementia, AD, type 2 diabetes, osteoporosis, chronic liver diseases, and chronic kidney diseases.

For all outcomes and all-cause mortality, I plotted the relative importance of each category of variable (age and sex, exposome, PRS) in the training multivariable models (English participants) according to the proportions of the total model chi-squared (X^2) that each variable category explained (Fig. 21). In models only including age, sex, exposures, and PRS (Fig. 21a), the exposome explained the most amount of model variation for lung cancer, emphysema/COPD, chronic liver diseases, and rheumatoid arthritis. Certain outcomes seem to be more influenced by genetics than the exposome, such as breast and prostate cancers, AD, all-cause dementia, macular degeneration, and colorectal cancer. Other diseases such as pancreatic cancer, leukemia, vascular dementia, and osteoporosis showed age and sex contributing the most to the model, followed by the exposome and PRS in equal parts. Of note, ovarian cancer and type II diabetes showed a small contribution of age and sex, with the exposome and PRS explaining the majority of variation in equal parts. And lastly, a number of outcomes showed age and sex as the most influential inputs but also showed the exposome explaining the majority of the residual variation not explained by age and sex. These include all-cause mortality, esophageal cancer, ischemic heart disease, and cerebrovascular diseases.

R^2 and partial R^2 analysis results (Fig. 21b) demonstrate that models including age, sex, exposome, and PRS capture the majority of variation in most outcomes, with the exception of type 2 diabetes and osteoporosis. For all-cause mortality, lung cancer, all-cause dementia, vascular dementia, and AD, additional clinical risk information only captures an extra 11% or less of the residual variation of these outcomes on top of age, sex, exposome, and PRS.

a



b

Partial R² across outcomes - Scottish/Welsh validation set

	All-cause mortality		Colorectal cancer		Lung cancer		Esophageal cancer		Liver cancer		Pancreatic cancer		Leukemia		Lymphoma		Breast cancer		Ovarian cancer		Prostate cancer		Type II diabetes	
Model	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²
Age, sex	0.4653	-	0.2962	-	0.4090	-	0.5316	-	0.4365	-	0.3390	-	0.4500	NA	0.2554	NA	0.0185	NA	0.1523	NA	0.3827	-	0.2273	-
+Exposome	0.6625	0.3687	0.3198	0.0336	0.8599	0.7630	0.6930	0.3446	0.5637	0.2258	0.3649	0.0392	0.4637	0.0249	0.2511	-0.0057	0.0156	-0.0029	0.2393	0.1026	0.3857	0.0048	0.6267	0.5169
+PRS	0.6628	0.0009	0.4178	0.1440	0.8667	0.0485	0.7065	0.0440	-	-	0.4135	0.0765	0.4545	-0.0172	-	NA	0.2222	0.2099	0.3595	0.1580	0.6207	0.3825	0.7135	0.2324
+Clinical	0.7004	0.1116	0.4237	0.0102	0.8736	0.0517	0.7197	0.0449	0.6868	0.2821	0.4487	0.0600	0.6522	0.3625	0.2568	0.0076	0.2370	0.0190	0.3531	-0.0101	0.6224	0.0047	0.8162	0.3585

Partial R² across outcomes - Scottish/Welsh validation set

	Ischemic heart disease		Cerebrovascular diseases		Emphysema, COPD		Chronic liver diseases		Chronic kidney diseases		All-cause dementia		Vascular dementia		Alzheimer's disease		Parkinson's disease		Rheumatoid arthritis		Macular degeneration		Osteoporosis		Osteoarthritis	
Model	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²	R²	Partial R²
Age, sex	0.3891	-	0.4466	-	0.3839	-	0.3123	-	0.5041	-	0.7738	-	0.8467	-	0.7572	-	0.6596	-	0.0855	-	0.5398	-	0.5557	-	0.2050	-
+Exposome	0.5167	0.2088	0.5691	0.2213	0.9150	0.8620	0.7962	0.7036	0.7727	0.5415	0.8767	0.4549	0.9241	0.5050	0.8129	0.2295	0.6873	0.0813	0.4108	0.3557	0.5820	0.0917	0.5670	0.0255	0.3227	0.1480
+PRS	0.5917	0.1552	0.5799	0.0252	-	-	-	-	-	-	0.9072	0.2473	0.9317	0.0995	0.8817	0.3676	0.7324	0.1443	0.5247	0.1934	0.6017	0.0472	0.5769	0.0228	-	-
+Clinical	0.6134	0.0530	0.5916	0.0278	0.9474	0.3814	0.8567	0.2969	0.8594	0.3817	0.9081	0.0099	0.9389	0.1053	0.8819	0.0015	0.7334	0.0040	0.5613	0.0769	0.6030	0.0033	0.7580	0.4280	0.3960	0.1083

Figure 21. Variable importance within multivariable Cox models for mortality and age-related chronic diseases according to major variable categories (age and sex, exposome, polygenic risk scores [PRS]). Variable importance is calculated as the proportional of the total model chi-squared (X^2) that each variable category explains and is plotted as the relative contribution to the total model X^2 for each category so that they sum to 1. In (**a**), variable importance is shown in models containing only age, sex, exposome, and PRS. The PRS category includes all polygenic risk scores, as well as genetic principal components and genotyping batch. In (**b**), R^2 and partial R^2 from the Scottish/Welsh validation set is shown for all outcomes. Partial R^2 was calculated sequentially, comparing the R^2 between each model. Each successive row indicates a model with all previous variables from the rows above. For example, the "+Clinical" row indicates model 5 with age, sex, exposome, PRS, and clinical variables. "+Exposome" indicates a model with age, sex, and exposome. If a PRS was not available for a particular outcome, then a PRS model was not calculated for that outcome (and a dash is shown) but a final "Clinical" model was still calculated using age, sex, exposome, and clinical variables.

5.3. Discussion

As discussed in Chapters 1-2, there are a number of methodological imperatives to move away from the traditional single exposure approach taken in observation epidemiology to an exposome-wide approach, including improvements in being able to account for confounding from intercorrelation, increasing the positive predictive value of findings, and uncovering the highest priority determinants of a given outcome among all environmental influences. From the results of this chapter, however, a number of further empirical justifications for an exposome approach have emerged. First and foremost, I have found that the exposome is characterized by many variables with small, individual effects that, when combined, explain a significant amount of the variation in mortality and several chronic diseases. As I show in the correlation analyses described in Chapter Three, the exposures that are associated with mortality are extremely intercorrelated, likely forming a web of combined influence on disease and mortality. I show that with an exposome-wide approach, we can begin to approximate the influence of this interplay of exposures on mortality and chronic disease by using the correlation structure of the exposome to create multivariable models to estimate the total impact of the exposome on mortality or disease. I also demonstrate that modelling the additive effects of the exposome together can be used to predict several diseases with extreme accuracy, and that in many cases adding in genetic and clinical information to these models only adds marginal improvement in R^2 or C-index.

Together, these results are a strong justification for measuring the exposome as a complete entity, and show that doing so will likely transform researchers' ability to predict and determine variation in diseases with new levels of accuracy. My thesis results indicate that this ability is strongest for age-related outcomes such as dementias. Results from these analyses also show that certain outcomes like emphysema/COPD and lung cancer that are thought to be predominantly determined by smoking are also influenced by a wide number of diverse exposome influences.

Not all diseases tested could be estimated or predicted with such high levels of accuracy, most notably cancers. It should be reiterated here, however, that I created prediction models for these diseases using the exposures that were associated with mortality in earlier XWAS analyses. It is possible that other sets of environmental and clinical information either not replicated in the mortality XWAS or not available in the UK Biobank dataset, as well as genetic influences, may be stronger drivers of these diseases. Future research conducting XWAS or exposome-wide analyses with these diseases as the outcomes from the start will be better suited to comprehensively identify the exposome determinants of these diseases. Instead, the goal in this thesis was to quantify the extent to which the exposome influences that limit lifespan through mortality are associated with and major drivers of these chronic diseases.

6. Chapter Six: Discussion and conclusion

In this thesis, I have conducted the first analysis to test and validate associations between the exposome and each stage of the human aging pathway (Fig. 4) available within the UK Biobank dataset. The results across the chapters of this thesis demonstrate that the aging exposome is composed of many interrelated yet independent factors that, although individually may have small effects, when combined additively explain a large percentage of the variation of mortality (61-66%) irrespective of genetic influence. I demonstrate that while polygenic risk may contribute significantly to risk of diagnosis for the chronic diseases studied, the exposome, age, and sex together explain the majority of variation in actual mortality irrespective of whether polygenic risk information is included in the model.

Through the many stages of my analysis, I show that the exposome shapes mortality risk through influencing a wide range of aging mechanisms, cardiometabolic risk factors, and disease pathways, and that the exposome is a major influence on age-related multimorbidity. This provides critical insights to address gaps in knowledge about the environmental influences that shape the cellular hallmarks of aging discussed in Chapter One, and further demonstrates that many age-related diseases share a common environmental etiology that influences disease multimorbidity. Together, these results provide the first picture of the environmental architecture of human aging. This architecture shows the correlations and interrelationships between exposures, as well as the many biological mechanisms, cardiometabolic risk factors, and disease pathways

through which the exposome ultimately determines mortality. While future analyses will need to be conducted to more firmly ascertain whether there is a causal relationship between each of the 55 exposures and mortality, the analyses in my thesis provide the first comprehensive and systematic exposome-wide discovery analyses identifying exposures associated with mortality and age-related disease that can be used as a strategic starting point for hypothesis generation and causal analysis.

Although the aim of my thesis work was not to develop prediction models, during the course of my thesis analysis I incidentally found that modeling together the additive effects of the exposome also provides unprecedented accuracy in predicting incident diagnosis of certain age-related chronic diseases such as vascular dementia, AD, all-cause dementia, and emphysema/COPD. Because of this, my thesis results also provide considerable advancements in methodologies for improving longitudinal prediction of a number of age-related diseases.

The exposome multivariable models analyzed in this thesis offer numerous novel insights into the possible determinants of priority population health conditions. The case of emphysema/COPD is a good example. In 2022, a systematic review of 162 population-based studies conducted across 260 sites in 65 countries showed that, among the risk factors studied globally, male sex, smoking, and occupational exposure to dust or smoke were well established environmental risk factors of COPD.[223] Another recent review of the population health literature on COPD discusses smoking, air pollution, occupational exposures, and maternal smoking as well established COPD risk factors, but maintains that socioeconomic and social exposures are understudied.[224] The exposome multivariable

model I conducted for emphysema/COPD showed strong effects for these known risk factors, but also showed strong associations between a wide range of diverse exposures and emphysema/COPD (Fig. S17). These included intakes of cereal, fiber, processed meat, read meat, and glucosamine supplements; childhood factors such as relative height and weight at 10 years old; socioeconomic factors such as employment, income, education, deprivation, home ownership, and accommodation type; physical activity (LTPA, sedentary behavior); chronotype; and mental health. Importantly, each of these other understudied factors remained significantly associated with emphysema/COPD while being tested in the same model with major known risk factors and all other exposures. This significantly improves our confidence in the robustness of these associations compared with a single exposure epidemiological approach, and demonstrates that the value of the exposome approach that I have developed lies in the potential ability to describe novel or understudied environmental influences on health outcomes while simultaneously being able to test their robustness by testing them alongside all other related exposome influences.

Cluster multivariable mortality analyses provide novel evidence about the determinants of mortality in the UK Biobank, including new insights gained from modeling diverse exposome influences together in additive models. As described in Chapter Three, total fruit and vegetable intake no longer exhibit a significant effect on mortality when assessed in a model together with fiber and other diet and socioeconomic variables. I also observed strong associations between never eating eggs, dairy, and sugar with increased risk of mortality and numerous cardiometabolic diseases, cancers, and

other age-related chronic diseases. I interpret these to be measures of extreme dietary choices and preferences, indicating that extreme diets of one kind or another ultimately have a negative impact on life expectancy through influencing a wide range of disease pathways. As discussed in Chapter Four, existing research on dietary extremes such as never eating sugar or dairy is somewhat inconsistent to date, and the analyses in my thesis provide novel and robust evidence that these factors influence mortality and age-related disease even after extensive adjustment for other confounding factors. Together, the results from my thesis provide robust evidence that intake of dietary fiber, alongside avoidance of processed meat and extreme diets (measured via variables on never eating eggs, dairy, and sugar), may be the highest priority and actionable diet-related population health targets for mortality in this population. It was only through the multi-stage exposome methods that I developed for this thesis that I can make such a conclusion about the priority dietary influences on mortality in the UK Biobank, after considering all dietary variables available in the dataset.

Interestingly, I found that years of education does not remain significantly associated with mortality when put in a model with all 55 exposures identified in the cluster models. This may indicate that the effect of education on mortality is completely mediated by the other exposures identified in this thesis and does not have an independent effect on mortality outside of these mediators, although this interpretation needs further testing. Other socioeconomic exposures, such as household income, home ownership, and employment all remain significant in this full exposome model and seem to have independent effects on mortality.

Furthermore, results from cluster multivariable mortality models support the conclusion that multiple dimensions of physical activity have independent, additive influences on mortality risk, and that even promotion of leisure time physical activities such as walking for pleasure, gardening, and home DIY will have positive benefits in reducing mortality burden.

Throughout these thesis analyses, measures of physical activity and individual socioeconomic status (household income and home ownership) had some of the strongest effects on mortality and associated with the greatest number of chronic diseases after smoking. These measures also associated with 24/25 aging biomarkers and all cardiometabolic risk factors analyzed. Together, this indicates widespread effects of these exposome influences across diverse disease pathologies and biological mechanisms, and implicates them as some of the strongest exposome determinants of disease multimorbidity and mortality. Population health efforts aimed at targeting the combined influences of smoking reduction, stimulating physical activity, and alleviating income and socioeconomic inequality may have some of the largest population health rewards in terms of alleviating multimorbidity and mortality burden. While numerous previous studies have already documented the significant role of smoking, physical activity, and socioeconomic inequality (e.g., income, employment, education) in shaping mortality risk,[105-108] the analyses in my thesis paint a more detailed picture of the myriad biological mechanisms, cardiometabolic risk factors, and disease pathways through which these environmental influences work to determine mortality in the UK Biobank. The picture that emerges is that these factors are some of the strongest exposome drivers of age-related

multimorbidity, and that their influence on mortality is so strong due to the sheer number of diseases with which each of these factors associates.

6.1. Thesis results in the context of existing exposome-wide analyses

To better understand how the results from this thesis compare with the landscape of exposome studies published to date, I carried out a systematic review to identify all exposome-wide or environment-wide studies that comprehensively studied the effect of environmental factors on human disease or mortality (described in Chapter One, methods in Chapter Two). The novel, multi-step exposome-wide approach that I developed improves significantly upon XWAS and exposome analysis studies of other outcomes conducted to date, which remain largely uncorrected for the correlation structure of exposures tested and suffer from high significance inflation.[148]

The work in this thesis also demonstrates the importance of operationalizing a far broader definition of the exposome than is often done in current exposome research. I show that exposures that are relatively understudied in the context of exposome research (e.g., social networks, psychosocial factors, deprivation) provide strong and multidimensional associations with aging mechanisms, chronic disease incidence, and mortality on par with well-documented factors like physical activity or smoking. Consequently, when compared with the only previously published "environment-wide" analysis of mortality[130] that more narrowly focused on chemical exposures and a few measures of smoking, diet, and physical activity, my approach found roughly 17x more

factors associated with all-cause mortality. Using the approach in this thesis, I was also able to significantly improve the ability to explain mortality by 31x, increasing the total R^2 estimate from 2.1% in this previous study to 61-66% in my analysis. This previous study also only had a median 5.5 years of mortality follow up and 655 deaths, which left the analyses underpowered to detect anything but factors with large effects. As described in Chapter One, a second phenome-wide analysis of mortality was published using UK Biobank data (n= 498,103).[131] This analysis did not restrict its scan to the exposome but also included measures of existing morbidity and disability and had a median 5-year mortality follow up period. Consequently, disability, frailty, and other disease indicators were found to be the strongest predictors of mortality risk.

In comparison with the existing literature, my thesis work is the first systematic analysis of exposome/environmental factors related to mortality that: (1) uses a large population that is adequately powered to detect small effects, even after splitting into independent discovery, replication, and validation sets; and (2) has an appropriately long mortality follow up time (discovery/replication median: 12.5 years; validation median: 13.7 years) to capture the longer-term effects of exposures on mortality. I also make significant contributions to the literature by: (1) empirically demonstrating that the exposome is the primary driver of mortality and chronic disease multimorbidity in the UK Biobank; and (2) comprehensively cataloguing the blood biomarkers and chronic diseases associated with exposures that are drivers of mortality, which provides information on the pathways through which each exposure ultimately influences mortality.

6.2. Strengths and limitations

There are several limitations to note for this analysis. First, I am unable to make definitive causal conclusions for individual exposures based on the findings presented, as the study design uses observational data. The disease sensitivity and cluster multivariable analyses I conducted allowed me to exclude a number of exposures that are likely to be confounded by reverse causation bias or exposure intercorrelation, however further methods may need to be developed to weed out confounded exposures that these methods could not identify. The methods that I have developed in this thesis allow for comprehensive and systematic exposome-wide discovery analyses that can be used as a strategic starting point for hypothesis generation and causal analysis. But further methods, such as Mendelian randomization or use of negative control exposures, will be needed to be used to ascertain causality. Second, exposome influences are dynamic over time and the study design used cannot capture this dynamic aspect of the exposome since all exposures were only measured at one time point in the full cohort. I also cannot claim to have captured all true exposome influences on aging, as I was limited to the exposures available in the UK Biobank. Conspicuously absent from the UK Biobank data are measures related to stress and inequality such as discrimination, as well as more detailed chemical and toxicological exposures.

Furthermore, a great deal of exposure variables tested in this thesis come from self-reported questionnaire data, which introduces potential bias and uncertainty into the reliability and accuracy of the responses. For physical activity, however, I was able to test

the concordance between self-reported and objective activity measures in a subset of the population with accelerometer data to show that the self-reported measures only underestimate the effect of accelerometer data on mortality by 3%. It is important to note that a great deal of the questionnaire measures used in the UK Biobank for self-reported traits (e.g., diet) often vary from those used in other cohort study populations, which introduces the potential for variability or "vibration"[225] between effects observed in the UK Biobank and those observed in other cohorts and consortia.

While there are certainly other aspects of the aging pathway not analyzed here (e.g., genomic instability), I have analyzed the fullest possible amount of the aging pathway within the confines of data available in the UK Biobank. Further, although other diseases could be studied, I have strategically chosen to study all of the top 20 non-communicable disease causes of death in the UK Biobank, further establishing the connection between the diseases studied and mortality risk.

Another limitation to note is that the UK Biobank population is not perfectly representative of the larger UK population, as it has been shown that the main UK Biobank population is healthier and more affluent than the general population and suffered from a low recruitment rate (5.5%).[157] Therefore, extrapolations to the entire UK population based on the results from this thesis should not be undertaken. Furthermore, the aging biomarker analyses reported here are cross-sectional, and thus are more susceptible to reverse causation or residual confounding than the prospective mortality or chronic disease analyses, although the variable filtering steps undertaken for the

exposures in relation to mortality produces a list of exposures less likely to suffer from disease- and correlation-related confounding or reverse causation bias.

The PCA analyses I completed to reduce air pollution, greenspace, noise pollution, and traffic proximity variables into principal components that summarize information across all measures of each domain could be seen as a limitation. Within the fields of toxicology and environmental science, more sophistical mixture models have been developed, particularly in the context of testing air pollution, that can identify the most harmful components of complicated mixtures of air pollution data.[226] Future exposome work in the UK Biobank could make use of these mixture models to further refine analyses and variable selection methods for these exposures.

Another limitation of this thesis work is that I was not able to assess other important cellular hallmarks of aging described in Chapter One (Box 1) outside of metabolism, telomere length, and inflammation. Further, the biomarkers analyzed in my thesis were taken from blood, however many aging mechanisms have tissue-specific effects.

In some respects, using a dataset such as the UK Biobank with a relatively young population at baseline (mean: 55 years) is a limitation, since limited numbers of cases for certain age-related disease exist in the cohort. This is particularly the case for dementias. However, despite this limitation, studying a population of this age provides the benefit of being able to better capture exposome influences that associate with earlier onset of age-related disease in mid-life instead of later in life, which as discussed in Chapter One is a hallmark of more accelerated aging trajectories.

Two further limitations of this thesis work are that I only systematically tested for linear associations and only tested for pairwise correlation between exposures. Some exposome influences such as physical activity have been shown in large meta-analyses to have non-linear associations with mortality,[106] and it is reasonable to assume that higher-order interactions and interrelations between environmental exposures occur, especially when shaping disease risk.

Lastly, while my thesis analyses use data with a significantly larger mortality follow up window than previous large phenome-wide studies of mortality, a 10-15 year follow up time is still a somewhat narrow window to assess environmental influences on mortality. Further analysis in datasets with broader follow up windows may provide even more powerful opportunities for discovery, since some exposome influences may take longer than 10-15 years to first shape disease and then ultimately influence mortality.

Despite these limitations, this thesis work possesses many unique strengths that contribute greatly to the robustness of the findings. First, the scope and diversity of exposures studied is greatly expanded beyond what has normally been tested in previous XWAS and exposome studies. This has allowed me to identify associations for understudied variables in the context of aging and mortality. Furthermore, I am afforded high confidence in the list of final exposures shown to be related to aging based on the many steps of variable filtering, disease sensitivity, and triangulation through biomarker and disease testing that I undertook. Previous epidemiological studies on environmental variables in relation to all-cause mortality, including large scale cohort studies[107] and previous exposome studies,[130] have not taken these extra analysis steps and are therefore

at greater risk of (1) reverse causation due to participants already being ill or having comorbid conditions at baseline; and (2) residual confounding due to potential random associations between environmental factors and accidental or other deaths not actually attributable to those factors. The study design that I have employed allows for a more fine-grained approach to systematically addressing bias in exposome-wide studies that greatly improves the ability to minimize risk of these biases.

6.3. Work not included in the thesis

While developing the analysis methods for my thesis, I tested many different models and analysis types to arrive at the final models used. In this section I give greater details on this early work, which gave me insight into methodological hurdles for both my own work in this thesis as well as future exposome work.

In the early stages of my DPhil, I tested a wide number of different models to address exposome correlation. Of note, I spent a considerable amount of time testing penalized regression models (e.g., lasso, elastic net) as a way to reduce the dimensions among correlated exposures that were replicated in the XWAS and arrive at a reduced list of independent exposures. Despite other published studies suggesting that such dimension reduction methods may work well in an exposomics setting,[227] my own results demonstrated that while these types of models are strong in finding optimal prediction models, they are not well suited to discovery analysis where the aim is to identify all relevant determinants of the disease. Whether using residual mean squared error (RMSE)

or C-index to apply shrinkage penalties, I found that lasso and elastic net models were always biased towards selecting the most optimal predictors for the outcome being tested. This had two major ramifications: (1) the models were prone to selecting predictors over actual known determinants, if these were strongly correlated and the correlated exposure predicted more strongly than the actual determinant; and (2) the models were prone to selecting the most downstream exposures that are most proximal to the outcome (as these tend to predict better) and would shrink the coefficients of the most upstream exposures. In certain cases, the model would shrink the coefficients for these most upstream exposures completely to 0. For example, I observed this happen for years of education, which is an undesirable result as education is a well-known determinant of mortality and disease.[228] For these reasons, I decided that these kinds of penalized regression models would not be appropriate in the context of discovery analyses.

Another method that I tested to reduce correlation confounding in my exposome analyses was to run a factor or principal components (PC) analysis on all exposure replicated in the XWAS and use the resulting factors in further modeling. Despite other studies using such a factor approach in exposome analyses,[229] I found this method to also be inadequate for three main reasons: (1) using factors or PCs instead of the exposures themselves in some cases significantly diminishes the interpretability of findings, as I would usually end up with at least one factor containing many different exposures and it was not entirely clear what it was measuring; (2) I was never able to reach a satisfactory level of total variance explained from resulting factor structures or PC analyses. Early factor analysis results showed a factor structure somewhere between 25-40 factors, and

although many of the factors grouped exposures into sensible categories (pollution, meat intake, physical activity, etc.), the total variance in the data explained by these factor solutions always remained quite low and never exceeded 35%. (3) As I thought ahead to using the methods I developed in my DPhil, I also noted that it would also likely be impossible to replicate latent factors in an external dataset.

It is also worth noting that I had initially tried splitting the UK Biobank sample from my thesis into different proportions for discovery and replication analyses. Specifically, I had previously tried a 70/30 split in order to maximize power for the discovery analyses. However, when taking this approach I noticed that far fewer exposures were replicating than were significant in the discovery analysis. I then switched to the 50/50 split I used in the final analyses. With this new approach roughly the same number of exposures were significant in the discovery, but far more exposures were significant in the replication analysis as well. In my thesis analyses, I found many exposures with small yet significant effects on mortality and age-related disease, and even a replication sample of 131,067 participants (30% of the total sample size of 436,891) was underpowered to detect some of these effects. This indicates that it will be imperative that future exposome studies have sample sizes large enough to capture these small effects, and that many existing exposome studies with sample sizes less than 50,000 or even 10,000 participants are likely dramatically underpowered to carry out discovery exposomics analyses.

6.4. Future directions

There are numerous further opportunities to improve upon the exposome work on aging that I've carried out in this thesis. First of all, since aging mechanisms analyses completed for this thesis only included blood biomarkers, future work connecting exposome influences to mortality via an even richer panel of aging mechanisms in a wider diversity of tissues would be poised to make an even greater contribution to elucidating the exposome-biology interactions influencing human aging.

I anticipate that future machine learning and artificial intelligence analysis methods that can capture systems-level effects of the exposome on disease by modeling higher-order interactions between exposome influences will be transformative in capturing the interactive complexity within the influence of the exposome on disease. Furthermore, these methods can inherently test for non-linear relationships, which I did not systematically test for in my own thesis. Given that I believe one of the major advantages of exposome research is being able to capture the complexity of interrelations between exposures when assessing their relationships to disease outcomes, I believe that future exposome research should begin to move in this direction.

Another fruitful area of future research may be multilevel modeling. As discussed in Chapter One and shown in Fig. 5, the exposome itself is comprised of multiple layers of influences. Some more fundamental layers, such as socioeconomic status, will tend to shape many other more intermediate aspects of the exposome such as diet lifestyle, and behaviors. More traditional modeling techniques that put many exposome influences

together into the same model will inevitably be mixing these two levels of exposures and will therefore be adding mediators to the model that may results in the most upstream exposures adjusting out. I saw this occur with years of education in the single exposome multivariable model run in Chapter Five. Multilevel modeling may provide a more precise way of estimating effects for many exposures across disparate clusters of socioeconomic or social groupings of participants.

Future research in this field will also benefit from developing methods that can be systematically applied within the context of an exposome-wide study to ascertain causality, as opposed to being limited to the discovery analyses described in this thesis. As mentioned above, this could include running Mendelian randomization or negative control exposure analyses on identified exposures to further identify those that are more likely to have a causal relationship with the outcome being studied. While there is certainly value in developing prediction models within the context of exposome research, particularly for the development of clinical risk prediction models, these methods only identify those exposures that predict with the most accuracy and cannot identify causal exposures. I believe that developing exposome-wide methods to identify causal determinants of disease will be important in future research, as exposures identified will be more likely to be causal determinants for which population health interventions can be developed to alleviate disease burden.

Finally, one of the major challenges that faces the field of exposome research is how to conduct replication analyses in independent datasets. Unlike genetic or biological analyses, where sequencing technologies and arrays are standardized across cohorts, there

is a wide diversity in the type and number of exposome influences collected across major cohort studies and biobanks, with exposome data often also coming from different sources (e.g., census records, self-report, regional surveillance data) across studies. This poses a significant challenge for replicating results across independent studies, when exposures studied in one dataset are not likely to be available for analysis in another. There are several possible solutions to this problem, most of which involve making use of existing biological data available in cohort or biobank datasets. For example, the phenome-wide analysis of longevity[64] discussed in Chapter One used Mendelian randomization as a solution to replication. Using this approach, they first used Mendelian randomization to find genetic instrument variables for the major exposome influences significantly associated with longevity in the discovery dataset. To replicate these results, an independent replication dataset need only have genotyping data so that the genetic instruments for the exposures, instead of the direct exposure measures themselves, can be tested in the new population. Others have suggested carrying out exposome analyses to search for "biologically-active" exposures, where each exposure identified can be associated with a distinct biological signature using concentrations of different compounds in blood, including dietary micronutrients, phytoestrogens, metabolites, drugs, consumer chemicals, and pollutants.[230] These biological signatures could then be tested in independent replication datasets.

A particularly powerful method to combine with these approaches may be to first calculate polyexposure[231] or exposome risk scores[125] (ERS), which similar to PRS would combine the effects of all exposome features associated with a particular disease to

estimate the total exposome risk of that disease. Genetic instruments or biological signatures could then be found for such an ERS and be used to validate results in an independent cohort.

I anticipate that greater use of exposome study designs will significantly accelerate identification of high-priority population health targets for aging, and in doing so increase the reproducibility these findings across study populations. This will have a tremendous impact on identifying priority population health targets where intervention would have a preventative impact to simultaneously alleviate age-related biological decline, burden of chronic disease multimorbidity, and mortality.

I believe that exposome-wide studies using robust, multi-stage approaches such as those contained in this thesis not only offer the opportunity to discover new environmental influences on aging, but can help to address the preponderance of false positives and non-replicated associations evident in observational epidemiology in a manner similar to the transition to genome-wide association studies (GWAS) in genomics research.[144,147] Through using large, well-characterized study samples with adequate power; use of stringent exposome-wide significance thresholds; performing concurrent replication analyses in independent populations; and undertaking a hypothesis-free analysis of all exposome features available in a given dataset and documenting results from all tests (both significant and null) without selective reporting, exposome-wide study designs will be crucial in increasing the reproducibility of significant associations in observational epidemiology.

Further, continued development of exposomics analysis methods that allow for comprehensive characterization of an individual's exposome has the potential to transform multi-omics modeling of diseases to better understand the layers of influence that inform the development of disease and, importantly, the interactions between these domains. As I demonstrate, exposome data can be used alongside polygenic and clinical risk information to create extremely accurate prediction models for certain chronic diseases. I envision that future integration of more detailed genomics, metabolomics, proteomic, and epigenomic information in these models will allow for fine grained mapping of the interplay between biological and environmental influences in shaping disease.

6.5. Conclusion

This thesis explores the exposome determinants of mortality, aging mechanisms, and age-related disease. By using large-scale datasets with independent replication and validation, analyses to detect for reverse causation and account for exposome intercorrelation, and a multi-layered approach across multiple diverse outcomes, my thesis work improves significantly upon both existing single exposure epidemiological and exposome research on the determinants of mortality and age-related disease. I identify many independent exposome influences that are strong determinants of mortality through influencing known age-related biological mechanisms and age-related disease multimorbidity. My work identifies many priority population health targets where

intervention would have the most strategic and maximal preventative impact across a wide range of age-related diseases and mortality.

7. References

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8. Appendix

8.1. Supplementary figures

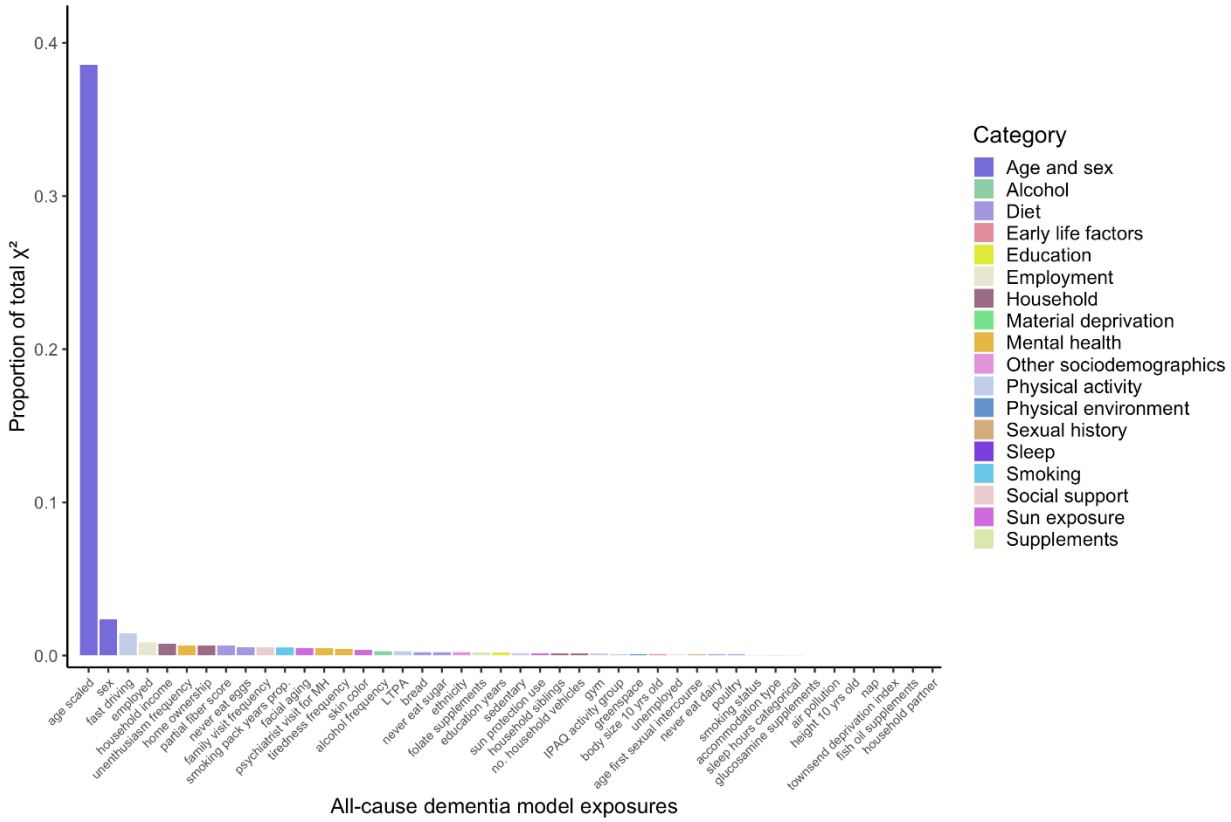


Figure S1. Variable importance according to proportion of total model chi-squared (X^2) for each exposure in the final multivariable all-cause dementia exposome Cox model.

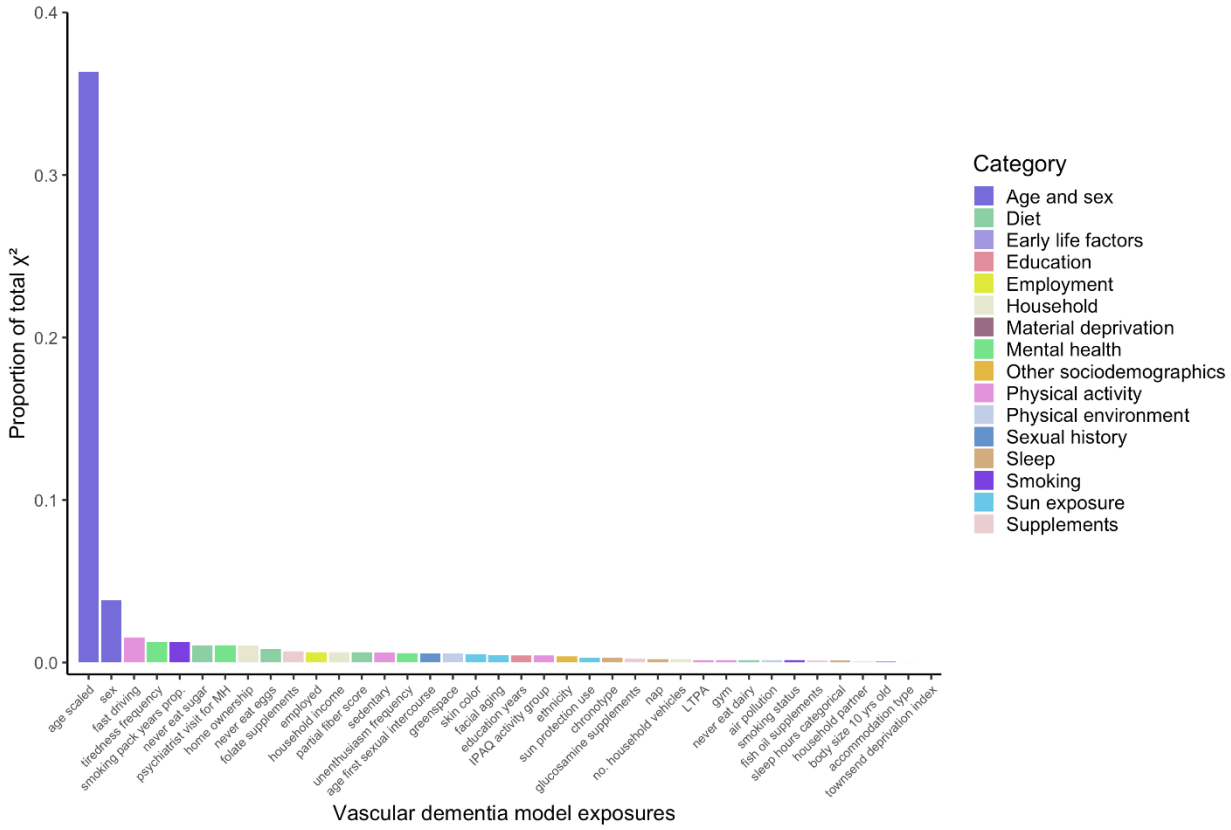


Figure S2. Variable importance according to proportion of total model chi-squared (X^2) for each exposure in the final multivariable vascular dementia exposome Cox model.

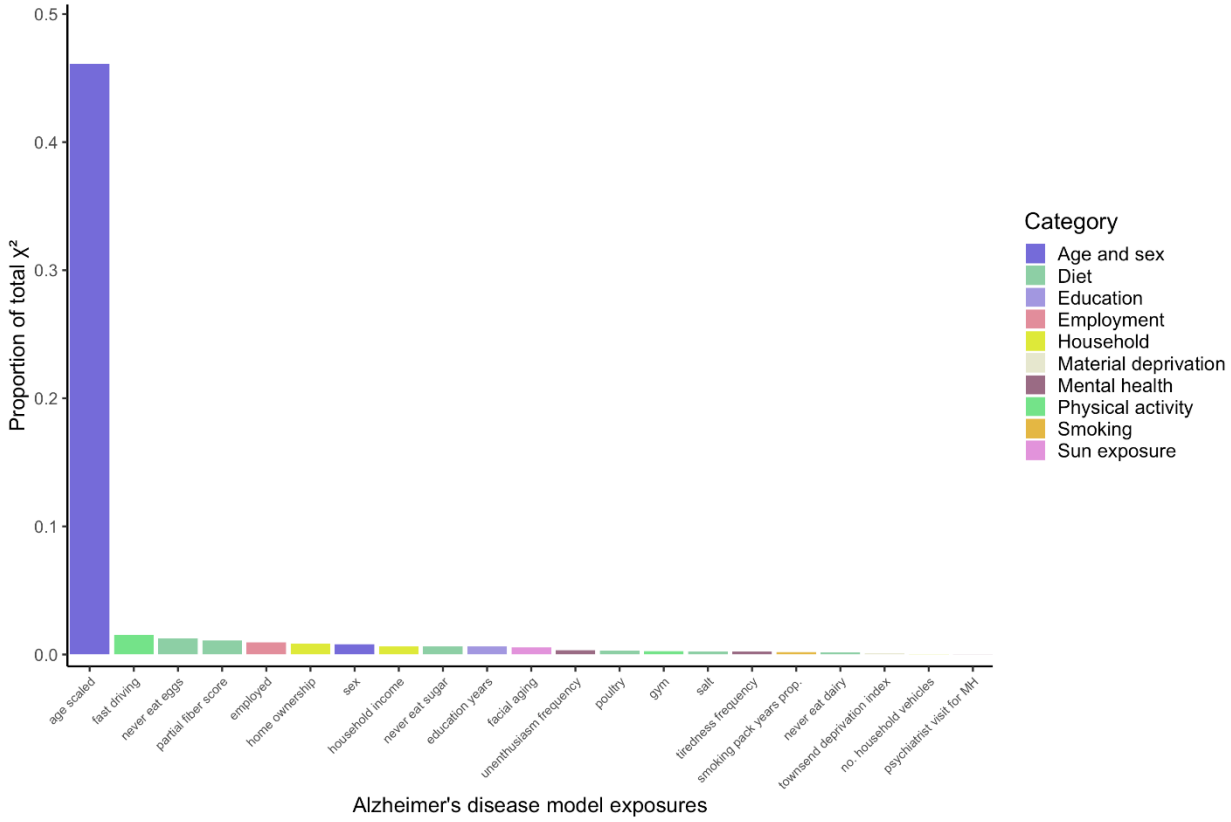


Figure S3. Variable importance according to proportion of total model chi-squared (X^2) for each exposure in the final multivariable Alzheimer's disease exposome Cox model.

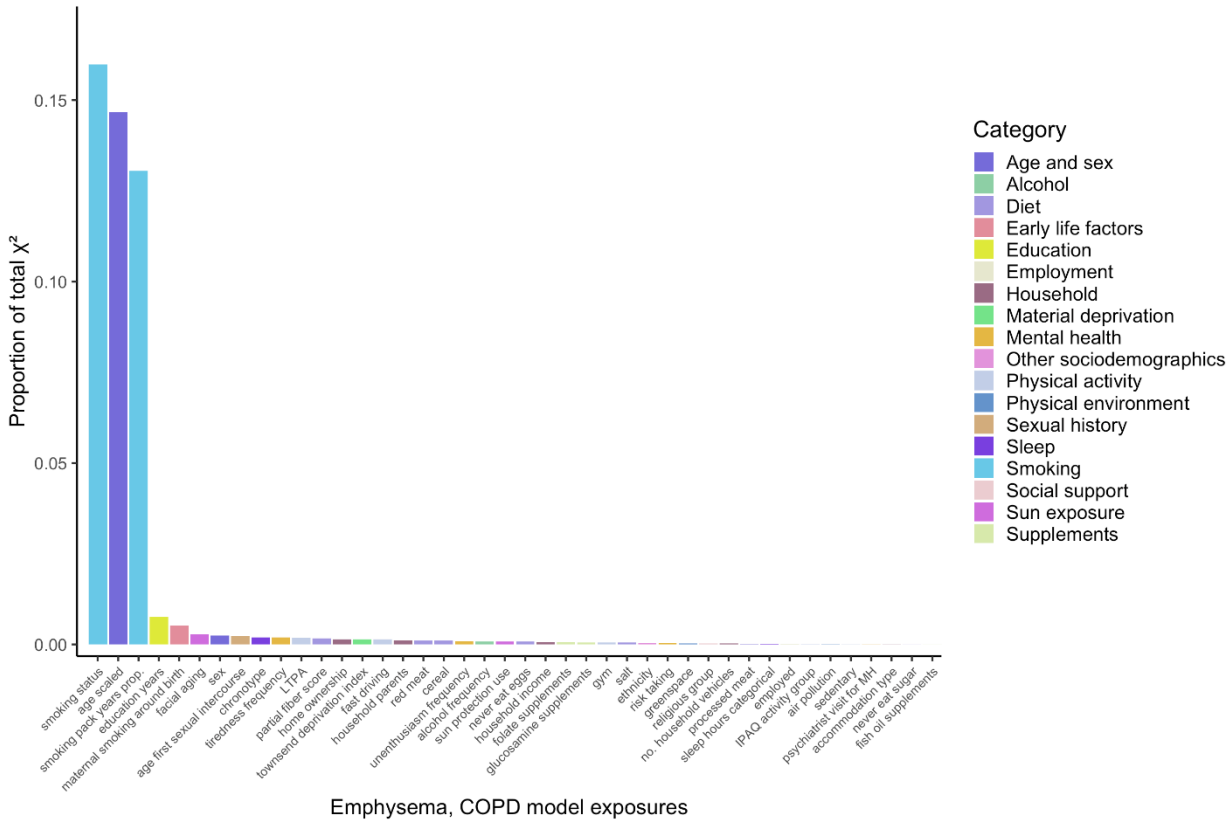


Figure S4. Variable importance according to proportion of total model chi-squared (X^2) for each exposure in the final multivariable emphysema, COPD exposome Cox model.

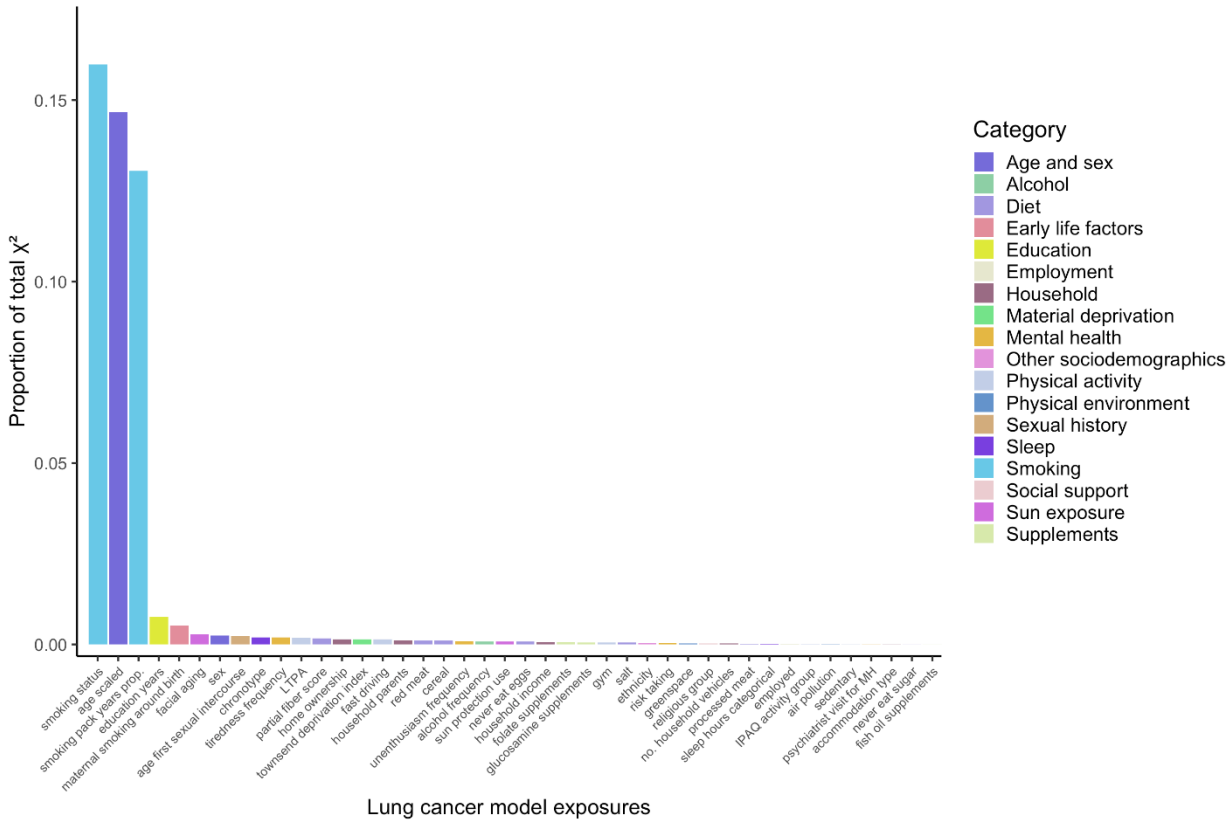


Figure S5. Variable importance according to proportion of total model chi-squared (X^2) for each exposure in the final multivariable lung cancer exposome Cox model.

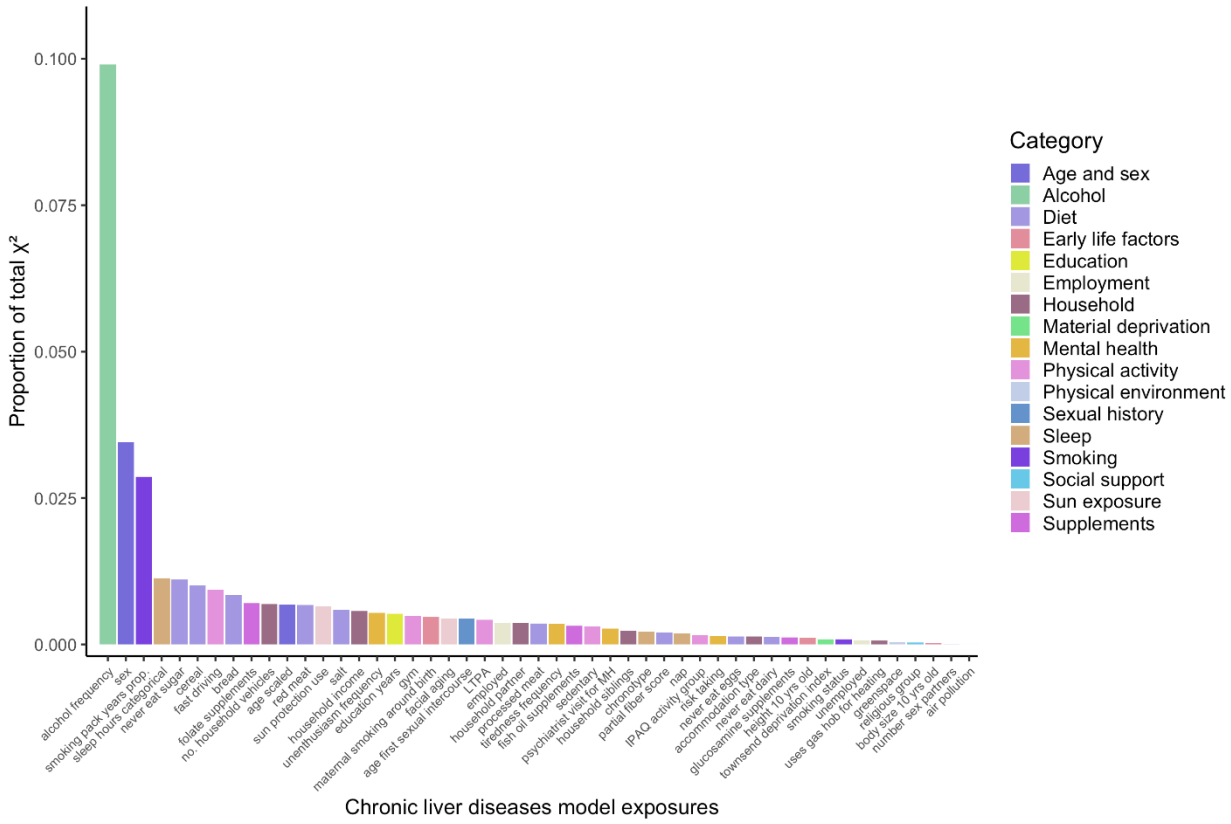


Figure S6. Variable importance according to proportion of total model chi-squared (X^2) for each exposure in the final multivariable chronic liver diseases exposome Cox model.

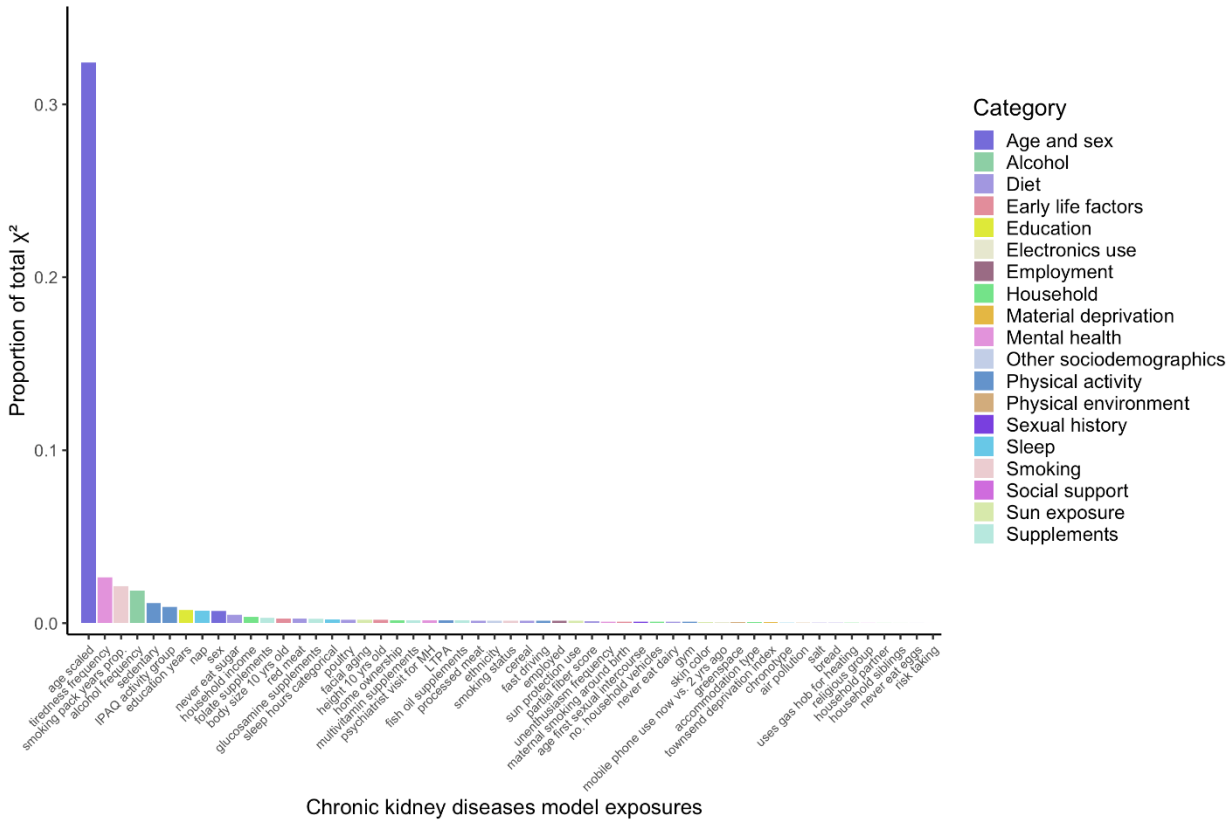


Figure S7. Variable importance according to proportion of total model chi-squared (X^2) for each exposure in the final multivariable chronic kidney diseases exposome Cox model.

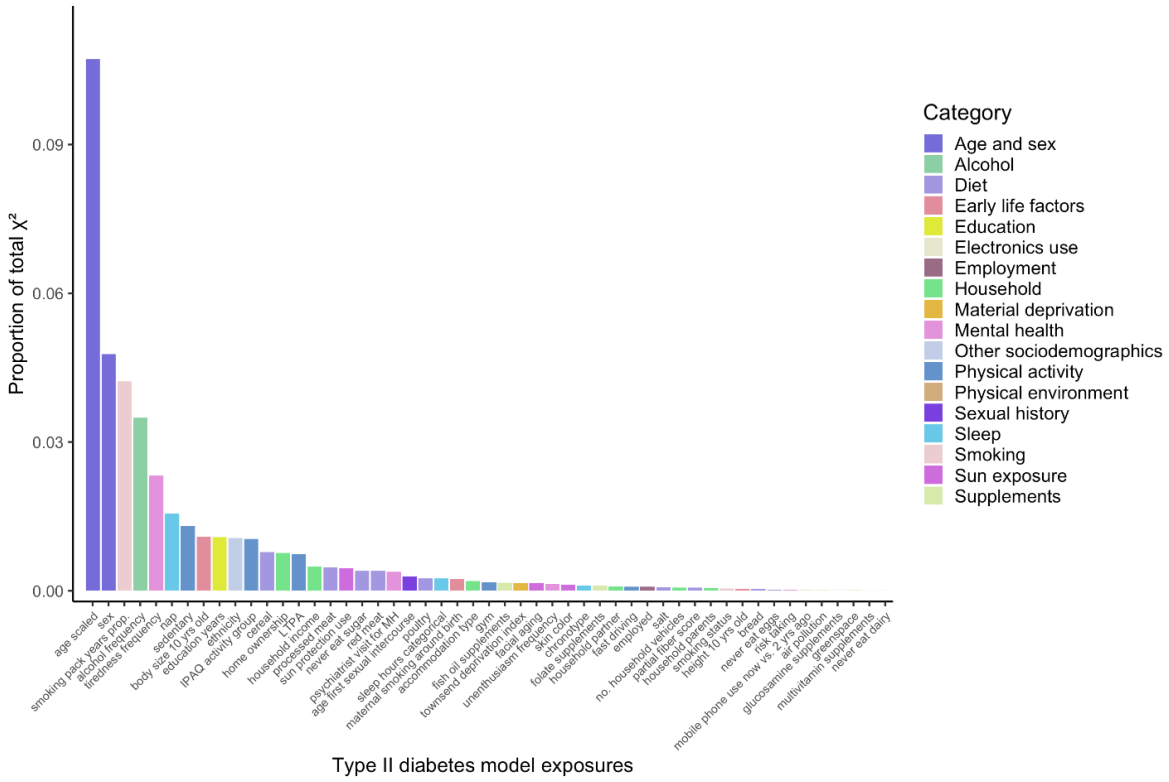


Figure S8. Variable importance according to proportion of total model chi-squared (X^2) for each exposure in the final multivariable type 2 diabetes exposome Cox model.

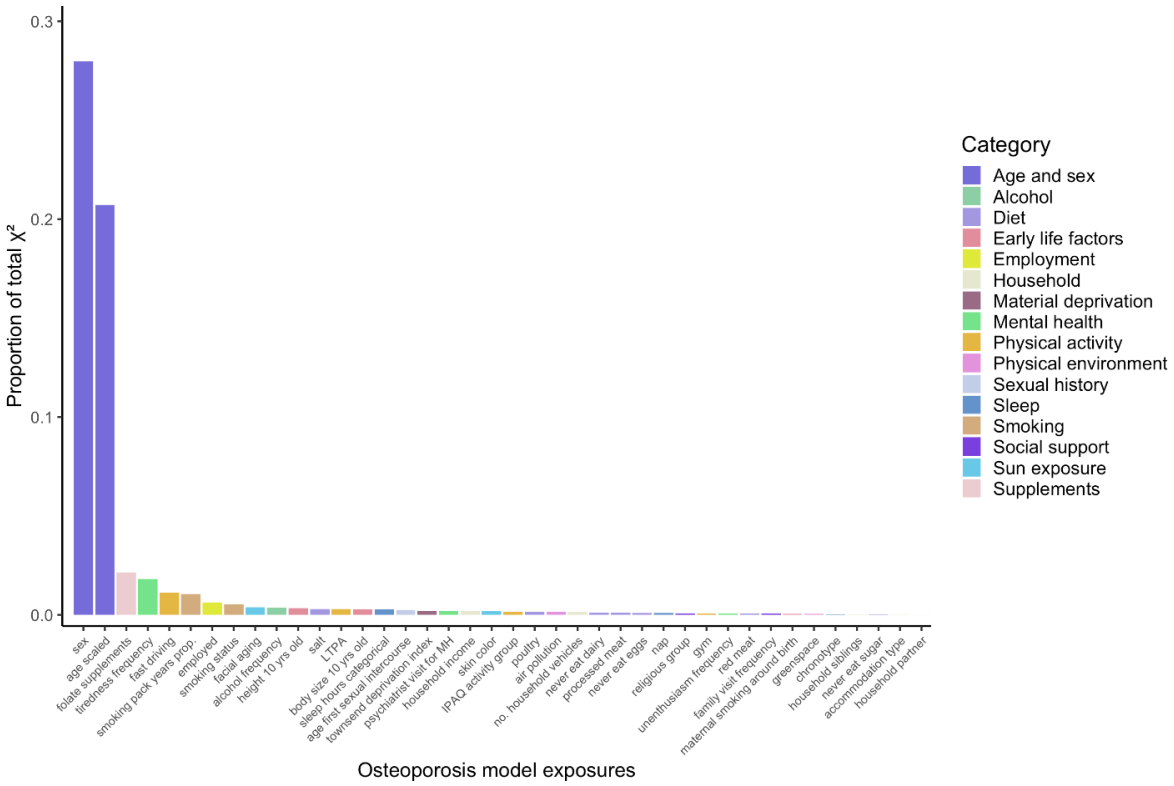


Figure S9. Variable importance according to proportion of total model chi-squared (X^2) for each exposure in the final multivariable osteoporosis exposome Cox model.

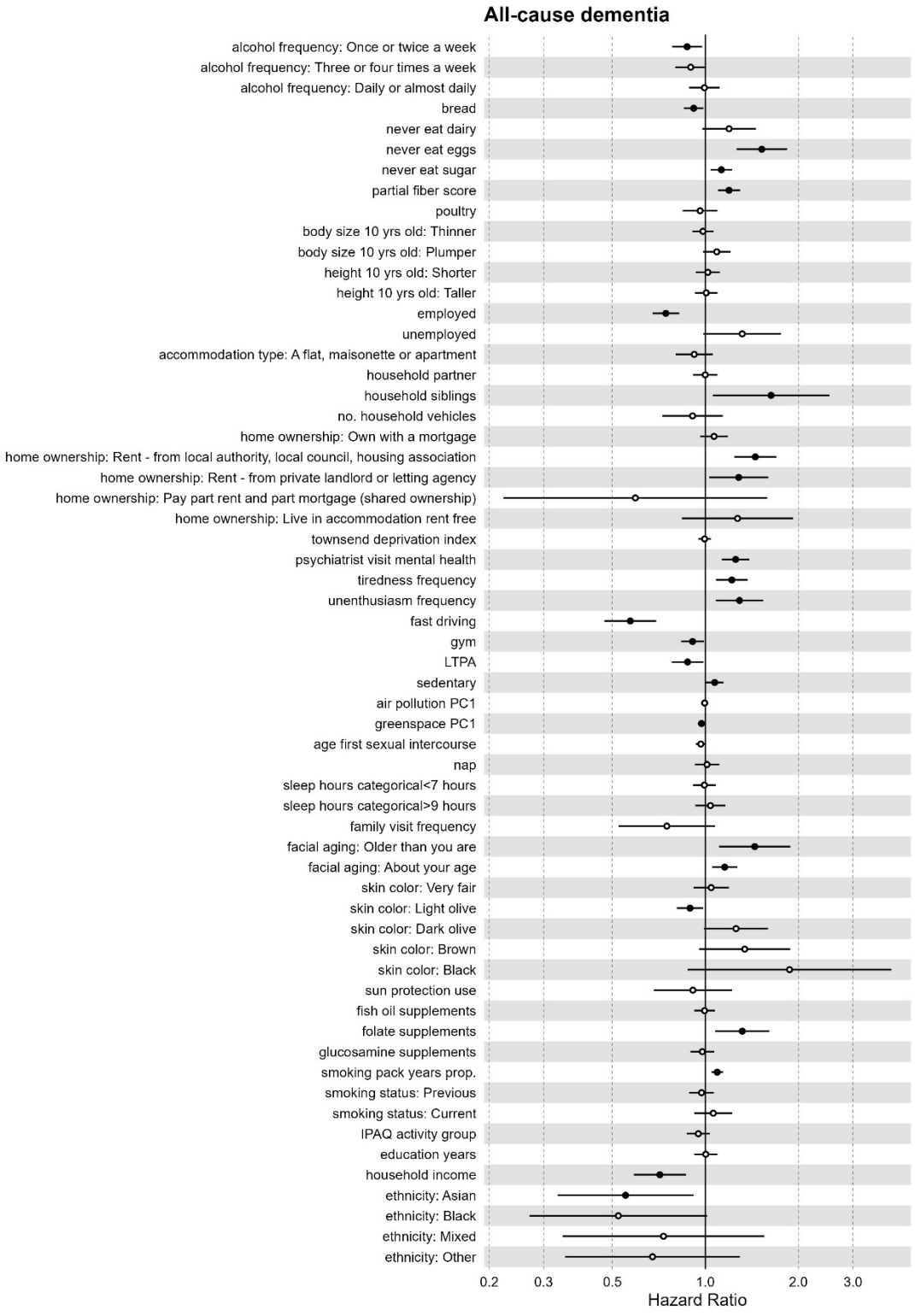


Figure S10. Effect estimates from the full exposome multivariable Cox model for All-cause dementia in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

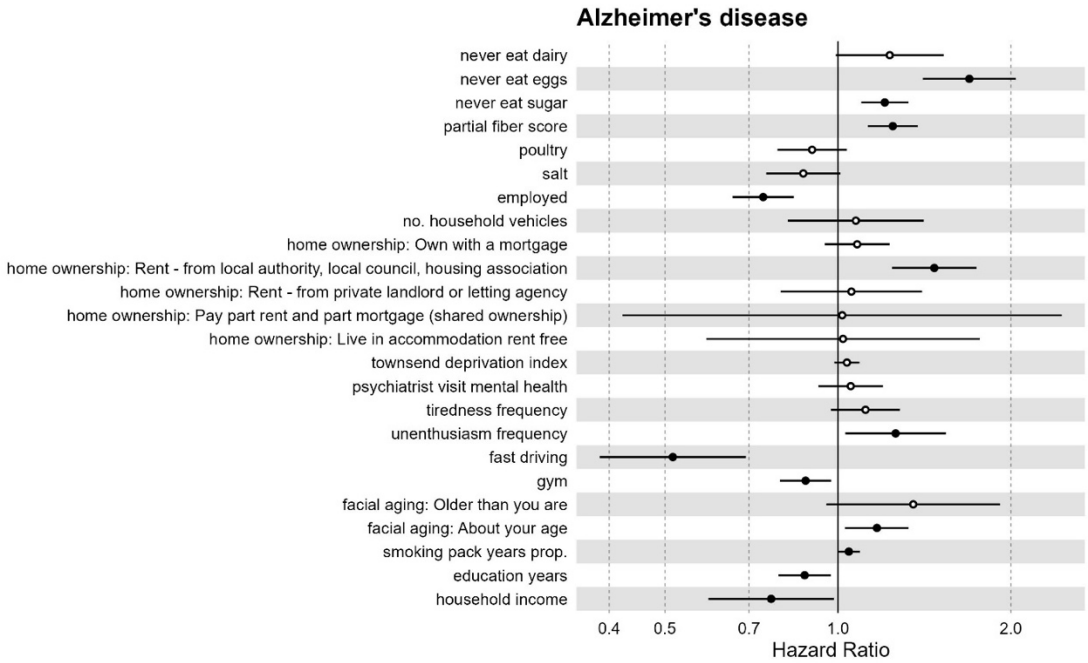


Figure S11. Effect estimates from the full exposome multivariable Cox model for Alzheimer's disease in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

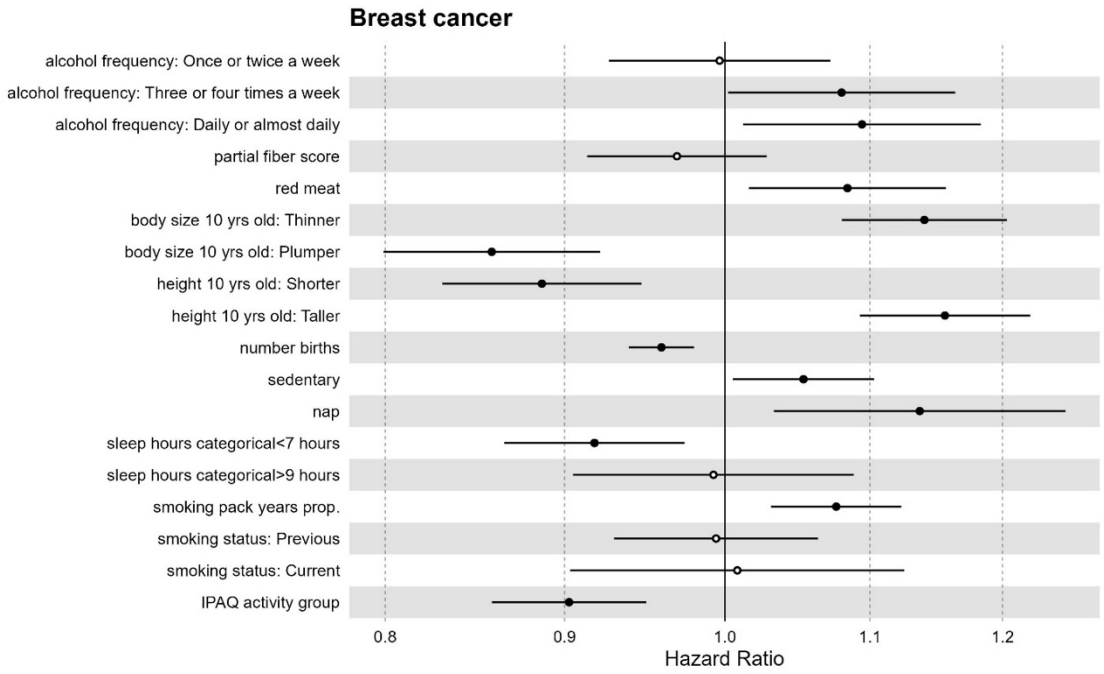


Figure S12. Effect estimates from the full exposome multivariable Cox model for breast cancer in UK Biobank women recruited in England (n = 237,634). Model also included covariates for age.

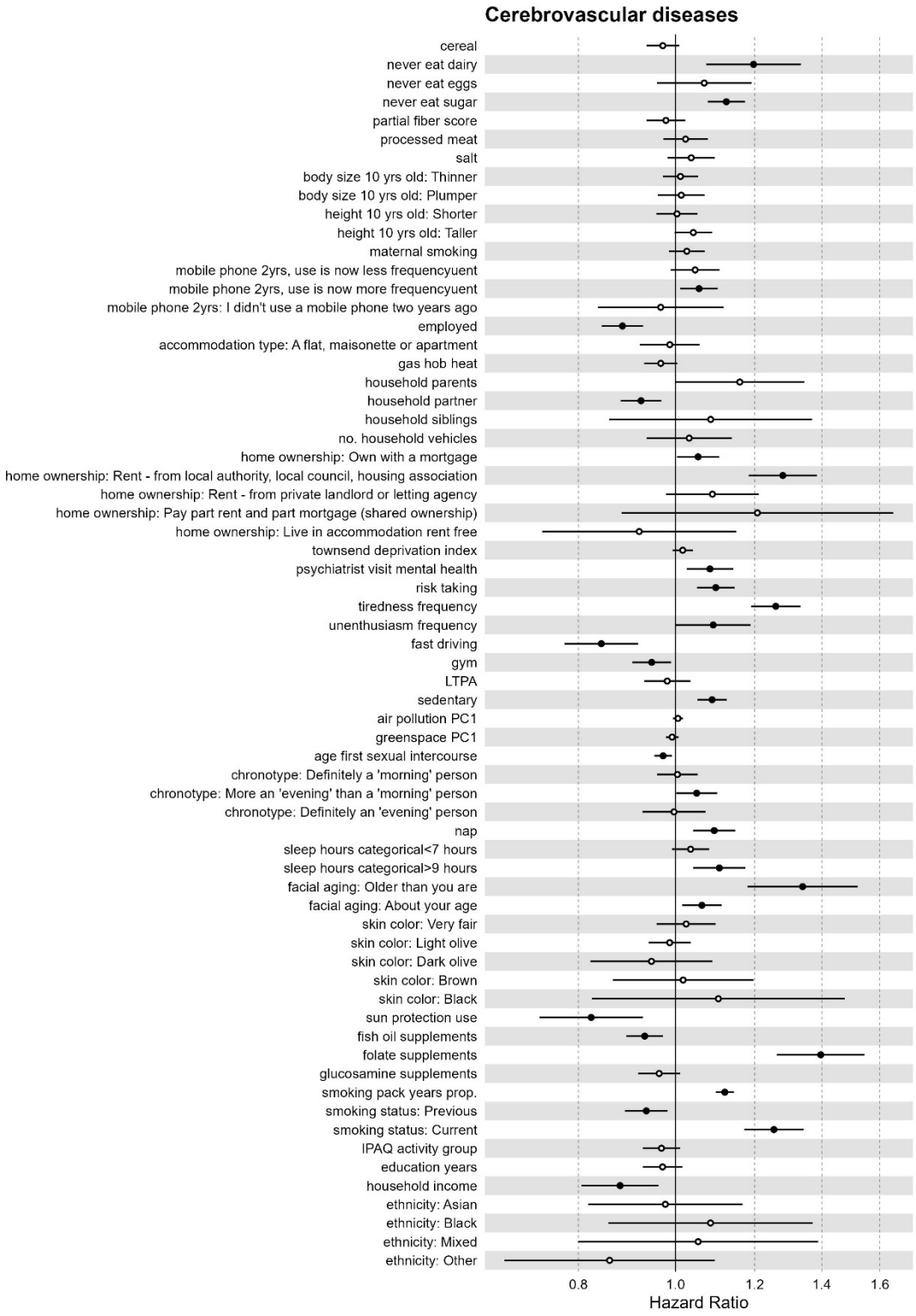


Figure S13. Effect estimates from the full exposome multivariable Cox model for cerebrovascular diseases in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

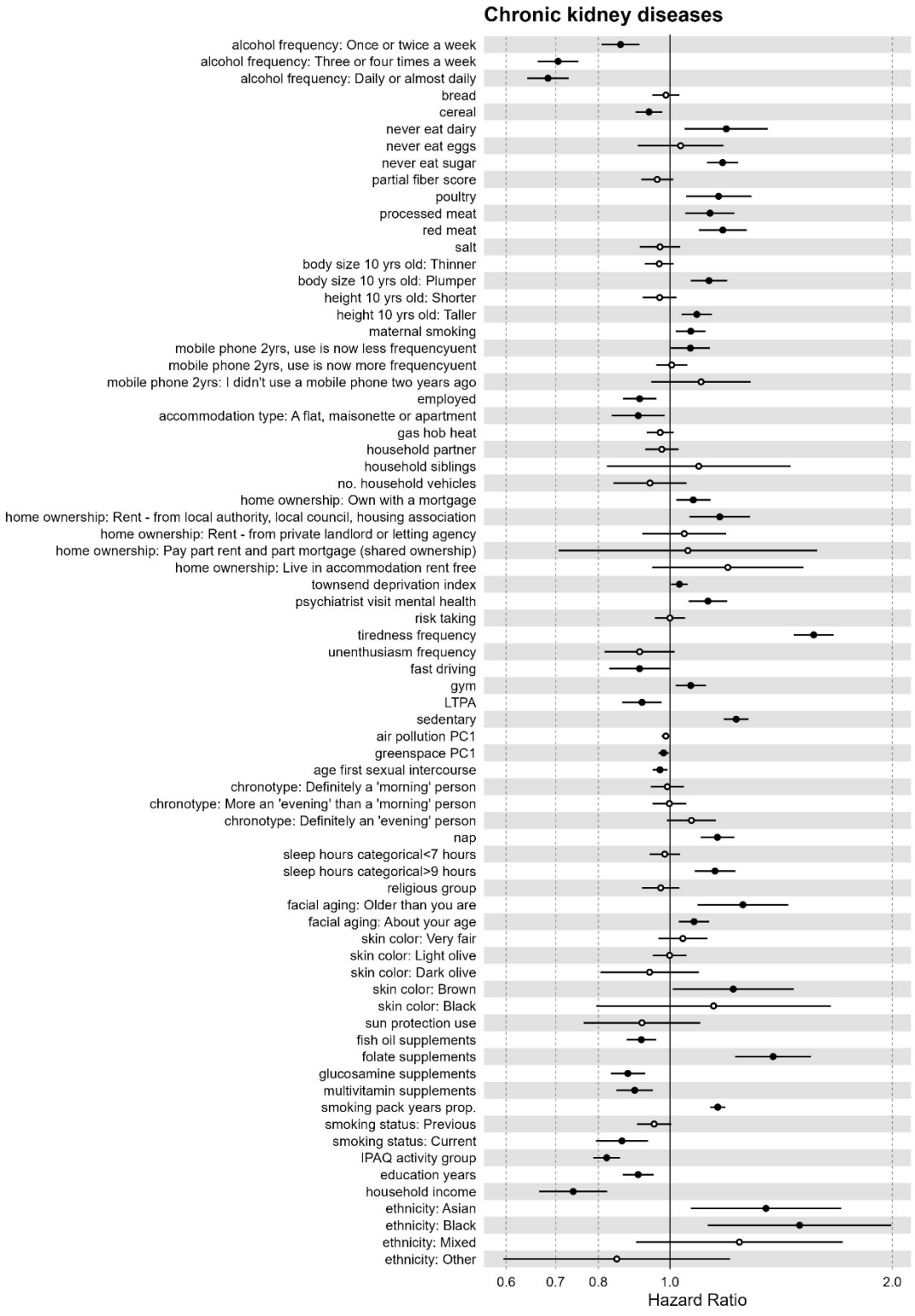


Figure S14. Effect estimates from the full exposome multivariable Cox model for chronic kidney diseases in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

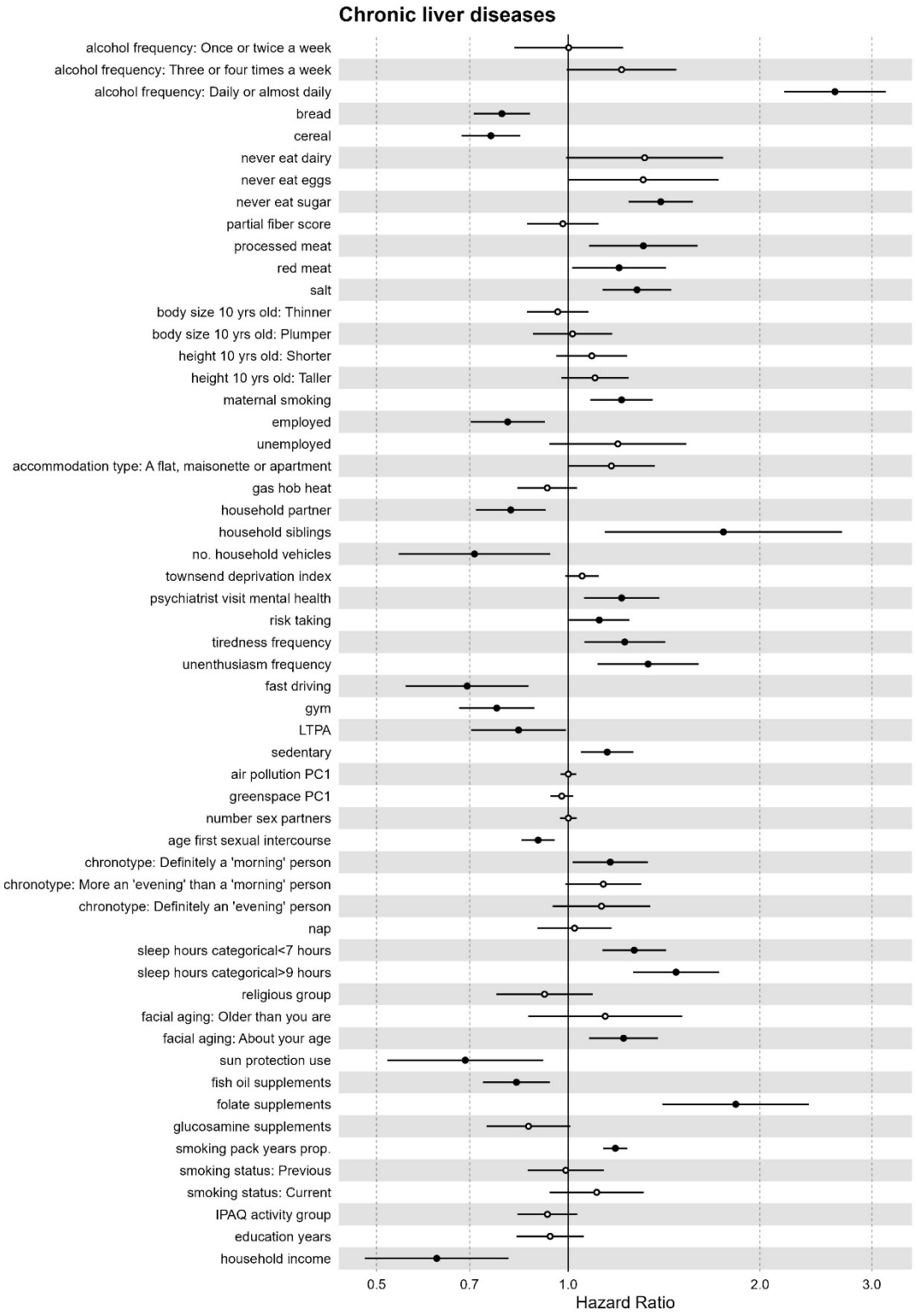


Figure S15. Effect estimates from the full exposome multivariable Cox model for chronic liver diseases in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

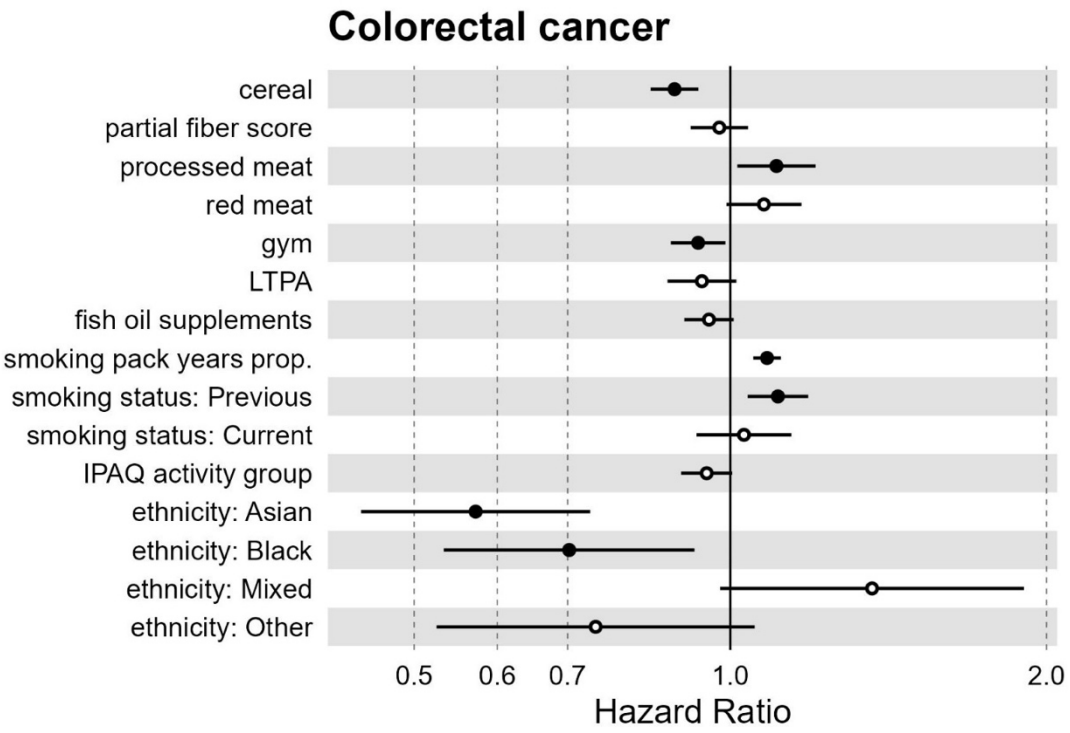


Figure S16. Effect estimates from the full exposome multivariable Cox model for colorectal cancer in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

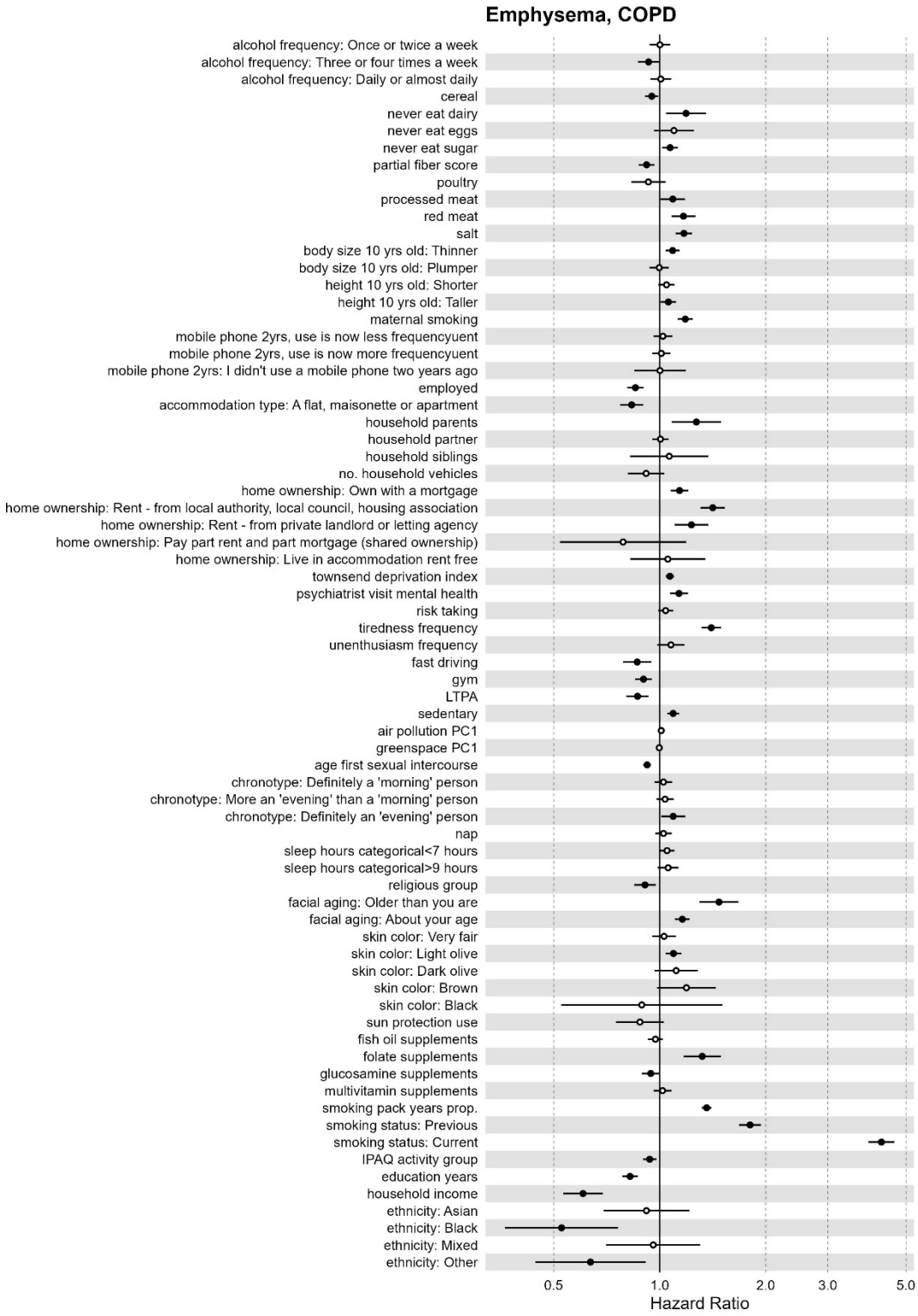


Figure S17. Effect estimates from the full exposome multivariable Cox model for emphysema, COPD in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

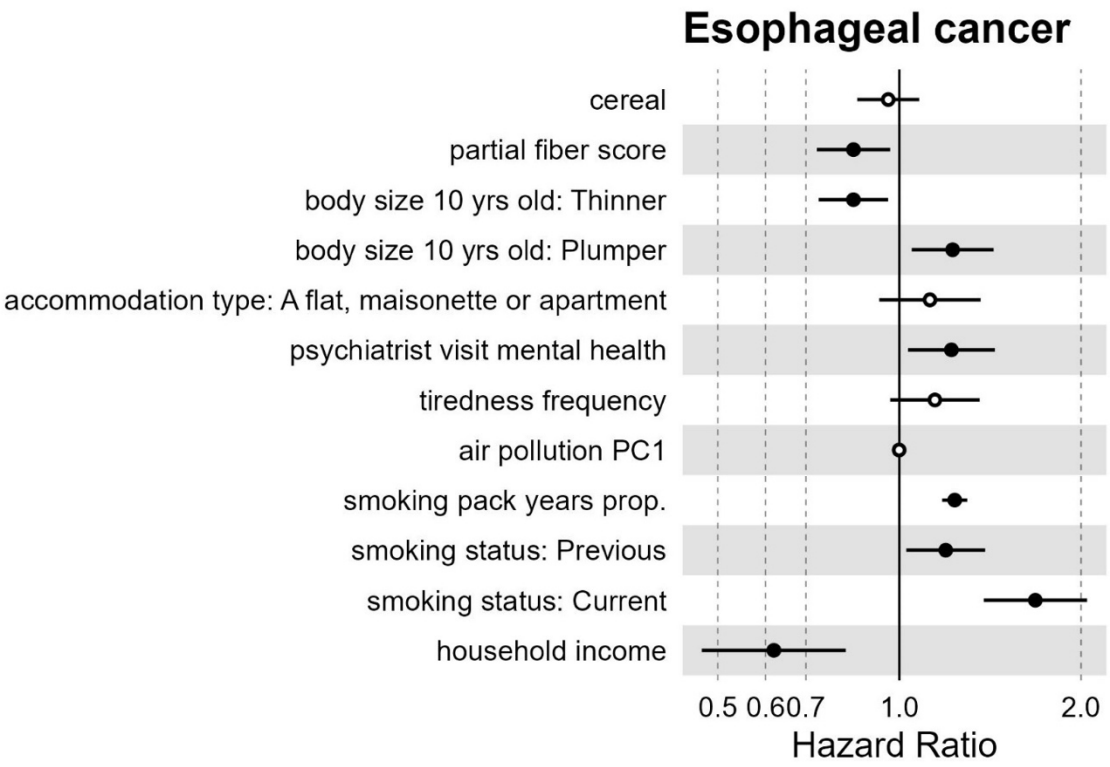


Figure S18. Effect estimates from the full exposome multivariable Cox model for esophageal cancer in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

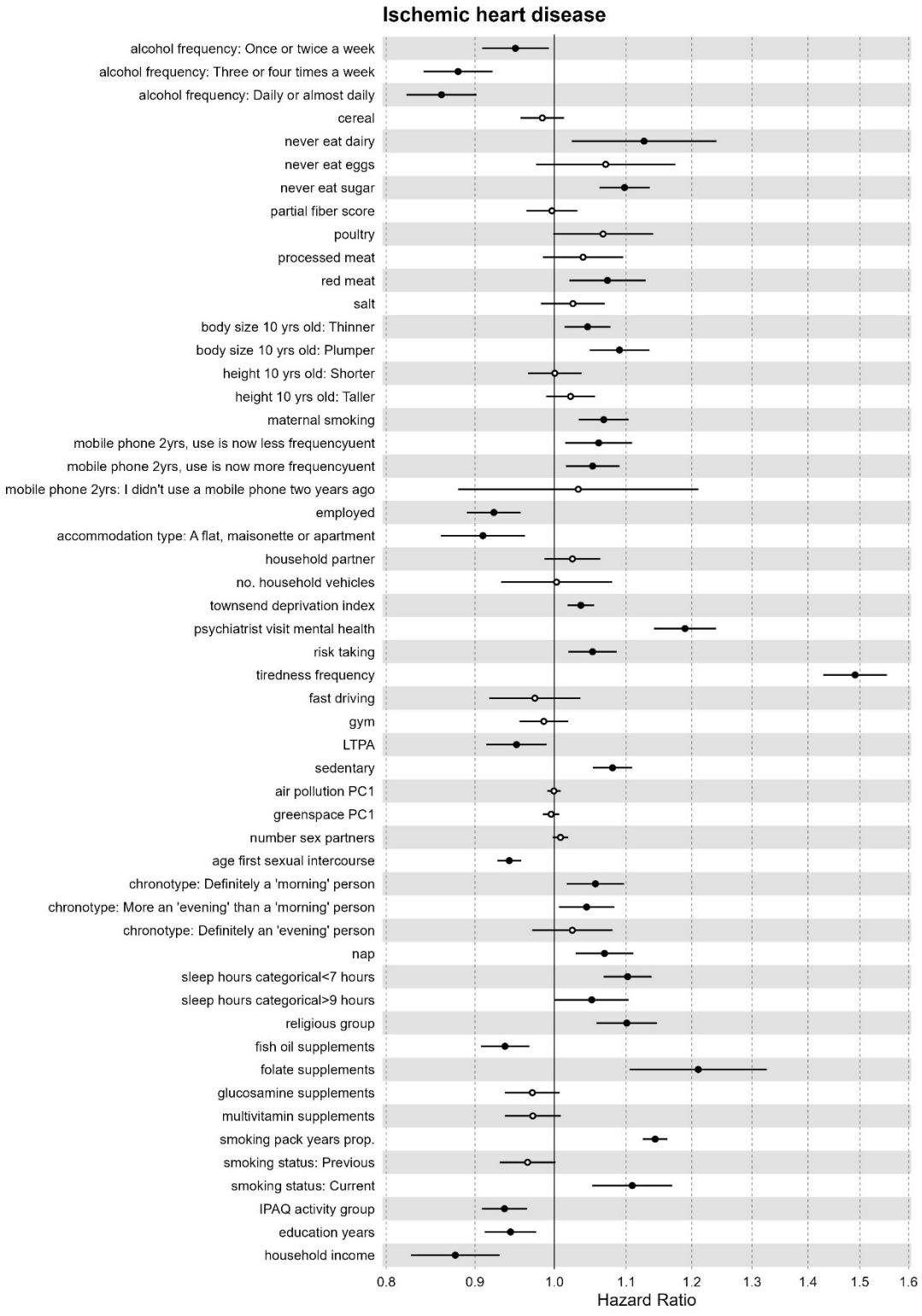


Figure S19. Effect estimates from the full exposome multivariable Cox model for ischemic heart disease in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

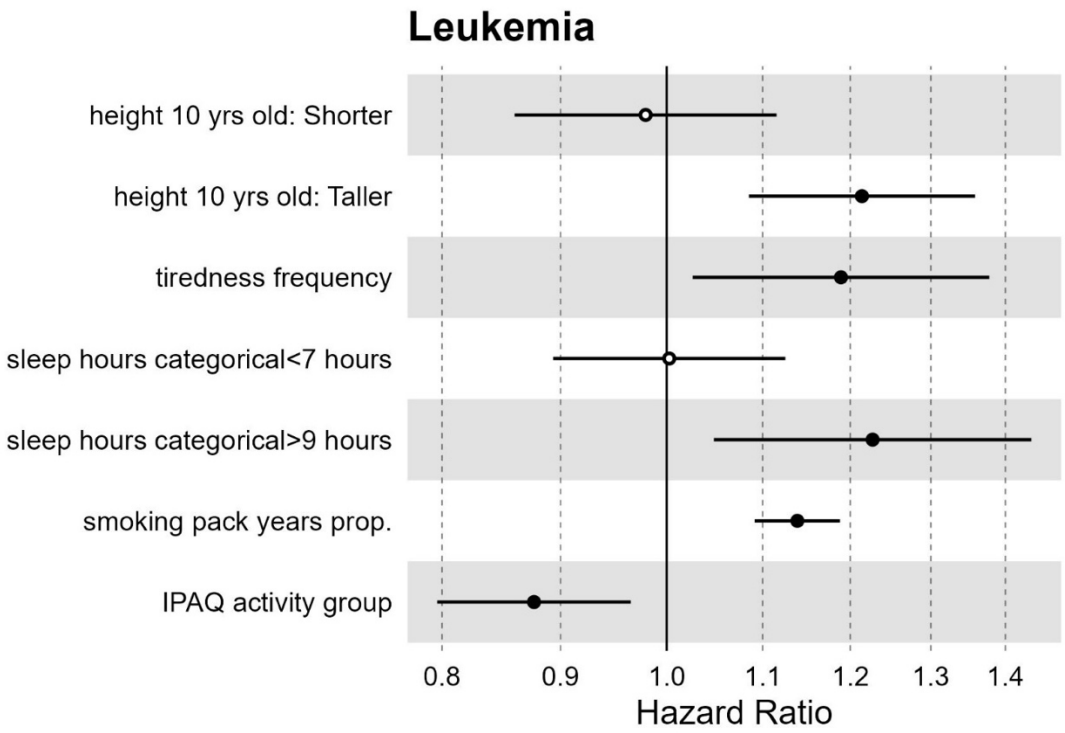


Figure S20. Effect estimates from the full exposome multivariable Cox model for leukemia in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

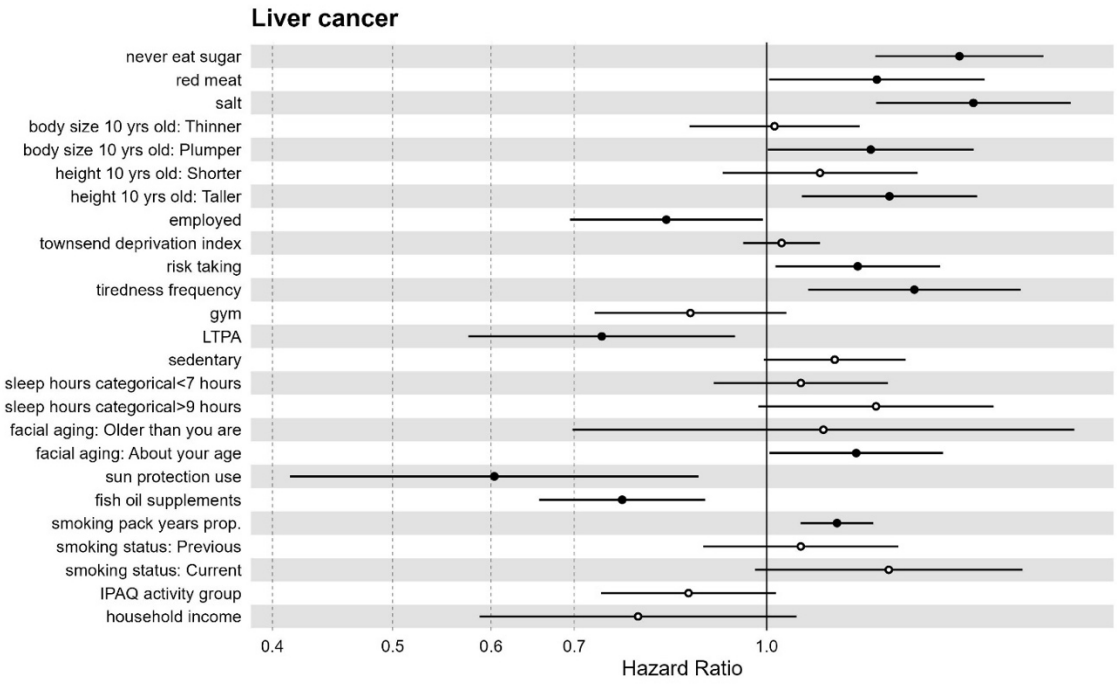


Figure S21. Effect estimates from the full exposome multivariable Cox model for liver cancer in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

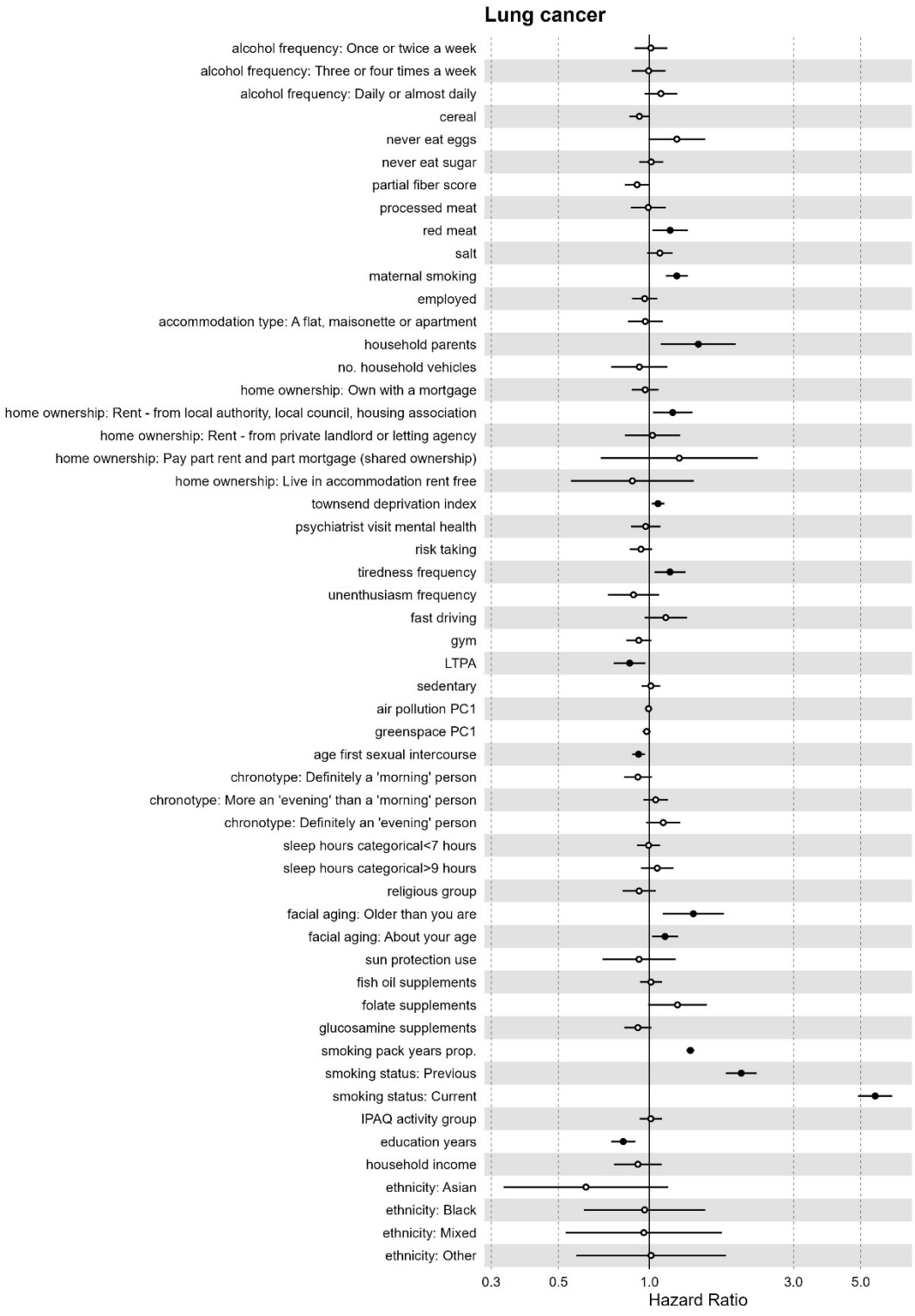


Figure S22. Effect estimates from the full exposome multivariable Cox model for lung cancer in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

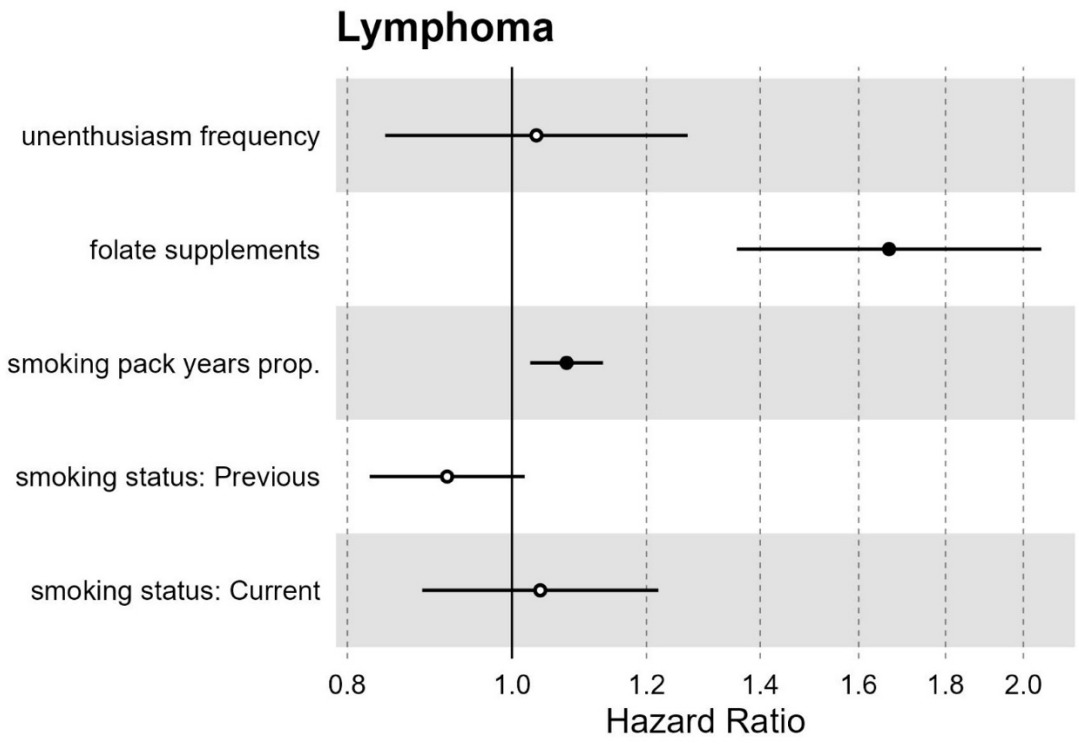


Figure S23. Effect estimates from the full exposome multivariable Cox model for lung cancer in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

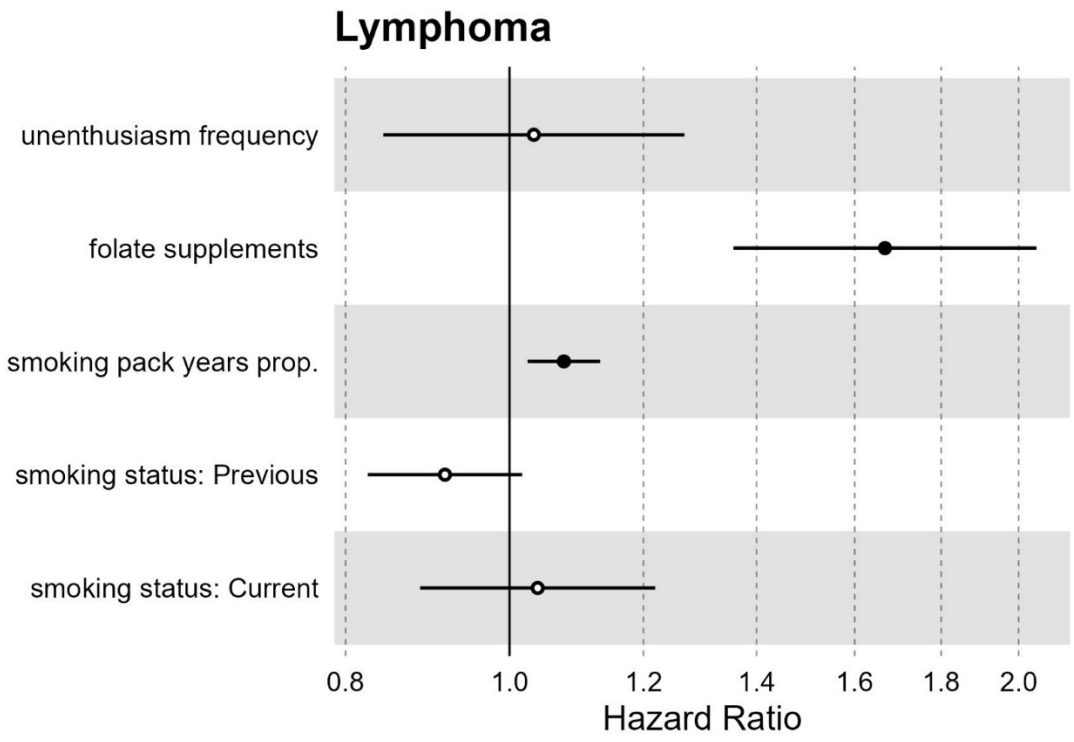


Figure S24. Effect estimates from the full exposome multivariable Cox model for lymphoma in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

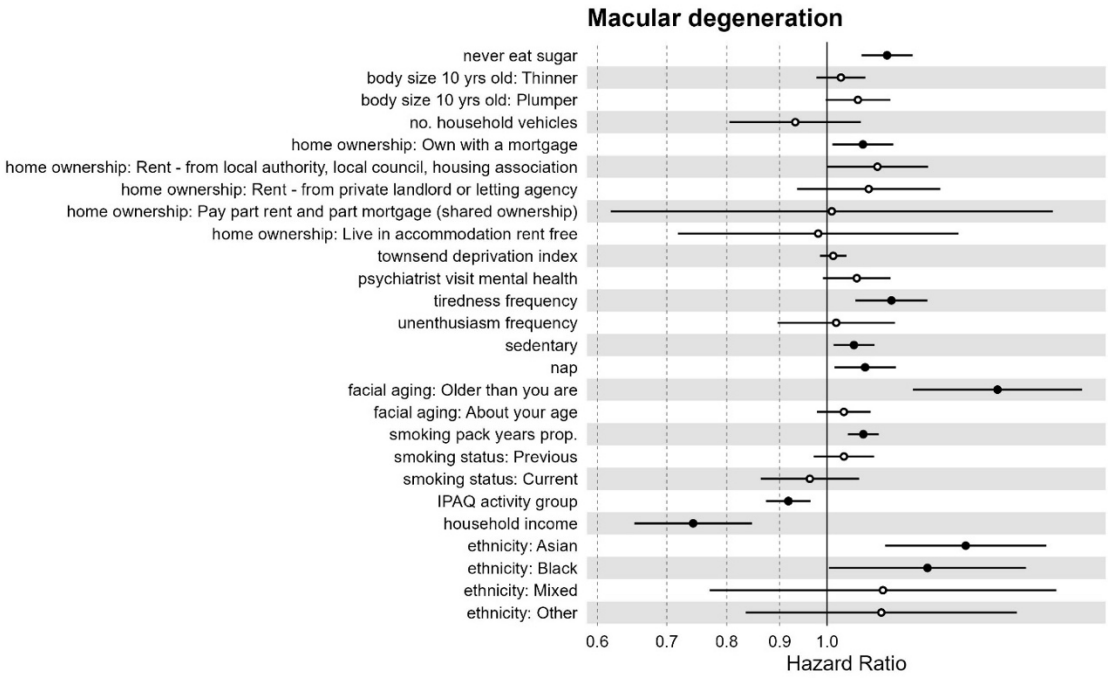


Figure S25. Effect estimates from the full exposome multivariable Cox model for macular degeneration in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

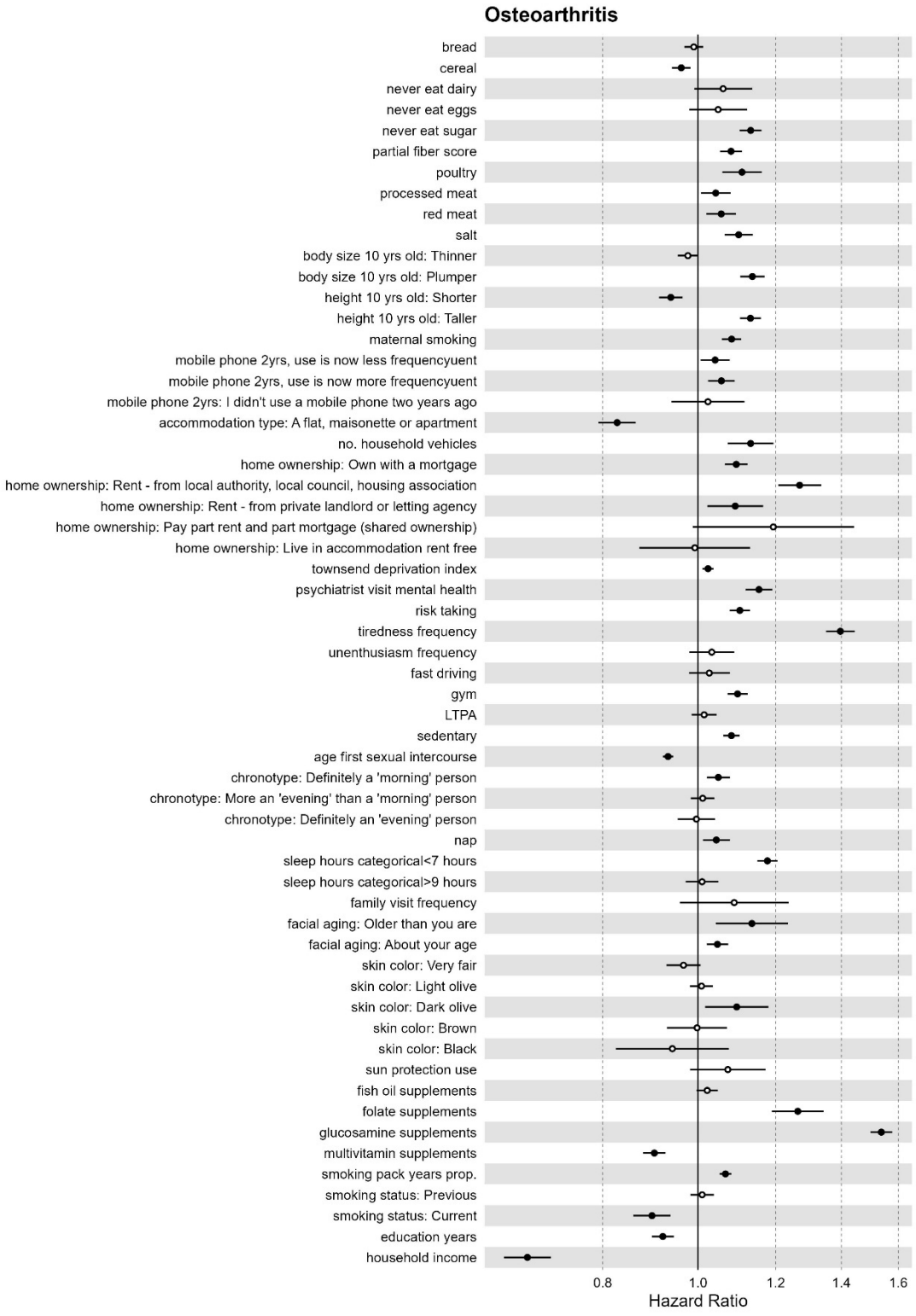


Figure S26. Effect estimates from the full exposome multivariable Cox model for osteoarthritis in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

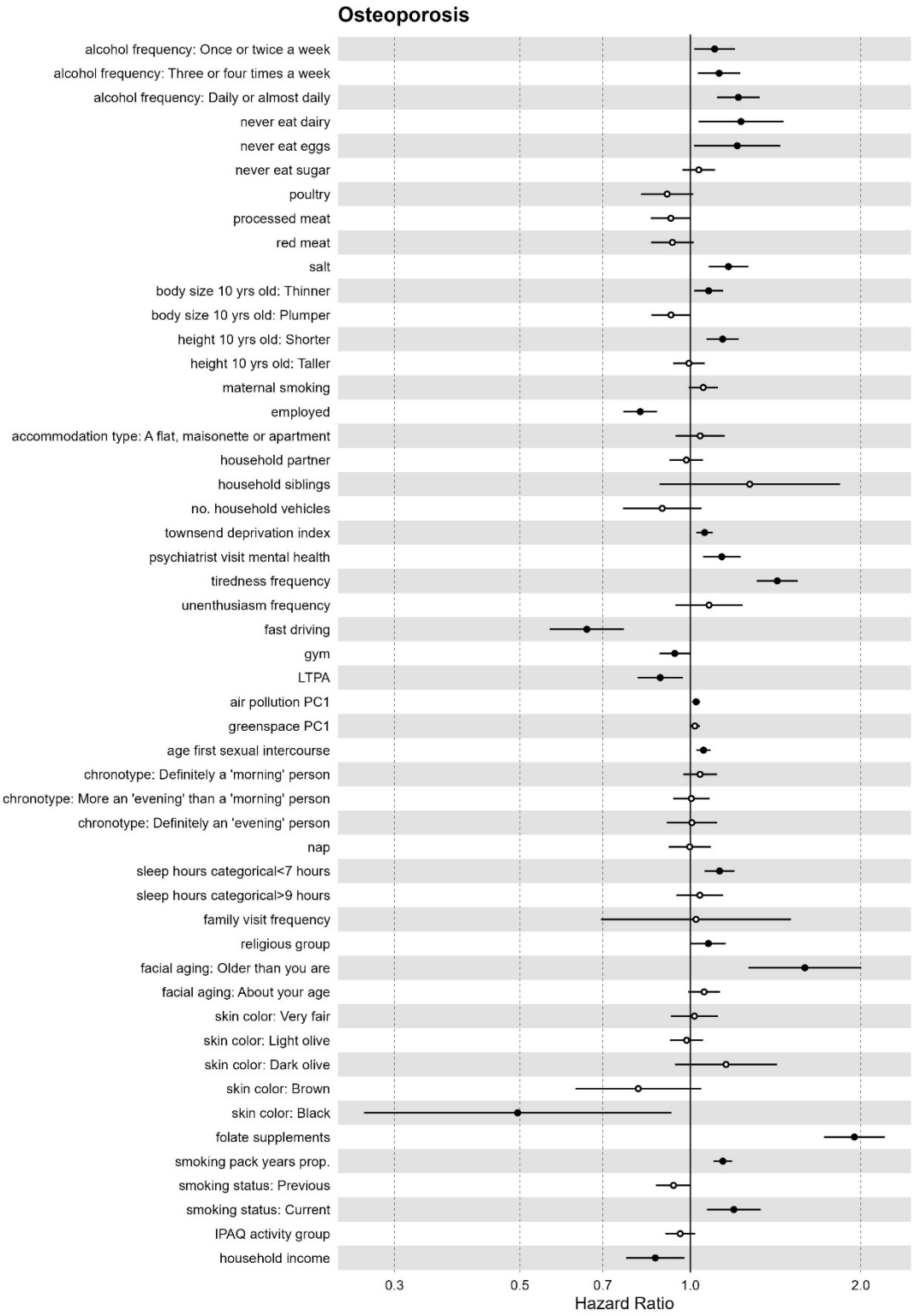


Figure S27. Effect estimates from the full exposome multivariable Cox model for osteoporosis in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

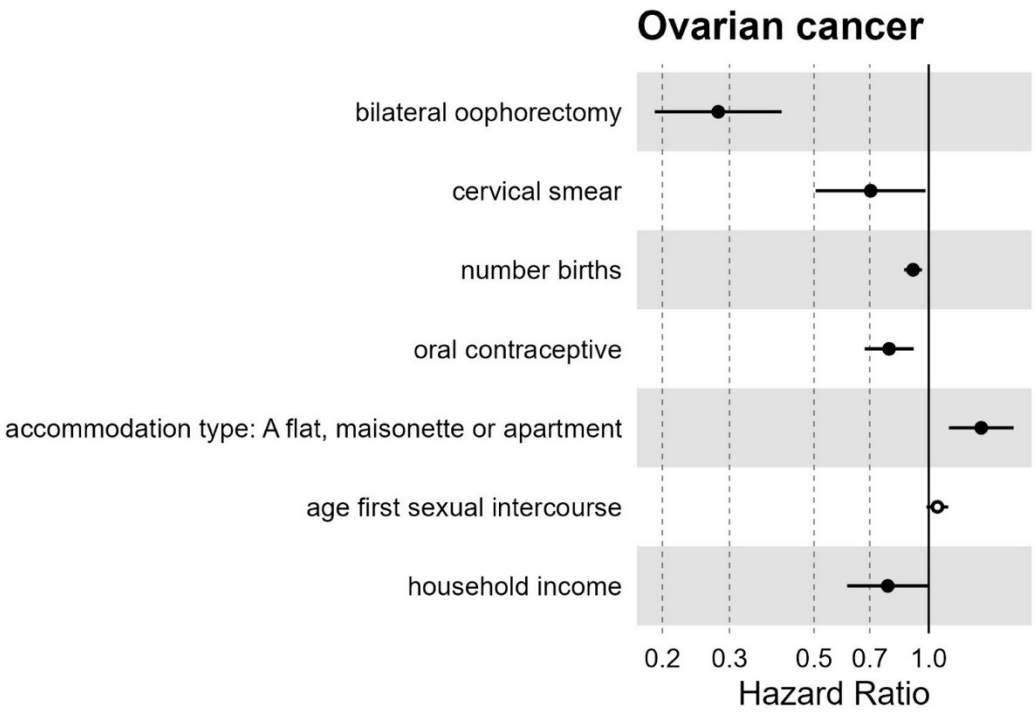


Figure S28. Effect estimates from the full exposome multivariable Cox model for ovarian cancer in UK Biobank women recruited in England (n = 237,634). Model also included covariates for age.

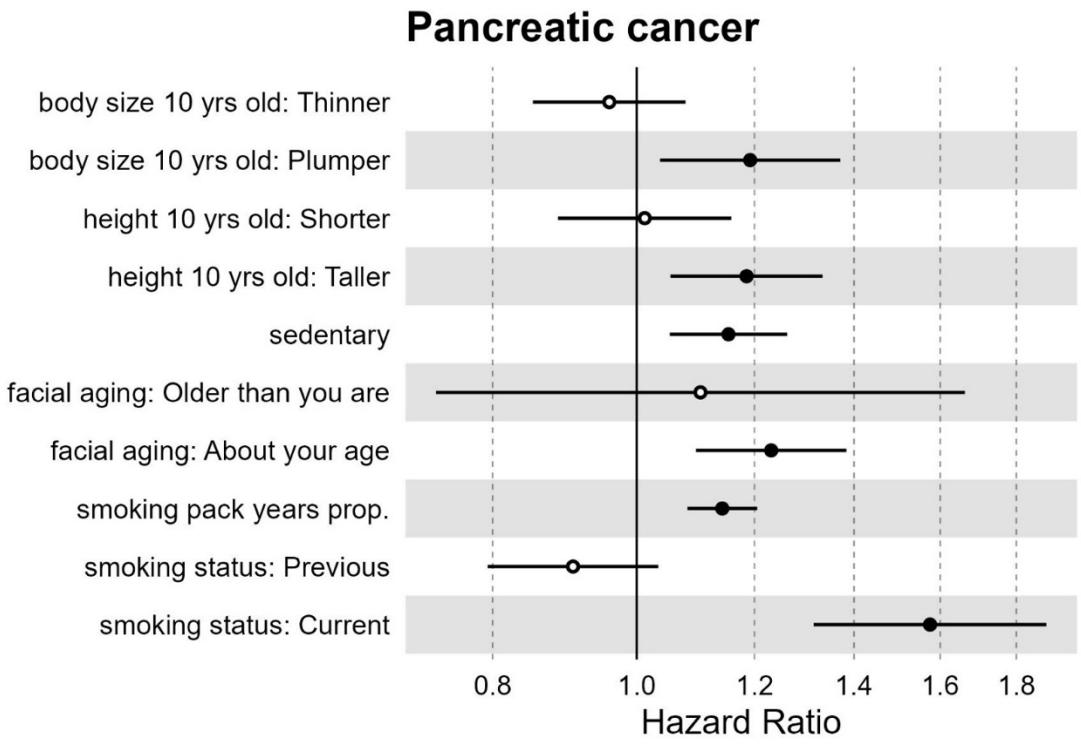


Figure S29. Effect estimates from the full exposome multivariable Cox model for pancreatic cancer in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

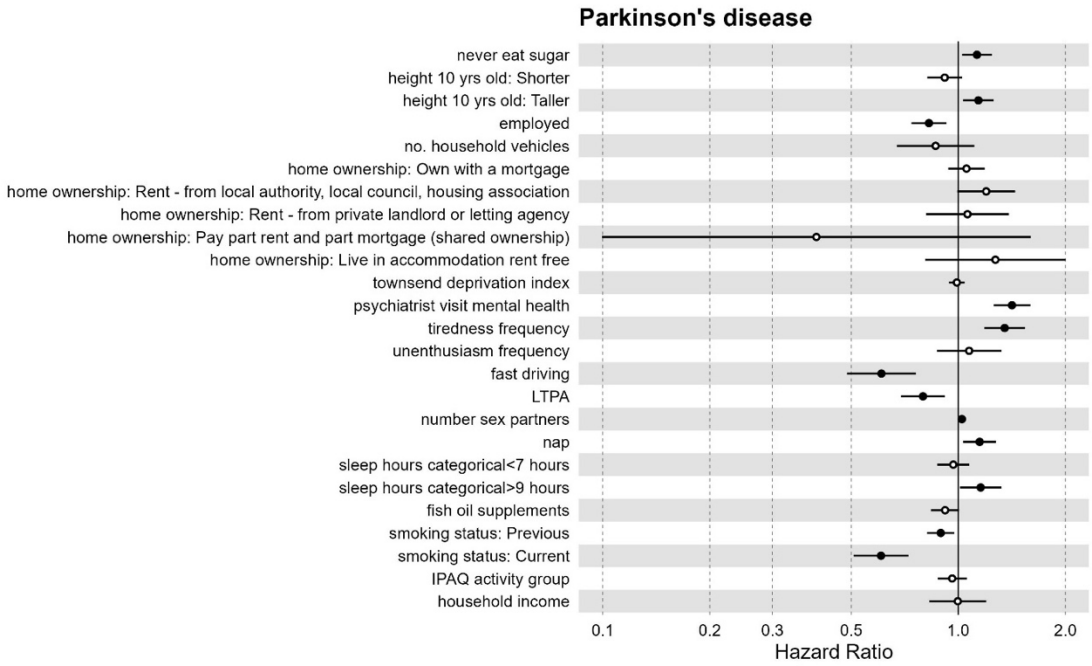


Figure S30. Effect estimates from the full exposome multivariable Cox model for Parkinson's disease in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

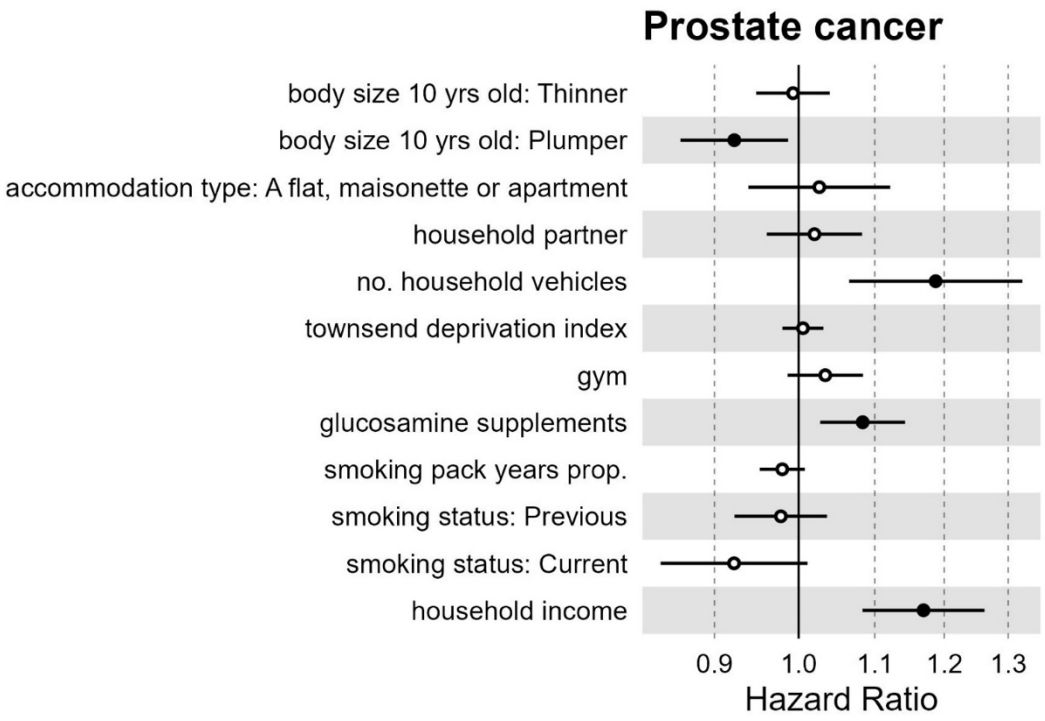


Figure S31. Effect estimates from the full exposome multivariable Cox model for prostate cancer in UK Biobank men recruited in England (n = 199,257). Model also included covariates for age.

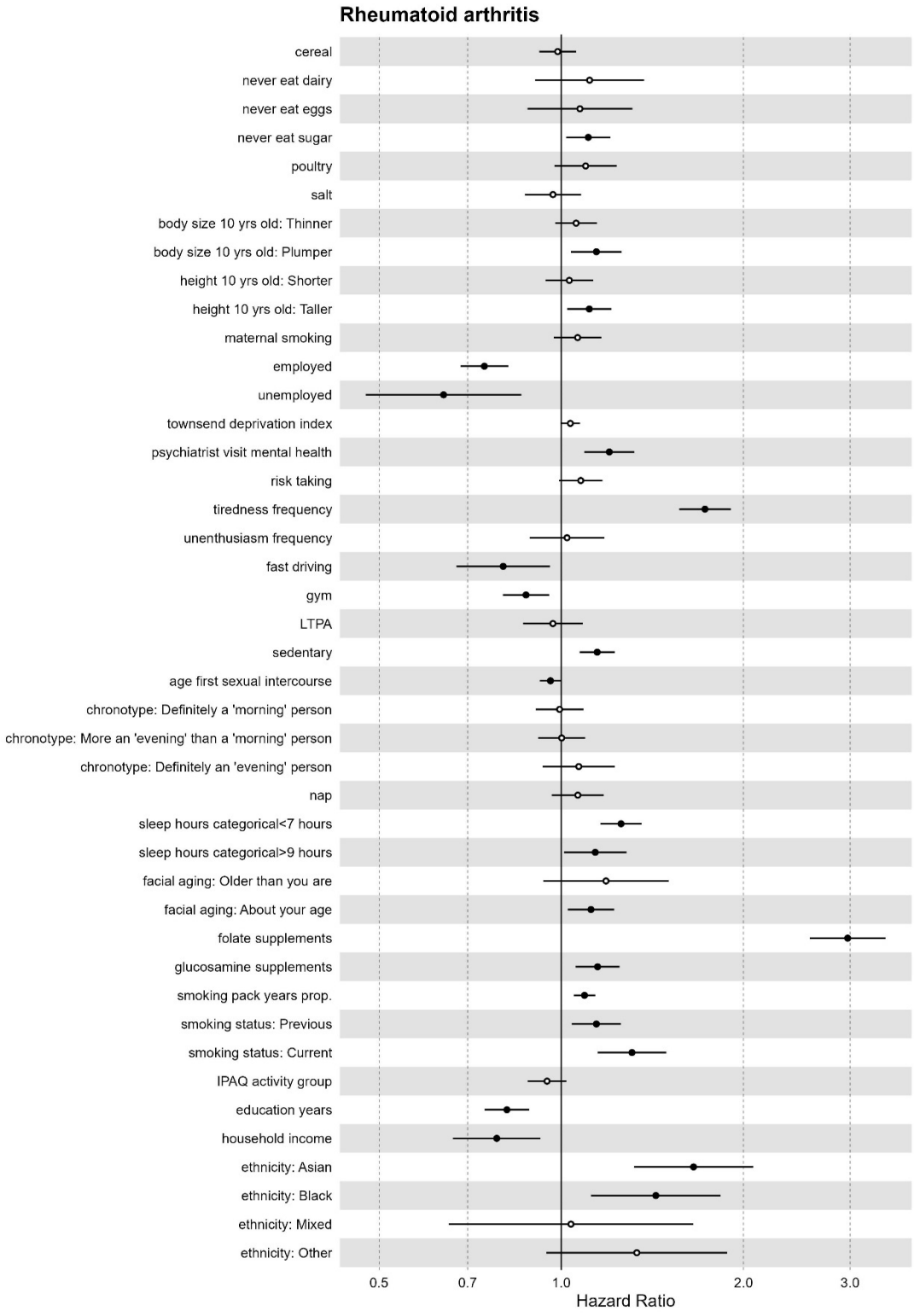


Figure S32. Effect estimates from the full exposome multivariable Cox model for Rheumatoid arthritis in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

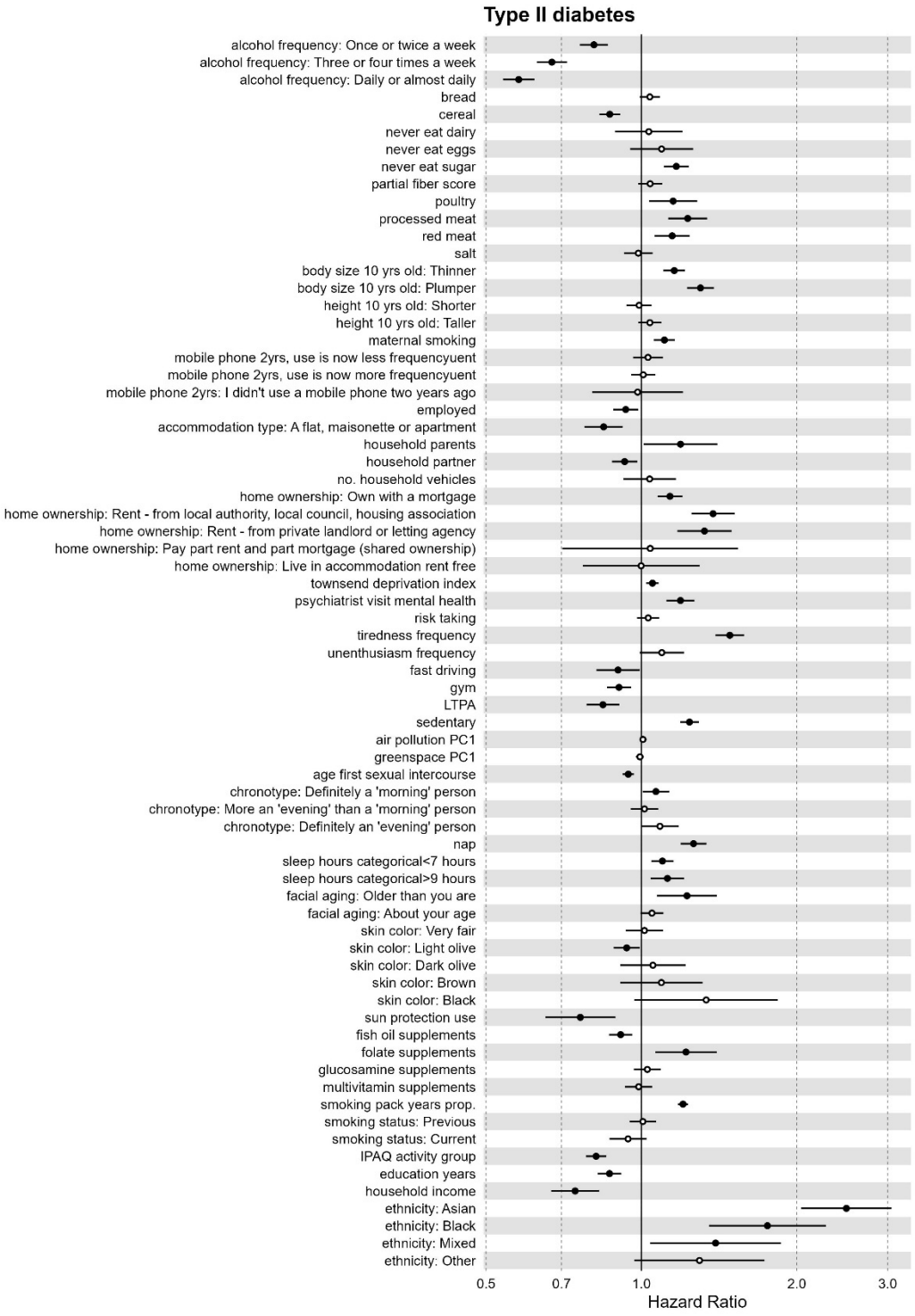


Figure S33. Effect estimates from the full exposome multivariable Cox model for type 2 diabetes in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

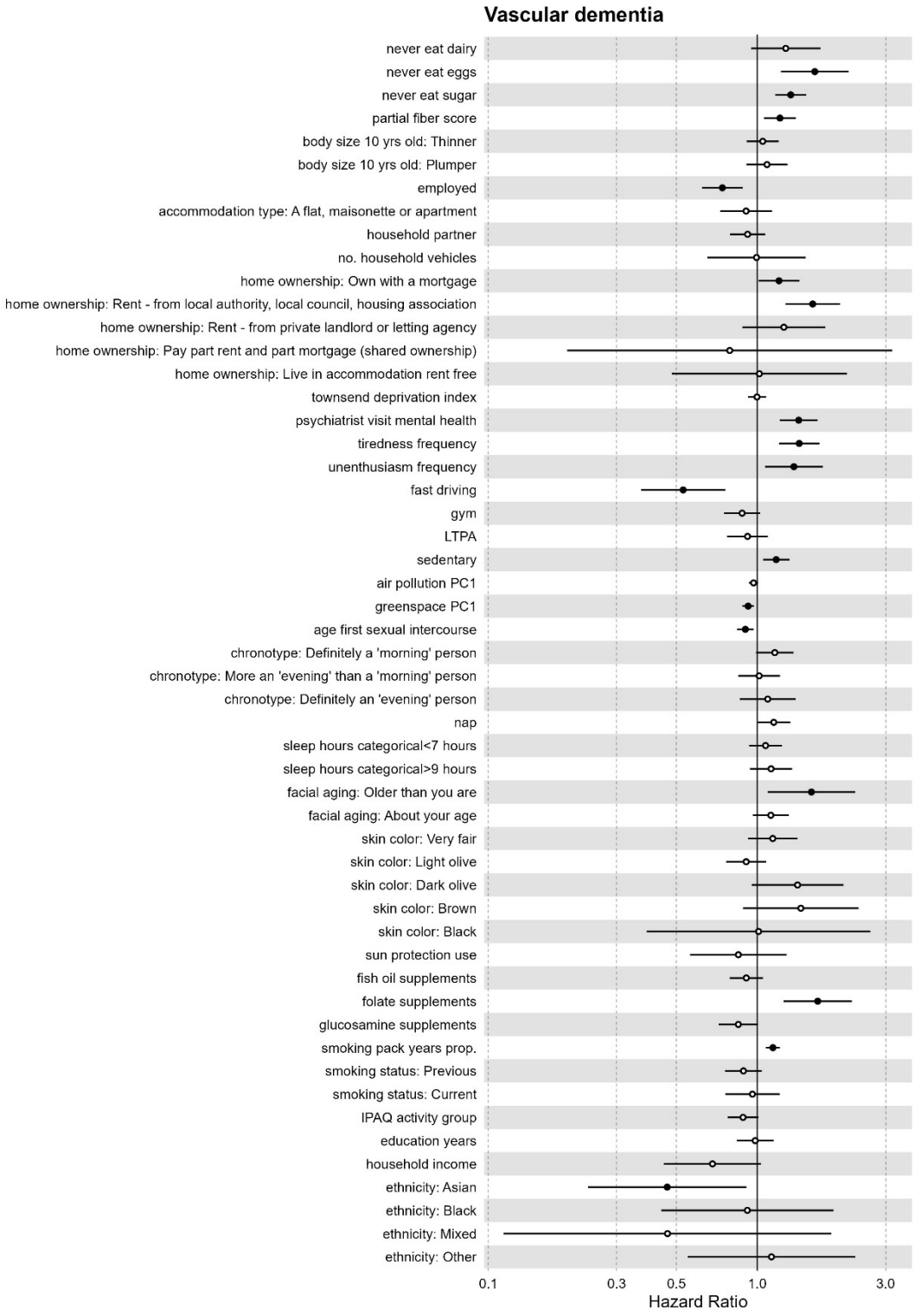


Figure S34. Effect estimates from the full exposome multivariable Cox model for vascular dementia in UK Biobank English participants (n = 436,891). Model also included covariates for age and sex.

8.2. Supplementary tables

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
country_birth	Country of birth (UK/elsewhere)	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=1647	Early life factors
breastfed	Breastfed as a baby	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=1677	Early life factors
body_size_10yrs_old	Comparative body size at age 10	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=1687	Early life factors
height_10yrs_old	Comparative height size at age 10	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=1697	Early life factors
handedness	Handedness (chirality/laterality)	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=1707	Early life factors
part_multiple_birth	Part of a multiple birth	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=1777	Early life factors
maternal_smoking	Maternal smoking around birth	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=1787	Early life factors
birth_weight	Birth weight	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=20022	Early life factors
relative_illness_injury_assault	Illness, injury, bereavement, stress in last 2 years	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6145	Stressful life events
death_relative	Illness, injury, bereavement, stress in last 2 years	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6145	Stressful life events
death_partner	Illness, injury, bereavement, stress in last 2 years	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6145	Stressful life events
divorce	Illness, injury, bereavement, stress in last 2 years	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6145	Stressful life events
financial_difficulty	Illness, injury, bereavement, stress in last 2 years	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6145	Stressful life events
family_visit_freq	Frequency of friend/family visits	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1031	Social support

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
gym	Leisure/social activities	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6160	Social support
pub	Leisure/social activities	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6160	Social support
religious_group	Leisure/social activities	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6160	Social support
adult_education	Leisure/social activities	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6160	Social support
confide_freq	Able to confide	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2110	Social support
loneliness	Loneliness, isolation	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2020	Social support
accommodation_type	Type of accommodation lived in	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=670	Household
own_or_rent	Own or rent accommodation lived in	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=680	Household
gas_hob_heat	Gas or solid-fuel cooking/heating	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6139	Household
gas_fire_heat	Gas or solid-fuel cooking/heating	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6139	Household
open_fire_heat	Gas or solid-fuel cooking/heating	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6139	Household
gas_central_heat	Heating type(s) in home	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6140	Household
electric_storage_heat	Heating type(s) in home	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6140	Household
oil_central_heat	Heating type(s) in home	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6140	Household
years_at_address	Length of time at current address	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=699	Household
hshld_number	Number in household	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=709	Household

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
hshld_partner	How are people in household related to participant	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6141	Household
hshld_children	How are people in household related to participant	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6141	Household
hshld_siblings	How are people in household related to participant	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6141	Household
hshld_parents	How are people in household related to participant	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6141	Household
hshld_grandchild	How are people in household related to participant	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6141	Household
hshld_vehicles	Number of vehicles in household	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=728	Household
hshld_income	Average total household income before tax	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=738	Household
education_years	Years of education (derived)		Education
employed	Current employment status	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6142	Employment
retired	Current employment status	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6142	Employment
home_maker	Current employment status	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6142	Employment
unemployed	Current employment status	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6142	Employment
volunteer	Current employment status	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6142	Employment
student	Current employment status	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6142	Employment

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
ethnicity	Ethnic background	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=21000	Other sociodemographics
private_healthcare	Private healthcare	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4674	Other sociodemographics
recruitment_centre	UK Biobank assessment centre	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=54	Other sociodemographics
multivitamin_supplements	Vitamin and mineral supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6155	Supplements
vitamin_A_supplements	Vitamin and mineral supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6155	Supplements
vitamin_B_supplements	Vitamin and mineral supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6155	Supplements
vitamin_C_supplements	Vitamin and mineral supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6155	Supplements
vitamin_D_supplements	Vitamin and mineral supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6155	Supplements
vitamin_E_supplements	Vitamin and mineral supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6155	Supplements
folate_supplements	Vitamin and mineral supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6155	Supplements
fish_oil_supplements	Mineral and other dietary supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6179	Supplements
calcium_supplements	Mineral and other dietary supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6179	Supplements
selenium_supplements	Mineral and other dietary supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6179	Supplements

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
glucosamine_supplements	Mineral and other dietary supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6179	Supplements
iron_supplements	Mineral and other dietary supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6179	Supplements
zinc_supplements	Mineral and other dietary supplements	https://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=6179	Supplements
neuroticism	Neuroticism score	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=20127	Mental health
mood_swings	Mood swings	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1920	Mental health
miserableness	Miserableness	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1930	Mental health
irritability	Irritability	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1940	Mental health
sensitivity	Sensitivity / hurt feelings	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1950	Mental health
fed_up_feelings	Fed-up feelings	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1960	Mental health
nervous	Nervous feelings	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1970	Mental health
worrier	Worrier / anxious feelings	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1980	Mental health
tense	Tense / 'highly strung'	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1990	Mental health
worry_embarassment	Worry too long after embarrassment	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2000	Mental health
nerves	Suffer from 'nerves'	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2010	Mental health
guilty_feelings	Guilty feelings	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2030	Mental health
risk_taking	Risk taking	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2040	Mental health

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
happiness	Happiness	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4526	Life satisfaction
job_satisfaction	Work/job satisfaction	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4537	Life satisfaction
health_satisfaction	Health satisfaction	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4548	Life satisfaction
family_satisfaction	Family relationship satisfaction	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4559	Life satisfaction
friends_satisfaction	Friendships satisfaction	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4570	Life satisfaction
financial_satisfaction	Financial situation satisfaction	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4581	Life satisfaction
depressed_mood_freq	Frequency of depressed mood in last 2 weeks	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2050	Mental health
unenthusiasm_freq	Frequency of unenthusiasm / disinterest in last 2 weeks	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2060	Mental health
tenseness_freq	Frequency of tenseness / restlessness in last 2 weeks	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2070	Mental health
tiredness_freq	Frequency of tiredness / lethargy in last 2 weeks	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2080	Mental health
doctor_visit_mental_health	Seen doctor (GP) for nerves, anxiety, tension or depression	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2090	Mental health
psychiatrist_visit_mental_health	Seen a psychiatrist for nerves, anxiety, tension or depression	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2100	Mental health
depressed_whole_week	Ever depressed for a whole week	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4598	Mental health

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
unenthusiastic_whole_week	Ever unenthusiastic/disinterested for a whole week	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4631	Mental health
manic	Ever manic/hyper for 2 days	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4642	Mental health
irritable	Ever highly irritable/argumentative for 2 days	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=4653	Mental health
mobile_phone_duration	Length of mobile phone use	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1110	Electronics use
mobile_phone_weekly_usage	Weekly usage of mobile phone in last 3 months	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1120	Electronics use
speakerphone	Hands-free device/speakerphone use with mobile phone in last 3 month	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1130	Electronics use
mobile_phone_2yrs	Difference in mobile phone use compared to two years previously	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1140	Electronics use
head_side_phone	Usual side of head for mobile phone use	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1150	Electronics use
computer_games	Plays computer games	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2237	Electronics use
sleep_hours_categorical	Sleep duration split according to <7, 7-9, and >9 hours of sleep (derived)		Sleep
easy_wake	Getting up in morning	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1170	Sleep
chronotype	Morning/evening person (chronotype)	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1180	Sleep

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
nap	Nap during day	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1190	Sleep
sleep_difficulty	Sleeplessness / insomnia	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1200	Sleep
snoring	Snoring	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1210	Sleep
ever_smoked	Ever smoked	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=20160	Smoking
pack_years_prop	Pack years adult smoking as proportion of life span exposed to smoking	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=20162	Smoking
pack_years	Pack years of smoking	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=20161	Smoking
smoking_status	Smoking status	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=20116	Smoking
tobacco	Current tobacco smoking	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1239	Smoking
oily_fish	Oily fish intake	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1329	Diet
non_oily_fish	Non-oily fish intake	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1339	Diet
processed_meat	Processed meat intake	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1349	Diet
poultry	Poultry intake	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1359	Diet
never_eat_sugar	Never eat eggs, dairy, wheat, sugar	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6144	Diet
never_eat_eggs	Never eat eggs, dairy, wheat, sugar	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6144	Diet
never_eat_wheat	Never eat eggs, dairy, wheat, sugar	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6144	Diet
never_eat_dairy	Never eat eggs, dairy, wheat, sugar	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6144	Diet

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
cheese	Cheese intake	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1408	Diet
bread	Bread intake	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1438	Diet
cereal	Cereal intake	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1458	Diet
salt	Salt added to food	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1478	Diet
tea	Tea intake	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1488	Diet
coffee	Coffee intake	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1498	Diet
water	Water intake	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1528	Diet
diet_change_5yrs	Major dietary changes in the last 5 years	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1538	Diet
diet_variation	Variation in diet	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1548	Diet
partial_fiber_score	Derived partial fiber score based on previous publication	https://doi.org/10.1017/jns.2017.66	Diet
total_fruit	Derived partial fiber score based on previous publication	https://doi.org/10.1093/ije/dyz064	Diet
total_veg	Derived partial fiber score based on previous publication	https://doi.org/10.1093/ije/dyz064	Diet
red_meat	Derived partial fiber score based on previous publication	https://doi.org/10.1093/ije/dyz064	Diet
dairy_milk	Derived partial fiber score based on previous publication	https://doi.org/10.1093/ije/dyz064	Diet

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
alcohol_daily_intake	Derived partial fiber score based on previous publication	https://doi.org/10.1093/ije/dyz064	Diet
summer_outdoors_time	Time spend outdoors in summer	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1050	Sun exposure
winter_outdoors_time	Time spent outdoors in winter	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1060	Sun exposure
skin_color	Skin colour	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1717	Sun exposure
skin_tan_ease	Ease of skin tanning	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1727	Sun exposure
childhood_sunburn_number	Childhood sunburn occasions	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1737	Sun exposure
hair_color	Hair colour (natural, before greying)	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1747	Sun exposure
facial_aging	Facial ageing	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1757	Sun exposure
sun_protection_use	Use of sun/uv protection	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2267	Sun exposure
solarium_freq	Frequency of solarium/sunlamp use	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2277	Sun exposure
sex_age_first	Age first had sexual intercourse	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2139	Sexual history
number_sex_partners	Lifetime number of sexual partners	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2149	Sexual history
same_sex_intercourse	Ever had same-sex intercourse	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=2159	Sexual history
IPAQ_activity_group	IPAQ activity group	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=22032	Physical activity
fast_driving	Drive faster than motorway speed limit	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1100	Physical activity

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
sedentary	Derived variable on total hours of sedentary behavior based on previous publication	https://doi.org/10.1186/s12916-019-1339-0	Physical activity
LTPA	Derived leisure time physical activity based on previous publication	https://doi.org/10.1186/s12966-020-00937-4	Physical activity
OPA	Derived occupational physical activity based on previous publication	https://doi.org/10.1186/s12966-020-00937-4	Physical activity
townsend_deprivation_index	Townsend deprivation index at recruitment	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=189	Material deprivation
close_to_major_road	Close to major road	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24014	Physical environment
inverse_distance_nearest_major_road	Inverse distance to the nearest major road	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24012	Physical environment
inverse_distance_nearest_road	Inverse distance to the nearest road	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24010	Physical environment
NO2_2005	Nitrogen dioxide air pollution; 2005	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24016	Physical environment
NO2_2006	Nitrogen dioxide air pollution; 2006	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24017	Physical environment
NO2_2007	Nitrogen dioxide air pollution; 2007	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24018	Physical environment

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
NO2_2010	Nitrogen dioxide air pollution; 2010	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24003	Physical environment
NO_2010	Nitrogen oxides air pollution; 2010	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24004	Physical environment
PM10_2007	Particulate matter air pollution (pm10); 2007	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24019	Physical environment
PM10_2010	Particulate matter air pollution (pm10); 2010	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24005	Physical environment
PM2.5_absorbance_2010	Particulate matter air pollution (pm2.5) absorbance; 2010	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24007	Physical environment
PM2.5_2010	Particulate matter air pollution (pm2.5); 2010	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24006	Physical environment
PM2.5_to_10_2010	Particulate matter air pollution 2.5-10um; 2010	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24008	Physical environment
road_length_sum_100m	Sum of road length of major roads within 100m	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24015	Physical environment
traffic_load_major_roads	Total traffic load on major roads	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24013	Physical environment
traffic_intensity_nearest_major_road	Traffic intensity on the nearest major road	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24011	Physical environment
traffic_intensity_nearest_road	Traffic intensity on the nearest road	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24009	Physical environment

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
sound_average_16hr	Average 16-hour sound level of noise pollution	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24023	Physical environment
sound_average_24hr	Average 24-hour sound level of noise pollution	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24024	Physical environment
daytime_sound_average	Average daytime sound level of noise pollution	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24020	Physical environment
evening_sound_average	Average evening sound level of noise pollution	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24021	Physical environment
night_sound_average	Average night-time sound level of noise pollution	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24022	Physical environment
natural_environment_buffer_1000m	Natural environment percentage, buffer 1000m	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24506	Physical environment
natural_environment_buffer_300m	Natural environment percentage, buffer 300m	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24507	Physical environment
greenspace_buffer_1000m	Greenspace percentage, buffer 1000m	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24500	Physical environment
greenspace_buffer_300m	Greenspace percentage, buffer 300m	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24503	Physical environment
domestic_garden_buffer_1000m	Domestic garden percentage, buffer 1000m	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24501	Physical environment
domestic_garden_buffer_300m	Domestic garden percentage, buffer 300m	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24504	Physical environment

Table S1. Table of all exposures used in thesis analyses

Variable	Description	URL	Category
water_buffer_1000m	Water percentage, buffer 1000m	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24502	Physical environment
water_buffer_300m	Water percentage, buffer 300m	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24505	Physical environment
distance_to_coast	Distance (Euclidean) to coast	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=24508	Physical environment
population_density	Derived urban/rural using home area population density variable (from field ID listed in this row)	http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=20118	Physical environment

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
alcohol_freqThree or four times a week	-0.1137	-0.2104	-0.0170	0.8925	0.8103	0.9831	0.0212	0.6627	0.0382	0.6682
bread	0.1144	0.0608	0.1680	1.1212	1.0627	1.1829	0.0000	0.0366	0.0001	0.0460
cereal	-0.2264	-0.2735	-0.1793	0.7974	0.7607	0.8358	0.0000	0.0000	0.0000	0.0000
cheese	-0.0823	-0.1449	-0.0196	0.9210	0.8651	0.9806	0.0103	0.0644	0.0198	0.0767
dairy_milk	-0.0923	-0.1575	-0.0271	0.9118	0.8543	0.9733	0.0055	0.1255	0.0116	0.1405
diet_variation	0.0930	0.0327	0.1532	1.0974	1.0333	1.1656	0.0025	0.0005	0.0055	0.0009
never_eat_dairyYes	0.3649	0.2345	0.4953	1.4404	1.2643	1.6409	0.0000	0.0648	0.0000	0.0767
never_eat_eggsYes	0.3315	0.2011	0.4620	1.3931	1.2227	1.5872	0.0000	0.0002	0.0000	0.0003
never_eat_sugarYes	0.1876	0.1298	0.2453	1.2063	1.1386	1.2780	0.0000	0.0000	0.0000	0.0000
never_eat_wheatYes	0.1955	0.0697	0.3212	1.2159	1.0722	1.3788	0.0023	0.0238	0.0051	0.0313
oily_fish	-0.2004	-0.2636	-0.1372	0.8184	0.7683	0.8718	0.0000	0.0000	0.0000	0.0000
partial_fiber_score	-0.3083	-0.3664	-0.2502	0.7347	0.6932	0.7786	0.0000	0.0000	0.0000	0.0000
poultry	-0.1357	-0.2003	-0.0710	0.8731	0.8185	0.9315	0.0000	0.0000	0.0001	0.0000
processed_meat	0.1373	0.0785	0.1961	1.1471	1.0816	1.2166	0.0000	0.0784	0.0000	0.0902
salt	0.1665	0.1030	0.2300	1.1812	1.1085	1.2586	0.0000	0.0000	0.0000	0.0000
tea	-0.0697	-0.1222	-0.0171	0.9327	0.8850	0.9830	0.0094	0.0185	0.0182	0.0245

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
total_fruit	-0.1762	-0.2253	-0.1271	0.8384	0.7983	0.8806	0.0000	0.0000	0.0000	0.0000
total_veg	-0.1658	-0.2218	-0.1097	0.8472	0.8011	0.8961	0.0000	0.0043	0.0000	0.0062
birth_weight	-0.0480	-0.0790	-0.0170	0.9531	0.9240	0.9832	0.0036	0.0007	0.0077	0.0010
body_size_10yrs_oldPlumper	0.2223	0.1557	0.2888	1.2489	1.1685	1.3348	0.0000	0.0000	0.0000	0.0000
breastfedYes	-0.0838	-0.1406	-0.0271	0.9196	0.8689	0.9733	0.0038	0.1654	0.0081	0.1818
height_10yrs_oldTaller	0.1001	0.0393	0.1609	1.1053	1.0401	1.1745	0.0013	0.0286	0.0030	0.0367
maternal_smokingYes	0.1667	0.1084	0.2250	1.1814	1.1145	1.2524	0.0000	0.0000	0.0000	0.0000
part_multiple_birthYes	0.1904	0.0383	0.3424	1.2097	1.0391	1.4084	0.0141	0.2034	0.0262	0.2158
computer_games	0.1747	0.1079	0.2416	1.1909	1.1140	1.2732	0.0000	0.0001	0.0000	0.0001
mobile_phone_2yrsYes, use is now less frequent	0.1797	0.0240	0.3353	1.1968	1.0243	1.3984	0.0273	0.0665	0.0481	0.0780
mobile_phone_duration	-0.1804	-0.2378	-0.1230	0.8350	0.7884	0.8843	0.0000	0.0000	0.0000	0.0000
employedYes	-0.3923	-0.4586	-0.3261	0.6755	0.6322	0.7217	0.0000	0.0000	0.0000	0.0000
unemployedYes	0.3530	0.1000	0.6060	1.4233	1.1052	1.8330	0.0062	0.0027	0.0128	0.0040

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
bilateral_oophorectomyYes	0.1360	0.0577	0.2143	1.1456	1.0593	1.2390	0.0007	0.0022	0.0017	0.0033
cervical_smearYes	-0.4020	-0.5297	-0.2742	0.6690	0.5888	0.7601	0.0000	0.0000	0.0000	0.0000
mammogramYes	-0.1772	-0.3100	-0.0445	0.8376	0.7334	0.9565	0.0089	0.6010	0.0174	0.6111
menarche_age	-0.0470	-0.0721	-0.0219	0.9541	0.9304	0.9783	0.0002	0.1625	0.0006	0.1802
menopauseYes	0.3500	0.1796	0.5204	1.4191	1.1967	1.6827	0.0001	0.0071	0.0004	0.0099
number_births	-0.0673	-0.0929	-0.0416	0.9349	0.9113	0.9592	0.0000	0.0000	0.0000	0.0000
oral_contraceptiveYes	-0.1092	-0.1667	-0.0516	0.8966	0.8464	0.9497	0.0002	0.0009	0.0005	0.0014
accommodation_typeA flat, maisonette or apartment	0.4676	0.3833	0.5518	1.5961	1.4671	1.7364	0.0000	0.0000	0.0000	0.0000
hshld_childrenYes	-0.1254	-0.1982	-0.0526	0.8822	0.8202	0.9488	0.0008	0.3622	0.0019	0.3745
hshld_income	-0.8314	-0.9315	-0.7314	0.4354	0.3940	0.4813	0.0000	0.0000	0.0000	0.0000
hshld_number	-0.1412	-0.1806	-0.1017	0.8684	0.8348	0.9033	0.0000	0.0000	0.0000	0.0000
hshld_parentsYes	0.3466	0.1501	0.5430	1.4142	1.1620	1.7212	0.0005	0.3342	0.0014	0.3485
hshld_partnerYes	-0.3651	-0.4163	-0.3138	0.6941	0.6595	0.7306	0.0000	0.0000	0.0000	0.0000
hshld_siblingsYes	0.6481	0.3663	0.9299	1.9118	1.4423	2.5342	0.0000	0.0326	0.0000	0.0414
hshld_vehicles	-0.8358	-0.9425	-0.7290	0.4335	0.3897	0.4824	0.0000	0.0000	0.0000	0.0000

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
oil_central_heatYes	-0.4729	-0.7495	-0.1962	0.6232	0.4726	0.8218	0.0011	0.0497	0.0025	0.0612
open_fire_heatYes	-0.2831	-0.3867	-0.1795	0.7534	0.6793	0.8357	0.0000	0.0021	0.0000	0.0031
own_or_rentOwn with a mortgage	0.0939	0.0249	0.1628	1.0984	1.0253	1.1768	0.0076	0.1808	0.0151	0.1935
own_or_rentRent - from local authority, local council, housing association	0.8267	0.7432	0.9102	2.2857	2.1027	2.4847	0.0000	0.0000	0.0000	0.0000
own_or_rentRent - from private landlord or letting agency	0.3771	0.2086	0.5456	1.4580	1.2319	1.7257	0.0000	0.0000	0.0000	0.0000
years_at_address	-0.0301	-0.0539	-0.0063	0.9704	0.9476	0.9937	0.0131	0.0568	0.0246	0.0693
family_satisfaction	-0.4181	-0.7443	-0.0918	0.6583	0.4751	0.9123	0.0198	0.0769	0.0361	0.0894
health_satisfaction	-1.7155	-2.6432	-0.7879	0.1799	0.0711	0.4548	0.0064	0.0495	0.0130	0.0612
townsend_deprivation_index	0.2212	0.1956	0.2468	1.2476	1.2161	1.2800	0.0000	0.0000	0.0000	0.0000
depressed_mood_freq	0.5129	0.4318	0.5939	1.6701	1.5400	1.8111	0.0000	0.0000	0.0000	0.0000
doctor_visit_mental_healthYes	0.1825	0.1325	0.2324	1.2002	1.1417	1.2617	0.0000	0.0000	0.0000	0.0000

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
fed_up_feelingsYes	0.2648	0.2141	0.3156	1.3032	1.2387	1.3710	0.0000	0.0000	0.0000	0.0000
miserablenessYes	0.1464	0.0963	0.1964	1.1576	1.1011	1.2171	0.0000	0.0027	0.0000	0.0040
mood_swingsYes	0.1856	0.1338	0.2375	1.2040	1.1432	1.2680	0.0000	0.0000	0.0000	0.0000
nervesYes	0.1438	0.0835	0.2040	1.1546	1.0871	1.2263	0.0000	0.0000	0.0000	0.0000
nervousYes	0.0816	0.0238	0.1395	1.0851	1.0240	1.1497	0.0058	0.0099	0.0121	0.0134
neuroticism	0.0800	0.0550	0.1051	1.0833	1.0565	1.1108	0.0000	0.0000	0.0000	0.0000
psychiatrist_visit_mental_healthYes	0.3459	0.2785	0.4132	1.4132	1.3212	1.5117	0.0000	0.0000	0.0000	0.0000
risk_takingYes	0.1435	0.0789	0.2080	1.1543	1.0821	1.2313	0.0000	0.0018	0.0000	0.0028
tenseYes	0.1044	0.0435	0.1653	1.1100	1.0445	1.1797	0.0008	0.0000	0.0019	0.0000
tenseness_freq	0.4483	0.3547	0.5419	1.5657	1.4258	1.7193	0.0000	0.0000	0.0000	0.0000
tiredness_freq	0.5840	0.5164	0.6517	1.7933	1.6759	1.9188	0.0000	0.0000	0.0000	0.0000
unenthusiasm_freq	0.5696	0.4889	0.6504	1.7676	1.6305	1.9163	0.0000	0.0000	0.0000	0.0000
worry_embarassmentYes	-0.0810	-0.1313	-0.0307	0.9222	0.8769	0.9698	0.0016	0.0007	0.0037	0.0011
fast_driving	-0.5598	-0.6728	-0.4467	0.5713	0.5103	0.6397	0.0000	0.0000	0.0000	0.0000
gymYes	-0.3406	-0.4008	-0.2805	0.7113	0.6698	0.7554	0.0000	0.0000	0.0000	0.0000
IPAQ_activity_group	-0.3336	-0.3866	-0.2806	0.7163	0.6793	0.7553	0.0000	0.0000	0.0000	0.0000

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
LTPA	-0.3700	-0.4540	-0.2860	0.6908	0.6351	0.7513	0.0000	0.0000	0.0000	0.0000
OPA	-0.2097	-0.2718	-0.1476	0.8109	0.7620	0.8628	0.0000	0.0002	0.0000	0.0004
sedentary	0.2487	0.2001	0.2973	1.2824	1.2215	1.3462	0.0000	0.0000	0.0000	0.0000
domestic_garden_buffer_300m	-0.0332	-0.0590	-0.0073	0.9674	0.9427	0.9927	0.0120	0.3845	0.0227	0.3942
greenspace_buffer_1000m	-0.0881	-0.1168	-0.0594	0.9156	0.8897	0.9423	0.0000	0.0000	0.0000	0.0000
greenspace_buffer_300m	-0.0708	-0.0979	-0.0437	0.9317	0.9067	0.9573	0.0000	0.0000	0.0000	0.0000
natural_environment_buffer_1000m	-0.1031	-0.1319	-0.0743	0.9021	0.8764	0.9284	0.0000	0.0000	0.0000	0.0000
natural_environment_buffer_300m	-0.0752	-0.1024	-0.0479	0.9276	0.9027	0.9532	0.0000	0.0000	0.0000	0.0000
NO_2010	0.1019	0.0770	0.1267	1.1073	1.0801	1.1351	0.0000	0.0000	0.0000	0.0000
NO2_2005	0.1572	0.1206	0.1939	1.1703	1.1282	1.2139	0.0000	0.0000	0.0000	0.0000
NO2_2006	0.1510	0.1160	0.1860	1.1630	1.1230	1.2045	0.0000	0.0000	0.0000	0.0000
NO2_2007	0.1600	0.1216	0.1984	1.1735	1.1293	1.2195	0.0000	0.0000	0.0000	0.0000
NO2_2010	0.1277	0.0994	0.1561	1.1363	1.1045	1.1690	0.0000	0.0000	0.0000	0.0000
PM10_2007	0.1832	0.1446	0.2218	1.2010	1.1555	1.2483	0.0000	0.0000	0.0000	0.0000
PM10_2010	0.0360	0.0107	0.0613	1.0366	1.0108	1.0632	0.0053	0.0085	0.0112	0.0117

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
PM2.5_2010	0.1128	0.0864	0.1392	1.1194	1.0903	1.1494	0.0000	0.0000	0.0000	0.0000
PM2.5_absorbance_2010	0.0570	0.0283	0.0856	1.0586	1.0288	1.0893	0.0001	0.0000	0.0003	0.0000
population_densityRural	-0.2193	-0.2970	-0.1417	0.8030	0.7430	0.8679	0.0000	0.0261	0.0000	0.0338
traffic_load_major_roads	0.0306	0.0067	0.0545	1.0311	1.0067	1.0560	0.0120	0.9250	0.0227	0.9250
number_sex_partners	0.0578	0.0354	0.0802	1.0595	1.0360	1.0835	0.0000	0.0000	0.0000	0.0000
same_sex_intercourseYes	0.3162	0.1430	0.4893	1.3719	1.1538	1.6312	0.0003	0.0085	0.0009	0.0117
sex_age_first	-0.0360	-0.0653	-0.0066	0.9647	0.9368	0.9934	0.0166	0.0831	0.0304	0.0947
chronotypeMore an 'evening' than a 'morning' person	0.1376	0.0684	0.2067	1.1475	1.0708	1.2297	0.0001	0.0000	0.0004	0.0000
chronotypeDefinitely an 'evening' person	0.4065	0.3148	0.4981	1.5015	1.3700	1.6455	0.0000	0.0000	0.0000	0.0000
easy_wake	-0.3237	-0.3936	-0.2539	0.7234	0.6746	0.7758	0.0000	0.0000	0.0000	0.0000
nap	0.3995	0.3415	0.4575	1.4911	1.4071	1.5801	0.0000	0.0000	0.0000	0.0000
sleep_difficulty	0.0808	0.0291	0.1325	1.0842	1.0296	1.1417	0.0022	0.0001	0.0049	0.0002

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
sleep_hours_categorical<7 hours	0.1184	0.0606	0.1762	1.1257	1.0625	1.1926	0.0001	0.0000	0.0002	0.0000
sleep_hours_categorical>9 hours	0.3533	0.2733	0.4333	1.4238	1.3143	1.5424	0.0000	0.0000	0.0000	0.0000
ever_smokedYes	0.3125	0.2610	0.3641	1.3669	1.2982	1.4392	0.0000	0.0000	0.0000	0.0000
pack_years	0.2840	0.2683	0.2997	1.3285	1.3078	1.3495	0.0000	0.0000	0.0000	0.0000
pack_years_prop	0.3084	0.2920	0.3249	1.3613	1.3391	1.3838	0.0000	0.0000	0.0000	0.0000
smoking_statusPrevious	0.2485	0.1936	0.3034	1.2821	1.2136	1.3545	0.0000	0.0000	0.0000	0.0000
smoking_statusCurrent	1.0349	0.9627	1.1070	2.8148	2.6188	3.0254	0.0000	0.0000	0.0000	0.0000
tobacco	0.7258	0.6747	0.7770	2.0665	1.9634	2.1750	0.0000	0.0000	0.0000	0.0000
confide_freq	-0.1661	-0.2223	-0.1098	0.8470	0.8007	0.8960	0.0000	0.0000	0.0000	0.0000
lonelinessYes	0.2904	0.2324	0.3484	1.3369	1.2616	1.4168	0.0000	0.0000	0.0000	0.0000
religious_groupYes	-0.1010	-0.1649	-0.0371	0.9039	0.8480	0.9636	0.0020	0.0114	0.0045	0.0152
financial_difficultyYes	0.3134	0.2322	0.3946	1.3680	1.2614	1.4837	0.0000	0.0000	0.0000	0.0000
relative_illness_injury_assaultYes	-0.0884	-0.1669	-0.0100	0.9154	0.8463	0.9901	0.0271	0.1685	0.0481	0.1836

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
childhood_sunburn_number	0.0134	0.0017	0.0250	1.0134	1.0017	1.0253	0.0242	0.0619	0.0434	0.0748
facial_agingOlder than you are	0.6338	0.2681	0.9994	1.8847	1.3075	2.7168	0.0027	0.0000	0.0059	0.0000
facial_agingAbout your age	0.1902	0.1261	0.2544	1.2095	1.1344	1.2896	0.0000	0.0000	0.0000	0.0000
hair_colorBlack	0.2415	0.1000	0.3830	1.2732	1.1052	1.4667	0.0008	0.0049	0.0020	0.0069
skin_colorVery fair	0.1149	0.0288	0.2010	1.1218	1.0293	1.2226	0.0089	0.1030	0.0174	0.1163
skin_colorLight olive	-0.0921	-0.1589	-0.0254	0.9120	0.8530	0.9750	0.0069	0.1716	0.0138	0.1853
sun_protection_use	-0.3770	-0.4641	-0.2899	0.6859	0.6287	0.7484	0.0000	0.0000	0.0000	0.0000
fish_oil_supplementsYes	-0.1720	-0.2247	-0.1192	0.8420	0.7987	0.8876	0.0000	0.0000	0.0000	0.0000
folate_supplementsYes	0.3214	0.1922	0.4507	1.3791	1.2119	1.5694	0.0000	0.0000	0.0000	0.0000
glucosamine_supplementsYes	-0.2422	-0.3031	-0.1813	0.7849	0.7385	0.8342	0.0000	0.0000	0.0000	0.0000
vitamin_B_supplementsYes	0.1637	0.0590	0.2684	1.1779	1.0608	1.3079	0.0022	0.2654	0.0049	0.2792
alcohol_freqOnce or twice a week	0.0192	-0.0698	0.1082	1.0194	0.9326	1.1142	0.6724	0.9809	0.7301	

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
head_side_phoneLeft	0.0291	-0.1351	0.1933	1.0295	0.8736	1.2133	0.6771	0.0332	0.7315	
alcohol_freqDaily or almost daily	0.0828	-0.0130	0.1786	1.0863	0.9871	1.1955	0.0903	0.0348	0.1377	
night_sound_average	0.0059	-0.0190	0.0308	1.0060	0.9812	1.0313	0.6398	0.5976	0.7081	
mobile_phone_2yrsYes, use is now more frequent	-0.0277	-0.1688	0.1135	0.9727	0.8447	1.1202	0.6557	0.1175	0.7156	
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.1987	0.0168	0.3806	1.2198	1.0169	1.4632	0.0324	0.5807	0.0557	
coffee	0.0282	-0.0214	0.0779	1.0286	0.9788	1.0810	0.2647	0.9902	0.3491	
mobile_phone_weekly_usage	0.0977	-0.0849	0.2804	1.1026	0.9186	1.3236	0.2584	0.0393	0.3429	
diet_change_5yrsYes, because of other reasons	-0.0392	-0.0979	0.0195	0.9616	0.9067	1.0197	0.1908	0.0278	0.2663	
friends_satisfaction	-0.4586	-0.9222	0.0049	0.6322	0.3977	1.0049	0.0519	0.0947	0.0838	
home_makerYes	-0.0740	-0.1787	0.0307	0.9287	0.8363	1.0312	0.1660	0.0024	0.2364	
retiredYes	0.0625	-0.0090	0.1341	1.0645	0.9911	1.1435	0.0865	0.3128	0.1329	

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
studentYes	0.0009	-0.3076	0.3094	1.0009	0.7352	1.3627	0.9952	0.4201	0.9952	
inverse_distance_nearest_road	0.0186	-0.0045	0.0418	1.0188	0.9955	1.0427	0.1147	0.2185	0.1692	
non_oily_fish	-0.0736	-0.1471	-0.0002	0.9290	0.8632	0.9998	0.0495	0.2565	0.0806	
depressed_whole_weekYes	0.0086	-0.1666	0.1838	1.0087	0.8466	1.2018	0.9055	0.0000	0.9226	
country_birthWales	-0.0601	-0.2505	0.1304	0.9417	0.7784	1.1392	0.5363	0.3488	0.6199	
HRTYes	-0.0007	-0.0526	0.0512	0.9993	0.9488	1.0525	0.9786	0.0044	0.9832	
hysterectomyYes	0.0730	-0.0047	0.1507	1.0757	0.9953	1.1626	0.0657	0.0188	0.1038	
red_meat	-0.0046	-0.0643	0.0551	0.9954	0.9377	1.0567	0.8802	0.2051	0.9099	
irritableYes	0.1966	-0.2164	0.6097	1.2173	0.8054	1.8399	0.2663	0.1546	0.3492	
manicYes	0.1269	-0.1420	0.3959	1.1353	0.8676	1.4857	0.3260	0.1535	0.4197	
divorceYes	-0.1525	-0.3421	0.0371	0.8586	0.7103	1.0378	0.1149	0.5936	0.1692	
height_10yrs_oldShorter	0.0342	-0.0305	0.0988	1.0348	0.9700	1.1038	0.3000	0.8090	0.3908	
water	-0.0180	-0.0704	0.0343	0.9821	0.9320	1.0349	0.4990	0.0014	0.5964	
solarium_freq	-0.0104	-0.0457	0.0248	0.9896	0.9554	1.0251	0.5625	0.5962	0.6433	

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
body_size_10yrs_oldThinner	0.0486	-0.0091	0.1062	1.0498	0.9910	1.1120	0.0987	0.0885	0.1483	
electric_storage_heatYes	0.0797	-0.1585	0.3180	1.0830	0.8534	1.3744	0.5076	0.1324	0.6030	
gas_central_heatYes	-0.0268	-0.1136	0.0600	0.9736	0.8926	1.0618	0.5245	0.5893	0.6155	
head_side_phoneEqually left and right	0.0049	-0.1254	0.1353	1.0049	0.8821	1.1448	0.9409	0.6862	0.9497	
country_birthScotland	0.1057	-0.0449	0.2564	1.1115	0.9561	1.2922	0.1688	0.7727	0.2387	
country_birthNorthern Ireland	0.1766	-0.1079	0.4611	1.1931	0.8977	1.5858	0.2237	0.0345	0.3044	
country_birthRepublic of Ireland	0.2057	0.0077	0.4037	1.2284	1.0077	1.4973	0.0418	0.3083	0.0691	
country_birthElsewhere	-0.0192	-0.1446	0.1063	0.9810	0.8653	1.1121	0.7644	0.3502	0.8136	
handednessLeft-handed	0.0272	-0.0617	0.1161	1.0276	0.9401	1.1231	0.5490	0.9234	0.6312	
handednessUse both right and left hands equally	0.1528	-0.0422	0.3478	1.1651	0.9587	1.4160	0.1245	0.1089	0.1809	
evening_sound_average	0.0058	-0.0191	0.0307	1.0059	0.9811	1.0312	0.6455	0.5959	0.7081	

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
private_healthcare	-0.2113	-0.4538	0.0312	0.8095	0.6352	1.0317	0.0801	0.3958	0.1239	
vitamin_C_supplementsYes	0.0896	0.0065	0.1726	1.0937	1.0066	1.1884	0.0345	0.2075	0.0583	
chronotypeDefinitely a 'morning' person	0.0538	-0.0178	0.1253	1.0553	0.9824	1.1335	0.1390	0.1547	0.2006	
vitamin_E_supplementsYes	-0.0483	-0.1810	0.0845	0.9529	0.8344	1.0882	0.4762	0.1726	0.5752	
winter_outdoors_time	-0.0160	-0.0421	0.0101	0.9842	0.9588	1.0102	0.2295	0.4625	0.3085	
road_length_sum_100m	0.0162	-0.0084	0.0407	1.0163	0.9916	1.0416	0.1970	0.4356	0.2698	
family_visit_freq	-0.1369	-0.2594	-0.0143	0.8721	0.7715	0.9858	0.0286	0.0000	0.0500	
own_or_rentPay part rent and part mortgage (shared ownership)	0.4128	-0.0070	0.8326	1.5110	0.9930	2.2993	0.0539	0.0159	0.0866	
own_or_rentLive in accommodation rent free	0.1988	-0.1255	0.5230	1.2199	0.8820	1.6872	0.2296	0.0890	0.3085	
distance_to_coast	-0.0210	-0.1025	0.0605	0.9792	0.9026	1.0624	0.6137	0.7395	0.6944	

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
domestic_garden_buffer_1000m	-0.0195	-0.0469	0.0078	0.9806	0.9542	1.0078	0.1609	0.1479	0.2306	
speakerphone	0.1349	-0.0227	0.2925	1.1444	0.9776	1.3398	0.0919	0.8456	0.1391	
worrierYes	-0.0203	-0.0723	0.0317	0.9799	0.9302	1.0322	0.4439	0.5425	0.5484	
happiness	-0.5187	-1.1965	0.1590	0.5953	0.3023	1.1723	0.1070	0.1563	0.1598	
stillbirthYes	0.0202	-0.0338	0.0741	1.0204	0.9668	1.0770	0.4638	0.0407	0.5665	
job_satisfaction	-0.1388	-0.6049	0.3273	0.8704	0.5462	1.3873	0.4993	0.1875	0.5964	
accommodation_typeMobile or temporary structure (i.e. caravan)	0.1886	-0.4040	0.7812	1.2076	0.6677	2.1841	0.5327	0.7516	0.6191	
volunteerYes	0.0099	-0.1014	0.1213	1.0100	0.9035	1.1289	0.8614	0.0984	0.8947	
adult_educationYes	-0.0359	-0.1206	0.0489	0.9648	0.8864	1.0501	0.4068	0.0002	0.5055	
gas_fire_heatYes	-0.0260	-0.0777	0.0256	0.9743	0.9253	1.0260	0.3234	0.0066	0.4189	
gas_hob_heatYes	-0.0545	-0.1076	-0.0014	0.9470	0.8980	0.9986	0.0443	0.2474	0.0727	
guilty_feelingsYes	-0.0195	-0.0723	0.0332	0.9806	0.9302	1.0338	0.4680	0.5057	0.5684	
irritabilityYes	0.0661	0.0054	0.1268	1.0683	1.0054	1.1352	0.0328	0.0014	0.0560	
death_partnerYes	0.0974	-0.0500	0.2448	1.1023	0.9513	1.2774	0.1951	0.0063	0.2688	

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
death_relativeYes	-0.0298	-0.0905	0.0309	0.9706	0.9135	1.0314	0.3360	0.3868	0.4278	
financial_satisfaction	-0.6105	-1.3293	0.1082	0.5431	0.2647	1.1143	0.0798	0.0751	0.1239	
skin_colorBlack	0.0279	-0.4202	0.4760	1.0283	0.6569	1.6095	0.9029	0.0322	0.9226	
skin_tan_ease	-0.0664	-0.1279	-0.0048	0.9358	0.8799	0.9952	0.0347	0.0155	0.0583	
calcium_supplementsYes	0.0342	-0.0398	0.1082	1.0348	0.9610	1.1142	0.3649	0.8936	0.4588	
summer_outdoors_time	-0.0210	-0.0473	0.0053	0.9792	0.9538	1.0053	0.1170	0.9634	0.1712	
PM2.5_to_10_2010	0.0080	-0.0168	0.0329	1.0081	0.9833	1.0334	0.5267	0.9447	0.6155	
hshld_grandchildYes	0.1914	-0.0088	0.3916	1.2109	0.9912	1.4794	0.0610	0.0685	0.0972	
iron_supplementsYes	0.1388	0.0062	0.2714	1.1489	1.0062	1.3118	0.0403	0.0000	0.0671	
sensitivityYes	0.0032	-0.0488	0.0553	1.0032	0.9524	1.0568	0.9033	0.8231	0.9226	
traffic_intensity_nearest_major_road	0.0091	-0.0153	0.0335	1.0092	0.9849	1.0341	0.4636	0.7229	0.5665	
vitamin_A_supplementsYes	-0.0296	-0.1959	0.1367	0.9708	0.8221	1.1465	0.7271	0.9929	0.7777	
skin_colorBrown	0.0373	-0.2305	0.3051	1.0380	0.7942	1.3568	0.7847	0.0277	0.8270	

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
unenthusiastic_whole_weekYes	0.1919	0.0266	0.3572	1.2116	1.0270	1.4293	0.0295	0.0657	0.0512	
water_buffer_1000m	0.0037	-0.0212	0.0286	1.0037	0.9790	1.0290	0.7726	0.3526	0.8182	
vitamin_D_supplementsYes	-0.0715	-0.1786	0.0355	0.9310	0.8365	1.0362	0.1903	0.2001	0.2663	
daytime_sound_average	0.0059	-0.0190	0.0308	1.0059	0.9812	1.0313	0.6429	0.5992	0.7081	
hair_colorBlonde	0.0035	-0.0769	0.0838	1.0035	0.9260	1.0874	0.9328	0.3559	0.9460	
inverse_distance_nearest_major_road	0.0102	-0.0139	0.0343	1.0103	0.9862	1.0349	0.4058	0.4267	0.5055	
close_to_major_roadYes	0.0097	-0.0870	0.1063	1.0097	0.9167	1.1122	0.8444	0.9528	0.8813	
water_buffer_300m	0.0026	-0.0215	0.0268	1.0026	0.9787	1.0272	0.8303	0.8457	0.8708	
traffic_intensity_nearest_road	-0.0071	-0.0325	0.0183	0.9929	0.9681	1.0185	0.5838	0.8124	0.6641	
snoringYes	0.0132	-0.0569	0.0833	1.0133	0.9447	1.0869	0.7045	0.5120	0.7573	
multivitamin_supplementsYes	-0.0548	-0.1134	0.0037	0.9466	0.8928	1.0037	0.0663	0.0172	0.1040	
sound_average_24hr	0.0059	-0.0190	0.0308	1.0059	0.9812	1.0312	0.6435	0.5950	0.7081	

Table S2. Female XWAS output (n=237,634)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
pubYes	-0.0316	-0.0961	0.0328	0.9689	0.9084	1.0334	0.3363	0.1055	0.4278	
zinc_supplementsYes	-0.0699	-0.1902	0.0504	0.9325	0.8268	1.0516	0.2544	0.0670	0.3398	
hair_colorRed	-0.0570	-0.1773	0.0633	0.9446	0.8375	1.0653	0.3528	0.1887	0.4462	
selenium_supplementsYes	0.0471	-0.0965	0.1908	1.0483	0.9080	1.2102	0.5199	0.5274	0.6142	
hair_colorDark brown	-0.0374	-0.0938	0.0189	0.9633	0.9105	1.0191	0.1930	0.3483	0.2677	
sound_average_16hr	0.0059	-0.0190	0.0308	1.0059	0.9812	1.0313	0.6410	0.5969	0.7081	
skin_colorDark olive	0.0499	-0.1606	0.2603	1.0511	0.8517	1.2973	0.6422	0.1339	0.7081	

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
alcohol_freqThree or four times a week	-0.1391	-0.2225	-0.0558	0.8701	0.8005	0.9458	0.0011	0.0460	0.0020	0.0503
cereal	-0.2209	-0.2597	-0.1821	0.8018	0.7713	0.8335	0.0000	0.0000	0.0000	0.0000
dairy_milk	-0.1412	-0.1984	-0.0839	0.8683	0.8200	0.9195	0.0000	0.0000	0.0000	0.0000
diet_variation	0.1589	0.1112	0.2066	1.1722	1.1177	1.2295	0.0000	0.0000	0.0000	0.0000
never_eat_dairyYes	0.3720	0.2618	0.4823	1.4506	1.2992	1.6197	0.0000	0.0000	0.0000	0.0000
never_eat_eggsYes	0.2521	0.1443	0.3599	1.2867	1.1552	1.4331	0.0000	0.0000	0.0000	0.0000
never_eat_sugarYes	0.1439	0.0960	0.1917	1.1547	1.1008	1.2113	0.0000	0.0000	0.0000	0.0000
never_eat_wheatYes	0.3766	0.2671	0.4862	1.4574	1.3061	1.6262	0.0000	0.0000	0.0000	0.0000
partial_fiber_score	-0.1889	-0.2355	-0.1422	0.8279	0.7902	0.8674	0.0000	0.0000	0.0000	0.0000
poultry	-0.1486	-0.2053	-0.0920	0.8619	0.8144	0.9121	0.0000	0.0000	0.0000	0.0000
processed_meat	0.1971	0.1447	0.2495	1.2179	1.1557	1.2834	0.0000	0.0000	0.0000	0.0000
red_meat	0.1421	0.0912	0.1929	1.1527	1.0955	1.2128	0.0000	0.0000	0.0000	0.0000
salt	0.2173	0.1677	0.2668	1.2427	1.1826	1.3058	0.0000	0.0000	0.0000	0.0000

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
tea	-0.0513	-0.0952	-0.0074	0.9500	0.9092	0.9926	0.0219	0.1901	0.0361	0.1955
total_fruit	-0.0882	-0.1291	-0.0474	0.9155	0.8789	0.9538	0.0000	0.0000	0.0001	0.0000
total_veg	-0.0706	-0.1160	-0.0252	0.9318	0.8905	0.9751	0.0023	0.0003	0.0043	0.0005
water	0.0797	0.0384	0.1211	1.0830	1.0391	1.1287	0.0002	0.0001	0.0003	0.0001
birth_weight	-0.0360	-0.0615	-0.0105	0.9646	0.9403	0.9895	0.0069	0.0473	0.0121	0.0513
body_size_10yrs_oldPlumper	0.1593	0.0977	0.2209	1.1727	1.1026	1.2472	0.0000	0.0000	0.0000	0.0000
height_10yrs_old Taller	0.1197	0.0709	0.1686	1.1272	1.0734	1.1837	0.0000	0.0348	0.0000	0.0390
maternal_smokingYes	0.1143	0.0678	0.1607	1.1210	1.0701	1.1744	0.0000	0.0003	0.0000	0.0005
computer_games	0.1141	0.0563	0.1718	1.1208	1.0579	1.1875	0.0001	0.0000	0.0002	0.0001
mobile_phone_duration	-0.1353	-0.1796	-0.0910	0.8735	0.8356	0.9130	0.0000	0.0000	0.0000	0.0000
speakerphone	-0.1453	-0.2495	-0.0410	0.8648	0.7792	0.9598	0.0075	0.0323	0.0130	0.0365
employedYes	-0.5157	-0.5680	-0.4633	0.5971	0.5667	0.6292	0.0000	0.0000	0.0000	0.0000
unemployedYes	0.5561	0.4358	0.6764	1.7438	1.5462	1.9668	0.0000	0.0000	0.0000	0.0000

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
accommodation_typeA flat, maisonette or apartment	0.6102	0.5457	0.6747	1.8408	1.7258	1.9635	0.0000	0.0000	0.0000	0.0000
gas_hob_heatYes	-0.0980	-0.1420	-0.0540	0.9066	0.8677	0.9474	0.0000	0.0008	0.0000	0.0009
hshld_childrenYes	-0.2412	-0.2981	-0.1842	0.7857	0.7422	0.8318	0.0000	0.3469	0.0000	0.3523
hshld_income	-0.8188	-0.8963	-0.7412	0.4410	0.4081	0.4765	0.0000	0.0000	0.0000	0.0000
hshld_number	-0.2160	-0.2492	-0.1828	0.8057	0.7794	0.8329	0.0000	0.0000	0.0000	0.0000
hshld_parentsYes	0.4179	0.2708	0.5651	1.5188	1.3110	1.7596	0.0000	0.0000	0.0000	0.0000
hshld_partnerYes	-0.5334	-0.5779	-0.4888	0.5866	0.5611	0.6133	0.0000	0.0000	0.0000	0.0000
hshld_siblingsYes	0.5335	0.3261	0.7408	1.7048	1.3856	2.0977	0.0000	0.0002	0.0000	0.0003
hshld_vehicles	-0.9927	-1.0804	-0.9050	0.3706	0.3395	0.4045	0.0000	0.0000	0.0000	0.0000
open_fire_heatYes	-0.1818	-0.2683	-0.0954	0.8337	0.7647	0.9090	0.0000	0.0001	0.0001	0.0002
own_or_rentRent - from local authority, local council, housing association	0.8639	0.7963	0.9316	2.3725	2.2173	2.5385	0.0000	0.0000	0.0000	0.0000

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
own_or_rentRent - from private landlord or letting agency	0.6958	0.5913	0.8003	2.0053	1.8062	2.2263	0.0000	0.0000	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.6759	0.3379	1.0140	1.9659	1.4020	2.7566	0.0001	0.0438	0.0002	0.0482
own_or_rentLive in accommodation rent free	0.2950	0.0619	0.5281	1.3431	1.0638	1.6957	0.0131	0.0001	0.0220	0.0001
years_at_address	-0.0273	-0.0474	-0.0071	0.9731	0.9537	0.9929	0.0081	0.0213	0.0139	0.0245
health_satisfaction	-1.7186	-2.7075	-0.7296	0.1793	0.0667	0.4821	0.0083	0.0547	0.0141	0.0588
age_voiceYounger than average	0.1706	0.0602	0.2811	1.1861	1.0620	1.3245	0.0025	0.0001	0.0046	0.0001
number_children	-0.0682	-0.0906	-0.0458	0.9341	0.9134	0.9552	0.0000	0.0006	0.0000	0.0008
townsend_deprivation_index	0.2528	0.2315	0.2740	1.2876	1.2605	1.3152	0.0000	0.0000	0.0000	0.0000
depressed_mood_freq	0.5141	0.4404	0.5878	1.6721	1.5533	1.8000	0.0000	0.0000	0.0000	0.0000
doctor_visit_mental_healthYes	0.1795	0.1334	0.2256	1.1966	1.1427	1.2531	0.0000	0.0000	0.0000	0.0000

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
fed_up_feelingsYes	0.2527	0.2102	0.2952	1.2875	1.2339	1.3434	0.0000	0.0000	0.0000	0.0000
miserablenessYes	0.1342	0.0908	0.1776	1.1436	1.0950	1.1943	0.0000	0.0000	0.0000	0.0000
mood_swingsYes	0.1593	0.1174	0.2012	1.1727	1.1246	1.2229	0.0000	0.0000	0.0000	0.0000
nervesYes	0.1184	0.0674	0.1695	1.1257	1.0697	1.1847	0.0000	0.0000	0.0000	0.0000
nervousYes	0.1119	0.0587	0.1652	1.1184	1.0604	1.1796	0.0000	0.0004	0.0001	0.0005
neuroticism	0.0783	0.0573	0.0993	1.0814	1.0590	1.1044	0.0000	0.0000	0.0000	0.0000
psychiatrist_visit_mental_healthYes	0.3044	0.2430	0.3658	1.3558	1.2751	1.4416	0.0000	0.0000	0.0000	0.0000
risk_takingYes	0.0672	0.0222	0.1123	1.0696	1.0224	1.1188	0.0035	0.0045	0.0064	0.0053
tenseYes	0.1131	0.0540	0.1722	1.1197	1.0555	1.1879	0.0002	0.0000	0.0004	0.0000
tenseness_freq	0.4256	0.3496	0.5015	1.5304	1.4185	1.6512	0.0000	0.0000	0.0000	0.0000
tiredness_freq	0.5940	0.5395	0.6485	1.8113	1.7152	1.9127	0.0000	0.0000	0.0000	0.0000
unenthusiasm_freq	0.5492	0.4813	0.6171	1.7319	1.6182	1.8536	0.0000	0.0000	0.0000	0.0000
worry_embarassmentYes	-0.0819	-0.1252	-0.0386	0.9214	0.8823	0.9621	0.0002	0.0623	0.0004	0.0664
fast_driving	-0.6269	-0.7083	-0.5456	0.5342	0.4925	0.5795	0.0000	0.0000	0.0000	0.0000
gymYes	-0.3473	-0.3992	-0.2955	0.7066	0.6709	0.7441	0.0000	0.0000	0.0000	0.0000

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
IPAQ_activity_group	-0.3056	-0.3446	-0.2667	0.7367	0.7085	0.7659	0.0000	0.0000	0.0000	0.0000
LTPA	-0.3974	-0.4463	-0.3485	0.6720	0.6400	0.7057	0.0000	0.0000	0.0000	0.0000
OPA	-0.2615	-0.3047	-0.2183	0.7699	0.7373	0.8039	0.0000	0.0000	0.0000	0.0000
sedentary	0.1335	0.0940	0.1730	1.1428	1.0986	1.1889	0.0000	0.0000	0.0000	0.0000
close_to_major_roadYes	0.1556	0.0808	0.2303	1.1683	1.0841	1.2590	0.0000	0.3614	0.0001	0.3614
daytime_sound_average	0.0553	0.0354	0.0752	1.0569	1.0361	1.0781	0.0000	0.0006	0.0000	0.0007
domestic_garden_buffer_1000m	-0.0316	-0.0545	-0.0087	0.9689	0.9470	0.9914	0.0069	0.1784	0.0121	0.1855
domestic_garden_buffer_300m	-0.0546	-0.0763	-0.0329	0.9469	0.9266	0.9676	0.0000	0.0000	0.0000	0.0000
evening_sound_average	0.0553	0.0354	0.0752	1.0569	1.0361	1.0781	0.0000	0.0006	0.0000	0.0007
greenspace_buffer_1000m	-0.0937	-0.1178	-0.0696	0.9106	0.8889	0.9327	0.0000	0.0000	0.0000	0.0000
greenspace_buffer_300m	-0.0556	-0.0782	-0.0330	0.9459	0.9248	0.9676	0.0000	0.0000	0.0000	0.0000
inverse_distance_nearest_major_road	0.0199	0.0065	0.0332	1.0200	1.0065	1.0337	0.0035	0.1547	0.0064	0.1622

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
natural_environment_buffer_1000m	-0.1076	-0.1318	-0.0835	0.8980	0.8765	0.9199	0.0000	0.0000	0.0000	0.0000
natural_environment_buffer_300m	-0.0714	-0.0941	-0.0486	0.9311	0.9102	0.9525	0.0000	0.0000	0.0000	0.0000
night_sound_average	0.0553	0.0354	0.0752	1.0569	1.0361	1.0781	0.0000	0.0006	0.0000	0.0007
NO_2010	0.1198	0.1003	0.1394	1.1273	1.1055	1.1496	0.0000	0.0000	0.0000	0.0000
NO2_2005	0.1809	0.1504	0.2114	1.1983	1.1623	1.2354	0.0000	0.0000	0.0000	0.0000
NO2_2006	0.1751	0.1461	0.2042	1.1914	1.1573	1.2266	0.0000	0.0000	0.0000	0.0000
NO2_2007	0.1879	0.1560	0.2199	1.2067	1.1688	1.2459	0.0000	0.0000	0.0000	0.0000
NO2_2010	0.1469	0.1238	0.1700	1.1583	1.1318	1.1853	0.0000	0.0000	0.0000	0.0000
PM10_2007	0.1934	0.1614	0.2254	1.2134	1.1752	1.2528	0.0000	0.0000	0.0000	0.0000
PM10_2010	0.0573	0.0363	0.0783	1.0590	1.0370	1.0815	0.0000	0.0000	0.0000	0.0000
PM2.5_2010	0.1296	0.1080	0.1513	1.1384	1.1140	1.1633	0.0000	0.0000	0.0000	0.0000
PM2.5_absorbance_2010	0.0950	0.0717	0.1183	1.0997	1.0743	1.1256	0.0000	0.0000	0.0000	0.0000
PM2.5_to_10_2010	0.0296	0.0093	0.0499	1.0300	1.0093	1.0512	0.0044	0.0124	0.0078	0.0145

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
population_densityRural	-0.1527	-0.2170	-0.0885	0.8584	0.8049	0.9153	0.0000	0.0000	0.0000	0.0000
road_length_sum_100m	0.0481	0.0287	0.0674	1.0493	1.0291	1.0698	0.0000	0.0355	0.0000	0.0395
sound_average_16hr	0.0554	0.0355	0.0753	1.0569	1.0361	1.0782	0.0000	0.0006	0.0000	0.0007
sound_average_24hr	0.0554	0.0355	0.0753	1.0569	1.0361	1.0782	0.0000	0.0006	0.0000	0.0007
traffic_load_major_roads	0.0450	0.0253	0.0647	1.0460	1.0256	1.0668	0.0000	0.0039	0.0000	0.0046
number_sex_partners	0.0210	0.0133	0.0288	1.0212	1.0134	1.0292	0.0000	0.0004	0.0000	0.0005
same_sex_intercourseYes	0.3396	0.2313	0.4479	1.4044	1.2603	1.5650	0.0000	0.0003	0.0000	0.0004
sex_age_first	-0.0823	-0.1063	-0.0582	0.9210	0.8991	0.9434	0.0000	0.0000	0.0000	0.0000
chronotypeDefinitely a 'morning' person	0.0800	0.0249	0.1351	1.0833	1.0252	1.1446	0.0045	0.0138	0.0080	0.0160
chronotypeMore an 'evening' than a 'morning' person	0.1336	0.0685	0.1987	1.1429	1.0709	1.2198	0.0002	0.0030	0.0004	0.0037

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
chronotypeDefinitely an 'evening' person	0.2426	0.1610	0.3242	1.2746	1.1747	1.3829	0.0000	0.0000	0.0000	0.0000
easy_wake	-0.3153	-0.3780	-0.2525	0.7296	0.6852	0.7769	0.0000	0.0000	0.0000	0.0000
nap	0.3025	0.2583	0.3466	1.3532	1.2947	1.4143	0.0000	0.0000	0.0000	0.0000
sleep_difficulty	0.1846	0.1450	0.2242	1.2028	1.1561	1.2513	0.0000	0.0000	0.0000	0.0000
sleep_hours_categorical<7 hours	0.2146	0.1661	0.2631	1.2393	1.1806	1.3010	0.0000	0.0000	0.0000	0.0000
sleep_hours_categorical>9 hours	0.3738	0.3099	0.4377	1.4532	1.3632	1.5491	0.0000	0.0000	0.0000	0.0000
snoringYes	-0.1328	-0.1804	-0.0852	0.8756	0.8349	0.9183	0.0000	0.0000	0.0000	0.0000
ever_smokedYes	0.3862	0.3380	0.4345	1.4714	1.4021	1.5441	0.0000	0.0000	0.0000	0.0000
pack_years	0.2737	0.2536	0.2939	1.3149	1.2886	1.3416	0.0000	0.0000	0.0000	0.0000
pack_years_prop	0.2999	0.2784	0.3214	1.3497	1.3210	1.3790	0.0000	0.0000	0.0000	0.0000
smoking_statusPrevious	0.3509	0.3034	0.3984	1.4204	1.3545	1.4895	0.0000	0.0000	0.0000	0.0000
smoking_statusCurrent	1.0113	0.9522	1.0704	2.7492	2.5914	2.9166	0.0000	0.0000	0.0000	0.0000
tobacco	0.6689	0.6294	0.7085	1.9522	1.8765	2.0309	0.0000	0.0000	0.0000	0.0000
confide_freq	-0.2086	-0.2500	-0.1671	0.8118	0.7788	0.8461	0.0000	0.0000	0.0000	0.0000

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
family_visit_freq	-0.3206	-0.4135	-0.2278	0.7257	0.6614	0.7963	0.0000	0.0000	0.0000	0.0000
lonelinessYes	0.3842	0.3306	0.4379	1.4685	1.3918	1.5494	0.0000	0.0000	0.0000	0.0000
religious_groupYes	-0.1203	-0.1855	-0.0551	0.8866	0.8307	0.9464	0.0003	0.0000	0.0006	0.0000
death_partnerYes	0.2033	0.0452	0.3614	1.2254	1.0462	1.4353	0.0117	0.0308	0.0198	0.0351
divorceYes	0.1667	0.0313	0.3021	1.1814	1.0318	1.3527	0.0158	0.0032	0.0263	0.0038
financial_difficultyYes	0.4310	0.3652	0.4968	1.5389	1.4409	1.6435	0.0000	0.0000	0.0000	0.0000
facial_agingOlder than you are	0.5796	0.4141	0.7451	1.7853	1.5130	2.1067	0.0000	0.0000	0.0000	0.0000
facial_agingAbout your age	0.1812	0.1320	0.2304	1.1986	1.1411	1.2591	0.0000	0.0001	0.0000	0.0002
skin_colorVery fair	0.1280	0.0468	0.2092	1.1366	1.0479	1.2327	0.0020	0.0000	0.0038	0.0001
sun_protection_use	-0.4267	-0.5004	-0.3529	0.6527	0.6063	0.7026	0.0000	0.0000	0.0000	0.0000
winter_outdoors_time	-0.0259	-0.0491	-0.0027	0.9744	0.9521	0.9973	0.0290	0.3509	0.0475	0.3536
calcium_supplementsYes	0.3138	0.2051	0.4225	1.3686	1.2277	1.5257	0.0000	0.0002	0.0000	0.0002

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
fish_oil_supplementsYes	-0.2234	-0.2687	-0.1781	0.7998	0.7644	0.8369	0.0000	0.0000	0.0000	0.0000
folate_supplementsYes	0.5712	0.4467	0.6957	1.7704	1.5631	2.0052	0.0000	0.0000	0.0000	0.0000
glucosamine_supplementsYes	-0.3173	-0.3766	-0.2581	0.7281	0.6862	0.7726	0.0000	0.0000	0.0000	0.0000
iron_supplementsYes	0.4673	0.3496	0.5849	1.5956	1.4186	1.7948	0.0000	0.0000	0.0000	0.0000
multivitamin_supplementsYes	-0.1133	-0.1698	-0.0568	0.8929	0.8438	0.9448	0.0001	0.0654	0.0002	0.0691
vitamin_B_supplementsYes	0.3450	0.2454	0.4446	1.4119	1.2781	1.5598	0.0000	0.0000	0.0000	0.0000
vitamin_D_supplementsYes	0.1685	0.0527	0.2842	1.1835	1.0542	1.3287	0.0043	0.1910	0.0078	0.1955
alcohol_freqOnce or twice a week	-0.0550	-0.1370	0.0270	0.9465	0.8720	1.0274	0.1887	0.0590	0.2405	
head_side_phoneLeft	-0.0017	-0.0988	0.0954	0.9983	0.9059	1.1001	0.9688	0.8648	0.9734	
alcohol_freqDaily or almost daily	0.0699	-0.0110	0.1508	1.0724	0.9890	1.1628	0.0904	0.0203	0.1234	
bread	0.0119	-0.0301	0.0540	1.0120	0.9704	1.0554	0.5776	0.1203	0.6374	

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
mobile_phone_2 yrsYes, use is now more frequent	-0.0914	-0.2003	0.0174	0.9126	0.8185	1.0176	0.0896	0.8138	0.1231	
cheese	-0.0573	-0.1234	0.0089	0.9443	0.8839	1.0089	0.0871	0.0834	0.1205	
coffee	0.0205	-0.0205	0.0616	1.0207	0.9797	1.0635	0.3273	0.9141	0.3873	
mobile_phone_w eekly_usage	-0.0342	-0.1564	0.0880	0.9664	0.8552	1.0920	0.5573	0.3715	0.6215	
diet_change_5yrs Yes, because of other reasons	0.0235	-0.0289	0.0760	1.0238	0.9715	1.0789	0.3794	0.5752	0.4392	
baldingPattern 4	-0.0667	-0.1273	-0.0062	0.9354	0.8805	0.9938	0.0308	0.6342	0.0500	
home_makerYes	0.1785	-0.0132	0.3702	1.1954	0.9869	1.4480	0.0680	0.5187	0.0995	
retiredYes	0.0156	-0.0386	0.0698	1.0157	0.9621	1.0723	0.5723	0.4085	0.6349	
studentYes	-0.0345	-0.4000	0.3309	0.9661	0.6703	1.3922	0.8531	0.1749	0.8863	
depressed_whole _weekYes	0.0101	-0.2640	0.2842	1.0101	0.7680	1.3286	0.9256	0.0057	0.9392	
non_oily_fish	-0.0492	-0.1120	0.0137	0.9520	0.8940	1.0138	0.1254	0.3992	0.1680	
oily_fish	-0.0545	-0.1077	-0.0013	0.9469	0.8979	0.9987	0.0445	0.0000	0.0686	

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
accommodation_typeMobile or temporary structure (i.e. caravan)	0.4031	0.0171	0.7891	1.4965	1.0173	2.2014	0.0407	0.1277	0.0637	
electric_storage_heatYes	0.1636	-0.0824	0.4096	1.1777	0.9209	1.5062	0.1765	0.0002	0.2278	
gas_central_heatYes	-0.0551	-0.1136	0.0034	0.9464	0.8926	1.0034	0.0641	0.0085	0.0955	
gas_fire_heatYes	-0.0333	-0.0761	0.0095	0.9673	0.9267	1.0096	0.1274	0.0021	0.1696	
country_birthElsewhere	-0.0244	-0.1525	0.1038	0.9759	0.8585	1.1093	0.7091	0.0418	0.7552	
handednessLeft-handed	0.0259	-0.0419	0.0937	1.0262	0.9590	1.0983	0.4540	0.4616	0.5172	
hshld_grandchildYes	-0.0088	-0.2146	0.1971	0.9913	0.8068	1.2179	0.9335	0.3401	0.9423	
childhood_sunburn_number	0.0062	-0.0051	0.0174	1.0062	0.9949	1.0175	0.2792	0.6272	0.3398	
family_satisfaction	-0.4407	-0.8965	0.0151	0.6436	0.4080	1.0152	0.0553	0.1103	0.0836	
financial_satisfaction	-0.6749	-1.4384	0.0886	0.5092	0.2373	1.0927	0.0709	0.0535	0.1021	

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
body_size_10yrs_oldThinner	-0.0234	-0.0723	0.0255	0.9769	0.9303	1.0259	0.3471	0.0366	0.4062	
sensitivityYes	-0.0020	-0.0437	0.0398	0.9980	0.9572	1.0406	0.9260	0.4696	0.9392	
breastfedYes	-0.0350	-0.0933	0.0233	0.9656	0.9110	1.0236	0.2342	0.0462	0.2917	
country_birthWales	0.0780	-0.0723	0.2284	1.0812	0.9303	1.2566	0.3088	0.8686	0.3688	
country_birthScotland	0.1126	-0.0150	0.2403	1.1192	0.9851	1.2716	0.0838	0.0767	0.1166	
country_birthNorthern Ireland	0.0703	-0.1951	0.3357	1.0728	0.8227	1.3990	0.6036	0.6767	0.6593	
country_birthRepublic of Ireland	0.1594	-0.0119	0.3308	1.1729	0.9882	1.3921	0.0682	0.2462	0.0995	
age_voiceOlder than average	0.0446	-0.0383	0.1275	1.0456	0.9624	1.1360	0.2905	0.0090	0.3515	
baldingPattern 2	-0.0079	-0.0670	0.0512	0.9921	0.9352	1.0525	0.7932	0.4834	0.8363	
handednessUse both right and left hands equally	0.0381	-0.1010	0.1772	1.0388	0.9040	1.1938	0.5913	0.0818	0.6492	
height_10yrs_oldShorter	-0.0473	-0.1056	0.0111	0.9538	0.8998	1.0112	0.1122	0.8701	0.1513	

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
solarium_freq	0.0074	-0.0136	0.0283	1.0074	0.9865	1.0287	0.4919	0.4380	0.5573	
inverse_distance_nearest_road	0.0150	-0.0043	0.0343	1.0151	0.9957	1.0349	0.1282	0.0939	0.1696	
part_multiple_birthYes	0.0902	-0.0422	0.2225	1.0943	0.9586	1.2493	0.1819	0.6648	0.2334	
happiness	-0.5334	-1.1347	0.0679	0.5866	0.3215	1.0703	0.0714	0.1244	0.1021	
volunteerYes	0.0132	-0.1064	0.1329	1.0133	0.8991	1.1421	0.8281	0.7773	0.8647	
head_side_phoneEqually left and right	0.0056	-0.1011	0.1124	1.0057	0.9038	1.1190	0.9164	0.4134	0.9392	
mobile_phone_2yrsYes, use is now less frequent	0.0628	0.0029	0.1227	1.0648	1.0029	1.1305	0.0399	0.0209	0.0629	
age_facial_hairOlder than average	-0.0085	-0.0805	0.0635	0.9915	0.9227	1.0656	0.8158	0.1537	0.8560	
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0356	-0.1306	0.2017	1.0362	0.8776	1.2234	0.6748	0.0273	0.7296	
manicYes	0.1543	-0.1870	0.4956	1.1669	0.8294	1.6415	0.3062	0.0844	0.3685	
worrierYes	0.0104	-0.0319	0.0527	1.0105	0.9686	1.0542	0.6299	0.2657	0.6845	

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
baldingPattern 3	-0.0530	-0.1072	0.0012	0.9484	0.8984	1.0012	0.0551	0.0217	0.0836	
vitamin_C_supplementsYes	-0.0241	-0.0982	0.0500	0.9762	0.9065	1.0513	0.5242	0.4917	0.5877	
skin_tan_ease	-0.0370	-0.0855	0.0114	0.9636	0.9181	1.0115	0.1337	0.2033	0.1758	
summer_outdoors_time	-0.0048	-0.0287	0.0191	0.9952	0.9717	1.0192	0.6898	0.3019	0.7420	
adult_educationYes	-0.1120	-0.2170	-0.0070	0.8941	0.8050	0.9931	0.0366	0.1042	0.0582	
hair_colorBlonde	0.0673	-0.0052	0.1398	1.0696	0.9948	1.1500	0.0689	0.0286	0.0998	
hair_colorRed	0.1006	-0.0105	0.2118	1.1059	0.9895	1.2359	0.0760	0.2039	0.1072	
hair_colorDark brown	-0.0006	-0.0494	0.0482	0.9994	0.9518	1.0493	0.9799	0.0582	0.9799	
guilty_feelingsYes	0.0464	-0.0051	0.0979	1.0475	0.9949	1.1029	0.0773	0.1005	0.1083	
irritabilityYes	0.0473	-0.0016	0.0961	1.0484	0.9984	1.1009	0.0577	0.1038	0.0865	
irritableYes	0.1549	-0.1439	0.4536	1.1675	0.8660	1.5740	0.2357	0.1437	0.2919	
unenthusiastic_whole_weekYes	0.2041	-0.0032	0.4114	1.2264	0.9968	1.5089	0.0525	0.0679	0.0805	
selenium_supplementsYes	-0.0559	-0.1958	0.0839	0.9456	0.8222	1.0875	0.4328	0.2649	0.4983	

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
skin_colorBlack	-0.0749	-0.4582	0.3085	0.9278	0.6324	1.3613	0.7017	0.1697	0.7511	
relative_illness_injury_assaultYes	-0.0768	-0.1583	0.0047	0.9261	0.8536	1.0047	0.0648	0.1110	0.0959	
own_or_rentOwn with a mortgage	0.0329	-0.0243	0.0900	1.0334	0.9760	1.0942	0.2593	0.6856	0.3174	
skin_colorLight olive	-0.0647	-0.1243	-0.0051	0.9373	0.8831	0.9949	0.0333	0.0051	0.0533	
vitamin_E_supplementsYes	0.0493	-0.0764	0.1750	1.0505	0.9264	1.1912	0.4422	0.3965	0.5064	
friends_satisfaction	-0.4350	-1.1301	0.2601	0.6473	0.3230	1.2971	0.1661	0.1586	0.2157	
private_healthcare	-0.2233	-0.4762	0.0297	0.7999	0.6211	1.0301	0.0751	0.3608	0.1066	
distance_to_coast	-0.0097	-0.0784	0.0589	0.9903	0.9246	1.0607	0.7810	0.2558	0.8276	
oil_central_heatYes	-0.1819	-0.3586	-0.0051	0.8337	0.6986	0.9949	0.0438	0.0315	0.0681	
traffic_intensity_nearest_road	0.0100	-0.0093	0.0292	1.0100	0.9908	1.0296	0.3099	0.2327	0.3688	
zinc_supplementsYes	-0.0784	-0.1965	0.0398	0.9246	0.8216	1.0406	0.1934	0.0394	0.2438	
skin_colorBrown	-0.0093	-0.1865	0.1679	0.9907	0.8299	1.1828	0.9180	0.0614	0.9392	

Table S3. Male XWAS output (n=199,257)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
death_relativeYes	0.0032	-0.0486	0.0551	1.0033	0.9526	1.0566	0.9023	0.4589	0.9329	
vitamin_A_supplementsYes	0.0679	-0.0704	0.2062	1.0703	0.9320	1.2291	0.3348	0.4732	0.3940	
age_facial_hairYounger than average	0.0975	0.0089	0.1860	1.1024	1.0089	1.2044	0.0310	0.0007	0.0500	
pubYes	0.0201	-0.0230	0.0631	1.0203	0.9773	1.0651	0.3610	0.0007	0.4202	
hair_colorBlack	0.0450	-0.0296	0.1196	1.0460	0.9708	1.1271	0.2371	0.6102	0.2919	
job_satisfaction	-0.1622	-0.7693	0.4448	0.8502	0.4634	1.5601	0.5193	0.5037	0.5852	
water_buffer_300m	0.0160	-0.0032	0.0352	1.0161	0.9968	1.0358	0.1022	0.8297	0.1386	
skin_colorDark olive	0.0997	-0.0337	0.2332	1.1049	0.9669	1.2626	0.1428	0.4831	0.1866	
traffic_intensity_nearest_major_road	0.0135	-0.0067	0.0337	1.0136	0.9933	1.0343	0.1897	0.0986	0.2405	
water_buffer_1000m	0.0136	-0.0070	0.0342	1.0137	0.9931	1.0348	0.1948	0.7863	0.2441	

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
alcohol_freqThree or four times a week	-0.1203	-0.1830	-0.0576	0.8866	0.8328	0.9440	0.0002	0.0879	0.0003	0.0953
alcohol_freqDaily or almost daily	0.0840	0.0228	0.1452	1.0876	1.0230	1.1563	0.0072	0.0004	0.0116	0.0006
bread	0.0525	0.0196	0.0855	1.0539	1.0198	1.0892	0.0018	0.0099	0.0030	0.0118
cereal	-0.2279	-0.2578	-0.1980	0.7962	0.7727	0.8204	0.0000	0.0000	0.0000	0.0000
cheese	-0.0672	-0.1194	-0.0151	0.9350	0.8875	0.9850	0.0137	0.0180	0.0203	0.0208
dairy_milk	-0.1235	-0.1665	-0.0805	0.8838	0.8466	0.9227	0.0000	0.0000	0.0000	0.0000
diet_variation	0.1326	0.0951	0.1701	1.1418	1.0998	1.1854	0.0000	0.0000	0.0000	0.0000
never_eat_dairyYes	0.3725	0.2883	0.4566	1.4513	1.3342	1.5787	0.0000	0.0000	0.0000	0.0000
never_eat_eggsYes	0.2830	0.1960	0.3699	1.3271	1.2165	1.4476	0.0000	0.0000	0.0000	0.0000
never_eat_sugarYes	0.1589	0.1221	0.1957	1.1722	1.1299	1.2161	0.0000	0.0000	0.0000	0.0000
never_eat_wheatYes	0.2995	0.2169	0.3821	1.3492	1.2423	1.4654	0.0000	0.0000	0.0000	0.0000
non_oily_fish	-0.0613	-0.1093	-0.0134	0.9405	0.8965	0.9867	0.0122	0.1705	0.0182	0.1820
oily_fish	-0.1141	-0.1554	-0.0729	0.8921	0.8561	0.9297	0.0000	0.0000	0.0000	0.0000
partial_fiber_score	-0.2356	-0.2722	-0.1991	0.7901	0.7617	0.8195	0.0000	0.0000	0.0000	0.0000
poultry	-0.1489	-0.1915	-0.1063	0.8617	0.8257	0.8992	0.0000	0.0000	0.0000	0.0000

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
processed_meat	0.1697	0.1307	0.2088	1.1850	1.1397	1.2321	0.0000	0.0000	0.0000	0.0000
red_meat	0.0789	0.0402	0.1176	1.0821	1.0411	1.1248	0.0001	0.0000	0.0001	0.0000
salt	0.2015	0.1625	0.2405	1.2232	1.1764	1.2719	0.0000	0.0000	0.0000	0.0000
tea	-0.0574	-0.0910	-0.0237	0.9443	0.9130	0.9766	0.0008	0.0172	0.0015	0.0200
total_fruit	-0.1226	-0.1541	-0.0911	0.8846	0.8572	0.9129	0.0000	0.0000	0.0000	0.0000
total_veg	-0.1068	-0.1421	-0.0714	0.8987	0.8675	0.9311	0.0000	0.0000	0.0000	0.0000
water	0.0435	0.0110	0.0760	1.0445	1.0111	1.0790	0.0087	0.0000	0.0136	0.0000
birth_weight	-0.0408	-0.0639	-0.0177	0.9600	0.9381	0.9824	0.0016	0.0024	0.0028	0.0031
body_size_10yrs_oldPlumper	0.1865	0.1411	0.2319	1.2050	1.1515	1.2609	0.0000	0.0000	0.0000	0.0000
breastfedYes	-0.0553	-0.0965	-0.0142	0.9462	0.9080	0.9859	0.0089	0.0219	0.0138	0.0249
country_birthScotland	0.1146	0.0172	0.2119	1.1214	1.0174	1.2361	0.0211	0.1114	0.0306	0.1199
country_birthRepublic of Ireland	0.1862	0.0567	0.3158	1.2047	1.0583	1.3713	0.0048	0.7474	0.0080	0.7527
height_10yrs_oldTaller	0.1142	0.0757	0.1526	1.1209	1.0786	1.1649	0.0000	0.0025	0.0000	0.0031
maternal_smokingYes	0.1353	0.0986	0.1720	1.1449	1.1036	1.1877	0.0000	0.0000	0.0000	0.0000

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
part_multiple_birth Yes	0.1311	0.0313	0.2309	1.1401	1.0318	1.2598	0.0101	0.6342	0.0153	0.6433
computer_games	0.1386	0.0949	0.1823	1.1486	1.0995	1.1999	0.0000	0.0000	0.0000	0.0000
mobile_phone_2yrs Yes, use is now less frequent	0.0988	0.0283	0.1694	1.1039	1.0287	1.1846	0.0088	0.0149	0.0137	0.0175
mobile_phone_duration	-0.1534	-0.1885	-0.1183	0.8578	0.8282	0.8884	0.0000	0.0000	0.0000	0.0000
employedYes	-0.4659	-0.5069	-0.4248	0.6276	0.6023	0.6539	0.0000	0.0000	0.0000	0.0000
unemployedYes	0.5229	0.4144	0.6313	1.6869	1.5135	1.8801	0.0000	0.0000	0.0000	0.0000
accommodation_typeA flat, maisonette or apartment	0.5595	0.5083	0.6108	1.7499	1.6625	1.8418	0.0000	0.0000	0.0000	0.0000
gas_hob_heatYes	-0.0799	-0.1138	-0.0459	0.9232	0.8924	0.9551	0.0000	0.0008	0.0000	0.0012
hshld_childrenYes	-0.1969	-0.2419	-0.1519	0.8213	0.7852	0.8591	0.0000	0.3500	0.0000	0.3681
hshld_income	-0.8307	-0.8931	-0.7683	0.4358	0.4094	0.4638	0.0000	0.0000	0.0000	0.0000
hshld_number	-0.1883	-0.2137	-0.1629	0.8284	0.8076	0.8497	0.0000	0.0000	0.0000	0.0000
hshld_parentsYes	0.3990	0.2813	0.5168	1.4904	1.3248	1.6767	0.0000	0.0000	0.0000	0.0000
hshld_partnerYes	-0.4653	-0.4990	-0.4317	0.6279	0.6071	0.6494	0.0000	0.0000	0.0000	0.0000

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
hshld_siblingsYes	0.5854	0.4185	0.7524	1.7957	1.5196	2.1220	0.0000	0.0000	0.0000	0.0000
hshld_vehicles	-0.9335	-1.0014	-0.8657	0.3932	0.3674	0.4207	0.0000	0.0000	0.0000	0.0000
oil_central_heatYes	-0.2899	-0.4415	-0.1383	0.7483	0.6430	0.8709	0.0002	0.0039	0.0004	0.0048
open_fire_heatYes	-0.2212	-0.2881	-0.1542	0.8016	0.7497	0.8571	0.0000	0.0000	0.0000	0.0000
own_or_rentOwn with a mortgage	0.0576	0.0135	0.1016	1.0593	1.0136	1.1070	0.0104	0.2555	0.0157	0.2708
own_or_rentRent - from local authority, local council, housing association	0.8508	0.7983	0.9034	2.3416	2.2218	2.4679	0.0000	0.0000	0.0000	0.0000
own_or_rentRent - from private landlord or letting agency	0.5932	0.5005	0.6859	1.8098	1.6496	1.9855	0.0000	0.0000	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.5700	0.3067	0.8332	1.7682	1.3590	2.3006	0.0000	0.0015	0.0000	0.0020
own_or_rentLive in accommodation rent free	0.2593	0.0700	0.4485	1.2960	1.0726	1.5660	0.0072	0.0000	0.0116	0.0001
years_at_address	-0.0291	-0.0444	-0.0137	0.9714	0.9565	0.9864	0.0002	0.0026	0.0004	0.0032

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
health_satisfaction	-1.7188	-2.6860	-0.7516	0.1793	0.0682	0.4716	0.0078	0.0528	0.0124	0.0577
townsend_deprivation_index	0.2408	0.2246	0.2571	1.2723	1.2518	1.2932	0.0000	0.0000	0.0000	0.0000
depressed_mood_freq	0.5138	0.4582	0.5695	1.6717	1.5812	1.7673	0.0000	0.0000	0.0000	0.0000
doctor_visit_mental_healthYes	0.1803	0.1463	0.2142	1.1975	1.1576	1.2388	0.0000	0.0000	0.0000	0.0000
fed_up_feelingsYes	0.2556	0.2231	0.2880	1.2912	1.2500	1.3338	0.0000	0.0000	0.0000	0.0000
irritabilityYes	0.0539	0.0161	0.0917	1.0554	1.0163	1.0961	0.0053	0.0013	0.0087	0.0018
miserablenessYes	0.1378	0.1049	0.1707	1.1478	1.1106	1.1861	0.0000	0.0000	0.0000	0.0000
mood_swingsYes	0.1705	0.1376	0.2033	1.1859	1.1475	1.2255	0.0000	0.0000	0.0000	0.0000
nervesYes	0.1244	0.0851	0.1636	1.1324	1.0888	1.1778	0.0000	0.0000	0.0000	0.0000
nervousYes	0.0928	0.0528	0.1329	1.0973	1.0542	1.1422	0.0000	0.0000	0.0000	0.0000
neuroticism	0.0781	0.0618	0.0943	1.0812	1.0638	1.0989	0.0000	0.0000	0.0000	0.0000
psychiatrist_visit_mental_healthYes	0.3237	0.2784	0.3690	1.3822	1.3210	1.4463	0.0000	0.0000	0.0000	0.0000
risk_takingYes	0.0969	0.0604	0.1334	1.1017	1.0622	1.1427	0.0000	0.0000	0.0000	0.0000
tenseYes	0.1083	0.0661	0.1506	1.1144	1.0683	1.1625	0.0000	0.0000	0.0000	0.0000
tenseness_freq	0.4339	0.3696	0.4982	1.5432	1.4472	1.6457	0.0000	0.0000	0.0000	0.0000

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
tiredness_freq	0.5911	0.5458	0.6364	1.8059	1.7259	1.8896	0.0000	0.0000	0.0000	0.0000
unenthusiasm_freq	0.5587	0.5065	0.6109	1.7485	1.6595	1.8422	0.0000	0.0000	0.0000	0.0000
worry_embarassmentYes	-0.0851	-0.1175	-0.0527	0.9184	0.8891	0.9487	0.0000	0.0003	0.0000	0.0005
fast_driving	-0.5994	-0.6655	-0.5333	0.5491	0.5140	0.5867	0.0000	0.0000	0.0000	0.0000
gymYes	-0.3429	-0.3821	-0.3036	0.7097	0.6824	0.7381	0.0000	0.0000	0.0000	0.0000
IPAQ_activity_group	-0.3127	-0.3444	-0.2810	0.7315	0.7086	0.7551	0.0000	0.0000	0.0000	0.0000
LTPA	-0.3867	-0.4335	-0.3398	0.6793	0.6482	0.7119	0.0000	0.0000	0.0000	0.0000
OPA	-0.2355	-0.2709	-0.2001	0.7902	0.7627	0.8186	0.0000	0.0000	0.0000	0.0000
sedentary	0.1814	0.1505	0.2123	1.1989	1.1624	1.2365	0.0000	0.0000	0.0000	0.0000
close_to_major_roadYes	0.0974	0.0384	0.1564	1.1023	1.0391	1.1693	0.0012	0.4772	0.0021	0.4947
daytime_sound_average	0.0358	0.0203	0.0513	1.0365	1.0205	1.0527	0.0000	0.0021	0.0000	0.0027
domestic_garden_buffer_1000m	-0.0267	-0.0443	-0.0092	0.9736	0.9567	0.9909	0.0029	0.9108	0.0048	0.9108
domestic_garden_buffer_300m	-0.0462	-0.0628	-0.0296	0.9548	0.9391	0.9708	0.0000	0.0001	0.0000	0.0002

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
evening_sound_average	0.0358	0.0203	0.0513	1.0365	1.0205	1.0527	0.0000	0.0021	0.0000	0.0027
greenspace_buffer_1000m	-0.0926	-0.1111	-0.0742	0.9115	0.8948	0.9285	0.0000	0.0000	0.0000	0.0000
greenspace_buffer_300m	-0.0626	-0.0800	-0.0453	0.9393	0.9231	0.9558	0.0000	0.0000	0.0000	0.0000
inverse_distance_nearest_major_road	0.0172	0.0056	0.0288	1.0174	1.0057	1.0292	0.0036	0.5223	0.0059	0.5375
inverse_distance_nearest_road	0.0168	0.0019	0.0316	1.0169	1.0019	1.0322	0.0272	0.5859	0.0393	0.5986
natural_environment_buffer_1000m	-0.1072	-0.1257	-0.0887	0.8983	0.8818	0.9151	0.0000	0.0000	0.0000	0.0000
natural_environment_buffer_300m	-0.0737	-0.0912	-0.0563	0.9289	0.9128	0.9453	0.0000	0.0000	0.0000	0.0000
night_sound_average	0.0359	0.0203	0.0514	1.0365	1.0205	1.0527	0.0000	0.0021	0.0000	0.0027
NO_2010	0.1136	0.0983	0.1288	1.1203	1.1033	1.1375	0.0000	0.0000	0.0000	0.0000
NO2_2005	0.1734	0.1500	0.1969	1.1894	1.1618	1.2176	0.0000	0.0000	0.0000	0.0000
NO2_2006	0.1674	0.1450	0.1898	1.1822	1.1561	1.2090	0.0000	0.0000	0.0000	0.0000
NO2_2007	0.1788	0.1542	0.2034	1.1958	1.1668	1.2256	0.0000	0.0000	0.0000	0.0000
NO2_2010	0.1406	0.1228	0.1585	1.1510	1.1306	1.1718	0.0000	0.0000	0.0000	0.0000

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
PM10_2007	0.1914	0.1667	0.2160	1.2109	1.1814	1.2411	0.0000	0.0000	0.0000	0.0000
PM10_2010	0.0488	0.0327	0.0649	1.0500	1.0332	1.0671	0.0000	0.0000	0.0000	0.0000
PM2.5_2010	0.1239	0.1072	0.1407	1.1320	1.1132	1.1510	0.0000	0.0000	0.0000	0.0000
PM2.5_absorbance_2010	0.0807	0.0627	0.0987	1.0841	1.0647	1.1038	0.0000	0.0000	0.0000	0.0000
PM2.5_to_10_2010	0.0209	0.0052	0.0366	1.0211	1.0052	1.0373	0.0092	0.0466	0.0141	0.0513
population_densityRural	-0.1809	-0.2304	-0.1314	0.8345	0.7942	0.8769	0.0000	0.0000	0.0000	0.0000
road_length_sum_100m	0.0355	0.0204	0.0506	1.0361	1.0206	1.0519	0.0000	0.0316	0.0000	0.0354
sound_average_16hr	0.0359	0.0203	0.0514	1.0365	1.0205	1.0527	0.0000	0.0021	0.0000	0.0027
sound_average_24hr	0.0359	0.0203	0.0514	1.0365	1.0205	1.0527	0.0000	0.0020	0.0000	0.0027
traffic_load_major_roads	0.0390	0.0238	0.0543	1.0398	1.0241	1.0558	0.0000	0.0277	0.0000	0.0312
number_sex_partners	0.0146	0.0095	0.0197	1.0147	1.0096	1.0199	0.0000	0.0000	0.0000	0.0001
same_sex_intercourseYes	0.3320	0.2403	0.4236	1.3937	1.2716	1.5275	0.0000	0.0000	0.0000	0.0000
sex_age_first	-0.0656	-0.0831	-0.0481	0.9366	0.9203	0.9531	0.0000	0.0000	0.0000	0.0000

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
chronotypeDefinitely a 'morning' person	0.0696	0.0243	0.1148	1.0720	1.0246	1.1217	0.0029	0.0062	0.0049	0.0075
chronotypeMore an 'evening' than a 'morning' person	0.1356	0.0854	0.1859	1.1453	1.0891	1.2043	0.0000	0.0001	0.0000	0.0001
chronotypeDefinitely an 'evening' person	0.3160	0.2530	0.3791	1.3717	1.2878	1.4609	0.0000	0.0000	0.0000	0.0000
easy_wake	-0.3215	-0.3685	-0.2746	0.7250	0.6918	0.7599	0.0000	0.0000	0.0000	0.0000
nap	0.3392	0.3041	0.3744	1.4039	1.3553	1.4541	0.0000	0.0000	0.0000	0.0000
sleep_difficulty	0.1441	0.1127	0.1756	1.1550	1.1193	1.1920	0.0000	0.0000	0.0000	0.0000
sleep_hours_categorical<7 hours	0.1743	0.1372	0.2115	1.1905	1.1471	1.2355	0.0000	0.0000	0.0000	0.0000
sleep_hours_categorical>9 hours	0.3658	0.3158	0.4158	1.4417	1.3714	1.5156	0.0000	0.0000	0.0000	0.0000
snoringYes	-0.0812	-0.1286	-0.0339	0.9220	0.8793	0.9667	0.0018	0.0032	0.0032	0.0039
ever_smokedYes	0.3535	0.3184	0.3885	1.4240	1.3750	1.4748	0.0000	0.0000	0.0000	0.0000
pack_years	0.2568	0.2426	0.2710	1.2928	1.2746	1.3113	0.0000	0.0000	0.0000	0.0000
pack_years_prop	0.2844	0.2621	0.3066	1.3289	1.2996	1.3588	0.0000	0.0000	0.0000	0.0000

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
smoking_statusPrevious	0.3099	0.2743	0.3456	1.3633	1.3155	1.4129	0.0000	0.0000	0.0000	0.0000
smoking_statusCurrent	1.0134	0.9679	1.0589	2.7550	2.6325	2.8832	0.0000	0.0000	0.0000	0.0000
tobacco	0.6900	0.6587	0.7213	1.9938	1.9323	2.0571	0.0000	0.0000	0.0000	0.0000
confide_freq	-0.1950	-0.2285	-0.1614	0.8228	0.7957	0.8509	0.0000	0.0000	0.0000	0.0000
family_visit_freq	-0.2567	-0.3306	-0.1829	0.7736	0.7185	0.8329	0.0000	0.0000	0.0000	0.0000
lonelinessYes	0.3379	0.2984	0.3773	1.4020	1.3478	1.4583	0.0000	0.0000	0.0000	0.0000
religious_groupYes	-0.1100	-0.1556	-0.0645	0.8958	0.8559	0.9376	0.0000	0.0000	0.0000	0.0000
death_partnerYes	0.1462	0.0384	0.2540	1.1574	1.0391	1.2892	0.0079	0.0005	0.0124	0.0006
financial_difficultyYes	0.3866	0.3353	0.4380	1.4720	1.3983	1.5495	0.0000	0.0000	0.0000	0.0000
relative_illness_injury_assaultYes	-0.0799	-0.1364	-0.0234	0.9232	0.8725	0.9769	0.0056	0.0433	0.0091	0.0480
facial_agingOlder than you are	0.5921	0.3908	0.7934	1.8078	1.4782	2.2109	0.0001	0.0000	0.0002	0.0000
facial_agingAbout your age	0.1840	0.1429	0.2252	1.2021	1.1536	1.2526	0.0000	0.0000	0.0000	0.0001
hair_colorBlack	0.0792	0.0138	0.1446	1.0824	1.0139	1.1556	0.0176	0.4608	0.0260	0.4811
skin_colorVery fair	0.1244	0.0652	0.1835	1.1324	1.0674	1.2015	0.0000	0.0000	0.0001	0.0001

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
skin_colorLight olive	-0.0766	-0.1220	-0.0311	0.9263	0.8851	0.9694	0.0010	0.0027	0.0018	0.0033
skin_tan_ease	-0.0470	-0.0859	-0.0080	0.9541	0.9176	0.9920	0.0185	0.0110	0.0270	0.0130
sun_protection_use	-0.4102	-0.4668	-0.3537	0.6635	0.6270	0.7021	0.0000	0.0000	0.0000	0.0000
calcium_supplementsYes	0.1270	0.0658	0.1882	1.1355	1.0681	1.2071	0.0000	0.0211	0.0001	0.0242
fish_oil_supplementsYes	-0.2000	-0.2345	-0.1656	0.8187	0.7910	0.8474	0.0000	0.0000	0.0000	0.0000
folate_supplementsYes	0.4458	0.3561	0.5355	1.5618	1.4277	1.7084	0.0000	0.0000	0.0000	0.0000
glucosamine_supplementsYes	-0.2773	-0.3201	-0.2346	0.7578	0.7261	0.7909	0.0000	0.0000	0.0000	0.0000
iron_supplementsYes	0.3169	0.2288	0.4050	1.3729	1.2571	1.4993	0.0000	0.0000	0.0000	0.0000
multivitamin_supplementsYes	-0.0837	-0.1244	-0.0431	0.9197	0.8830	0.9578	0.0001	0.0035	0.0001	0.0042
vitamin_B_supplementsYes	0.2596	0.1874	0.3318	1.2964	1.2061	1.3935	0.0000	0.0000	0.0000	0.0000
alcohol_freqOnce or twice a week	-0.0186	-0.0788	0.0416	0.9816	0.9242	1.0425	0.5449	0.1732	0.6137	
head_side_phoneLeft	0.0093	-0.1179	0.1365	1.0093	0.8887	1.1462	0.8602	0.2662	0.8951	

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
head_side_phoneEqually left and right	0.0048	-0.0861	0.0956	1.0048	0.9175	1.1003	0.9162	0.4946	0.9298	
vitamin_E_supplementsYes	0.0052	-0.0861	0.0965	1.0052	0.9175	1.1013	0.9113	0.1304	0.9295	
mobile_phone_2yrsYes, use is now more frequent	-0.0613	-0.1814	0.0589	0.9406	0.8341	1.0607	0.2560	0.3610	0.3105	
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.1088	-0.0141	0.2317	1.1149	0.9860	1.2607	0.0827	0.1439	0.1107	
coffee	0.0218	-0.0097	0.0534	1.0221	0.9903	1.0549	0.1754	0.9858	0.2233	
mobile_phone_weekly_usage	0.0161	-0.1218	0.1540	1.0162	0.8854	1.1664	0.7919	0.7072	0.8411	
diet_change_5yrsYes, because of other reasons	-0.0049	-0.0441	0.0342	0.9951	0.9569	1.0348	0.8052	0.0684	0.8508	
hshld_grandchildYes	0.0888	-0.0546	0.2323	1.0929	0.9469	1.2615	0.2248	0.0565	0.2760	
home_makerYes	-0.0214	-0.1135	0.0707	0.9788	0.8927	1.0732	0.6485	0.0141	0.7109	
retiredYes	0.0273	-0.0158	0.0704	1.0276	0.9843	1.0729	0.2151	0.2513	0.2672	
studentYes	0.0019	-0.2338	0.2375	1.0019	0.7915	1.2681	0.9877	0.7503	0.9877	

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
body_size_10yrs_oldThinner	0.0032	-0.0345	0.0409	1.0032	0.9661	1.0418	0.8670	0.0084	0.8976	
volunteerYes	0.0191	-0.0623	0.1005	1.0193	0.9396	1.1058	0.6458	0.1812	0.7109	
childhood_sunburn_number	0.0076	-0.0002	0.0155	1.0077	0.9998	1.0156	0.0561	0.5586	0.0777	
accommodation_typeMobile or temporary structure (i.e. caravan)	0.3417	0.0184	0.6650	1.4073	1.0185	1.9446	0.0383	0.3261	0.0542	
electric_storage_heatYes	0.1338	-0.0792	0.3468	1.1432	0.9239	1.4146	0.1963	0.0001	0.2453	
gas_central_heatYes	-0.0439	-0.0864	-0.0014	0.9571	0.9172	0.9986	0.0433	0.0155	0.0607	
gas_fire_heatYes	-0.0301	-0.0631	0.0029	0.9704	0.9389	1.0029	0.0739	0.0000	0.1004	
hair_colorDark brown	-0.0180	-0.0548	0.0188	0.9822	0.9467	1.0190	0.3384	0.0340	0.3987	
traffic_intensity_nearest_major_road	0.0116	-0.0040	0.0271	1.0116	0.9960	1.0275	0.1445	0.1374	0.1864	
handednessUse both right and left hands equally	0.0769	-0.0364	0.1901	1.0799	0.9643	1.2094	0.1833	0.0187	0.2315	

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
height_10yrs_oldShorter	-0.0093	-0.0539	0.0352	0.9907	0.9476	1.0359	0.6810	0.9573	0.7387	
unenthusiastic_whole_weekYes	0.1996	0.0195	0.3797	1.2209	1.0197	1.4619	0.0362	0.0572	0.0519	
worrierYes	-0.0046	-0.0376	0.0284	0.9954	0.9631	1.0288	0.7834	0.6644	0.8364	
friends_satisfaction	-0.4425	-1.0304	0.1453	0.6424	0.3569	1.1564	0.1087	0.1161	0.1438	
private_healthcare	-0.2205	-0.4662	0.0253	0.8021	0.6274	1.0256	0.0701	0.3681	0.0965	
solarium_freq	0.0007	-0.0188	0.0202	1.0007	0.9814	1.0205	0.9425	0.3351	0.9518	
country_birthWales	0.0241	-0.0938	0.1421	1.0244	0.9104	1.1526	0.6887	0.4783	0.7431	
summer_outdoors_time	-0.0055	-0.0227	0.0116	0.9945	0.9776	1.0117	0.5252	0.5297	0.5982	
country_birthNorthern Ireland	0.1222	-0.0718	0.3163	1.1300	0.9307	1.3720	0.2169	0.1111	0.2679	
depressed_whole_weekYes	0.0103	-0.2187	0.2394	1.0104	0.8035	1.2705	0.9085	0.0015	0.9295	
country_birthElsewhere	-0.0108	-0.1004	0.0789	0.9893	0.9045	1.0821	0.8140	0.0460	0.8557	
handednessLeft-handed	0.0260	-0.0280	0.0799	1.0263	0.9724	1.0832	0.3454	0.6016	0.4046	
speakerphone	-0.0690	-0.1686	0.0307	0.9334	0.8448	1.0312	0.1653	0.2129	0.2118	

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
traffic_intensity_nearest_road	0.0033	-0.0119	0.0186	1.0033	0.9882	1.0188	0.6673	0.4118	0.7277	
family_satisfaction	-0.4322	-0.8271	-0.0373	0.6491	0.4373	0.9634	0.0378	0.0971	0.0538	
financial_satisfaction	-0.6539	-1.4045	0.0966	0.5200	0.2455	1.1015	0.0734	0.0589	0.1003	
divorceYes	0.0479	-0.0622	0.1581	1.0491	0.9397	1.1713	0.3936	0.0086	0.4584	
happiness	-0.5284	-1.1446	0.0879	0.5896	0.3183	1.0919	0.0775	0.1346	0.1046	
vitamin_C_supplementsYes	0.0279	-0.0277	0.0834	1.0283	0.9727	1.0870	0.3250	0.2091	0.3851	
job_satisfaction	-0.1526	-0.6941	0.3888	0.8584	0.4995	1.4752	0.4939	0.3166	0.5688	
vitamin_D_supplementsYes	0.0407	-0.0380	0.1193	1.0415	0.9627	1.1267	0.3111	0.0573	0.3708	
adult_educationYes	-0.0519	-0.1176	0.0138	0.9494	0.8891	1.0139	0.1213	0.0003	0.1594	
hair_colorBlonde	0.0407	-0.0131	0.0945	1.0416	0.9870	1.0991	0.1380	0.0254	0.1791	
sensitivityYes	-0.0050	-0.0375	0.0275	0.9950	0.9632	1.0279	0.7622	0.5565	0.8181	
hair_colorRed	0.0258	-0.0558	0.1075	1.0262	0.9457	1.1134	0.5354	0.0704	0.6064	
water_buffer_300m	0.0103	-0.0049	0.0254	1.0103	0.9951	1.0257	0.1841	0.9689	0.2315	
guilty_feelingsYes	0.0142	-0.0226	0.0510	1.0143	0.9776	1.0523	0.4498	0.0935	0.5210	

Table S4. Pooled XWAS output with women and men (n=436,891)

Exposure	Beta	Beta_2.5%	Beta_97.5%	Hazard.Ratio	HR_2.5%	HR_97.5%	p.value	p.value.rep	FDR.disc	FDR.rep
irritableYes	0.1727	-0.1705	0.5159	1.1885	0.8433	1.6751	0.2405	0.1464	0.2935	
manicYes	0.1470	-0.1646	0.4585	1.1583	0.8482	1.5817	0.2841	0.1104	0.3406	
water_buffer_1000 m	0.0092	-0.0068	0.0252	1.0092	0.9933	1.0255	0.2588	0.4250	0.3121	
skin_colorBlack	-0.0315	-0.3233	0.2603	0.9690	0.7238	1.2973	0.8324	0.0184	0.8707	
winter_outdoors_ti me	-0.0166	-0.0337	0.0004	0.9835	0.9669	1.0004	0.0556	0.8697	0.0775	
distance_to_coast	-0.0130	-0.0654	0.0395	0.9871	0.9367	1.0403	0.6282	0.5106	0.6998	
pubYes	0.0086	-0.0271	0.0442	1.0086	0.9733	1.0452	0.6373	0.0480	0.7062	
selenium_supplem entsYes	-0.0071	-0.1072	0.0931	0.9929	0.8983	1.0975	0.8895	0.6881	0.9164	
vitamin_A_supple mentsYes	0.0368	-0.0695	0.1430	1.0375	0.9329	1.1538	0.4969	0.5138	0.5691	
zinc_supplementsY es	-0.0701	-0.1544	0.0141	0.9323	0.8569	1.0142	0.1027	0.0069	0.1367	
death_relativeYes	-0.0106	-0.0500	0.0288	0.9895	0.9512	1.0293	0.5986	0.2709	0.6705	
skin_colorBrown	0.0048	-0.1438	0.1533	1.0048	0.8661	1.1657	0.9498	0.0032	0.9545	
skin_colorDark olive	0.0871	-0.0255	0.1998	1.0910	0.9748	1.2211	0.1295	0.1684	0.1690	

Table S5. Alanine aminotransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0021	-0.0068	0.0027	0.3969	0.4184	0.0024	-0.8475
alcohol_freqDaily or almost daily	0.0155	0.0106	0.0205	0.0000	0.0000	0.0025	6.1338
alcohol_freqOnce or twice a week	-0.0036	-0.0082	0.0009	0.1201	0.1464	0.0023	-1.5544
bread	0.0050	0.0023	0.0078	0.0003	0.0005	0.0014	3.6477
cereal	-0.0183	-0.0209	-0.0158	0.0000	0.0000	0.0013	-14.0844
never_eat_dairyYes	-0.0253	-0.0344	-0.0162	0.0000	0.0000	0.0046	-5.4868
never_eat_eggsYes	-0.0100	-0.0181	-0.0019	0.0151	0.0227	0.0041	-2.4399
never_eat_sugarYes	0.0255	0.0221	0.0289	0.0000	0.0000	0.0017	14.6158
partial_fiber_score	-0.0072	-0.0101	-0.0042	0.0000	0.0000	0.0015	-4.7794
poultry	0.0599	0.0565	0.0632	0.0000	0.0000	0.0017	34.9299
processed_meat	0.0478	0.0448	0.0509	0.0000	0.0000	0.0016	30.5074
red_meat	0.0557	0.0526	0.0588	0.0000	0.0000	0.0016	34.9565
salt	0.0120	0.0086	0.0154	0.0000	0.0000	0.0017	6.9308
body_size_10yrs_oldThinner	0.0128	0.0098	0.0159	0.0000	0.0000	0.0015	8.2828
body_size_10yrs_oldPlumper	0.0365	0.0327	0.0403	0.0000	0.0000	0.0019	18.9725
height_10yrs_oldShorter	0.0072	0.0038	0.0107	0.0000	0.0001	0.0017	4.1664
height_10yrs_oldTaller	-0.0034	-0.0066	-0.0001	0.0415	0.0572	0.0016	-2.0462

Table S5. Alanine aminotransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0177	0.0138	0.0215	0.0000	0.0000	0.0019	9.4233
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0132	-0.0245	-0.0019	0.0217	0.0319	0.0057	-2.3063
mobile_phone_2yrsYes, use is now less frequent	0.0233	0.0171	0.0295	0.0000	0.0000	0.0029	7.9670
mobile_phone_2yrsYes, use is now more frequent	0.0050	-0.0025	0.0126	0.1570	0.1827	0.0032	1.6002
employedYes	0.0036	0.0002	0.0069	0.0369	0.0523	0.0017	2.0932
unemployedYes	0.0149	0.0051	0.0248	0.0031	0.0050	0.0050	2.9822
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0244	-0.0114	0.0603	0.1814	0.2051	0.0183	1.3365
accommodation_typeA flat, maisonette or apartment	0.0098	0.0048	0.0148	0.0001	0.0003	0.0026	3.8407
gas_hob_heatYes	0.0002	-0.0027	0.0032	0.8750	0.8750	0.0015	0.1574
hshld_income	0.0039	-0.0004	0.0082	0.0730	0.0965	0.0022	1.7952
hshld_parentsYes	0.0076	-0.0021	0.0174	0.1247	0.1497	0.0050	1.5385
hshld_partnerYes	0.0025	-0.0004	0.0054	0.0952	0.1218	0.0015	1.6685
hshld_siblingsYes	0.0118	-0.0048	0.0283	0.1650	0.1893	0.0085	1.3896
hshld_vehicles	0.0232	0.0182	0.0281	0.0000	0.0000	0.0025	9.2154

Table S5. Alanine aminotransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0231	0.0157	0.0305	0.0000	0.0000	0.0038	6.0929
own_or_rentPay part rent and part mortgage (shared ownership)	0.0232	-0.0006	0.0470	0.0560	0.0753	0.0121	1.9137
own_or_rentOwn with a mortgage	0.0199	0.0167	0.0231	0.0000	0.0000	0.0016	12.1741
own_or_rentRent - from local authority, local council, housing association	0.0184	0.0123	0.0246	0.0000	0.0000	0.0031	5.9132
own_or_rentLive in accommodation rent free	0.0192	0.0040	0.0345	0.0135	0.0207	0.0078	2.4704
townsend_deprivation_index	0.0046	0.0030	0.0062	0.0000	0.0000	0.0008	5.6252
psychiatrist_visit_mental_healthYes	0.0011	-0.0031	0.0053	0.6223	0.6340	0.0021	0.4928
risk_takingYes	0.0156	0.0125	0.0186	0.0000	0.0000	0.0016	10.0253
tiredness_freq	0.0294	0.0258	0.0330	0.0000	0.0000	0.0018	15.9307
unenthusiasm_freq	0.0200	0.0152	0.0247	0.0000	0.0000	0.0024	8.2113
fast_driving	0.0257	0.0205	0.0308	0.0000	0.0000	0.0026	9.8459
gymYes	-0.0137	-0.0167	-0.0107	0.0000	0.0000	0.0015	-8.9296
LTPA	-0.0307	-0.0352	-0.0262	0.0000	0.0000	0.0021	-14.2986
sedentary	0.0535	0.0512	0.0559	0.0000	0.0000	0.0012	44.3420
air_pollution_PC1	0.0010	0.0003	0.0016	0.0030	0.0050	0.0003	2.9643

Table S5. Alanine aminotransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0004	-0.0003	0.0012	0.2664	0.2927	0.0004	1.1116
number_sex_partners	0.0025	0.0010	0.0041	0.0015	0.0025	0.0008	3.3356
sex_age_first	-0.0159	-0.0173	-0.0144	0.0000	0.0000	0.0007	-21.2151
chronotypeDefinitely an 'evening' person	0.0177	0.0122	0.0231	0.0000	0.0000	0.0028	6.4088
chronotypeDefinitely a 'morning' person	0.0078	0.0028	0.0128	0.0044	0.0068	0.0024	3.3217
chronotypeMore an 'evening' than a 'morning' person	0.0048	-0.0008	0.0104	0.0857	0.1114	0.0026	1.8897
nap	0.0299	0.0267	0.0331	0.0000	0.0000	0.0016	18.2520
sleep_hours_categorical>9 hours	0.0229	0.0180	0.0279	0.0000	0.0000	0.0025	9.1052
sleep_hours_categorical<7 hours	0.0162	0.0132	0.0193	0.0000	0.0000	0.0015	10.5090
family_visit_freq	0.0221	0.0158	0.0284	0.0000	0.0000	0.0032	6.8920
religious_groupYes	-0.0099	-0.0137	-0.0061	0.0000	0.0000	0.0019	-5.1411
facial_agingAbout your age	0.0023	-0.0020	0.0066	0.2748	0.2977	0.0020	1.1211
facial_agingOlder than you are	0.0073	-0.0042	0.0188	0.2051	0.2285	0.0057	1.2880
skin_colorDark olive	0.0103	0.0008	0.0198	0.0329	0.0475	0.0048	2.1334
skin_colorLight olive	-0.0015	-0.0049	0.0018	0.3706	0.3960	0.0017	-0.8955
skin_colorBlack	-0.0049	-0.0246	0.0148	0.6259	0.6340	0.0100	-0.4876
skin_colorBrown	0.0085	-0.0032	0.0202	0.1527	0.1805	0.0059	1.4344

Table S5. Alanine aminotransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0056	0.0002	0.0110	0.0418	0.0572	0.0027	2.0564
sun_protection_use	0.0076	0.0027	0.0126	0.0027	0.0045	0.0025	3.0466
fish_oil_supplementsYes	0.0023	-0.0006	0.0052	0.1192	0.1464	0.0015	1.5604
folate_supplementsYes	-0.0073	-0.0164	0.0017	0.1129	0.1421	0.0046	-1.5879
glucosamine_supplementsYes	-0.0060	-0.0093	-0.0027	0.0004	0.0007	0.0017	-3.5453
multivitamin_supplementsYes	0.0259	0.0227	0.0291	0.0000	0.0000	0.0016	15.8947
pack_years_prop	0.0136	0.0119	0.0153	0.0000	0.0000	0.0008	16.4436
smoking_statusPrevious	0.0272	0.0243	0.0300	0.0000	0.0000	0.0014	18.8914
smoking_statusCurrent	-0.0525	-0.0570	-0.0480	0.0000	0.0000	0.0023	-22.9382
IPAQ_activity_group	-0.0436	-0.0473	-0.0398	0.0000	0.0000	0.0018	-24.8002
education_years	-0.0306	-0.0336	-0.0276	0.0000	0.0000	0.0015	-20.1076
ethnicityAsian	0.0132	0.0042	0.0221	0.0039	0.0062	0.0045	2.8974
ethnicityBlack	-0.0184	-0.0284	-0.0084	0.0003	0.0006	0.0051	-3.6018
ethnicityMixed	0.0048	-0.0122	0.0217	0.5829	0.6063	0.0087	0.5492
ethnicityOther	0.0271	0.0134	0.0407	0.0001	0.0002	0.0070	3.8885

Table S6. Albumin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.0085	0.0078	0.0092	0.0000	0.0000	0.0003	24.5138
alcohol_freqDaily or almost daily	0.0100	0.0093	0.0107	0.0000	0.0000	0.0004	27.0487
alcohol_freqOnce or twice a week	0.0040	0.0034	0.0046	0.0000	0.0000	0.0003	12.8080
bread	-0.0034	-0.0039	-0.0029	0.0000	0.0000	0.0002	-14.8480
cereal	-0.0008	-0.0011	-0.0005	0.0000	0.0000	0.0002	-4.5952
never_eat_dairyYes	-0.0010	-0.0023	0.0002	0.0953	0.1004	0.0006	-1.6762
never_eat_eggsYes	-0.0014	-0.0024	-0.0003	0.0094	0.0108	0.0005	-2.5982
never_eat_sugarYes	0.0019	0.0014	0.0023	0.0000	0.0000	0.0002	8.1563
partial_fiber_score	0.0023	0.0018	0.0027	0.0000	0.0000	0.0002	10.2032
poultry	0.0024	0.0019	0.0028	0.0000	0.0000	0.0002	9.8330
processed_meat	-0.0023	-0.0027	-0.0019	0.0000	0.0000	0.0002	-10.6886
red_meat	0.0010	0.0005	0.0015	0.0002	0.0003	0.0003	4.0030
salt	-0.0029	-0.0034	-0.0024	0.0000	0.0000	0.0002	-11.8399
body_size_10yrs_oldThinner	0.0017	0.0013	0.0021	0.0000	0.0000	0.0002	7.9671
body_size_10yrs_oldPlumper	-0.0071	-0.0076	-0.0065	0.0000	0.0000	0.0003	-25.4850
height_10yrs_oldShorter	0.0021	0.0016	0.0025	0.0000	0.0000	0.0002	8.8816
height_10yrs_oldTaller	-0.0024	-0.0029	-0.0020	0.0000	0.0000	0.0002	-10.9506

Table S6. Albumin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0019	-0.0024	-0.0015	0.0000	0.0000	0.0002	-8.5609
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0007	-0.0024	0.0010	0.4035	0.4141	0.0008	-0.8401
mobile_phone_2yrsYes, use is now less frequent	-0.0013	-0.0020	-0.0006	0.0008	0.0010	0.0004	-3.7221
mobile_phone_2yrsYes, use is now more frequent	-0.0017	-0.0024	-0.0010	0.0004	0.0005	0.0003	-5.2147
employedYes	-0.0012	-0.0016	-0.0007	0.0000	0.0000	0.0002	-5.0647
unemployedYes	-0.0033	-0.0046	-0.0019	0.0000	0.0000	0.0007	-4.8224
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0017	-0.0070	0.0035	0.5153	0.5220	0.0027	-0.6522
accommodation_typeA flat, maisonette or apartment	-0.0041	-0.0048	-0.0035	0.0000	0.0000	0.0003	-12.3547
gas_hob_heatYes	0.0003	-0.0001	0.0006	0.1863	0.1938	0.0002	1.3216
hshld_income	0.0082	0.0076	0.0089	0.0000	0.0000	0.0003	26.1712
hshld_parentsYes	-0.0042	-0.0055	-0.0028	0.0000	0.0000	0.0007	-6.0655
hshld_partnerYes	0.0063	0.0058	0.0068	0.0000	0.0000	0.0002	27.2062
hshld_siblingsYes	-0.0056	-0.0078	-0.0033	0.0000	0.0000	0.0011	-4.8980
hshld_vehicles	0.0065	0.0058	0.0073	0.0000	0.0000	0.0004	17.9891

Table S6. Albumin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0059	-0.0071	-0.0048	0.0000	0.0000	0.0006	-10.5478
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0056	-0.0090	-0.0022	0.0013	0.0016	0.0017	-3.2704
own_or_rentOwn with a mortgage	-0.0019	-0.0024	-0.0014	0.0000	0.0000	0.0002	-8.0242
own_or_rentRent - from local authority, local council, housing association	-0.0098	-0.0106	-0.0089	0.0000	0.0000	0.0004	-23.3080
own_or_rentLive in accommodation rent free	-0.0043	-0.0064	-0.0021	0.0001	0.0001	0.0011	-3.9419
townsend_deprivation_index	-0.0032	-0.0034	-0.0029	0.0000	0.0000	0.0001	-29.5853
psychiatrist_visit_mental_healthYes	-0.0022	-0.0028	-0.0016	0.0000	0.0000	0.0003	-7.0052
risk_takingYes	-0.0038	-0.0042	-0.0033	0.0000	0.0000	0.0002	-17.8642
tiredness_freq	-0.0076	-0.0081	-0.0071	0.0000	0.0000	0.0003	-30.0394
unenthusiasm_freq	-0.0055	-0.0062	-0.0049	0.0000	0.0000	0.0003	-16.6528
fast_driving	-0.0000	-0.0007	0.0007	0.9602	0.9602	0.0004	-0.0500
gymYes	0.0009	0.0004	0.0013	0.0002	0.0002	0.0002	3.8929
LTPA	0.0027	0.0022	0.0032	0.0000	0.0000	0.0003	10.8367
sedentary	-0.0023	-0.0026	-0.0020	0.0000	0.0000	0.0002	-13.9163
air_pollution_PC1	-0.0010	-0.0011	-0.0009	0.0000	0.0000	0.0000	-21.2515

Table S6. Albumin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0010	0.0009	0.0011	0.0000	0.0000	0.0001	16.5937
number_sex_partners	-0.0004	-0.0006	-0.0001	0.0037	0.0043	0.0001	-3.2525
sex_age_first	-0.0002	-0.0004	-0.0000	0.0281	0.0309	0.0001	-2.2140
chronotypeDefinitely an 'evening' person	-0.0048	-0.0055	-0.0041	0.0000	0.0000	0.0004	-12.9000
chronotypeDefinitely a 'morning' person	-0.0014	-0.0019	-0.0009	0.0000	0.0000	0.0002	-6.0414
chronotypeMore an 'evening' than a 'morning' person	-0.0013	-0.0018	-0.0008	0.0000	0.0000	0.0002	-5.4558
nap	-0.0045	-0.0049	-0.0040	0.0000	0.0000	0.0002	-20.0897
sleep_hours_categorical>9 hours	-0.0025	-0.0032	-0.0018	0.0000	0.0000	0.0004	-6.9352
sleep_hours_categorical<7 hours	-0.0022	-0.0027	-0.0018	0.0000	0.0000	0.0002	-10.7373
family_visit_freq	-0.0009	-0.0019	-0.0000	0.0500	0.0541	0.0005	-1.9889
religious_groupYes	-0.0035	-0.0040	-0.0030	0.0000	0.0000	0.0003	-13.3363
facial_agingAbout your age	-0.0021	-0.0025	-0.0017	0.0000	0.0000	0.0002	-9.7271
facial_agingOlder than you are	-0.0094	-0.0118	-0.0070	0.0000	0.0000	0.0011	-8.7255
skin_colorDark olive	-0.0012	-0.0025	0.0002	0.0925	0.0988	0.0007	-1.6872
skin_colorLight olive	0.0007	0.0002	0.0012	0.0064	0.0075	0.0003	2.7833
skin_colorBlack	-0.0031	-0.0058	-0.0003	0.0280	0.0309	0.0014	-2.2027
skin_colorBrown	-0.0032	-0.0047	-0.0017	0.0000	0.0001	0.0008	-4.1002

Table S6. Albumin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.0023	-0.0030	-0.0016	0.0000	0.0000	0.0003	-6.5734
sun_protection_use	0.0055	0.0049	0.0062	0.0000	0.0000	0.0003	16.2174
fish_oil_supplementsYes	0.0039	0.0035	0.0043	0.0000	0.0000	0.0002	19.6719
folate_supplementsYes	-0.0060	-0.0074	-0.0046	0.0000	0.0000	0.0007	-8.5219
glucosamine_supplementsYes	0.0024	0.0019	0.0029	0.0000	0.0000	0.0002	9.6799
multivitamin_supplementsYes	0.0015	0.0010	0.0019	0.0000	0.0000	0.0002	6.6277
pack_years_prop	-0.0029	-0.0031	-0.0027	0.0000	0.0000	0.0001	-26.7795
smoking_statusPrevious	-0.0004	-0.0008	-0.0001	0.0224	0.0253	0.0002	-2.2853
smoking_statusCurrent	-0.0072	-0.0078	-0.0065	0.0000	0.0000	0.0003	-21.7913
IPAQ_activity_group	0.0035	0.0031	0.0040	0.0000	0.0000	0.0002	16.3117
education_years	0.0019	0.0015	0.0023	0.0000	0.0000	0.0002	8.8514
ethnicityAsian	-0.0111	-0.0124	-0.0098	0.0000	0.0000	0.0006	-17.1947
ethnicityBlack	-0.0228	-0.0244	-0.0212	0.0000	0.0000	0.0008	-28.1289
ethnicityMixed	-0.0068	-0.0091	-0.0044	0.0000	0.0000	0.0012	-5.6131
ethnicityOther	-0.0069	-0.0088	-0.0051	0.0000	0.0000	0.0010	-7.2454

Table S7. Alkaline phosphatase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0539	-0.0570	-0.0509	0.0000	0.0000	0.0016	-34.5599
alcohol_freqDaily or almost daily	-0.0700	-0.0731	-0.0668	0.0000	0.0000	0.0016	-43.9212
alcohol_freqOnce or twice a week	-0.0253	-0.0283	-0.0224	0.0000	0.0000	0.0015	-17.0641
bread	0.0221	0.0204	0.0238	0.0000	0.0000	0.0009	25.0328
cereal	0.0001	-0.0016	0.0017	0.9465	0.9588	0.0009	0.0672
never_eat_dairyYes	0.0153	0.0100	0.0207	0.0000	0.0000	0.0027	5.6129
never_eat_eggsYes	0.0235	0.0184	0.0286	0.0000	0.0000	0.0026	9.0401
never_eat_sugarYes	-0.0132	-0.0154	-0.0111	0.0000	0.0000	0.0011	-11.8868
partial_fiber_score	-0.0168	-0.0188	-0.0149	0.0000	0.0000	0.0010	-16.8997
poultry	-0.0033	-0.0055	-0.0012	0.0023	0.0028	0.0011	-3.0527
processed_meat	0.0171	0.0151	0.0191	0.0000	0.0000	0.0010	16.8741
red_meat	0.0027	0.0008	0.0047	0.0065	0.0079	0.0010	2.7215
salt	0.0067	0.0045	0.0089	0.0000	0.0000	0.0011	5.9323
body_size_10yrs_oldThinner	0.0077	0.0056	0.0097	0.0000	0.0000	0.0010	7.4313
body_size_10yrs_oldPlumper	0.0120	0.0097	0.0144	0.0000	0.0000	0.0012	9.9689
height_10yrs_oldShorter	0.0024	0.0002	0.0047	0.0368	0.0423	0.0012	2.1046
height_10yrs_oldTaller	-0.0012	-0.0033	0.0008	0.2424	0.2590	0.0010	-1.1710

Table S7. Alkaline phosphatase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0057	0.0038	0.0075	0.0000	0.0000	0.0009	5.9885
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0162	0.0052	0.0272	0.0072	0.0087	0.0051	3.1690
mobile_phone_2yrsYes, use is now less frequent	0.0070	0.0035	0.0104	0.0003	0.0004	0.0017	4.1568
mobile_phone_2yrsYes, use is now more frequent	-0.0024	-0.0066	0.0017	0.2070	0.2243	0.0018	-1.3793
employedYes	-0.0156	-0.0177	-0.0136	0.0000	0.0000	0.0011	-14.8117
unemployedYes	0.0399	0.0336	0.0462	0.0000	0.0000	0.0032	12.4186
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0530	0.0305	0.0755	0.0000	0.0000	0.0115	4.6184
accommodation_typeA flat, maisonette or apartment	0.0273	0.0241	0.0305	0.0000	0.0000	0.0016	16.9135
gas_hob_heatYes	-0.0049	-0.0067	-0.0031	0.0000	0.0000	0.0009	-5.2273
hshld_income	-0.0710	-0.0740	-0.0680	0.0000	0.0000	0.0015	-47.0827
hshld_parentsYes	0.0245	0.0186	0.0305	0.0000	0.0000	0.0030	8.0896
hshld_partnerYes	-0.0243	-0.0262	-0.0224	0.0000	0.0000	0.0010	-24.8802
hshld_siblingsYes	0.0313	0.0208	0.0417	0.0000	0.0000	0.0053	5.8843
hshld_vehicles	-0.0426	-0.0457	-0.0394	0.0000	0.0000	0.0016	-26.6799

Table S7. Alkaline phosphatase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0315	0.0266	0.0364	0.0000	0.0000	0.0025	12.6181
own_or_rentPay part rent and part mortgage (shared ownership)	0.0280	0.0130	0.0431	0.0003	0.0004	0.0077	3.6546
own_or_rentOwn with a mortgage	0.0045	0.0023	0.0067	0.0001	0.0001	0.0011	4.0510
own_or_rentRent - from local authority, local council, housing association	0.0705	0.0664	0.0745	0.0000	0.0000	0.0020	34.4809
own_or_rentLive in accommodation rent free	0.0174	0.0076	0.0272	0.0005	0.0006	0.0050	3.4970
townsend_deprivation_index	0.0158	0.0148	0.0167	0.0000	0.0000	0.0005	32.3687
psychiatrist_visit_mental_healthYes	0.0148	0.0122	0.0174	0.0000	0.0000	0.0013	11.1349
risk_takingYes	-0.0024	-0.0047	-0.0002	0.0367	0.0423	0.0011	-2.1582
tiredness_freq	0.0345	0.0322	0.0368	0.0000	0.0000	0.0012	29.2849
unenthusiasm_freq	0.0325	0.0289	0.0361	0.0000	0.0000	0.0018	18.1736
fast_driving	-0.0485	-0.0515	-0.0454	0.0000	0.0000	0.0016	-31.0360
gymYes	-0.0268	-0.0287	-0.0248	0.0000	0.0000	0.0010	-26.7187
LTPA	-0.0210	-0.0235	-0.0185	0.0000	0.0000	0.0012	-17.2584
sedentary	0.0246	0.0231	0.0261	0.0000	0.0000	0.0008	31.4414
air_pollution_PC1	0.0033	0.0029	0.0037	0.0000	0.0000	0.0002	15.3151

Table S7. Alkaline phosphatase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	-0.0030	-0.0035	-0.0026	0.0000	0.0000	0.0002	-12.5119
number_sex_partners	0.0006	-0.0002	0.0015	0.1426	0.1566	0.0004	1.4683
sex_age_first	-0.0001	-0.0011	0.0009	0.8292	0.8510	0.0005	-0.2166
chronotypeDefinitely an 'evening' person	0.0147	0.0112	0.0182	0.0000	0.0000	0.0018	8.2832
chronotypeDefinitely a 'morning' person	0.0050	0.0025	0.0076	0.0003	0.0004	0.0013	3.9717
chronotypeMore an 'evening' than a 'morning' person	0.0044	0.0022	0.0067	0.0001	0.0002	0.0011	3.9744
nap	0.0196	0.0176	0.0217	0.0000	0.0000	0.0010	18.7835
sleep_hours_categorical>9 hours	0.0259	0.0227	0.0291	0.0000	0.0000	0.0016	15.8783
sleep_hours_categorical<7 hours	0.0153	0.0133	0.0172	0.0000	0.0000	0.0010	15.0419
family_visit_freq	0.0011	-0.0033	0.0055	0.6248	0.6498	0.0022	0.4911
religious_groupYes	0.0022	-0.0001	0.0045	0.0585	0.0662	0.0012	1.8920
facial_agingAbout your age	0.0047	0.0025	0.0068	0.0000	0.0000	0.0011	4.3288
facial_agingOlder than you are	0.0271	0.0192	0.0349	0.0000	0.0000	0.0038	7.0812
skin_colorDark olive	-0.0000	-0.0064	0.0064	0.9925	0.9925	0.0033	-0.0095
skin_colorLight olive	-0.0085	-0.0110	-0.0061	0.0000	0.0000	0.0012	-7.0255
skin_colorBlack	0.0124	-0.0012	0.0260	0.0738	0.0822	0.0069	1.8014
skin_colorBrown	0.0151	0.0079	0.0223	0.0000	0.0001	0.0037	4.1085

Table S7. Alkaline phosphatase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0106	0.0073	0.0138	0.0000	0.0000	0.0016	6.4122
sun_protection_use	-0.0239	-0.0268	-0.0210	0.0000	0.0000	0.0015	-16.1043
fish_oil_supplementsYes	-0.0206	-0.0225	-0.0188	0.0000	0.0000	0.0010	-21.5566
folate_supplementsYes	0.0024	-0.0032	0.0079	0.3997	0.4213	0.0028	0.8422
glucosamine_supplementsYes	-0.0187	-0.0208	-0.0165	0.0000	0.0000	0.0011	-16.9248
multivitamin_supplementsYes	-0.0142	-0.0162	-0.0121	0.0000	0.0000	0.0010	-13.6413
pack_years_prop	0.0206	0.0193	0.0219	0.0000	0.0000	0.0006	33.6932
smoking_statusPrevious	-0.0023	-0.0041	-0.0005	0.0110	0.0130	0.0009	-2.5456
smoking_statusCurrent	0.0602	0.0573	0.0632	0.0000	0.0000	0.0015	40.1833
IPAQ_activity_group	-0.0244	-0.0269	-0.0219	0.0000	0.0000	0.0012	-20.7492
education_years	-0.0490	-0.0509	-0.0471	0.0000	0.0000	0.0010	-51.2206
ethnicityAsian	0.0743	0.0684	0.0801	0.0000	0.0000	0.0030	25.0755
ethnicityBlack	0.0501	0.0430	0.0573	0.0000	0.0000	0.0036	13.9175
ethnicityMixed	0.0172	0.0064	0.0281	0.0018	0.0023	0.0055	3.1200
ethnicityOther	0.0485	0.0399	0.0571	0.0000	0.0000	0.0044	11.0795

Table S8. Apolipoprotein A

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.0780	0.0761	0.0798	0.0000	0.0000	0.0009	84.3233
alcohol_freqDaily or almost daily	0.1220	0.1201	0.1239	0.0000	0.0000	0.0010	126.8585
alcohol_freqOnce or twice a week	0.0303	0.0286	0.0319	0.0000	0.0000	0.0008	35.8415
bread	-0.0089	-0.0099	-0.0078	0.0000	0.0000	0.0005	-17.2267
cereal	-0.0216	-0.0226	-0.0207	0.0000	0.0000	0.0005	-45.2740
never_eat_dairyYes	-0.0094	-0.0126	-0.0062	0.0000	0.0000	0.0016	-5.7341
never_eat_eggsYes	-0.0162	-0.0194	-0.0129	0.0000	0.0000	0.0016	-9.9047
never_eat_sugarYes	0.0019	0.0007	0.0031	0.0028	0.0034	0.0006	2.9917
partial_fiber_score	-0.0180	-0.0192	-0.0168	0.0000	0.0000	0.0006	-30.1405
poultry	-0.0061	-0.0075	-0.0048	0.0000	0.0000	0.0007	-8.9054
processed_meat	0.0008	-0.0004	0.0020	0.1849	0.2003	0.0006	1.3285
red_meat	0.0050	0.0038	0.0061	0.0000	0.0000	0.0006	8.2859
salt	0.0079	0.0067	0.0092	0.0000	0.0000	0.0006	12.2630
body_size_10yrs_oldThinner	0.0009	-0.0002	0.0020	0.1146	0.1277	0.0006	1.5794
body_size_10yrs_oldPlumper	-0.0185	-0.0198	-0.0171	0.0000	0.0000	0.0007	-26.3558
height_10yrs_oldShorter	0.0090	0.0078	0.0103	0.0000	0.0000	0.0006	14.2625
height_10yrs_oldTaller	-0.0070	-0.0081	-0.0058	0.0000	0.0000	0.0006	-11.9141

Table S8. Apolipoprotein A

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0026	-0.0038	-0.0013	0.0002	0.0002	0.0006	-4.0356
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0047	-0.0117	0.0023	0.1697	0.1865	0.0032	-1.4687
mobile_phone_2yrsYes, use is now less frequent	-0.0085	-0.0105	-0.0065	0.0000	0.0000	0.0010	-8.6963
mobile_phone_2yrsYes, use is now more frequent	-0.0009	-0.0023	0.0005	0.1932	0.2064	0.0007	-1.3292
employedYes	-0.0012	-0.0025	0.0000	0.0580	0.0656	0.0006	-1.9006
unemployedYes	-0.0078	-0.0112	-0.0043	0.0000	0.0000	0.0018	-4.3499
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0251	-0.0388	-0.0113	0.0004	0.0005	0.0070	-3.5851
accommodation_typeA flat, maisonette or apartment	-0.0083	-0.0102	-0.0064	0.0000	0.0000	0.0010	-8.6722
gas_hob_heatYes	0.0006	-0.0004	0.0017	0.2486	0.2586	0.0005	1.1538
hshld_income	0.0290	0.0272	0.0307	0.0000	0.0000	0.0009	32.4800
hshld_parentsYes	-0.0067	-0.0104	-0.0029	0.0005	0.0007	0.0019	-3.5227
hshld_partnerYes	0.0047	0.0036	0.0059	0.0000	0.0000	0.0006	7.9775
hshld_siblingsYes	-0.0081	-0.0147	-0.0015	0.0163	0.0193	0.0033	-2.4310
hshld_vehicles	0.0135	0.0117	0.0154	0.0000	0.0000	0.0009	14.3616

Table S8. Apolipoprotein A

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0192	-0.0220	-0.0163	0.0000	0.0000	0.0015	-13.1455
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0180	-0.0268	-0.0093	0.0001	0.0001	0.0045	-4.0477
own_or_rentOwn with a mortgage	-0.0097	-0.0110	-0.0085	0.0000	0.0000	0.0006	-15.8476
own_or_rentRent - from local authority, local council, housing association	-0.0342	-0.0369	-0.0316	0.0000	0.0000	0.0013	-25.8987
own_or_rentLive in accommodation rent free	-0.0180	-0.0238	-0.0123	0.0000	0.0000	0.0029	-6.1760
townsend_deprivation_index	-0.0075	-0.0081	-0.0070	0.0000	0.0000	0.0003	-26.5520
psychiatrist_visit_mental_healthYes	-0.0053	-0.0069	-0.0037	0.0000	0.0000	0.0008	-6.5048
risk_takingYes	-0.0007	-0.0019	0.0004	0.2109	0.2223	0.0006	-1.2545
tiredness_freq	-0.0248	-0.0263	-0.0234	0.0000	0.0000	0.0007	-34.2902
unenthusiasm_freq	-0.0150	-0.0168	-0.0132	0.0000	0.0000	0.0009	-16.4199
fast_driving	0.0123	0.0105	0.0141	0.0000	0.0000	0.0009	13.3454
gymYes	0.0138	0.0126	0.0150	0.0000	0.0000	0.0006	23.3946
LTPA	0.0248	0.0228	0.0268	0.0000	0.0000	0.0009	27.3608
sedentary	-0.0228	-0.0237	-0.0218	0.0000	0.0000	0.0005	-47.2544
air_pollution_PC1	-0.0021	-0.0024	-0.0018	0.0000	0.0000	0.0001	-16.1618

Table S8. Apolipoprotein A

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0031	0.0028	0.0034	0.0000	0.0000	0.0001	21.0533
number_sex_partners	-0.0001	-0.0006	0.0004	0.7939	0.8042	0.0003	-0.2614
sex_age_first	0.0006	0.0001	0.0012	0.0199	0.0231	0.0003	2.3369
chronotypeDefinitely an 'evening' person	-0.0076	-0.0097	-0.0054	0.0000	0.0000	0.0011	-7.0570
chronotypeDefinitely a 'morning' person	-0.0037	-0.0053	-0.0021	0.0001	0.0001	0.0008	-4.7194
chronotypeMore an 'evening' than a 'morning' person	0.0003	-0.0011	0.0018	0.6291	0.6457	0.0007	0.4863
nap	-0.0243	-0.0255	-0.0231	0.0000	0.0000	0.0006	-39.7433
sleep_hours_categorical>9 hours	-0.0109	-0.0128	-0.0090	0.0000	0.0000	0.0010	-11.0987
sleep_hours_categorical<7 hours	-0.0029	-0.0041	-0.0018	0.0000	0.0000	0.0006	-5.1236
family_visit_freq	-0.0029	-0.0051	-0.0006	0.0124	0.0149	0.0012	-2.5008
religious_groupYes	-0.0150	-0.0164	-0.0137	0.0000	0.0000	0.0007	-21.4456
facial_agingAbout your age	-0.0052	-0.0064	-0.0040	0.0000	0.0000	0.0006	-8.6765
facial_agingOlder than you are	-0.0177	-0.0218	-0.0136	0.0000	0.0000	0.0021	-8.5985
skin_colorDark olive	0.0003	-0.0037	0.0043	0.8712	0.8712	0.0020	0.1626
skin_colorLight olive	0.0045	0.0032	0.0058	0.0000	0.0000	0.0007	6.7958
skin_colorBlack	-0.0089	-0.0165	-0.0013	0.0218	0.0251	0.0039	-2.3007
skin_colorBrown	-0.0083	-0.0127	-0.0039	0.0002	0.0003	0.0022	-3.7485

Table S8. Apolipoprotein A

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.0069	-0.0090	-0.0049	0.0000	0.0000	0.0010	-6.7186
sun_protection_use	0.0063	0.0044	0.0082	0.0000	0.0000	0.0010	6.5022
fish_oil_supplementsYes	0.0129	0.0116	0.0142	0.0000	0.0000	0.0006	20.6296
folate_supplementsYes	0.0087	0.0051	0.0123	0.0000	0.0000	0.0018	4.7494
glucosamine_supplementsYes	0.0134	0.0122	0.0147	0.0000	0.0000	0.0006	21.3230
multivitamin_supplementsYes	0.0121	0.0109	0.0133	0.0000	0.0000	0.0006	19.5422
pack_years_prop	-0.0063	-0.0069	-0.0057	0.0000	0.0000	0.0003	-21.7761
smoking_statusPrevious	0.0094	0.0083	0.0105	0.0000	0.0000	0.0005	17.2238
smoking_statusCurrent	-0.0134	-0.0151	-0.0117	0.0000	0.0000	0.0009	-15.3024
IPAQ_activity_group	0.0321	0.0303	0.0338	0.0000	0.0000	0.0008	41.3297
education_years	0.0162	0.0150	0.0173	0.0000	0.0000	0.0006	27.9913
ethnicityAsian	-0.0586	-0.0619	-0.0553	0.0000	0.0000	0.0017	-34.8085
ethnicityBlack	-0.0344	-0.0383	-0.0305	0.0000	0.0000	0.0020	-17.3593
ethnicityMixed	-0.0134	-0.0199	-0.0068	0.0001	0.0001	0.0033	-3.9938
ethnicityOther	-0.0449	-0.0501	-0.0397	0.0000	0.0000	0.0026	-17.0134

Table S9. Apolipoprotein B

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0050	-0.0076	-0.0025	0.0001	0.0002	0.0013	-3.8981
alcohol_freqDaily or almost daily	-0.0022	-0.0048	0.0004	0.0924	0.1146	0.0013	-1.6828
alcohol_freqOnce or twice a week	-0.0059	-0.0084	-0.0034	0.0000	0.0000	0.0013	-4.6656
bread	-0.0147	-0.0162	-0.0133	0.0000	0.0000	0.0007	-20.0364
cereal	-0.0234	-0.0248	-0.0220	0.0000	0.0000	0.0007	-33.1616
never_eat_dairyYes	-0.0145	-0.0191	-0.0100	0.0000	0.0000	0.0023	-6.2375
never_eat_eggsYes	-0.0115	-0.0158	-0.0071	0.0000	0.0000	0.0022	-5.1943
never_eat_sugarYes	-0.0251	-0.0270	-0.0232	0.0000	0.0000	0.0009	-26.4570
partial_fiber_score	-0.0222	-0.0238	-0.0205	0.0000	0.0000	0.0008	-27.0303
poultry	0.0187	0.0169	0.0206	0.0000	0.0000	0.0009	20.2433
processed_meat	0.0193	0.0175	0.0210	0.0000	0.0000	0.0009	21.4797
red_meat	0.0191	0.0174	0.0208	0.0000	0.0000	0.0009	22.3339
salt	0.0201	0.0183	0.0220	0.0000	0.0000	0.0009	21.3313
body_size_10yrs_oldThinner	0.0049	0.0033	0.0065	0.0000	0.0000	0.0008	6.0562
body_size_10yrs_oldPlumper	0.0040	0.0020	0.0060	0.0001	0.0001	0.0010	3.9808
height_10yrs_oldShorter	0.0116	0.0098	0.0134	0.0000	0.0000	0.0009	12.4879
height_10yrs_oldTaller	-0.0096	-0.0112	-0.0079	0.0000	0.0000	0.0008	-11.3380

Table S9. Apolipoprotein B

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0064	0.0048	0.0080	0.0000	0.0000	0.0008	7.8699
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0037	-0.0101	0.0028	0.2615	0.3044	0.0033	-1.1293
mobile_phone_2yrsYes, use is now less frequent	0.0090	0.0059	0.0120	0.0000	0.0000	0.0015	6.0794
mobile_phone_2yrsYes, use is now more frequent	0.0001	-0.0016	0.0017	0.9475	0.9598	0.0009	0.0659
employedYes	-0.0079	-0.0097	-0.0062	0.0000	0.0000	0.0009	-8.9930
unemployedYes	0.0087	0.0033	0.0140	0.0016	0.0023	0.0027	3.1942
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0001	-0.0191	0.0193	0.9943	0.9943	0.0098	0.0072
accommodation_typeA flat, maisonette or apartment	-0.0017	-0.0044	0.0010	0.2283	0.2698	0.0014	-1.2061
gas_hob_heatYes	-0.0005	-0.0020	0.0011	0.5505	0.5963	0.0008	-0.5972
hshld_income	-0.0064	-0.0087	-0.0041	0.0000	0.0000	0.0012	-5.4266
hshld_parentsYes	0.0044	-0.0009	0.0096	0.1049	0.1278	0.0027	1.6256
hshld_partnerYes	0.0021	0.0005	0.0037	0.0084	0.0107	0.0008	2.6368
hshld_siblingsYes	-0.0035	-0.0123	0.0052	0.4280	0.4702	0.0045	-0.7927
hshld_vehicles	0.0123	0.0097	0.0150	0.0000	0.0000	0.0013	9.1425

Table S9. Apolipoprotein B

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0063	0.0022	0.0104	0.0025	0.0034	0.0021	3.0329
own_or_rentPay part rent and part mortgage (shared ownership)	0.0067	-0.0060	0.0194	0.3038	0.3485	0.0065	1.0288
own_or_rentOwn with a mortgage	0.0026	0.0008	0.0044	0.0054	0.0073	0.0009	2.7975
own_or_rentRent - from local authority, local council, housing association	0.0052	0.0020	0.0084	0.0013	0.0020	0.0016	3.2166
own_or_rentLive in accommodation rent free	0.0037	-0.0044	0.0118	0.3726	0.4151	0.0042	0.8917
townsend_deprivation_index	-0.0013	-0.0020	-0.0005	0.0020	0.0029	0.0004	-3.0920
psychiatrist_visit_mental_healthYes	0.0164	0.0142	0.0186	0.0000	0.0000	0.0011	14.6535
risk_takingYes	0.0072	0.0056	0.0087	0.0000	0.0000	0.0008	8.7886
tiredness_freq	0.0180	0.0161	0.0200	0.0000	0.0000	0.0010	18.0619
unenthusiasm_freq	0.0228	0.0201	0.0254	0.0000	0.0000	0.0013	16.9351
fast_driving	0.0119	0.0092	0.0145	0.0000	0.0000	0.0014	8.7486
gymYes	-0.0098	-0.0114	-0.0082	0.0000	0.0000	0.0008	-12.1317
LTPA	-0.0076	-0.0095	-0.0058	0.0000	0.0000	0.0009	-8.1801
sedentary	0.0198	0.0186	0.0211	0.0000	0.0000	0.0007	30.4438
air_pollution_PC1	-0.0017	-0.0021	-0.0014	0.0000	0.0000	0.0002	-9.7495

Table S9. Apolipoprotein B

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0019	0.0015	0.0023	0.0000	0.0000	0.0002	8.9946
number_sex_partners	-0.0001	-0.0012	0.0009	0.7720	0.7923	0.0005	-0.2940
sex_age_first	-0.0061	-0.0068	-0.0053	0.0000	0.0000	0.0004	-15.5461
chronotypeDefinitely an 'evening' person	0.0093	0.0064	0.0122	0.0000	0.0000	0.0015	6.2889
chronotypeDefinitely a 'morning' person	-0.0011	-0.0032	0.0011	0.3191	0.3607	0.0011	-1.0072
chronotypeMore an 'evening' than a 'morning' person	0.0057	0.0034	0.0079	0.0000	0.0000	0.0011	5.1419
nap	0.0101	0.0084	0.0118	0.0000	0.0000	0.0009	11.6420
sleep_hours_categorical>9 hours	0.0143	0.0115	0.0170	0.0000	0.0000	0.0014	10.2617
sleep_hours_categorical<7 hours	0.0040	0.0024	0.0056	0.0000	0.0000	0.0008	4.7986
family_visit_freq	0.0142	0.0108	0.0176	0.0000	0.0000	0.0017	8.2220
religious_groupYes	-0.0067	-0.0087	-0.0047	0.0000	0.0000	0.0010	-6.6047
facial_agingAbout your age	-0.0037	-0.0060	-0.0013	0.0037	0.0051	0.0011	-3.2795
facial_agingOlder than you are	-0.0078	-0.0128	-0.0028	0.0022	0.0031	0.0026	-3.0650
skin_colorDark olive	0.0044	-0.0007	0.0096	0.0926	0.1146	0.0026	1.6824
skin_colorLight olive	0.0025	0.0007	0.0043	0.0070	0.0093	0.0009	2.6979
skin_colorBlack	-0.0144	-0.0250	-0.0038	0.0075	0.0098	0.0054	-2.6742
skin_colorBrown	-0.0015	-0.0077	0.0047	0.6345	0.6599	0.0032	-0.4757

Table S9. Apolipoprotein B

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0020	-0.0006	0.0047	0.1360	0.1632	0.0014	1.4918
sun_protection_use	0.0086	0.0060	0.0112	0.0000	0.0000	0.0013	6.5489
fish_oil_supplementsYes	0.0199	0.0184	0.0215	0.0000	0.0000	0.0008	25.3385
folate_supplementsYes	0.0092	0.0045	0.0140	0.0001	0.0002	0.0024	3.8345
glucosamine_supplementsYes	0.0190	0.0172	0.0208	0.0000	0.0000	0.0009	20.5678
multivitamin_supplementsYes	0.0126	0.0109	0.0143	0.0000	0.0000	0.0009	14.5207
pack_years_prop	0.0064	0.0057	0.0072	0.0000	0.0000	0.0004	16.7521
smoking_statusPrevious	0.0044	0.0028	0.0059	0.0000	0.0000	0.0008	5.6010
smoking_statusCurrent	0.0274	0.0250	0.0298	0.0000	0.0000	0.0012	22.6081
IPAQ_activity_group	-0.0160	-0.0176	-0.0143	0.0000	0.0000	0.0008	-19.6026
education_years	-0.0090	-0.0106	-0.0074	0.0000	0.0000	0.0008	-10.9408
ethnicityAsian	-0.0145	-0.0192	-0.0097	0.0000	0.0000	0.0024	-6.0014
ethnicityBlack	-0.0439	-0.0494	-0.0384	0.0000	0.0000	0.0028	-15.6982
ethnicityMixed	0.0023	-0.0071	0.0116	0.6304	0.6599	0.0048	0.4814
ethnicityOther	-0.0020	-0.0093	0.0052	0.5817	0.6215	0.0037	-0.5510

Table S10. Aspartate aminotransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.0131	0.0102	0.0161	0.0000	0.0000	0.0015	8.6738
alcohol_freqDaily or almost daily	0.0399	0.0368	0.0431	0.0000	0.0000	0.0016	24.6361
alcohol_freqOnce or twice a week	0.0023	-0.0006	0.0051	0.1248	0.1432	0.0015	1.5353
bread	0.0027	0.0010	0.0045	0.0022	0.0034	0.0009	3.0701
cereal	-0.0045	-0.0062	-0.0029	0.0000	0.0000	0.0008	-5.3643
never_eat_dairyYes	0.0091	0.0037	0.0145	0.0010	0.0017	0.0028	3.2916
never_eat_eggsYes	0.0090	0.0039	0.0142	0.0007	0.0011	0.0026	3.4427
never_eat_sugarYes	0.0075	0.0054	0.0097	0.0000	0.0000	0.0011	6.8373
partial_fiber_score	0.0086	0.0067	0.0105	0.0000	0.0000	0.0010	8.9339
poultry	0.0012	-0.0010	0.0034	0.2826	0.3062	0.0011	1.0759
processed_meat	-0.0006	-0.0025	0.0013	0.5168	0.5236	0.0010	-0.6482
red_meat	0.0002	-0.0017	0.0022	0.8320	0.8320	0.0010	0.2121
salt	0.0040	0.0018	0.0061	0.0002	0.0004	0.0011	3.6752
body_size_10yrs_oldThinner	-0.0038	-0.0056	-0.0020	0.0000	0.0001	0.0009	-4.1995
body_size_10yrs_oldPlumper	0.0139	0.0116	0.0163	0.0000	0.0000	0.0012	11.5118
height_10yrs_oldShorter	0.0033	0.0012	0.0055	0.0019	0.0030	0.0011	3.1029
height_10yrs_oldTaller	-0.0020	-0.0041	0.0000	0.0521	0.0635	0.0010	-1.9515

Table S10. Aspartate aminotransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0090	0.0066	0.0114	0.0000	0.0000	0.0012	7.7695
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0032	-0.0102	0.0038	0.3715	0.3844	0.0036	-0.8944
mobile_phone_2yrsYes, use is now less frequent	0.0044	0.0014	0.0074	0.0048	0.0067	0.0015	2.9121
mobile_phone_2yrsYes, use is now more frequent	-0.0025	-0.0048	-0.0003	0.0291	0.0372	0.0011	-2.2713
employedYes	-0.0122	-0.0144	-0.0100	0.0000	0.0000	0.0011	-10.7843
unemployedYes	0.0225	0.0165	0.0285	0.0000	0.0000	0.0031	7.3731
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0244	0.0014	0.0474	0.0378	0.0475	0.0117	2.0802
accommodation_typeA flat, maisonette or apartment	0.0208	0.0177	0.0239	0.0000	0.0000	0.0016	13.1287
gas_hob_heatYes	-0.0032	-0.0050	-0.0014	0.0005	0.0009	0.0009	-3.4841
hshld_income	-0.0150	-0.0179	-0.0120	0.0000	0.0000	0.0015	-10.0570
hshld_parentsYes	0.0039	-0.0023	0.0101	0.2184	0.2469	0.0031	1.2334
hshld_partnerYes	-0.0134	-0.0153	-0.0115	0.0000	0.0000	0.0010	-13.9338
hshld_siblingsYes	0.0152	0.0051	0.0253	0.0032	0.0046	0.0051	2.9493
hshld_vehicles	-0.0221	-0.0253	-0.0190	0.0000	0.0000	0.0016	-13.8227

Table S10. Aspartate aminotransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0124	0.0077	0.0171	0.0000	0.0000	0.0024	5.1433
own_or_rentPay part rent and part mortgage (shared ownership)	0.0141	-0.0013	0.0295	0.0735	0.0869	0.0078	1.7962
own_or_rentOwn with a mortgage	-0.0012	-0.0033	0.0008	0.2444	0.2685	0.0011	-1.1650
own_or_rentRent - from local authority, local council, housing association	0.0193	0.0153	0.0233	0.0000	0.0000	0.0020	9.6114
own_or_rentLive in accommodation rent free	0.0120	0.0018	0.0222	0.0213	0.0277	0.0052	2.3190
townsend_deprivation_index	0.0058	0.0047	0.0068	0.0000	0.0000	0.0005	11.0251
psychiatrist_visit_mental_healthYes	0.0096	0.0070	0.0122	0.0000	0.0000	0.0013	7.1715
risk_takingYes	0.0075	0.0056	0.0094	0.0000	0.0000	0.0010	7.6776
tiredness_freq	0.0073	0.0050	0.0096	0.0000	0.0000	0.0012	6.1799
unenthusiasm_freq	0.0114	0.0081	0.0147	0.0000	0.0000	0.0017	6.8865
fast_driving	-0.0079	-0.0109	-0.0048	0.0000	0.0000	0.0016	-4.9896
gymYes	0.0087	0.0068	0.0105	0.0000	0.0000	0.0009	9.2093
LTPA	0.0077	0.0056	0.0099	0.0000	0.0000	0.0011	7.0454
sedentary	0.0053	0.0038	0.0068	0.0000	0.0000	0.0008	6.8652
air_pollution_PC1	0.0017	0.0013	0.0021	0.0000	0.0000	0.0002	7.8681

Table S10. Aspartate aminotransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	-0.0006	-0.0011	-0.0001	0.0116	0.0156	0.0003	-2.5335
number_sex_partners	0.0025	0.0015	0.0035	0.0000	0.0000	0.0005	5.1408
sex_age_first	-0.0036	-0.0045	-0.0026	0.0000	0.0000	0.0005	-7.1898
chronotypeDefinitely an 'evening' person	0.0050	0.0017	0.0082	0.0025	0.0038	0.0016	3.0297
chronotypeDefinitely a 'morning' person	0.0059	0.0032	0.0086	0.0001	0.0002	0.0013	4.4886
chronotypeMore an 'evening' than a 'morning' person	0.0016	-0.0016	0.0048	0.2944	0.3146	0.0015	1.0898
nap	0.0064	0.0045	0.0084	0.0000	0.0000	0.0010	6.4050
sleep_hours_categorical>9 hours	0.0126	0.0094	0.0157	0.0000	0.0000	0.0016	7.8588
sleep_hours_categorical<7 hours	0.0080	0.0061	0.0099	0.0000	0.0000	0.0010	8.3310
family_visit_freq	-0.0065	-0.0105	-0.0025	0.0013	0.0021	0.0020	-3.2252
religious_groupYes	-0.0036	-0.0060	-0.0012	0.0030	0.0044	0.0012	-2.9843
facial_agingAbout your age	0.0030	0.0009	0.0050	0.0045	0.0064	0.0010	2.8718
facial_agingOlder than you are	0.0055	-0.0016	0.0126	0.1235	0.1432	0.0035	1.5679
skin_colorDark olive	0.0037	-0.0023	0.0096	0.2252	0.2509	0.0030	1.2129
skin_colorLight olive	-0.0029	-0.0050	-0.0007	0.0083	0.0114	0.0011	-2.6426
skin_colorBlack	0.0056	-0.0068	0.0179	0.3746	0.3844	0.0063	0.8880
skin_colorBrown	0.0089	0.0019	0.0160	0.0133	0.0176	0.0036	2.4800

Table S10. Aspartate aminotransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0030	-0.0003	0.0064	0.0729	0.0869	0.0017	1.8054
sun_protection_use	-0.0015	-0.0045	0.0014	0.3112	0.3280	0.0015	-1.0137
fish_oil_supplementsYes	0.0101	0.0083	0.0119	0.0000	0.0000	0.0009	11.0377
folate_supplementsYes	0.0212	0.0157	0.0267	0.0000	0.0000	0.0028	7.5364
glucosamine_supplementsYes	0.0033	0.0012	0.0053	0.0019	0.0030	0.0010	3.1125
multivitamin_supplementsYes	0.0288	0.0268	0.0308	0.0000	0.0000	0.0010	28.3737
pack_years_prop	0.0022	0.0011	0.0034	0.0006	0.0011	0.0006	3.9894
smoking_statusPrevious	0.0092	0.0074	0.0110	0.0000	0.0000	0.0009	10.2549
smoking_statusCurrent	-0.0413	-0.0441	-0.0385	0.0000	0.0000	0.0014	-28.9678
IPAQ_activity_group	0.0180	0.0163	0.0196	0.0000	0.0000	0.0008	21.4501
education_years	-0.0107	-0.0125	-0.0088	0.0000	0.0000	0.0009	-11.2436
ethnicityAsian	0.0059	0.0001	0.0118	0.0446	0.0553	0.0029	2.0186
ethnicityBlack	0.0493	0.0429	0.0557	0.0000	0.0000	0.0032	15.2080
ethnicityMixed	0.0197	0.0092	0.0302	0.0002	0.0004	0.0054	3.6764
ethnicityOther	0.0184	0.0099	0.0269	0.0000	0.0000	0.0043	4.2490

Table S11. C-reactive protein

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.1498	-0.1614	-0.1381	0.0000	0.0000	0.0059	-25.2597
alcohol_freqDaily or almost daily	-0.1557	-0.1678	-0.1437	0.0000	0.0000	0.0061	-25.4279
alcohol_freqOnce or twice a week	-0.0699	-0.0814	-0.0584	0.0000	0.0000	0.0058	-11.9825
bread	0.0182	0.0117	0.0248	0.0000	0.0000	0.0034	5.4245
cereal	-0.1195	-0.1256	-0.1135	0.0000	0.0000	0.0031	-38.6672
never_eat_dairyYes	-0.0815	-0.1031	-0.0598	0.0000	0.0000	0.0110	-7.4043
never_eat_eggsYes	0.0083	-0.0107	0.0273	0.3917	0.3968	0.0097	0.8567
never_eat_sugarYes	-0.0053	-0.0134	0.0028	0.1972	0.2051	0.0041	-1.2896
partial_fiber_score	-0.1537	-0.1609	-0.1464	0.0000	0.0000	0.0037	-41.6566
poultry	0.1206	0.1119	0.1293	0.0000	0.0000	0.0044	27.2782
processed_meat	0.1973	0.1893	0.2054	0.0000	0.0000	0.0041	48.5595
red_meat	0.1638	0.1560	0.1715	0.0000	0.0000	0.0039	41.4896
salt	0.1234	0.1153	0.1316	0.0000	0.0000	0.0042	29.6637
body_size_10yrs_oldThinner	0.0260	0.0187	0.0334	0.0000	0.0000	0.0037	6.9608
body_size_10yrs_oldPlumper	0.1921	0.1832	0.2009	0.0000	0.0000	0.0045	42.5911
height_10yrs_oldShorter	0.0249	0.0167	0.0330	0.0000	0.0000	0.0042	5.9784
height_10yrs_oldTaller	-0.0076	-0.0156	0.0004	0.0622	0.0655	0.0041	-1.8743

Table S11. C-reactive protein

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0828	0.0736	0.0920	0.0000	0.0000	0.0045	18.4801
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0071	-0.0349	0.0491	0.7228	0.7228	0.0195	0.3623
mobile_phone_2yrsYes, use is now less frequent	0.0735	0.0569	0.0900	0.0000	0.0000	0.0076	9.6130
mobile_phone_2yrsYes, use is now more frequent	0.0080	-0.0061	0.0220	0.2306	0.2367	0.0062	1.2867
employedYes	-0.0687	-0.0766	-0.0608	0.0000	0.0000	0.0040	-17.0248
unemployedYes	0.1607	0.1366	0.1848	0.0000	0.0000	0.0122	13.1177
accommodation_typeMobile or temporary structure (i.e. caravan)	0.2599	0.1732	0.3467	0.0000	0.0000	0.0442	5.8763
accommodation_typeA flat, maisonette or apartment	0.0976	0.0853	0.1098	0.0000	0.0000	0.0062	15.6243
gas_hob_heatYes	-0.0107	-0.0175	-0.0038	0.0024	0.0027	0.0035	-3.0360
hshld_income	-0.1895	-0.2019	-0.1772	0.0000	0.0000	0.0061	-30.8647
hshld_parentsYes	0.1174	0.0948	0.1399	0.0000	0.0000	0.0115	10.1996
hshld_partnerYes	-0.0572	-0.0644	-0.0499	0.0000	0.0000	0.0037	-15.4460
hshld_siblingsYes	0.1086	0.0688	0.1484	0.0000	0.0000	0.0203	5.3549
hshld_vehicles	-0.0901	-0.1022	-0.0781	0.0000	0.0000	0.0062	-14.6236

Table S11. C-reactive protein

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.1553	0.1373	0.1733	0.0000	0.0000	0.0092	16.9244
own_or_rentPay part rent and part mortgage (shared ownership)	0.2146	0.1576	0.2715	0.0000	0.0000	0.0290	7.3868
own_or_rentOwn with a mortgage	0.0837	0.0760	0.0914	0.0000	0.0000	0.0039	21.2833
own_or_rentRent - from local authority, local council, housing association	0.3191	0.3039	0.3343	0.0000	0.0000	0.0077	41.3435
own_or_rentLive in accommodation rent free	0.1293	0.0922	0.1663	0.0000	0.0000	0.0189	6.8380
townsend_deprivation_index	0.0699	0.0663	0.0735	0.0000	0.0000	0.0018	38.0640
psychiatrist_visit_mental_healthYes	0.0316	0.0212	0.0419	0.0000	0.0000	0.0053	5.9969
risk_takingYes	0.0487	0.0412	0.0563	0.0000	0.0000	0.0038	12.6944
tiredness_freq	0.1959	0.1863	0.2054	0.0000	0.0000	0.0048	40.5361
unenthusiasm_freq	0.1355	0.1233	0.1476	0.0000	0.0000	0.0062	21.9759
fast_driving	-0.0460	-0.0578	-0.0342	0.0000	0.0000	0.0060	-7.6634
gymYes	-0.1026	-0.1110	-0.0941	0.0000	0.0000	0.0042	-24.3668
LTPA	-0.1511	-0.1645	-0.1377	0.0000	0.0000	0.0061	-24.7808
sedentary	0.1954	0.1896	0.2012	0.0000	0.0000	0.0029	66.2290
air_pollution_PC1	0.0138	0.0122	0.0153	0.0000	0.0000	0.0008	16.9535

Table S11. C-reactive protein

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	-0.0096	-0.0115	-0.0077	0.0000	0.0000	0.0010	-10.0015
number_sex_partners	0.0052	0.0018	0.0086	0.0028	0.0031	0.0017	3.0180
sex_age_first	-0.0494	-0.0530	-0.0459	0.0000	0.0000	0.0018	-27.3649
chronotypeDefinitely an 'evening' person	0.1165	0.1028	0.1303	0.0000	0.0000	0.0069	16.9004
chronotypeDefinitely a 'morning' person	0.0342	0.0197	0.0487	0.0003	0.0004	0.0065	5.2246
chronotypeMore an 'evening' than a 'morning' person	0.0473	0.0296	0.0650	0.0003	0.0004	0.0076	6.2540
nap	0.1331	0.1255	0.1407	0.0000	0.0000	0.0039	34.2047
sleep_hours_categorical>9 hours	0.1352	0.1232	0.1472	0.0000	0.0000	0.0061	22.0752
sleep_hours_categorical<7 hours	0.0513	0.0437	0.0588	0.0000	0.0000	0.0039	13.2756
family_visit_freq	0.0964	0.0814	0.1114	0.0000	0.0000	0.0076	12.6140
religious_groupYes	-0.0215	-0.0310	-0.0119	0.0000	0.0000	0.0048	-4.4441
facial_agingAbout your age	0.0433	0.0360	0.0507	0.0000	0.0000	0.0038	11.5274
facial_agingOlder than you are	0.1477	0.1027	0.1926	0.0000	0.0000	0.0199	7.4316
skin_colorDark olive	0.0333	0.0096	0.0570	0.0060	0.0064	0.0121	2.7537
skin_colorLight olive	-0.0171	-0.0259	-0.0084	0.0002	0.0002	0.0044	-3.8613
skin_colorBlack	0.0852	0.0379	0.1326	0.0004	0.0005	0.0242	3.5273
skin_colorBrown	0.0873	0.0593	0.1153	0.0000	0.0000	0.0142	6.1306

Table S11. C-reactive protein

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0469	0.0347	0.0592	0.0000	0.0000	0.0062	7.5097
sun_protection_use	-0.0658	-0.0778	-0.0537	0.0000	0.0000	0.0061	-10.7974
fish_oil_supplementsYes	-0.1032	-0.1105	-0.0959	0.0000	0.0000	0.0037	-27.8136
folate_supplementsYes	0.0617	0.0405	0.0829	0.0000	0.0000	0.0108	5.7088
glucosamine_supplementsYes	-0.0805	-0.0889	-0.0721	0.0000	0.0000	0.0043	-18.8545
multivitamin_supplementsYes	-0.0565	-0.0643	-0.0487	0.0000	0.0000	0.0040	-14.1820
pack_years_prop	0.1455	0.1419	0.1491	0.0000	0.0000	0.0018	80.1778
smoking_statusPrevious	0.0753	0.0683	0.0822	0.0000	0.0000	0.0035	21.3465
smoking_statusCurrent	0.3002	0.2895	0.3109	0.0000	0.0000	0.0055	54.9285
IPAQ_activity_group	-0.2044	-0.2195	-0.1893	0.0000	0.0000	0.0063	-32.3072
education_years	-0.2076	-0.2154	-0.1998	0.0000	0.0000	0.0039	-52.6100
ethnicityAsian	0.1200	0.0989	0.1411	0.0000	0.0000	0.0108	11.1532
ethnicityBlack	0.1736	0.1488	0.1983	0.0000	0.0000	0.0126	13.7659
ethnicityMixed	0.0639	0.0225	0.1053	0.0025	0.0027	0.0211	3.0303
ethnicityOther	0.1114	0.0773	0.1456	0.0000	0.0000	0.0174	6.4147

Table S12. Cholesterol

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.0213	0.0192	0.0235	0.0000	0.0000	0.0011	19.8168
alcohol_freqDaily or almost daily	0.0402	0.0380	0.0423	0.0000	0.0000	0.0011	36.5038
alcohol_freqOnce or twice a week	0.0047	0.0027	0.0068	0.0000	0.0000	0.0010	4.5313
bread	-0.0136	-0.0148	-0.0124	0.0000	0.0000	0.0006	-21.7817
cereal	-0.0241	-0.0253	-0.0230	0.0000	0.0000	0.0006	-41.2595
never_eat_dairyYes	-0.0203	-0.0242	-0.0165	0.0000	0.0000	0.0020	-10.2750
never_eat_eggsYes	-0.0183	-0.0222	-0.0145	0.0000	0.0000	0.0019	-9.4732
never_eat_sugarYes	-0.0233	-0.0249	-0.0216	0.0000	0.0000	0.0008	-28.3534
partial_fiber_score	-0.0251	-0.0264	-0.0237	0.0000	0.0000	0.0007	-36.6281
poultry	0.0091	0.0076	0.0107	0.0000	0.0000	0.0008	11.7190
processed_meat	0.0157	0.0142	0.0171	0.0000	0.0000	0.0007	21.5122
red_meat	0.0160	0.0146	0.0175	0.0000	0.0000	0.0007	21.6762
salt	0.0200	0.0184	0.0215	0.0000	0.0000	0.0008	25.1169
body_size_10yrs_oldThinner	0.0037	0.0024	0.0051	0.0000	0.0000	0.0007	5.4005
body_size_10yrs_oldPlumper	-0.0060	-0.0076	-0.0043	0.0000	0.0000	0.0008	-7.0244
height_10yrs_oldShorter	0.0111	0.0096	0.0126	0.0000	0.0000	0.0008	14.2817
height_10yrs_oldTaller	-0.0082	-0.0096	-0.0068	0.0000	0.0000	0.0007	-11.5787

Table S12. Cholesterol

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0027	0.0014	0.0040	0.0001	0.0001	0.0007	3.9906
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0033	-0.0098	0.0031	0.2949	0.3240	0.0031	-1.0686
mobile_phone_2yrsYes, use is now less frequent	0.0030	0.0008	0.0051	0.0088	0.0113	0.0011	2.7050
mobile_phone_2yrsYes, use is now more frequent	0.0001	-0.0013	0.0016	0.8498	0.8498	0.0007	0.1897
employedYes	-0.0085	-0.0100	-0.0071	0.0000	0.0000	0.0007	-11.4845
unemployedYes	0.0021	-0.0023	0.0066	0.3453	0.3690	0.0023	0.9452
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0160	-0.0321	0.0001	0.0515	0.0628	0.0082	-1.9473
accommodation_typeA flat, maisonette or apartment	-0.0049	-0.0071	-0.0026	0.0000	0.0000	0.0011	-4.2780
gas_hob_heatYes	-0.0007	-0.0020	0.0007	0.3214	0.3482	0.0007	-0.9923
hshld_income	0.0035	0.0015	0.0054	0.0004	0.0006	0.0010	3.5250
hshld_parentsYes	0.0024	-0.0019	0.0068	0.2778	0.3096	0.0022	1.0862
hshld_partnerYes	0.0038	0.0025	0.0052	0.0000	0.0000	0.0007	5.7395
hshld_siblingsYes	-0.0084	-0.0158	-0.0010	0.0254	0.0314	0.0038	-2.2367
hshld_vehicles	0.0137	0.0115	0.0159	0.0000	0.0000	0.0011	12.1779

Table S12. Cholesterol

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0026	-0.0061	0.0008	0.1361	0.1561	0.0018	-1.4921
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0023	-0.0130	0.0083	0.6676	0.6851	0.0054	-0.4296
own_or_rentOwn with a mortgage	-0.0031	-0.0046	-0.0016	0.0001	0.0001	0.0008	-4.0495
own_or_rentRent - from local authority, local council, housing association	-0.0096	-0.0122	-0.0069	0.0000	0.0000	0.0014	-7.0699
own_or_rentLive in accommodation rent free	-0.0030	-0.0099	0.0038	0.3892	0.4102	0.0035	-0.8612
townsend_deprivation_index	-0.0043	-0.0049	-0.0036	0.0000	0.0000	0.0003	-12.4410
psychiatrist_visit_mental_healthYes	0.0138	0.0120	0.0157	0.0000	0.0000	0.0010	14.5686
risk_takingYes	0.0047	0.0033	0.0061	0.0000	0.0000	0.0007	6.7850
tiredness_freq	0.0076	0.0059	0.0092	0.0000	0.0000	0.0008	9.0126
unenthusiasm_freq	0.0149	0.0126	0.0172	0.0000	0.0000	0.0011	12.9873
fast_driving	0.0117	0.0095	0.0139	0.0000	0.0000	0.0011	10.3219
gymYes	-0.0031	-0.0044	-0.0018	0.0000	0.0000	0.0007	-4.5734
LTPA	0.0039	0.0023	0.0056	0.0000	0.0000	0.0008	4.6910
sedentary	0.0047	0.0037	0.0058	0.0000	0.0000	0.0005	8.6886
air_pollution_PC1	-0.0022	-0.0025	-0.0019	0.0000	0.0000	0.0001	-14.8359

Table S12. Cholesterol

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0025	0.0022	0.0029	0.0000	0.0000	0.0002	14.3594
number_sex_partners	-0.0002	-0.0009	0.0005	0.5248	0.5458	0.0004	-0.6406
sex_age_first	-0.0036	-0.0042	-0.0029	0.0000	0.0000	0.0003	-10.7706
chronotypeDefinitely an 'evening' person	0.0046	0.0021	0.0071	0.0004	0.0005	0.0013	3.6454
chronotypeDefinitely a 'morning' person	-0.0034	-0.0051	-0.0017	0.0001	0.0002	0.0009	-4.0219
chronotypeMore an 'evening' than a 'morning' person	0.0048	0.0029	0.0067	0.0000	0.0000	0.0009	5.2501
nap	-0.0029	-0.0043	-0.0014	0.0001	0.0001	0.0007	-3.9402
sleep_hours_categorical>9 hours	0.0078	0.0054	0.0101	0.0000	0.0000	0.0012	6.5548
sleep_hours_categorical<7 hours	0.0026	0.0012	0.0039	0.0003	0.0004	0.0007	3.6238
family_visit_freq	0.0085	0.0057	0.0114	0.0000	0.0000	0.0014	5.8857
religious_groupYes	-0.0080	-0.0097	-0.0064	0.0000	0.0000	0.0009	-9.4065
facial_agingAbout your age	-0.0051	-0.0070	-0.0032	0.0000	0.0000	0.0009	-5.4783
facial_agingOlder than you are	-0.0135	-0.0178	-0.0091	0.0000	0.0000	0.0022	-6.1301
skin_colorDark olive	0.0041	-0.0003	0.0085	0.0656	0.0787	0.0022	1.8434
skin_colorLight olive	0.0033	0.0018	0.0049	0.0000	0.0000	0.0008	4.2509
skin_colorBlack	-0.0203	-0.0291	-0.0115	0.0000	0.0000	0.0045	-4.5301
skin_colorBrown	-0.0069	-0.0122	-0.0017	0.0102	0.0129	0.0027	-2.5881

Table S12. Cholesterol

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.0013	-0.0036	0.0010	0.2567	0.2902	0.0011	-1.1349
sun_protection_use	0.0077	0.0055	0.0099	0.0000	0.0000	0.0011	6.9297
fish_oil_supplementsYes	0.0206	0.0192	0.0220	0.0000	0.0000	0.0007	29.6344
folate_supplementsYes	0.0138	0.0098	0.0177	0.0000	0.0000	0.0020	6.8521
glucosamine_supplementsYes	0.0228	0.0213	0.0243	0.0000	0.0000	0.0008	29.6510
multivitamin_supplementsYes	0.0148	0.0134	0.0163	0.0000	0.0000	0.0007	20.0426
pack_years_prop	0.0010	0.0004	0.0017	0.0016	0.0021	0.0003	3.1814
smoking_statusPrevious	0.0049	0.0037	0.0062	0.0000	0.0000	0.0007	7.5847
smoking_statusCurrent	0.0120	0.0100	0.0140	0.0000	0.0000	0.0010	11.7783
IPAQ_activity_group	-0.0001	-0.0013	0.0011	0.8145	0.8250	0.0006	-0.2350
education_years	0.0012	-0.0001	0.0026	0.0703	0.0831	0.0007	1.8130
ethnicityAsian	-0.0432	-0.0472	-0.0393	0.0000	0.0000	0.0020	-21.2570
ethnicityBlack	-0.0630	-0.0676	-0.0583	0.0000	0.0000	0.0024	-26.6697
ethnicityMixed	-0.0065	-0.0143	0.0012	0.0980	0.1141	0.0039	-1.6562
ethnicityOther	-0.0291	-0.0352	-0.0231	0.0000	0.0000	0.0031	-9.4285

Table S13. Creatinine

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0092	-0.0110	-0.0075	0.0000	0.0000	0.0009	-10.2633
alcohol_freqDaily or almost daily	-0.0196	-0.0214	-0.0177	0.0000	0.0000	0.0009	-20.9883
alcohol_freqOnce or twice a week	-0.0027	-0.0044	-0.0010	0.0021	0.0028	0.0009	-3.0812
bread	-0.0034	-0.0045	-0.0024	0.0000	0.0000	0.0006	-6.2270
cereal	-0.0020	-0.0030	-0.0010	0.0001	0.0001	0.0005	-3.9679
never_eat_dairyYes	-0.0114	-0.0148	-0.0079	0.0000	0.0000	0.0017	-6.5379
never_eat_eggsYes	-0.0065	-0.0096	-0.0033	0.0001	0.0001	0.0016	-4.0540
never_eat_sugarYes	-0.0127	-0.0140	-0.0113	0.0000	0.0000	0.0007	-18.5973
partial_fiber_score	-0.0219	-0.0231	-0.0207	0.0000	0.0000	0.0006	-35.2154
poultry	0.0299	0.0286	0.0313	0.0000	0.0000	0.0007	43.4261
processed_meat	0.0266	0.0254	0.0278	0.0000	0.0000	0.0006	43.1973
red_meat	0.0216	0.0204	0.0228	0.0000	0.0000	0.0006	35.3058
salt	0.0004	-0.0009	0.0017	0.5344	0.5710	0.0007	0.6213
body_size_10yrs_oldThinner	-0.0062	-0.0074	-0.0051	0.0000	0.0000	0.0006	-10.5756
body_size_10yrs_oldPlumper	-0.0070	-0.0085	-0.0054	0.0000	0.0000	0.0008	-8.9484
height_10yrs_oldShorter	-0.0078	-0.0092	-0.0065	0.0000	0.0000	0.0007	-11.2514
height_10yrs_oldTaller	0.0075	0.0062	0.0087	0.0000	0.0000	0.0006	12.1171

Table S13. Creatinine

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0012	-0.0000	0.0025	0.0549	0.0649	0.0006	1.9415
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0002	-0.0045	0.0050	0.9267	0.9457	0.0024	0.0923
mobile_phone_2yrsYes, use is now less frequent	0.0029	0.0008	0.0050	0.0096	0.0125	0.0010	2.7782
mobile_phone_2yrsYes, use is now more frequent	0.0014	0.0001	0.0028	0.0347	0.0429	0.0007	2.1647
employedYes	0.0068	0.0054	0.0081	0.0000	0.0000	0.0007	10.1478
unemployedYes	-0.0163	-0.0199	-0.0126	0.0000	0.0000	0.0019	-8.7129
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0006	-0.0135	0.0147	0.9336	0.9457	0.0072	0.0833
accommodation_typeA flat, maisonette or apartment	-0.0116	-0.0135	-0.0097	0.0000	0.0000	0.0010	-11.7410
gas_hob_heatYes	0.0006	-0.0005	0.0018	0.2631	0.2974	0.0006	1.1194
hshld_income	0.0120	0.0103	0.0137	0.0000	0.0000	0.0009	13.6600
hshld_parentsYes	-0.0054	-0.0092	-0.0016	0.0053	0.0070	0.0019	-2.8001
hshld_partnerYes	0.0060	0.0048	0.0072	0.0000	0.0000	0.0006	10.0429
hshld_siblingsYes	-0.0028	-0.0092	0.0036	0.3875	0.4198	0.0033	-0.8643
hshld_vehicles	0.0228	0.0209	0.0248	0.0000	0.0000	0.0010	22.9627

Table S13. Creatinine

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0062	-0.0094	-0.0030	0.0002	0.0003	0.0016	-3.8319
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0025	-0.0115	0.0065	0.5814	0.6129	0.0046	-0.5513
own_or_rentOwn with a mortgage	0.0061	0.0048	0.0073	0.0000	0.0000	0.0006	9.4263
own_or_rentRent - from local authority, local council, housing association	-0.0019	-0.0042	0.0004	0.1112	0.1294	0.0012	-1.5942
own_or_rentLive in accommodation rent free	-0.0065	-0.0125	-0.0005	0.0344	0.0429	0.0031	-2.1162
townsend_deprivation_index	-0.0030	-0.0035	-0.0024	0.0000	0.0000	0.0003	-10.1293
psychiatrist_visit_mental_healthYes	-0.0039	-0.0056	-0.0023	0.0000	0.0000	0.0008	-4.6568
risk_takingYes	0.0034	0.0021	0.0046	0.0000	0.0000	0.0006	5.2597
tiredness_freq	0.0000	-0.0014	0.0014	0.9734	0.9734	0.0007	0.0333
unenthusiasm_freq	-0.0047	-0.0066	-0.0028	0.0000	0.0000	0.0010	-4.8488
fast_driving	0.0257	0.0238	0.0276	0.0000	0.0000	0.0010	26.8761
gymYes	0.0145	0.0134	0.0157	0.0000	0.0000	0.0006	24.5091
LTPA	0.0033	0.0020	0.0046	0.0000	0.0000	0.0007	4.9957
sedentary	0.0129	0.0119	0.0138	0.0000	0.0000	0.0005	27.0238
air_pollution_PC1	-0.0016	-0.0018	-0.0013	0.0000	0.0000	0.0001	-11.9964

Table S13. Creatinine

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0017	0.0014	0.0020	0.0000	0.0000	0.0002	10.6493
number_sex_partners	-0.0006	-0.0021	0.0009	0.3644	0.4003	0.0006	-0.9832
sex_age_first	-0.0038	-0.0043	-0.0032	0.0000	0.0000	0.0003	-13.6905
chronotypeDefinitely an 'evening' person	0.0010	-0.0010	0.0030	0.3357	0.3740	0.0010	0.9632
chronotypeDefinitely a 'morning' person	-0.0029	-0.0042	-0.0016	0.0000	0.0000	0.0007	-4.3477
chronotypeMore an 'evening' than a 'morning' person	0.0013	0.0000	0.0027	0.0496	0.0595	0.0007	1.9737
nap	0.0050	0.0038	0.0062	0.0000	0.0000	0.0006	7.8795
sleep_hours_categorical>9 hours	0.0086	0.0067	0.0105	0.0000	0.0000	0.0010	8.7511
sleep_hours_categorical<7 hours	-0.0041	-0.0053	-0.0029	0.0000	0.0000	0.0006	-6.6461
family_visit_freq	0.0017	-0.0008	0.0042	0.1794	0.2058	0.0013	1.3448
religious_groupYes	-0.0046	-0.0060	-0.0031	0.0000	0.0000	0.0007	-6.1621
facial_agingAbout your age	-0.0003	-0.0016	0.0011	0.6874	0.7148	0.0007	-0.4038
facial_agingOlder than you are	-0.0038	-0.0076	-0.0000	0.0474	0.0578	0.0019	-1.9859
skin_colorDark olive	0.0077	0.0037	0.0116	0.0002	0.0003	0.0020	3.7988
skin_colorLight olive	0.0047	0.0033	0.0061	0.0000	0.0000	0.0007	6.6153
skin_colorBlack	0.0363	0.0283	0.0443	0.0000	0.0000	0.0041	8.9425
skin_colorBrown	0.0174	0.0122	0.0225	0.0000	0.0000	0.0026	6.7959

Table S13. Creatinine

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.0067	-0.0086	-0.0048	0.0000	0.0000	0.0010	-6.8525
sun_protection_use	-0.0048	-0.0066	-0.0029	0.0000	0.0000	0.0010	-4.9916
fish_oil_supplementsYes	-0.0148	-0.0159	-0.0137	0.0000	0.0000	0.0006	-26.0942
folate_supplementsYes	-0.0120	-0.0157	-0.0084	0.0000	0.0000	0.0018	-6.5547
glucosamine_supplementsYes	-0.0138	-0.0151	-0.0125	0.0000	0.0000	0.0007	-20.9931
multivitamin_supplementsYes	-0.0164	-0.0176	-0.0151	0.0000	0.0000	0.0007	-24.9243
pack_years_prop	-0.0074	-0.0080	-0.0068	0.0000	0.0000	0.0003	-24.2712
smoking_statusPrevious	-0.0069	-0.0080	-0.0058	0.0000	0.0000	0.0006	-12.3233
smoking_statusCurrent	-0.0365	-0.0382	-0.0347	0.0000	0.0000	0.0009	-40.5910
IPAQ_activity_group	-0.0038	-0.0050	-0.0027	0.0000	0.0000	0.0006	-6.7259
education_years	-0.0035	-0.0046	-0.0024	0.0000	0.0000	0.0006	-5.9872
ethnicityAsian	-0.0387	-0.0421	-0.0352	0.0000	0.0000	0.0018	-22.0401
ethnicityBlack	0.0974	0.0936	0.1013	0.0000	0.0000	0.0020	49.0646
ethnicityMixed	0.0082	0.0016	0.0147	0.0150	0.0191	0.0034	2.4334
ethnicityOther	-0.0122	-0.0176	-0.0068	0.0000	0.0000	0.0027	-4.4462

Table S14. Cystatin C

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0352	-0.0368	-0.0337	0.0000	0.0000	0.0008	-44.6642
alcohol_freqDaily or almost daily	-0.0458	-0.0474	-0.0442	0.0000	0.0000	0.0008	-56.1449
alcohol_freqOnce or twice a week	-0.0169	-0.0184	-0.0154	0.0000	0.0000	0.0008	-22.0812
bread	0.0107	0.0098	0.0116	0.0000	0.0000	0.0005	22.4331
cereal	-0.0073	-0.0082	-0.0064	0.0000	0.0000	0.0004	-16.2621
never_eat_dairyYes	0.0026	-0.0003	0.0055	0.0804	0.0860	0.0015	1.7483
never_eat_eggsYes	0.0188	0.0157	0.0218	0.0000	0.0000	0.0015	12.3095
never_eat_sugarYes	-0.0134	-0.0146	-0.0123	0.0000	0.0000	0.0006	-23.0452
partial_fiber_score	-0.0186	-0.0197	-0.0176	0.0000	0.0000	0.0005	-34.7496
poultry	-0.0163	-0.0175	-0.0152	0.0000	0.0000	0.0006	-27.3700
processed_meat	0.0069	0.0058	0.0080	0.0000	0.0000	0.0006	12.5286
red_meat	-0.0068	-0.0079	-0.0058	0.0000	0.0000	0.0005	-12.6968
salt	0.0067	0.0055	0.0078	0.0000	0.0000	0.0006	11.3465
body_size_10yrs_oldThinner	0.0004	-0.0007	0.0015	0.4410	0.4526	0.0006	0.7745
body_size_10yrs_oldPlumper	0.0206	0.0191	0.0220	0.0000	0.0000	0.0007	28.4549
height_10yrs_oldShorter	-0.0088	-0.0100	-0.0076	0.0000	0.0000	0.0006	-14.8112
height_10yrs_oldTaller	0.0112	0.0102	0.0123	0.0000	0.0000	0.0005	20.5609

Table S14. Cystatin C

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0049	0.0038	0.0060	0.0000	0.0000	0.0006	8.5805
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0112	0.0026	0.0199	0.0181	0.0202	0.0037	3.0453
mobile_phone_2yrsYes, use is now less frequent	0.0065	0.0046	0.0084	0.0000	0.0000	0.0009	6.9180
mobile_phone_2yrsYes, use is now more frequent	-0.0013	-0.0034	0.0007	0.1784	0.1880	0.0009	-1.4673
employedYes	-0.0056	-0.0068	-0.0045	0.0000	0.0000	0.0006	-9.5430
unemployedYes	0.0149	0.0115	0.0182	0.0000	0.0000	0.0017	8.7641
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0285	0.0160	0.0410	0.0000	0.0000	0.0064	4.4675
accommodation_typeA flat, maisonette or apartment	0.0150	0.0133	0.0167	0.0000	0.0000	0.0009	17.6347
gas_hob_heatYes	-0.0026	-0.0036	-0.0016	0.0000	0.0000	0.0005	-5.1918
hshld_income	-0.0347	-0.0370	-0.0325	0.0000	0.0000	0.0010	-33.2889
hshld_parentsYes	0.0153	0.0121	0.0185	0.0000	0.0000	0.0016	9.2947
hshld_partnerYes	-0.0174	-0.0184	-0.0164	0.0000	0.0000	0.0005	-33.7206
hshld_siblingsYes	0.0214	0.0158	0.0270	0.0000	0.0000	0.0029	7.4918
hshld_vehicles	-0.0274	-0.0292	-0.0257	0.0000	0.0000	0.0009	-31.0415

Table S14. Cystatin C

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0232	0.0203	0.0261	0.0000	0.0000	0.0014	16.0240
own_or_rentPay part rent and part mortgage (shared ownership)	0.0227	0.0147	0.0306	0.0000	0.0000	0.0041	5.5843
own_or_rentOwn with a mortgage	0.0092	0.0080	0.0103	0.0000	0.0000	0.0006	15.6100
own_or_rentRent - from local authority, local council, housing association	0.0463	0.0442	0.0484	0.0000	0.0000	0.0011	43.3968
own_or_rentLive in accommodation rent free	0.0185	0.0133	0.0237	0.0000	0.0000	0.0026	6.9998
townsend_deprivation_index	0.0113	0.0108	0.0118	0.0000	0.0000	0.0003	43.8565
psychiatrist_visit_mental_healthYes	0.0040	0.0025	0.0055	0.0000	0.0000	0.0008	5.2495
risk_takingYes	0.0028	0.0015	0.0041	0.0001	0.0001	0.0006	4.3896
tiredness_freq	0.0241	0.0229	0.0254	0.0000	0.0000	0.0006	37.8014
unenthusiasm_freq	0.0163	0.0146	0.0180	0.0000	0.0000	0.0009	18.7877
fast_driving	-0.0152	-0.0168	-0.0135	0.0000	0.0000	0.0008	-17.9747
gymYes	-0.0142	-0.0153	-0.0131	0.0000	0.0000	0.0006	-24.9726
LTPA	-0.0188	-0.0205	-0.0171	0.0000	0.0000	0.0008	-23.7885
sedentary	0.0197	0.0189	0.0205	0.0000	0.0000	0.0004	45.8481
air_pollution_PC1	0.0023	0.0021	0.0025	0.0000	0.0000	0.0001	19.9825

Table S14. Cystatin C

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	-0.0021	-0.0024	-0.0019	0.0000	0.0000	0.0001	-16.0612
number_sex_partners	0.0008	0.0000	0.0015	0.0409	0.0450	0.0003	2.2837
sex_age_first	-0.0010	-0.0014	-0.0005	0.0001	0.0001	0.0002	-3.9645
chronotypeDefinitely an 'evening' person	0.0124	0.0107	0.0141	0.0000	0.0000	0.0009	14.3207
chronotypeDefinitely a 'morning' person	0.0054	0.0038	0.0071	0.0000	0.0000	0.0008	6.9123
chronotypeMore an 'evening' than a 'morning' person	0.0024	0.0006	0.0041	0.0106	0.0120	0.0008	2.9424
nap	0.0196	0.0185	0.0206	0.0000	0.0000	0.0006	35.3328
sleep_hours_categorical>9 hours	0.0179	0.0161	0.0196	0.0000	0.0000	0.0009	20.4082
sleep_hours_categorical<7 hours	0.0078	0.0068	0.0089	0.0000	0.0000	0.0005	14.7496
family_visit_freq	0.0031	0.0009	0.0052	0.0047	0.0055	0.0011	2.8303
religious_groupYes	0.0036	0.0023	0.0049	0.0000	0.0000	0.0007	5.4263
facial_agingAbout your age	0.0098	0.0083	0.0112	0.0000	0.0000	0.0007	14.0629
facial_agingOlder than you are	0.0297	0.0230	0.0363	0.0000	0.0000	0.0029	10.2299
skin_colorDark olive	0.0081	0.0046	0.0115	0.0000	0.0000	0.0017	4.6166
skin_colorLight olive	-0.0023	-0.0038	-0.0008	0.0048	0.0055	0.0007	-3.0734
skin_colorBlack	0.0072	0.0001	0.0143	0.0463	0.0501	0.0036	2.0014
skin_colorBrown	0.0131	0.0087	0.0176	0.0000	0.0000	0.0022	5.9029

Table S14. Cystatin C

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0010	-0.0008	0.0028	0.2548	0.2650	0.0009	1.1420
sun_protection_use	-0.0214	-0.0230	-0.0197	0.0000	0.0000	0.0008	-25.2404
fish_oil_supplementsYes	-0.0239	-0.0250	-0.0228	0.0000	0.0000	0.0006	-42.6727
folate_supplementsYes	0.0010	-0.0022	0.0041	0.5417	0.5487	0.0016	0.6108
glucosamine_supplementsYes	-0.0226	-0.0238	-0.0215	0.0000	0.0000	0.0006	-39.3422
multivitamin_supplementsYes	-0.0155	-0.0166	-0.0144	0.0000	0.0000	0.0006	-27.5023
pack_years_prop	0.0147	0.0142	0.0153	0.0000	0.0000	0.0003	53.3167
smoking_statusPrevious	-0.0023	-0.0033	-0.0013	0.0000	0.0000	0.0005	-4.6040
smoking_statusCurrent	0.0554	0.0539	0.0569	0.0000	0.0000	0.0008	71.5331
IPAQ_activity_group	-0.0230	-0.0247	-0.0214	0.0000	0.0000	0.0007	-31.0688
education_years	-0.0219	-0.0229	-0.0208	0.0000	0.0000	0.0005	-41.3492
ethnicityAsian	0.0369	0.0338	0.0400	0.0000	0.0000	0.0016	23.5605
ethnicityBlack	-0.0205	-0.0241	-0.0169	0.0000	0.0000	0.0018	-11.2384
ethnicityMixed	-0.0166	-0.0224	-0.0109	0.0000	0.0000	0.0029	-5.6745
ethnicityOther	0.0003	-0.0043	0.0049	0.9033	0.9033	0.0024	0.1215

Table S15. Direct bilirubin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.0328	0.0290	0.0366	0.0000	0.0000	0.0019	16.9156
alcohol_freqDaily or almost daily	0.0519	0.0480	0.0559	0.0000	0.0000	0.0020	26.0191
alcohol_freqOnce or twice a week	0.0121	0.0084	0.0158	0.0000	0.0000	0.0019	6.4398
bread	-0.0150	-0.0172	-0.0128	0.0000	0.0000	0.0011	-13.4059
cereal	0.0003	-0.0018	0.0023	0.7912	0.8228	0.0010	0.2649
never_eat_dairyYes	0.0158	0.0084	0.0232	0.0001	0.0001	0.0038	4.2070
never_eat_eggsYes	0.0057	-0.0009	0.0123	0.0901	0.1301	0.0033	1.7042
never_eat_sugarYes	0.0064	0.0037	0.0091	0.0000	0.0000	0.0014	4.6897
partial_fiber_score	0.0040	0.0017	0.0064	0.0008	0.0015	0.0012	3.3423
poultry	-0.0077	-0.0104	-0.0050	0.0000	0.0000	0.0014	-5.5680
processed_meat	-0.0197	-0.0223	-0.0170	0.0000	0.0000	0.0013	-14.7026
red_meat	-0.0148	-0.0173	-0.0124	0.0000	0.0000	0.0013	-11.7951
salt	-0.0095	-0.0122	-0.0069	0.0000	0.0000	0.0014	-6.9630
body_size_10yrs_oldThinner	-0.0054	-0.0078	-0.0030	0.0000	0.0000	0.0012	-4.3984
body_size_10yrs_oldPlumper	-0.0111	-0.0143	-0.0080	0.0000	0.0000	0.0016	-7.0149
height_10yrs_oldShorter	-0.0194	-0.0221	-0.0167	0.0000	0.0000	0.0014	-14.0560
height_10yrs_oldTaller	0.0248	0.0224	0.0273	0.0000	0.0000	0.0012	19.9121

Table S15. Direct bilirubin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0015	-0.0038	0.0009	0.2185	0.2990	0.0012	-1.2311
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0065	-0.0064	0.0194	0.2986	0.3697	0.0061	1.0749
mobile_phone_2yrsYes, use is now less frequent	-0.0007	-0.0039	0.0026	0.6908	0.7605	0.0017	-0.3977
mobile_phone_2yrsYes, use is now more frequent	0.0004	-0.0025	0.0033	0.7769	0.8189	0.0014	0.2857
employedYes	-0.0001	-0.0028	0.0025	0.9127	0.9127	0.0013	-0.1096
unemployedYes	-0.0007	-0.0083	0.0068	0.8502	0.8726	0.0038	-0.1889
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0068	-0.0349	0.0213	0.6333	0.7159	0.0143	-0.4771
accommodation_typeA flat, maisonette or apartment	-0.0002	-0.0041	0.0036	0.9122	0.9127	0.0020	-0.1103
gas_hob_heatYes	0.0011	-0.0011	0.0034	0.3346	0.4078	0.0011	0.9651
hshld_income	0.0311	0.0275	0.0347	0.0000	0.0000	0.0018	17.0314
hshld_parentsYes	-0.0069	-0.0147	0.0009	0.0822	0.1210	0.0040	-1.7434
hshld_partnerYes	0.0046	0.0023	0.0070	0.0001	0.0002	0.0012	3.8460
hshld_siblingsYes	-0.0123	-0.0256	0.0010	0.0708	0.1082	0.0068	-1.8112
hshld_vehicles	0.0072	0.0031	0.0113	0.0006	0.0011	0.0021	3.4770

Table S15. Direct bilirubin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0101	-0.0160	-0.0041	0.0009	0.0016	0.0030	-3.3107
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0087	-0.0272	0.0099	0.3597	0.4316	0.0095	-0.9161
own_or_rentOwn with a mortgage	-0.0009	-0.0035	0.0016	0.4814	0.5522	0.0013	-0.7042
own_or_rentRent - from local authority, local council, housing association	-0.0125	-0.0175	-0.0076	0.0000	0.0000	0.0025	-5.0278
own_or_rentLive in accommodation rent free	-0.0074	-0.0197	0.0048	0.2339	0.3145	0.0062	-1.1911
townsend_deprivation_index	-0.0044	-0.0056	-0.0033	0.0000	0.0000	0.0006	-7.4744
psychiatrist_visit_mental_healthYes	-0.0208	-0.0242	-0.0173	0.0000	0.0000	0.0017	-11.9228
risk_takingYes	-0.0013	-0.0037	0.0011	0.2760	0.3530	0.0012	-1.0898
tiredness_freq	-0.0264	-0.0293	-0.0235	0.0000	0.0000	0.0015	-17.9729
unenthusiasm_freq	-0.0201	-0.0238	-0.0163	0.0000	0.0000	0.0019	-10.5189
fast_driving	0.0100	0.0061	0.0138	0.0000	0.0000	0.0020	5.0694
gymYes	0.0193	0.0169	0.0217	0.0000	0.0000	0.0012	15.5860
LTPA	0.0128	0.0099	0.0157	0.0000	0.0000	0.0014	8.8629
sedentary	-0.0109	-0.0128	-0.0090	0.0000	0.0000	0.0010	-11.3744
air_pollution_PC1	-0.0001	-0.0006	0.0004	0.7237	0.7840	0.0003	-0.3535

Table S15. Direct bilirubin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0011	0.0005	0.0017	0.0006	0.0011	0.0003	3.4350
number_sex_partners	0.0014	0.0002	0.0026	0.0210	0.0335	0.0006	2.3614
sex_age_first	0.0024	0.0013	0.0035	0.0000	0.0000	0.0006	4.3501
chronotypeDefinitely an 'evening' person	-0.0037	-0.0079	0.0004	0.0752	0.1127	0.0021	-1.7851
chronotypeDefinitely a 'morning' person	-0.0011	-0.0040	0.0018	0.4473	0.5287	0.0015	-0.7623
chronotypeMore an 'evening' than a 'morning' person	-0.0017	-0.0043	0.0009	0.2049	0.2906	0.0013	-1.2692
nap	-0.0138	-0.0163	-0.0112	0.0000	0.0000	0.0013	-10.6198
sleep_hours_categorical>9 hours	-0.0083	-0.0124	-0.0042	0.0001	0.0002	0.0021	-3.9800
sleep_hours_categorical<7 hours	-0.0013	-0.0037	0.0011	0.2977	0.3697	0.0012	-1.0415
family_visit_freq	-0.0032	-0.0083	0.0019	0.2138	0.2978	0.0026	-1.2452
religious_groupYes	-0.0056	-0.0086	-0.0026	0.0003	0.0006	0.0015	-3.6478
facial_agingAbout your age	0.0010	-0.0015	0.0035	0.4545	0.5291	0.0013	0.7485
facial_agingOlder than you are	-0.0103	-0.0186	-0.0020	0.0159	0.0259	0.0042	-2.4554
skin_colorDark olive	0.0176	0.0096	0.0256	0.0000	0.0000	0.0041	4.3402
skin_colorLight olive	0.0108	0.0081	0.0135	0.0000	0.0000	0.0014	7.8383
skin_colorBlack	0.0190	0.0025	0.0354	0.0240	0.0375	0.0084	2.2699
skin_colorBrown	0.0120	0.0032	0.0207	0.0073	0.0122	0.0045	2.6820

Table S15. Direct bilirubin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.0109	-0.0148	-0.0069	0.0000	0.0000	0.0020	-5.4121
sun_protection_use	-0.0008	-0.0047	0.0031	0.6922	0.7605	0.0020	-0.3965
fish_oil_supplementsYes	-0.0118	-0.0141	-0.0094	0.0000	0.0000	0.0012	-9.8627
folate_supplementsYes	-0.0012	-0.0083	0.0059	0.7430	0.7939	0.0036	-0.3280
glucosamine_supplementsYes	-0.0139	-0.0166	-0.0111	0.0000	0.0000	0.0014	-9.9448
multivitamin_supplementsYes	-0.0151	-0.0178	-0.0123	0.0000	0.0000	0.0014	-10.9482
pack_years_prop	-0.0228	-0.0239	-0.0217	0.0000	0.0000	0.0006	-41.3854
smoking_statusPrevious	-0.0112	-0.0135	-0.0089	0.0000	0.0000	0.0012	-9.6957
smoking_statusCurrent	-0.0990	-0.1026	-0.0955	0.0000	0.0000	0.0018	-54.4835
IPAQ_activity_group	0.0187	0.0165	0.0208	0.0000	0.0000	0.0011	16.9896
education_years	0.0147	0.0123	0.0170	0.0000	0.0000	0.0012	12.2968
ethnicityAsian	-0.0308	-0.0378	-0.0238	0.0000	0.0000	0.0036	-8.6110
ethnicityBlack	0.0047	-0.0036	0.0131	0.2632	0.3422	0.0042	1.1205
ethnicityMixed	-0.0077	-0.0212	0.0058	0.2624	0.3422	0.0069	-1.1212
ethnicityOther	-0.0211	-0.0317	-0.0104	0.0001	0.0002	0.0054	-3.8787

Table S16. Gamma glutamyltransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.0981	0.0916	0.1047	0.0000	0.0000	0.0033	29.4396
alcohol_freqDaily or almost daily	0.2133	0.2060	0.2205	0.0000	0.0000	0.0036	58.4327
alcohol_freqOnce or twice a week	0.0339	0.0273	0.0405	0.0000	0.0000	0.0033	10.1829
bread	-0.0040	-0.0077	-0.0002	0.0373	0.0416	0.0019	-2.0851
cereal	-0.0796	-0.0830	-0.0761	0.0000	0.0000	0.0018	-45.1953
never_eat_dairyYes	-0.0413	-0.0541	-0.0285	0.0000	0.0000	0.0065	-6.4043
never_eat_eggsYes	-0.0120	-0.0236	-0.0004	0.0423	0.0465	0.0059	-2.0515
never_eat_sugarYes	0.0213	0.0166	0.0260	0.0000	0.0000	0.0024	8.9294
partial_fiber_score	-0.0877	-0.0918	-0.0836	0.0000	0.0000	0.0021	-41.6909
poultry	0.0767	0.0721	0.0813	0.0000	0.0000	0.0023	32.6405
processed_meat	0.0906	0.0863	0.0948	0.0000	0.0000	0.0022	41.8457
red_meat	0.1034	0.0992	0.1076	0.0000	0.0000	0.0021	48.2979
salt	0.0709	0.0663	0.0755	0.0000	0.0000	0.0024	30.0978
body_size_10yrs_oldThinner	0.0296	0.0255	0.0337	0.0000	0.0000	0.0021	14.2469
body_size_10yrs_oldPlumper	0.0364	0.0314	0.0413	0.0000	0.0000	0.0025	14.3140
height_10yrs_oldShorter	0.0311	0.0265	0.0356	0.0000	0.0000	0.0023	13.3299
height_10yrs_oldTaller	-0.0143	-0.0187	-0.0099	0.0000	0.0000	0.0022	-6.4063

Table S16. Gamma glutamyltransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0427	0.0360	0.0494	0.0000	0.0000	0.0031	13.9413
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0090	-0.0266	0.0085	0.3067	0.3147	0.0087	-1.0332
mobile_phone_2yrsYes, use is now less frequent	0.0297	0.0214	0.0379	0.0000	0.0000	0.0039	7.5555
mobile_phone_2yrsYes, use is now more frequent	0.0047	-0.0034	0.0129	0.2212	0.2301	0.0036	1.3206
employedYes	-0.0208	-0.0253	-0.0163	0.0000	0.0000	0.0023	-9.1273
unemployedYes	0.0507	0.0374	0.0641	0.0000	0.0000	0.0068	7.4611
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0856	0.0362	0.1350	0.0007	0.0009	0.0252	3.3969
accommodation_typeA flat, maisonette or apartment	0.0480	0.0410	0.0549	0.0000	0.0000	0.0035	13.5387
gas_hob_heatYes	-0.0020	-0.0060	0.0019	0.3188	0.3229	0.0020	-0.9975
hshld_income	-0.0080	-0.0147	-0.0012	0.0212	0.0243	0.0034	-2.3712
hshld_parentsYes	0.0295	0.0160	0.0430	0.0000	0.0000	0.0069	4.2966
hshld_partnerYes	-0.0112	-0.0153	-0.0071	0.0000	0.0000	0.0021	-5.3308
hshld_siblingsYes	0.0320	0.0094	0.0546	0.0055	0.0065	0.0115	2.7831
hshld_vehicles	-0.0111	-0.0180	-0.0043	0.0015	0.0019	0.0035	-3.1821

Table S16. Gamma glutamyltransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0545	0.0434	0.0657	0.0000	0.0000	0.0056	9.6584
own_or_rentPay part rent and part mortgage (shared ownership)	0.0549	0.0221	0.0878	0.0011	0.0014	0.0167	3.2855
own_or_rentOwn with a mortgage	0.0342	0.0296	0.0388	0.0000	0.0000	0.0023	14.6651
own_or_rentRent - from local authority, local council, housing association	0.1012	0.0923	0.1100	0.0000	0.0000	0.0045	22.6684
own_or_rentLive in accommodation rent free	0.0379	0.0156	0.0603	0.0010	0.0013	0.0113	3.3499
townsend_deprivation_index	0.0187	0.0165	0.0208	0.0000	0.0000	0.0011	17.2918
psychiatrist_visit_mental_healthYes	0.0047	-0.0008	0.0102	0.0958	0.1010	0.0028	1.6655
risk_takingYes	0.0288	0.0244	0.0332	0.0000	0.0000	0.0022	13.0568
tiredness_freq	0.0562	0.0512	0.0611	0.0000	0.0000	0.0025	22.2331
unenthusiasm_freq	0.0567	0.0500	0.0635	0.0000	0.0000	0.0034	16.5610
fast_driving	0.0127	0.0060	0.0195	0.0002	0.0003	0.0034	3.7010
gymYes	-0.0360	-0.0401	-0.0319	0.0000	0.0000	0.0021	-17.2674
LTPA	-0.0620	-0.0684	-0.0556	0.0000	0.0000	0.0030	-20.4631
sedentary	0.0726	0.0692	0.0759	0.0000	0.0000	0.0017	42.7337
air_pollution_PC1	0.0041	0.0032	0.0050	0.0000	0.0000	0.0005	9.0558

Table S16. Gamma glutamyltransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	-0.0016	-0.0027	-0.0006	0.0020	0.0024	0.0005	-3.0955
number_sex_partners	0.0048	0.0030	0.0066	0.0000	0.0000	0.0009	5.2963
sex_age_first	-0.0314	-0.0334	-0.0295	0.0000	0.0000	0.0010	-31.6288
chronotypeDefinitely an 'evening' person	0.0457	0.0378	0.0536	0.0000	0.0000	0.0040	11.5566
chronotypeDefinitely a 'morning' person	0.0091	0.0020	0.0162	0.0157	0.0183	0.0033	2.7462
chronotypeMore an 'evening' than a 'morning' person	0.0257	0.0174	0.0339	0.0000	0.0001	0.0037	6.9741
nap	0.0401	0.0357	0.0445	0.0000	0.0000	0.0022	17.8468
sleep_hours_categorical>9 hours	0.0584	0.0516	0.0651	0.0000	0.0000	0.0034	16.9665
sleep_hours_categorical<7 hours	0.0316	0.0275	0.0357	0.0000	0.0000	0.0021	15.1000
family_visit_freq	0.0248	0.0162	0.0333	0.0000	0.0000	0.0044	5.6732
religious_groupYes	-0.0287	-0.0340	-0.0235	0.0000	0.0000	0.0027	-10.7687
facial_agingAbout your age	0.0061	-0.0010	0.0132	0.0841	0.0899	0.0032	1.8854
facial_agingOlder than you are	0.0285	0.0106	0.0464	0.0034	0.0040	0.0086	3.3149
skin_colorDark olive	0.0224	0.0093	0.0356	0.0008	0.0011	0.0067	3.3437
skin_colorLight olive	-0.0015	-0.0061	0.0031	0.5264	0.5264	0.0023	-0.6336
skin_colorBlack	0.0815	0.0548	0.1083	0.0000	0.0000	0.0136	5.9748
skin_colorBrown	0.0448	0.0296	0.0599	0.0000	0.0000	0.0077	5.7943

Table S16. Gamma glutamyltransferase

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0069	-0.0002	0.0140	0.0578	0.0627	0.0036	1.9074
sun_protection_use	-0.0120	-0.0188	-0.0051	0.0007	0.0010	0.0035	-3.4596
fish_oil_supplementsYes	-0.0176	-0.0216	-0.0136	0.0000	0.0000	0.0020	-8.6187
folate_supplementsYes	-0.0562	-0.0683	-0.0441	0.0000	0.0000	0.0062	-9.1223
glucosamine_supplementsYes	-0.0298	-0.0343	-0.0253	0.0000	0.0000	0.0023	-12.9813
multivitamin_supplementsYes	-0.0110	-0.0153	-0.0067	0.0000	0.0000	0.0022	-4.9935
pack_years_prop	0.0630	0.0606	0.0653	0.0000	0.0000	0.0011	54.8878
smoking_statusPrevious	0.0619	0.0579	0.0659	0.0000	0.0000	0.0020	30.4735
smoking_statusCurrent	0.1117	0.1051	0.1183	0.0000	0.0000	0.0033	33.3983
IPAQ_activity_group	-0.0822	-0.0879	-0.0765	0.0000	0.0000	0.0026	-31.2257
education_years	-0.0669	-0.0710	-0.0628	0.0000	0.0000	0.0021	-32.1810
ethnicityAsian	0.0134	0.0013	0.0254	0.0303	0.0342	0.0062	2.1695
ethnicityBlack	0.2251	0.2113	0.2389	0.0000	0.0000	0.0070	32.0375
ethnicityMixed	0.0521	0.0290	0.0751	0.0000	0.0000	0.0118	4.4222
ethnicityOther	0.0881	0.0694	0.1067	0.0000	0.0000	0.0095	9.2508

Table S17. Glucose

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0025	-0.0043	-0.0007	0.0070	0.0096	0.0009	-2.6989
alcohol_freqDaily or almost daily	0.0032	0.0012	0.0051	0.0013	0.0019	0.0010	3.2247
alcohol_freqOnce or twice a week	-0.0022	-0.0040	-0.0004	0.0192	0.0254	0.0009	-2.3439
bread	0.0071	0.0060	0.0082	0.0000	0.0000	0.0006	12.6555
cereal	-0.0110	-0.0121	-0.0099	0.0000	0.0000	0.0006	-19.9193
never_eat_dairyYes	-0.0012	-0.0047	0.0023	0.4876	0.5209	0.0018	-0.6945
never_eat_eggsYes	0.0038	0.0003	0.0072	0.0333	0.0426	0.0017	2.1546
never_eat_sugarYes	0.0332	0.0319	0.0346	0.0000	0.0000	0.0007	48.1069
partial_fiber_score	-0.0020	-0.0032	-0.0007	0.0018	0.0025	0.0006	-3.1314
poultry	0.0028	0.0014	0.0042	0.0001	0.0001	0.0007	3.9857
processed_meat	0.0113	0.0100	0.0126	0.0000	0.0000	0.0007	17.3148
red_meat	0.0104	0.0091	0.0117	0.0000	0.0000	0.0007	15.8145
salt	-0.0013	-0.0028	0.0002	0.0831	0.1012	0.0007	-1.7428
body_size_10yrs_oldThinner	0.0029	0.0015	0.0044	0.0002	0.0004	0.0007	4.0854
body_size_10yrs_oldPlumper	0.0107	0.0091	0.0123	0.0000	0.0000	0.0008	13.0657
height_10yrs_oldShorter	-0.0013	-0.0028	0.0002	0.0985	0.1182	0.0008	-1.6706
height_10yrs_oldTaller	0.0008	-0.0005	0.0021	0.2517	0.2805	0.0007	1.1480

Table S17. Glucose

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0024	0.0010	0.0038	0.0011	0.0016	0.0007	3.4525
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0003	-0.0061	0.0067	0.9276	0.9396	0.0030	0.0923
mobile_phone_2yrsYes, use is now less frequent	0.0016	-0.0004	0.0037	0.1132	0.1338	0.0010	1.6181
mobile_phone_2yrsYes, use is now more frequent	-0.0044	-0.0074	-0.0014	0.0107	0.0144	0.0012	-3.5169
employedYes	-0.0081	-0.0094	-0.0068	0.0000	0.0000	0.0007	-12.2344
unemployedYes	0.0140	0.0102	0.0178	0.0000	0.0000	0.0019	7.1785
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0096	-0.0058	0.0251	0.2214	0.2502	0.0078	1.2268
accommodation_typeA flat, maisonette or apartment	0.0105	0.0085	0.0125	0.0000	0.0000	0.0010	10.3729
gas_hob_heatYes	-0.0021	-0.0033	-0.0010	0.0004	0.0006	0.0006	-3.5761
hshld_income	-0.0106	-0.0124	-0.0088	0.0000	0.0000	0.0009	-11.5299
hshld_parentsYes	0.0169	0.0131	0.0207	0.0000	0.0000	0.0020	8.6532
hshld_partnerYes	-0.0080	-0.0094	-0.0067	0.0000	0.0000	0.0007	-11.9559
hshld_siblingsYes	0.0234	0.0167	0.0301	0.0000	0.0000	0.0034	6.8916
hshld_vehicles	-0.0131	-0.0151	-0.0111	0.0000	0.0000	0.0010	-12.9445

Table S17. Glucose

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0181	0.0148	0.0214	0.0000	0.0000	0.0017	10.9214
own_or_rentPay part rent and part mortgage (shared ownership)	0.0035	-0.0070	0.0140	0.5120	0.5397	0.0053	0.6582
own_or_rentOwn with a mortgage	0.0022	0.0009	0.0035	0.0009	0.0014	0.0007	3.3137
own_or_rentRent - from local authority, local council, housing association	0.0173	0.0147	0.0198	0.0000	0.0000	0.0013	13.4497
own_or_rentLive in accommodation rent free	0.0102	0.0041	0.0162	0.0010	0.0015	0.0031	3.2892
townsend_deprivation_index	0.0052	0.0046	0.0058	0.0000	0.0000	0.0003	16.7087
psychiatrist_visit_mental_healthYes	-0.0065	-0.0083	-0.0047	0.0000	0.0000	0.0009	-7.2136
risk_takingYes	0.0009	-0.0003	0.0021	0.1496	0.1716	0.0006	1.4425
tiredness_freq	0.0012	-0.0003	0.0027	0.1231	0.1433	0.0008	1.5435
unenthusiasm_freq	0.0047	0.0027	0.0068	0.0000	0.0000	0.0010	4.6086
fast_driving	-0.0110	-0.0130	-0.0091	0.0000	0.0000	0.0010	-11.2000
gymYes	-0.0089	-0.0101	-0.0077	0.0000	0.0000	0.0006	-14.2564
LTPA	-0.0072	-0.0086	-0.0059	0.0000	0.0000	0.0007	-10.3659
sedentary	0.0087	0.0077	0.0096	0.0000	0.0000	0.0005	17.5699
air_pollution_PC1	0.0001	-0.0002	0.0004	0.4110	0.4515	0.0001	0.8236

Table S17. Glucose

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0003	0.0000	0.0007	0.0408	0.0514	0.0002	2.0531
number_sex_partners	0.0003	-0.0005	0.0011	0.4476	0.4849	0.0004	0.7793
sex_age_first	-0.0019	-0.0026	-0.0013	0.0000	0.0000	0.0003	-5.8230
chronotypeDefinitely an 'evening' person	0.0083	0.0061	0.0105	0.0000	0.0000	0.0011	7.4460
chronotypeDefinitely a 'morning' person	0.0037	0.0022	0.0051	0.0000	0.0000	0.0007	4.9583
chronotypeMore an 'evening' than a 'morning' person	0.0028	0.0013	0.0044	0.0004	0.0006	0.0008	3.7690
nap	0.0111	0.0098	0.0124	0.0000	0.0000	0.0007	16.3155
sleep_hours_categorical>9 hours	0.0101	0.0080	0.0123	0.0000	0.0000	0.0011	9.3374
sleep_hours_categorical<7 hours	0.0030	0.0018	0.0042	0.0000	0.0000	0.0006	4.8216
family_visit_freq	-0.0053	-0.0080	-0.0026	0.0002	0.0003	0.0014	-3.8639
religious_groupYes	-0.0052	-0.0067	-0.0036	0.0000	0.0000	0.0008	-6.6342
facial_agingAbout your age	0.0048	0.0029	0.0066	0.0000	0.0001	0.0009	5.5123
facial_agingOlder than you are	0.0141	0.0096	0.0187	0.0000	0.0000	0.0023	6.2717
skin_colorDark olive	-0.0048	-0.0089	-0.0006	0.0245	0.0319	0.0021	-2.2679
skin_colorLight olive	-0.0040	-0.0055	-0.0025	0.0000	0.0000	0.0008	-5.1981
skin_colorBlack	0.0079	-0.0007	0.0165	0.0712	0.0881	0.0044	1.8165
skin_colorBrown	0.0009	-0.0036	0.0054	0.7072	0.7258	0.0023	0.3757

Table S17. Glucose

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0006	-0.0014	0.0027	0.5268	0.5478	0.0010	0.6332
sun_protection_use	-0.0108	-0.0126	-0.0089	0.0000	0.0000	0.0009	-11.4274
fish_oil_supplementsYes	-0.0113	-0.0124	-0.0101	0.0000	0.0000	0.0006	-19.2817
folate_supplementsYes	-0.0165	-0.0201	-0.0130	0.0000	0.0000	0.0018	-9.1952
glucosamine_supplementsYes	-0.0168	-0.0182	-0.0155	0.0000	0.0000	0.0007	-24.0593
multivitamin_supplementsYes	-0.0108	-0.0120	-0.0095	0.0000	0.0000	0.0006	-16.5658
pack_years_prop	0.0061	0.0054	0.0068	0.0000	0.0000	0.0003	18.3358
smoking_statusPrevious	0.0037	0.0025	0.0048	0.0000	0.0000	0.0006	6.3814
smoking_statusCurrent	-0.0086	-0.0103	-0.0068	0.0000	0.0000	0.0009	-9.5869
IPAQ_activity_group	-0.0082	-0.0093	-0.0070	0.0000	0.0000	0.0006	-14.4624
education_years	-0.0085	-0.0097	-0.0073	0.0000	0.0000	0.0006	-13.7346
ethnicityAsian	0.0334	0.0298	0.0370	0.0000	0.0000	0.0018	18.1066
ethnicityBlack	0.0090	0.0045	0.0135	0.0001	0.0002	0.0023	3.9721
ethnicityMixed	0.0001	-0.0069	0.0071	0.9716	0.9716	0.0036	0.0356
ethnicityOther	0.0271	0.0217	0.0325	0.0000	0.0000	0.0028	9.8323

Table S18. hbA1c

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0248	-0.0264	-0.0232	0.0000	0.0000	0.0008	-31.2321
alcohol_freqDaily or almost daily	-0.0331	-0.0347	-0.0315	0.0000	0.0000	0.0008	-41.1784
alcohol_freqOnce or twice a week	-0.0126	-0.0141	-0.0110	0.0000	0.0000	0.0008	-16.3124
bread	0.0161	0.0151	0.0170	0.0000	0.0000	0.0005	34.8521
cereal	-0.0035	-0.0043	-0.0026	0.0000	0.0000	0.0004	-7.8959
never_eat_dairyYes	-0.0059	-0.0088	-0.0030	0.0001	0.0001	0.0015	-3.9449
never_eat_eggsYes	-0.0002	-0.0029	0.0025	0.8844	0.8844	0.0014	-0.1454
never_eat_sugarYes	0.0261	0.0249	0.0273	0.0000	0.0000	0.0006	42.5721
partial_fiber_score	-0.0023	-0.0033	-0.0013	0.0000	0.0000	0.0005	-4.5273
poultry	0.0004	-0.0007	0.0016	0.4676	0.4928	0.0006	0.7265
processed_meat	0.0167	0.0157	0.0177	0.0000	0.0000	0.0005	31.9370
red_meat	0.0089	0.0078	0.0100	0.0000	0.0000	0.0005	16.4671
salt	0.0010	-0.0001	0.0022	0.0762	0.0887	0.0006	1.7746
body_size_10yrs_oldThinner	0.0049	0.0039	0.0059	0.0000	0.0000	0.0005	9.7012
body_size_10yrs_oldPlumper	0.0118	0.0104	0.0132	0.0000	0.0000	0.0007	16.8678
height_10yrs_oldShorter	-0.0007	-0.0019	0.0004	0.2033	0.2298	0.0006	-1.2727
height_10yrs_oldTaller	-0.0006	-0.0017	0.0004	0.2541	0.2752	0.0005	-1.1410

Table S18. hbA1c

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0009	-0.0001	0.0019	0.0677	0.0800	0.0005	1.8291
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0024	-0.0014	0.0062	0.2089	0.2328	0.0019	1.2592
mobile_phone_2yrsYes, use is now less frequent	0.0033	0.0018	0.0048	0.0000	0.0000	0.0008	4.2868
mobile_phone_2yrsYes, use is now more frequent	-0.0003	-0.0018	0.0012	0.6564	0.6649	0.0007	-0.4535
employedYes	0.0022	0.0011	0.0032	0.0001	0.0001	0.0006	3.8954
unemployedYes	0.0113	0.0082	0.0145	0.0000	0.0000	0.0016	7.0407
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0101	-0.0020	0.0221	0.1019	0.1169	0.0061	1.6360
accommodation_typeA flat, maisonette or apartment	0.0087	0.0071	0.0103	0.0000	0.0000	0.0008	10.4925
gas_hob_heatYes	-0.0023	-0.0033	-0.0014	0.0000	0.0000	0.0005	-4.7965
hshld_income	-0.0190	-0.0206	-0.0173	0.0000	0.0000	0.0008	-22.7134
hshld_parentsYes	0.0157	0.0125	0.0189	0.0000	0.0000	0.0016	9.6709
hshld_partnerYes	-0.0094	-0.0104	-0.0084	0.0000	0.0000	0.0005	-18.7134
hshld_siblingsYes	0.0200	0.0146	0.0254	0.0000	0.0000	0.0028	7.2477
hshld_vehicles	-0.0105	-0.0122	-0.0089	0.0000	0.0000	0.0008	-12.6235

Table S18. hbA1c

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0209	0.0183	0.0235	0.0000	0.0000	0.0013	15.6195
own_or_rentPay part rent and part mortgage (shared ownership)	0.0043	-0.0034	0.0120	0.2769	0.2958	0.0039	1.0874
own_or_rentOwn with a mortgage	0.0056	0.0045	0.0067	0.0000	0.0000	0.0005	10.2457
own_or_rentRent - from local authority, local council, housing association	0.0274	0.0254	0.0294	0.0000	0.0000	0.0010	27.0015
own_or_rentLive in accommodation rent free	0.0120	0.0069	0.0172	0.0000	0.0000	0.0026	4.6069
townsend_deprivation_index	0.0073	0.0068	0.0078	0.0000	0.0000	0.0003	27.9693
psychiatrist_visit_mental_healthYes	-0.0037	-0.0051	-0.0024	0.0000	0.0000	0.0007	-5.3342
risk_takingYes	0.0026	0.0015	0.0036	0.0000	0.0000	0.0005	4.6830
tiredness_freq	0.0111	0.0098	0.0124	0.0000	0.0000	0.0006	17.4028
unenthusiasm_freq	0.0094	0.0078	0.0110	0.0000	0.0000	0.0008	11.5214
fast_driving	-0.0086	-0.0102	-0.0069	0.0000	0.0000	0.0008	-10.1605
gymYes	-0.0117	-0.0127	-0.0107	0.0000	0.0000	0.0005	-22.7317
LTPA	-0.0084	-0.0101	-0.0068	0.0000	0.0000	0.0008	-10.8360
sedentary	0.0074	0.0066	0.0083	0.0000	0.0000	0.0004	18.0094
air_pollution_PC1	0.0012	0.0009	0.0014	0.0000	0.0000	0.0001	10.2456

Table S18. hbA1c

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	-0.0009	-0.0012	-0.0007	0.0000	0.0000	0.0001	-7.1996
number_sex_partners	-0.0002	-0.0007	0.0003	0.4807	0.4999	0.0003	-0.7115
sex_age_first	-0.0019	-0.0023	-0.0014	0.0000	0.0000	0.0002	-7.5652
chronotypeDefinitely an 'evening' person	0.0060	0.0042	0.0078	0.0000	0.0000	0.0009	6.4970
chronotypeDefinitely a 'morning' person	0.0043	0.0029	0.0056	0.0000	0.0000	0.0007	6.2556
chronotypeMore an 'evening' than a 'morning' person	0.0004	-0.0011	0.0020	0.5522	0.5668	0.0007	0.6050
nap	0.0152	0.0141	0.0162	0.0000	0.0000	0.0005	28.2347
sleep_hours_categorical>9 hours	0.0074	0.0057	0.0090	0.0000	0.0000	0.0008	8.7211
sleep_hours_categorical<7 hours	0.0063	0.0053	0.0073	0.0000	0.0000	0.0005	12.2177
family_visit_freq	0.0013	-0.0008	0.0034	0.2165	0.2378	0.0011	1.2362
religious_groupYes	0.0022	0.0010	0.0035	0.0004	0.0006	0.0006	3.5141
facial_agingAbout your age	0.0042	0.0026	0.0059	0.0001	0.0001	0.0008	5.5452
facial_agingOlder than you are	0.0202	0.0148	0.0257	0.0000	0.0000	0.0025	8.1325
skin_colorDark olive	-0.0035	-0.0069	-0.0000	0.0494	0.0592	0.0018	-1.9788
skin_colorLight olive	-0.0041	-0.0053	-0.0030	0.0000	0.0000	0.0006	-6.9440
skin_colorBlack	0.0327	0.0258	0.0396	0.0000	0.0000	0.0035	9.3181
skin_colorBrown	0.0148	0.0110	0.0186	0.0000	0.0000	0.0019	7.6306

Table S18. hbA1c

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0020	0.0003	0.0037	0.0183	0.0223	0.0009	2.3632
sun_protection_use	-0.0207	-0.0223	-0.0191	0.0000	0.0000	0.0008	-25.7786
fish_oil_supplementsYes	-0.0162	-0.0172	-0.0152	0.0000	0.0000	0.0005	-32.1062
folate_supplementsYes	-0.0354	-0.0385	-0.0324	0.0000	0.0000	0.0015	-22.8834
glucosamine_supplementsYes	-0.0197	-0.0209	-0.0186	0.0000	0.0000	0.0006	-33.5684
multivitamin_supplementsYes	-0.0163	-0.0173	-0.0153	0.0000	0.0000	0.0005	-30.6420
pack_years_prop	0.0154	0.0149	0.0159	0.0000	0.0000	0.0003	58.9535
smoking_statusPrevious	0.0037	0.0027	0.0047	0.0000	0.0000	0.0005	7.3492
smoking_statusCurrent	0.0366	0.0351	0.0380	0.0000	0.0000	0.0007	48.9701
IPAQ_activity_group	-0.0090	-0.0101	-0.0078	0.0000	0.0000	0.0006	-15.8626
education_years	-0.0131	-0.0141	-0.0121	0.0000	0.0000	0.0005	-26.5488
ethnicityAsian	0.1078	0.1049	0.1107	0.0000	0.0000	0.0015	72.9502
ethnicityBlack	0.1038	0.1001	0.1075	0.0000	0.0000	0.0019	55.5800
ethnicityMixed	0.0372	0.0315	0.0430	0.0000	0.0000	0.0029	12.6464
ethnicityOther	0.0752	0.0707	0.0797	0.0000	0.0000	0.0023	32.4897

Table S19. HDL cholesterol

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.1069	0.1041	0.1096	0.0000	0.0000	0.0014	77.9472
alcohol_freqDaily or almost daily	0.1657	0.1627	0.1686	0.0000	0.0000	0.0015	112.6987
alcohol_freqOnce or twice a week	0.0419	0.0394	0.0445	0.0000	0.0000	0.0013	32.6258
bread	-0.0186	-0.0201	-0.0172	0.0000	0.0000	0.0007	-24.8574
cereal	-0.0226	-0.0240	-0.0212	0.0000	0.0000	0.0007	-32.0215
never_eat_dairyYes	-0.0087	-0.0133	-0.0042	0.0002	0.0002	0.0023	-3.7762
never_eat_eggsYes	-0.0226	-0.0273	-0.0179	0.0000	0.0000	0.0024	-9.5409
never_eat_sugarYes	0.0033	0.0014	0.0051	0.0005	0.0006	0.0009	3.5031
partial_fiber_score	-0.0144	-0.0160	-0.0127	0.0000	0.0000	0.0008	-16.9709
poultry	-0.0148	-0.0167	-0.0129	0.0000	0.0000	0.0010	-15.4588
processed_meat	-0.0139	-0.0157	-0.0122	0.0000	0.0000	0.0009	-15.6286
red_meat	-0.0042	-0.0059	-0.0025	0.0000	0.0000	0.0009	-4.8238
salt	0.0054	0.0035	0.0072	0.0000	0.0000	0.0009	5.7657
body_size_10yrs_oldThinner	-0.0024	-0.0040	-0.0009	0.0024	0.0027	0.0008	-3.0467
body_size_10yrs_oldPlumper	-0.0327	-0.0347	-0.0307	0.0000	0.0000	0.0010	-32.5556
height_10yrs_oldShorter	0.0119	0.0101	0.0137	0.0000	0.0000	0.0009	13.0156
height_10yrs_oldTaller	-0.0088	-0.0105	-0.0070	0.0000	0.0000	0.0009	-9.9441

Table S19. HDL cholesterol

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0074	-0.0093	-0.0054	0.0000	0.0000	0.0010	-7.6278
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0049	-0.0155	0.0058	0.3346	0.3575	0.0048	-1.0135
mobile_phone_2yrsYes, use is now less frequent	-0.0163	-0.0194	-0.0132	0.0000	0.0000	0.0015	-10.8896
mobile_phone_2yrsYes, use is now more frequent	-0.0019	-0.0044	0.0006	0.1294	0.1402	0.0012	-1.6138
employedYes	-0.0017	-0.0035	0.0001	0.0592	0.0650	0.0009	-1.8897
unemployedYes	-0.0128	-0.0179	-0.0077	0.0000	0.0000	0.0026	-4.9036
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0383	-0.0583	-0.0183	0.0002	0.0002	0.0102	-3.7670
accommodation_typeA flat, maisonette or apartment	-0.0101	-0.0127	-0.0074	0.0000	0.0000	0.0013	-7.4719
gas_hob_heatYes	0.0007	-0.0009	0.0022	0.3871	0.4080	0.0008	0.8652
hshld_income	0.0452	0.0426	0.0477	0.0000	0.0000	0.0013	35.0057
hshld_parentsYes	-0.0136	-0.0188	-0.0083	0.0000	0.0000	0.0027	-5.0441
hshld_partnerYes	0.0052	0.0036	0.0068	0.0000	0.0000	0.0008	6.4663
hshld_siblingsYes	-0.0145	-0.0237	-0.0052	0.0023	0.0027	0.0047	-3.0819
hshld_vehicles	0.0159	0.0132	0.0185	0.0000	0.0000	0.0014	11.7314

Table S19. HDL cholesterol

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0320	-0.0361	-0.0279	0.0000	0.0000	0.0021	-15.3046
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0337	-0.0464	-0.0209	0.0000	0.0000	0.0065	-5.1857
own_or_rentOwn with a mortgage	-0.0176	-0.0193	-0.0158	0.0000	0.0000	0.0009	-19.7254
own_or_rentRent - from local authority, local council, housing association	-0.0545	-0.0584	-0.0507	0.0000	0.0000	0.0019	-28.5298
own_or_rentLive in accommodation rent free	-0.0284	-0.0370	-0.0197	0.0000	0.0000	0.0044	-6.4788
townsend_deprivation_index	-0.0125	-0.0132	-0.0117	0.0000	0.0000	0.0004	-31.5577
psychiatrist_visit_mental_healthYes	-0.0060	-0.0082	-0.0037	0.0000	0.0000	0.0012	-5.1547
risk_takingYes	-0.0032	-0.0049	-0.0015	0.0003	0.0004	0.0009	-3.6900
tiredness_freq	-0.0387	-0.0407	-0.0367	0.0000	0.0000	0.0010	-37.5788
unenthusiasm_freq	-0.0232	-0.0258	-0.0205	0.0000	0.0000	0.0014	-17.1127
fast_driving	0.0136	0.0110	0.0162	0.0000	0.0000	0.0013	10.1722
gymYes	0.0238	0.0221	0.0256	0.0000	0.0000	0.0009	27.2763
LTPA	0.0382	0.0355	0.0409	0.0000	0.0000	0.0013	30.4573
sedentary	-0.0414	-0.0428	-0.0401	0.0000	0.0000	0.0007	-61.5669
air_pollution_PC1	-0.0032	-0.0035	-0.0028	0.0000	0.0000	0.0002	-17.0569

Table S19. HDL cholesterol

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0044	0.0040	0.0048	0.0000	0.0000	0.0002	20.8422
number_sex_partners	-0.0002	-0.0010	0.0006	0.6398	0.6595	0.0004	-0.4693
sex_age_first	0.0044	0.0037	0.0052	0.0000	0.0000	0.0004	11.5641
chronotypeDefinitely an 'evening' person	-0.0129	-0.0161	-0.0098	0.0000	0.0000	0.0016	-8.2450
chronotypeDefinitely a 'morning' person	-0.0078	-0.0105	-0.0051	0.0000	0.0000	0.0013	-6.1711
chronotypeMore an 'evening' than a 'morning' person	-0.0002	-0.0025	0.0020	0.8279	0.8279	0.0011	-0.2195
nap	-0.0434	-0.0451	-0.0417	0.0000	0.0000	0.0009	-49.7424
sleep_hours_categorical>9 hours	-0.0191	-0.0217	-0.0164	0.0000	0.0000	0.0013	-14.1998
sleep_hours_categorical<7 hours	-0.0052	-0.0068	-0.0036	0.0000	0.0000	0.0008	-6.2960
family_visit_freq	-0.0121	-0.0153	-0.0088	0.0000	0.0000	0.0017	-7.2246
religious_groupYes	-0.0165	-0.0185	-0.0145	0.0000	0.0000	0.0010	-16.2531
facial_agingAbout your age	-0.0080	-0.0098	-0.0063	0.0000	0.0000	0.0009	-9.0103
facial_agingOlder than you are	-0.0282	-0.0354	-0.0210	0.0000	0.0000	0.0034	-8.2259
skin_colorDark olive	-0.0013	-0.0066	0.0041	0.6426	0.6595	0.0027	-0.4643
skin_colorLight olive	0.0068	0.0050	0.0087	0.0000	0.0000	0.0010	7.1438
skin_colorBlack	-0.0021	-0.0127	0.0084	0.6919	0.7008	0.0054	-0.3963
skin_colorBrown	-0.0087	-0.0148	-0.0026	0.0054	0.0061	0.0031	-2.7914

Table S19. HDL cholesterol

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.0094	-0.0122	-0.0066	0.0000	0.0000	0.0014	-6.5659
sun_protection_use	0.0102	0.0074	0.0130	0.0000	0.0000	0.0014	7.2119
fish_oil_supplementsYes	0.0232	0.0213	0.0251	0.0000	0.0000	0.0009	24.9552
folate_supplementsYes	0.0239	0.0187	0.0292	0.0000	0.0000	0.0026	9.0986
glucosamine_supplementsYes	0.0235	0.0216	0.0254	0.0000	0.0000	0.0010	24.4817
multivitamin_supplementsYes	0.0144	0.0127	0.0162	0.0000	0.0000	0.0009	16.0961
pack_years_prop	-0.0141	-0.0149	-0.0133	0.0000	0.0000	0.0004	-35.0005
smoking_statusPrevious	0.0075	0.0060	0.0090	0.0000	0.0000	0.0008	9.6755
smoking_statusCurrent	-0.0282	-0.0307	-0.0258	0.0000	0.0000	0.0012	-22.8482
IPAQ_activity_group	0.0499	0.0472	0.0527	0.0000	0.0000	0.0012	41.7270
education_years	0.0320	0.0304	0.0336	0.0000	0.0000	0.0008	39.7342
ethnicityAsian	-0.0905	-0.0955	-0.0855	0.0000	0.0000	0.0025	-35.7743
ethnicityBlack	-0.0271	-0.0328	-0.0214	0.0000	0.0000	0.0029	-9.3496
ethnicityMixed	-0.0133	-0.0227	-0.0039	0.0058	0.0065	0.0048	-2.7710
ethnicityOther	-0.0645	-0.0717	-0.0573	0.0000	0.0000	0.0037	-17.5278

Table S20. LDL direct

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0024	-0.0051	0.0002	0.0693	0.0916	0.0013	-1.8168
alcohol_freqDaily or almost daily	0.0028	0.0001	0.0055	0.0422	0.0567	0.0014	2.0321
alcohol_freqOnce or twice a week	-0.0058	-0.0084	-0.0033	0.0000	0.0000	0.0013	-4.4626
bread	-0.0156	-0.0171	-0.0141	0.0000	0.0000	0.0008	-20.1889
cereal	-0.0217	-0.0231	-0.0202	0.0000	0.0000	0.0007	-29.7001
never_eat_dairyYes	-0.0244	-0.0292	-0.0195	0.0000	0.0000	0.0025	-9.8443
never_eat_eggsYes	-0.0191	-0.0236	-0.0145	0.0000	0.0000	0.0023	-8.1599
never_eat_sugarYes	-0.0338	-0.0359	-0.0318	0.0000	0.0000	0.0010	-32.7594
partial_fiber_score	-0.0258	-0.0275	-0.0241	0.0000	0.0000	0.0009	-30.0884
poultry	0.0148	0.0129	0.0167	0.0000	0.0000	0.0010	15.2067
processed_meat	0.0200	0.0181	0.0218	0.0000	0.0000	0.0009	21.4366
red_meat	0.0191	0.0173	0.0209	0.0000	0.0000	0.0009	21.2832
salt	0.0218	0.0198	0.0237	0.0000	0.0000	0.0010	21.8630
body_size_10yrs_oldThinner	0.0047	0.0030	0.0064	0.0000	0.0000	0.0009	5.4414
body_size_10yrs_oldPlumper	-0.0015	-0.0036	0.0005	0.1458	0.1750	0.0011	-1.4546
height_10yrs_oldShorter	0.0106	0.0087	0.0125	0.0000	0.0000	0.0010	11.0100
height_10yrs_oldTaller	-0.0079	-0.0096	-0.0061	0.0000	0.0000	0.0009	-8.9238

Table S20. LDL direct

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0035	0.0018	0.0051	0.0000	0.0001	0.0008	4.0882
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0036	-0.0105	0.0034	0.3060	0.3510	0.0035	-1.0307
mobile_phone_2yrsYes, use is now less frequent	0.0064	0.0032	0.0095	0.0003	0.0005	0.0015	4.1693
mobile_phone_2yrsYes, use is now more frequent	0.0001	-0.0017	0.0020	0.8724	0.8837	0.0009	0.1610
employedYes	-0.0082	-0.0100	-0.0064	0.0000	0.0000	0.0009	-8.8578
unemployedYes	0.0040	-0.0015	0.0096	0.1540	0.1820	0.0028	1.4283
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0137	-0.0339	0.0065	0.1826	0.2126	0.0103	-1.3328
accommodation_typeA flat, maisonette or apartment	-0.0062	-0.0090	-0.0034	0.0000	0.0000	0.0014	-4.3905
gas_hob_heatYes	-0.0007	-0.0024	0.0010	0.4018	0.4478	0.0009	-0.8394
hshld_income	-0.0036	-0.0060	-0.0012	0.0032	0.0045	0.0012	-2.9553
hshld_parentsYes	0.0042	-0.0012	0.0097	0.1279	0.1558	0.0028	1.5246
hshld_partnerYes	0.0048	0.0031	0.0064	0.0000	0.0000	0.0008	5.6720
hshld_siblingsYes	-0.0078	-0.0170	0.0013	0.0919	0.1175	0.0047	-1.6854
hshld_vehicles	0.0158	0.0131	0.0186	0.0000	0.0000	0.0014	11.2684

Table S20. LDL direct

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0012	-0.0031	0.0054	0.5971	0.6468	0.0022	0.5287
own_or_rentPay part rent and part mortgage (shared ownership)	0.0019	-0.0114	0.0151	0.7817	0.8129	0.0068	0.2772
own_or_rentOwn with a mortgage	-0.0003	-0.0022	0.0015	0.7224	0.7614	0.0010	-0.3556
own_or_rentRent - from local authority, local council, housing association	-0.0031	-0.0064	0.0003	0.0716	0.0931	0.0017	-1.8019
own_or_rentLive in accommodation rent free	0.0008	-0.0078	0.0095	0.8533	0.8757	0.0044	0.1849
townsend_deprivation_index	-0.0036	-0.0044	-0.0027	0.0000	0.0000	0.0004	-8.3294
psychiatrist_visit_mental_healthYes	0.0187	0.0164	0.0210	0.0000	0.0000	0.0012	15.8221
risk_takingYes	0.0057	0.0041	0.0074	0.0000	0.0000	0.0009	6.7530
tiredness_freq	0.0169	0.0149	0.0190	0.0000	0.0000	0.0010	16.1426
unenthusiasm_freq	0.0220	0.0192	0.0248	0.0000	0.0000	0.0014	15.5483
fast_driving	0.0121	0.0093	0.0149	0.0000	0.0000	0.0014	8.5036
gymYes	-0.0087	-0.0103	-0.0070	0.0000	0.0000	0.0009	-10.1739
LTPA	-0.0027	-0.0047	-0.0007	0.0076	0.0106	0.0010	-2.7274
sedentary	0.0138	0.0125	0.0152	0.0000	0.0000	0.0007	20.1369
air_pollution_PC1	-0.0023	-0.0027	-0.0020	0.0000	0.0000	0.0002	-12.6083

Table S20. LDL direct

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0024	0.0020	0.0028	0.0000	0.0000	0.0002	11.0560
number_sex_partners	-0.0005	-0.0014	0.0005	0.3201	0.3618	0.0005	-1.0084
sex_age_first	-0.0044	-0.0052	-0.0036	0.0000	0.0000	0.0004	-10.5508
chronotypeDefinitely an 'evening' person	0.0078	0.0047	0.0108	0.0000	0.0000	0.0015	5.0541
chronotypeDefinitely a 'morning' person	-0.0032	-0.0052	-0.0011	0.0030	0.0043	0.0010	-3.0348
chronotypeMore an 'evening' than a 'morning' person	0.0056	0.0032	0.0079	0.0000	0.0001	0.0011	4.8653
nap	0.0042	0.0024	0.0060	0.0000	0.0000	0.0009	4.6002
sleep_hours_categorical>9 hours	0.0115	0.0086	0.0144	0.0000	0.0000	0.0015	7.8124
sleep_hours_categorical<7 hours	0.0037	0.0020	0.0054	0.0000	0.0000	0.0009	4.2701
family_visit_freq	0.0138	0.0103	0.0174	0.0000	0.0000	0.0018	7.6267
religious_groupYes	-0.0047	-0.0068	-0.0027	0.0000	0.0000	0.0011	-4.4970
facial_agingAbout your age	-0.0049	-0.0072	-0.0026	0.0002	0.0002	0.0011	-4.4066
facial_agingOlder than you are	-0.0139	-0.0192	-0.0086	0.0000	0.0000	0.0027	-5.1568
skin_colorDark olive	0.0046	-0.0009	0.0101	0.0989	0.1244	0.0028	1.6512
skin_colorLight olive	0.0031	0.0012	0.0050	0.0012	0.0018	0.0010	3.2305
skin_colorBlack	-0.0235	-0.0346	-0.0125	0.0000	0.0000	0.0056	-4.1707
skin_colorBrown	-0.0054	-0.0120	0.0012	0.1059	0.1312	0.0033	-1.6213

Table S20. LDL direct

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0008	-0.0020	0.0037	0.5569	0.6119	0.0014	0.5875
sun_protection_use	0.0096	0.0069	0.0123	0.0000	0.0000	0.0014	7.0413
fish_oil_supplementsYes	0.0225	0.0209	0.0242	0.0000	0.0000	0.0008	26.6900
folate_supplementsYes	0.0156	0.0106	0.0206	0.0000	0.0000	0.0026	6.0775
glucosamine_supplementsYes	0.0258	0.0239	0.0277	0.0000	0.0000	0.0010	26.8822
multivitamin_supplementsYes	0.0159	0.0141	0.0177	0.0000	0.0000	0.0009	17.3075
pack_years_prop	0.0009	0.0001	0.0016	0.0317	0.0433	0.0004	2.1548
smoking_statusPrevious	0.0001	-0.0015	0.0016	0.9471	0.9471	0.0008	0.0663
smoking_statusCurrent	0.0141	0.0116	0.0166	0.0000	0.0000	0.0013	11.1420
IPAQ_activity_group	-0.0105	-0.0120	-0.0089	0.0000	0.0000	0.0008	-13.3557
education_years	-0.0036	-0.0053	-0.0020	0.0000	0.0000	0.0008	-4.3302
ethnicityAsian	-0.0373	-0.0423	-0.0323	0.0000	0.0000	0.0025	-14.7287
ethnicityBlack	-0.0611	-0.0670	-0.0553	0.0000	0.0000	0.0030	-20.5293
ethnicityMixed	-0.0018	-0.0115	0.0078	0.7083	0.7568	0.0049	-0.3742
ethnicityOther	-0.0187	-0.0263	-0.0111	0.0000	0.0000	0.0039	-4.8233

Table S21. Lipoprotein(a)

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0033	-0.0170	0.0105	0.6364	0.7091	0.0070	-0.4738
alcohol_freqDaily or almost daily	-0.0241	-0.0382	-0.0100	0.0009	0.0051	0.0071	-3.3802
alcohol_freqOnce or twice a week	-0.0060	-0.0205	0.0085	0.4118	0.5416	0.0072	-0.8270
bread	-0.0021	-0.0096	0.0053	0.5726	0.6768	0.0038	-0.5647
cereal	0.0085	0.0008	0.0162	0.0313	0.0843	0.0039	2.1978
never_eat_dairyYes	0.0253	-0.0001	0.0507	0.0512	0.1248	0.0128	1.9781
never_eat_eggsYes	0.0340	0.0098	0.0582	0.0067	0.0229	0.0121	2.8160
never_eat_sugarYes	0.0175	0.0081	0.0270	0.0003	0.0019	0.0048	3.6661
partial_fiber_score	0.0239	0.0138	0.0339	0.0000	0.0003	0.0049	4.8318
poultry	0.0029	-0.0085	0.0144	0.6059	0.6849	0.0056	0.5211
processed_meat	-0.0215	-0.0298	-0.0133	0.0000	0.0000	0.0042	-5.1077
red_meat	-0.0147	-0.0244	-0.0050	0.0036	0.0167	0.0048	-3.0377
salt	-0.0153	-0.0258	-0.0049	0.0048	0.0188	0.0052	-2.9289
body_size_10yrs_oldThinner	-0.0054	-0.0143	0.0036	0.2348	0.3871	0.0045	-1.2013
body_size_10yrs_oldPlumper	0.0133	0.0028	0.0237	0.0129	0.0402	0.0053	2.5076
height_10yrs_oldShorter	0.0140	0.0028	0.0252	0.0159	0.0459	0.0055	2.5445
height_10yrs_oldTaller	0.0076	-0.0016	0.0168	0.1043	0.2086	0.0046	1.6399

Table S21. Lipoprotein(a)

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0013	-0.0096	0.0071	0.7612	0.8023	0.0042	-0.3045
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0024	-0.0370	0.0322	0.8900	0.9064	0.0172	-0.1391
mobile_phone_2yrsYes, use is now less frequent	0.0013	-0.0104	0.0130	0.8310	0.8643	0.0059	0.2136
mobile_phone_2yrsYes, use is now more frequent	-0.0052	-0.0167	0.0063	0.3509	0.4802	0.0054	-0.9596
employedYes	-0.0029	-0.0119	0.0060	0.5184	0.6318	0.0045	-0.6465
unemployedYes	-0.0109	-0.0373	0.0154	0.4157	0.5416	0.0134	-0.8153
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0488	-0.0719	0.1694	0.4166	0.5416	0.0593	0.8228
accommodation_typeA flat, maisonette or apartment	0.0167	0.0010	0.0324	0.0381	0.0990	0.0078	2.1395
gas_hob_heatYes	0.0026	-0.0065	0.0117	0.5645	0.6768	0.0045	0.5804
hshld_income	-0.0293	-0.0407	-0.0180	0.0000	0.0000	0.0058	-5.0762
hshld_parentsYes	0.0150	-0.0126	0.0426	0.2831	0.4293	0.0139	1.0789
hshld_partnerYes	-0.0112	-0.0193	-0.0032	0.0064	0.0226	0.0041	-2.7379
hshld_siblingsYes	0.0234	-0.0211	0.0680	0.3019	0.4297	0.0227	1.0335
hshld_vehicles	-0.0137	-0.0274	-0.0000	0.0495	0.1245	0.0070	-1.9730

Table S21. Lipoprotein(a)

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0208	-0.0036	0.0452	0.0929	0.1907	0.0121	1.7204
own_or_rentPay part rent and part mortgage (shared ownership)	0.0129	-0.0531	0.0789	0.7001	0.7481	0.0335	0.3857
own_or_rentOwn with a mortgage	0.0005	-0.0089	0.0099	0.9136	0.9136	0.0047	0.1087
own_or_rentRent - from local authority, local council, housing association	0.0356	0.0084	0.0628	0.0148	0.0445	0.0124	2.8777
own_or_rentLive in accommodation rent free	0.0404	-0.0044	0.0852	0.0769	0.1713	0.0226	1.7868
townsend_deprivation_index	0.0069	0.0023	0.0115	0.0040	0.0172	0.0023	3.0158
psychiatrist_visit_mental_healthYes	0.0101	-0.0016	0.0217	0.0896	0.1890	0.0059	1.7068
risk_takingYes	0.0082	-0.0006	0.0169	0.0660	0.1561	0.0044	1.8579
tiredness_freq	0.0030	-0.0086	0.0147	0.5995	0.6849	0.0058	0.5291
unenthusiasm_freq	0.0230	0.0077	0.0384	0.0042	0.0172	0.0076	3.0283
fast_driving	-0.0234	-0.0408	-0.0060	0.0105	0.0343	0.0084	-2.7804
gymYes	-0.0074	-0.0183	0.0036	0.1775	0.3051	0.0053	-1.3983
LTPA	-0.0046	-0.0138	0.0046	0.3264	0.4546	0.0046	-0.9854
sedentary	0.0051	-0.0024	0.0127	0.1792	0.3051	0.0038	1.3635
air_pollution_PC1	0.0033	0.0015	0.0050	0.0002	0.0016	0.0009	3.6896

Table S21. Lipoprotein(a)

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0012	-0.0010	0.0033	0.2931	0.4297	0.0011	1.0548
number_sex_partners	-0.0013	-0.0050	0.0025	0.5028	0.6225	0.0019	-0.6715
sex_age_first	0.0062	0.0021	0.0103	0.0031	0.0153	0.0021	3.0163
chronotypeDefinitely an 'evening' person	0.0100	-0.0041	0.0242	0.1643	0.2979	0.0072	1.3964
chronotypeDefinitely a 'morning' person	0.0065	-0.0045	0.0175	0.2382	0.3871	0.0054	1.2002
chronotypeMore an 'evening' than a 'morning' person	0.0034	-0.0062	0.0131	0.4785	0.6020	0.0048	0.7122
nap	-0.0057	-0.0139	0.0026	0.1800	0.3051	0.0042	-1.3410
sleep_hours_categorical>9 hours	0.0110	-0.0026	0.0247	0.1124	0.2191	0.0069	1.5911
sleep_hours_categorical<7 hours	0.0118	0.0034	0.0201	0.0058	0.0217	0.0043	2.7704
family_visit_freq	-0.0167	-0.0378	0.0044	0.1164	0.2214	0.0103	-1.6189
religious_groupYes	0.0195	0.0089	0.0300	0.0004	0.0023	0.0053	3.6428
facial_agingAbout your age	0.0026	-0.0070	0.0123	0.5852	0.6813	0.0048	0.5492
facial_agingOlder than you are	0.0226	-0.0021	0.0473	0.0729	0.1672	0.0126	1.7938
skin_colorDark olive	0.0075	-0.0273	0.0422	0.6605	0.7257	0.0168	0.4451
skin_colorLight olive	0.0007	-0.0093	0.0106	0.8948	0.9064	0.0050	0.1326
skin_colorBlack	0.2697	0.2139	0.3255	0.0000	0.0000	0.0283	9.5243
skin_colorBrown	0.1157	0.0833	0.1482	0.0000	0.0000	0.0164	7.0762

Table S21. Lipoprotein(a)

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0106	-0.0036	0.0248	0.1427	0.2651	0.0072	1.4744
sun_protection_use	0.0073	-0.0061	0.0208	0.2825	0.4293	0.0068	1.0798
fish_oil_supplementsYes	-0.0043	-0.0126	0.0039	0.3030	0.4297	0.0042	-1.0343
folate_supplementsYes	0.0152	-0.0123	0.0427	0.2713	0.4293	0.0137	1.1116
glucosamine_supplementsYes	-0.0082	-0.0174	0.0010	0.0806	0.1747	0.0047	-1.7526
multivitamin_supplementsYes	-0.0035	-0.0124	0.0053	0.4326	0.5531	0.0045	-0.7864
pack_years_prop	0.0050	0.0007	0.0093	0.0237	0.0661	0.0021	2.3437
smoking_statusPrevious	0.0017	-0.0065	0.0100	0.6793	0.7359	0.0042	0.4144
smoking_statusCurrent	0.0236	0.0092	0.0379	0.0019	0.0100	0.0071	3.3224
IPAQ_activity_group	0.0044	-0.0039	0.0127	0.2862	0.4293	0.0041	1.0826
education_years	-0.0186	-0.0275	-0.0097	0.0001	0.0007	0.0045	-4.1806
ethnicityAsian	0.2137	0.1901	0.2372	0.0000	0.0000	0.0120	17.8033
ethnicityBlack	0.9380	0.9073	0.9688	0.0000	0.0000	0.0154	60.8802
ethnicityMixed	0.2571	0.2116	0.3025	0.0000	0.0000	0.0232	11.0979
ethnicityOther	0.3297	0.2896	0.3699	0.0000	0.0000	0.0202	16.3113

Table S22. Phosphate

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.0042	0.0026	0.0058	0.0000	0.0000	0.0008	5.2283
alcohol_freqDaily or almost daily	0.0007	-0.0009	0.0023	0.3987	0.4937	0.0008	0.8443
alcohol_freqOnce or twice a week	0.0023	0.0008	0.0038	0.0020	0.0034	0.0007	3.0926
bread	-0.0040	-0.0049	-0.0031	0.0000	0.0000	0.0005	-8.7772
cereal	0.0135	0.0127	0.0143	0.0000	0.0000	0.0004	32.8211
never_eat_dairyYes	-0.0062	-0.0091	-0.0033	0.0000	0.0001	0.0015	-4.2632
never_eat_eggsYes	-0.0026	-0.0056	0.0004	0.0876	0.1242	0.0015	-1.7488
never_eat_sugarYes	0.0020	0.0009	0.0030	0.0003	0.0005	0.0005	3.6412
partial_fiber_score	0.0115	0.0105	0.0125	0.0000	0.0000	0.0005	23.0266
poultry	-0.0003	-0.0015	0.0008	0.5946	0.6722	0.0006	-0.5328
processed_meat	-0.0018	-0.0029	-0.0008	0.0005	0.0009	0.0005	-3.5337
red_meat	0.0017	0.0006	0.0027	0.0020	0.0034	0.0005	3.1264
salt	0.0008	-0.0003	0.0020	0.1454	0.1955	0.0006	1.4586
body_size_10yrs_oldThinner	-0.0004	-0.0014	0.0006	0.4462	0.5354	0.0005	-0.7634
body_size_10yrs_oldPlumper	-0.0037	-0.0051	-0.0023	0.0000	0.0000	0.0007	-5.2748
height_10yrs_oldShorter	0.0024	0.0013	0.0035	0.0000	0.0001	0.0006	4.2087
height_10yrs_oldTaller	-0.0036	-0.0047	-0.0024	0.0000	0.0000	0.0006	-6.3188

Table S22. Phosphate

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0003	-0.0014	0.0007	0.5434	0.6326	0.0005	-0.6100
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0003	-0.0047	0.0053	0.9132	0.9512	0.0024	0.1105
mobile_phone_2yrsYes, use is now less frequent	0.0011	-0.0006	0.0028	0.1822	0.2409	0.0008	1.3641
mobile_phone_2yrsYes, use is now more frequent	0.0029	0.0016	0.0043	0.0002	0.0003	0.0006	4.6534
employedYes	-0.0026	-0.0037	-0.0015	0.0000	0.0000	0.0006	-4.5764
unemployedYes	-0.0007	-0.0039	0.0024	0.6463	0.7100	0.0016	-0.4595
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0013	-0.0107	0.0134	0.8306	0.8875	0.0061	0.2141
accommodation_typeA flat, maisonette or apartment	-0.0035	-0.0052	-0.0018	0.0001	0.0001	0.0009	-4.1131
gas_hob_heatYes	0.0002	-0.0007	0.0011	0.6121	0.6820	0.0005	0.5072
hshld_income	0.0056	0.0042	0.0069	0.0000	0.0000	0.0007	8.0894
hshld_parentsYes	-0.0104	-0.0136	-0.0073	0.0000	0.0000	0.0016	-6.4781
hshld_partnerYes	0.0057	0.0048	0.0067	0.0000	0.0000	0.0005	11.6662
hshld_siblingsYes	-0.0086	-0.0139	-0.0033	0.0015	0.0027	0.0027	-3.1807
hshld_vehicles	0.0057	0.0041	0.0073	0.0000	0.0000	0.0008	6.9356

Table S22. Phosphate

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0048	-0.0073	-0.0024	0.0001	0.0003	0.0013	-3.8463
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0114	-0.0194	-0.0035	0.0051	0.0083	0.0040	-2.8327
own_or_rentOwn with a mortgage	-0.0032	-0.0042	-0.0021	0.0000	0.0000	0.0005	-6.0349
own_or_rentRent - from local authority, local council, housing association	-0.0057	-0.0077	-0.0036	0.0000	0.0000	0.0010	-5.4971
own_or_rentLive in accommodation rent free	-0.0020	-0.0070	0.0029	0.4150	0.5057	0.0025	-0.8155
townsend_deprivation_index	-0.0036	-0.0040	-0.0031	0.0000	0.0000	0.0002	-14.4341
psychiatrist_visit_mental_healthYes	0.0025	0.0011	0.0039	0.0006	0.0011	0.0007	3.5099
risk_takingYes	0.0027	0.0012	0.0042	0.0013	0.0023	0.0007	3.9593
tiredness_freq	0.0015	0.0004	0.0027	0.0087	0.0136	0.0006	2.6225
unenthusiasm_freq	0.0003	-0.0014	0.0021	0.7025	0.7611	0.0009	0.3833
fast_driving	0.0058	0.0041	0.0075	0.0000	0.0000	0.0008	6.8691
gymYes	0.0069	0.0059	0.0079	0.0000	0.0000	0.0005	13.2140
LTPA	0.0069	0.0059	0.0080	0.0000	0.0000	0.0005	12.9528
sedentary	-0.0049	-0.0057	-0.0041	0.0000	0.0000	0.0004	-11.7062
air_pollution_PC1	-0.0013	-0.0015	-0.0011	0.0000	0.0000	0.0001	-12.0111

Table S22. Phosphate

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0015	0.0013	0.0018	0.0000	0.0000	0.0001	11.9983
number_sex_partners	-0.0000	-0.0005	0.0005	0.9540	0.9728	0.0003	-0.0582
sex_age_first	-0.0007	-0.0012	-0.0002	0.0060	0.0095	0.0002	-2.7967
chronotypeDefinitely an 'evening' person	-0.0077	-0.0098	-0.0055	0.0000	0.0000	0.0010	-7.4639
chronotypeDefinitely a 'morning' person	0.0009	-0.0003	0.0021	0.1252	0.1713	0.0006	1.5468
chronotypeMore an 'evening' than a 'morning' person	-0.0043	-0.0054	-0.0032	0.0000	0.0000	0.0006	-7.8460
nap	-0.0000	-0.0011	0.0010	0.9603	0.9728	0.0005	-0.0498
sleep_hours_categorical>9 hours	-0.0025	-0.0042	-0.0009	0.0027	0.0044	0.0008	-3.0244
sleep_hours_categorical<7 hours	0.0004	-0.0006	0.0014	0.3956	0.4937	0.0005	0.8500
family_visit_freq	0.0018	-0.0003	0.0039	0.0847	0.1224	0.0011	1.7314
religious_groupYes	0.0027	0.0016	0.0039	0.0000	0.0000	0.0006	4.5438
facial_agingAbout your age	0.0005	-0.0013	0.0023	0.5824	0.6681	0.0008	0.5679
facial_agingOlder than you are	-0.0002	-0.0033	0.0029	0.9147	0.9512	0.0016	-0.1072
skin_colorDark olive	0.0045	0.0006	0.0084	0.0239	0.0365	0.0019	2.3709
skin_colorLight olive	0.0010	-0.0002	0.0022	0.0995	0.1385	0.0006	1.6651
skin_colorBlack	-0.0065	-0.0134	0.0004	0.0658	0.0968	0.0035	-1.8565
skin_colorBrown	-0.0001	-0.0042	0.0040	0.9741	0.9741	0.0021	-0.0325

Table S22. Phosphate

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.0010	-0.0026	0.0006	0.2290	0.2929	0.0008	-1.2035
sun_protection_use	0.0036	0.0021	0.0051	0.0000	0.0000	0.0008	4.7094
fish_oil_supplementsYes	0.0073	0.0063	0.0082	0.0000	0.0000	0.0005	15.3006
folate_supplementsYes	0.0019	-0.0011	0.0049	0.2154	0.2800	0.0015	1.2428
glucosamine_supplementsYes	0.0088	0.0077	0.0099	0.0000	0.0000	0.0005	16.1740
multivitamin_supplementsYes	0.0070	0.0060	0.0081	0.0000	0.0000	0.0005	13.2664
pack_years_prop	0.0064	0.0059	0.0069	0.0000	0.0000	0.0003	25.4050
smoking_statusPrevious	0.0075	0.0064	0.0085	0.0000	0.0000	0.0005	14.1659
smoking_statusCurrent	0.0306	0.0291	0.0322	0.0000	0.0000	0.0008	38.9147
IPAQ_activity_group	0.0060	0.0048	0.0072	0.0000	0.0000	0.0006	10.7455
education_years	0.0045	0.0035	0.0055	0.0000	0.0000	0.0005	8.8502
ethnicityAsian	0.0212	0.0183	0.0241	0.0000	0.0000	0.0015	14.3966
ethnicityBlack	-0.0249	-0.0285	-0.0213	0.0000	0.0000	0.0018	-13.7053
ethnicityMixed	-0.0054	-0.0110	0.0003	0.0643	0.0964	0.0029	-1.8576
ethnicityOther	0.0015	-0.0032	0.0061	0.5421	0.6326	0.0024	0.6112

Table S23. Total bilirubin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.0429	0.0387	0.0471	0.0000	0.0000	0.0021	20.1145
alcohol_freqDaily or almost daily	0.0573	0.0528	0.0617	0.0000	0.0000	0.0022	25.5272
alcohol_freqOnce or twice a week	0.0154	0.0114	0.0194	0.0000	0.0000	0.0020	7.5312
bread	-0.0241	-0.0265	-0.0216	0.0000	0.0000	0.0013	-19.2388
cereal	0.0037	0.0014	0.0059	0.0012	0.0017	0.0011	3.2467
never_eat_dairyYes	0.0040	-0.0035	0.0114	0.2976	0.3464	0.0038	1.0418
never_eat_eggsYes	-0.0056	-0.0130	0.0018	0.1384	0.1687	0.0037	-1.4899
never_eat_sugarYes	-0.0074	-0.0105	-0.0043	0.0000	0.0000	0.0016	-4.6712
partial_fiber_score	0.0081	0.0054	0.0107	0.0000	0.0000	0.0013	6.0274
poultry	-0.0015	-0.0045	0.0015	0.3230	0.3705	0.0015	-0.9885
processed_meat	-0.0237	-0.0264	-0.0210	0.0000	0.0000	0.0014	-17.1287
red_meat	-0.0161	-0.0188	-0.0134	0.0000	0.0000	0.0014	-11.6305
salt	-0.0131	-0.0161	-0.0102	0.0000	0.0000	0.0015	-8.6158
body_size_10yrs_oldThinner	-0.0067	-0.0092	-0.0042	0.0000	0.0000	0.0013	-5.1733
body_size_10yrs_oldPlumper	-0.0204	-0.0238	-0.0170	0.0000	0.0000	0.0017	-11.6917
height_10yrs_oldShorter	-0.0216	-0.0246	-0.0186	0.0000	0.0000	0.0015	-14.1413
height_10yrs_oldTaller	0.0239	0.0212	0.0267	0.0000	0.0000	0.0014	17.0490

Table S23. Total bilirubin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0049	-0.0074	-0.0024	0.0001	0.0002	0.0013	-3.7995
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0004	-0.0117	0.0125	0.9469	0.9592	0.0059	0.0672
mobile_phone_2yrsYes, use is now less frequent	0.0002	-0.0036	0.0040	0.9277	0.9521	0.0019	0.0908
mobile_phone_2yrsYes, use is now more frequent	-0.0004	-0.0040	0.0031	0.8039	0.8590	0.0017	-0.2515
employedYes	-0.0010	-0.0039	0.0019	0.5047	0.5624	0.0015	-0.6674
unemployedYes	-0.0114	-0.0200	-0.0027	0.0101	0.0134	0.0044	-2.5870
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0313	-0.0626	0.0001	0.0508	0.0639	0.0160	-1.9538
accommodation_typeA flat, maisonette or apartment	-0.0159	-0.0202	-0.0116	0.0000	0.0000	0.0022	-7.2315
gas_hob_heatYes	0.0018	-0.0007	0.0043	0.1487	0.1784	0.0013	1.4444
hshld_income	0.0491	0.0454	0.0529	0.0000	0.0000	0.0019	25.6752
hshld_parentsYes	-0.0186	-0.0270	-0.0102	0.0000	0.0000	0.0043	-4.3606
hshld_partnerYes	0.0181	0.0155	0.0207	0.0000	0.0000	0.0013	13.8587
hshld_siblingsYes	-0.0303	-0.0446	-0.0161	0.0000	0.0000	0.0073	-4.1840
hshld_vehicles	0.0288	0.0243	0.0333	0.0000	0.0000	0.0023	12.6392

Table S23. Total bilirubin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0266	-0.0331	-0.0201	0.0000	0.0000	0.0033	-8.0051
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0211	-0.0414	-0.0008	0.0416	0.0541	0.0104	-2.0378
own_or_rentOwn with a mortgage	-0.0047	-0.0075	-0.0019	0.0011	0.0015	0.0014	-3.2741
own_or_rentRent - from local authority, local council, housing association	-0.0421	-0.0473	-0.0369	0.0000	0.0000	0.0027	-15.7905
own_or_rentLive in accommodation rent free	-0.0235	-0.0370	-0.0101	0.0006	0.0009	0.0069	-3.4289
townsend_deprivation_index	-0.0126	-0.0139	-0.0113	0.0000	0.0000	0.0007	-19.2066
psychiatrist_visit_mental_healthYes	-0.0227	-0.0265	-0.0190	0.0000	0.0000	0.0019	-11.9256
risk_takingYes	-0.0036	-0.0063	-0.0010	0.0079	0.0106	0.0014	-2.6661
tiredness_freq	-0.0390	-0.0423	-0.0358	0.0000	0.0000	0.0016	-23.8349
unenthusiasm_freq	-0.0294	-0.0336	-0.0253	0.0000	0.0000	0.0021	-13.9188
fast_driving	0.0245	0.0203	0.0287	0.0000	0.0000	0.0022	11.3945
gymYes	0.0274	0.0248	0.0299	0.0000	0.0000	0.0013	20.8977
LTPA	0.0233	0.0197	0.0268	0.0000	0.0000	0.0017	13.3205
sedentary	-0.0133	-0.0153	-0.0112	0.0000	0.0000	0.0011	-12.6328
air_pollution_PC1	-0.0026	-0.0032	-0.0020	0.0000	0.0000	0.0003	-8.8952

Table S23. Total bilirubin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0029	0.0022	0.0036	0.0000	0.0000	0.0003	8.5298
number_sex_partners	-0.0002	-0.0017	0.0012	0.7391	0.8007	0.0007	-0.3354
sex_age_first	0.0031	0.0018	0.0043	0.0000	0.0000	0.0006	4.8824
chronotypeDefinitely an 'evening' person	-0.0078	-0.0125	-0.0032	0.0010	0.0014	0.0023	-3.3397
chronotypeDefinitely a 'morning' person	-0.0055	-0.0086	-0.0024	0.0006	0.0009	0.0016	-3.4827
chronotypeMore an 'evening' than a 'morning' person	-0.0026	-0.0056	0.0004	0.0864	0.1069	0.0015	-1.7237
nap	-0.0212	-0.0240	-0.0185	0.0000	0.0000	0.0014	-15.2106
sleep_hours_categorical>9 hours	-0.0149	-0.0194	-0.0103	0.0000	0.0000	0.0023	-6.4418
sleep_hours_categorical<7 hours	-0.0044	-0.0071	-0.0017	0.0013	0.0018	0.0014	-3.2213
family_visit_freq	0.0033	-0.0021	0.0087	0.2260	0.2671	0.0028	1.2108
religious_groupYes	-0.0061	-0.0095	-0.0027	0.0004	0.0007	0.0017	-3.5531
facial_agingAbout your age	-0.0031	-0.0060	-0.0001	0.0441	0.0564	0.0015	-2.0360
facial_agingOlder than you are	-0.0269	-0.0388	-0.0150	0.0002	0.0002	0.0057	-4.7456
skin_colorDark olive	0.0184	0.0098	0.0269	0.0000	0.0000	0.0043	4.2254
skin_colorLight olive	0.0140	0.0110	0.0170	0.0000	0.0000	0.0015	9.1161
skin_colorBlack	0.0010	-0.0166	0.0186	0.9115	0.9480	0.0090	0.1112
skin_colorBrown	0.0002	-0.0095	0.0100	0.9649	0.9649	0.0050	0.0440

Table S23. Total bilirubin

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.0185	-0.0228	-0.0142	0.0000	0.0000	0.0022	-8.4245
sun_protection_use	0.0103	0.0060	0.0146	0.0000	0.0000	0.0022	4.6853
fish_oil_supplementsYes	0.0011	-0.0017	0.0040	0.4230	0.4781	0.0014	0.8055
folate_supplementsYes	-0.0019	-0.0096	0.0057	0.6198	0.6809	0.0039	-0.4961
glucosamine_supplementsYes	0.0003	-0.0027	0.0033	0.8455	0.8912	0.0015	0.1950
multivitamin_supplementsYes	-0.0089	-0.0116	-0.0062	0.0000	0.0000	0.0014	-6.3654
pack_years_prop	-0.0355	-0.0368	-0.0343	0.0000	0.0000	0.0006	-55.7544
smoking_statusPrevious	-0.0158	-0.0183	-0.0133	0.0000	0.0000	0.0013	-12.5949
smoking_statusCurrent	-0.1391	-0.1429	-0.1352	0.0000	0.0000	0.0020	-70.7134
IPAQ_activity_group	0.0252	0.0223	0.0280	0.0000	0.0000	0.0014	17.9781
education_years	0.0267	0.0241	0.0292	0.0000	0.0000	0.0013	20.6204
ethnicityAsian	-0.0512	-0.0588	-0.0435	0.0000	0.0000	0.0039	-13.1048
ethnicityBlack	-0.0440	-0.0529	-0.0351	0.0000	0.0000	0.0045	-9.6947
ethnicityMixed	-0.0236	-0.0390	-0.0082	0.0028	0.0038	0.0078	-3.0095
ethnicityOther	-0.0391	-0.0509	-0.0274	0.0000	0.0000	0.0060	-6.5401

Table S24. Triglycerides

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0699	-0.0753	-0.0645	0.0000	0.0000	0.0028	-25.2154
alcohol_freqDaily or almost daily	-0.0916	-0.0972	-0.0859	0.0000	0.0000	0.0029	-31.7019
alcohol_freqOnce or twice a week	-0.0350	-0.0403	-0.0297	0.0000	0.0000	0.0027	-12.9604
bread	0.0368	0.0336	0.0401	0.0000	0.0000	0.0016	22.4988
cereal	-0.0107	-0.0137	-0.0076	0.0000	0.0000	0.0016	-6.8776
never_eat_dairyYes	-0.0322	-0.0423	-0.0221	0.0000	0.0000	0.0051	-6.2675
never_eat_eggsYes	0.0101	0.0006	0.0196	0.0368	0.0428	0.0048	2.0986
never_eat_sugarYes	-0.0216	-0.0255	-0.0177	0.0000	0.0000	0.0020	-10.8706
partial_fiber_score	-0.0339	-0.0374	-0.0304	0.0000	0.0000	0.0018	-19.0254
poultry	0.0339	0.0299	0.0379	0.0000	0.0000	0.0020	16.6972
processed_meat	0.0742	0.0706	0.0778	0.0000	0.0000	0.0019	40.0408
red_meat	0.0500	0.0462	0.0537	0.0000	0.0000	0.0019	26.1933
salt	0.0321	0.0281	0.0361	0.0000	0.0000	0.0021	15.5904
body_size_10yrs_oldThinner	0.0267	0.0234	0.0300	0.0000	0.0000	0.0017	15.8629
body_size_10yrs_oldPlumper	0.0443	0.0401	0.0486	0.0000	0.0000	0.0022	20.3869
height_10yrs_oldShorter	0.0130	0.0091	0.0169	0.0000	0.0000	0.0020	6.5771
height_10yrs_oldTaller	-0.0056	-0.0093	-0.0019	0.0032	0.0040	0.0019	-2.9603

Table S24. Triglycerides

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0282	0.0243	0.0321	0.0000	0.0000	0.0020	14.3993
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0003	-0.0147	0.0154	0.9655	0.9655	0.0075	0.0435
mobile_phone_2yrsYes, use is now less frequent	0.0372	0.0302	0.0441	0.0000	0.0000	0.0033	11.2127
mobile_phone_2yrsYes, use is now more frequent	0.0042	-0.0005	0.0089	0.0796	0.0862	0.0023	1.8423
employedYes	-0.0323	-0.0361	-0.0286	0.0000	0.0000	0.0019	-16.9308
unemployedYes	0.0470	0.0356	0.0585	0.0000	0.0000	0.0058	8.0900
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0427	0.0011	0.0843	0.0444	0.0502	0.0212	2.0107
accommodation_typeA flat, maisonette or apartment	0.0183	0.0126	0.0239	0.0000	0.0000	0.0029	6.3523
gas_hob_heatYes	-0.0023	-0.0056	0.0010	0.1714	0.1831	0.0017	-1.3681
hshld_income	-0.0823	-0.0872	-0.0773	0.0000	0.0000	0.0025	-32.4677
hshld_parentsYes	0.0398	0.0285	0.0512	0.0000	0.0000	0.0058	6.9008
hshld_partnerYes	-0.0055	-0.0090	-0.0021	0.0016	0.0021	0.0018	-3.1559
hshld_siblingsYes	0.0104	-0.0083	0.0292	0.2761	0.2911	0.0096	1.0891
hshld_vehicles	-0.0181	-0.0239	-0.0123	0.0000	0.0000	0.0030	-6.1082

Table S24. Triglycerides

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0530	0.0439	0.0620	0.0000	0.0000	0.0046	11.4623
own_or_rentPay part rent and part mortgage (shared ownership)	0.0695	0.0417	0.0972	0.0000	0.0000	0.0141	4.9150
own_or_rentOwn with a mortgage	0.0203	0.0166	0.0241	0.0000	0.0000	0.0019	10.7462
own_or_rentRent - from local authority, local council, housing association	0.0772	0.0701	0.0843	0.0000	0.0000	0.0036	21.3393
own_or_rentLive in accommodation rent free	0.0571	0.0395	0.0748	0.0000	0.0000	0.0090	6.3428
townsend_deprivation_index	0.0158	0.0140	0.0177	0.0000	0.0000	0.0009	17.1707
psychiatrist_visit_mental_healthYes	0.0361	0.0315	0.0408	0.0000	0.0000	0.0024	15.1020
risk_takingYes	0.0181	0.0146	0.0216	0.0000	0.0000	0.0018	10.2733
tiredness_freq	0.0793	0.0749	0.0837	0.0000	0.0000	0.0022	35.6192
unenthusiasm_freq	0.0670	0.0615	0.0725	0.0000	0.0000	0.0028	23.7851
fast_driving	-0.0020	-0.0078	0.0038	0.5007	0.5138	0.0030	-0.6739
gymYes	-0.0462	-0.0497	-0.0427	0.0000	0.0000	0.0018	-25.9697
LTPA	-0.0575	-0.0618	-0.0533	0.0000	0.0000	0.0021	-27.0430
sedentary	0.0843	0.0815	0.0871	0.0000	0.0000	0.0014	59.6105
air_pollution_PC1	0.0016	0.0008	0.0023	0.0000	0.0001	0.0004	4.1007

Table S24. Triglycerides

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	-0.0021	-0.0030	-0.0012	0.0000	0.0000	0.0005	-4.5728
number_sex_partners	0.0015	-0.0001	0.0031	0.0625	0.0687	0.0008	1.8677
sex_age_first	-0.0212	-0.0228	-0.0196	0.0000	0.0000	0.0008	-25.5533
chronotypeDefinitely an 'evening' person	0.0347	0.0286	0.0408	0.0000	0.0000	0.0031	11.1709
chronotypeDefinitely a 'morning' person	0.0073	0.0006	0.0139	0.0345	0.0408	0.0030	2.4015
chronotypeMore an 'evening' than a 'morning' person	0.0128	0.0046	0.0209	0.0072	0.0087	0.0035	3.6230
nap	0.0854	0.0817	0.0890	0.0000	0.0000	0.0018	46.2155
sleep_hours_categorical>9 hours	0.0665	0.0607	0.0723	0.0000	0.0000	0.0030	22.3338
sleep_hours_categorical<7 hours	0.0065	0.0030	0.0100	0.0003	0.0004	0.0018	3.6085
family_visit_freq	0.0374	0.0301	0.0447	0.0000	0.0000	0.0037	10.0844
religious_groupYes	-0.0010	-0.0053	0.0032	0.6311	0.6393	0.0022	-0.4802
facial_agingAbout your age	0.0049	0.0001	0.0097	0.0444	0.0502	0.0023	2.1180
facial_agingOlder than you are	0.0283	0.0112	0.0454	0.0031	0.0040	0.0080	3.5483
skin_colorDark olive	0.0061	-0.0054	0.0176	0.2952	0.3070	0.0058	1.0479
skin_colorLight olive	-0.0076	-0.0115	-0.0037	0.0002	0.0002	0.0020	-3.7951
skin_colorBlack	-0.0892	-0.1120	-0.0664	0.0000	0.0000	0.0116	-7.6800
skin_colorBrown	-0.0224	-0.0358	-0.0089	0.0012	0.0016	0.0068	-3.2702

Table S24. Triglycerides

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0137	0.0078	0.0196	0.0000	0.0000	0.0030	4.5851
sun_protection_use	-0.0056	-0.0114	0.0002	0.0569	0.0634	0.0029	-1.9185
fish_oil_supplementsYes	-0.0171	-0.0205	-0.0136	0.0000	0.0000	0.0018	-9.7314
folate_supplementsYes	-0.0454	-0.0556	-0.0351	0.0000	0.0000	0.0052	-8.6866
glucosamine_supplementsYes	-0.0176	-0.0215	-0.0138	0.0000	0.0000	0.0020	-8.9758
multivitamin_supplementsYes	0.0085	0.0048	0.0121	0.0000	0.0000	0.0019	4.5576
pack_years_prop	0.0487	0.0470	0.0505	0.0000	0.0000	0.0009	56.3094
smoking_statusPrevious	0.0344	0.0310	0.0378	0.0000	0.0000	0.0017	19.8972
smoking_statusCurrent	0.1063	0.1012	0.1115	0.0000	0.0000	0.0026	40.4542
IPAQ_activity_group	-0.0876	-0.0923	-0.0829	0.0000	0.0000	0.0022	-40.4543
education_years	-0.0568	-0.0603	-0.0533	0.0000	0.0000	0.0018	-31.6814
ethnicityAsian	0.1156	0.1048	0.1263	0.0000	0.0000	0.0054	21.2244
ethnicityBlack	-0.2446	-0.2564	-0.2328	0.0000	0.0000	0.0060	-40.6096
ethnicityMixed	-0.0289	-0.0484	-0.0093	0.0038	0.0046	0.0100	-2.8979
ethnicityOther	0.0291	0.0130	0.0452	0.0004	0.0006	0.0082	3.5454

Table S25. Urate

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.0169	0.0145	0.0193	0.0000	0.0000	0.0012	13.8391
alcohol_freqDaily or almost daily	0.0300	0.0275	0.0325	0.0000	0.0000	0.0013	23.5462
alcohol_freqOnce or twice a week	0.0058	0.0035	0.0082	0.0000	0.0000	0.0012	4.8486
bread	-0.0043	-0.0058	-0.0029	0.0000	0.0000	0.0007	-5.8172
cereal	-0.0462	-0.0476	-0.0448	0.0000	0.0000	0.0007	-66.0301
never_eat_dairyYes	0.0137	0.0093	0.0181	0.0000	0.0000	0.0023	6.0440
never_eat_eggsYes	0.0022	-0.0022	0.0066	0.3312	0.3690	0.0022	0.9751
never_eat_sugarYes	0.0073	0.0056	0.0091	0.0000	0.0000	0.0009	8.1951
partial_fiber_score	-0.0242	-0.0258	-0.0225	0.0000	0.0000	0.0008	-29.0848
poultry	0.0496	0.0478	0.0514	0.0000	0.0000	0.0009	54.1716
processed_meat	0.0409	0.0392	0.0425	0.0000	0.0000	0.0008	48.5384
red_meat	0.0407	0.0391	0.0423	0.0000	0.0000	0.0008	48.5638
salt	0.0130	0.0112	0.0148	0.0000	0.0000	0.0009	14.1091
body_size_10yrs_oldThinner	0.0040	0.0024	0.0056	0.0000	0.0000	0.0008	4.9151
body_size_10yrs_oldPlumper	0.0329	0.0308	0.0351	0.0000	0.0000	0.0011	30.3698
height_10yrs_oldShorter	-0.0037	-0.0057	-0.0018	0.0003	0.0004	0.0010	-3.7883
height_10yrs_oldTaller	0.0083	0.0066	0.0100	0.0000	0.0000	0.0008	9.7985

Table S25. Urate

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	0.0170	0.0151	0.0188	0.0000	0.0000	0.0009	18.6549
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0049	-0.0132	0.0035	0.2339	0.2683	0.0039	-1.2340
mobile_phone_2yrsYes, use is now less frequent	0.0166	0.0121	0.0211	0.0000	0.0000	0.0020	8.4777
mobile_phone_2yrsYes, use is now more frequent	0.0016	-0.0022	0.0055	0.3435	0.3722	0.0016	1.0193
employedYes	0.0049	0.0032	0.0066	0.0000	0.0000	0.0009	5.5776
unemployedYes	0.0046	-0.0004	0.0096	0.0711	0.0853	0.0026	1.8069
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0006	-0.0194	0.0181	0.9469	0.9592	0.0096	-0.0666
accommodation_typeA flat, maisonette or apartment	0.0026	0.0001	0.0051	0.0439	0.0543	0.0013	2.0152
gas_hob_heatYes	0.0025	0.0010	0.0040	0.0010	0.0014	0.0008	3.2834
hshld_income	0.0101	0.0079	0.0123	0.0000	0.0000	0.0011	8.8365
hshld_parentsYes	0.0036	-0.0014	0.0086	0.1577	0.1836	0.0025	1.4138
hshld_partnerYes	0.0003	-0.0013	0.0018	0.7395	0.7690	0.0008	0.3326
hshld_siblingsYes	0.0091	0.0007	0.0175	0.0339	0.0427	0.0043	2.1208
hshld_vehicles	0.0093	0.0067	0.0118	0.0000	0.0000	0.0013	7.1135

Table S25. Urate

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	0.0137	0.0096	0.0178	0.0000	0.0000	0.0021	6.6098
own_or_rentPay part rent and part mortgage (shared ownership)	0.0225	0.0101	0.0348	0.0004	0.0005	0.0063	3.5764
own_or_rentOwn with a mortgage	0.0169	0.0152	0.0186	0.0000	0.0000	0.0009	19.4694
own_or_rentRent - from local authority, local council, housing association	0.0198	0.0166	0.0230	0.0000	0.0000	0.0016	12.3240
own_or_rentLive in accommodation rent free	0.0089	0.0010	0.0169	0.0276	0.0353	0.0041	2.2030
townsend_deprivation_index	0.0057	0.0050	0.0065	0.0000	0.0000	0.0004	14.5145
psychiatrist_visit_mental_healthYes	-0.0078	-0.0100	-0.0056	0.0000	0.0000	0.0011	-6.9377
risk_takingYes	0.0162	0.0145	0.0178	0.0000	0.0000	0.0008	19.2768
tiredness_freq	0.0060	0.0040	0.0079	0.0000	0.0000	0.0010	5.9332
unenthusiasm_freq	0.0051	0.0026	0.0076	0.0001	0.0001	0.0013	3.9836
fast_driving	0.0304	0.0278	0.0329	0.0000	0.0000	0.0013	23.0663
gymYes	-0.0000	-0.0016	0.0015	0.9731	0.9731	0.0008	-0.0337
LTPA	-0.0156	-0.0176	-0.0137	0.0000	0.0000	0.0010	-16.0706
sedentary	0.0314	0.0301	0.0326	0.0000	0.0000	0.0006	48.8518
air_pollution_PC1	0.0015	0.0012	0.0018	0.0000	0.0000	0.0002	8.6908

Table S25. Urate

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	-0.0005	-0.0009	-0.0001	0.0083	0.0112	0.0002	-2.6392
number_sex_partners	0.0001	-0.0009	0.0011	0.8423	0.8645	0.0005	0.2019
sex_age_first	-0.0135	-0.0143	-0.0128	0.0000	0.0000	0.0004	-34.9605
chronotypeDefinitely an 'evening' person	0.0185	0.0158	0.0211	0.0000	0.0000	0.0013	13.8097
chronotypeDefinitely a 'morning' person	0.0039	0.0011	0.0066	0.0092	0.0121	0.0013	3.0278
chronotypeMore an 'evening' than a 'morning' person	0.0075	0.0043	0.0107	0.0005	0.0006	0.0014	5.2450
nap	0.0189	0.0172	0.0206	0.0000	0.0000	0.0009	21.9641
sleep_hours_categorical>9 hours	0.0155	0.0128	0.0181	0.0000	0.0000	0.0013	11.5196
sleep_hours_categorical<7 hours	0.0052	0.0036	0.0069	0.0000	0.0000	0.0008	6.3649
family_visit_freq	0.0173	0.0141	0.0205	0.0000	0.0000	0.0016	10.5336
religious_groupYes	-0.0145	-0.0164	-0.0125	0.0000	0.0000	0.0010	-14.5326
facial_agingAbout your age	0.0046	0.0026	0.0065	0.0000	0.0000	0.0010	4.7462
facial_agingOlder than you are	0.0025	-0.0027	0.0077	0.3416	0.3722	0.0026	0.9528
skin_colorDark olive	0.0066	0.0015	0.0117	0.0114	0.0148	0.0026	2.5339
skin_colorLight olive	-0.0017	-0.0035	0.0000	0.0558	0.0680	0.0009	-1.9135
skin_colorBlack	0.0099	-0.0009	0.0207	0.0726	0.0859	0.0055	1.8010
skin_colorBrown	0.0026	-0.0034	0.0085	0.3950	0.4220	0.0030	0.8512

Table S25. Urate

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0014	-0.0012	0.0040	0.2813	0.3179	0.0013	1.0776
sun_protection_use	-0.0080	-0.0108	-0.0052	0.0000	0.0000	0.0014	-5.7097
fish_oil_supplementsYes	-0.0174	-0.0189	-0.0158	0.0000	0.0000	0.0008	-22.0544
folate_supplementsYes	-0.0268	-0.0316	-0.0220	0.0000	0.0000	0.0024	-10.9871
glucosamine_supplementsYes	-0.0172	-0.0189	-0.0154	0.0000	0.0000	0.0009	-19.4582
multivitamin_supplementsYes	-0.0178	-0.0195	-0.0161	0.0000	0.0000	0.0009	-20.4938
pack_years_prop	0.0144	0.0133	0.0154	0.0000	0.0000	0.0005	29.7454
smoking_statusPrevious	0.0257	0.0242	0.0271	0.0000	0.0000	0.0008	33.8562
smoking_statusCurrent	-0.0113	-0.0138	-0.0089	0.0000	0.0000	0.0012	-9.1964
IPAQ_activity_group	-0.0236	-0.0251	-0.0220	0.0000	0.0000	0.0008	-31.1722
education_years	-0.0152	-0.0168	-0.0137	0.0000	0.0000	0.0008	-19.6165
ethnicityAsian	0.0238	0.0193	0.0284	0.0000	0.0000	0.0023	10.2843
ethnicityBlack	0.0384	0.0328	0.0440	0.0000	0.0000	0.0028	13.5591
ethnicityMixed	0.0033	-0.0056	0.0123	0.4684	0.4937	0.0046	0.7253
ethnicityOther	0.0161	0.0085	0.0238	0.0001	0.0001	0.0039	4.1571

Table S26. Urea

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0083	-0.0108	-0.0057	0.0000	0.0000	0.0013	-6.4101
alcohol_freqDaily or almost daily	-0.0254	-0.0280	-0.0228	0.0000	0.0000	0.0013	-19.1121
alcohol_freqOnce or twice a week	0.0035	0.0010	0.0060	0.0052	0.0063	0.0013	2.7938
bread	0.0179	0.0163	0.0194	0.0000	0.0000	0.0008	22.9557
cereal	0.0041	0.0026	0.0055	0.0000	0.0000	0.0007	5.5291
never_eat_dairyYes	-0.0435	-0.0493	-0.0378	0.0000	0.0000	0.0028	-15.3171
never_eat_eggsYes	-0.0331	-0.0376	-0.0285	0.0000	0.0000	0.0023	-14.2555
never_eat_sugarYes	0.0231	0.0213	0.0250	0.0000	0.0000	0.0009	24.4130
partial_fiber_score	-0.0093	-0.0110	-0.0075	0.0000	0.0000	0.0009	-10.4946
poultry	0.0760	0.0741	0.0779	0.0000	0.0000	0.0010	79.8404
processed_meat	0.0506	0.0488	0.0524	0.0000	0.0000	0.0009	55.8971
red_meat	0.0540	0.0523	0.0558	0.0000	0.0000	0.0009	61.6353
salt	-0.0063	-0.0081	-0.0044	0.0000	0.0000	0.0010	-6.5622
body_size_10yrs_oldThinner	0.0010	-0.0006	0.0026	0.2217	0.2337	0.0008	1.2222
body_size_10yrs_oldPlumper	0.0052	0.0031	0.0072	0.0000	0.0000	0.0011	4.8427
height_10yrs_oldShorter	-0.0057	-0.0076	-0.0037	0.0000	0.0000	0.0010	-5.7657
height_10yrs_oldTaller	0.0021	0.0003	0.0038	0.0205	0.0239	0.0009	2.3242

Table S26. Urea

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0011	-0.0027	0.0005	0.1899	0.2029	0.0008	-1.3124
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0019	-0.0111	0.0073	0.6652	0.6827	0.0043	-0.4417
mobile_phone_2yrsYes, use is now less frequent	0.0006	-0.0037	0.0049	0.7631	0.7631	0.0019	0.3099
mobile_phone_2yrsYes, use is now more frequent	0.0049	0.0004	0.0094	0.0381	0.0431	0.0019	2.6405
employedYes	0.0176	0.0158	0.0195	0.0000	0.0000	0.0009	18.7778
unemployedYes	-0.0429	-0.0481	-0.0377	0.0000	0.0000	0.0026	-16.2095
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0040	-0.0239	0.0160	0.6964	0.7054	0.0102	-0.3903
accommodation_typeA flat, maisonette or apartment	-0.0273	-0.0300	-0.0245	0.0000	0.0000	0.0014	-19.4680
gas_hob_heatYes	0.0026	0.0010	0.0041	0.0012	0.0015	0.0008	3.2401
hshld_income	0.0273	0.0249	0.0297	0.0000	0.0000	0.0012	22.4665
hshld_parentsYes	-0.0126	-0.0180	-0.0073	0.0000	0.0000	0.0027	-4.6418
hshld_partnerYes	0.0164	0.0147	0.0181	0.0000	0.0000	0.0009	19.0692
hshld_siblingsYes	-0.0097	-0.0192	-0.0002	0.0456	0.0508	0.0048	-2.0104
hshld_vehicles	0.0436	0.0408	0.0464	0.0000	0.0000	0.0014	30.7878

Table S26. Urea

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0164	-0.0207	-0.0121	0.0000	0.0000	0.0022	-7.5133
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0229	-0.0358	-0.0100	0.0005	0.0007	0.0066	-3.4779
own_or_rentOwn with a mortgage	0.0036	0.0018	0.0054	0.0001	0.0001	0.0009	3.9892
own_or_rentRent - from local authority, local council, housing association	-0.0322	-0.0356	-0.0288	0.0000	0.0000	0.0017	-18.8283
own_or_rentLive in accommodation rent free	-0.0158	-0.0243	-0.0074	0.0003	0.0003	0.0043	-3.6626
townsend_deprivation_index	-0.0078	-0.0086	-0.0070	0.0000	0.0000	0.0004	-19.1719
psychiatrist_visit_mental_healthYes	-0.0105	-0.0129	-0.0081	0.0000	0.0000	0.0012	-8.6181
risk_takingYes	-0.0021	-0.0041	-0.0002	0.0353	0.0405	0.0010	-2.1747
tiredness_freq	-0.0047	-0.0067	-0.0027	0.0000	0.0000	0.0010	-4.6411
unenthusiasm_freq	-0.0180	-0.0208	-0.0153	0.0000	0.0000	0.0014	-12.9738
fast_driving	0.0253	0.0226	0.0279	0.0000	0.0000	0.0014	18.5829
gymYes	0.0145	0.0129	0.0161	0.0000	0.0000	0.0008	17.5793
LTPA	0.0110	0.0088	0.0131	0.0000	0.0000	0.0011	10.2541
sedentary	0.0041	0.0027	0.0055	0.0000	0.0000	0.0007	5.9133
air_pollution_PC1	-0.0019	-0.0023	-0.0015	0.0000	0.0000	0.0002	-10.2337

Table S26. Urea

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0022	0.0018	0.0026	0.0000	0.0000	0.0002	10.3651
number_sex_partners	-0.0008	-0.0016	0.0001	0.0815	0.0896	0.0004	-1.7749
sex_age_first	-0.0018	-0.0027	-0.0010	0.0000	0.0001	0.0004	-4.2714
chronotypeDefinitely an 'evening' person	-0.0166	-0.0195	-0.0137	0.0000	0.0000	0.0015	-11.2190
chronotypeDefinitely a 'morning' person	0.0026	0.0007	0.0046	0.0067	0.0080	0.0010	2.7273
chronotypeMore an 'evening' than a 'morning' person	-0.0073	-0.0091	-0.0056	0.0000	0.0000	0.0009	-8.2634
nap	0.0080	0.0061	0.0098	0.0000	0.0000	0.0009	8.5357
sleep_hours_categorical>9 hours	0.0010	-0.0019	0.0040	0.4901	0.5098	0.0015	0.6919
sleep_hours_categorical<7 hours	-0.0049	-0.0065	-0.0032	0.0000	0.0000	0.0009	-5.6532
family_visit_freq	0.0114	0.0079	0.0149	0.0000	0.0000	0.0018	6.4127
religious_groupYes	-0.0049	-0.0069	-0.0029	0.0000	0.0000	0.0010	-4.8277
facial_agingAbout your age	-0.0033	-0.0055	-0.0011	0.0052	0.0063	0.0011	-3.0294
facial_agingOlder than you are	-0.0190	-0.0243	-0.0137	0.0000	0.0000	0.0027	-7.0600
skin_colorDark olive	0.0085	0.0028	0.0143	0.0039	0.0048	0.0029	2.9406
skin_colorLight olive	0.0073	0.0054	0.0093	0.0000	0.0000	0.0010	7.3198
skin_colorBlack	-0.0217	-0.0332	-0.0103	0.0002	0.0003	0.0058	-3.7337
skin_colorBrown	-0.0118	-0.0181	-0.0054	0.0003	0.0004	0.0032	-3.6519

Table S26. Urea

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.0106	-0.0135	-0.0077	0.0000	0.0000	0.0015	-7.2200
sun_protection_use	0.0081	0.0055	0.0108	0.0000	0.0000	0.0014	6.0148
fish_oil_supplementsYes	-0.0066	-0.0081	-0.0050	0.0000	0.0000	0.0008	-8.3577
folate_supplementsYes	-0.0241	-0.0290	-0.0192	0.0000	0.0000	0.0025	-9.6843
glucosamine_supplementsYes	-0.0014	-0.0032	0.0005	0.1492	0.1616	0.0009	-1.4432
multivitamin_supplementsYes	-0.0146	-0.0164	-0.0129	0.0000	0.0000	0.0009	-16.3933
pack_years_prop	-0.0127	-0.0135	-0.0119	0.0000	0.0000	0.0004	-31.7176
smoking_statusPrevious	-0.0056	-0.0071	-0.0040	0.0000	0.0000	0.0008	-7.0214
smoking_statusCurrent	-0.0660	-0.0685	-0.0636	0.0000	0.0000	0.0013	-52.5158
IPAQ_activity_group	0.0155	0.0140	0.0170	0.0000	0.0000	0.0007	20.7271
education_years	-0.0127	-0.0143	-0.0111	0.0000	0.0000	0.0008	-15.4279
ethnicityAsian	-0.0598	-0.0649	-0.0546	0.0000	0.0000	0.0026	-22.9219
ethnicityBlack	-0.0786	-0.0843	-0.0728	0.0000	0.0000	0.0029	-26.7096
ethnicityMixed	-0.0328	-0.0420	-0.0237	0.0000	0.0000	0.0047	-7.0137
ethnicityOther	-0.0270	-0.0343	-0.0197	0.0000	0.0000	0.0037	-7.2347

Table S27. IGF-1

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	0.0008	-0.0022	0.0038	0.6174	0.6174	0.0015	0.5000
alcohol_freqDaily or almost daily	-0.0320	-0.0352	-0.0289	0.0000	0.0000	0.0016	-19.9654
alcohol_freqOnce or twice a week	0.0086	0.0058	0.0115	0.0000	0.0000	0.0014	5.9653
bread	0.0047	0.0030	0.0065	0.0000	0.0000	0.0009	5.2791
cereal	0.0424	0.0407	0.0441	0.0000	0.0000	0.0009	48.9276
never_eat_dairyYes	-0.0164	-0.0222	-0.0106	0.0000	0.0000	0.0029	-5.6051
never_eat_eggsYes	-0.0257	-0.0307	-0.0206	0.0000	0.0000	0.0026	-10.0274
never_eat_sugarYes	0.0016	-0.0006	0.0037	0.1472	0.1688	0.0011	1.4501
partial_fiber_score	0.0361	0.0342	0.0380	0.0000	0.0000	0.0010	37.7060
poultry	0.0243	0.0221	0.0264	0.0000	0.0000	0.0011	22.1682
processed_meat	-0.0096	-0.0115	-0.0076	0.0000	0.0000	0.0010	-9.7826
red_meat	-0.0007	-0.0026	0.0013	0.5135	0.5270	0.0010	-0.6536
salt	-0.0422	-0.0444	-0.0400	0.0000	0.0000	0.0011	-37.9336
body_size_10yrs_oldThinner	-0.0024	-0.0043	-0.0006	0.0099	0.0122	0.0009	-2.5919
body_size_10yrs_oldPlumper	-0.0308	-0.0332	-0.0285	0.0000	0.0000	0.0012	-25.6424
height_10yrs_oldShorter	-0.0057	-0.0079	-0.0034	0.0000	0.0000	0.0011	-4.9850
height_10yrs_oldTaller	0.0017	-0.0005	0.0038	0.1226	0.1428	0.0011	1.5440

Table S27. IGF-1

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0161	-0.0184	-0.0138	0.0000	0.0000	0.0011	-14.2629
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0036	-0.0036	0.0107	0.3259	0.3436	0.0036	0.9842
mobile_phone_2yrsYes, use is now less frequent	-0.0083	-0.0117	-0.0048	0.0000	0.0001	0.0017	-4.9484
mobile_phone_2yrsYes, use is now more frequent	-0.0025	-0.0058	0.0007	0.1163	0.1374	0.0015	-1.7127
employedYes	-0.0053	-0.0073	-0.0032	0.0000	0.0000	0.0010	-5.0978
unemployedYes	-0.0135	-0.0196	-0.0075	0.0000	0.0000	0.0031	-4.4013
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0137	-0.0359	0.0085	0.2260	0.2518	0.0113	-1.2108
accommodation_typeA flat, maisonette or apartment	-0.0331	-0.0363	-0.0298	0.0000	0.0000	0.0016	-20.1126
gas_hob_heatYes	0.0010	-0.0008	0.0028	0.2880	0.3120	0.0009	1.0630
hshld_income	0.0183	0.0156	0.0210	0.0000	0.0000	0.0014	13.3894
hshld_parentsYes	-0.0225	-0.0286	-0.0164	0.0000	0.0000	0.0031	-7.2463
hshld_partnerYes	0.0167	0.0148	0.0186	0.0000	0.0000	0.0010	17.0180
hshld_siblingsYes	-0.0216	-0.0319	-0.0113	0.0000	0.0001	0.0052	-4.1214
hshld_vehicles	0.0244	0.0213	0.0276	0.0000	0.0000	0.0016	15.4401

Table S27. IGF-1

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0418	-0.0466	-0.0370	0.0000	0.0000	0.0025	-17.0556
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0409	-0.0557	-0.0261	0.0000	0.0000	0.0075	-5.4344
own_or_rentOwn with a mortgage	-0.0158	-0.0178	-0.0139	0.0000	0.0000	0.0010	-15.6212
own_or_rentRent - from local authority, local council, housing association	-0.0661	-0.0701	-0.0621	0.0000	0.0000	0.0020	-32.5740
own_or_rentLive in accommodation rent free	-0.0324	-0.0419	-0.0229	0.0000	0.0000	0.0048	-6.7076
townsend_deprivation_index	-0.0171	-0.0181	-0.0161	0.0000	0.0000	0.0005	-33.6967
psychiatrist_visit_mental_healthYes	-0.0170	-0.0195	-0.0144	0.0000	0.0000	0.0013	-13.1085
risk_takingYes	-0.0153	-0.0173	-0.0133	0.0000	0.0000	0.0010	-15.4355
tiredness_freq	-0.0268	-0.0292	-0.0244	0.0000	0.0000	0.0012	-21.7787
unenthusiasm_freq	-0.0237	-0.0267	-0.0207	0.0000	0.0000	0.0015	-15.4351
fast_driving	0.0038	0.0008	0.0068	0.0140	0.0168	0.0015	2.4576
gymYes	0.0174	0.0155	0.0193	0.0000	0.0000	0.0010	17.8318
LTPA	0.0154	0.0128	0.0179	0.0000	0.0000	0.0012	12.3369
sedentary	-0.0120	-0.0135	-0.0105	0.0000	0.0000	0.0008	-15.7331
air_pollution_PC1	-0.0041	-0.0045	-0.0037	0.0000	0.0000	0.0002	-19.4680

Table S27. IGF-1

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0027	0.0022	0.0032	0.0000	0.0000	0.0002	10.9740
number_sex_partners	-0.0021	-0.0031	-0.0010	0.0002	0.0003	0.0005	-4.0712
sex_age_first	0.0060	0.0050	0.0069	0.0000	0.0000	0.0005	12.5260
chronotypeDefinitely an 'evening' person	-0.0206	-0.0246	-0.0166	0.0000	0.0000	0.0020	-10.5461
chronotypeDefinitely a 'morning' person	-0.0099	-0.0126	-0.0073	0.0000	0.0000	0.0013	-7.6271
chronotypeMore an 'evening' than a 'morning' person	-0.0075	-0.0108	-0.0042	0.0003	0.0004	0.0015	-4.9117
nap	-0.0120	-0.0140	-0.0100	0.0000	0.0000	0.0010	-11.7929
sleep_hours_categorical>9 hours	-0.0142	-0.0173	-0.0111	0.0000	0.0000	0.0016	-8.8811
sleep_hours_categorical<7 hours	-0.0111	-0.0131	-0.0090	0.0000	0.0000	0.0010	-10.7148
family_visit_freq	-0.0092	-0.0130	-0.0053	0.0000	0.0000	0.0019	-4.7104
religious_groupYes	0.0014	-0.0010	0.0038	0.2556	0.2808	0.0012	1.1388
facial_agingAbout your age	-0.0040	-0.0061	-0.0019	0.0002	0.0003	0.0011	-3.7841
facial_agingOlder than you are	-0.0185	-0.0251	-0.0118	0.0000	0.0000	0.0033	-5.5378
skin_colorDark olive	0.0101	0.0041	0.0160	0.0008	0.0011	0.0030	3.3368
skin_colorLight olive	0.0114	0.0091	0.0136	0.0000	0.0000	0.0011	10.0964
skin_colorBlack	-0.0037	-0.0159	0.0085	0.5522	0.5593	0.0062	-0.5945
skin_colorBrown	-0.0102	-0.0171	-0.0034	0.0033	0.0042	0.0035	-2.9370

Table S27. IGF-1

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.0138	-0.0170	-0.0106	0.0000	0.0000	0.0016	-8.5038
sun_protection_use	0.0240	0.0211	0.0270	0.0000	0.0000	0.0015	15.8001
fish_oil_supplementsYes	0.0308	0.0288	0.0327	0.0000	0.0000	0.0010	31.6398
folate_supplementsYes	-0.0026	-0.0081	0.0029	0.3568	0.3711	0.0028	-0.9218
glucosamine_supplementsYes	0.0219	0.0198	0.0240	0.0000	0.0000	0.0011	20.4676
multivitamin_supplementsYes	0.0098	0.0078	0.0119	0.0000	0.0000	0.0011	9.2828
pack_years_prop	-0.0204	-0.0216	-0.0193	0.0000	0.0000	0.0006	-36.6892
smoking_statusPrevious	-0.0195	-0.0212	-0.0177	0.0000	0.0000	0.0009	-21.4730
smoking_statusCurrent	-0.0383	-0.0412	-0.0354	0.0000	0.0000	0.0015	-25.8162
IPAQ_activity_group	0.0119	0.0099	0.0139	0.0000	0.0000	0.0010	12.1819
education_years	0.0189	0.0170	0.0208	0.0000	0.0000	0.0010	19.7477
ethnicityAsian	-0.0488	-0.0544	-0.0432	0.0000	0.0000	0.0028	-17.1413
ethnicityBlack	0.0045	-0.0020	0.0111	0.1716	0.1940	0.0033	1.3693
ethnicityMixed	-0.0053	-0.0158	0.0052	0.3235	0.3436	0.0054	-0.9873
ethnicityOther	-0.0108	-0.0194	-0.0022	0.0140	0.0168	0.0044	-2.4611

Table S28. Vitamin D

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqDaily or almost daily	0.0493	0.0442	0.0544	0.0000	0.0000	0.0026	18.8596
alcohol_freqThree or four times a week	0.0621	0.0571	0.0670	0.0000	0.0000	0.0025	24.5887
alcohol_freqOnce or twice a week	0.0446	0.0397	0.0496	0.0000	0.0000	0.0025	17.7449
bread	-0.0426	-0.0456	-0.0395	0.0000	0.0000	0.0015	-27.5064
cereal	0.0533	0.0505	0.0560	0.0000	0.0000	0.0014	37.8083
never_eat_dairyYes	-0.0132	-0.0224	-0.0041	0.0046	0.0053	0.0047	-2.8352
never_eat_eggsYes	-0.0598	-0.0682	-0.0514	0.0000	0.0000	0.0043	-13.9424
never_eat_sugarYes	0.0289	0.0252	0.0325	0.0000	0.0000	0.0019	15.4427
partial_fiber_score	0.0741	0.0706	0.0776	0.0000	0.0000	0.0018	41.7806
poultry	0.0550	0.0513	0.0587	0.0000	0.0000	0.0019	29.1941
processed_meat	-0.0289	-0.0325	-0.0254	0.0000	0.0000	0.0018	-15.9909
red_meat	-0.0047	-0.0081	-0.0013	0.0075	0.0083	0.0017	-2.6788
salt	-0.0111	-0.0148	-0.0073	0.0000	0.0000	0.0019	-5.8310
body_size_10yrs_oldThinner	-0.0075	-0.0107	-0.0043	0.0000	0.0000	0.0016	-4.5926
body_size_10yrs_oldPlumper	-0.0384	-0.0431	-0.0337	0.0000	0.0000	0.0023	-16.3594
height_10yrs_oldTaller	-0.0069	-0.0103	-0.0034	0.0001	0.0001	0.0018	-3.9161
height_10yrs_oldShorter	-0.0039	-0.0077	-0.0000	0.0493	0.0527	0.0020	-1.9780

Table S28. Vitamin D

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0013	-0.0047	0.0021	0.4515	0.4515	0.0017	-0.7546
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0439	-0.0565	-0.0314	0.0000	0.0000	0.0064	-6.9152
mobile_phone_2yrsYes, use is now more frequent	0.0149	0.0008	0.0290	0.0421	0.0456	0.0054	2.7535
mobile_phone_2yrsYes, use is now less frequent	0.0061	-0.0048	0.0170	0.2262	0.2353	0.0046	1.3277
employedYes	-0.0271	-0.0308	-0.0234	0.0000	0.0000	0.0019	-14.4487
unemployedYes	-0.0943	-0.1044	-0.0841	0.0000	0.0000	0.0052	-18.1853
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0197	-0.0180	0.0574	0.3065	0.3105	0.0192	1.0226
accommodation_typeA flat, maisonette or apartment	-0.1099	-0.1154	-0.1044	0.0000	0.0000	0.0028	-39.2442
gas_hob_heatYes	0.0119	0.0088	0.0149	0.0000	0.0000	0.0016	7.5864
hshld_income	0.1150	0.1085	0.1215	0.0000	0.0000	0.0031	37.1907
hshld_parentsYes	-0.1011	-0.1116	-0.0905	0.0000	0.0000	0.0054	-18.8776
hshld_partnerYes	0.0918	0.0886	0.0949	0.0000	0.0000	0.0016	56.5553
hshld_siblingsYes	-0.1026	-0.1202	-0.0851	0.0000	0.0000	0.0090	-11.4626
hshld_vehicles	0.1776	0.1720	0.1831	0.0000	0.0000	0.0028	62.9164

Table S28. Vitamin D

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.1401	-0.1484	-0.1318	0.0000	0.0000	0.0042	-33.1360
own_or_rentPay part rent and part mortgage (shared ownership)	-0.1251	-0.1499	-0.1002	0.0000	0.0000	0.0127	-9.8532
own_or_rentOwn with a mortgage	-0.0303	-0.0338	-0.0269	0.0000	0.0000	0.0018	-17.2449
own_or_rentRent - from local authority, local council, housing association	-0.1925	-0.1993	-0.1858	0.0000	0.0000	0.0034	-56.1148
own_or_rentLive in accommodation rent free	-0.1264	-0.1428	-0.1100	0.0000	0.0000	0.0084	-15.1293
townsend_deprivation_index	-0.0588	-0.0604	-0.0571	0.0000	0.0000	0.0008	-69.7036
psychiatrist_visit_mental_healthYes	-0.0446	-0.0490	-0.0402	0.0000	0.0000	0.0022	-19.8293
risk_takingYes	0.0120	0.0058	0.0181	0.0015	0.0018	0.0027	4.3945
tiredness_freq	-0.0965	-0.1007	-0.0923	0.0000	0.0000	0.0021	-44.9322
unenthusiasm_freq	-0.1041	-0.1108	-0.0975	0.0000	0.0000	0.0033	-32.0030
fast_driving	0.1378	0.1324	0.1432	0.0000	0.0000	0.0028	50.0109
gymYes	0.1105	0.1066	0.1144	0.0000	0.0000	0.0019	57.0486
LTPA	0.1456	0.1338	0.1575	0.0000	0.0000	0.0047	31.0130
sedentary	-0.0267	-0.0293	-0.0240	0.0000	0.0000	0.0014	-19.5975
air_pollution_PC1	-0.0166	-0.0174	-0.0159	0.0000	0.0000	0.0004	-42.8838

Table S28. Vitamin D

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	0.0149	0.0140	0.0157	0.0000	0.0000	0.0004	33.2630
number_sex_partners	0.0009	-0.0007	0.0024	0.2609	0.2678	0.0008	1.1308
sex_age_first	-0.0215	-0.0231	-0.0199	0.0000	0.0000	0.0008	-26.4639
chronotypeDefinitely an 'evening' person	-0.0790	-0.0857	-0.0723	0.0000	0.0000	0.0033	-23.8538
chronotypeDefinitely a 'morning' person	-0.0084	-0.0129	-0.0039	0.0005	0.0006	0.0022	-3.8183
chronotypeMore an 'evening' than a 'morning' person	-0.0222	-0.0285	-0.0160	0.0000	0.0000	0.0028	-7.9045
nap	-0.0508	-0.0542	-0.0474	0.0000	0.0000	0.0017	-29.4574
sleep_hours_categorical>9 hours	-0.0265	-0.0320	-0.0210	0.0000	0.0000	0.0028	-9.4927
sleep_hours_categorical<7 hours	-0.0396	-0.0430	-0.0363	0.0000	0.0000	0.0017	-23.0029
family_visit_freq	0.0821	0.0755	0.0888	0.0000	0.0000	0.0034	24.2456
religious_groupYes	-0.0421	-0.0461	-0.0381	0.0000	0.0000	0.0020	-20.6852
facial_agingAbout your age	-0.0186	-0.0288	-0.0083	0.0047	0.0054	0.0041	-4.4854
facial_agingOlder than you are	-0.0676	-0.0793	-0.0558	0.0000	0.0000	0.0059	-11.4608
skin_colorDark olive	0.0780	0.0655	0.0905	0.0000	0.0000	0.0062	12.5687
skin_colorBlack	-0.0295	-0.0510	-0.0079	0.0075	0.0083	0.0110	-2.6770
skin_colorLight olive	0.0580	0.0535	0.0626	0.0000	0.0000	0.0022	25.8771
skin_colorBrown	-0.0323	-0.0442	-0.0204	0.0000	0.0000	0.0061	-5.3266

Table S28. Vitamin D

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	-0.1001	-0.1057	-0.0945	0.0000	0.0000	0.0028	-35.1991
sun_protection_use	0.1102	0.1052	0.1152	0.0000	0.0000	0.0026	42.8578
fish_oil_supplementsYes	0.1989	0.1958	0.2020	0.0000	0.0000	0.0016	124.8403
folate_supplementsYes	0.0468	0.0375	0.0562	0.0000	0.0000	0.0048	9.7881
glucosamine_supplementsYes	0.1268	0.1232	0.1304	0.0000	0.0000	0.0019	68.5411
multivitamin_supplementsYes	0.1786	0.1751	0.1820	0.0000	0.0000	0.0018	101.2142
pack_years_prop	-0.0417	-0.0434	-0.0400	0.0000	0.0000	0.0008	-49.1969
smoking_statusPrevious	-0.0026	-0.0058	0.0005	0.1040	0.1096	0.0016	-1.6286
smoking_statusCurrent	-0.1219	-0.1267	-0.1171	0.0000	0.0000	0.0024	-49.7690
IPAQ_activity_group	0.1305	0.1223	0.1387	0.0000	0.0000	0.0033	39.3195
education_years	-0.0220	-0.0255	-0.0185	0.0000	0.0000	0.0018	-12.5593
ethnicityAsian	-0.5665	-0.5769	-0.5561	0.0000	0.0000	0.0053	-107.9022
ethnicityBlack	-0.3685	-0.3798	-0.3573	0.0000	0.0000	0.0057	-64.4307
ethnicityMixed	-0.2115	-0.2300	-0.1931	0.0000	0.0000	0.0094	-22.4759
ethnicityOther	-0.3325	-0.3475	-0.3175	0.0000	0.0000	0.0077	-43.4175

Table S29. Leukocyte Telomere Length

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
alcohol_freqThree or four times a week	-0.0027	-0.0138	0.0083	0.6308	0.7500	0.0056	-0.4806
alcohol_freqDaily or almost daily	-0.0113	-0.0227	0.0001	0.0527	0.1083	0.0058	-1.9370
alcohol_freqOnce or twice a week	0.0009	-0.0099	0.0117	0.8745	0.8976	0.0055	0.1579
bread	-0.0011	-0.0075	0.0053	0.7348	0.7852	0.0032	-0.3387
cereal	0.0114	0.0055	0.0173	0.0002	0.0005	0.0030	3.7800
never_eat_dairyYes	0.0134	-0.0065	0.0334	0.1867	0.3034	0.0102	1.3204
never_eat_eggsYes	-0.0046	-0.0230	0.0138	0.6253	0.7500	0.0094	-0.4884
never_eat_sugarYes	-0.0124	-0.0203	-0.0045	0.0020	0.0051	0.0040	-3.0933
partial_fiber_score	0.0269	0.0199	0.0339	0.0000	0.0000	0.0036	7.5090
poultry	-0.0210	-0.0290	-0.0130	0.0000	0.0000	0.0041	-5.1740
processed_meat	-0.0257	-0.0329	-0.0184	0.0000	0.0000	0.0037	-6.9582
red_meat	-0.0146	-0.0219	-0.0073	0.0001	0.0003	0.0037	-3.9309
salt	-0.0336	-0.0415	-0.0257	0.0000	0.0000	0.0040	-8.3106
body_size_10yrs_oldThinner	0.0001	-0.0066	0.0068	0.9808	0.9808	0.0034	0.0241
body_size_10yrs_oldPlumper	-0.0038	-0.0124	0.0049	0.3946	0.5255	0.0044	-0.8514
height_10yrs_oldShorter	-0.0049	-0.0127	0.0029	0.2217	0.3529	0.0040	-1.2220
height_10yrs_oldTaller	-0.0018	-0.0091	0.0056	0.6390	0.7500	0.0037	-0.4692

Table S29. Leukocyte Telomere Length

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
maternal_smokingYes	-0.0405	-0.0474	-0.0335	0.0000	0.0000	0.0036	-11.3815
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0172	-0.0109	0.0453	0.2284	0.3564	0.0142	1.2105
mobile_phone_2yrsYes, use is now less frequent	-0.0057	-0.0159	0.0046	0.2780	0.4092	0.0052	-1.0862
mobile_phone_2yrsYes, use is now more frequent	-0.0073	-0.0159	0.0014	0.0961	0.1666	0.0042	-1.7083
employedYes	-0.0005	-0.0081	0.0070	0.8882	0.8997	0.0039	-0.1406
unemployedYes	0.0045	-0.0175	0.0266	0.6880	0.7666	0.0113	0.4016
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0095	-0.0737	0.0928	0.8223	0.8638	0.0425	0.2245
accommodation_typeA flat, maisonette or apartment	-0.0078	-0.0193	0.0036	0.1813	0.3009	0.0058	-1.3367
gas_hob_heatYes	0.0019	-0.0047	0.0086	0.5704	0.7062	0.0034	0.5675
hshld_income	0.0119	0.0018	0.0219	0.0208	0.0478	0.0051	2.3124
hshld_parentsYes	0.0042	-0.0178	0.0262	0.7064	0.7760	0.0112	0.3768
hshld_partnerYes	-0.0035	-0.0104	0.0034	0.3215	0.4560	0.0035	-0.9913
hshld_siblingsYes	-0.0199	-0.0582	0.0184	0.3077	0.4445	0.0195	-1.0201
hshld_vehicles	-0.0104	-0.0219	0.0011	0.0771	0.1399	0.0059	-1.7676

Table S29. Leukocyte Telomere Length

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
own_or_rentRent - from private landlord or letting agency	-0.0164	-0.0341	0.0012	0.0679	0.1260	0.0090	-1.8259
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0513	-0.1063	0.0036	0.0672	0.1260	0.0280	-1.8302
own_or_rentOwn with a mortgage	-0.0306	-0.0382	-0.0231	0.0000	0.0000	0.0038	-7.9866
own_or_rentRent - from local authority, local council, housing association	-0.0587	-0.0726	-0.0448	0.0000	0.0000	0.0071	-8.2829
own_or_rentLive in accommodation rent free	0.0154	-0.0202	0.0509	0.3975	0.5255	0.0182	0.8460
townsend_deprivation_index	-0.0061	-0.0095	-0.0027	0.0005	0.0014	0.0017	-3.4832
psychiatrist_visit_mental_healthYes	-0.0045	-0.0141	0.0051	0.3596	0.5008	0.0049	-0.9162
risk_takingYes	-0.0072	-0.0146	0.0003	0.0604	0.1179	0.0038	-1.8870
tiredness_freq	-0.0160	-0.0245	-0.0075	0.0002	0.0007	0.0043	-3.6806
unenthusiasm_freq	-0.0134	-0.0251	-0.0017	0.0248	0.0552	0.0060	-2.2514
fast_driving	0.0033	-0.0080	0.0146	0.5680	0.7062	0.0058	0.5709
gymYes	0.0059	-0.0009	0.0128	0.0908	0.1610	0.0035	1.6911
LTPA	0.0124	0.0049	0.0200	0.0012	0.0032	0.0038	3.2426
sedentary	-0.0209	-0.0265	-0.0153	0.0000	0.0000	0.0029	-7.3247
air_pollution_PC1	-0.0009	-0.0024	0.0006	0.2540	0.3810	0.0008	-1.1406

Table S29. Leukocyte Telomere Length

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
greenspace_PC1	-0.0007	-0.0024	0.0011	0.4611	0.5994	0.0009	-0.7370
number_sex_partners	-0.0027	-0.0064	0.0010	0.1450	0.2458	0.0018	-1.4748
sex_age_first	0.0244	0.0211	0.0278	0.0000	0.0000	0.0017	14.3396
chronotypeDefinitely an 'evening' person	0.0151	0.0033	0.0268	0.0121	0.0286	0.0060	2.5098
chronotypeDefinitely a 'morning' person	-0.0101	-0.0190	-0.0012	0.0266	0.0577	0.0045	-2.2590
chronotypeMore an 'evening' than a 'morning' person	-0.0017	-0.0094	0.0060	0.6626	0.7600	0.0039	-0.4364
nap	-0.0071	-0.0145	0.0002	0.0575	0.1150	0.0037	-1.8994
sleep_hours_categorical>9 hours	-0.0128	-0.0244	-0.0012	0.0308	0.0649	0.0059	-2.1597
sleep_hours_categorical<7 hours	-0.0119	-0.0190	-0.0048	0.0011	0.0029	0.0036	-3.2767
family_visit_freq	-0.0428	-0.0572	-0.0284	0.0000	0.0000	0.0073	-5.8398
religious_groupYes	0.0289	0.0204	0.0375	0.0000	0.0000	0.0044	6.6053
facial_agingAbout your age	-0.0253	-0.0327	-0.0179	0.0000	0.0000	0.0038	-6.6956
facial_agingOlder than you are	-0.0510	-0.0735	-0.0285	0.0000	0.0000	0.0115	-4.4469
skin_colorDark olive	0.0134	-0.0090	0.0358	0.2406	0.3680	0.0114	1.1735
skin_colorLight olive	-0.0016	-0.0096	0.0063	0.6865	0.7666	0.0041	-0.4036
skin_colorBlack	0.0052	-0.0423	0.0527	0.8306	0.8638	0.0242	0.2139
skin_colorBrown	-0.0117	-0.0384	0.0151	0.3917	0.5255	0.0136	-0.8567

Table S29. Leukocyte Telomere Length

Exposure	Beta	Beta_2.5%	Beta_97.5%	p.value	FDR	std.error	statistic
skin_colorVery fair	0.0037	-0.0078	0.0152	0.5284	0.6757	0.0059	0.6305
sun_protection_use	-0.0197	-0.0305	-0.0090	0.0003	0.0010	0.0055	-3.5879
fish_oil_supplementsYes	0.0102	0.0035	0.0168	0.0026	0.0067	0.0034	3.0058
folate_supplementsYes	-0.0048	-0.0254	0.0157	0.6442	0.7500	0.0105	-0.4618
glucosamine_supplementsYes	0.0104	0.0026	0.0182	0.0087	0.0213	0.0040	2.6219
multivitamin_supplementsYes	0.0153	0.0080	0.0227	0.0000	0.0001	0.0037	4.1090
pack_years_prop	-0.0231	-0.0264	-0.0197	0.0000	0.0000	0.0017	-13.5818
smoking_statusPrevious	-0.0166	-0.0232	-0.0099	0.0000	0.0000	0.0034	-4.9037
smoking_statusCurrent	-0.0763	-0.0868	-0.0658	0.0000	0.0000	0.0054	-14.2042
IPAQ_activity_group	-0.0011	-0.0072	0.0050	0.7178	0.7776	0.0031	-0.3615
education_years	0.0653	0.0585	0.0721	0.0000	0.0000	0.0035	18.8047
ethnicityAsian	0.0499	0.0293	0.0704	0.0000	0.0000	0.0105	4.7576
ethnicityBlack	0.3989	0.3748	0.4231	0.0000	0.0000	0.0123	32.3977
ethnicityMixed	0.1102	0.0703	0.1500	0.0000	0.0000	0.0203	5.4194
ethnicityOther	0.1615	0.1297	0.1933	0.0000	0.0000	0.0162	9.9596

Table S30. Colorectal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	0.1139	0.0137	0.2141	1.1206	1.0137	1.2387	0.0260	0.1012
alcohol_freqOnce or twice a week	-0.0891	-0.1895	0.0113	0.9147	0.8274	1.0114	0.0820	0.2460
alcohol_freqThree or four times a week	-0.0515	-0.1529	0.0499	0.9498	0.8582	1.0511	0.3193	0.5189
bread	0.0381	-0.0168	0.0930	1.0389	0.9834	1.0975	0.1735	0.3758
cereal	-0.1471	-0.1976	-0.0966	0.8632	0.8207	0.9080	0.0000	0.0000
never_eat_dairyYes	0.0928	-0.0737	0.2593	1.0972	0.9290	1.2960	0.2744	0.4790
never_eat_eggsYes	0.0703	-0.0820	0.2226	1.0728	0.9213	1.2493	0.3655	0.5702
never_eat_sugarYes	0.0674	0.0035	0.1313	1.0697	1.0035	1.1403	0.0387	0.1372
partial_fiber_score	-0.1035	-0.1651	-0.0419	0.9017	0.8478	0.9590	0.0010	0.0087
poultry	0.0863	0.0140	0.1586	1.0902	1.0141	1.1719	0.0193	0.0881
processed_meat	0.1122	0.0479	0.1765	1.1187	1.0491	1.1930	0.0006	0.0061
red_meat	0.1232	0.0589	0.1875	1.1311	1.0607	1.2063	0.0002	0.0025
salt	0.0206	-0.0476	0.0889	1.0209	0.9535	1.0930	0.5532	0.7687
body_size_10yrs_oldThinner	-0.0217	-0.0813	0.0378	0.9785	0.9219	1.0386	0.4746	0.6856
body_size_10yrs_oldPlumper	0.0620	-0.0162	0.1401	1.0639	0.9840	1.1504	0.1200	0.3157
height_10yrs_oldShorter	-0.0380	-0.1082	0.0322	0.9627	0.8974	1.0327	0.2887	0.4790

Table S30. Colorectal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0803	0.0182	0.1424	1.0836	1.0184	1.1531	0.0113	0.0629
maternal_smokingYes	0.0467	-0.0149	0.1083	1.0478	0.9852	1.1143	0.1369	0.3157
mobile_phone_2yrsYes, use is now more frequent	-0.0042	-0.0776	0.0691	0.9958	0.9253	1.0716	0.9082	0.9573
mobile_phone_2yrsYes, use is now less frequent	0.0611	-0.0196	0.1418	1.0630	0.9806	1.1523	0.1376	0.3157
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.1878	-0.4289	0.0533	0.8288	0.6512	1.0548	0.1266	0.3157
employedYes	-0.0197	-0.0862	0.0468	0.9805	0.9174	1.0479	0.5618	0.7687
unemployedYes	0.0463	-0.1669	0.2596	1.0474	0.8462	1.2964	0.6703	0.8288
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0680	-0.5872	0.7231	1.0703	0.5559	2.0608	0.8388	0.9087
accommodation_typeA flat, maisonette or apartment	0.1231	0.0256	0.2205	1.1310	1.0260	1.2467	0.0133	0.0649
gas_hob_heatYes	-0.0257	-0.0828	0.0315	0.9747	0.9205	1.0320	0.3788	0.5793
hshld_parentsYes	-0.0274	-0.2594	0.2046	0.9730	0.7715	1.2271	0.8171	0.8977
hshld_partnerYes	0.0025	-0.0618	0.0667	1.0025	0.9401	1.0690	0.9402	0.9649
hshld_siblingsYes	-0.2526	-0.6818	0.1765	0.7768	0.5057	1.1931	0.2486	0.4509
hshld_vehicles	0.0054	-0.1100	0.1209	1.0054	0.8958	1.1285	0.9268	0.9638

Table S30. Colorectal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	-0.1088	-0.2875	0.0700	0.8970	0.7501	1.0725	0.2330	0.4445
own_or_rentOwn with a mortgage	-0.0010	-0.0696	0.0677	0.9990	0.9327	1.0700	0.9775	0.9794
own_or_rentRent - from local authority, local council, housing association	0.0923	-0.0237	0.2083	1.0967	0.9765	1.2316	0.1190	0.3157
own_or_rentPay part rent and part mortgage (shared ownership)	0.0770	-0.4315	0.5855	1.0800	0.6495	1.7958	0.7667	0.8667
own_or_rentLive in accommodation rent free	-0.0259	-0.3507	0.2989	0.9744	0.7042	1.3483	0.8758	0.9358
townsend_deprivation_index	-0.0071	-0.0378	0.0235	0.9929	0.9629	1.0238	0.6475	0.8288
psychiatrist_visit_mental_health Yes	-0.0993	-0.1856	-0.0131	0.9054	0.8306	0.9870	0.0240	0.0986
risk_takingYes	-0.0114	-0.0720	0.0492	0.9886	0.9305	1.0504	0.7119	0.8288
tiredness_freq	0.0143	-0.0611	0.0896	1.0144	0.9408	1.0938	0.7101	0.8288
unenthusiasm_freq	-0.0702	-0.1771	0.0367	0.9322	0.8377	1.0374	0.1979	0.3957
fast_driving	-0.0737	-0.1780	0.0307	0.9290	0.8370	1.0311	0.1664	0.3708
gymYes	-0.0990	-0.1618	-0.0362	0.9058	0.8506	0.9645	0.0020	0.0157
LTPA	-0.1012	-0.1666	-0.0358	0.9038	0.8466	0.9649	0.0024	0.0173

Table S30. Colorectal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.0524	0.0034	0.1015	1.0538	1.0034	1.1068	0.0360	0.1338
air_pollution_PC1	0.0027	-0.0108	0.0162	1.0027	0.9893	1.0163	0.6937	0.8288
greenspace_PC1	-0.0044	-0.0200	0.0113	0.9956	0.9802	1.0113	0.5834	0.7846
number_sex_partners	0.0004	-0.0302	0.0310	1.0004	0.9703	1.0315	0.9794	0.9794
sex_age_first	-0.0044	-0.0322	0.0234	0.9956	0.9683	1.0237	0.7577	0.8667
chronotypeMore an 'evening' than a 'morning' person	0.0534	-0.0143	0.1212	1.0549	0.9858	1.1288	0.1217	0.3157
chronotypeDefinitely an 'evening' person	0.0637	-0.0421	0.1694	1.0658	0.9588	1.1846	0.2376	0.4445
chronotypeDefinitely a 'morning' person	0.0195	-0.0564	0.0954	1.0197	0.9451	1.1001	0.6115	0.8084
nap	0.0367	-0.0245	0.0980	1.0374	0.9758	1.1029	0.2394	0.4445
sleep_hours_categorical<7 hours	-0.0305	-0.0937	0.0328	0.9700	0.9105	1.0333	0.3449	0.5491
sleep_hours_categorical>9 hours	-0.0531	-0.1505	0.0442	0.9483	0.8603	1.0452	0.2848	0.4790
family_visit_freq	-0.0840	-0.2081	0.0401	0.9194	0.8121	1.0410	0.1848	0.3793
religious_groupYes	-0.0968	-0.1728	-0.0208	0.9077	0.8413	0.9794	0.0125	0.0649
facial_agingOlder than you are	0.1762	-0.0249	0.3773	1.1927	0.9754	1.4583	0.0857	0.2475
facial_agingAbout your age	0.0457	-0.0215	0.1129	1.0468	0.9788	1.1195	0.1811	0.3793
skin_colorVery fair	0.0330	-0.0677	0.1337	1.0335	0.9346	1.1430	0.5206	0.7382

Table S30. Colorectal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.2090	-0.3375	0.7554	1.2324	0.7136	2.1286	0.4534	0.6690
skin_colorLight olive	-0.0143	-0.0852	0.0566	0.9858	0.9184	1.0582	0.6930	0.8288
skin_colorDark olive	0.1413	-0.0452	0.3278	1.1518	0.9558	1.3879	0.1376	0.3157
skin_colorBrown	0.0523	-0.2084	0.3130	1.0537	0.8118	1.3676	0.6942	0.8288
sun_protection_use	-0.0197	-0.1136	0.0742	0.9805	0.8926	1.0770	0.6806	0.8288
fish_oil_supplementsYes	-0.0780	-0.1347	-0.0214	0.9249	0.8740	0.9788	0.0069	0.0416
folate_supplementsYes	0.0668	-0.1083	0.2418	1.0690	0.8974	1.2735	0.4546	0.6690
glucosamine_supplementsYes	-0.0660	-0.1323	0.0004	0.9362	0.8761	1.0004	0.0513	0.1738
multivitamin_supplementsYes	-0.0357	-0.1014	0.0300	0.9649	0.9036	1.0304	0.2864	0.4790
pack_years_prop	0.1107	0.0866	0.1347	1.1170	1.0905	1.1442	0.0000	0.0000
smoking_statusPrevious	0.2240	0.1678	0.2803	1.2511	1.1827	1.3236	0.0000	0.0000
smoking_statusCurrent	0.2125	0.1207	0.3044	1.2368	1.1283	1.3558	0.0000	0.0001
IPAQ_activity_group	-0.1030	-0.1568	-0.0493	0.9021	0.8549	0.9519	0.0002	0.0025
education_years	-0.0076	-0.0685	0.0533	0.9924	0.9338	1.0547	0.8064	0.8977
hshld_income	-0.1005	-0.1854	-0.0156	0.9044	0.8308	0.9845	0.0203	0.0881
ethnicityAsian	-0.4815	-0.7369	-0.2260	0.6179	0.4786	0.7977	0.0002	0.0025
ethnicityBlack	-0.4443	-0.7482	-0.1404	0.6413	0.4732	0.8690	0.0042	0.0271

Table S30. Colorectal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.3229	-0.0258	0.6716	1.3811	0.9745	1.9574	0.0695	0.2260
ethnicityOther	-0.3378	-0.7112	0.0355	0.7133	0.4911	1.0362	0.0761	0.2375

Table S31. Lung cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	0.1579	0.0390	0.2769	1.1711	1.0397	1.3190	0.0093	0.0196
alcohol_freqOnce or twice a week	0.0368	-0.0823	0.1558	1.0374	0.9210	1.1686	0.5452	0.6443
alcohol_freqThree or four times a week	-0.0019	-0.1253	0.1215	0.9981	0.8823	1.1292	0.9764	0.9764
bread	0.0602	-0.0044	0.1247	1.0620	0.9956	1.1329	0.0676	0.1146
cereal	-0.1888	-0.2476	-0.1300	0.8280	0.7806	0.8781	0.0000	0.0000
never_eat_dairyYes	0.1352	-0.0488	0.3193	1.1448	0.9524	1.3761	0.1497	0.2203
never_eat_eggsYes	0.2328	0.0768	0.3887	1.2621	1.0799	1.4750	0.0034	0.0079
never_eat_sugarYes	0.0882	0.0156	0.1608	1.0922	1.0157	1.1745	0.0173	0.0330
partial_fiber_score	-0.2372	-0.3086	-0.1657	0.7889	0.7345	0.8473	0.0000	0.0000
poultry	-0.0723	-0.1543	0.0097	0.9303	0.8570	1.0098	0.0841	0.1367
processed_meat	0.1445	0.0686	0.2204	1.1555	1.0710	1.2466	0.0002	0.0006
red_meat	0.1445	0.0698	0.2192	1.1554	1.0723	1.2451	0.0002	0.0005
salt	0.2029	0.1315	0.2742	1.2249	1.1406	1.3155	0.0000	0.0000
body_size_10yrs_oldThinner	0.0239	-0.0442	0.0919	1.0241	0.9567	1.0963	0.4923	0.6137
body_size_10yrs_oldPlumper	-0.0026	-0.0925	0.0872	0.9974	0.9116	1.0911	0.9539	0.9663
height_10yrs_oldShorter	-0.0175	-0.0971	0.0621	0.9826	0.9074	1.0641	0.6665	0.7645

Table S31. Lung cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0092	-0.0660	0.0844	1.0092	0.9362	1.0880	0.8105	0.8661
maternal_smokingYes	0.2827	0.2139	0.3514	1.3267	1.2385	1.4211	0.0000	0.0000
mobile_phone_2yrsYes, use is now more frequent	-0.0627	-0.1468	0.0215	0.9393	0.8635	1.0217	0.1427	0.2140
mobile_phone_2yrsYes, use is now less frequent	0.0561	-0.0448	0.1570	1.0577	0.9562	1.1700	0.2742	0.3819
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0373	-0.3316	0.2570	0.9634	0.7178	1.2930	0.7987	0.8652
employedYes	-0.0997	-0.1783	-0.0210	0.9051	0.8367	0.9792	0.0130	0.0253
unemployedYes	0.0717	-0.1385	0.2819	1.0743	0.8707	1.3256	0.5036	0.6137
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0579	-0.5982	0.7140	1.0596	0.5498	2.0421	0.8626	0.9005
accommodation_typeA flat, maisonette or apartment	0.2334	0.1372	0.3295	1.2629	1.1471	1.3903	0.0000	0.0000
gas_hob_heatYes	0.0089	-0.0576	0.0754	1.0089	0.9440	1.0783	0.7935	0.8652
hshld_parentsYes	0.2708	0.0312	0.5104	1.3110	1.0317	1.6659	0.0268	0.0464
hshld_partnerYes	-0.0597	-0.1303	0.0110	0.9421	0.8778	1.0110	0.0978	0.1557
hshld_siblingsYes	0.3166	-0.0379	0.6711	1.3725	0.9629	1.9563	0.0800	0.1327
hshld_vehicles	-0.3572	-0.4961	-0.2182	0.6997	0.6089	0.8039	0.0000	0.0000

Table S31. Lung cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.2905	0.1310	0.4500	1.3371	1.1399	1.5684	0.0004	0.0009
own_or_rentOwn with a mortgage	0.0646	-0.0207	0.1498	1.0667	0.9795	1.1616	0.1376	0.2105
own_or_rentRent - from local authority, local council, housing association	0.5436	0.4487	0.6384	1.7221	1.5663	1.8935	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.2350	-0.2918	0.7618	1.2649	0.7469	2.1421	0.3819	0.4965
own_or_rentLive in accommodation rent free	-0.0713	-0.4745	0.3319	0.9312	0.6222	1.3936	0.7288	0.8238
townsend_deprivation_index	0.1822	0.1505	0.2139	1.1999	1.1625	1.2385	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.1113	0.0254	0.1973	1.1178	1.0258	1.2181	0.0111	0.0227
risk_takingYes	0.0794	0.0107	0.1482	1.0827	1.0107	1.1597	0.0236	0.0419
tiredness_freq	0.3223	0.2432	0.4014	1.3803	1.2753	1.4939	0.0000	0.0000
unenthusiasm_freq	0.2040	0.1015	0.3066	1.2263	1.1068	1.3588	0.0001	0.0004
fast_driving	-0.1730	-0.2994	-0.0466	0.8411	0.7412	0.9545	0.0073	0.0159
gymYes	-0.1908	-0.2723	-0.1093	0.8263	0.7616	0.8965	0.0000	0.0000
LTPA	-0.2075	-0.2859	-0.1291	0.8126	0.7513	0.8789	0.0000	0.0000

Table S31. Lung cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.1031	0.0456	0.1606	1.1086	1.0466	1.1742	0.0004	0.0011
air_pollution_PC1	0.0438	0.0285	0.0592	1.0448	1.0289	1.0610	0.0000	0.0000
greenspace_PC1	-0.0367	-0.0563	-0.0171	0.9640	0.9452	0.9830	0.0002	0.0007
number_sex_partners	-0.0024	-0.0324	0.0277	0.9977	0.9681	1.0281	0.8780	0.9011
sex_age_first	-0.1645	-0.2065	-0.1225	0.8483	0.8134	0.8847	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.0576	-0.0344	0.1496	1.0593	0.9661	1.1613	0.2151	0.3050
chronotypeDefinitely an 'evening' person	0.1805	0.0673	0.2937	1.1978	1.0697	1.3414	0.0018	0.0043
chronotypeDefinitely a 'morning' person	-0.0074	-0.0939	0.0790	0.9926	0.9104	1.0822	0.8659	0.9005
nap	0.0367	-0.0332	0.1066	1.0373	0.9673	1.1124	0.3039	0.4087
sleep_hours_categorical<7 hours	0.1292	0.0587	0.1998	1.1380	1.0605	1.2211	0.0003	0.0009
sleep_hours_categorical>9 hours	0.1953	0.0964	0.2943	1.2157	1.1012	1.3421	0.0001	0.0004
family_visit_freq	-0.0507	-0.1900	0.0887	0.9506	0.8269	1.0928	0.4760	0.6087
religious_groupYes	-0.2261	-0.3284	-0.1237	0.7977	0.7201	0.8836	0.0000	0.0001
facial_agingOlder than you are	0.4467	0.2469	0.6465	1.5632	1.2801	1.9088	0.0000	0.0001
facial_agingAbout your age	0.1352	0.0435	0.2269	1.1448	1.0445	1.2547	0.0052	0.0116
skin_colorVery fair	0.1306	0.0182	0.2430	1.1395	1.0183	1.2750	0.0228	0.0419

Table S31. Lung cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	-0.5244	-1.2432	0.1944	0.5919	0.2885	1.2146	0.1527	0.2206
skin_colorLight olive	0.0281	-0.0538	0.1100	1.0285	0.9477	1.1163	0.5006	0.6137
skin_colorDark olive	0.0638	-0.1564	0.2840	1.0659	0.8552	1.3284	0.5699	0.6635
skin_colorBrown	0.1308	-0.1584	0.4200	1.1398	0.8535	1.5220	0.3751	0.4959
sun_protection_use	-0.1732	-0.2780	-0.0685	0.8409	0.7573	0.9338	0.0012	0.0029
fish_oil_supplementsYes	-0.1277	-0.1950	-0.0604	0.8801	0.8229	0.9413	0.0002	0.0006
folate_supplementsYes	0.2353	0.0532	0.4175	1.2653	1.0546	1.5181	0.0113	0.0227
glucosamine_supplementsYes	-0.1641	-0.2474	-0.0808	0.8487	0.7809	0.9224	0.0001	0.0004
multivitamin_supplementsYes	-0.0633	-0.1421	0.0154	0.9386	0.8675	1.0155	0.1150	0.1793
pack_years_prop	0.4260	0.3748	0.4772	1.5312	1.4547	1.6116	0.0000	0.0000
smoking_statusPrevious	1.2534	1.1642	1.3426	3.5022	3.2034	3.8289	0.0000	0.0000
smoking_statusCurrent	2.5363	2.4438	2.6288	12.6334	11.5172	13.8578	0.0000	0.0000
IPAQ_activity_group	-0.1403	-0.2011	-0.0795	0.8691	0.8179	0.9236	0.0000	0.0000
education_years	-0.3773	-0.4487	-0.3059	0.6857	0.6385	0.7365	0.0000	0.0000
hshld_income	-0.5975	-0.7059	-0.4891	0.5502	0.4937	0.6131	0.0000	0.0000
ethnicityAsian	-0.3834	-0.7154	-0.0514	0.6816	0.4890	0.9499	0.0236	0.0419
ethnicityBlack	-0.1841	-0.5219	0.1536	0.8318	0.5934	1.1661	0.2852	0.3903

Table S31. Lung cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.0616	-0.3686	0.4919	1.0636	0.6917	1.6353	0.7789	0.8652
ethnicityOther	-0.1255	-0.5296	0.2785	0.8820	0.5888	1.3212	0.5425	0.6443

Table S32. Esophageal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	0.0821	-0.1460	0.3101	1.0855	0.8642	1.3636	0.4801	0.6369
alcohol_freqOnce or twice a week	0.0041	-0.2242	0.2325	1.0042	0.7991	1.2618	0.9716	0.9716
alcohol_freqThree or four times a week	-0.0399	-0.2722	0.1923	0.9609	0.7617	1.2120	0.7359	0.8499
bread	0.1147	-0.0039	0.2333	1.1215	0.9961	1.2627	0.0581	0.1416
cereal	-0.1488	-0.2578	-0.0398	0.8617	0.7727	0.9610	0.0075	0.0450
never_eat_dairyYes	0.1115	-0.2395	0.4626	1.1180	0.7870	1.5882	0.5331	0.6707
never_eat_eggsYes	0.1862	-0.1191	0.4916	1.2047	0.8877	1.6349	0.2316	0.4172
never_eat_sugarYes	0.1419	0.0082	0.2757	1.1525	1.0082	1.3174	0.0375	0.1084
partial_fiber_score	-0.1840	-0.3163	-0.0516	0.8320	0.7288	0.9497	0.0065	0.0421
poultry	0.0264	-0.1302	0.1830	1.0267	0.8779	1.2008	0.7410	0.8499
processed_meat	0.0176	-0.1226	0.1578	1.0178	0.8846	1.1710	0.8055	0.8976
red_meat	0.0111	-0.1291	0.1514	1.0112	0.8789	1.1635	0.8763	0.9493
salt	0.0145	-0.1289	0.1578	1.0146	0.8791	1.1709	0.8432	0.9263
body_size_10yrs_oldThinner	-0.1441	-0.2756	-0.0127	0.8658	0.7591	0.9873	0.0316	0.0948
body_size_10yrs_oldPlumper	0.2284	0.0729	0.3840	1.2566	1.0756	1.4681	0.0040	0.0315
height_10yrs_oldShorter	-0.0667	-0.2213	0.0879	0.9355	0.8015	1.0918	0.3971	0.5845

Table S32. Esophageal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0515	-0.0854	0.1884	1.0529	0.9182	1.2073	0.4603	0.6369
maternal_smokingYes	0.0972	-0.0336	0.2280	1.1021	0.9669	1.2561	0.1448	0.3051
mobile_phone_2yrsYes, use is now more frequent	0.0755	-0.0722	0.2233	1.0785	0.9304	1.2501	0.3141	0.5213
mobile_phone_2yrsYes, use is now less frequent	0.0780	-0.0956	0.2516	1.0811	0.9088	1.2861	0.3774	0.5661
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.3282	-1.0244	0.3681	0.7203	0.3590	1.4450	0.3450	0.5380
employedYes	-0.0317	-0.1753	0.1120	0.9688	0.8392	1.1185	0.6655	0.8111
unemployedYes	0.1326	-0.2459	0.5110	1.1417	0.7820	1.6669	0.4921	0.6369
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.7970	-2.7616	1.1676	0.4507	0.0632	3.2141	0.4262	0.6044
accommodation_typeA flat, maisonette or apartment	0.3081	0.1176	0.4986	1.3609	1.1248	1.6464	0.0015	0.0172
gas_hob_heatYes	-0.0743	-0.1963	0.0477	0.9284	0.8218	1.0488	0.2323	0.4172
hshld_parentsYes	0.0872	-0.3816	0.5559	1.0911	0.6828	1.7435	0.7153	0.8499
hshld_partnerYes	-0.1762	-0.3102	-0.0422	0.8385	0.7333	0.9587	0.0100	0.0552
hshld_siblingsYes	0.5885	-0.0076	1.1845	1.8012	0.9924	3.2692	0.0530	0.1378
hshld_vehicles	-0.3059	-0.5598	-0.0520	0.7365	0.5713	0.9494	0.0183	0.0712

Table S32. Esophageal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.0159	-0.3312	0.3630	1.0160	0.7181	1.4377	0.9283	0.9528
own_or_rentOwn with a mortgage	0.0277	-0.1236	0.1790	1.0281	0.8837	1.1960	0.7199	0.8499
own_or_rentRent - from local authority, local council, housing association	0.3803	0.1713	0.5892	1.4627	1.1869	1.8025	0.0004	0.0058
own_or_rentPay part rent and part mortgage (shared ownership)	0.5814	-0.3017	1.4644	1.7885	0.7396	4.3251	0.1967	0.3934
own_or_rentLive in accommodation rent free	0.2234	-0.4031	0.8499	1.2503	0.6682	2.3395	0.4843	0.6369
townsend_deprivation_index	0.0813	0.0187	0.1439	1.0847	1.0188	1.1547	0.0110	0.0552
psychiatrist_visit_mental_health Yes	0.2353	0.0723	0.3982	1.2653	1.0750	1.4892	0.0047	0.0333
risk_takingYes	0.0641	-0.0646	0.1927	1.0661	0.9374	1.2126	0.3288	0.5251
tiredness_freq	0.2466	0.0946	0.3987	1.2797	1.0992	1.4899	0.0015	0.0172
unenthusiasm_freq	0.2219	0.0098	0.4341	1.2485	1.0098	1.5435	0.0404	0.1126
fast_driving	-0.1561	-0.3818	0.0696	0.8555	0.6826	1.0721	0.1751	0.3595
gymYes	-0.1702	-0.3129	-0.0276	0.8435	0.7313	0.9728	0.0194	0.0721
LTPA	-0.1297	-0.2794	0.0200	0.8784	0.7562	1.0202	0.0891	0.2043

Table S32. Esophageal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.0664	-0.0395	0.1723	1.0687	0.9613	1.1881	0.2188	0.4162
air_pollution_PC1	0.0430	0.0141	0.0720	1.0440	1.0142	1.0746	0.0036	0.0312
greenspace_PC1	-0.0339	-0.0689	0.0011	0.9667	0.9334	1.0011	0.0579	0.1416
number_sex_partners	0.0026	-0.0435	0.0487	1.0026	0.9575	1.0499	0.9108	0.9528
sex_age_first	-0.0382	-0.1013	0.0250	0.9625	0.9036	1.0253	0.2353	0.4172
chronotypeMore an 'evening' than a 'morning' person	0.0469	-0.1140	0.2078	1.0480	0.8923	1.2310	0.5645	0.6989
chronotypeDefinitely an 'evening' person	0.1721	-0.0475	0.3916	1.1878	0.9536	1.4794	0.1243	0.2770
chronotypeDefinitely a 'morning' person	0.1408	-0.0063	0.2879	1.1512	0.9937	1.3336	0.0606	0.1432
nap	0.1632	0.0360	0.2905	1.1773	1.0366	1.3371	0.0120	0.0552
sleep_hours_categorical<7 hours	0.1367	0.0035	0.2700	1.1465	1.0035	1.3099	0.0443	0.1192
sleep_hours_categorical>9 hours	0.2154	0.0276	0.4031	1.2403	1.0280	1.4964	0.0246	0.0872
family_visit_freq	-0.3259	-0.5818	-0.0701	0.7219	0.5589	0.9323	0.0126	0.0552
religious_groupYes	-0.0059	-0.1754	0.1637	0.9941	0.8391	1.1778	0.9457	0.9580
facial_agingOlder than you are	0.2295	-0.1323	0.5912	1.2579	0.8761	1.8062	0.2136	0.4162
facial_agingAbout your age	0.0730	-0.0611	0.2072	1.0757	0.9407	1.2302	0.2856	0.4843
skin_colorVery fair	-0.0159	-0.2424	0.2107	0.9843	0.7847	1.2345	0.8907	0.9517

Table S32. Esophageal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.4873	-0.9236	1.8982	1.6280	0.3971	6.6742	0.4981	0.6369
skin_colorLight olive	-0.0655	-0.2218	0.0907	0.9366	0.8011	1.0949	0.4105	0.5930
skin_colorDark olive	0.2798	-0.0840	0.6437	1.3229	0.9194	1.9034	0.1314	0.2848
skin_colorBrown	-1.0239	-1.8677	-0.1801	0.3592	0.1545	0.8352	0.0174	0.0712
sun_protection_use	-0.0946	-0.2940	0.1047	0.9097	0.7453	1.1104	0.3518	0.5380
fish_oil_supplementsYes	-0.1398	-0.2637	-0.0159	0.8696	0.7682	0.9842	0.0271	0.0885
folate_supplementsYes	-0.0208	-0.4346	0.3929	0.9794	0.6475	1.4812	0.9213	0.9528
glucosamine_supplementsYes	-0.1971	-0.3521	-0.0421	0.8211	0.7032	0.9588	0.0127	0.0552
multivitamin_supplementsYes	-0.0733	-0.2208	0.0742	0.9293	0.8019	1.0771	0.3299	0.5251
pack_years_prop	0.2698	0.2330	0.3066	1.3097	1.2624	1.3587	0.0000	0.0000
smoking_statusPrevious	0.4808	0.3511	0.6105	1.6173	1.4206	1.8413	0.0000	0.0000
smoking_statusCurrent	0.9988	0.8328	1.1648	2.7150	2.2998	3.2052	0.0000	0.0000
IPAQ_activity_group	-0.1220	-0.2332	-0.0108	0.8852	0.7920	0.9893	0.0316	0.0948
education_years	-0.0208	-0.1519	0.1103	0.9794	0.8591	1.1166	0.7554	0.8540
hshld_income	-0.5627	-0.7617	-0.3638	0.5696	0.4669	0.6951	0.0000	0.0000
ethnicityAsian	-1.2803	-2.0879	-0.4728	0.2779	0.1239	0.6233	0.0019	0.0186
ethnicityBlack	-0.9972	-1.8822	-0.1122	0.3689	0.1523	0.8938	0.0272	0.0885

Table S32. Esophageal cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.4226	-1.5583	0.7131	0.6553	0.2105	2.0403	0.4655	0.6369
ethnicityOther	-0.4894	-1.3723	0.3935	0.6130	0.2535	1.4822	0.2770	0.4801

Table S33. Liver cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.1126	-0.3713	0.1461	0.8935	0.6899	1.1573	0.3930	0.4945
alcohol_freqOnce or twice a week	-0.2291	-0.4858	0.0275	0.7952	0.6152	1.0279	0.0801	0.1724
alcohol_freqThree or four times a week	-0.1434	-0.4022	0.1154	0.8664	0.6689	1.1223	0.2769	0.4153
bread	0.0628	-0.0788	0.2044	1.0648	0.9242	1.2268	0.3841	0.4912
cereal	-0.1534	-0.2844	-0.0224	0.8578	0.7525	0.9779	0.0218	0.0630
never_eat_dairyYes	0.4280	0.0710	0.7850	1.5341	1.0736	2.1923	0.0189	0.0588
never_eat_eggsYes	0.2749	-0.0870	0.6369	1.3165	0.9166	1.8906	0.1360	0.2307
never_eat_sugarYes	0.3350	0.1813	0.4887	1.3979	1.1988	1.6301	0.0000	0.0002
partial_fiber_score	-0.0709	-0.2292	0.0873	0.9315	0.7952	1.0913	0.3794	0.4912
poultry	0.0643	-0.1226	0.2512	1.0664	0.8846	1.2855	0.4998	0.6188
processed_meat	0.1731	0.0045	0.3417	1.1890	1.0046	1.4074	0.0441	0.1043
red_meat	0.2923	0.1256	0.4591	1.3395	1.1338	1.5826	0.0006	0.0043
salt	0.4249	0.2643	0.5855	1.5294	1.3025	1.7959	0.0000	0.0000
body_size_10yrs_oldThinner	0.0729	-0.0816	0.2275	1.0757	0.9216	1.2554	0.3544	0.4685
body_size_10yrs_oldPlumper	0.2600	0.0699	0.4500	1.2969	1.0724	1.5683	0.0074	0.0304
height_10yrs_oldShorter	0.1405	-0.0363	0.3173	1.1509	0.9643	1.3734	0.1192	0.2214

Table S33. Liver cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.2689	0.1083	0.4295	1.3085	1.1144	1.5364	0.0011	0.0069
maternal_smokingYes	0.1153	-0.0599	0.2905	1.1222	0.9419	1.3372	0.1932	0.3206
mobile_phone_2yrsYes, use is now more frequent	0.1308	-0.0354	0.2970	1.1397	0.9652	1.3458	0.1226	0.2224
mobile_phone_2yrsYes, use is now less frequent	0.1809	-0.0244	0.3861	1.1983	0.9759	1.4713	0.0840	0.1724
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0149	-0.5546	0.5844	1.0150	0.5743	1.7940	0.9590	0.9842
employedYes	-0.2323	-0.4085	-0.0561	0.7927	0.6647	0.9454	0.0098	0.0383
unemployedYes	0.0512	-0.4414	0.5437	1.0525	0.6432	1.7223	0.8385	0.9077
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.3926	-2.3593	1.5741	0.6753	0.0945	4.8265	0.6953	0.7747
accommodation_typeA flat, maisonette or apartment	0.2715	0.0413	0.5017	1.3120	1.0422	1.6515	0.0208	0.0625
gas_hob_heatYes	-0.0011	-0.1486	0.1464	0.9989	0.8619	1.1576	0.9884	0.9905
hshld_parentsYes	-0.3707	-1.0707	0.3294	0.6903	0.3428	1.3901	0.2990	0.4318
hshld_partnerYes	-0.0495	-0.2111	0.1122	0.9517	0.8097	1.1187	0.5481	0.6542
hshld_siblingsYes	0.6169	-0.0830	1.3167	1.8531	0.9204	3.7310	0.0840	0.1724
hshld_vehicles	-0.2459	-0.5536	0.0617	0.7820	0.5749	1.0636	0.1169	0.2214

Table S33. Liver cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.3816	0.0172	0.7459	1.4646	1.0174	2.1084	0.0401	0.1010
own_or_rentOwn with a mortgage	-0.0465	-0.2337	0.1407	0.9546	0.7916	1.1511	0.6259	0.7179
own_or_rentRent - from local authority, local council, housing association	0.5324	0.2918	0.7731	1.7031	1.3388	2.1665	0.0000	0.0002
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0085	-1.4017	1.3847	0.9916	0.2462	3.9938	0.9905	0.9905
own_or_rentLive in accommodation rent free	-0.6203	-1.7585	0.5179	0.5378	0.1723	1.6785	0.2850	0.4195
townsend_deprivation_index	0.1098	0.0351	0.1844	1.1160	1.0358	1.2025	0.0040	0.0213
psychiatrist_visit_mental_health Yes	0.0610	-0.1453	0.2673	1.0629	0.8648	1.3064	0.5619	0.6542
risk_takingYes	0.2183	0.0665	0.3701	1.2440	1.0688	1.4479	0.0049	0.0224
tiredness_freq	0.4221	0.2456	0.5987	1.5252	1.2784	1.8198	0.0000	0.0001
unenthusiasm_freq	0.2539	0.0126	0.4951	1.2890	1.0127	1.6407	0.0392	0.1010
fast_driving	-0.2960	-0.5740	-0.0181	0.7438	0.5632	0.9821	0.0369	0.0992
gymYes	-0.2295	-0.4054	-0.0537	0.7949	0.6667	0.9478	0.0106	0.0394
LTPA	-0.2881	-0.4851	-0.0912	0.7497	0.6156	0.9129	0.0046	0.0224

Table S33. Liver cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.1797	0.0496	0.3098	1.1969	1.0509	1.3631	0.0069	0.0297
air_pollution_PC1	0.0300	-0.0048	0.0648	1.0304	0.9952	1.0669	0.0911	0.1821
greenspace_PC1	-0.0512	-0.0939	-0.0085	0.9501	0.9103	0.9915	0.0187	0.0588
number_sex_partners	0.0044	-0.0564	0.0652	1.0044	0.9452	1.0674	0.8867	0.9221
sex_age_first	-0.0654	-0.1499	0.0191	0.9367	0.8608	1.0193	0.1278	0.2266
chronotypeMore an 'evening' than a 'morning' person	0.1966	-0.0057	0.3989	1.2173	0.9943	1.4901	0.0565	0.1297
chronotypeDefinitely an 'evening' person	0.2740	0.0093	0.5387	1.3152	1.0093	1.7138	0.0425	0.1037
chronotypeDefinitely a 'morning' person	0.1419	-0.0426	0.3264	1.1525	0.9583	1.3860	0.1314	0.2277
nap	0.0950	-0.0601	0.2501	1.0997	0.9417	1.2841	0.2295	0.3653
sleep_hours_categorical<7 hours	0.1532	-0.0059	0.3123	1.1656	0.9942	1.3666	0.0590	0.1316
sleep_hours_categorical>9 hours	0.3203	0.1042	0.5364	1.3775	1.1098	1.7098	0.0037	0.0213
family_visit_freq	0.0660	-0.2514	0.3833	1.0682	0.7777	1.4671	0.6834	0.7726
religious_groupYes	-0.2342	-0.4433	-0.0252	0.7912	0.6419	0.9751	0.0281	0.0783
facial_agingOlder than you are	0.2709	-0.1887	0.7306	1.3112	0.8280	2.0763	0.2476	0.3862
facial_agingAbout your age	0.2034	0.0425	0.3643	1.2256	1.0434	1.4395	0.0134	0.0475
skin_colorVery fair	0.0817	-0.1772	0.3406	1.0851	0.8376	1.4058	0.5359	0.6531

Table S33. Liver cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.5813	-0.5489	1.7116	1.7884	0.5776	5.5378	0.3130	0.4439
skin_colorLight olive	-0.0566	-0.2463	0.1330	0.9450	0.7817	1.1423	0.5580	0.6542
skin_colorDark olive	0.4935	0.0898	0.8971	1.6380	1.0940	2.4525	0.0166	0.0564
skin_colorBrown	0.3346	-0.2408	0.9100	1.3974	0.7860	2.4842	0.2540	0.3885
sun_protection_use	-0.3491	-0.5870	-0.1111	0.7053	0.5560	0.8948	0.0041	0.0213
fish_oil_supplementsYes	-0.3136	-0.4665	-0.1607	0.7308	0.6272	0.8516	0.0001	0.0005
folate_supplementsYes	-0.2586	-0.7886	0.2713	0.7721	0.4545	1.3117	0.3383	0.4630
glucosamine_supplementsYes	-0.1168	-0.2968	0.0632	0.8898	0.7432	1.0653	0.2031	0.3300
multivitamin_supplementsYes	-0.1501	-0.3291	0.0290	0.8606	0.7195	1.0294	0.1003	0.1955
pack_years_prop	0.2207	0.1718	0.2695	1.2469	1.1875	1.3094	0.0000	0.0000
smoking_statusPrevious	0.2924	0.1418	0.4430	1.3396	1.1523	1.5573	0.0001	0.0012
smoking_statusCurrent	0.6688	0.4623	0.8754	1.9520	1.5877	2.3999	0.0000	0.0000
IPAQ_activity_group	-0.3300	-0.4722	-0.1879	0.7189	0.6236	0.8287	0.0000	0.0001
education_years	-0.0779	-0.2344	0.0786	0.9251	0.7910	1.0818	0.3289	0.4581
hshld_income	-0.5968	-0.8293	-0.3644	0.5506	0.4364	0.6946	0.0000	0.0000
ethnicityAsian	-0.1019	-0.6610	0.4571	0.9031	0.5163	1.5795	0.7205	0.7915
ethnicityBlack	-0.0648	-0.7347	0.6052	0.9373	0.4796	1.8316	0.8495	0.9077

Table S33. Liver cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.0835	-1.2213	1.0543	0.9199	0.2948	2.8700	0.8855	0.9221
ethnicityOther	0.3359	-0.3688	1.0406	1.3992	0.6916	2.8309	0.3498	0.4685

Table S34. Pancreatic cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	0.1597	-0.0486	0.3680	1.1732	0.9525	1.4449	0.1328	0.5117
alcohol_freqOnce or twice a week	0.0177	-0.1893	0.2248	1.0179	0.8275	1.2520	0.8665	0.9259
alcohol_freqThree or four times a week	0.0716	-0.1378	0.2809	1.0742	0.8713	1.3244	0.5024	0.7512
bread	-0.1540	-0.2655	-0.0425	0.8573	0.7669	0.9584	0.0068	0.0590
cereal	0.0441	-0.0593	0.1476	1.0451	0.9424	1.1590	0.4027	0.6828
never_eat_dairyYes	0.1394	-0.1770	0.4558	1.1496	0.8378	1.5774	0.3875	0.6828
never_eat_eggsYes	-0.1756	-0.5155	0.1644	0.8390	0.5972	1.1787	0.3110	0.6828
never_eat_sugarYes	0.0765	-0.0508	0.2038	1.0795	0.9504	1.2260	0.2389	0.6010
partial_fiber_score	-0.0606	-0.1837	0.0625	0.9412	0.8322	1.0645	0.3343	0.6828
poultry	-0.0535	-0.1958	0.0888	0.9479	0.8221	1.0928	0.4607	0.7377
processed_meat	0.1219	-0.0077	0.2515	1.1296	0.9924	1.2859	0.0652	0.3631
red_meat	0.0447	-0.0848	0.1741	1.0457	0.9187	1.1902	0.4984	0.7512
salt	0.0608	-0.0739	0.1954	1.0626	0.9288	1.2158	0.3761	0.6828
body_size_10yrs_oldThinner	-0.0345	-0.1560	0.0871	0.9661	0.8555	1.0910	0.5778	0.7512
body_size_10yrs_oldPlumper	0.2136	0.0667	0.3605	1.2381	1.0689	1.4341	0.0044	0.0492
height_10yrs_oldShorter	-0.0126	-0.1547	0.1295	0.9875	0.8567	1.1382	0.8616	0.9259

Table S34. Pancreatic cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.2355	0.1127	0.3583	1.2656	1.1193	1.4309	0.0002	0.0046
maternal_smokingYes	0.0377	-0.0937	0.1691	1.0384	0.9106	1.1843	0.5711	0.7512
mobile_phone_2yrsYes, use is now more frequent	0.0213	-0.1130	0.1557	1.0216	0.8931	1.1684	0.7547	0.9016
mobile_phone_2yrsYes, use is now less frequent	0.1274	-0.0496	0.3044	1.1359	0.9516	1.3558	0.1568	0.5558
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0089	-0.4423	0.4246	0.9912	0.6425	1.5289	0.9679	0.9813
employedYes	-0.0663	-0.2016	0.0689	0.9358	0.8174	1.0714	0.3362	0.6828
unemployedYes	0.4981	0.1420	0.8543	1.6456	1.1525	2.3497	0.0062	0.0590
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.8409	-2.8049	1.1231	0.4313	0.0605	3.0745	0.4011	0.6828
accommodation_typeA flat, maisonette or apartment	0.1300	-0.0621	0.3222	1.1389	0.9398	1.3801	0.1845	0.5559
gas_hob_heatYes	0.0216	-0.0932	0.1363	1.0218	0.9110	1.1461	0.7121	0.8817
hshld_parentsYes	0.1334	-0.3109	0.5776	1.1426	0.7328	1.7817	0.5560	0.7512
hshld_partnerYes	-0.0396	-0.1664	0.0873	0.9612	0.8467	1.0912	0.5406	0.7512
hshld_siblingsYes	0.0345	-0.7102	0.7792	1.0351	0.4916	2.1797	0.9276	0.9777
hshld_vehicles	-0.1072	-0.3421	0.1278	0.8984	0.7103	1.1363	0.3710	0.6828

Table S34. Pancreatic cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	-0.1391	-0.4995	0.2214	0.8702	0.6068	1.2478	0.4492	0.7377
own_or_rentOwn with a mortgage	-0.0441	-0.1875	0.0994	0.9569	0.8290	1.1046	0.5471	0.7512
own_or_rentRent - from local authority, local council, housing association	0.3380	0.1334	0.5425	1.4021	1.1427	1.7203	0.0012	0.0190
own_or_rentPay part rent and part mortgage (shared ownership)	-0.5198	-1.9101	0.8705	0.5946	0.1481	2.3881	0.4634	0.7377
own_or_rentLive in accommodation rent free	0.0992	-0.5263	0.7247	1.1043	0.5908	2.0641	0.7557	0.9016
townsend_deprivation_index	0.0799	0.0203	0.1395	1.0832	1.0205	1.1497	0.0086	0.0674
psychiatrist_visit_mental_health Yes	0.1656	0.0086	0.3226	1.1801	1.0086	1.3807	0.0387	0.2517
risk_takingYes	0.0843	-0.0387	0.2072	1.0879	0.9620	1.2303	0.1789	0.5559
tiredness_freq	0.1297	-0.0177	0.2772	1.1385	0.9824	1.3194	0.0846	0.4397
unenthusiasm_freq	0.1653	-0.0343	0.3648	1.1797	0.9663	1.4403	0.1044	0.4933
fast_driving	-0.1371	-0.3508	0.0766	0.8719	0.7041	1.0796	0.2083	0.5559
gymYes	0.0281	-0.0965	0.1526	1.0284	0.9080	1.1649	0.6587	0.8422
LTPA	-0.0734	-0.2181	0.0712	0.9292	0.8041	1.0738	0.3164	0.6828

Table S34. Pancreatic cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.1519	0.0534	0.2503	1.1640	1.0549	1.2844	0.0025	0.0327
air_pollution_PC1	0.0181	-0.0090	0.0453	1.0183	0.9910	1.0463	0.1908	0.5559
greenspace_PC1	-0.0202	-0.0520	0.0117	0.9800	0.9493	1.0117	0.2138	0.5559
number_sex_partners	-0.0613	-0.2424	0.1198	0.9405	0.7848	1.1272	0.5065	0.7512
sex_age_first	-0.0083	-0.0648	0.0483	0.9918	0.9372	1.0495	0.7744	0.9016
chronotypeMore an 'evening' than a 'morning' person	0.0407	-0.1023	0.1837	1.0415	0.9027	1.2016	0.5751	0.7512
chronotypeDefinitely an 'evening' person	0.0008	-0.2163	0.2179	1.0008	0.8055	1.2434	0.9943	0.9943
chronotypeDefinitely a 'morning' person	-0.0035	-0.1678	0.1607	0.9965	0.8456	1.1743	0.9657	0.9813
nap	0.0919	-0.0295	0.2132	1.0962	0.9710	1.2376	0.1378	0.5117
sleep_hours_categorical<7 hours	0.0801	-0.0442	0.2044	1.0834	0.9567	1.2268	0.2065	0.5559
sleep_hours_categorical>9 hours	0.0372	-0.1502	0.2246	1.0379	0.8606	1.2518	0.6970	0.8769
family_visit_freq	-0.3076	-0.5516	-0.0637	0.7352	0.5760	0.9383	0.0135	0.0957
religious_groupYes	-0.0148	-0.1628	0.1332	0.9853	0.8497	1.1425	0.8446	0.9259
facial_agingOlder than you are	0.1986	-0.2415	0.6386	1.2197	0.7855	1.8939	0.3725	0.6828
facial_agingAbout your age	0.2199	0.0983	0.3414	1.2459	1.1033	1.4070	0.0004	0.0079
skin_colorVery fair	0.1898	-0.0011	0.3806	1.2090	0.9989	1.4632	0.0513	0.3079

Table S34. Pancreatic cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.1039	-0.8365	1.0442	1.1095	0.4332	2.8412	0.8285	0.9232
skin_colorLight olive	-0.0432	-0.1889	0.1025	0.9577	0.8279	1.1079	0.5608	0.7512
skin_colorDark olive	0.2880	-0.0691	0.6451	1.3337	0.9332	1.9061	0.1138	0.4933
skin_colorBrown	-0.0667	-0.5904	0.4570	0.9355	0.5541	1.5794	0.8027	0.9074
sun_protection_use	-0.0918	-0.2775	0.0938	0.9123	0.7577	1.0984	0.3320	0.6828
fish_oil_supplementsYes	0.0498	-0.0626	0.1622	1.0511	0.9393	1.1760	0.3848	0.6828
folate_supplementsYes	0.2594	-0.0601	0.5789	1.2961	0.9416	1.7840	0.1115	0.4933
glucosamine_supplementsYes	0.0896	-0.0392	0.2184	1.0937	0.9615	1.2441	0.1727	0.5559
multivitamin_supplementsYes	-0.0178	-0.1491	0.1135	0.9824	0.8615	1.1202	0.7905	0.9068
pack_years_prop	0.1669	0.1236	0.2102	1.1816	1.1316	1.2339	0.0000	0.0000
smoking_statusPrevious	0.0508	-0.0666	0.1682	1.0521	0.9355	1.1832	0.3963	0.6828
smoking_statusCurrent	0.7057	0.5501	0.8613	2.0252	1.7334	2.3662	0.0000	0.0000
IPAQ_activity_group	-0.0818	-0.1859	0.0223	0.9215	0.8304	1.0225	0.1233	0.5063
education_years	-0.0619	-0.1836	0.0599	0.9400	0.8323	1.0617	0.3189	0.6828
hshld_income	-0.1161	-0.2910	0.0587	0.8904	0.7476	1.0605	0.1928	0.5559
ethnicityAsian	-0.2400	-0.7121	0.2322	0.7867	0.4906	1.2614	0.3190	0.6828
ethnicityBlack	0.0100	-0.4924	0.5125	1.0101	0.6112	1.6694	0.9687	0.9813

Table S34. Pancreatic cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.3113	-1.2953	0.6727	0.7325	0.2738	1.9594	0.5349	0.7512
ethnicityOther	0.0938	-0.5335	0.7211	1.0983	0.5865	2.0567	0.7694	0.9016

Table S35. Brain cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.0221	-0.3019	0.2577	0.9782	0.7394	1.2940	0.8769	0.9997
alcohol_freqOnce or twice a week	-0.0545	-0.3254	0.2165	0.9470	0.7222	1.2417	0.6931	0.9761
alcohol_freqThree or four times a week	0.0004	-0.2732	0.2740	1.0004	0.7610	1.3152	0.9976	0.9997
bread	-0.0218	-0.1726	0.1289	0.9784	0.8415	1.1376	0.7763	0.9766
cereal	0.1290	-0.0149	0.2730	1.1377	0.9852	1.3138	0.0789	0.8792
never_eat_dairyYes	0.2515	-0.1774	0.6805	1.2860	0.8374	1.9748	0.2500	0.9541
never_eat_eggsYes	0.1999	-0.1976	0.5974	1.2213	0.8207	1.8174	0.3239	0.9541
never_eat_sugarYes	0.0113	-0.1697	0.1924	1.0114	0.8439	1.2122	0.9021	0.9997
partial_fiber_score	0.0282	-0.1398	0.1961	1.0286	0.8696	1.2167	0.7419	0.9761
poultry	-0.1920	-0.3800	-0.0040	0.8253	0.6838	0.9960	0.0453	0.8792
processed_meat	-0.0704	-0.2442	0.1035	0.9320	0.7833	1.1090	0.4270	0.9541
red_meat	-0.0897	-0.2670	0.0875	0.9142	0.7657	1.0914	0.3204	0.9541
salt	-0.0564	-0.2482	0.1354	0.9452	0.7802	1.1450	0.5641	0.9761
body_size_10yrs_oldThinner	0.0518	-0.1089	0.2125	1.0532	0.8968	1.2367	0.5270	0.9761
body_size_10yrs_oldPlumper	0.0429	-0.1713	0.2571	1.0438	0.8426	1.2931	0.6941	0.9761
height_10yrs_oldShorter	-0.0969	-0.2937	0.0999	0.9076	0.7455	1.1050	0.3339	0.9541

Table S35. Brain cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.1639	-0.0035	0.3313	1.1781	0.9965	1.3927	0.0550	0.8792
maternal_smokingYes	-0.1018	-0.2876	0.0840	0.9032	0.7500	1.0876	0.2793	0.9541
mobile_phone_2yrsYes, use is now more frequent	-0.0903	-0.2977	0.1171	0.9137	0.7425	1.1242	0.3851	0.9541
mobile_phone_2yrsYes, use is now less frequent	0.1013	-0.1412	0.3437	1.1066	0.8684	1.4101	0.4091	0.9541
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.3101	-1.0039	0.3838	0.7334	0.3664	1.4679	0.3804	0.9541
employedYes	-0.1168	-0.2992	0.0655	0.8897	0.7414	1.0677	0.2088	0.9541
unemployedYes	-0.1088	-0.6898	0.4721	0.8969	0.5017	1.6034	0.7132	0.9761
accommodation_typeMobile or temporary structure (i.e. caravan)	0.6598	-0.7342	2.0537	1.9343	0.4799	7.7970	0.3531	0.9541
accommodation_typeA flat, maisonette or apartment	-0.1710	-0.4676	0.1257	0.8428	0.6265	1.1339	0.2581	0.9541
gas_hob_heatYes	-0.0336	-0.1901	0.1229	0.9669	0.8269	1.1307	0.6732	0.9761
hshld_parentsYes	0.0064	-0.5682	0.5811	1.0065	0.5665	1.7880	0.9824	0.9997
hshld_partnerYes	-0.0101	-0.1865	0.1664	0.9900	0.8299	1.1810	0.9109	0.9997
hshld_siblingsYes	0.4140	-0.3930	1.2211	1.5129	0.6750	3.3908	0.3142	0.9541
hshld_vehicles	-0.2001	-0.5129	0.1127	0.8187	0.5988	1.1193	0.2096	0.9541

Table S35. Brain cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.0051	-0.4497	0.4599	1.0051	0.6378	1.5840	0.9823	0.9997
own_or_rentOwn with a mortgage	-0.0293	-0.2120	0.1535	0.9712	0.8090	1.1659	0.7534	0.9761
own_or_rentRent - from local authority, local council, housing association	0.0001	-0.3342	0.3343	1.0001	0.7159	1.3970	0.9997	0.9997
own_or_rentPay part rent and part mortgage (shared ownership)	-0.6719	-2.6399	1.2962	0.5108	0.0714	3.6555	0.5029	0.9597
own_or_rentLive in accommodation rent free	-0.9972	-2.3902	0.3958	0.3689	0.0916	1.4855	0.1603	0.9541
townsend_deprivation_index	0.0045	-0.0791	0.0882	1.0045	0.9239	1.0922	0.9153	0.9997
psychiatrist_visit_mental_health Yes	-0.0454	-0.2786	0.1878	0.9556	0.7568	1.2066	0.7025	0.9761
risk_takingYes	-0.1588	-0.3315	0.0139	0.8532	0.7178	1.0140	0.0715	0.8792
tiredness_freq	0.0333	-0.1697	0.2363	1.0339	0.8439	1.2666	0.7472	0.9761
unenthusiasm_freq	0.0222	-0.2563	0.3007	1.0225	0.7739	1.3508	0.8756	0.9997
fast_driving	-0.3600	-0.6490	-0.0709	0.6977	0.5226	0.9316	0.0147	0.8792
gymYes	0.0073	-0.1605	0.1751	1.0074	0.8517	1.1914	0.9316	0.9997
LTPA	0.0783	-0.1013	0.2579	1.0814	0.9036	1.2942	0.3922	0.9541

Table S35. Brain cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.0267	-0.1089	0.1622	1.0270	0.8968	1.1761	0.6995	0.9761
air_pollution_PC1	0.0065	-0.0305	0.0436	1.0066	0.9699	1.0446	0.7288	0.9761
greenspace_PC1	-0.0101	-0.0532	0.0330	0.9900	0.9482	1.0336	0.6459	0.9761
number_sex_partners	-0.2851	-0.7420	0.1717	0.7519	0.4762	1.1874	0.2205	0.9541
sex_age_first	0.0689	-0.0048	0.1425	1.0713	0.9952	1.1532	0.0667	0.8792
chronotypeMore an 'evening' than a 'morning' person	-0.0510	-0.2426	0.1405	0.9503	0.7846	1.1509	0.6002	0.9761
chronotypeDefinitely an 'evening' person	0.0899	-0.1973	0.3770	1.0940	0.8209	1.4580	0.5382	0.9761
chronotypeDefinitely a 'morning' person	-0.0481	-0.2492	0.1530	0.9531	0.7794	1.1654	0.6373	0.9761
nap	0.0667	-0.1029	0.2363	1.0690	0.9022	1.2665	0.4403	0.9541
sleep_hours_categorical<7 hours	-0.0023	-0.1728	0.1682	0.9977	0.8413	1.1832	0.9790	0.9997
sleep_hours_categorical>9 hours	-0.0428	-0.3175	0.2319	0.9581	0.7280	1.2610	0.7599	0.9761
family_visit_freq	-0.2489	-0.5872	0.0893	0.7796	0.5559	1.0934	0.1489	0.9541
religious_groupYes	-0.2065	-0.4251	0.0120	0.8134	0.6537	1.0121	0.0640	0.8792
facial_agingOlder than you are	0.2421	-0.2260	0.7101	1.2739	0.7977	2.0342	0.3103	0.9541
facial_agingAbout your age	-0.0754	-0.2640	0.1133	0.9274	0.7679	1.1199	0.4312	0.9541
skin_colorVery fair	0.1175	-0.1496	0.3847	1.1247	0.8611	1.4691	0.3879	0.9541

Table S35. Brain cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.7764	-0.5845	2.1372	2.1736	0.5574	8.4759	0.2630	0.9541
skin_colorLight olive	-0.0491	-0.2445	0.1462	0.9520	0.7831	1.1574	0.6216	0.9761
skin_colorDark olive	0.3753	-0.0843	0.8349	1.4554	0.9191	2.3045	0.1093	0.9541
skin_colorBrown	0.3851	-0.2754	1.0457	1.4698	0.7593	2.8453	0.2526	0.9541
sun_protection_use	-0.0934	-0.3510	0.1642	0.9108	0.7040	1.1784	0.4767	0.9597
fish_oil_supplementsYes	-0.0540	-0.2107	0.1027	0.9474	0.8100	1.1081	0.4988	0.9597
folate_supplementsYes	-0.1872	-0.7375	0.3631	0.8293	0.4783	1.4378	0.5045	0.9597
glucosamine_supplementsYes	-0.0882	-0.2735	0.0971	0.9156	0.7607	1.1020	0.3503	0.9541
multivitamin_supplementsYes	-0.0276	-0.2076	0.1524	0.9728	0.8125	1.1646	0.7634	0.9761
pack_years_prop	-0.0015	-0.0781	0.0750	0.9985	0.9249	1.0779	0.9684	0.9997
smoking_statusPrevious	0.0154	-0.1400	0.1708	1.0155	0.8694	1.1863	0.8455	0.9997
smoking_statusCurrent	-0.0231	-0.2791	0.2329	0.9772	0.7564	1.2623	0.8595	0.9997
IPAQ_activity_group	-0.0686	-0.2141	0.0769	0.9337	0.8072	1.0799	0.3540	0.9541
education_years	-0.0498	-0.2189	0.1194	0.9515	0.8034	1.1268	0.5637	0.9761
hshld_income	-0.0837	-0.3113	0.1440	0.9197	0.7325	1.1549	0.4707	0.9597
ethnicityAsian	-0.3012	-0.9072	0.3047	0.7399	0.4037	1.3563	0.3294	0.9541
ethnicityBlack	-0.7195	-1.6097	0.1707	0.4870	0.1999	1.1862	0.1130	0.9541

Table S35. Brain cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.1043	-1.2427	1.0341	0.9010	0.2886	2.8126	0.8573	0.9997
ethnicityOther	0.0785	-0.7363	0.8933	1.0817	0.4789	2.4432	0.8500	0.9997

Table S36. Leukemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.0140	-0.2107	0.1828	0.9861	0.8100	1.2005	0.8891	0.9632
alcohol_freqOnce or twice a week	-0.0231	-0.2159	0.1696	0.9771	0.8058	1.1849	0.8138	0.9335
alcohol_freqThree or four times a week	-0.0449	-0.2412	0.1513	0.9561	0.7857	1.1634	0.6533	0.8644
bread	0.0690	-0.0385	0.1764	1.0714	0.9623	1.1930	0.2080	0.7052
cereal	-0.0464	-0.1451	0.0523	0.9546	0.8649	1.0537	0.3564	0.8015
never_eat_dairyYes	0.0753	-0.2528	0.4035	1.0783	0.7766	1.4970	0.6523	0.8644
never_eat_eggsYes	0.3881	0.1206	0.6556	1.4741	1.1282	1.9262	0.0046	0.0514
never_eat_sugarYes	0.0754	-0.0484	0.1992	1.0783	0.9527	1.2204	0.2327	0.7250
partial_fiber_score	-0.0026	-0.1216	0.1164	0.9974	0.8855	1.1235	0.9662	0.9788
poultry	-0.0562	-0.1939	0.0814	0.9453	0.8237	1.0849	0.4232	0.8464
processed_meat	-0.0226	-0.1464	0.1013	0.9777	0.8638	1.1066	0.7210	0.8787
red_meat	0.0495	-0.0755	0.1745	1.0508	0.9273	1.1907	0.4371	0.8464
salt	-0.0396	-0.1733	0.0940	0.9612	0.8409	1.0986	0.5609	0.8644
body_size_10yrs_oldThinner	-0.0428	-0.1558	0.0702	0.9581	0.8558	1.0727	0.4578	0.8464
body_size_10yrs_oldPlumper	-0.0309	-0.1847	0.1230	0.9696	0.8313	1.1309	0.6939	0.8644
height_10yrs_oldShorter	0.0042	-0.1338	0.1422	1.0042	0.8747	1.1528	0.9523	0.9774

Table S36. Leukemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.2316	0.1125	0.3506	1.2606	1.1191	1.4200	0.0001	0.0040
maternal_smokingYes	-0.0001	-0.1250	0.1249	0.9999	0.8825	1.1331	0.9992	0.9992
mobile_phone_2yrsYes, use is now more frequent	-0.0322	-0.2022	0.1379	0.9684	0.8169	1.1478	0.6981	0.8644
mobile_phone_2yrsYes, use is now less frequent	-0.0586	-0.2298	0.1126	0.9431	0.7947	1.1192	0.5008	0.8464
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.1575	-0.6369	0.3219	0.8543	0.5290	1.3798	0.5170	0.8464
employedYes	-0.0683	-0.1973	0.0607	0.9340	0.8209	1.0626	0.2992	0.7529
unemployedYes	-0.5297	-1.0621	0.0028	0.5888	0.3457	1.0028	0.0512	0.2719
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.9027	-2.8664	1.0610	0.4055	0.0569	2.8892	0.3673	0.8015
accommodation_typeA flat, maisonette or apartment	0.1813	-0.0018	0.3644	1.1988	0.9982	1.4397	0.0523	0.2719
gas_hob_heatYes	-0.0362	-0.1468	0.0744	0.9645	0.8635	1.0772	0.5208	0.8464
hshld_parentsYes	0.1612	-0.2534	0.5758	1.1750	0.7762	1.7786	0.4457	0.8464
hshld_partnerYes	-0.0175	-0.1417	0.1066	0.9826	0.8679	1.1125	0.7817	0.9239
hshld_siblingsYes	-0.2037	-1.0073	0.5999	0.8157	0.3652	1.8219	0.6191	0.8644
hshld_vehicles	-0.0759	-0.2991	0.1472	0.9269	0.7415	1.1586	0.5045	0.8464

Table S36. Leukemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	-0.0687	-0.4071	0.2696	0.9336	0.6656	1.3095	0.6903	0.8644
own_or_rentOwn with a mortgage	0.1145	-0.0174	0.2464	1.1213	0.9828	1.2795	0.0888	0.4329
own_or_rentRent - from local authority, local council, housing association	0.0874	-0.1370	0.3118	1.0913	0.8720	1.3659	0.4450	0.8464
own_or_rentPay part rent and part mortgage (shared ownership)	-0.1614	-1.2976	0.9749	0.8510	0.2732	2.6509	0.7806	0.9239
own_or_rentLive in accommodation rent free	0.3974	-0.1151	0.9098	1.4879	0.8913	2.4838	0.1285	0.5567
townsend_deprivation_index	0.0342	-0.0242	0.0927	1.0348	0.9761	1.0971	0.2510	0.7250
psychiatrist_visit_mental_health Yes	0.0547	-0.1040	0.2134	1.0562	0.9012	1.2378	0.4993	0.8464
risk_takingYes	0.0396	-0.0787	0.1580	1.0404	0.9243	1.1712	0.5111	0.8464
tiredness_freq	0.2683	0.1297	0.4070	1.3078	1.1385	1.5023	0.0002	0.0040
unenthusiasm_freq	0.0944	-0.0988	0.2876	1.0990	0.9059	1.3332	0.3382	0.7993
fast_driving	-0.0494	-0.2516	0.1528	0.9518	0.7776	1.1650	0.6318	0.8644
gymYes	-0.0042	-0.1247	0.1162	0.9958	0.8828	1.1233	0.9451	0.9774
LTPA	0.0645	-0.0780	0.2070	1.0666	0.9250	1.2300	0.3699	0.8015

Table S36. Leukemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	-0.0251	-0.1208	0.0707	0.9752	0.8862	1.0732	0.6076	0.8644
air_pollution_PC1	0.0377	0.0119	0.0634	1.0384	1.0120	1.0655	0.0042	0.0514
greenspace_PC1	-0.0320	-0.0630	-0.0011	0.9685	0.9390	0.9989	0.0424	0.2650
number_sex_partners	0.0169	0.0013	0.0324	1.0170	1.0013	1.0330	0.0342	0.2426
sex_age_first	0.0127	-0.0454	0.0708	1.0128	0.9556	1.0734	0.6653	0.8644
chronotypeMore an 'evening' than a 'morning' person	-0.0679	-0.2051	0.0693	0.9343	0.8146	1.0717	0.3306	0.7993
chronotypeDefinitely an 'evening' person	-0.0272	-0.2352	0.1807	0.9731	0.7904	1.1980	0.7972	0.9281
chronotypeDefinitely a 'morning' person	0.0772	-0.0585	0.2130	1.0803	0.9432	1.2373	0.2635	0.7341
nap	0.0628	-0.0546	0.1801	1.0648	0.9469	1.1973	0.2941	0.7529
sleep_hours_categorical<7 hours	-0.0063	-0.1301	0.1176	0.9938	0.8780	1.1248	0.9210	0.9708
sleep_hours_categorical>9 hours	0.2794	0.1136	0.4453	1.3224	1.1203	1.5609	0.0010	0.0190
family_visit_freq	-0.0672	-0.3093	0.1750	0.9350	0.7339	1.1912	0.5864	0.8644
religious_groupYes	-0.0114	-0.1545	0.1318	0.9887	0.8568	1.1408	0.8761	0.9625
facial_agingOlder than you are	0.0336	-0.3599	0.4271	1.0342	0.6977	1.5329	0.8670	0.9625
facial_agingAbout your age	0.1241	-0.0280	0.2761	1.1321	0.9724	1.3180	0.1061	0.4867
skin_colorVery fair	-0.1237	-0.3329	0.0856	0.8837	0.7168	1.0894	0.2466	0.7250

Table S36. Leukemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	-0.8323	-2.0181	0.3535	0.4350	0.1329	1.4240	0.1687	0.6578
skin_colorLight olive	-0.0560	-0.1976	0.0856	0.9455	0.8207	1.0893	0.4374	0.8464
skin_colorDark olive	0.0874	-0.2792	0.4541	1.0914	0.7564	1.5747	0.6400	0.8644
skin_colorBrown	0.1384	-0.3517	0.6285	1.1485	0.7035	1.8749	0.5796	0.8644
sun_protection_use	0.1344	-0.0479	0.3167	1.1438	0.9532	1.3726	0.1484	0.6092
fish_oil_supplementsYes	-0.0652	-0.1744	0.0440	0.9369	0.8400	1.0449	0.2414	0.7250
folate_supplementsYes	0.3436	0.0458	0.6414	1.4100	1.0468	1.8992	0.0238	0.1854
glucosamine_supplementsYes	0.0066	-0.1200	0.1331	1.0066	0.8869	1.1424	0.9189	0.9708
multivitamin_supplementsYes	-0.0107	-0.1380	0.1166	0.9893	0.8711	1.1236	0.8686	0.9625
pack_years_prop	0.1347	0.0893	0.1801	1.1442	1.0934	1.1973	0.0000	0.0000
smoking_statusPrevious	0.1364	0.0269	0.2460	1.1462	1.0273	1.2788	0.0147	0.1270
smoking_statusCurrent	0.2250	0.0509	0.3991	1.2523	1.0523	1.4904	0.0113	0.1104
IPAQ_activity_group	-0.1660	-0.2693	-0.0628	0.8470	0.7639	0.9392	0.0017	0.0267
education_years	-0.0778	-0.1971	0.0416	0.9252	0.8211	1.0425	0.2016	0.7052
hshld_income	-0.1084	-0.2756	0.0587	0.8972	0.7591	1.0605	0.2032	0.7052
ethnicityAsian	-0.4978	-0.9825	-0.0130	0.6079	0.3744	0.9871	0.0442	0.2650
ethnicityBlack	-0.1088	-0.6104	0.3928	0.8969	0.5431	1.4812	0.6706	0.8644

Table S36. Leukemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.1986	-1.0790	0.6818	0.8199	0.3399	1.9775	0.6582	0.8644
ethnicityOther	-0.4040	-1.1507	0.3427	0.6676	0.3164	1.4087	0.2887	0.7529

Table S37. Lymphoma

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.1486	-0.3044	0.0072	0.8619	0.7375	1.0073	0.0616	0.2530
alcohol_freqOnce or twice a week	-0.0845	-0.2341	0.0652	0.9190	0.7913	1.0674	0.2685	0.5494
alcohol_freqThree or four times a week	-0.1659	-0.3201	-0.0116	0.8472	0.7260	0.9885	0.0351	0.2303
bread	0.0888	0.0029	0.1748	1.0929	1.0029	1.1909	0.0427	0.2303
cereal	0.0268	-0.0535	0.1072	1.0272	0.9479	1.1131	0.5130	0.7550
never_eat_dairyYes	0.1518	-0.0981	0.4016	1.1639	0.9066	1.4943	0.2337	0.5494
never_eat_eggsYes	0.1874	-0.0427	0.4175	1.2061	0.9582	1.5182	0.1104	0.3444
never_eat_sugarYes	0.0330	-0.0684	0.1344	1.0335	0.9339	1.1439	0.5235	0.7561
partial_fiber_score	0.0299	-0.0658	0.1256	1.0303	0.9363	1.1338	0.5405	0.7624
poultry	0.0333	-0.0780	0.1447	1.0339	0.9250	1.1557	0.5571	0.7624
processed_meat	-0.0232	-0.1224	0.0761	0.9771	0.8848	1.0790	0.6472	0.8276
red_meat	0.0639	-0.0363	0.1642	1.0660	0.9643	1.1785	0.2112	0.5313
salt	0.0182	-0.0892	0.1255	1.0183	0.9147	1.1337	0.7402	0.8870
body_size_10yrs_oldThinner	-0.1014	-0.1941	-0.0087	0.9036	0.8236	0.9913	0.0320	0.2303
body_size_10yrs_oldPlumper	0.0549	-0.0626	0.1724	1.0564	0.9393	1.1881	0.3595	0.6097
height_10yrs_oldShorter	-0.1093	-0.2217	0.0032	0.8965	0.8012	1.0032	0.0568	0.2462

Table S37. Lymphoma

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0808	-0.0160	0.1777	1.0842	0.9841	1.1944	0.1017	0.3444
maternal_smokingYes	0.0921	0.0009	0.1834	1.0965	1.0009	1.2013	0.0479	0.2315
mobile_phone_2yrsYes, use is now more frequent	-0.0485	-0.1519	0.0550	0.9527	0.8591	1.0565	0.3571	0.6097
mobile_phone_2yrsYes, use is now less frequent	0.0062	-0.1295	0.1418	1.0062	0.8786	1.1523	0.9289	0.9491
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.2112	-0.1082	0.5307	1.2352	0.8974	1.7001	0.1938	0.5088
employedYes	-0.1083	-0.2123	-0.0044	0.8973	0.8087	0.9956	0.0411	0.2303
unemployedYes	0.0517	-0.2751	0.3784	1.0530	0.7595	1.4600	0.7565	0.8870
accommodation_typeMobile or temporary structure (i.e. caravan)	-1.2952	-3.2575	0.6671	0.2738	0.0385	1.9486	0.1957	0.5088
accommodation_typeA flat, maisonette or apartment	-0.0905	-0.2528	0.0719	0.9135	0.7766	1.0745	0.2747	0.5494
gas_hob_heatYes	0.0066	-0.0826	0.0959	1.0067	0.9207	1.1006	0.8841	0.9447
hshld_parentsYes	0.0605	-0.2802	0.4012	1.0624	0.7557	1.4936	0.7277	0.8868
hshld_partnerYes	0.0246	-0.0760	0.1252	1.0249	0.9268	1.1333	0.6315	0.8276
hshld_siblingsYes	0.1284	-0.4181	0.6749	1.1370	0.6583	1.9639	0.6451	0.8276
hshld_vehicles	-0.1031	-0.2822	0.0760	0.9021	0.7541	1.0790	0.2592	0.5494

Table S37. Lymphoma

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	-0.2353	-0.5202	0.0497	0.7903	0.5944	1.0509	0.1055	0.3444
own_or_rentOwn with a mortgage	-0.0095	-0.1162	0.0972	0.9905	0.8903	1.1021	0.8615	0.9447
own_or_rentRent - from local authority, local council, housing association	0.0148	-0.1716	0.2011	1.0149	0.8424	1.2228	0.8764	0.9447
own_or_rentPay part rent and part mortgage (shared ownership)	-0.3889	-1.3724	0.5946	0.6778	0.2535	1.8124	0.4382	0.6976
own_or_rentLive in accommodation rent free	0.2613	-0.1714	0.6939	1.2986	0.8425	2.0015	0.2364	0.5494
townsend_deprivation_index	0.0573	0.0102	0.1044	1.0590	1.0102	1.1101	0.0172	0.1921
psychiatrist_visit_mental_health Yes	0.0634	-0.0639	0.1908	1.0655	0.9381	1.2102	0.3289	0.6097
risk_takingYes	-0.0048	-0.1006	0.0910	0.9952	0.9043	1.0953	0.9223	0.9491
tiredness_freq	0.1654	0.0517	0.2791	1.1799	1.0530	1.3220	0.0044	0.0684
unenthusiasm_freq	0.2882	0.1407	0.4357	1.3340	1.1511	1.5460	0.0001	0.0051
fast_driving	-0.1682	-0.3321	-0.0043	0.8452	0.7174	0.9957	0.0443	0.2303
gymYes	-0.0097	-0.1053	0.0859	0.9904	0.9001	1.0897	0.8426	0.9389
LTPA	0.0360	-0.0684	0.1404	1.0366	0.9338	1.1507	0.4984	0.7476

Table S37. Lymphoma

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.0362	-0.0399	0.1123	1.0369	0.9608	1.1189	0.3513	0.6097
air_pollution_PC1	0.0147	-0.0063	0.0357	1.0148	0.9937	1.0363	0.1695	0.4723
greenspace_PC1	-0.0245	-0.0491	0.0000	0.9758	0.9521	1.0000	0.0504	0.2315
number_sex_partners	0.0023	-0.0368	0.0413	1.0023	0.9639	1.0422	0.9087	0.9491
sex_age_first	0.0486	0.0075	0.0897	1.0498	1.0076	1.0939	0.0204	0.1989
chronotypeMore an 'evening' than a 'morning' person	-0.0491	-0.1628	0.0645	0.9521	0.8498	1.0666	0.3939	0.6537
chronotypeDefinitely an 'evening' person	-0.0067	-0.1716	0.1583	0.9934	0.8423	1.1715	0.9369	0.9491
chronotypeDefinitely a 'morning' person	-0.0386	-0.1459	0.0686	0.9621	0.8642	1.0710	0.4797	0.7337
nap	0.0846	-0.0109	0.1801	1.0883	0.9892	1.1973	0.0825	0.3217
sleep_hours_categorical<7 hours	0.0793	-0.0176	0.1762	1.0825	0.9826	1.1927	0.1086	0.3444
sleep_hours_categorical>9 hours	0.0590	-0.0898	0.2079	1.0608	0.9141	1.2311	0.4370	0.6976
family_visit_freq	0.0715	-0.1258	0.2689	1.0741	0.8818	1.3085	0.4774	0.7337
religious_groupYes	0.1448	0.0356	0.2541	1.1559	1.0362	1.2893	0.0094	0.1222
facial_agingOlder than you are	0.1778	-0.1195	0.4750	1.1945	0.8873	1.6081	0.2411	0.5494
facial_agingAbout your age	0.0549	-0.0430	0.1529	1.0565	0.9579	1.1652	0.2716	0.5494
skin_colorVery fair	-0.0250	-0.1865	0.1366	0.9753	0.8299	1.1463	0.7619	0.8870

Table S37. Lymphoma

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	-0.5067	-1.3834	0.3700	0.6025	0.2507	1.4477	0.2571	0.5494
skin_colorLight olive	0.0240	-0.0859	0.1339	1.0243	0.9177	1.1433	0.6684	0.8408
skin_colorDark olive	-0.0879	-0.4202	0.2444	0.9159	0.6569	1.2768	0.6039	0.8122
skin_colorBrown	0.1210	-0.2746	0.5166	1.1286	0.7599	1.6764	0.5487	0.7624
sun_protection_use	0.0307	-0.1154	0.1767	1.0311	0.8910	1.1933	0.6806	0.8426
fish_oil_supplementsYes	-0.0751	-0.1635	0.0132	0.9276	0.8492	1.0133	0.0955	0.3444
folate_supplementsYes	0.4898	0.2659	0.7137	1.6320	1.3045	2.0415	0.0000	0.0015
glucosamine_supplementsYes	0.0015	-0.0996	0.1026	1.0015	0.9052	1.1081	0.9764	0.9764
multivitamin_supplementsYes	0.0523	-0.0470	0.1515	1.0537	0.9541	1.1636	0.3018	0.5742
pack_years_prop	0.0631	0.0227	0.1035	1.0651	1.0230	1.1091	0.0023	0.0445
smoking_statusPrevious	-0.0116	-0.1008	0.0776	0.9885	0.9041	1.0807	0.7989	0.9164
smoking_statusCurrent	0.2175	0.0803	0.3546	1.2429	1.0837	1.4256	0.0019	0.0445
IPAQ_activity_group	-0.0091	-0.0904	0.0721	0.9909	0.9136	1.0748	0.8253	0.9330
education_years	0.1014	0.0051	0.1978	1.1068	1.0051	1.2187	0.0390	0.2303
hshld_income	-0.1414	-0.2749	-0.0078	0.8682	0.7597	0.9922	0.0380	0.2303
ethnicityAsian	-0.2639	-0.6132	0.0854	0.7681	0.5416	1.0891	0.1386	0.4004
ethnicityBlack	-0.2246	-0.6337	0.1845	0.7988	0.5306	1.2026	0.2818	0.5494

Table S37. Lymphoma

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.6903	-1.5695	0.1888	0.5014	0.2082	1.2078	0.1237	0.3712
ethnicityOther	-0.2567	-0.8061	0.2927	0.7736	0.4466	1.3400	0.3596	0.6097

Table S38. Breast cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	0.1109	0.0272	0.1946	1.1173	1.0276	1.2149	0.0094	0.0488
alcohol_freqOnce or twice a week	0.0233	-0.0542	0.1007	1.0236	0.9473	1.1060	0.5557	0.7321
alcohol_freqThree or four times a week	0.0850	0.0049	0.1652	1.0888	1.0049	1.1796	0.0375	0.1532
bread	0.0265	-0.0224	0.0754	1.0268	0.9778	1.0783	0.2886	0.4519
cereal	-0.0272	-0.0712	0.0167	0.9731	0.9313	1.0168	0.2239	0.3957
never_eat_dairyYes	0.0284	-0.1217	0.1785	1.0288	0.8854	1.1955	0.7103	0.8304
never_eat_eggsYes	0.0897	-0.0506	0.2301	1.0939	0.9506	1.2587	0.2099	0.3957
never_eat_sugarYes	0.0046	-0.0543	0.0635	1.0046	0.9471	1.0655	0.8788	0.9117
partial_fiber_score	-0.0743	-0.1275	-0.0212	0.9284	0.8803	0.9791	0.0061	0.0392
poultry	0.0500	-0.0080	0.1081	1.0513	0.9920	1.1142	0.0911	0.2520
processed_meat	0.0665	0.0138	0.1192	1.0688	1.0139	1.1266	0.0133	0.0651
red_meat	0.0908	0.0370	0.1446	1.0951	1.0377	1.1556	0.0009	0.0071
salt	0.0252	-0.0343	0.0848	1.0255	0.9663	1.0885	0.4065	0.5718
body_size_10yrs_oldPlumper	-0.1636	-0.2292	-0.0981	0.8491	0.7952	0.9066	0.0000	0.0000
body_size_10yrs_oldThinner	0.1181	0.0684	0.1678	1.1254	1.0708	1.1827	0.0000	0.0001
height_10yrs_oldTaller	0.1346	0.0825	0.1866	1.1440	1.0860	1.2052	0.0000	0.0000

Table S38. Breast cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldShorter	-0.1051	-0.1647	-0.0454	0.9003	0.8481	0.9557	0.0006	0.0047
maternal_smokingYes	-0.0424	-0.0949	0.0101	0.9585	0.9095	1.0101	0.1132	0.2763
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0481	-0.2801	0.1839	0.9530	0.7557	1.2019	0.6766	0.8251
mobile_phone_2yrsYes, use is now less frequent	0.0048	-0.0811	0.0907	1.0048	0.9221	1.0949	0.9132	0.9245
mobile_phone_2yrsYes, use is now more frequent	-0.0174	-0.0705	0.0356	0.9827	0.9319	1.0363	0.5175	0.7159
employedYes	0.0354	-0.0210	0.0918	1.0360	0.9792	1.0962	0.2186	0.3957
unemployedYes	0.2107	0.0190	0.4024	1.2346	1.0192	1.4955	0.0312	0.1363
bilateral_oophorectomyYes	-0.0093	-0.0921	0.0735	0.9908	0.9120	1.0763	0.8260	0.8903
cervical_smearYes	0.0752	-0.0851	0.2355	1.0781	0.9184	1.2656	0.3580	0.5306
menopauseYes	-0.1203	-0.2363	-0.0044	0.8866	0.7896	0.9957	0.0428	0.1553
number_births	-0.0461	-0.0655	-0.0267	0.9550	0.9366	0.9737	0.0000	0.0001
oral_contraceptiveYes	-0.0503	-0.1103	0.0097	0.9510	0.8956	1.0098	0.1006	0.2530
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.6667	-1.5443	0.2109	0.5134	0.2135	1.2348	0.1365	0.3176
accommodation_typeA flat, maisonette or apartment	-0.0557	-0.1464	0.0350	0.9458	0.8638	1.0356	0.2286	0.3957
gas_hob_heatYes	-0.0027	-0.0521	0.0466	0.9973	0.9493	1.0477	0.9133	0.9245

Table S38. Breast cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
hshld_parentsYes	-0.0585	-0.2449	0.1278	0.9431	0.7828	1.1363	0.5380	0.7320
hshld_partnerYes	-0.0363	-0.0895	0.0170	0.9644	0.9144	1.0171	0.1818	0.3773
hshld_siblingsYes	-0.1536	-0.5014	0.1941	0.8576	0.6057	1.2142	0.3865	0.5530
hshld_vehicles	-0.0580	-0.1545	0.0384	0.9436	0.8568	1.0392	0.2384	0.3957
own_or_rentRent - from private landlord or letting agency	0.0834	-0.0544	0.2212	1.0869	0.9470	1.2475	0.2357	0.3957
own_or_rentOwn with a mortgage	0.0571	0.0013	0.1128	1.0587	1.0013	1.1194	0.0449	0.1553
own_or_rentRent - from local authority, local council, housing association	-0.0789	-0.1870	0.0292	0.9242	0.8295	1.0297	0.1528	0.3427
own_or_rentPay part rent and part mortgage (shared ownership)	-0.2644	-0.7286	0.1998	0.7677	0.4826	1.2211	0.2642	0.4217
own_or_rentLive in accommodation rent free	0.1369	-0.1299	0.4038	1.1468	0.8782	1.4975	0.3145	0.4833
townsend_deprivation_index	0.0054	-0.0209	0.0317	1.0054	0.9793	1.0322	0.6859	0.8251
psychiatrist_visit_mental_health Yes	-0.0085	-0.0761	0.0592	0.9916	0.9267	1.0610	0.8065	0.8808
risk_takingYes	0.0351	-0.0218	0.0921	1.0358	0.9784	1.0965	0.2266	0.3957
tiredness_freq	0.0550	-0.0049	0.1149	1.0566	0.9951	1.1218	0.0719	0.2294

Table S38. Breast cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
unenthusiasm_freq	0.0212	-0.0627	0.1051	1.0215	0.9392	1.1109	0.6200	0.7917
fast_driving	0.0177	-0.0735	0.1088	1.0178	0.9291	1.1150	0.7042	0.8304
gymYes	0.0080	-0.0437	0.0596	1.0080	0.9573	1.0614	0.7625	0.8553
LTPA	-0.0598	-0.1228	0.0033	0.9420	0.8844	1.0033	0.0630	0.2091
sedentary	0.0560	0.0142	0.0979	1.0576	1.0143	1.1028	0.0087	0.0480
air_pollution_PC1	0.0097	-0.0018	0.0212	1.0098	0.9982	1.0214	0.0978	0.2530
greenspace_PC1	-0.0064	-0.0197	0.0068	0.9936	0.9805	1.0068	0.3397	0.5127
number_sex_partners	-0.0388	-0.2058	0.1281	0.9619	0.8140	1.1367	0.6484	0.8154
sex_age_first	0.0240	-0.0028	0.0507	1.0243	0.9972	1.0520	0.0787	0.2402
chronotypeMore an 'evening' than a 'morning' person	0.0678	0.0096	0.1260	1.0702	1.0097	1.1343	0.0225	0.1039
chronotypeDefinitely an 'evening' person	0.0903	0.0047	0.1759	1.0945	1.0047	1.1923	0.0388	0.1532
chronotypeDefinitely a 'morning' person	-0.0342	-0.0942	0.0258	0.9664	0.9101	1.0261	0.2637	0.4217
nap	0.1158	0.0599	0.1717	1.1227	1.0617	1.1873	0.0000	0.0005
sleep_hours_categorical<7 hours	-0.0747	-0.1289	-0.0204	0.9280	0.8790	0.9798	0.0070	0.0415
sleep_hours_categorical>9 hours	0.0688	-0.0130	0.1506	1.0713	0.9871	1.1626	0.0991	0.2530
family_visit_freq	-0.0836	-0.1940	0.0268	0.9198	0.8236	1.0272	0.1378	0.3176

Table S38. Breast cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
religious_groupYes	-0.0028	-0.0622	0.0566	0.9972	0.9397	1.0582	0.9263	0.9263
facial_agingOlder than you are	-0.2465	-0.5302	0.0371	0.7815	0.5885	1.0378	0.0884	0.2520
facial_agingAbout your age	-0.0176	-0.0760	0.0408	0.9826	0.9268	1.0417	0.5548	0.7321
skin_colorVery fair	-0.0527	-0.1347	0.0293	0.9487	0.8740	1.0297	0.2075	0.3957
skin_colorBlack	0.0664	-0.3610	0.4938	1.0687	0.6970	1.6385	0.7607	0.8553
skin_colorLight olive	0.0501	-0.0062	0.1063	1.0514	0.9938	1.1122	0.0810	0.2402
skin_colorDark olive	-0.0375	-0.2445	0.1696	0.9632	0.7831	1.1848	0.7225	0.8329
skin_colorBrown	0.0668	-0.1763	0.3098	1.0690	0.8384	1.3632	0.5902	0.7655
sun_protection_use	0.0113	-0.0697	0.0924	1.0114	0.9326	1.0968	0.7843	0.8680
fish_oil_supplementsYes	0.0338	-0.0145	0.0820	1.0343	0.9856	1.0855	0.1705	0.3724
folate_supplementsYes	-0.0639	-0.2049	0.0772	0.9381	0.8147	1.0803	0.3750	0.5461
glucosamine_supplementsYes	0.0118	-0.0421	0.0658	1.0119	0.9587	1.0680	0.6677	0.8251
multivitamin_supplementsYes	0.0048	-0.0471	0.0567	1.0048	0.9540	1.0583	0.8556	0.8990
pack_years_prop	0.0803	0.0536	0.1069	1.0836	1.0550	1.1129	0.0000	0.0000
smoking_statusPrevious	0.0725	0.0236	0.1214	1.0752	1.0239	1.1291	0.0037	0.0253
smoking_statusCurrent	0.1688	0.0904	0.2472	1.1839	1.0946	1.2805	0.0000	0.0003
IPAQ_activity_group	-0.1051	-0.1521	-0.0580	0.9002	0.8589	0.9436	0.0000	0.0002

Table S38. Breast cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
education_years	0.0319	-0.0210	0.0847	1.0324	0.9793	1.0884	0.2372	0.3957
hshld_income	-0.0068	-0.0782	0.0645	0.9932	0.9248	1.0666	0.8509	0.8990
ethnicityAsian	-0.1928	-0.3801	-0.0054	0.8247	0.6838	0.9946	0.0437	0.1553
ethnicityBlack	-0.4203	-0.6380	-0.2026	0.6569	0.5284	0.8166	0.0002	0.0014
ethnicityMixed	-0.1931	-0.5012	0.1149	0.8244	0.6058	1.1218	0.2191	0.3957
ethnicityOther	-0.1781	-0.4389	0.0827	0.8369	0.6448	1.0862	0.1807	0.3773

Table S39. Ovarian cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.2293	-0.4669	0.0083	0.7951	0.6270	1.0084	0.0586	0.4043
alcohol_freqOnce or twice a week	0.0302	-0.1745	0.2349	1.0306	0.8398	1.2648	0.7724	0.9467
alcohol_freqThree or four times a week	-0.0673	-0.2866	0.1521	0.9350	0.7508	1.1642	0.5474	0.8656
bread	0.0557	-0.0781	0.1895	1.0573	0.9249	1.2087	0.4140	0.7992
cereal	0.0247	-0.0960	0.1454	1.0250	0.9084	1.1565	0.6885	0.9070
never_eat_dairyYes	-0.4280	-0.9040	0.0480	0.6518	0.4049	1.0491	0.0779	0.4043
never_eat_eggsYes	-0.3252	-0.7859	0.1356	0.7224	0.4557	1.1452	0.1655	0.5724
never_eat_sugarYes	-0.0466	-0.2053	0.1121	0.9544	0.8144	1.1186	0.5642	0.8672
partial_fiber_score	-0.0668	-0.2121	0.0784	0.9354	0.8089	1.0816	0.3669	0.7981
poultry	0.0257	-0.1331	0.1845	1.0260	0.8754	1.2026	0.7510	0.9467
processed_meat	-0.0039	-0.1483	0.1405	0.9961	0.8622	1.1508	0.9577	0.9819
red_meat	-0.0369	-0.1842	0.1105	0.9638	0.8317	1.1169	0.6238	0.9045
salt	-0.0827	-0.2486	0.0833	0.9207	0.7799	1.0868	0.3285	0.7791
body_size_10yrs_oldPlumper	0.0250	-0.1432	0.1932	1.0253	0.8666	1.2131	0.7708	0.9467
body_size_10yrs_oldThinner	-0.0146	-0.1532	0.1239	0.9855	0.8580	1.1320	0.8361	0.9467
height_10yrs_oldTaller	-0.0177	-0.1633	0.1280	0.9825	0.8494	1.1365	0.8120	0.9467

Table S39. Ovarian cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldShorter	-0.2207	-0.3873	-0.0541	0.8020	0.6789	0.9473	0.0095	0.0983
maternal_smokingYes	-0.1238	-0.2807	0.0332	0.8836	0.7552	1.0338	0.1212	0.5265
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.1854	-0.2503	0.6211	1.2037	0.7786	1.8610	0.4039	0.7981
mobile_phone_2yrsYes, use is now less frequent	-0.2011	-0.4595	0.0573	0.8178	0.6316	1.0589	0.1269	0.5265
mobile_phone_2yrsYes, use is now more frequent	0.0188	-0.1430	0.1805	1.0189	0.8668	1.1978	0.8166	0.9467
employedYes	-0.0246	-0.1791	0.1298	0.9757	0.8360	1.1386	0.7544	0.9467
unemployedYes	-0.0492	-0.6514	0.5530	0.9520	0.5213	1.7385	0.8726	0.9467
bilateral_oophorectomyYes	-1.2603	-1.6370	-0.8836	0.2836	0.1946	0.4133	0.0000	0.0000
cervical_smearYes	-0.4702	-0.7893	-0.1511	0.6249	0.4542	0.8598	0.0039	0.0464
menopauseYes	0.0941	-0.2130	0.4011	1.0986	0.8082	1.4935	0.5371	0.8656
number_births	-0.1170	-0.1701	-0.0638	0.8896	0.8435	0.9382	0.0000	0.0007
oral_contraceptiveYes	-0.3033	-0.4497	-0.1569	0.7384	0.6378	0.8548	0.0001	0.0014
accommodation_typeMobile or temporary structure (i.e. caravan)	-12.9842	-1,137.3715	1,111.4030	0.0000	0.0000	Inf	0.9819	0.9819
accommodation_typeA flat, maisonette or apartment	0.3587	0.1495	0.5678	1.4315	1.1613	1.7645	0.0008	0.0132
gas_hob_heatYes	-0.0960	-0.2280	0.0360	0.9085	0.7961	1.0367	0.1539	0.5555

Table S39. Ovarian cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
hshld_parentsYes	0.3633	-0.0713	0.7979	1.4381	0.9312	2.2210	0.1012	0.4667
hshld_partnerYes	-0.0715	-0.2127	0.0698	0.9310	0.8084	1.0723	0.3211	0.7791
hshld_siblingsYes	0.5943	-0.0647	1.2533	1.8118	0.9374	3.5019	0.0771	0.4043
hshld_vehicles	-0.1060	-0.3783	0.1664	0.8995	0.6850	1.1810	0.4453	0.8127
own_or_rentRent - from private landlord or letting agency	-0.0402	-0.4351	0.3548	0.9606	0.6472	1.4259	0.8419	0.9467
own_or_rentOwn with a mortgage	0.0641	-0.0941	0.2223	1.0662	0.9102	1.2489	0.4270	0.8056
own_or_rentRent - from local authority, local council, housing association	0.0201	-0.2465	0.2867	1.0203	0.7815	1.3320	0.8825	0.9467
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0993	-1.2381	1.0395	0.9055	0.2899	2.8277	0.8641	0.9467
own_or_rentLive in accommodation rent free	0.2120	-0.4885	0.9125	1.2361	0.6135	2.4905	0.5528	0.8656
townsend_deprivation_index	-0.0198	-0.0911	0.0514	0.9804	0.9129	1.0528	0.5851	0.8813
psychiatrist_visit_mental_health Yes	-0.0507	-0.2378	0.1363	0.9505	0.7884	1.1460	0.5946	0.8813
risk_takingYes	-0.1334	-0.3138	0.0470	0.8751	0.7307	1.0481	0.1455	0.5490
tiredness_freq	0.0711	-0.0917	0.2339	1.0737	0.9124	1.2635	0.3914	0.7981

Table S39. Ovarian cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
unenthusiasm_freq	-0.1465	-0.3939	0.1010	0.8637	0.6744	1.1062	0.2453	0.7024
fast_driving	-0.0052	-0.2670	0.2566	0.9948	0.7656	1.2925	0.9689	0.9819
gymYes	0.0699	-0.0703	0.2101	1.0724	0.9321	1.2338	0.3280	0.7791
LTPA	-0.0546	-0.2209	0.1118	0.9469	0.8018	1.1182	0.5187	0.8656
sedentary	0.0411	-0.0739	0.1561	1.0419	0.9288	1.1689	0.4834	0.8536
air_pollution_PC1	0.0071	-0.0247	0.0389	1.0071	0.9756	1.0396	0.6627	0.9070
greenspace_PC1	0.0076	-0.0294	0.0446	1.0076	0.9710	1.0456	0.6865	0.9070
number_sex_partners	0.0569	-0.0269	0.1407	1.0585	0.9734	1.1511	0.1832	0.5849
sex_age_first	0.1050	0.0388	0.1712	1.1107	1.0395	1.1868	0.0020	0.0273
chronotypeMore an 'evening' than a 'morning' person	-0.0022	-0.1588	0.1544	0.9978	0.8531	1.1670	0.9778	0.9819
chronotypeDefinitely an 'evening' person	0.2097	-0.0153	0.4347	1.2333	0.9849	1.5445	0.0676	0.4043
chronotypeDefinitely a 'morning' person	-0.1562	-0.3197	0.0074	0.8554	0.7263	1.0075	0.0613	0.4043
nap	-0.0516	-0.2060	0.1029	0.9497	0.8138	1.1083	0.5123	0.8656
sleep_hours_categorical<7 hours	-0.0961	-0.2432	0.0510	0.9084	0.7841	1.0523	0.2002	0.6155
sleep_hours_categorical>9 hours	-0.0470	-0.2754	0.1814	0.9541	0.7593	1.1988	0.6863	0.9070
family_visit_freq	-0.3167	-0.6114	-0.0220	0.7286	0.5426	0.9782	0.0352	0.2922

Table S39. Ovarian cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
religious_groupYes	-0.0957	-0.2572	0.0659	0.9087	0.7732	1.0681	0.2454	0.7024
facial_agingOlder than you are	0.0474	-0.6234	0.7182	1.0486	0.5361	2.0507	0.8897	0.9467
facial_agingAbout your age	-0.0699	-0.2316	0.0918	0.9325	0.7933	1.0962	0.3963	0.7981
skin_colorVery fair	0.1896	-0.0142	0.3934	1.2088	0.9859	1.4821	0.0682	0.4043
skin_colorBlack	-0.3996	-1.4381	0.6390	0.6706	0.2374	1.8946	0.4504	0.8127
skin_colorLight olive	-0.1172	-0.2880	0.0536	0.8894	0.7498	1.0550	0.1780	0.5849
skin_colorDark olive	0.2469	-0.2113	0.7052	1.2801	0.8095	2.0243	0.2906	0.7695
skin_colorBrown	-0.3123	-0.8992	0.2746	0.7318	0.4069	1.3161	0.2967	0.7695
sun_protection_use	0.0086	-0.2112	0.2285	1.0087	0.8096	1.2567	0.9386	0.9819
fish_oil_supplementsYes	0.0975	-0.0314	0.2264	1.1024	0.9691	1.2541	0.1380	0.5453
folate_supplementsYes	-0.1247	-0.5153	0.2659	0.8827	0.5973	1.3046	0.5311	0.8656
glucosamine_supplementsYes	-0.0646	-0.2110	0.0819	0.9375	0.8098	1.0853	0.3872	0.7981
multivitamin_supplementsYes	0.0342	-0.1061	0.1746	1.0348	0.8994	1.1907	0.6321	0.9045
pack_years_prop	0.0431	-0.0320	0.1182	1.0440	0.9685	1.1254	0.2601	0.7196
smoking_statusPrevious	0.0289	-0.1039	0.1617	1.0293	0.9013	1.1756	0.6696	0.9070
smoking_statusCurrent	0.0173	-0.2101	0.2447	1.0175	0.8105	1.2773	0.8813	0.9467
IPAQ_activity_group	0.0136	-0.1136	0.1409	1.0137	0.8926	1.1513	0.8331	0.9467

Table S39. Ovarian cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
education_years	0.0642	-0.0784	0.2069	1.0664	0.9246	1.2299	0.3771	0.7981
hshld_income	-0.3871	-0.5927	-0.1815	0.6790	0.5529	0.8340	0.0002	0.0050
ethnicityAsian	-0.0613	-0.5510	0.4284	0.9405	0.5764	1.5348	0.8060	0.9467
ethnicityBlack	-0.2661	-0.8253	0.2931	0.7664	0.4381	1.3406	0.3506	0.7981
ethnicityMixed	0.5258	-0.1016	1.1533	1.6918	0.9034	3.1685	0.1004	0.4667
ethnicityOther	0.5686	0.0656	1.0717	1.7659	1.0678	2.9202	0.0268	0.2468

Table S40. Prostate cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqThree or four times a week	0.0230	-0.0616	0.1076	1.0232	0.9402	1.1136	0.5944	0.7766
alcohol_freqOnce or twice a week	-0.0030	-0.0883	0.0823	0.9970	0.9155	1.0858	0.9447	0.9838
alcohol_freqDaily or almost daily	-0.0021	-0.0869	0.0826	0.9979	0.9168	1.0861	0.9607	0.9838
bread	-0.0321	-0.0747	0.0104	0.9684	0.9280	1.0105	0.1388	0.4135
cereal	0.0233	-0.0177	0.0643	1.0236	0.9824	1.0664	0.2657	0.5069
never_eat_dairyYes	0.0001	-0.1411	0.1413	1.0001	0.8684	1.1517	0.9994	0.9994
never_eat_eggsYes	-0.0436	-0.1694	0.0821	0.9573	0.8442	1.0855	0.4962	0.6813
never_eat_sugarYes	-0.0565	-0.1087	-0.0044	0.9450	0.8970	0.9957	0.0337	0.1368
partial_fiber_score	-0.0385	-0.0866	0.0095	0.9622	0.9170	1.0096	0.1162	0.3921
poultry	0.0417	-0.0175	0.1008	1.0426	0.9827	1.1061	0.1673	0.4461
processed_meat	0.0355	-0.0164	0.0874	1.0362	0.9838	1.0913	0.1795	0.4461
red_meat	0.0329	-0.0189	0.0847	1.0334	0.9812	1.0884	0.2134	0.4940
salt	0.0115	-0.0429	0.0660	1.0116	0.9580	1.0682	0.6781	0.8451
body_size_10yrs_oldPlumper	-0.0995	-0.1671	-0.0319	0.9053	0.8461	0.9686	0.0039	0.0226
body_size_10yrs_oldThinner	-0.0068	-0.0530	0.0394	0.9932	0.9484	1.0401	0.7724	0.8908
height_10yrs_oldShorter	-0.0132	-0.0689	0.0425	0.9869	0.9334	1.0435	0.6427	0.8135

Table S40. Prostate cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0071	-0.0431	0.0574	1.0072	0.9578	1.0590	0.7808	0.8908
maternal_smokingYes	-0.0087	-0.0571	0.0398	0.9914	0.9445	1.0406	0.7260	0.8522
mobile_phone_2yrsYes, use is now less frequent	0.0367	-0.0267	0.1001	1.0374	0.9737	1.1053	0.2544	0.5069
mobile_phone_2yrsYes, use is now more frequent	0.0281	-0.0275	0.0837	1.0285	0.9729	1.0873	0.3199	0.5398
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0886	-0.1514	0.3286	1.0926	0.8595	1.3890	0.4509	0.6640
employedYes	-0.0196	-0.0718	0.0327	0.9806	0.9307	1.0332	0.4631	0.6698
unemployedYes	-0.1692	-0.3355	-0.0028	0.8444	0.7150	0.9972	0.0462	0.1783
accommodation_typeA flat, maisonette or apartment	-0.1368	-0.2217	-0.0519	0.8721	0.8012	0.9494	0.0016	0.0117
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.3441	-0.9651	0.2769	0.7089	0.3809	1.3190	0.2774	0.5107
gas_hob_heatYes	0.0534	0.0074	0.0993	1.0548	1.0075	1.1044	0.0228	0.1027
hshld_parentsYes	-0.0861	-0.2800	0.1079	0.9175	0.7558	1.1139	0.3844	0.6279
hshld_partnerYes	0.0975	0.0418	0.1531	1.1024	1.0427	1.1655	0.0006	0.0061
hshld_siblingsYes	0.1812	-0.0847	0.4471	1.1986	0.9187	1.5638	0.1817	0.4461
hshld_vehicles	0.1848	0.0971	0.2726	1.2030	1.1019	1.3134	0.0000	0.0007

Table S40. Prostate cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from local authority, local council, housing association	-0.2288	-0.3387	-0.1190	0.7955	0.7127	0.8878	0.0000	0.0007
own_or_rentOwn with a mortgage	-0.0016	-0.0549	0.0516	0.9984	0.9466	1.0529	0.9516	0.9838
own_or_rentRent - from private landlord or letting agency	-0.2177	-0.3611	-0.0743	0.8043	0.6969	0.9284	0.0029	0.0182
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0487	-0.5125	0.4151	0.9524	0.5990	1.5144	0.8369	0.9271
own_or_rentLive in accommodation rent free	-0.0485	-0.2956	0.1986	0.9527	0.7441	1.2197	0.7006	0.8456
age_voiceYounger than average	-0.0019	-0.1063	0.1025	0.9981	0.8992	1.1079	0.9716	0.9838
age_voiceOlder than average	0.0170	-0.0730	0.1071	1.0172	0.9296	1.1130	0.7099	0.8456
number_children	0.0113	-0.0051	0.0278	1.0114	0.9949	1.0282	0.1772	0.4461
townsend_deprivation_index	-0.0427	-0.0679	-0.0175	0.9582	0.9344	0.9826	0.0009	0.0075
psychiatrist_visit_mental_health Yes	0.0418	-0.0280	0.1116	1.0426	0.9724	1.1180	0.2409	0.5069
risk_takingYes	0.0298	-0.0152	0.0749	1.0303	0.9849	1.0777	0.1947	0.4639
tiredness_freq	0.0192	-0.0434	0.0817	1.0193	0.9576	1.0851	0.5482	0.7279
unenthusiasm_freq	0.0637	-0.0216	0.1489	1.0658	0.9787	1.1606	0.1430	0.4135

Table S40. Prostate cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
fast_driving	0.0945	0.0158	0.1732	1.0991	1.0160	1.1891	0.0186	0.0885
gymYes	0.0663	0.0181	0.1146	1.0686	1.0183	1.1214	0.0070	0.0379
LTPA	0.0679	0.0156	0.1202	1.0703	1.0157	1.1277	0.0111	0.0563
sedentary	0.0073	-0.0312	0.0458	1.0074	0.9693	1.0469	0.7091	0.8456
air_pollution_PC1	-0.0014	-0.0122	0.0094	0.9986	0.9879	1.0094	0.7988	0.8986
greenspace_PC1	-0.0050	-0.0174	0.0074	0.9950	0.9828	1.0074	0.4305	0.6457
number_sex_partners	-0.0088	-0.0353	0.0177	0.9912	0.9653	1.0179	0.5149	0.6951
sex_age_first	-0.0165	-0.0383	0.0053	0.9837	0.9625	1.0053	0.1377	0.4135
chronotypeMore an 'evening' than a 'morning' person	0.0555	-0.0045	0.1155	1.0570	0.9955	1.1224	0.0695	0.2558
chronotypeDefinitely an 'evening' person	0.0351	-0.0520	0.1222	1.0357	0.9493	1.1300	0.4295	0.6457
chronotypeDefinitely a 'morning' person	0.0405	-0.0131	0.0941	1.0413	0.9870	1.0986	0.1387	0.4135
nap	-0.0270	-0.0742	0.0202	0.9734	0.9285	1.0204	0.2624	0.5069
sleep_hours_categorical<7 hours	-0.0306	-0.0817	0.0206	0.9699	0.9216	1.0208	0.2412	0.5069
sleep_hours_categorical>9 hours	-0.0396	-0.1177	0.0384	0.9612	0.8890	1.0392	0.3199	0.5398
family_visit_freq	0.1544	0.0560	0.2527	1.1669	1.0576	1.2875	0.0021	0.0142
religious_groupYes	-0.0035	-0.0656	0.0585	0.9965	0.9365	1.0603	0.9108	0.9836

Table S40. Prostate cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
facial_agingOlder than you are	-0.0835	-0.2317	0.0646	0.9199	0.7932	1.0667	0.2691	0.5069
facial_agingAbout your age	-0.0271	-0.0788	0.0247	0.9733	0.9242	1.0250	0.3043	0.5359
skin_colorVery fair	-0.0318	-0.1211	0.0576	0.9687	0.8859	1.0593	0.4861	0.6789
skin_colorBlack	-0.0070	-0.3186	0.3046	0.9930	0.7272	1.3560	0.9647	0.9838
skin_colorLight olive	0.0244	-0.0334	0.0822	1.0247	0.9671	1.0856	0.4082	0.6359
skin_colorDark olive	-0.1388	-0.2949	0.0173	0.8704	0.7446	1.0175	0.0814	0.2868
skin_colorBrown	0.0814	-0.1051	0.2680	1.0848	0.9002	1.3074	0.3922	0.6279
sun_protection_use	0.0186	-0.0566	0.0937	1.0188	0.9450	1.0983	0.6278	0.8072
fish_oil_supplementsYes	0.0319	-0.0127	0.0766	1.0325	0.9874	1.0796	0.1610	0.4461
folate_supplementsYes	-0.0978	-0.2674	0.0718	0.9068	0.7654	1.0744	0.2582	0.5069
glucosamine_supplementsYes	0.0896	0.0366	0.1426	1.0938	1.0373	1.1533	0.0009	0.0075
multivitamin_supplementsYes	0.0292	-0.0243	0.0827	1.0296	0.9760	1.0862	0.2852	0.5134
pack_years_prop	-0.0393	-0.0596	-0.0189	0.9615	0.9421	0.9813	0.0002	0.0022
smoking_statusPrevious	-0.0482	-0.0927	-0.0037	0.9529	0.9115	0.9963	0.0338	0.1368
smoking_statusCurrent	-0.1459	-0.2225	-0.0693	0.8642	0.8005	0.9331	0.0002	0.0022
IPAQ_activity_group	-0.0148	-0.0562	0.0265	0.9853	0.9454	1.0269	0.4817	0.6789
education_years	0.0301	-0.0191	0.0793	1.0305	0.9811	1.0825	0.2306	0.5069

Table S40. Prostate cancer

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
hshld_income	0.1415	0.0755	0.2075	1.1520	1.0784	1.2306	0.0000	0.0007
ethnicityAsian	-0.6132	-0.8159	-0.4105	0.5416	0.4422	0.6633	0.0000	0.0000
ethnicityBlack	0.7869	0.6368	0.9371	2.1966	1.8903	2.5526	0.0000	0.0000
ethnicityMixed	0.1533	-0.2002	0.5068	1.1657	0.8185	1.6600	0.3954	0.6279
ethnicityOther	0.0265	-0.2424	0.2953	1.0268	0.7848	1.3435	0.8470	0.9271

Table S41. Type II diabetes

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.5144	-0.5805	-0.4482	0.5979	0.5596	0.6388	0.0000	0.0000
alcohol_freqOnce or twice a week	-0.2160	-0.2757	-0.1562	0.8058	0.7590	0.8554	0.0000	0.0000
alcohol_freqThree or four times a week	-0.4037	-0.4676	-0.3397	0.6679	0.6265	0.7120	0.0000	0.0000
bread	0.0752	0.0391	0.1113	1.0781	1.0399	1.1178	0.0000	0.0001
cereal	-0.2069	-0.2398	-0.1740	0.8131	0.7868	0.8403	0.0000	0.0000
never_eat_dairyYes	0.1329	0.0289	0.2370	1.1422	1.0293	1.2674	0.0123	0.0155
never_eat_eggsYes	0.1458	0.0573	0.2344	1.1570	1.0590	1.2641	0.0012	0.0018
never_eat_sugarYes	0.1108	0.0673	0.1543	1.1172	1.0696	1.1668	0.0000	0.0000
partial_fiber_score	-0.0544	-0.0937	-0.0152	0.9470	0.9106	0.9849	0.0066	0.0085
poultry	0.1943	0.1472	0.2415	1.2145	1.1585	1.2732	0.0000	0.0000
processed_meat	0.2833	0.2413	0.3253	1.3275	1.2729	1.3845	0.0000	0.0000
red_meat	0.2085	0.1669	0.2501	1.2318	1.1817	1.2841	0.0000	0.0000
salt	0.1570	0.1156	0.1984	1.1699	1.1225	1.2194	0.0000	0.0000
body_size_10yrs_oldThinner	0.2136	0.1746	0.2525	1.2381	1.1908	1.2873	0.0000	0.0000
body_size_10yrs_oldPlumper	0.3688	0.3201	0.4175	1.4460	1.3772	1.5182	0.0000	0.0000
height_10yrs_oldShorter	0.0295	-0.0151	0.0741	1.0300	0.9851	1.0769	0.1942	0.2075

Table S41. Type II diabetes

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0487	0.0069	0.0904	1.0499	1.0070	1.0947	0.0223	0.0267
maternal_smokingYes	0.1901	0.1506	0.2297	1.2094	1.1626	1.2582	0.0000	0.0000
mobile_phone_2yrsYes, use is now more frequent	0.0880	0.0323	0.1437	1.0920	1.0329	1.1546	0.0035	0.0048
mobile_phone_2yrsYes, use is now less frequent	0.1331	0.0757	0.1905	1.1424	1.0787	1.2099	0.0000	0.0000
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0714	-0.1508	0.2936	1.0740	0.8600	1.3412	0.4963	0.5162
employedYes	-0.1011	-0.1477	-0.0546	0.9038	0.8627	0.9469	0.0000	0.0000
unemployedYes	0.0842	-0.0223	0.1907	1.0879	0.9779	1.2101	0.1213	0.1333
accommodation_typeMobile or temporary structure (i.e. caravan)	0.1710	-0.2211	0.5631	1.1865	0.8016	1.7562	0.3927	0.4139
accommodation_typeA flat, maisonette or apartment	0.1891	0.1316	0.2466	1.2082	1.1406	1.2797	0.0000	0.0000
gas_hob_heatYes	-0.0064	-0.0444	0.0316	0.9936	0.9565	1.0321	0.7401	0.7401
hshld_parentsYes	0.1324	0.0121	0.2527	1.1415	1.0122	1.2874	0.0310	0.0366
hshld_partnerYes	-0.1033	-0.1444	-0.0621	0.9019	0.8655	0.9397	0.0000	0.0000
hshld_siblingsYes	0.1710	-0.0198	0.3617	1.1865	0.9804	1.4358	0.0790	0.0906
hshld_vehicles	-0.2468	-0.3255	-0.1680	0.7813	0.7222	0.8453	0.0000	0.0000

Table S41. Type II diabetes

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.4892	0.4034	0.5750	1.6310	1.4968	1.7772	0.0000	0.0000
own_or_rentOwn with a mortgage	0.2413	0.1964	0.2863	1.2729	1.2170	1.3315	0.0000	0.0000
own_or_rentRent - from local authority, local council, housing association	0.6942	0.6354	0.7529	2.0020	1.8877	2.1232	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.3756	0.1017	0.6495	1.4559	1.1071	1.9147	0.0072	0.0092
own_or_rentLive in accommodation rent free	0.1741	-0.0221	0.3703	1.1902	0.9781	1.4482	0.0820	0.0927
townsend_deprivation_index	0.1885	0.1700	0.2070	1.2074	1.1852	1.2300	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.3922	0.3459	0.4385	1.4803	1.4133	1.5504	0.0000	0.0000
risk_takingYes	0.1210	0.0820	0.1600	1.1286	1.0854	1.1735	0.0000	0.0000
tiredness_freq	0.6859	0.6436	0.7282	1.9855	1.9033	2.0713	0.0000	0.0000
unenthusiasm_freq	0.5503	0.4990	0.6017	1.7338	1.6470	1.8252	0.0000	0.0000
fast_driving	-0.2043	-0.2751	-0.1334	0.8153	0.7595	0.8751	0.0000	0.0000
gymYes	-0.2567	-0.3009	-0.2126	0.7736	0.7402	0.8085	0.0000	0.0000
LTPA	-0.3670	-0.4245	-0.3095	0.6928	0.6541	0.7338	0.0000	0.0000

Table S41. Type II diabetes

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.3324	0.3005	0.3643	1.3943	1.3506	1.4395	0.0000	0.0000
air_pollution_PC1	0.0408	0.0322	0.0494	1.0417	1.0327	1.0507	0.0000	0.0000
greenspace_PC1	-0.0385	-0.0495	-0.0275	0.9622	0.9517	0.9729	0.0000	0.0000
number_sex_partners	-0.0050	-0.0289	0.0190	0.9951	0.9715	1.0192	0.6803	0.6892
sex_age_first	-0.1043	-0.1249	-0.0836	0.9010	0.8826	0.9198	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.0524	-0.0037	0.1085	1.0538	0.9963	1.1146	0.0663	0.0772
chronotypeDefinitely an 'evening' person	0.2345	0.1675	0.3015	1.2643	1.1824	1.3518	0.0000	0.0000
chronotypeDefinitely a 'morning' person	0.1322	0.0827	0.1817	1.1414	1.0862	1.1993	0.0000	0.0000
nap	0.4560	0.4180	0.4940	1.5778	1.5189	1.6389	0.0000	0.0000
sleep_hours_categorical<7 hours	0.2835	0.2451	0.3219	1.3277	1.2777	1.3797	0.0000	0.0000
sleep_hours_categorical>9 hours	0.3026	0.2454	0.3599	1.3534	1.2781	1.4332	0.0000	0.0000
family_visit_freq	0.0707	-0.0101	0.1516	1.0733	0.9899	1.1637	0.0865	0.0964
religious_groupYes	0.0145	-0.0334	0.0623	1.0146	0.9672	1.0643	0.5535	0.5680
facial_agingOlder than you are	0.4310	0.3148	0.5472	1.5389	1.3700	1.7285	0.0000	0.0000
facial_agingAbout your age	0.0686	0.0262	0.1109	1.0710	1.0266	1.1172	0.0016	0.0022
skin_colorVery fair	0.1386	0.0743	0.2029	1.1486	1.0771	1.2249	0.0000	0.0000

Table S41. Type II diabetes

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.2378	0.0441	0.4314	1.2684	1.0451	1.5394	0.0161	0.0196
skin_colorLight olive	-0.0626	-0.1118	-0.0134	0.9393	0.8942	0.9866	0.0127	0.0157
skin_colorDark olive	0.0878	-0.0289	0.2046	1.0918	0.9715	1.2271	0.1404	0.1521
skin_colorBrown	0.1722	0.0531	0.2913	1.1879	1.0546	1.3381	0.0046	0.0062
sun_protection_use	-0.2432	-0.3032	-0.1832	0.7841	0.7384	0.8326	0.0000	0.0000
fish_oil_supplementsYes	-0.1754	-0.2143	-0.1365	0.8391	0.8071	0.8724	0.0000	0.0000
folate_supplementsYes	0.2204	0.1150	0.3257	1.2465	1.1219	1.3851	0.0000	0.0001
glucosamine_supplementsYes	-0.1073	-0.1533	-0.0614	0.8982	0.8579	0.9405	0.0000	0.0000
multivitamin_supplementsYes	-0.0619	-0.1049	-0.0188	0.9400	0.9004	0.9814	0.0049	0.0064
pack_years_prop	0.2442	0.2314	0.2569	1.2766	1.2604	1.2929	0.0000	0.0000
smoking_statusPrevious	0.2590	0.2213	0.2968	1.2957	1.2477	1.3456	0.0000	0.0000
smoking_statusCurrent	0.4934	0.4419	0.5448	1.6378	1.5557	1.7243	0.0000	0.0000
IPAQ_activity_group	-0.3910	-0.4294	-0.3525	0.6764	0.6509	0.7029	0.0000	0.0000
education_years	-0.3805	-0.4228	-0.3382	0.6835	0.6552	0.7131	0.0000	0.0000
hshld_income	-0.7776	-0.8426	-0.7126	0.4595	0.4306	0.4904	0.0000	0.0000
ethnicityAsian	1.0714	0.9826	1.1603	2.9196	2.6713	3.1910	0.0000	0.0000
ethnicityBlack	1.0649	0.9647	1.1651	2.9005	2.6239	3.2062	0.0000	0.0000

Table S41. Type II diabetes

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.4320	0.2184	0.6455	1.5403	1.2441	1.9070	0.0001	0.0001
ethnicityOther	0.7513	0.6021	0.9004	2.1197	1.8260	2.4607	0.0000	0.0000

Table S42. Ischemic heart disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.1149	-0.1609	-0.0688	0.8915	0.8514	0.9335	0.0000	0.0000
alcohol_freqOnce or twice a week	-0.0555	-0.0998	-0.0111	0.9460	0.9050	0.9890	0.0143	0.0182
alcohol_freqThree or four times a week	-0.1328	-0.1786	-0.0870	0.8757	0.8365	0.9167	0.0000	0.0000
bread	0.0189	-0.0059	0.0436	1.0191	0.9942	1.0446	0.1347	0.1501
cereal	-0.0726	-0.0956	-0.0495	0.9300	0.9088	0.9517	0.0000	0.0000
never_eat_dairyYes	0.1646	0.0917	0.2375	1.1789	1.0961	1.2680	0.0000	0.0000
never_eat_eggsYes	0.1470	0.0803	0.2137	1.1583	1.0836	1.2382	0.0000	0.0000
never_eat_sugarYes	0.1107	0.0818	0.1397	1.1171	1.0852	1.1499	0.0000	0.0000
partial_fiber_score	-0.0641	-0.0917	-0.0365	0.9379	0.9124	0.9642	0.0000	0.0000
poultry	0.0903	0.0576	0.1230	1.0945	1.0593	1.1309	0.0000	0.0000
processed_meat	0.0908	0.0617	0.1200	1.0951	1.0636	1.1275	0.0000	0.0000
red_meat	0.0993	0.0704	0.1283	1.1044	1.0729	1.1369	0.0000	0.0000
salt	0.1164	0.0865	0.1462	1.1234	1.0904	1.1574	0.0000	0.0000
body_size_10yrs_oldThinner	0.0743	0.0479	0.1007	1.0771	1.0491	1.1059	0.0000	0.0000
body_size_10yrs_oldPlumper	0.1534	0.1188	0.1880	1.1658	1.1261	1.2069	0.0000	0.0000
height_10yrs_oldShorter	0.0360	0.0050	0.0670	1.0367	1.0050	1.0693	0.0227	0.0277

Table S42. Ischemic heart disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0226	-0.0064	0.0516	1.0229	0.9937	1.0530	0.1262	0.1426
maternal_smokingYes	0.1117	0.0813	0.1420	1.1181	1.0847	1.1526	0.0000	0.0000
mobile_phone_2yrsYes, use is now more frequent	0.0741	0.0374	0.1108	1.0769	1.0381	1.1172	0.0003	0.0004
mobile_phone_2yrsYes, use is now less frequent	0.0955	0.0536	0.1374	1.1002	1.0550	1.1473	0.0000	0.0000
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0358	-0.1217	0.1932	1.0364	0.8854	1.2132	0.6302	0.6302
employedYes	-0.0979	-0.1288	-0.0670	0.9067	0.8791	0.9352	0.0000	0.0000
unemployedYes	0.0972	0.0154	0.1791	1.1021	1.0155	1.1961	0.0199	0.0250
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.1016	-0.4162	0.2130	0.9034	0.6596	1.2373	0.5267	0.5477
accommodation_typeA flat, maisonette or apartment	0.1212	0.0782	0.1642	1.1289	1.0814	1.1784	0.0000	0.0000
gas_hob_heatYes	-0.0080	-0.0343	0.0183	0.9921	0.9663	1.0185	0.5524	0.5669
hshld_parentsYes	0.0608	-0.0308	0.1525	1.0627	0.9697	1.1647	0.1933	0.2094
hshld_partnerYes	-0.0477	-0.0766	-0.0188	0.9534	0.9263	0.9814	0.0012	0.0018
hshld_siblingsYes	0.1220	-0.0271	0.2711	1.1297	0.9732	1.3114	0.1089	0.1249
hshld_vehicles	-0.0947	-0.1471	-0.0422	0.9097	0.8632	0.9586	0.0004	0.0006

Table S42. Ischemic heart disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.2123	0.1429	0.2818	1.2366	1.1536	1.3255	0.0000	0.0000
own_or_rentOwn with a mortgage	0.1350	0.1039	0.1660	1.1445	1.1095	1.1806	0.0000	0.0000
own_or_rentRent - from local authority, local council, housing association	0.4703	0.4238	0.5168	1.6005	1.5278	1.6766	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.3249	0.1170	0.5328	1.3839	1.1241	1.7037	0.0022	0.0031
own_or_rentLive in accommodation rent free	0.1980	0.0654	0.3306	1.2190	1.0676	1.3918	0.0034	0.0045
townsend_deprivation_index	0.1003	0.0870	0.1137	1.1055	1.0909	1.1204	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.2978	0.2634	0.3322	1.3469	1.3013	1.3940	0.0000	0.0000
risk_takingYes	0.1061	0.0789	0.1334	1.1120	1.0821	1.1427	0.0000	0.0000
tiredness_freq	0.5353	0.5045	0.5660	1.7079	1.6562	1.7613	0.0000	0.0000
unenthusiasm_freq	0.3644	0.3228	0.4060	1.4397	1.3811	1.5007	0.0000	0.0000
fast_driving	-0.0680	-0.1155	-0.0205	0.9342	0.8909	0.9797	0.0050	0.0065
gymYes	-0.0877	-0.1166	-0.0587	0.9161	0.8899	0.9430	0.0000	0.0000
LTPA	-0.1209	-0.1563	-0.0855	0.8861	0.8553	0.9180	0.0000	0.0000

Table S42. Ischemic heart disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.1434	0.1206	0.1662	1.1542	1.1282	1.1809	0.0000	0.0000
air_pollution_PC1	0.0201	0.0140	0.0262	1.0203	1.0141	1.0265	0.0000	0.0000
greenspace_PC1	-0.0166	-0.0238	-0.0093	0.9836	0.9765	0.9907	0.0000	0.0000
number_sex_partners	0.0099	0.0041	0.0158	1.0100	1.0041	1.0159	0.0009	0.0014
sex_age_first	-0.0875	-0.1009	-0.0740	0.9163	0.9040	0.9287	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.0645	0.0316	0.0974	1.0666	1.0321	1.1023	0.0002	0.0002
chronotypeDefinitely an 'evening' person	0.1358	0.0891	0.1825	1.1455	1.0932	1.2002	0.0000	0.0000
chronotypeDefinitely a 'morning' person	0.0819	0.0477	0.1161	1.0854	1.0489	1.1231	0.0000	0.0000
nap	0.2123	0.1853	0.2394	1.2365	1.2035	1.2704	0.0000	0.0000
sleep_hours_categorical<7 hours	0.1993	0.1719	0.2266	1.2205	1.1875	1.2543	0.0000	0.0000
sleep_hours_categorical>9 hours	0.1832	0.1415	0.2250	1.2011	1.1520	1.2523	0.0000	0.0000
family_visit_freq	0.0650	0.0089	0.1211	1.0672	1.0090	1.1288	0.0231	0.0277
religious_groupYes	0.0354	0.0017	0.0691	1.0360	1.0017	1.0715	0.0396	0.0467
facial_agingOlder than you are	0.3975	0.2895	0.5055	1.4881	1.3358	1.6579	0.0000	0.0000
facial_agingAbout your age	0.0706	0.0413	0.0998	1.0731	1.0422	1.1050	0.0000	0.0000
skin_colorVery fair	0.0718	0.0257	0.1180	1.0745	1.0260	1.1252	0.0023	0.0032

Table S42. Ischemic heart disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.1243	-0.0842	0.3328	1.1324	0.9193	1.3949	0.2426	0.2592
skin_colorLight olive	-0.0085	-0.0405	0.0235	0.9915	0.9603	1.0238	0.6015	0.6093
skin_colorDark olive	-0.0789	-0.1692	0.0114	0.9241	0.8443	1.0114	0.0867	0.1009
skin_colorBrown	0.1169	0.0179	0.2159	1.1240	1.0181	1.2410	0.0206	0.0255
sun_protection_use	-0.1261	-0.1685	-0.0837	0.8815	0.8449	0.9197	0.0000	0.0000
fish_oil_supplementsYes	-0.1033	-0.1294	-0.0773	0.9018	0.8786	0.9256	0.0000	0.0000
folate_supplementsYes	0.2600	0.1842	0.3357	1.2969	1.2023	1.3989	0.0000	0.0000
glucosamine_supplementsYes	-0.0939	-0.1246	-0.0633	0.9104	0.8829	0.9387	0.0000	0.0000
multivitamin_supplementsYes	-0.0460	-0.0762	-0.0159	0.9550	0.9266	0.9843	0.0028	0.0038
pack_years_prop	0.1890	0.1783	0.1997	1.2080	1.1952	1.2210	0.0000	0.0000
smoking_statusPrevious	0.1836	0.1575	0.2098	1.2016	1.1705	1.2334	0.0000	0.0000
smoking_statusCurrent	0.5312	0.4949	0.5675	1.7010	1.6403	1.7639	0.0000	0.0000
IPAQ_activity_group	-0.1468	-0.1722	-0.1214	0.8634	0.8418	0.8857	0.0000	0.0000
education_years	-0.1791	-0.2072	-0.1510	0.8361	0.8129	0.8599	0.0000	0.0000
hshld_income	-0.3992	-0.4396	-0.3589	0.6708	0.6443	0.6984	0.0000	0.0000
ethnicityAsian	0.5601	0.4866	0.6335	1.7508	1.6268	1.8843	0.0000	0.0000
ethnicityBlack	-0.1797	-0.2984	-0.0609	0.8356	0.7420	0.9409	0.0030	0.0041

Table S42. Ischemic heart disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.0701	-0.1105	0.2506	1.0726	0.8954	1.2848	0.4470	0.4711
ethnicityOther	0.1015	-0.0372	0.2402	1.1068	0.9634	1.2715	0.1516	0.1666

Table S43. Cerebrovascular diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	0.0480	-0.0182	0.1143	1.0492	0.9820	1.1210	0.1549	0.1981
alcohol_freqOnce or twice a week	-0.0190	-0.0838	0.0457	0.9812	0.9197	1.0468	0.5646	0.6117
alcohol_freqThree or four times a week	-0.0473	-0.1140	0.0194	0.9538	0.8923	1.0196	0.1647	0.2039
bread	-0.0190	-0.0548	0.0168	0.9812	0.9467	1.0170	0.2984	0.3423
cereal	-0.1034	-0.1362	-0.0707	0.9017	0.8727	0.9318	0.0000	0.0000
never_eat_dairyYes	0.2812	0.1844	0.3781	1.3248	1.2025	1.4595	0.0000	0.0000
never_eat_eggsYes	0.1925	0.0990	0.2860	1.2122	1.1040	1.3310	0.0001	0.0001
never_eat_sugarYes	0.1437	0.1037	0.1838	1.1546	1.1092	1.2018	0.0000	0.0000
partial_fiber_score	-0.0710	-0.1106	-0.0313	0.9315	0.8953	0.9692	0.0005	0.0009
poultry	-0.0293	-0.0752	0.0166	0.9711	0.9275	1.0168	0.2114	0.2536
processed_meat	0.0540	0.0127	0.0954	1.0555	1.0128	1.1000	0.0104	0.0160
red_meat	0.0376	-0.0040	0.0792	1.0383	0.9960	1.0824	0.0764	0.1010
salt	0.0753	0.0325	0.1181	1.0782	1.0330	1.1253	0.0006	0.0011
body_size_10yrs_oldThinner	0.0420	0.0044	0.0796	1.0429	1.0044	1.0829	0.0286	0.0405
body_size_10yrs_oldPlumper	0.0772	0.0268	0.1276	1.0803	1.0272	1.1361	0.0027	0.0047
height_10yrs_oldShorter	0.0350	-0.0095	0.0794	1.0356	0.9906	1.0826	0.1232	0.1601

Table S43. Cerebrovascular diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0530	0.0120	0.0940	1.0545	1.0121	1.0986	0.0113	0.0169
maternal_smokingYes	0.0789	0.0381	0.1198	1.0821	1.0388	1.1273	0.0002	0.0004
mobile_phone_2yrsYes, use is now more frequent	0.0598	0.0178	0.1018	1.0616	1.0179	1.1072	0.0054	0.0087
mobile_phone_2yrsYes, use is now less frequent	0.0780	0.0241	0.1318	1.0811	1.0244	1.1409	0.0046	0.0077
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0480	-0.0832	0.1792	1.0492	0.9202	1.1963	0.4727	0.5193
employedYes	-0.1241	-0.1694	-0.0787	0.8833	0.8441	0.9243	0.0000	0.0000
unemployedYes	0.1256	-0.0019	0.2531	1.1338	0.9981	1.2880	0.0535	0.0732
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0948	-0.5236	0.3340	0.9095	0.5924	1.3965	0.6647	0.6913
accommodation_typeA flat, maisonette or apartment	0.2371	0.1789	0.2952	1.2675	1.1959	1.3434	0.0000	0.0000
gas_hob_heatYes	-0.0480	-0.0845	-0.0115	0.9531	0.9190	0.9885	0.0099	0.0155
hshld_parentsYes	0.1624	0.0242	0.3006	1.1763	1.0245	1.3507	0.0213	0.0308
hshld_partnerYes	-0.1730	-0.2132	-0.1328	0.8412	0.8080	0.8757	0.0000	0.0000
hshld_siblingsYes	0.2518	0.0450	0.4586	1.2863	1.0461	1.5818	0.0170	0.0250
hshld_vehicles	-0.2707	-0.3496	-0.1918	0.7628	0.7050	0.8254	0.0000	0.0000

Table S43. Cerebrovascular diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.2674	0.1697	0.3651	1.3066	1.1850	1.4406	0.0000	0.0000
own_or_rentOwn with a mortgage	0.0800	0.0329	0.1270	1.0833	1.0335	1.1354	0.0009	0.0016
own_or_rentRent - from local authority, local council, housing association	0.5429	0.4811	0.6047	1.7210	1.6179	1.8308	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.3946	0.1129	0.6763	1.4838	1.1195	1.9666	0.0060	0.0096
own_or_rentLive in accommodation rent free	0.0430	-0.1666	0.2526	1.0439	0.8465	1.2873	0.6877	0.7058
townsend_deprivation_index	0.1224	0.1035	0.1412	1.1302	1.1091	1.1517	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.2481	0.1991	0.2971	1.2816	1.2203	1.3459	0.0000	0.0000
risk_takingYes	0.1275	0.0860	0.1689	1.1359	1.0898	1.1840	0.0000	0.0000
tiredness_freq	0.4520	0.4080	0.4960	1.5714	1.5038	1.6421	0.0000	0.0000
unenthusiasm_freq	0.4189	0.3617	0.4761	1.5203	1.4357	1.6098	0.0000	0.0000
fast_driving	-0.3033	-0.3740	-0.2326	0.7384	0.6880	0.7924	0.0000	0.0000
gymYes	-0.1302	-0.1723	-0.0881	0.8779	0.8418	0.9156	0.0000	0.0000
LTPA	-0.1323	-0.1806	-0.0840	0.8761	0.8348	0.9194	0.0000	0.0000

Table S43. Cerebrovascular diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.1246	0.0929	0.1563	1.1327	1.0974	1.1692	0.0000	0.0000
air_pollution_PC1	0.0200	0.0112	0.0287	1.0202	1.0113	1.0291	0.0000	0.0000
greenspace_PC1	-0.0156	-0.0260	-0.0052	0.9845	0.9743	0.9948	0.0034	0.0059
number_sex_partners	0.0066	-0.0042	0.0175	1.0067	0.9958	1.0176	0.2295	0.2697
sex_age_first	-0.0618	-0.0818	-0.0418	0.9401	0.9215	0.9591	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.0838	0.0324	0.1352	1.0874	1.0330	1.1448	0.0019	0.0035
chronotypeDefinitely an 'evening' person	0.1159	0.0479	0.1839	1.1229	1.0491	1.2019	0.0009	0.0016
chronotypeDefinitely a 'morning' person	0.0451	-0.0011	0.0914	1.0462	0.9989	1.0957	0.0558	0.0750
nap	0.2038	0.1653	0.2422	1.2260	1.1798	1.2740	0.0000	0.0000
sleep_hours_categorical<7 hours	0.1363	0.0964	0.1762	1.1460	1.1012	1.1926	0.0000	0.0000
sleep_hours_categorical>9 hours	0.2299	0.1738	0.2860	1.2585	1.1898	1.3311	0.0000	0.0000
family_visit_freq	-0.0555	-0.1353	0.0243	0.9460	0.8734	1.0246	0.1725	0.2103
religious_groupYes	0.0110	-0.0360	0.0579	1.0110	0.9647	1.0596	0.6464	0.6814
facial_agingOlder than you are	0.4041	0.2586	0.5496	1.4980	1.2952	1.7325	0.0000	0.0000
facial_agingAbout your age	0.0712	0.0304	0.1120	1.0738	1.0308	1.1185	0.0006	0.0012
skin_colorVery fair	0.0941	0.0300	0.1582	1.0987	1.0305	1.1714	0.0040	0.0068

Table S43. Cerebrovascular diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.2829	0.0191	0.5468	1.3270	1.0193	1.7277	0.0356	0.0495
skin_colorLight olive	-0.0231	-0.0700	0.0239	0.9772	0.9324	1.0241	0.3352	0.3790
skin_colorDark olive	-0.0084	-0.1382	0.1214	0.9916	0.8709	1.1291	0.8988	0.8988
skin_colorBrown	0.1057	-0.0431	0.2545	1.1115	0.9578	1.2898	0.1639	0.2039
sun_protection_use	-0.1795	-0.2394	-0.1196	0.8357	0.7871	0.8873	0.0000	0.0000
fish_oil_supplementsYes	-0.1058	-0.1435	-0.0682	0.8996	0.8663	0.9341	0.0000	0.0000
folate_supplementsYes	0.3998	0.3035	0.4961	1.4916	1.3546	1.6423	0.0000	0.0000
glucosamine_supplementsYes	-0.0949	-0.1386	-0.0513	0.9094	0.8706	0.9500	0.0000	0.0000
multivitamin_supplementsYes	-0.0099	-0.0521	0.0323	0.9901	0.9492	1.0328	0.6446	0.6814
pack_years_prop	0.1905	0.1762	0.2048	1.2098	1.1926	1.2273	0.0000	0.0000
smoking_statusPrevious	0.1337	0.0964	0.1711	1.1431	1.1011	1.1866	0.0000	0.0000
smoking_statusCurrent	0.6191	0.5675	0.6707	1.8572	1.7638	1.9556	0.0000	0.0000
IPAQ_activity_group	-0.1351	-0.1717	-0.0986	0.8736	0.8423	0.9061	0.0000	0.0000
education_years	-0.1284	-0.1699	-0.0869	0.8795	0.8437	0.9167	0.0000	0.0000
hshld_income	-0.5019	-0.5656	-0.4382	0.6054	0.5680	0.6452	0.0000	0.0000
ethnicityAsian	0.0490	-0.0788	0.1768	1.0502	0.9242	1.1933	0.4524	0.5042
ethnicityBlack	0.2695	0.1311	0.4079	1.3093	1.1400	1.5037	0.0001	0.0003

Table S43. Cerebrovascular diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.1527	-0.0976	0.4030	1.1650	0.9070	1.4964	0.2317	0.2697
ethnicityOther	0.0203	-0.1830	0.2235	1.0205	0.8328	1.2504	0.8451	0.8561

Table S44. Emphysema, COPD

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	0.1124	0.0463	0.1785	1.1190	1.0474	1.1955	0.0009	0.0012
alcohol_freqOnce or twice a week	0.0284	-0.0367	0.0934	1.0288	0.9640	1.0979	0.3927	0.4084
alcohol_freqThree or four times a week	-0.0720	-0.1405	-0.0035	0.9305	0.8689	0.9965	0.0394	0.0473
bread	0.0350	-0.0009	0.0708	1.0356	0.9991	1.0734	0.0560	0.0662
cereal	-0.2552	-0.2876	-0.2228	0.7748	0.7501	0.8003	0.0000	0.0000
never_eat_dairyYes	0.3040	0.2103	0.3977	1.3553	1.2340	1.4884	0.0000	0.0000
never_eat_eggsYes	0.2573	0.1716	0.3430	1.2935	1.1872	1.4092	0.0000	0.0000
never_eat_sugarYes	0.0732	0.0325	0.1139	1.0759	1.0331	1.1206	0.0004	0.0006
partial_fiber_score	-0.2735	-0.3132	-0.2338	0.7607	0.7311	0.7915	0.0000	0.0000
poultry	-0.0582	-0.1040	-0.0125	0.9434	0.9012	0.9876	0.0126	0.0154
processed_meat	0.2120	0.1697	0.2543	1.2361	1.1849	1.2895	0.0000	0.0000
red_meat	0.1831	0.1413	0.2249	1.2009	1.1517	1.2522	0.0000	0.0000
salt	0.3086	0.2694	0.3477	1.3615	1.3092	1.4158	0.0000	0.0000
body_size_10yrs_oldThinner	0.1384	0.1008	0.1760	1.1484	1.1060	1.1925	0.0000	0.0000
body_size_10yrs_oldPlumper	0.1132	0.0641	0.1624	1.1199	1.0662	1.1763	0.0000	0.0000
height_10yrs_oldShorter	0.1142	0.0707	0.1576	1.1209	1.0733	1.1707	0.0000	0.0000

Table S44. Emphysema, COPD

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0588	0.0171	0.1004	1.0606	1.0173	1.1057	0.0057	0.0072
maternal_smokingYes	0.2734	0.2293	0.3175	1.3145	1.2578	1.3737	0.0000	0.0000
mobile_phone_2yrsYes, use is now more frequent	0.0305	-0.0155	0.0765	1.0309	0.9846	1.0795	0.1918	0.2137
mobile_phone_2yrsYes, use is now less frequent	0.0975	0.0442	0.1507	1.1024	1.0452	1.1627	0.0004	0.0005
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0394	-0.0979	0.1766	1.0402	0.9068	1.1932	0.5720	0.5720
employedYes	-0.2364	-0.2872	-0.1856	0.7895	0.7504	0.8306	0.0000	0.0000
unemployedYes	0.0972	-0.0113	0.2057	1.1020	0.9887	1.2284	0.0792	0.0922
accommodation_typeMobile or temporary structure (i.e. caravan)	0.2339	-0.0945	0.5623	1.2635	0.9098	1.7547	0.1627	0.1839
accommodation_typeA flat, maisonette or apartment	0.2769	0.2234	0.3304	1.3190	1.2503	1.3916	0.0000	0.0000
gas_hob_heatYes	-0.0202	-0.0572	0.0169	0.9800	0.9444	1.0170	0.2859	0.3013
hshld_parentsYes	0.1773	0.0482	0.3064	1.1940	1.0494	1.3585	0.0071	0.0088
hshld_partnerYes	-0.1680	-0.2111	-0.1248	0.8454	0.8097	0.8826	0.0000	0.0000
hshld_siblingsYes	0.2892	0.0956	0.4828	1.3353	1.1003	1.6206	0.0034	0.0045
hshld_vehicles	-0.5247	-0.6157	-0.4337	0.5917	0.5402	0.6481	0.0000	0.0000

Table S44. Emphysema, COPD

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.4760	0.3851	0.5668	1.6096	1.4698	1.7627	0.0000	0.0000
own_or_rentOwn with a mortgage	0.1811	0.1332	0.2289	1.1985	1.1425	1.2572	0.0000	0.0000
own_or_rentRent - from local authority, local council, housing association	0.7942	0.7388	0.8497	2.2128	2.0933	2.3390	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.1774	-0.1275	0.4822	1.1941	0.8803	1.6197	0.2541	0.2715
own_or_rentLive in accommodation rent free	0.2770	0.0805	0.4735	1.3192	1.0838	1.6056	0.0057	0.0072
townsend_deprivation_index	0.2378	0.2185	0.2570	1.2684	1.2442	1.2931	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.3868	0.3420	0.4315	1.4722	1.4078	1.5396	0.0000	0.0000
risk_takingYes	0.1504	0.1109	0.1898	1.1623	1.1173	1.2090	0.0000	0.0000
tiredness_freq	0.6537	0.6126	0.6949	1.9227	1.8453	2.0034	0.0000	0.0000
unenthusiasm_freq	0.5525	0.5014	0.6036	1.7376	1.6510	1.8287	0.0000	0.0000
fast_driving	-0.3625	-0.4393	-0.2857	0.6959	0.6445	0.7515	0.0000	0.0000
gymYes	-0.3145	-0.3615	-0.2676	0.7301	0.6966	0.7652	0.0000	0.0000
LTPA	-0.3289	-0.3806	-0.2772	0.7197	0.6834	0.7579	0.0000	0.0000

Table S44. Emphysema, COPD

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.2014	0.1693	0.2336	1.2232	1.1845	1.2631	0.0000	0.0000
air_pollution_PC1	0.0563	0.0475	0.0651	1.0579	1.0487	1.0672	0.0000	0.0000
greenspace_PC1	-0.0458	-0.0570	-0.0347	0.9552	0.9446	0.9659	0.0000	0.0000
number_sex_partners	0.0073	-0.0010	0.0156	1.0073	0.9990	1.0157	0.0858	0.0984
sex_age_first	-0.1766	-0.2000	-0.1532	0.8381	0.8188	0.8580	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.1094	0.0600	0.1588	1.1156	1.0619	1.1721	0.0000	0.0001
chronotypeDefinitely an 'evening' person	0.2686	0.2025	0.3347	1.3081	1.2244	1.3975	0.0000	0.0000
chronotypeDefinitely a 'morning' person	0.0893	0.0429	0.1357	1.0935	1.0439	1.1454	0.0002	0.0003
nap	0.2615	0.2235	0.2995	1.2989	1.2504	1.3492	0.0000	0.0000
sleep_hours_categorical<7 hours	0.2900	0.2517	0.3284	1.3365	1.2862	1.3888	0.0000	0.0000
sleep_hours_categorical>9 hours	0.3012	0.2470	0.3554	1.3515	1.2801	1.4268	0.0000	0.0000
family_visit_freq	-0.0322	-0.1107	0.0462	0.9683	0.8952	1.0473	0.4204	0.4259
religious_groupYes	-0.1778	-0.2335	-0.1221	0.8371	0.7917	0.8850	0.0000	0.0000
facial_agingOlder than you are	0.6505	0.4967	0.8043	1.9166	1.6433	2.2352	0.0000	0.0000
facial_agingAbout your age	0.1823	0.1422	0.2224	1.2000	1.1528	1.2490	0.0000	0.0000
skin_colorVery fair	0.2194	0.1570	0.2818	1.2454	1.1700	1.3256	0.0000	0.0000

Table S44. Emphysema, COPD

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.1514	-0.2114	0.5143	1.1635	0.8094	1.6724	0.4134	0.4243
skin_colorLight olive	0.0681	0.0228	0.1134	1.0705	1.0231	1.1201	0.0032	0.0043
skin_colorDark olive	0.1732	0.0565	0.2900	1.1892	1.0581	1.3364	0.0036	0.0047
skin_colorBrown	0.3118	0.1623	0.4613	1.3659	1.1763	1.5862	0.0000	0.0001
sun_protection_use	-0.3191	-0.3781	-0.2600	0.7268	0.6851	0.7711	0.0000	0.0000
fish_oil_supplementsYes	-0.1741	-0.2131	-0.1352	0.8402	0.8081	0.8736	0.0000	0.0000
folate_supplementsYes	0.3758	0.2783	0.4733	1.4561	1.3208	1.6053	0.0000	0.0000
glucosamine_supplementsYes	-0.1673	-0.2140	-0.1206	0.8459	0.8073	0.8864	0.0000	0.0000
multivitamin_supplementsYes	-0.0683	-0.1122	-0.0244	0.9340	0.8939	0.9759	0.0023	0.0032
pack_years_prop	0.4342	0.3598	0.5086	1.5437	1.4331	1.6629	0.0001	0.0001
smoking_statusPrevious	1.1254	1.0784	1.1723	3.0813	2.9400	3.2294	0.0000	0.0000
smoking_statusCurrent	2.3607	2.3110	2.4105	10.5989	10.0842	11.1398	0.0000	0.0000
IPAQ_activity_group	-0.2571	-0.2976	-0.2166	0.7733	0.7426	0.8052	0.0000	0.0000
education_years	-0.4779	-0.5211	-0.4347	0.6201	0.5939	0.6475	0.0000	0.0000
hshld_income	-1.0691	-1.1564	-0.9817	0.3433	0.3146	0.3747	0.0000	0.0000
ethnicityAsian	-0.0962	-0.2479	0.0555	0.9083	0.7804	1.0571	0.2140	0.2351
ethnicityBlack	-0.5849	-0.7904	-0.3794	0.5571	0.4536	0.6842	0.0000	0.0000

Table S44. Emphysema, COPD

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.1533	-0.4122	0.1056	0.8579	0.6622	1.1114	0.2458	0.2663
ethnicityOther	-0.3851	-0.6234	-0.1467	0.6804	0.5361	0.8635	0.0015	0.0022

Table S45. Chronic liver diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	1.1008	0.9295	1.2721	3.0065	2.5332	3.5683	0.0000	0.0000
alcohol_freqOnce or twice a week	0.0252	-0.1598	0.2103	1.0256	0.8523	1.2341	0.7890	0.8098
alcohol_freqThree or four times a week	0.2388	0.0526	0.4250	1.2697	1.0540	1.5296	0.0120	0.0167
bread	-0.1619	-0.2482	-0.0756	0.8505	0.7802	0.9272	0.0002	0.0004
cereal	-0.4779	-0.5578	-0.3980	0.6201	0.5725	0.6717	0.0000	0.0000
never_eat_dairyYes	0.4873	0.2763	0.6983	1.6279	1.3182	2.0104	0.0000	0.0000
never_eat_eggsYes	0.4111	0.2122	0.6101	1.5085	1.2363	1.8406	0.0001	0.0001
never_eat_sugarYes	0.4086	0.3139	0.5033	1.5047	1.3687	1.6542	0.0000	0.0000
partial_fiber_score	-0.2545	-0.3514	-0.1577	0.7753	0.7037	0.8541	0.0000	0.0000
poultry	0.0986	-0.0142	0.2114	1.1036	0.9859	1.2354	0.0866	0.1072
processed_meat	0.2376	0.1353	0.3399	1.2682	1.1449	1.4048	0.0000	0.0000
red_meat	0.3447	0.2446	0.4447	1.4115	1.2771	1.5601	0.0000	0.0000
salt	0.4433	0.3484	0.5382	1.5579	1.4168	1.7130	0.0000	0.0000
body_size_10yrs_oldThinner	0.0689	-0.0236	0.1613	1.0713	0.9767	1.1751	0.1443	0.1732
body_size_10yrs_oldPlumper	0.1462	0.0284	0.2641	1.1575	1.0288	1.3022	0.0150	0.0202
height_10yrs_oldShorter	0.1635	0.0593	0.2677	1.1776	1.0611	1.3070	0.0021	0.0033

Table S45. Chronic liver diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0868	-0.0143	0.1879	1.0907	0.9858	1.2067	0.0923	0.1125
maternal_smokingYes	0.3213	0.2180	0.4246	1.3789	1.2436	1.5290	0.0000	0.0000
mobile_phone_2yrsYes, use is now more frequent	0.0437	-0.0543	0.1417	1.0447	0.9472	1.1523	0.3814	0.4132
mobile_phone_2yrsYes, use is now less frequent	0.0767	-0.0517	0.2050	1.0797	0.9496	1.2275	0.2410	0.2764
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0413	-0.3743	0.2917	0.9595	0.6877	1.3387	0.8078	0.8161
employedYes	-0.4318	-0.5419	-0.3217	0.6493	0.5816	0.7249	0.0000	0.0000
unemployedYes	0.4556	0.2578	0.6535	1.5771	1.2940	1.9222	0.0000	0.0000
accommodation_typeMobile or temporary structure (i.e. caravan)	0.8474	0.1890	1.5058	2.3336	1.2081	4.5078	0.0117	0.0166
accommodation_typeA flat, maisonette or apartment	0.6482	0.5299	0.7665	1.9121	1.6987	2.1523	0.0000	0.0000
gas_hob_heatYes	-0.1099	-0.1984	-0.0214	0.8959	0.8201	0.9788	0.0149	0.0202
hshld_parentsYes	0.2618	0.0043	0.5193	1.2993	1.0043	1.6808	0.0463	0.0592
hshld_partnerYes	-0.3901	-0.4865	-0.2937	0.6770	0.6148	0.7455	0.0000	0.0000
hshld_siblingsYes	0.5717	0.1965	0.9469	1.7713	1.2172	2.5777	0.0028	0.0042
hshld_vehicles	-0.9231	-1.1233	-0.7230	0.3973	0.3252	0.4853	0.0000	0.0000

Table S45. Chronic liver diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.6428	0.4529	0.8328	1.9019	1.5728	2.2998	0.0000	0.0000
own_or_rentOwn with a mortgage	0.1850	0.0742	0.2958	1.2032	1.0770	1.3443	0.0011	0.0018
own_or_rentRent - from local authority, local council, housing association	0.8584	0.7245	0.9923	2.3593	2.0637	2.6974	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.3619	-0.2976	1.0213	1.4360	0.7426	2.7769	0.2820	0.3142
own_or_rentLive in accommodation rent free	0.0588	-0.4366	0.5541	1.0605	0.6462	1.7404	0.8161	0.8161
townsend_deprivation_index	0.2479	0.2037	0.2922	1.2814	1.2259	1.3393	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.4987	0.3945	0.6029	1.6466	1.4836	1.8273	0.0000	0.0000
risk_takingYes	0.2567	0.1671	0.3464	1.2927	1.1819	1.4140	0.0000	0.0000
tiredness_freq	0.6205	0.5199	0.7210	1.8598	1.6819	2.0566	0.0000	0.0000
unenthusiasm_freq	0.7127	0.5967	0.8287	2.0395	1.8162	2.2904	0.0000	0.0000
fast_driving	-0.5767	-0.7482	-0.4053	0.5617	0.4732	0.6668	0.0000	0.0000
gymYes	-0.3337	-0.4458	-0.2216	0.7163	0.6403	0.8012	0.0000	0.0000
LTPA	-0.3981	-0.5159	-0.2803	0.6716	0.5970	0.7556	0.0000	0.0000

Table S45. Chronic liver diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.2237	0.1455	0.3019	1.2507	1.1566	1.3525	0.0000	0.0000
air_pollution_PC1	0.0791	0.0587	0.0995	1.0823	1.0604	1.1046	0.0000	0.0000
greenspace_PC1	-0.0661	-0.0933	-0.0388	0.9361	0.9109	0.9620	0.0000	0.0000
number_sex_partners	0.0141	0.0051	0.0232	1.0142	1.0051	1.0234	0.0023	0.0035
sex_age_first	-0.1704	-0.2228	-0.1179	0.8433	0.8002	0.8888	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.1755	0.0609	0.2901	1.1918	1.0628	1.3365	0.0029	0.0042
chronotypeDefinitely an 'evening' person	0.3181	0.1673	0.4688	1.3745	1.1822	1.5981	0.0000	0.0001
chronotypeDefinitely a 'morning' person	0.1960	0.0821	0.3098	1.2165	1.0855	1.3632	0.0008	0.0013
nap	0.2882	0.1956	0.3809	1.3340	1.2160	1.4635	0.0000	0.0000
sleep_hours_categorical<7 hours	0.3692	0.2758	0.4625	1.4465	1.3176	1.5881	0.0000	0.0000
sleep_hours_categorical>9 hours	0.5364	0.4079	0.6649	1.7099	1.5037	1.9444	0.0000	0.0000
family_visit_freq	-0.1199	-0.3056	0.0659	0.8870	0.7367	1.0681	0.2058	0.2432
religious_groupYes	-0.2642	-0.4027	-0.1256	0.7678	0.6685	0.8819	0.0002	0.0003
facial_agingOlder than you are	0.2831	0.0461	0.5202	1.3273	1.0471	1.6824	0.0193	0.0251
facial_agingAbout your age	0.1780	0.0768	0.2792	1.1949	1.0799	1.3221	0.0007	0.0011
skin_colorVery fair	0.0672	-0.0860	0.2204	1.0695	0.9176	1.2465	0.3901	0.4168

Table S45. Chronic liver diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	-0.2352	-1.0328	0.5625	0.7904	0.3560	1.7551	0.5632	0.5937
skin_colorLight olive	-0.0657	-0.1800	0.0487	0.9364	0.8353	1.0499	0.2600	0.2939
skin_colorDark olive	0.2371	-0.0308	0.5050	1.2675	0.9697	1.6569	0.0827	0.1041
skin_colorBrown	0.0758	-0.2911	0.4428	1.0788	0.7474	1.5570	0.6853	0.7127
sun_protection_use	-0.3235	-0.4681	-0.1789	0.7236	0.6262	0.8362	0.0000	0.0000
fish_oil_supplementsYes	-0.2704	-0.3663	-0.1745	0.7631	0.6933	0.8399	0.0000	0.0000
folate_supplementsYes	0.6150	0.3973	0.8327	1.8497	1.4878	2.2996	0.0000	0.0000
glucosamine_supplementsYes	-0.2928	-0.4155	-0.1701	0.7462	0.6600	0.8436	0.0000	0.0000
multivitamin_supplementsYes	0.0520	-0.0516	0.1557	1.0534	0.9497	1.1684	0.3249	0.3569
pack_years_prop	0.2960	0.2725	0.3196	1.3445	1.3132	1.3766	0.0000	0.0000
smoking_statusPrevious	0.4353	0.3396	0.5310	1.5454	1.4043	1.7006	0.0000	0.0000
smoking_statusCurrent	0.9686	0.8546	1.0826	2.6342	2.3505	2.9522	0.0000	0.0000
IPAQ_activity_group	-0.3211	-0.4005	-0.2418	0.7253	0.6700	0.7852	0.0000	0.0000
education_years	-0.2569	-0.3543	-0.1595	0.7735	0.7017	0.8526	0.0000	0.0000
hshld_income	-1.1982	-1.3599	-1.0365	0.3017	0.2567	0.3547	0.0000	0.0000
ethnicityAsian	-0.5657	-0.9268	-0.2047	0.5679	0.3958	0.8149	0.0021	0.0033
ethnicityBlack	-0.6078	-1.0184	-0.1972	0.5446	0.3612	0.8211	0.0037	0.0054

Table S45. Chronic liver diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.2890	-0.1776	0.7556	1.3351	0.8373	2.1289	0.2246	0.2615
ethnicityOther	-0.6599	-1.2098	-0.1101	0.5169	0.2983	0.8957	0.0187	0.0247

Table S46. Chronic kidney diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.3377	-0.3989	-0.2766	0.7134	0.6711	0.7584	0.0000	0.0000
alcohol_freqOnce or twice a week	-0.1429	-0.1993	-0.0865	0.8668	0.8193	0.9171	0.0000	0.0000
alcohol_freqThree or four times a week	-0.3366	-0.3971	-0.2761	0.7142	0.6723	0.7587	0.0000	0.0000
bread	0.0531	0.0197	0.0865	1.0545	1.0199	1.0903	0.0019	0.0026
cereal	-0.1224	-0.1527	-0.0921	0.8848	0.8584	0.9121	0.0000	0.0000
never_eat_dairyYes	0.2525	0.1665	0.3386	1.2873	1.1811	1.4030	0.0000	0.0000
never_eat_eggsYes	0.1884	0.1078	0.2690	1.2073	1.1139	1.3086	0.0000	0.0000
never_eat_sugarYes	0.2186	0.1824	0.2547	1.2443	1.2002	1.2901	0.0000	0.0000
partial_fiber_score	-0.1014	-0.1380	-0.0649	0.9035	0.8711	0.9371	0.0000	0.0000
poultry	0.1334	0.0896	0.1772	1.1427	1.0937	1.1939	0.0000	0.0000
processed_meat	0.1784	0.1399	0.2168	1.1952	1.1501	1.2422	0.0000	0.0000
red_meat	0.1737	0.1355	0.2119	1.1897	1.1451	1.2360	0.0000	0.0000
salt	0.0539	0.0142	0.0935	1.0553	1.0143	1.0980	0.0077	0.0100
body_size_10yrs_oldThinner	0.0345	-0.0018	0.0707	1.0351	0.9982	1.0733	0.0622	0.0724
body_size_10yrs_oldPlumper	0.2314	0.1874	0.2755	1.2604	1.2061	1.3171	0.0000	0.0000
height_10yrs_oldShorter	-0.0067	-0.0476	0.0341	0.9933	0.9535	1.0347	0.7464	0.7661

Table S46. Chronic kidney diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0785	0.0406	0.1165	1.0817	1.0414	1.1236	0.0001	0.0001
maternal_smokingYes	0.1441	0.1054	0.1828	1.1550	1.1112	1.2005	0.0000	0.0000
mobile_phone_2yrsYes, use is now more frequent	0.0391	-0.0001	0.0782	1.0399	0.9999	1.0814	0.0505	0.0597
mobile_phone_2yrsYes, use is now less frequent	0.1098	0.0600	0.1597	1.1161	1.0618	1.1731	0.0000	0.0000
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.1406	0.0070	0.2743	1.1510	1.0070	1.3156	0.0396	0.0475
employedYes	-0.1463	-0.1898	-0.1029	0.8639	0.8272	0.9022	0.0000	0.0000
unemployedYes	0.0065	-0.1247	0.1378	1.0065	0.8827	1.1477	0.9225	0.9225
accommodation_typeMobile or temporary structure (i.e. caravan)	0.1375	-0.1998	0.4749	1.1475	0.8189	1.6078	0.4242	0.4532
accommodation_typeA flat, maisonette or apartment	0.1937	0.1382	0.2492	1.2137	1.1482	1.2829	0.0000	0.0000
gas_hob_heatYes	-0.0367	-0.0704	-0.0030	0.9640	0.9320	0.9970	0.0330	0.0408
hshld_parentsYes	0.1000	-0.0379	0.2379	1.1051	0.9628	1.2685	0.1552	0.1681
hshld_partnerYes	-0.1375	-0.1755	-0.0996	0.8715	0.8390	0.9052	0.0000	0.0000
hshld_siblingsYes	0.2984	0.1067	0.4900	1.3476	1.1126	1.6323	0.0023	0.0031
hshld_vehicles	-0.3064	-0.3830	-0.2297	0.7361	0.6818	0.7948	0.0000	0.0000

Table S46. Chronic kidney diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.2979	0.2055	0.3902	1.3470	1.2282	1.4773	0.0000	0.0000
own_or_rentOwn with a mortgage	0.1499	0.1062	0.1935	1.1617	1.1121	1.2134	0.0000	0.0000
own_or_rentRent - from local authority, local council, housing association	0.5669	0.5111	0.6227	1.7628	1.6671	1.8639	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.2538	-0.0367	0.5443	1.2889	0.9639	1.7234	0.0869	0.0968
own_or_rentLive in accommodation rent free	0.2687	0.0902	0.4473	1.3083	1.0944	1.5640	0.0032	0.0043
townsend_deprivation_index	0.1514	0.1340	0.1689	1.1635	1.1434	1.1840	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.3040	0.2596	0.3485	1.3553	1.2964	1.4169	0.0000	0.0000
risk_takingYes	0.0799	0.0416	0.1182	1.0831	1.0425	1.1254	0.0001	0.0001
tiredness_freq	0.6783	0.6370	0.7197	1.9706	1.8908	2.0538	0.0000	0.0000
unenthusiasm_freq	0.4506	0.3972	0.5040	1.5693	1.4877	1.6553	0.0000	0.0000
fast_driving	-0.2483	-0.3155	-0.1812	0.7801	0.7294	0.8343	0.0000	0.0000
gymYes	-0.0683	-0.1076	-0.0290	0.9340	0.8980	0.9714	0.0007	0.0009
LTPA	-0.2648	-0.3087	-0.2209	0.7674	0.7344	0.8018	0.0000	0.0000

Table S46. Chronic kidney diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.3056	0.2757	0.3355	1.3574	1.3175	1.3986	0.0000	0.0000
air_pollution_PC1	0.0415	0.0334	0.0496	1.0424	1.0340	1.0509	0.0000	0.0000
greenspace_PC1	-0.0336	-0.0434	-0.0239	0.9669	0.9576	0.9764	0.0000	0.0000
number_sex_partners	0.0090	-0.0033	0.0213	1.0091	0.9967	1.0216	0.1511	0.1660
sex_age_first	-0.0820	-0.1013	-0.0628	0.9212	0.9037	0.9391	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.0555	0.0095	0.1015	1.0571	1.0096	1.1068	0.0186	0.0238
chronotypeDefinitely an 'evening' person	0.2341	0.1739	0.2944	1.2638	1.1900	1.3423	0.0000	0.0000
chronotypeDefinitely a 'morning' person	0.0401	-0.0041	0.0843	1.0409	0.9959	1.0880	0.0752	0.0850
nap	0.3534	0.3184	0.3884	1.4239	1.3749	1.4747	0.0000	0.0000
sleep_hours_categorical<7 hours	0.1661	0.1293	0.2029	1.1807	1.1380	1.2249	0.0000	0.0000
sleep_hours_categorical>9 hours	0.3461	0.2971	0.3951	1.4135	1.3459	1.4845	0.0000	0.0000
family_visit_freq	-0.0046	-0.0783	0.0691	0.9954	0.9247	1.0716	0.9031	0.9148
religious_groupYes	-0.0618	-0.1053	-0.0183	0.9401	0.9000	0.9819	0.0054	0.0071
facial_agingOlder than you are	0.5107	0.3754	0.6459	1.6664	1.4556	1.9078	0.0000	0.0000
facial_agingAbout your age	0.0816	0.0426	0.1205	1.0850	1.0436	1.1280	0.0000	0.0001
skin_colorVery fair	0.1279	0.0693	0.1866	1.1365	1.0717	1.2052	0.0000	0.0000

Table S46. Chronic kidney diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.2048	-0.0170	0.4265	1.2273	0.9832	1.5320	0.0703	0.0806
skin_colorLight olive	-0.0133	-0.0567	0.0300	0.9868	0.9449	1.0305	0.5471	0.5766
skin_colorDark olive	0.0314	-0.0859	0.1486	1.0319	0.9177	1.1602	0.6001	0.6241
skin_colorBrown	0.1416	0.0123	0.2709	1.1521	1.0124	1.3111	0.0319	0.0401
sun_protection_use	-0.2317	-0.2866	-0.1769	0.7931	0.7508	0.8378	0.0000	0.0000
fish_oil_supplementsYes	-0.2283	-0.2627	-0.1940	0.7959	0.7690	0.8237	0.0000	0.0000
folate_supplementsYes	0.3431	0.2531	0.4331	1.4093	1.2880	1.5420	0.0000	0.0000
glucosamine_supplementsYes	-0.2282	-0.2693	-0.1871	0.7960	0.7639	0.8293	0.0000	0.0000
multivitamin_supplementsYes	-0.1602	-0.2010	-0.1194	0.8520	0.8179	0.8875	0.0000	0.0000
pack_years_prop	0.1990	0.1842	0.2137	1.2201	1.2022	1.2383	0.0000	0.0000
smoking_statusPrevious	0.1761	0.1422	0.2101	1.1926	1.1528	1.2338	0.0000	0.0000
smoking_statusCurrent	0.3329	0.2801	0.3857	1.3950	1.3233	1.4706	0.0000	0.0000
IPAQ_activity_group	-0.3705	-0.4055	-0.3356	0.6904	0.6667	0.7149	0.0000	0.0000
education_years	-0.3045	-0.3428	-0.2662	0.7375	0.7097	0.7663	0.0000	0.0000
hshld_income	-0.6274	-0.6932	-0.5615	0.5340	0.5000	0.5704	0.0000	0.0000
ethnicityAsian	0.5371	0.4305	0.6437	1.7111	1.5381	1.9036	0.0000	0.0000
ethnicityBlack	0.8057	0.6924	0.9190	2.2382	1.9984	2.5068	0.0000	0.0000

Table S46. Chronic kidney diseases

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.2573	0.0166	0.4980	1.2934	1.0167	1.6454	0.0362	0.0441
ethnicityOther	0.3618	0.1812	0.5424	1.4359	1.1987	1.7202	0.0001	0.0001

Table S47. All-cause dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.0392	-0.1457	0.0674	0.9616	0.8644	1.0697	0.4713	0.5254
alcohol_freqOnce or twice a week	-0.1415	-0.2457	-0.0372	0.8681	0.7821	0.9634	0.0078	0.0136
alcohol_freqThree or four times a week	-0.1227	-0.2304	-0.0151	0.8845	0.7942	0.9851	0.0255	0.0406
bread	-0.0952	-0.1530	-0.0374	0.9092	0.8581	0.9633	0.0012	0.0026
cereal	-0.0275	-0.0810	0.0259	0.9728	0.9222	1.0262	0.3122	0.3635
never_eat_dairyYes	0.4969	0.3619	0.6319	1.6436	1.4361	1.8811	0.0000	0.0000
never_eat_eggsYes	0.5939	0.4690	0.7188	1.8110	1.5984	2.0520	0.0000	0.0000
never_eat_sugarYes	0.2141	0.1516	0.2765	1.2387	1.1637	1.3185	0.0000	0.0000
partial_fiber_score	0.1654	0.1005	0.2303	1.1799	1.1057	1.2590	0.0000	0.0000
poultry	-0.1019	-0.1763	-0.0275	0.9031	0.8384	0.9729	0.0073	0.0129
processed_meat	0.0405	-0.0270	0.1080	1.0413	0.9733	1.1141	0.2399	0.2835
red_meat	-0.0677	-0.1357	0.0003	0.9345	0.8731	1.0003	0.0510	0.0750
salt	-0.0533	-0.1247	0.0181	0.9481	0.8827	1.0182	0.1430	0.1800
body_size_10yrs_oldThinner	0.0534	-0.0085	0.1153	1.0548	0.9915	1.1222	0.0910	0.1185
body_size_10yrs_oldPlumper	0.1536	0.0705	0.2367	1.1660	1.0730	1.2670	0.0003	0.0007
height_10yrs_oldShorter	0.0864	0.0160	0.1569	1.0903	1.0162	1.1698	0.0161	0.0268

Table S47. All-cause dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0189	-0.0505	0.0883	1.0191	0.9508	1.0923	0.5930	0.6250
maternal_smokingYes	0.0640	-0.0042	0.1322	1.0661	0.9958	1.1413	0.0659	0.0918
mobile_phone_2yrsYes, use is now more frequent	-0.0125	-0.1531	0.1282	0.9876	0.8580	1.1368	0.8446	0.8668
mobile_phone_2yrsYes, use is now less frequent	0.0768	-0.0118	0.1653	1.0798	0.9883	1.1798	0.0893	0.1185
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.1604	-0.0398	0.3606	1.1740	0.9610	1.4342	0.1159	0.1482
employedYes	-0.3766	-0.4600	-0.2932	0.6862	0.6313	0.7459	0.0000	0.0000
unemployedYes	0.4486	0.2237	0.6735	1.5661	1.2507	1.9610	0.0001	0.0002
accommodation_typeMobile or temporary structure (i.e. caravan)	0.2006	-0.3456	0.7467	1.2221	0.7078	2.1100	0.4716	0.5254
accommodation_typeA flat, maisonette or apartment	0.2211	0.1252	0.3171	1.2475	1.1333	1.3731	0.0000	0.0000
gas_hob_heatYes	-0.0280	-0.0895	0.0335	0.9724	0.9144	1.0341	0.3714	0.4260
hshld_parentsYes	-0.2132	-0.5377	0.1113	0.8080	0.5841	1.1178	0.1978	0.2374
hshld_partnerYes	-0.1777	-0.2436	-0.1118	0.8372	0.7838	0.8942	0.0000	0.0000
hshld_siblingsYes	0.5066	0.1822	0.8310	1.6596	1.1998	2.2956	0.0022	0.0042
hshld_vehicles	-0.5959	-0.7382	-0.4537	0.5510	0.4780	0.6352	0.0000	0.0000

Table S47. All-cause dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.3041	0.1346	0.4736	1.3554	1.1441	1.6057	0.0005	0.0010
own_or_rentOwn with a mortgage	0.1112	0.0262	0.1961	1.1176	1.0266	1.2166	0.0103	0.0175
own_or_rentRent - from local authority, local council, housing association	0.6384	0.5420	0.7348	1.8935	1.7195	2.0850	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	-0.2174	-0.8726	0.4378	0.8046	0.4178	1.5494	0.5154	0.5659
own_or_rentLive in accommodation rent free	0.2319	-0.0933	0.5571	1.2610	0.9109	1.7455	0.1622	0.1977
townsend_deprivation_index	0.1371	0.1062	0.1680	1.1469	1.1120	1.1829	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.4043	0.3279	0.4807	1.4983	1.3880	1.6172	0.0000	0.0000
risk_takingYes	0.0622	-0.0043	0.1287	1.0642	0.9957	1.1374	0.0669	0.0918
tiredness_freq	0.5580	0.4882	0.6279	1.7472	1.6293	1.8737	0.0000	0.0000
unenthusiasm_freq	0.6191	0.5262	0.7120	1.8573	1.6925	2.0380	0.0000	0.0000
fast_driving	-0.8492	-0.9762	-0.7223	0.4277	0.3767	0.4857	0.0000	0.0000
gymYes	-0.2157	-0.2864	-0.1450	0.8060	0.7509	0.8650	0.0000	0.0000
LTPA	-0.2177	-0.2968	-0.1385	0.8044	0.7432	0.8706	0.0000	0.0000

Table S47. All-cause dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.1051	0.0531	0.1570	1.1108	1.0546	1.1700	0.0001	0.0002
air_pollution_PC1	0.0363	0.0219	0.0507	1.0370	1.0222	1.0520	0.0000	0.0000
greenspace_PC1	-0.0514	-0.0688	-0.0340	0.9499	0.9335	0.9665	0.0000	0.0000
number_sex_partners	0.0139	-0.0049	0.0327	1.0140	0.9951	1.0333	0.1454	0.1801
sex_age_first	-0.0456	-0.0758	-0.0153	0.9555	0.9270	0.9848	0.0032	0.0059
chronotypeMore an 'evening' than a 'morning' person	0.0668	-0.0109	0.1444	1.0690	0.9892	1.1553	0.0912	0.1185
chronotypeDefinitely an 'evening' person	0.1238	0.0089	0.2386	1.1317	1.0090	1.2695	0.0347	0.0542
chronotypeDefinitely a 'morning' person	0.0739	0.0025	0.1454	1.0767	1.0025	1.1565	0.0425	0.0637
nap	0.1618	0.1001	0.2235	1.1757	1.1053	1.2505	0.0000	0.0000
sleep_hours_categorical<7 hours	0.1698	0.1047	0.2349	1.1851	1.1104	1.2647	0.0000	0.0000
sleep_hours_categorical>9 hours	0.2340	0.1472	0.3207	1.2636	1.1586	1.3781	0.0000	0.0000
family_visit_freq	-0.2672	-0.3955	-0.1389	0.7655	0.6734	0.8703	0.0000	0.0001
religious_groupYes	-0.0237	-0.0978	0.0503	0.9765	0.9069	1.0516	0.5296	0.5659
facial_agingOlder than you are	0.5862	0.3667	0.8056	1.7971	1.4430	2.2381	0.0000	0.0000
facial_agingAbout your age	0.1388	0.0585	0.2191	1.1489	1.0602	1.2449	0.0012	0.0025
skin_colorVery fair	0.1982	0.0972	0.2991	1.2192	1.1021	1.3486	0.0001	0.0003

Table S47. All-cause dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.4105	-0.0289	0.8499	1.5076	0.9715	2.3394	0.0671	0.0918
skin_colorLight olive	-0.0763	-0.1579	0.0053	0.9265	0.8539	1.0053	0.0667	0.0918
skin_colorDark olive	0.2086	0.0071	0.4100	1.2319	1.0072	1.5068	0.0424	0.0637
skin_colorBrown	0.2818	0.0365	0.5270	1.3254	1.0372	1.6938	0.0243	0.0396
sun_protection_use	-0.2662	-0.3621	-0.1703	0.7663	0.6962	0.8434	0.0000	0.0000
fish_oil_supplementsYes	-0.0963	-0.1552	-0.0374	0.9082	0.8563	0.9632	0.0014	0.0027
folate_supplementsYes	0.3638	0.2095	0.5182	1.4389	1.2331	1.6790	0.0000	0.0000
glucosamine_supplementsYes	-0.1121	-0.1821	-0.0421	0.8940	0.8335	0.9588	0.0017	0.0034
multivitamin_supplementsYes	-0.0226	-0.0919	0.0467	0.9777	0.9122	1.0478	0.5226	0.5659
pack_years_prop	0.1469	0.1233	0.1705	1.1582	1.1312	1.1859	0.0000	0.0000
smoking_statusPrevious	0.0849	0.0256	0.1442	1.0886	1.0259	1.1551	0.0050	0.0091
smoking_statusCurrent	0.3215	0.2270	0.4159	1.3791	1.2548	1.5158	0.0000	0.0000
IPAQ_activity_group	-0.1871	-0.2471	-0.1272	0.8293	0.7811	0.8806	0.0000	0.0000
education_years	-0.1911	-0.2615	-0.1206	0.8261	0.7699	0.8864	0.0000	0.0000
hshld_income	-0.8609	-0.9927	-0.7290	0.4228	0.3706	0.4824	0.0000	0.0000
ethnicityAsian	0.0031	-0.2241	0.2303	1.0031	0.7992	1.2590	0.9787	0.9914
ethnicityBlack	0.4034	0.1745	0.6324	1.4970	1.1906	1.8822	0.0006	0.0012

Table S47. All-cause dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.1235	-0.3405	0.5875	1.1314	0.7114	1.7995	0.6019	0.6260
ethnicityOther	-0.0019	-0.3768	0.3730	0.9981	0.6860	1.4520	0.9920	0.9920

Table S48. Vascular dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	0.0805	-0.1375	0.2985	1.0838	0.8715	1.3479	0.4689	0.5725
alcohol_freqOnce or twice a week	-0.0506	-0.2643	0.1631	0.9506	0.7677	1.1772	0.6422	0.7155
alcohol_freqThree or four times a week	-0.0631	-0.2853	0.1591	0.9388	0.7518	1.1724	0.5773	0.6622
bread	-0.1073	-0.2222	0.0076	0.8983	0.8008	1.0076	0.0672	0.1116
cereal	-0.0771	-0.1831	0.0290	0.9258	0.8327	1.0294	0.1541	0.2404
never_eat_dairyYes	0.5991	0.3354	0.8628	1.8205	1.3985	2.3698	0.0000	0.0001
never_eat_eggsYes	0.6401	0.3918	0.8885	1.8967	1.4796	2.4315	0.0000	0.0000
never_eat_sugarYes	0.3568	0.2361	0.4776	1.4288	1.2663	1.6122	0.0000	0.0000
partial_fiber_score	0.1791	0.0503	0.3079	1.1961	1.0516	1.3605	0.0065	0.0144
poultry	-0.0037	-0.1550	0.1476	0.9963	0.8564	1.1591	0.9618	0.9743
processed_meat	-0.0391	-0.1739	0.0957	0.9617	0.8404	1.1005	0.5696	0.6622
red_meat	-0.0018	-0.1368	0.1331	0.9982	0.8722	1.1424	0.9790	0.9790
salt	-0.0609	-0.2022	0.0804	0.9409	0.8170	1.0837	0.3978	0.5259
body_size_10yrs_oldThinner	0.1063	-0.0188	0.2314	1.1121	0.9813	1.2604	0.0958	0.1556
body_size_10yrs_oldPlumper	0.2185	0.0546	0.3824	1.2442	1.0561	1.4657	0.0091	0.0191
height_10yrs_oldShorter	0.0854	-0.0524	0.2233	1.0892	0.9489	1.2502	0.2243	0.3302

Table S48. Vascular dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	-0.0475	-0.1856	0.0906	0.9536	0.8306	1.0948	0.5001	0.6001
maternal_smokingYes	0.0550	-0.0771	0.1870	1.0565	0.9258	1.2057	0.4138	0.5306
mobile_phone_2yrsYes, use is now more frequent	-0.0192	-0.2432	0.2047	0.9810	0.7841	1.2272	0.8564	0.8944
mobile_phone_2yrsYes, use is now less frequent	0.1039	-0.0773	0.2851	1.1095	0.9257	1.3298	0.2587	0.3669
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.1630	-0.6746	0.3487	0.8496	0.5093	1.4172	0.5266	0.6224
employedYes	-0.3446	-0.5107	-0.1786	0.7085	0.6001	0.8365	0.0001	0.0002
unemployedYes	0.3122	-0.1549	0.7793	1.3664	0.8565	2.1799	0.1901	0.2851
accommodation_typeMobile or temporary structure (i.e. caravan)	0.9631	0.2153	1.7110	2.6199	1.2402	5.5347	0.0116	0.0233
accommodation_typeA flat, maisonette or apartment	0.3455	0.1615	0.5296	1.4127	1.1752	1.6983	0.0002	0.0008
gas_hob_heatYes	-0.0453	-0.1670	0.0764	0.9557	0.8462	1.0794	0.4647	0.5725
hshld_parentsYes	0.1114	-0.4599	0.6827	1.1178	0.6313	1.9792	0.7022	0.7714
hshld_partnerYes	-0.2112	-0.3379	-0.0845	0.8096	0.7132	0.9190	0.0011	0.0032
hshld_siblingsYes	0.2039	-0.5410	0.9488	1.2262	0.5821	2.5826	0.5914	0.6685
hshld_vehicles	-0.4124	-0.6893	-0.1354	0.6621	0.5019	0.8734	0.0036	0.0085

Table S48. Vascular dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.4456	0.1206	0.7705	1.5614	1.1282	2.1609	0.0073	0.0158
own_or_rentOwn with a mortgage	0.3006	0.1370	0.4642	1.3506	1.1468	1.5907	0.0003	0.0010
own_or_rentRent - from local authority, local council, housing association	0.7894	0.6131	0.9656	2.2020	1.8461	2.6264	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.1026	-1.0339	1.2390	1.1080	0.3556	3.4522	0.8595	0.8944
own_or_rentLive in accommodation rent free	0.2740	-0.3852	0.9333	1.3153	0.6803	2.5428	0.4149	0.5306
townsend_deprivation_index	0.1729	0.1140	0.2319	1.1888	1.1208	1.2610	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.6012	0.4584	0.7440	1.8243	1.5816	2.1043	0.0000	0.0000
risk_takingYes	0.1356	0.0073	0.2638	1.1452	1.0074	1.3019	0.0383	0.0664
tiredness_freq	0.7265	0.5933	0.8596	2.0678	1.8100	2.3623	0.0000	0.0000
unenthusiasm_freq	0.7361	0.5627	0.9096	2.0878	1.7553	2.4833	0.0000	0.0000
fast_driving	-0.8187	-1.0735	-0.5639	0.4410	0.3418	0.5690	0.0000	0.0000
gymYes	-0.2367	-0.3813	-0.0921	0.7892	0.6830	0.9120	0.0014	0.0037
LTPA	-0.2439	-0.3905	-0.0973	0.7835	0.6767	0.9073	0.0012	0.0033

Table S48. Vascular dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.2362	0.1321	0.3403	1.2664	1.1412	1.4054	0.0000	0.0001
air_pollution_PC1	0.0341	0.0053	0.0629	1.0347	1.0053	1.0649	0.0204	0.0379
greenspace_PC1	-0.0559	-0.0912	-0.0206	0.9457	0.9129	0.9796	0.0019	0.0049
number_sex_partners	0.0160	-0.0188	0.0508	1.0162	0.9814	1.0522	0.3630	0.4882
sex_age_first	-0.1398	-0.2056	-0.0740	0.8695	0.8142	0.9287	0.0000	0.0002
chronotypeMore an 'evening' than a 'morning' person	0.0591	-0.1026	0.2209	1.0609	0.9025	1.2472	0.4697	0.5725
chronotypeDefinitely an 'evening' person	0.2760	0.0599	0.4921	1.3179	1.0617	1.6358	0.0124	0.0239
chronotypeDefinitely a 'morning' person	0.2213	0.0742	0.3684	1.2477	1.0770	1.4454	0.0034	0.0082
nap	0.2577	0.1365	0.3788	1.2939	1.1462	1.4606	0.0000	0.0001
sleep_hours_categorical<7 hours	0.2533	0.1246	0.3819	1.2882	1.1327	1.4650	0.0001	0.0005
sleep_hours_categorical>9 hours	0.3595	0.1955	0.5234	1.4326	1.2159	1.6878	0.0000	0.0001
family_visit_freq	0.0068	-0.2516	0.2652	1.0069	0.7776	1.3037	0.9586	0.9743
religious_groupYes	-0.1045	-0.2576	0.0486	0.9008	0.7729	1.0498	0.1806	0.2763
facial_agingOlder than you are	0.6971	0.3319	1.0623	2.0079	1.3936	2.8929	0.0002	0.0008
facial_agingAbout your age	0.1463	0.0177	0.2749	1.1575	1.0178	1.3164	0.0258	0.0468
skin_colorVery fair	0.2798	0.0846	0.4749	1.3228	1.0883	1.6078	0.0050	0.0114

Table S48. Vascular dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.0766	-0.7750	0.9282	1.0796	0.4607	2.5300	0.8600	0.8944
skin_colorLight olive	-0.0889	-0.2510	0.0732	0.9149	0.7780	1.0759	0.2819	0.3926
skin_colorDark olive	0.3940	0.0225	0.7656	1.4830	1.0227	2.1503	0.0377	0.0664
skin_colorBrown	0.3698	-0.1006	0.8402	1.4474	0.9043	2.3167	0.1232	0.1962
sun_protection_use	-0.3240	-0.5162	-0.1318	0.7233	0.5968	0.8765	0.0010	0.0029
fish_oil_supplementsYes	-0.1600	-0.2837	-0.0364	0.8521	0.7530	0.9643	0.0114	0.0233
folate_supplementsYes	0.6518	0.3754	0.9282	1.9190	1.4555	2.5300	0.0000	0.0000
glucosamine_supplementsYes	-0.2744	-0.4202	-0.1287	0.7600	0.6569	0.8793	0.0002	0.0008
multivitamin_supplementsYes	-0.1404	-0.2876	0.0068	0.8690	0.7501	1.0068	0.0616	0.1044
pack_years_prop	0.2186	0.1770	0.2603	1.2444	1.1936	1.2973	0.0000	0.0000
smoking_statusPrevious	0.1523	0.0327	0.2718	1.1645	1.0333	1.3123	0.0126	0.0239
smoking_statusCurrent	0.4761	0.2956	0.6566	1.6098	1.3440	1.9283	0.0000	0.0000
IPAQ_activity_group	-0.2855	-0.3987	-0.1724	0.7516	0.6712	0.8417	0.0000	0.0000
education_years	-0.2606	-0.4001	-0.1211	0.7706	0.6702	0.8859	0.0003	0.0010
hshld_income	-0.9721	-1.2291	-0.7150	0.3783	0.2925	0.4892	0.0000	0.0000
ethnicityAsian	-0.2804	-0.8158	0.2550	0.7555	0.4423	1.2904	0.3044	0.4165
ethnicityBlack	0.6773	0.2514	1.1031	1.9685	1.2859	3.0135	0.0018	0.0048

Table S48. Vascular dementia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.1715	-1.3073	0.9643	0.8424	0.2705	2.6228	0.7671	0.8310
ethnicityOther	0.3845	-0.2781	1.0470	1.4688	0.7572	2.8490	0.2552	0.3669

Table S49. Alzheimer's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.1038	-0.2627	0.0550	0.9014	0.7690	1.0565	0.1999	0.3897
alcohol_freqOnce or twice a week	-0.0361	-0.1870	0.1148	0.9645	0.8294	1.1216	0.6387	0.8532
alcohol_freqThree or four times a week	-0.1122	-0.2703	0.0459	0.8939	0.7632	1.0469	0.1640	0.3458
bread	-0.0893	-0.1773	-0.0013	0.9146	0.8375	0.9987	0.0466	0.1136
cereal	0.0842	0.0039	0.1645	1.0878	1.0039	1.1788	0.0398	0.1001
never_eat_dairyYes	0.5475	0.3479	0.7471	1.7290	1.4161	2.1109	0.0000	0.0000
never_eat_eggsYes	0.6869	0.5155	0.8584	1.9876	1.6745	2.3593	0.0000	0.0000
never_eat_sugarYes	0.2631	0.1724	0.3539	1.3010	1.1881	1.4246	0.0000	0.0000
partial_fiber_score	0.2468	0.1503	0.3433	1.2800	1.1622	1.4096	0.0000	0.0000
poultry	-0.1422	-0.2514	-0.0331	0.8674	0.7777	0.9674	0.0106	0.0461
processed_meat	0.0059	-0.0931	0.1050	1.0059	0.9111	1.1107	0.9066	0.9821
red_meat	-0.1207	-0.2207	-0.0207	0.8863	0.8019	0.9795	0.0181	0.0570
salt	-0.1666	-0.2754	-0.0579	0.8465	0.7593	0.9438	0.0027	0.0135
body_size_10yrs_oldThinner	0.0743	-0.0163	0.1648	1.0771	0.9839	1.1792	0.1077	0.2401
body_size_10yrs_oldPlumper	0.0342	-0.0909	0.1592	1.0348	0.9131	1.1726	0.5919	0.8395
height_10yrs_oldShorter	0.1136	0.0088	0.2184	1.1203	1.0089	1.2441	0.0336	0.0881

Table S49. Alzheimer's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0222	-0.0790	0.1234	1.0224	0.9240	1.1313	0.6676	0.8678
maternal_smokingYes	0.0277	-0.0717	0.1272	1.0281	0.9308	1.1356	0.5838	0.8395
mobile_phone_2yrsYes, use is now more frequent	-0.0357	-0.1991	0.1276	0.9649	0.8195	1.1361	0.6454	0.8532
mobile_phone_2yrsYes, use is now less frequent	0.0887	-0.0640	0.2413	1.0927	0.9380	1.2730	0.2492	0.4521
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0403	-0.3537	0.2731	0.9605	0.7021	1.3141	0.8007	0.8962
employedYes	-0.3135	-0.4336	-0.1933	0.7309	0.6481	0.8242	0.0000	0.0000
unemployedYes	0.4617	0.0973	0.8261	1.5868	1.1022	2.2844	0.0130	0.0500
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.1169	-1.1002	0.8665	0.8897	0.3328	2.3786	0.8157	0.8962
accommodation_typeA flat, maisonette or apartment	0.1173	-0.0304	0.2650	1.1244	0.9700	1.3034	0.1197	0.2592
gas_hob_heatYes	-0.0008	-0.0892	0.0877	0.9992	0.9147	1.0916	0.9863	0.9973
hshld_parentsYes	-0.2649	-0.7741	0.2443	0.7673	0.4611	1.2768	0.3078	0.5308
hshld_partnerYes	-0.0397	-0.1365	0.0572	0.9611	0.8724	1.0589	0.4218	0.6580
hshld_siblingsYes	0.5557	0.0772	1.0341	1.7431	1.0803	2.8126	0.0229	0.0686
hshld_vehicles	-0.2595	-0.4602	-0.0588	0.7714	0.6312	0.9429	0.0113	0.0465

Table S49. Alzheimer's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.0541	-0.2247	0.3328	1.0556	0.7988	1.3949	0.7036	0.8812
own_or_rentOwn with a mortgage	0.0302	-0.0971	0.1576	1.0307	0.9075	1.1707	0.6414	0.8532
own_or_rentRent - from local authority, local council, housing association	0.5252	0.3835	0.6669	1.6907	1.4674	1.9481	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	-0.0353	-0.9147	0.8440	0.9653	0.4006	2.3258	0.9372	0.9879
own_or_rentLive in accommodation rent free	-0.0128	-0.5600	0.5344	0.9873	0.5712	1.7064	0.9635	0.9919
townsend_deprivation_index	0.0966	0.0514	0.1419	1.1015	1.0527	1.1524	0.0000	0.0002
psychiatrist_visit_mental_health Yes	0.1855	0.0640	0.3070	1.2038	1.0661	1.3593	0.0028	0.0135
risk_takingYes	-0.0178	-0.1216	0.0859	0.9823	0.8855	1.0897	0.7350	0.8951
tiredness_freq	0.3194	0.2100	0.4288	1.3763	1.2337	1.5354	0.0000	0.0000
unenthusiasm_freq	0.4153	0.2684	0.5623	1.5149	1.3078	1.7547	0.0000	0.0000
fast_driving	-0.7420	-0.9263	-0.5577	0.4762	0.3960	0.5725	0.0000	0.0000
gymYes	-0.1863	-0.2882	-0.0845	0.8300	0.7496	0.9189	0.0003	0.0020
LTPA	-0.1255	-0.2287	-0.0223	0.8820	0.7956	0.9779	0.0172	0.0570

Table S49. Alzheimer's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.0274	-0.0498	0.1045	1.0277	0.9515	1.1101	0.4865	0.7441
air_pollution_PC1	0.0256	0.0046	0.0466	1.0259	1.0046	1.0477	0.0171	0.0570
greenspace_PC1	-0.0282	-0.0534	-0.0029	0.9722	0.9480	0.9971	0.0287	0.0830
number_sex_partners	-0.0015	-0.0702	0.0672	0.9985	0.9322	1.0695	0.9664	0.9919
sex_age_first	-0.0205	-0.0644	0.0233	0.9797	0.9377	1.0235	0.3575	0.5932
chronotypeMore an 'evening' than a 'morning' person	-0.0135	-0.1265	0.0994	0.9866	0.8812	1.1045	0.8133	0.8962
chronotypeDefinitely an 'evening' person	-0.1231	-0.3086	0.0623	0.8841	0.7345	1.0643	0.1927	0.3854
chronotypeDefinitely a 'morning' person	-0.0262	-0.1298	0.0774	0.9741	0.8783	1.0804	0.6197	0.8532
nap	-0.0391	-0.1325	0.0542	0.9616	0.8759	1.0557	0.4113	0.6547
sleep_hours_categorical<7 hours	0.0664	-0.0310	0.1639	1.0687	0.9695	1.1781	0.1814	0.3724
sleep_hours_categorical>9 hours	0.1632	0.0338	0.2925	1.1772	1.0344	1.3398	0.0135	0.0500
family_visit_freq	-0.0998	-0.2933	0.0938	0.9051	0.7458	1.0983	0.3122	0.5308
religious_groupYes	0.0221	-0.0848	0.1289	1.0223	0.9187	1.1376	0.6858	0.8770
facial_agingOlder than you are	0.3863	0.0299	0.7428	1.4716	1.0303	2.1018	0.0339	0.0881
facial_agingAbout your age	0.1806	0.0570	0.3042	1.1979	1.0587	1.3555	0.0057	0.0260
skin_colorVery fair	0.1778	0.0302	0.3255	1.1946	1.0306	1.3847	0.0183	0.0570

Table S49. Alzheimer's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.7740	0.0639	1.4840	2.1683	1.0660	4.4106	0.0327	0.0881
skin_colorLight olive	-0.0502	-0.1670	0.0665	0.9510	0.8462	1.0688	0.3986	0.6478
skin_colorDark olive	-0.0422	-0.3817	0.2972	0.9586	0.6827	1.3461	0.8071	0.8962
skin_colorBrown	0.2273	-0.1528	0.6074	1.2552	0.8583	1.8357	0.2410	0.4476
sun_protection_use	-0.0890	-0.2357	0.0577	0.9148	0.7900	1.0594	0.2340	0.4451
fish_oil_supplementsYes	-0.0125	-0.0975	0.0725	0.9876	0.9071	1.0752	0.7738	0.8962
folate_supplementsYes	0.2336	-0.0067	0.4739	1.2631	0.9933	1.6063	0.0568	0.1341
glucosamine_supplementsYes	0.0116	-0.0856	0.1089	1.0117	0.9179	1.1151	0.8144	0.8962
multivitamin_supplementsYes	0.0309	-0.0696	0.1314	1.0314	0.9328	1.1405	0.5461	0.8037
pack_years_prop	0.0671	0.0271	0.1071	1.0694	1.0274	1.1131	0.0011	0.0061
smoking_statusPrevious	0.0164	-0.0705	0.1032	1.0165	0.9319	1.1087	0.7117	0.8812
smoking_statusCurrent	0.1385	-0.0105	0.2875	1.1486	0.9896	1.3331	0.0684	0.1568
IPAQ_activity_group	0.0035	-0.0833	0.0903	1.0035	0.9201	1.0945	0.9362	0.9879
education_years	-0.2322	-0.3296	-0.1348	0.7928	0.7192	0.8739	0.0000	0.0000
hshld_income	-0.6872	-0.8521	-0.5223	0.5030	0.4265	0.5932	0.0000	0.0000
ethnicityAsian	0.0006	-0.3450	0.3462	1.0006	0.7082	1.4137	0.9973	0.9973
ethnicityBlack	0.1224	-0.2594	0.5043	1.1303	0.7715	1.6558	0.5295	0.7943

Table S49. Alzheimer's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.1150	-0.5810	0.8110	1.1219	0.5593	2.2502	0.7459	0.8951
ethnicityOther	-0.3389	-0.9974	0.3197	0.7126	0.3689	1.3766	0.3130	0.5308

Table S50. Parkinson's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.0236	-0.1833	0.1360	0.9766	0.8325	1.1457	0.7715	0.8573
alcohol_freqOnce or twice a week	-0.0060	-0.1619	0.1498	0.9940	0.8506	1.1616	0.9396	0.9518
alcohol_freqThree or four times a week	-0.0596	-0.2194	0.1001	0.9421	0.8030	1.1053	0.4643	0.6133
bread	-0.0366	-0.1208	0.0476	0.9641	0.8862	1.0488	0.3945	0.5688
cereal	0.0633	-0.0156	0.1423	1.0654	0.9845	1.1530	0.1160	0.2918
never_eat_dairyYes	0.1551	-0.0799	0.3901	1.1677	0.9232	1.4771	0.1958	0.3916
never_eat_eggsYes	0.1867	-0.0417	0.4151	1.2053	0.9591	1.5145	0.1084	0.2835
never_eat_sugarYes	0.1335	0.0395	0.2274	1.1428	1.0403	1.2553	0.0054	0.0262
partial_fiber_score	0.0500	-0.0440	0.1440	1.0513	0.9570	1.1549	0.2967	0.5375
poultry	-0.0564	-0.1652	0.0525	0.9452	0.8477	1.0539	0.3101	0.5375
processed_meat	-0.0703	-0.1680	0.0275	0.9321	0.8453	1.0278	0.1587	0.3537
red_meat	-0.0920	-0.1909	0.0068	0.9121	0.8262	1.0069	0.0681	0.2212
salt	-0.0921	-0.1992	0.0149	0.9120	0.8194	1.0150	0.0916	0.2553
body_size_10yrs_oldThinner	0.0055	-0.0854	0.0965	1.0056	0.9182	1.1013	0.9047	0.9285
body_size_10yrs_oldPlumper	0.1235	0.0055	0.2415	1.1315	1.0056	1.2732	0.0402	0.1492
height_10yrs_oldShorter	-0.0731	-0.1815	0.0353	0.9295	0.8340	1.0360	0.1863	0.3916

Table S50. Parkinson's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.1235	0.0282	0.2187	1.1314	1.0286	1.2445	0.0111	0.0482
maternal_smokingYes	0.0292	-0.0652	0.1236	1.0296	0.9369	1.1316	0.5441	0.6736
mobile_phone_2yrsYes, use is now more frequent	-0.0171	-0.1395	0.1054	0.9831	0.8698	1.1111	0.7796	0.8573
mobile_phone_2yrsYes, use is now less frequent	0.0209	-0.1047	0.1465	1.0211	0.9006	1.1578	0.7439	0.8533
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.1566	-0.1989	0.5122	1.1695	0.8196	1.6689	0.3773	0.5659
employedYes	-0.1768	-0.2827	-0.0710	0.8379	0.7538	0.9315	0.0011	0.0064
unemployedYes	0.1000	-0.2504	0.4504	1.1051	0.7785	1.5689	0.5758	0.7018
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.1297	-1.1127	0.8534	0.8784	0.3287	2.3476	0.7959	0.8622
accommodation_typeA flat, maisonette or apartment	0.1310	-0.0159	0.2779	1.1400	0.9842	1.3204	0.0805	0.2492
gas_hob_heatYes	-0.0747	-0.1600	0.0107	0.9280	0.8521	1.0107	0.0863	0.2492
hshld_parentsYes	0.2322	-0.1187	0.5830	1.2613	0.8881	1.7915	0.1945	0.3916
hshld_partnerYes	-0.0356	-0.1325	0.0613	0.9651	0.8759	1.0633	0.4718	0.6133
hshld_siblingsYes	0.3292	-0.1798	0.8383	1.3899	0.8354	2.3124	0.2048	0.3994
hshld_vehicles	-0.2843	-0.4694	-0.0992	0.7526	0.6254	0.9056	0.0026	0.0147

Table S50. Parkinson's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.1120	-0.1495	0.3736	1.1185	0.8611	1.4529	0.4011	0.5688
own_or_rentOwn with a mortgage	0.0828	-0.0295	0.1952	1.0864	0.9709	1.2155	0.1482	0.3504
own_or_rentRent - from local authority, local council, housing association	0.3882	0.2285	0.5480	1.4744	1.2567	1.7298	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	-0.2412	-1.2239	0.7416	0.7857	0.2941	2.0992	0.6304	0.7450
own_or_rentLive in accommodation rent free	0.2767	-0.1657	0.7191	1.3188	0.8473	2.0527	0.2201	0.4187
townsend_deprivation_index	0.0679	0.0223	0.1135	1.0703	1.0226	1.1202	0.0035	0.0183
psychiatrist_visit_mental_health Yes	0.4849	0.3754	0.5944	1.6240	1.4556	1.8120	0.0000	0.0000
risk_takingYes	-0.0435	-0.1379	0.0508	0.9574	0.8712	1.0522	0.3658	0.5600
tiredness_freq	0.5190	0.4153	0.6228	1.6804	1.5149	1.8641	0.0000	0.0000
unenthusiasm_freq	0.4702	0.3284	0.6121	1.6004	1.3887	1.8443	0.0000	0.0000
fast_driving	-0.6280	-0.7981	-0.4579	0.5337	0.4502	0.6326	0.0000	0.0000
gymYes	0.0324	-0.0629	0.1277	1.0329	0.9391	1.1362	0.5049	0.6352
LTPA	-0.2930	-0.3954	-0.1906	0.7460	0.6734	0.8264	0.0000	0.0000

Table S50. Parkinson's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.0741	-0.0008	0.1489	1.0769	0.9992	1.1606	0.0524	0.1777
air_pollution_PC1	0.0138	-0.0069	0.0345	1.0139	0.9931	1.0351	0.1909	0.3916
greenspace_PC1	-0.0215	-0.0458	0.0029	0.9787	0.9552	1.0029	0.0837	0.2492
number_sex_partners	0.0238	0.0123	0.0354	1.0241	1.0124	1.0360	0.0001	0.0004
sex_age_first	0.0013	-0.0424	0.0450	1.0013	0.9585	1.0460	0.9541	0.9541
chronotypeMore an 'evening' than a 'morning' person	0.0313	-0.0916	0.1543	1.0318	0.9124	1.1669	0.6099	0.7319
chronotypeDefinitely an 'evening' person	0.0860	-0.0783	0.2504	1.0898	0.9247	1.2845	0.3046	0.5375
chronotypeDefinitely a 'morning' person	-0.0120	-0.1210	0.0971	0.9881	0.8860	1.1019	0.8289	0.8623
nap	0.2163	0.1267	0.3059	1.2414	1.1350	1.3578	0.0000	0.0000
sleep_hours_categorical<7 hours	0.0435	-0.0549	0.1420	1.0445	0.9466	1.1526	0.3859	0.5679
sleep_hours_categorical>9 hours	0.2799	0.1541	0.4057	1.3230	1.1667	1.5003	0.0000	0.0001
family_visit_freq	-0.0878	-0.2783	0.1027	0.9160	0.7571	1.1082	0.3662	0.5600
religious_groupYes	0.0153	-0.0922	0.1228	1.0154	0.9119	1.1306	0.7804	0.8573
facial_agingOlder than you are	0.3335	0.0417	0.6253	1.3958	1.0425	1.8688	0.0251	0.0980
facial_agingAbout your age	0.1071	0.0013	0.2129	1.1130	1.0013	1.2373	0.0474	0.1679
skin_colorVery fair	0.1176	-0.0332	0.2684	1.1248	0.9674	1.3079	0.1263	0.3078

Table S50. Parkinson's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	-0.1286	-0.8968	0.6395	0.8793	0.4079	1.8956	0.7427	0.8533
skin_colorLight olive	-0.0828	-0.1976	0.0319	0.9205	0.8207	1.0325	0.1571	0.3537
skin_colorDark olive	0.0352	-0.2831	0.3535	1.0359	0.7535	1.4241	0.8278	0.8623
skin_colorBrown	0.1714	-0.1946	0.5373	1.1869	0.8232	1.7113	0.3585	0.5600
sun_protection_use	-0.0690	-0.2101	0.0721	0.9334	0.8105	1.0748	0.3380	0.5600
fish_oil_supplementsYes	-0.1197	-0.2083	-0.0312	0.8872	0.8120	0.9693	0.0082	0.0374
folate_supplementsYes	0.1196	-0.1394	0.3787	1.1271	0.8699	1.4604	0.3652	0.5600
glucosamine_supplementsYes	-0.0486	-0.1490	0.0519	0.9526	0.8616	1.0533	0.3431	0.5600
multivitamin_supplementsYes	-0.0419	-0.1429	0.0591	0.9590	0.8669	1.0609	0.4161	0.5775
pack_years_prop	-0.0334	-0.0742	0.0075	0.9672	0.9285	1.0075	0.1090	0.2835
smoking_statusPrevious	-0.1084	-0.1934	-0.0234	0.8972	0.8241	0.9769	0.0124	0.0511
smoking_statusCurrent	-0.2975	-0.4601	-0.1349	0.7427	0.6312	0.8738	0.0003	0.0022
IPAQ_activity_group	-0.1912	-0.2774	-0.1049	0.8260	0.7577	0.9004	0.0000	0.0002
education_years	0.0345	-0.0586	0.1275	1.0351	0.9431	1.1360	0.4675	0.6133
hshld_income	-0.5273	-0.6673	-0.3874	0.5902	0.5131	0.6788	0.0000	0.0000
ethnicityAsian	-0.1939	-0.5207	0.1329	0.8237	0.5941	1.1421	0.2447	0.4544
ethnicityBlack	-0.0433	-0.4368	0.3502	0.9576	0.6461	1.4194	0.8291	0.8623

Table S50. Parkinson's disease

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.2772	-1.0800	0.5256	0.7579	0.3396	1.6914	0.4984	0.6352
ethnicityOther	-0.2337	-0.8044	0.3370	0.7916	0.4474	1.4007	0.4220	0.5775

Table S51. Rheumatoid arthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.0101	-0.1421	0.1219	0.9900	0.8676	1.1297	0.8810	0.9042
alcohol_freqOnce or twice a week	0.0349	-0.0878	0.1575	1.0355	0.9160	1.1706	0.5773	0.6640
alcohol_freqThree or four times a week	-0.0245	-0.1540	0.1050	0.9758	0.8572	1.1107	0.7104	0.7805
bread	-0.0749	-0.1460	-0.0038	0.9279	0.8642	0.9962	0.0389	0.0690
cereal	-0.0798	-0.1448	-0.0148	0.9233	0.8652	0.9853	0.0161	0.0320
never_eat_dairyYes	0.2631	0.0780	0.4482	1.3009	1.0811	1.5655	0.0054	0.0119
never_eat_eggsYes	0.2026	0.0290	0.3762	1.2246	1.0294	1.4568	0.0222	0.0423
never_eat_sugarYes	0.1243	0.0442	0.2045	1.1324	1.0452	1.2269	0.0024	0.0058
partial_fiber_score	0.0863	0.0080	0.1646	1.0902	1.0081	1.1789	0.0307	0.0557
poultry	0.1101	0.0202	0.2001	1.1164	1.0204	1.2215	0.0164	0.0320
processed_meat	-0.0226	-0.1023	0.0571	0.9777	0.9028	1.0588	0.5789	0.6640
red_meat	0.0746	-0.0062	0.1554	1.0775	0.9939	1.1682	0.0702	0.1141
salt	0.1078	0.0247	0.1908	1.1138	1.0250	1.2103	0.0110	0.0239
body_size_10yrs_oldThinner	0.1379	0.0630	0.2128	1.1478	1.0650	1.2371	0.0003	0.0010
body_size_10yrs_oldPlumper	0.2197	0.1269	0.3124	1.2457	1.1353	1.3668	0.0000	0.0000
height_10yrs_oldShorter	0.0805	-0.0049	0.1659	1.0838	0.9952	1.1804	0.0645	0.1071

Table S51. Rheumatoid arthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.1335	0.0528	0.2143	1.1429	1.0542	1.2390	0.0012	0.0031
maternal_smokingYes	0.1485	0.0613	0.2357	1.1600	1.0632	1.2657	0.0012	0.0031
mobile_phone_2yrsYes, use is now more frequent	0.0814	0.0009	0.1620	1.0849	1.0009	1.1759	0.0476	0.0825
mobile_phone_2yrsYes, use is now less frequent	0.0865	-0.0398	0.2127	1.0903	0.9610	1.2371	0.1761	0.2453
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0493	-0.3509	0.2522	0.9519	0.7041	1.2869	0.7457	0.7836
employedYes	-0.2793	-0.3655	-0.1932	0.7563	0.6939	0.8244	0.0000	0.0000
unemployedYes	-0.3264	-0.6108	-0.0419	0.7215	0.5429	0.9589	0.0245	0.0455
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.3109	-1.2930	0.6711	0.7328	0.2744	1.9565	0.5348	0.6456
accommodation_typeA flat, maisonette or apartment	0.0865	-0.0319	0.2049	1.0904	0.9686	1.2274	0.1520	0.2196
gas_hob_heatYes	-0.0395	-0.1118	0.0328	0.9613	0.8942	1.0334	0.2846	0.3827
hshld_parentsYes	0.0435	-0.2221	0.3092	1.0445	0.8008	1.3623	0.7479	0.7836
hshld_partnerYes	-0.0586	-0.1361	0.0190	0.9431	0.8728	1.0191	0.1387	0.2041
hshld_siblingsYes	0.0163	-0.4245	0.4572	1.0165	0.6541	1.5796	0.9420	0.9420
hshld_vehicles	-0.0339	-0.1806	0.1128	0.9667	0.8348	1.1194	0.6504	0.7248

Table S51. Rheumatoid arthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.3561	0.1747	0.5376	1.4278	1.1909	1.7118	0.0001	0.0004
own_or_rentOwn with a mortgage	0.1466	0.0582	0.2351	1.1579	1.0599	1.2651	0.0012	0.0031
own_or_rentRent - from local authority, local council, housing association	0.5882	0.4721	0.7044	1.8008	1.6033	2.0226	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.2591	-0.3104	0.8285	1.2957	0.7331	2.2899	0.3725	0.4763
own_or_rentLive in accommodation rent free	0.0736	-0.3389	0.4860	1.0763	0.7126	1.6258	0.7266	0.7836
townsend_deprivation_index	0.1204	0.0839	0.1568	1.1279	1.0875	1.1698	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.4207	0.3331	0.5084	1.5230	1.3952	1.6625	0.0000	0.0000
risk_takingYes	0.1327	0.0549	0.2104	1.1419	1.0564	1.2342	0.0008	0.0024
tiredness_freq	0.7526	0.6720	0.8332	2.1225	1.9582	2.3007	0.0000	0.0000
unenthusiasm_freq	0.5448	0.4442	0.6454	1.7243	1.5593	1.9068	0.0000	0.0000
fast_driving	-0.2140	-0.3533	-0.0747	0.8074	0.7024	0.9281	0.0026	0.0062
gymYes	-0.1971	-0.2813	-0.1129	0.8211	0.7548	0.8932	0.0000	0.0000
LTPA	-0.1838	-0.2728	-0.0947	0.8321	0.7612	0.9096	0.0001	0.0002

Table S51. Rheumatoid arthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.2132	0.1493	0.2771	1.2377	1.1611	1.3193	0.0000	0.0000
air_pollution_PC1	0.0146	-0.0025	0.0317	1.0147	0.9975	1.0322	0.0950	0.1483
greenspace_PC1	0.0064	-0.0139	0.0266	1.0064	0.9862	1.0270	0.5380	0.6456
number_sex_partners	-0.0030	-0.0554	0.0494	0.9970	0.9461	1.0507	0.9105	0.9223
sex_age_first	-0.0815	-0.1212	-0.0417	0.9218	0.8859	0.9591	0.0001	0.0002
chronotypeMore an 'evening' than a 'morning' person	0.0462	-0.0454	0.1378	1.0473	0.9556	1.1478	0.3208	0.4170
chronotypeDefinitely an 'evening' person	0.2128	0.0805	0.3451	1.2372	1.0839	1.4122	0.0017	0.0044
chronotypeDefinitely a 'morning' person	0.0360	-0.0537	0.1256	1.0366	0.9477	1.1339	0.4310	0.5423
nap	0.1798	0.1022	0.2573	1.1970	1.1076	1.2935	0.0000	0.0000
sleep_hours_categorical<7 hours	0.3610	0.2870	0.4350	1.4347	1.3324	1.5449	0.0000	0.0000
sleep_hours_categorical>9 hours	0.3028	0.1914	0.4142	1.3536	1.2109	1.5132	0.0000	0.0000
family_visit_freq	0.1142	-0.0443	0.2727	1.1210	0.9567	1.3136	0.1578	0.2238
religious_groupYes	0.0351	-0.0566	0.1267	1.0357	0.9450	1.1351	0.4531	0.5609
facial_agingOlder than you are	0.3883	0.1620	0.6145	1.4744	1.1759	1.8488	0.0008	0.0023
facial_agingAbout your age	0.1072	0.0216	0.1928	1.1132	1.0219	1.2126	0.0144	0.0295
skin_colorVery fair	0.1025	-0.0211	0.2260	1.1079	0.9791	1.2536	0.1041	0.1561

Table S51. Rheumatoid arthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.3808	-0.0702	0.8319	1.4635	0.9322	2.2976	0.0979	0.1498
skin_colorLight olive	0.0491	-0.0392	0.1373	1.0503	0.9615	1.1472	0.2760	0.3777
skin_colorDark olive	0.2911	0.0647	0.5175	1.3379	1.0668	1.6779	0.0118	0.0248
skin_colorBrown	0.2348	-0.0327	0.5023	1.2646	0.9678	1.6525	0.0853	0.1358
sun_protection_use	-0.0279	-0.1449	0.0891	0.9725	0.8651	1.0932	0.6401	0.7236
fish_oil_supplementsYes	0.0369	-0.0340	0.1079	1.0376	0.9665	1.1139	0.3077	0.4068
folate_supplementsYes	1.2296	1.0916	1.3675	3.4198	2.9792	3.9255	0.0000	0.0000
glucosamine_supplementsYes	0.1151	0.0346	0.1956	1.1220	1.0352	1.2160	0.0051	0.0117
multivitamin_supplementsYes	0.0240	-0.0562	0.1041	1.0242	0.9454	1.1097	0.5577	0.6590
pack_years_prop	0.2137	0.1866	0.2409	1.2383	1.2052	1.2723	0.0000	0.0000
smoking_statusPrevious	0.3048	0.2314	0.3783	1.3564	1.2603	1.4598	0.0000	0.0000
smoking_statusCurrent	0.6240	0.5224	0.7256	1.8664	1.6861	2.0661	0.0000	0.0000
IPAQ_activity_group	-0.1735	-0.2435	-0.1035	0.8407	0.7839	0.9017	0.0000	0.0000
education_years	-0.3339	-0.4118	-0.2559	0.7161	0.6625	0.7742	0.0000	0.0000
hshld_income	-0.6696	-0.7841	-0.5552	0.5119	0.4566	0.5740	0.0000	0.0000
ethnicityAsian	0.6300	0.4290	0.8309	1.8775	1.5357	2.2955	0.0000	0.0000
ethnicityBlack	0.4886	0.2548	0.7224	1.6300	1.2902	2.0593	0.0000	0.0002

Table S51. Rheumatoid arthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.0745	-0.3906	0.5396	1.0774	0.6767	1.7153	0.7535	0.7836
ethnicityOther	0.3261	-0.0069	0.6592	1.3856	0.9931	1.9332	0.0550	0.0932

Table S52. Macular degeneration

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	0.0956	0.0012	0.1899	1.1003	1.0012	1.2091	0.0471	0.1360
alcohol_freqOnce or twice a week	0.0093	-0.0824	0.1009	1.0093	0.9209	1.1062	0.8429	0.8947
alcohol_freqThree or four times a week	0.0147	-0.0796	0.1089	1.0148	0.9235	1.1151	0.7606	0.8724
bread	-0.0123	-0.0635	0.0390	0.9878	0.9385	1.0397	0.6387	0.7908
cereal	-0.0306	-0.0779	0.0167	0.9699	0.9251	1.0169	0.2052	0.3812
never_eat_dairyYes	-0.0626	-0.2221	0.0968	0.9393	0.8009	1.1017	0.4412	0.6016
never_eat_eggsYes	0.0721	-0.0662	0.2104	1.0747	0.9359	1.2342	0.3069	0.5092
never_eat_sugarYes	0.1338	0.0772	0.1905	1.1432	1.0803	1.2098	0.0000	0.0001
partial_fiber_score	0.0624	0.0053	0.1196	1.0644	1.0053	1.1270	0.0323	0.1050
poultry	-0.0549	-0.1199	0.0101	0.9466	0.8870	1.0101	0.0976	0.2175
processed_meat	-0.0099	-0.0687	0.0488	0.9901	0.9336	1.0500	0.7405	0.8621
red_meat	0.0041	-0.0552	0.0633	1.0041	0.9463	1.0654	0.8928	0.9285
salt	0.0594	-0.0033	0.1221	1.0612	0.9967	1.1299	0.0632	0.1700
body_size_10yrs_oldThinner	0.0461	-0.0081	0.1002	1.0471	0.9919	1.1054	0.0956	0.2175
body_size_10yrs_oldPlumper	0.1011	0.0288	0.1735	1.1064	1.0292	1.1895	0.0062	0.0269
height_10yrs_oldShorter	0.0061	-0.0569	0.0691	1.0061	0.9447	1.0716	0.8488	0.8947

Table S52. Macular degeneration

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0280	-0.0310	0.0871	1.0284	0.9695	1.0910	0.3522	0.5495
maternal_smokingYes	0.0405	-0.0159	0.0969	1.0413	0.9843	1.1017	0.1590	0.3263
mobile_phone_2yrsYes, use is now more frequent	0.0303	-0.0311	0.0918	1.0308	0.9693	1.0962	0.3318	0.5281
mobile_phone_2yrsYes, use is now less frequent	0.0010	-0.0845	0.0864	1.0010	0.9190	1.0903	0.9824	0.9824
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0821	-0.1604	0.3246	1.0856	0.8518	1.3834	0.4906	0.6378
employedYes	-0.0416	-0.1048	0.0217	0.9593	0.9005	1.0220	0.1980	0.3767
unemployedYes	0.2046	-0.0188	0.4280	1.2270	0.9814	1.5342	0.0726	0.1828
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.0820	-0.7034	0.5394	0.9213	0.4949	1.7150	0.7960	0.8947
accommodation_typeA flat, maisonette or apartment	0.0282	-0.0646	0.1211	1.0286	0.9374	1.1287	0.5511	0.6933
gas_hob_heatYes	-0.0584	-0.1103	-0.0065	0.9432	0.8955	0.9935	0.0274	0.0949
hshld_parentsYes	0.2521	0.0396	0.4646	1.2867	1.0404	1.5914	0.0201	0.0783
hshld_partnerYes	-0.0103	-0.0681	0.0475	0.9898	0.9342	1.0487	0.7272	0.8621
hshld_siblingsYes	0.1439	-0.1988	0.4865	1.1547	0.8197	1.6267	0.4105	0.6016
hshld_vehicles	-0.1555	-0.2676	-0.0434	0.8560	0.7652	0.9575	0.0066	0.0269

Table S52. Macular degeneration

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.1668	0.0107	0.3230	1.1815	1.0107	1.3813	0.0363	0.1132
own_or_rentOwn with a mortgage	0.1013	0.0343	0.1682	1.1066	1.0349	1.1832	0.0030	0.0140
own_or_rentRent - from local authority, local council, housing association	0.2122	0.1120	0.3123	1.2364	1.1185	1.3666	0.0000	0.0003
own_or_rentPay part rent and part mortgage (shared ownership)	0.0592	-0.4326	0.5509	1.0610	0.6488	1.7349	0.8135	0.8947
own_or_rentLive in accommodation rent free	0.0326	-0.2794	0.3445	1.0331	0.7562	1.4113	0.8379	0.8947
townsend_deprivation_index	0.0424	0.0146	0.0701	1.0433	1.0147	1.0726	0.0028	0.0134
psychiatrist_visit_mental_health Yes	0.1142	0.0406	0.1877	1.1209	1.0414	1.2065	0.0024	0.0122
risk_takingYes	0.0590	0.0015	0.1165	1.0608	1.0015	1.1235	0.0444	0.1331
tiredness_freq	0.2301	0.1642	0.2960	1.2587	1.1784	1.3445	0.0000	0.0000
unenthusiasm_freq	0.1650	0.0735	0.2564	1.1794	1.0763	1.2923	0.0004	0.0029
fast_driving	-0.1211	-0.2241	-0.0181	0.8859	0.7992	0.9821	0.0213	0.0789
gymYes	-0.0538	-0.1119	0.0043	0.9476	0.8942	1.0043	0.0693	0.1802
LTPA	-0.0685	-0.1296	-0.0074	0.9338	0.8784	0.9926	0.0280	0.0949

Table S52. Macular degeneration

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.0713	0.0258	0.1168	1.0739	1.0262	1.1238	0.0021	0.0118
air_pollution_PC1	0.0125	0.0000	0.0250	1.0126	1.0000	1.0253	0.0491	0.1369
greenspace_PC1	-0.0099	-0.0245	0.0048	0.9902	0.9758	1.0048	0.1880	0.3760
number_sex_partners	0.0007	-0.0382	0.0395	1.0007	0.9625	1.0403	0.9727	0.9824
sex_age_first	-0.0122	-0.0424	0.0180	0.9879	0.9585	1.0181	0.4222	0.6016
chronotypeMore an 'evening' than a 'morning' person	0.0408	-0.0304	0.1119	1.0416	0.9701	1.1184	0.2568	0.4552
chronotypeDefinitely an 'evening' person	0.0021	-0.0990	0.1032	1.0021	0.9057	1.1087	0.9680	0.9824
chronotypeDefinitely a 'morning' person	0.0273	-0.0354	0.0900	1.0276	0.9652	1.0941	0.3936	0.5904
nap	0.1193	0.0633	0.1754	1.1268	1.0653	1.1917	0.0000	0.0003
sleep_hours_categorical<7 hours	0.0339	-0.0239	0.0918	1.0345	0.9763	1.0962	0.2504	0.4542
sleep_hours_categorical>9 hours	0.0642	-0.0193	0.1477	1.0663	0.9809	1.1591	0.1320	0.2860
family_visit_freq	-0.0581	-0.1742	0.0580	0.9436	0.8402	1.0597	0.3266	0.5281
religious_groupYes	-0.0147	-0.0786	0.0491	0.9854	0.9244	1.0504	0.6509	0.7933
facial_agingOlder than you are	0.4624	0.2688	0.6560	1.5879	1.3084	1.9271	0.0000	0.0001
facial_agingAbout your age	0.0393	-0.0203	0.0988	1.0400	0.9799	1.1039	0.1963	0.3767
skin_colorVery fair	0.0798	-0.0100	0.1697	1.0831	0.9900	1.1849	0.0817	0.1931

Table S52. Macular degeneration

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.0502	-0.3733	0.4737	1.0515	0.6884	1.6060	0.8162	0.8947
skin_colorLight olive	-0.0601	-0.1267	0.0066	0.9417	0.8810	1.0066	0.0772	0.1881
skin_colorDark olive	-0.0777	-0.2783	0.1228	0.9252	0.7571	1.1307	0.4473	0.6016
skin_colorBrown	0.1019	-0.1241	0.3279	1.1072	0.8833	1.3880	0.3767	0.5762
sun_protection_use	-0.0348	-0.1208	0.0512	0.9658	0.8862	1.0525	0.4272	0.6016
fish_oil_supplementsYes	0.0181	-0.0323	0.0686	1.0183	0.9682	1.0710	0.4813	0.6364
folate_supplementsYes	0.0596	-0.0930	0.2123	1.0614	0.9112	1.2365	0.4439	0.6016
glucosamine_supplementsYes	0.0099	-0.0480	0.0678	1.0099	0.9531	1.0701	0.7381	0.8621
multivitamin_supplementsYes	-0.0438	-0.1034	0.0157	0.9571	0.9017	1.0159	0.1492	0.3146
pack_years_prop	0.1101	0.0852	0.1350	1.1164	1.0889	1.1445	0.0000	0.0000
smoking_statusPrevious	0.1550	0.1033	0.2066	1.1676	1.1089	1.2295	0.0000	0.0000
smoking_statusCurrent	0.1540	0.0633	0.2448	1.1665	1.0653	1.2773	0.0009	0.0057
IPAQ_activity_group	-0.1139	-0.1625	-0.0653	0.8923	0.8500	0.9368	0.0000	0.0001
education_years	-0.0173	-0.0734	0.0387	0.9828	0.9293	1.0394	0.5439	0.6933
hshld_income	-0.2284	-0.3144	-0.1425	0.7958	0.7302	0.8672	0.0000	0.0000
ethnicityAsian	0.3846	0.2092	0.5600	1.4690	1.2327	1.7507	0.0000	0.0002
ethnicityBlack	0.3465	0.1311	0.5618	1.4141	1.1401	1.7539	0.0016	0.0097

Table S52. Macular degeneration

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.2063	-0.1726	0.5852	1.2291	0.8415	1.7954	0.2858	0.4954
ethnicityOther	0.1611	-0.1410	0.4631	1.1747	0.8685	1.5890	0.2960	0.5019

Table S53. Osteoporosis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	0.1839	0.1008	0.2671	1.2019	1.1060	1.3062	0.0000	0.0000
alcohol_freqOnce or twice a week	0.0702	-0.0089	0.1492	1.0727	0.9912	1.1609	0.0819	0.1205
alcohol_freqThree or four times a week	0.0799	-0.0029	0.1626	1.0831	0.9971	1.1766	0.0585	0.0943
bread	-0.0323	-0.0780	0.0135	0.9683	0.9250	1.0135	0.1666	0.2240
cereal	-0.0400	-0.0816	0.0016	0.9608	0.9217	1.0016	0.0593	0.0943
never_eat_dairyYes	0.4324	0.3220	0.5428	1.5410	1.3799	1.7209	0.0000	0.0000
never_eat_eggsYes	0.3659	0.2585	0.4733	1.4419	1.2950	1.6053	0.0000	0.0000
never_eat_sugarYes	0.0849	0.0337	0.1362	1.0886	1.0343	1.1459	0.0012	0.0023
partial_fiber_score	-0.0078	-0.0586	0.0430	0.9922	0.9430	1.0439	0.7622	0.7926
poultry	-0.1726	-0.2276	-0.1176	0.8415	0.7965	0.8891	0.0000	0.0000
processed_meat	-0.1168	-0.1680	-0.0657	0.8897	0.8454	0.9364	0.0000	0.0000
red_meat	-0.1422	-0.1944	-0.0900	0.8675	0.8234	0.9139	0.0000	0.0000
salt	0.1194	0.0648	0.1739	1.1268	1.0670	1.1899	0.0000	0.0000
body_size_10yrs_oldThinner	0.1102	0.0620	0.1584	1.1165	1.0640	1.1716	0.0000	0.0000
body_size_10yrs_oldPlumper	-0.0137	-0.0784	0.0511	0.9864	0.9246	1.0524	0.6787	0.7154
height_10yrs_oldShorter	0.1764	0.1231	0.2297	1.1929	1.1310	1.2582	0.0000	0.0000

Table S53. Osteoporosis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0289	-0.0245	0.0823	1.0293	0.9758	1.0857	0.2886	0.3463
maternal_smokingYes	0.0827	0.0343	0.1310	1.0862	1.0349	1.1400	0.0008	0.0017
mobile_phone_2yrsYes, use is now more frequent	0.0437	-0.0066	0.0939	1.0446	0.9935	1.0984	0.0882	0.1274
mobile_phone_2yrsYes, use is now less frequent	0.0197	-0.0608	0.1003	1.0199	0.9410	1.1055	0.6301	0.6732
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0774	-0.1081	0.2629	1.0805	0.8975	1.3007	0.4064	0.4661
employedYes	-0.2606	-0.3166	-0.2046	0.7706	0.7286	0.8150	0.0000	0.0000
unemployedYes	0.1125	-0.0801	0.3051	1.1190	0.9230	1.3567	0.2524	0.3076
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.4011	-1.0557	0.2534	0.6696	0.3479	1.2884	0.2296	0.2889
accommodation_typeA flat, maisonette or apartment	0.2257	0.1515	0.2999	1.2532	1.1635	1.3497	0.0000	0.0000
gas_hob_heatYes	-0.0313	-0.0771	0.0145	0.9692	0.9258	1.0146	0.1804	0.2385
hshld_parentsYes	0.0975	-0.0873	0.2823	1.1024	0.9164	1.3262	0.3011	0.3559
hshld_partnerYes	-0.1155	-0.1644	-0.0666	0.8910	0.8484	0.9356	0.0000	0.0000
hshld_siblingsYes	0.3570	0.0888	0.6252	1.4291	1.0929	1.8686	0.0091	0.0161
hshld_vehicles	-0.4045	-0.5040	-0.3051	0.6673	0.6041	0.7370	0.0000	0.0000

Table S53. Osteoporosis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.2705	0.1452	0.3958	1.3106	1.1563	1.4855	0.0000	0.0001
own_or_rentOwn with a mortgage	0.0055	-0.0533	0.0643	1.0055	0.9481	1.0664	0.8549	0.8660
own_or_rentRent - from local authority, local council, housing association	0.4922	0.4150	0.5694	1.6359	1.5144	1.7671	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.4766	0.1432	0.8100	1.6107	1.1540	2.2480	0.0051	0.0092
own_or_rentLive in accommodation rent free	0.0660	-0.2027	0.3347	1.0683	0.8165	1.3975	0.6301	0.6732
townsend_deprivation_index	0.1224	0.0988	0.1461	1.1302	1.1038	1.1573	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.3119	0.2530	0.3707	1.3660	1.2879	1.4488	0.0000	0.0000
risk_takingYes	0.0514	-0.0036	0.1064	1.0527	0.9964	1.1123	0.0670	0.1025
tiredness_freq	0.5559	0.5018	0.6100	1.7435	1.6517	1.8405	0.0000	0.0000
unenthusiasm_freq	0.4495	0.3772	0.5218	1.5675	1.4583	1.6850	0.0000	0.0000
fast_driving	-0.5562	-0.6497	-0.4627	0.5734	0.5222	0.6296	0.0000	0.0000
gymYes	-0.1313	-0.1838	-0.0788	0.8770	0.8321	0.9242	0.0000	0.0000
LTPA	-0.2049	-0.2704	-0.1393	0.8148	0.7630	0.8700	0.0000	0.0000

Table S53. Osteoporosis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	-0.0413	-0.0814	-0.0011	0.9596	0.9218	0.9989	0.0442	0.0733
air_pollution_PC1	0.0396	0.0287	0.0505	1.0404	1.0291	1.0518	0.0000	0.0000
greenspace_PC1	-0.0322	-0.0453	-0.0190	0.9684	0.9557	0.9812	0.0000	0.0000
number_sex_partners	0.0023	-0.0339	0.0385	1.0023	0.9666	1.0393	0.9011	0.9011
sex_age_first	0.0477	0.0246	0.0709	1.0489	1.0249	1.0734	0.0001	0.0001
chronotypeMore an 'evening' than a 'morning' person	0.0321	-0.0325	0.0967	1.0326	0.9680	1.1016	0.3233	0.3764
chronotypeDefinitely an 'evening' person	0.1014	0.0147	0.1882	1.1068	1.0148	1.2070	0.0220	0.0381
chronotypeDefinitely a 'morning' person	0.0474	-0.0111	0.1059	1.0486	0.9890	1.1118	0.1114	0.1580
nap	0.0758	0.0248	0.1268	1.0788	1.0252	1.1352	0.0036	0.0066
sleep_hours_categorical<7 hours	0.2261	0.1778	0.2745	1.2538	1.1946	1.3159	0.0000	0.0000
sleep_hours_categorical>9 hours	0.1965	0.1231	0.2698	1.2171	1.1310	1.3097	0.0000	0.0000
family_visit_freq	-0.1705	-0.2725	-0.0685	0.8433	0.7615	0.9338	0.0011	0.0021
religious_groupYes	0.0838	0.0290	0.1385	1.0874	1.0294	1.1486	0.0027	0.0052
facial_agingOlder than you are	0.5793	0.3761	0.7826	1.7848	1.4565	2.1871	0.0000	0.0000
facial_agingAbout your age	0.0970	0.0416	0.1524	1.1019	1.0425	1.1647	0.0007	0.0014
skin_colorVery fair	0.1357	0.0603	0.2110	1.1453	1.0622	1.2349	0.0004	0.0009

Table S53. Osteoporosis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	-0.4476	-0.9290	0.0337	0.6391	0.3950	1.0342	0.0683	0.1025
skin_colorLight olive	-0.0190	-0.0754	0.0375	0.9812	0.9273	1.0382	0.5096	0.5679
skin_colorDark olive	0.1800	0.0128	0.3472	1.1972	1.0129	1.4151	0.0349	0.0592
skin_colorBrown	0.0639	-0.1516	0.2793	1.0660	0.8594	1.3222	0.5611	0.6164
sun_protection_use	-0.0108	-0.0861	0.0645	0.9893	0.9175	1.0666	0.7790	0.7995
fish_oil_supplementsYes	-0.0427	-0.0875	0.0022	0.9582	0.9162	1.0022	0.0625	0.0974
folate_supplementsYes	0.7820	0.6868	0.8772	2.1859	1.9874	2.4043	0.0000	0.0000
glucosamine_supplementsYes	-0.0370	-0.0874	0.0135	0.9637	0.9163	1.0136	0.1512	0.2070
multivitamin_supplementsYes	0.0390	-0.0110	0.0891	1.0398	0.9890	1.0932	0.1263	0.1759
pack_years_prop	0.1770	0.1551	0.1989	1.1936	1.1678	1.2200	0.0000	0.0000
smoking_statusPrevious	0.0955	0.0490	0.1421	1.1002	1.0502	1.1527	0.0001	0.0001
smoking_statusCurrent	0.5174	0.4490	0.5858	1.6776	1.5667	1.7964	0.0000	0.0000
IPAQ_activity_group	-0.1435	-0.1948	-0.0921	0.8663	0.8230	0.9120	0.0000	0.0000
education_years	-0.0301	-0.0801	0.0198	0.9703	0.9231	1.0200	0.2372	0.2936
hshld_income	-0.5297	-0.6031	-0.4563	0.5888	0.5471	0.6336	0.0000	0.0000
ethnicityAsian	0.1084	-0.0586	0.2753	1.1145	0.9431	1.3170	0.2032	0.2598
ethnicityBlack	-0.5665	-0.8087	-0.3243	0.5675	0.4455	0.7230	0.0000	0.0000

Table S53. Osteoporosis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.2330	-0.5811	0.1151	0.7922	0.5593	1.1220	0.1896	0.2464
ethnicityOther	-0.1052	-0.3642	0.1537	0.9001	0.6948	1.1661	0.4256	0.4812

Table S54. Osteoarthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqDaily or almost daily	-0.0097	-0.0474	0.0280	0.9903	0.9537	1.0284	0.6141	0.6746
alcohol_freqOnce or twice a week	-0.0073	-0.0432	0.0285	0.9927	0.9577	1.0289	0.6882	0.7455
alcohol_freqThree or four times a week	-0.0204	-0.0573	0.0166	0.9798	0.9443	1.0167	0.2799	0.3465
bread	-0.0459	-0.0668	-0.0250	0.9552	0.9354	0.9753	0.0000	0.0000
cereal	-0.0667	-0.0858	-0.0475	0.9355	0.9177	0.9536	0.0000	0.0000
never_eat_dairyYes	0.1355	0.0743	0.1966	1.1451	1.0771	1.2173	0.0000	0.0000
never_eat_eggsYes	0.0644	0.0072	0.1215	1.0665	1.0073	1.1292	0.0272	0.0401
never_eat_sugarYes	0.1428	0.1189	0.1667	1.1535	1.1262	1.1814	0.0000	0.0000
partial_fiber_score	0.0813	0.0583	0.1043	1.0847	1.0600	1.1099	0.0000	0.0000
poultry	0.1645	0.1375	0.1915	1.1788	1.1474	1.2111	0.0000	0.0000
processed_meat	0.0751	0.0514	0.0989	1.0780	1.0527	1.1039	0.0000	0.0000
red_meat	0.1094	0.0852	0.1335	1.1156	1.0890	1.1428	0.0000	0.0000
salt	0.1558	0.1307	0.1809	1.1686	1.1396	1.1983	0.0000	0.0000
body_size_10yrs_oldThinner	0.0074	-0.0152	0.0300	1.0074	0.9849	1.0304	0.5229	0.5911
body_size_10yrs_oldPlumper	0.1862	0.1588	0.2136	1.2047	1.1721	1.2382	0.0000	0.0000
height_10yrs_oldShorter	-0.0497	-0.0758	-0.0235	0.9515	0.9270	0.9768	0.0002	0.0004

Table S54. Osteoarthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.1401	0.1167	0.1635	1.1504	1.1238	1.1777	0.0000	0.0000
maternal_smokingYes	0.1272	0.1051	0.1494	1.1357	1.1108	1.1611	0.0000	0.0000
mobile_phone_2yrsYes, use is now more frequent	0.1091	0.0406	0.1775	1.1152	1.0414	1.1942	0.0082	0.0134
mobile_phone_2yrsYes, use is now less frequent	0.1049	0.0639	0.1460	1.1106	1.0660	1.1571	0.0000	0.0000
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0007	-0.0889	0.0875	0.9993	0.9149	1.0914	0.9874	0.9969
employedYes	-0.0093	-0.0346	0.0160	0.9907	0.9660	1.0162	0.4720	0.5495
unemployedYes	-0.0132	-0.0914	0.0649	0.9868	0.9126	1.0671	0.7399	0.7906
accommodation_typeMobile or temporary structure (i.e. caravan)	-0.1222	-0.3920	0.1476	0.8850	0.6757	1.1591	0.3747	0.4567
accommodation_typeA flat, maisonette or apartment	-0.0514	-0.0902	-0.0126	0.9499	0.9138	0.9875	0.0094	0.0150
gas_hob_heatYes	0.0126	-0.0092	0.0345	1.0127	0.9909	1.0351	0.2561	0.3222
hshld_parentsYes	-0.0616	-0.1438	0.0207	0.9403	0.8660	1.0209	0.1424	0.1852
hshld_partnerYes	0.0070	-0.0169	0.0309	1.0071	0.9833	1.0314	0.5634	0.6278
hshld_siblingsYes	-0.0203	-0.1553	0.1146	0.9799	0.8562	1.1214	0.7677	0.8092
hshld_vehicles	0.1791	0.1357	0.2225	1.1961	1.1454	1.2492	0.0000	0.0000

Table S54. Osteoarthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentRent - from private landlord or letting agency	0.1376	0.0769	0.1984	1.1476	1.0799	1.2194	0.0000	0.0000
own_or_rentOwn with a mortgage	0.1363	0.1111	0.1616	1.1461	1.1175	1.1754	0.0000	0.0000
own_or_rentRent - from local authority, local council, housing association	0.3072	0.2659	0.3485	1.3596	1.3046	1.4170	0.0000	0.0000
own_or_rentPay part rent and part mortgage (shared ownership)	0.2451	0.0681	0.4221	1.2777	1.0704	1.5252	0.0067	0.0111
own_or_rentLive in accommodation rent free	-0.0002	-0.1242	0.1237	0.9998	0.8832	1.1317	0.9969	0.9969
townsend_deprivation_index	0.0449	0.0335	0.0562	1.0459	1.0341	1.0579	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.2385	0.2097	0.2674	1.2694	1.2333	1.3065	0.0000	0.0000
risk_takingYes	0.1731	0.1504	0.1958	1.1889	1.1623	1.2162	0.0000	0.0000
tiredness_freq	0.4474	0.4214	0.4735	1.5643	1.5241	1.6056	0.0000	0.0000
unenthusiasm_freq	0.3142	0.2794	0.3490	1.3691	1.3223	1.4176	0.0000	0.0000
fast_driving	0.1624	0.1233	0.2016	1.1763	1.1312	1.2233	0.0000	0.0000
gymYes	0.0826	0.0599	0.1052	1.0861	1.0618	1.1109	0.0000	0.0000
LTPA	-0.0328	-0.0595	-0.0061	0.9677	0.9422	0.9939	0.0163	0.0249

Table S54. Osteoarthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.1466	0.1281	0.1650	1.1579	1.1367	1.1794	0.0000	0.0000
air_pollution_PC1	0.0022	-0.0029	0.0073	1.0022	0.9971	1.0073	0.3978	0.4773
greenspace_PC1	0.0004	-0.0055	0.0063	1.0004	0.9945	1.0064	0.8865	0.9219
number_sex_partners	0.0073	-0.0002	0.0148	1.0073	0.9998	1.0149	0.0549	0.0765
sex_age_first	-0.1202	-0.1321	-0.1083	0.8867	0.8763	0.8973	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.0367	0.0105	0.0630	1.0374	1.0105	1.0650	0.0062	0.0106
chronotypeDefinitely an 'evening' person	0.0786	0.0370	0.1203	1.0818	1.0377	1.1278	0.0002	0.0004
chronotypeDefinitely a 'morning' person	0.0735	0.0478	0.0992	1.0762	1.0489	1.1043	0.0000	0.0000
nap	0.1209	0.0976	0.1441	1.1285	1.1026	1.1550	0.0000	0.0000
sleep_hours_categorical<7 hours	0.2353	0.2128	0.2577	1.2652	1.2371	1.2940	0.0000	0.0000
sleep_hours_categorical>9 hours	0.0804	0.0443	0.1164	1.0837	1.0453	1.1235	0.0000	0.0000
family_visit_freq	0.2621	0.2141	0.3101	1.2997	1.2387	1.3636	0.0000	0.0000
religious_groupYes	-0.0211	-0.0486	0.0064	0.9791	0.9526	1.0064	0.1319	0.1744
facial_agingOlder than you are	0.2318	0.1073	0.3564	1.2609	1.1132	1.4282	0.0017	0.0029
facial_agingAbout your age	0.0283	0.0021	0.0545	1.0287	1.0021	1.0560	0.0344	0.0488
skin_colorVery fair	-0.0019	-0.0401	0.0363	0.9981	0.9607	1.0369	0.9214	0.9456

Table S54. Osteoarthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBlack	0.1826	0.0149	0.3504	1.2004	1.0150	1.4196	0.0328	0.0474
skin_colorLight olive	0.0294	0.0034	0.0553	1.0298	1.0034	1.0569	0.0266	0.0399
skin_colorDark olive	0.1424	0.0680	0.2168	1.1530	1.0703	1.2420	0.0002	0.0004
skin_colorBrown	0.1636	0.0713	0.2558	1.1777	1.0739	1.2915	0.0005	0.0009
sun_protection_use	0.0439	0.0088	0.0790	1.0449	1.0089	1.0822	0.0141	0.0220
fish_oil_supplementsYes	0.1081	0.0872	0.1290	1.1142	1.0912	1.1377	0.0000	0.0000
folate_supplementsYes	0.3443	0.2862	0.4024	1.4110	1.3313	1.4954	0.0000	0.0000
glucosamine_supplementsYes	0.4174	0.3944	0.4403	1.5180	1.4835	1.5532	0.0000	0.0000
multivitamin_supplementsYes	0.0465	0.0225	0.0704	1.0475	1.0228	1.0729	0.0001	0.0003
pack_years_prop	0.1130	0.1036	0.1224	1.1196	1.1092	1.1302	0.0000	0.0000
smoking_statusPrevious	0.1722	0.1510	0.1933	1.1879	1.1630	1.2133	0.0000	0.0000
smoking_statusCurrent	0.1411	0.1067	0.1755	1.1515	1.1126	1.1918	0.0000	0.0000
IPAQ_activity_group	0.0134	-0.0071	0.0339	1.0135	0.9929	1.0345	0.1992	0.2547
education_years	-0.1663	-0.1898	-0.1429	0.8468	0.8271	0.8669	0.0000	0.0000
hshld_income	-0.3017	-0.3350	-0.2685	0.7395	0.7153	0.7645	0.0000	0.0000
ethnicityAsian	-0.0295	-0.1072	0.0483	0.9710	0.8983	1.0495	0.4580	0.5413
ethnicityBlack	0.0731	-0.0131	0.1593	1.0758	0.9869	1.1727	0.0967	0.1300

Table S54. Osteoarthritis

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.0524	-0.2018	0.0969	0.9489	0.8173	1.1018	0.4913	0.5635
ethnicityOther	-0.1207	-0.2447	0.0033	0.8863	0.7829	1.0033	0.0564	0.0772

Table S55. Hypertension

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Odds Ratio	OR 2.5% CI	OR 97.5% CI	P-value	FDR
alcohol_freqOnce or twice a week	-0.0364	-0.0637	-0.0092	0.9642	0.9383	0.9909	0.0088	0.0099
alcohol_freqDaily or almost daily	0.0420	0.0135	0.0705	1.0429	1.0136	1.0731	0.0039	0.0047
alcohol_freqThree or four times a week	-0.0280	-0.0559	0.0000	0.9724	0.9456	1.0000	0.0502	0.0536
bread	0.0205	0.0053	0.0357	1.0207	1.0053	1.0363	0.0083	0.0095
cereal	-0.1971	-0.2113	-0.1829	0.8211	0.8096	0.8329	0.0000	0.0000
never_eat_dairyYes	0.0948	0.0464	0.1432	1.0994	1.0475	1.1539	0.0001	0.0002
never_eat_eggsYes	0.1694	0.1221	0.2167	1.1846	1.1299	1.2420	0.0000	0.0000
never_eat_sugarYes	0.3045	0.2862	0.3228	1.3559	1.3313	1.3810	0.0000	0.0000
partial_fiber_score	0.0461	0.0288	0.0633	1.0471	1.0293	1.0653	0.0000	0.0000
poultry	0.2547	0.2347	0.2747	1.2901	1.2646	1.3161	0.0000	0.0000
processed_meat	0.1559	0.1384	0.1735	1.1688	1.1485	1.1894	0.0000	0.0000
red_meat	0.1393	0.1216	0.1569	1.1495	1.1294	1.1699	0.0000	0.0000
salt	-0.2953	-0.3148	-0.2758	0.7443	0.7300	0.7590	0.0000	0.0000
body_size_10yrs_oldThinner	0.0698	0.0530	0.0867	1.0723	1.0544	1.0906	0.0000	0.0000
body_size_10yrs_oldPlumper	0.3461	0.3244	0.3678	1.4135	1.3832	1.4445	0.0000	0.0000
height_10yrs_oldShorter	0.0314	0.0124	0.0504	1.0319	1.0125	1.0517	0.0012	0.0015

Table S55. Hypertension

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Odds Ratio	OR 2.5% CI	OR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0076	-0.0103	0.0255	1.0076	0.9898	1.0258	0.4037	0.4144
maternal_smokingYes	0.1465	0.1286	0.1645	1.1578	1.1372	1.1788	0.0000	0.0000
mobile_phone_2yrsYes, use is now less frequent	0.1402	0.1132	0.1672	1.1505	1.1198	1.1820	0.0000	0.0000
mobile_phone_2yrsI didn't use a mobile phone two years ago	0.0112	-0.0616	0.0840	1.0113	0.9403	1.0876	0.7583	0.7583
mobile_phone_2yrsYes, use is now more frequent	0.0077	-0.0112	0.0266	1.0078	0.9889	1.0270	0.4189	0.4243
employedYes	-0.1517	-0.1707	-0.1326	0.8593	0.8431	0.8758	0.0000	0.0000
unemployedYes	0.0902	0.0372	0.1431	1.0943	1.0379	1.1539	0.0009	0.0011
accommodation_typeMobile or temporary structure (i.e. caravan)	0.2107	0.0220	0.3993	1.2345	1.0222	1.4908	0.0286	0.0315
accommodation_typeA flat, maisonette or apartment	0.1424	0.1152	0.1696	1.1531	1.1222	1.1849	0.0000	0.0000
gas_hob_heatYes	-0.0241	-0.0401	-0.0081	0.9762	0.9607	0.9920	0.0032	0.0039
hshld_parentsYes	0.0750	0.0204	0.1297	1.0779	1.0206	1.1385	0.0071	0.0083
hshld_partnerYes	-0.0557	-0.0743	-0.0370	0.9459	0.9284	0.9636	0.0000	0.0000
hshld_siblingsYes	0.3192	0.2300	0.4085	1.3761	1.2586	1.5046	0.0000	0.0000
hshld_vehicles	-0.1650	-0.1981	-0.1319	0.8479	0.8202	0.8764	0.0000	0.0000

Table S55. Hypertension

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Odds Ratio	OR 2.5% CI	OR 97.5% CI	P-value	FDR
own_or_rentPay part rent and part mortgage (shared ownership)	0.2187	0.0881	0.3494	1.2445	1.0921	1.4182	0.0010	0.0013
own_or_rentRent - from local authority, local council, housing association	0.5007	0.4688	0.5326	1.6499	1.5981	1.7033	0.0000	0.0000
own_or_rentLive in accommodation rent free	0.1336	0.0483	0.2189	1.1429	1.0495	1.2448	0.0022	0.0027
own_or_rentRent - from private landlord or letting agency	0.2698	0.2275	0.3120	1.3096	1.2555	1.3661	0.0000	0.0000
own_or_rentOwn with a mortgage	0.1075	0.0890	0.1261	1.1135	1.0930	1.1344	0.0000	0.0000
townsend_deprivation_index	0.1111	0.1025	0.1196	1.1175	1.1079	1.1270	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.2317	0.2095	0.2539	1.2607	1.2331	1.2890	0.0000	0.0000
risk_takingYes	0.0382	0.0215	0.0549	1.0389	1.0218	1.0564	0.0000	0.0000
tiredness_freq	0.5038	0.4832	0.5243	1.6549	1.6213	1.6893	0.0000	0.0000
unenthusiasm_freq	0.3816	0.3548	0.4084	1.4646	1.4259	1.5044	0.0000	0.0000
fast_driving	-0.2201	-0.2490	-0.1911	0.8025	0.7796	0.8261	0.0000	0.0000
gymYes	-0.1344	-0.1519	-0.1168	0.8743	0.8591	0.8897	0.0000	0.0000
LTPA	-0.2514	-0.2739	-0.2290	0.7777	0.7604	0.7953	0.0000	0.0000

Table S55. Hypertension

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Odds Ratio	OR 2.5% CI	OR 97.5% CI	P-value	FDR
sedentary	0.2428	0.2293	0.2564	1.2748	1.2577	1.2922	0.0000	0.0000
air_pollution_PC1	0.0226	0.0189	0.0264	1.0229	1.0191	1.0267	0.0000	0.0000
greenspace_PC1	-0.0163	-0.0207	-0.0119	0.9838	0.9795	0.9881	0.0000	0.0000
number_sex_partners	0.0053	-0.0021	0.0127	1.0053	0.9979	1.0127	0.1620	0.1685
sex_age_first	-0.0855	-0.0934	-0.0775	0.9181	0.9108	0.9254	0.0000	0.0000
chronotypeDefinitely an 'evening' person	0.1069	0.0780	0.1357	1.1128	1.0811	1.1453	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.0219	-0.0056	0.0495	1.0222	0.9944	1.0507	0.1112	0.1173
chronotypeDefinitely a 'morning' person	0.0605	0.0365	0.0846	1.0624	1.0371	1.0883	0.0000	0.0000
nap	0.3044	0.2873	0.3215	1.3559	1.3329	1.3793	0.0000	0.0000
sleep_hours_categorical<7 hours	0.1850	0.1681	0.2019	1.2032	1.1830	1.2238	0.0000	0.0000
sleep_hours_categorical>9 hours	0.2258	0.1991	0.2526	1.2533	1.2203	1.2873	0.0000	0.0000
family_visit_freq	0.0714	0.0369	0.1059	1.0740	1.0376	1.1118	0.0000	0.0001
religious_groupYes	-0.0573	-0.0779	-0.0368	0.9443	0.9251	0.9638	0.0000	0.0000
facial_agingAbout your age	0.0982	0.0808	0.1157	1.1032	1.0841	1.1226	0.0000	0.0000
facial_agingOlder than you are	0.4058	0.2974	0.5141	1.5005	1.3464	1.6722	0.0000	0.0000
skin_colorLight olive	-0.0218	-0.0412	-0.0023	0.9785	0.9596	0.9977	0.0281	0.0313

Table S55. Hypertension

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Odds Ratio	OR 2.5% CI	OR 97.5% CI	P-value	FDR
skin_colorBrown	0.1464	0.0818	0.2109	1.1576	1.0852	1.2348	0.0000	0.0000
skin_colorVery fair	0.0795	0.0518	0.1073	1.0828	1.0532	1.1133	0.0000	0.0000
skin_colorDark olive	0.0588	0.0048	0.1128	1.0606	1.0048	1.1194	0.0328	0.0355
skin_colorBlack	0.2740	0.1662	0.3819	1.3152	1.1808	1.4650	0.0000	0.0000
sun_protection_use	-0.1020	-0.1280	-0.0761	0.9030	0.8798	0.9267	0.0000	0.0000
fish_oil_supplementsYes	-0.0790	-0.0948	-0.0631	0.9241	0.9095	0.9389	0.0000	0.0000
folate_supplementsYes	0.1353	0.0870	0.1836	1.1449	1.0909	1.2015	0.0000	0.0000
glucosamine_supplementsYes	-0.1772	-0.1964	-0.1581	0.8376	0.8217	0.8538	0.0000	0.0000
multivitamin_supplementsYes	-0.1103	-0.1284	-0.0922	0.8955	0.8795	0.9119	0.0000	0.0000
pack_years_prop	0.1544	0.1463	0.1624	1.1669	1.1575	1.1764	0.0000	0.0000
smoking_statusPrevious	0.1757	0.1601	0.1914	1.1921	1.1736	1.2110	0.0000	0.0000
smoking_statusCurrent	-0.0428	-0.0681	-0.0174	0.9582	0.9341	0.9828	0.0010	0.0013
IPAQ_activity_group	-0.2644	-0.2837	-0.2450	0.7677	0.7530	0.7827	0.0000	0.0000
education_years	-0.2331	-0.2524	-0.2138	0.7921	0.7769	0.8075	0.0000	0.0000
hshld_income	-0.3947	-0.4216	-0.3678	0.6739	0.6560	0.6923	0.0000	0.0000
ethnicityAsian	0.3149	0.2650	0.3649	1.3702	1.3034	1.4403	0.0000	0.0000
ethnicityBlack	0.7988	0.7443	0.8532	2.2228	2.1050	2.3472	0.0000	0.0000

Table S55. Hypertension

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Odds Ratio	OR 2.5% CI	OR 97.5% CI	P-value	FDR
ethnicityMixed	0.1395	0.0389	0.2401	1.1497	1.0397	1.2713	0.0065	0.0077
ethnicityOther	0.2582	0.1807	0.3357	1.2946	1.1981	1.3989	0.0000	0.0000

Table S56. Obesity

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqOnce or twice a week	-0.2301	-0.2568	-0.2035	0.7944	0.7735	0.8159	0.0000	0.0000
alcohol_freqDaily or almost daily	-0.5941	-0.6235	-0.5647	0.5521	0.5361	0.5685	0.0000	0.0000
alcohol_freqThree or four times a week	-0.4563	-0.4843	-0.4283	0.6336	0.6161	0.6516	0.0000	0.0000
bread	0.0607	0.0445	0.0768	1.0626	1.0455	1.0799	0.0000	0.0000
cereal	-0.3038	-0.3185	-0.2892	0.7380	0.7272	0.7489	0.0000	0.0000
never_eat_dairyYes	-0.0251	-0.0758	0.0257	0.9753	0.9270	1.0261	0.3334	0.3467
never_eat_eggsYes	0.0486	0.0037	0.0935	1.0498	1.0037	1.0980	0.0340	0.0374
never_eat_sugarYes	0.2988	0.2787	0.3188	1.3482	1.3214	1.3755	0.0000	0.0000
partial_fiber_score	0.0162	-0.0023	0.0347	1.0163	0.9977	1.0353	0.0860	0.0932
poultry	0.4526	0.4315	0.4737	1.5724	1.5396	1.6060	0.0000	0.0000
processed_meat	0.4441	0.4256	0.4625	1.5590	1.5306	1.5880	0.0000	0.0000
red_meat	0.3937	0.3753	0.4121	1.4824	1.4554	1.5100	0.0000	0.0000
salt	0.1946	0.1753	0.2139	1.2148	1.1916	1.2385	0.0000	0.0000
body_size_10yrs_oldThinner	-0.3020	-0.3245	-0.2796	0.7393	0.7229	0.7561	0.0000	0.0000
body_size_10yrs_oldPlumper	0.9233	0.9013	0.9454	2.5177	2.4627	2.5738	0.0000	0.0000
height_10yrs_oldShorter	-0.0967	-0.1168	-0.0766	0.9078	0.8898	0.9262	0.0000	0.0000

Table S56. Obesity

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	0.0326	0.0141	0.0511	1.0331	1.0142	1.0524	0.0006	0.0007
maternal_smokingYes	0.2681	0.2463	0.2899	1.3075	1.2792	1.3363	0.0000	0.0000
mobile_phone_2yrsYes, use is now less frequent	0.2618	0.2130	0.3105	1.2993	1.2374	1.3642	0.0000	0.0000
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0366	-0.1421	0.0689	0.9641	0.8675	1.0713	0.4668	0.4790
mobile_phone_2yrsYes, use is now more frequent	0.0777	0.0282	0.1272	1.0808	1.0286	1.1356	0.0085	0.0099
employedYes	0.0367	0.0147	0.0588	1.0374	1.0148	1.0606	0.0014	0.0017
unemployedYes	0.0998	0.0456	0.1540	1.1049	1.0467	1.1664	0.0003	0.0004
accommodation_typeMobile or temporary structure (i.e. caravan)	0.3366	0.1445	0.5286	1.4001	1.1555	1.6966	0.0006	0.0007
accommodation_typeA flat, maisonette or apartment	0.1241	0.0961	0.1521	1.1321	1.1009	1.1643	0.0000	0.0000
gas_hob_heatYes	-0.0036	-0.0203	0.0131	0.9964	0.9799	1.0132	0.6756	0.6844
hshld_parentsYes	0.2438	0.1915	0.2961	1.2761	1.2111	1.3446	0.0000	0.0000
hshld_partnerYes	-0.0941	-0.1144	-0.0739	0.9102	0.8919	0.9288	0.0000	0.0000
hshld_siblingsYes	0.2780	0.1888	0.3672	1.3204	1.2078	1.4436	0.0000	0.0000
hshld_vehicles	0.0656	0.0300	0.1012	1.0678	1.0304	1.1065	0.0004	0.0005

Table S56. Obesity

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentPay part rent and part mortgage (shared ownership)	0.2983	0.1677	0.4290	1.3476	1.1826	1.5358	0.0000	0.0000
own_or_rentRent - from local authority, local council, housing association	0.6761	0.6444	0.7078	1.9661	1.9048	2.0294	0.0000	0.0000
own_or_rentLive in accommodation rent free	0.3911	0.3062	0.4760	1.4786	1.3582	1.6097	0.0000	0.0000
own_or_rentRent - from private landlord or letting agency	0.4240	0.3812	0.4667	1.5280	1.4641	1.5948	0.0000	0.0000
own_or_rentOwn with a mortgage	0.3092	0.2899	0.3284	1.3623	1.3363	1.3888	0.0000	0.0000
townsend_deprivation_index	0.1735	0.1649	0.1821	1.1895	1.1792	1.1998	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.1630	0.1403	0.1858	1.1771	1.1506	1.2042	0.0000	0.0000
risk_takingYes	0.2044	0.1873	0.2215	1.2268	1.2060	1.2479	0.0000	0.0000
tiredness_freq	0.5737	0.5530	0.5945	1.7749	1.7384	1.8121	0.0000	0.0000
unenthusiasm_freq	0.4244	0.3962	0.4527	1.5287	1.4861	1.5726	0.0000	0.0000
fast_driving	0.1339	0.1044	0.1633	1.1433	1.1101	1.1774	0.0000	0.0000
gymYes	-0.1913	-0.2108	-0.1718	0.8259	0.8099	0.8421	0.0000	0.0000
LTPA	-0.4486	-0.4836	-0.4135	0.6385	0.6166	0.6613	0.0000	0.0000

Table S56. Obesity

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.6147	0.6004	0.6290	1.8491	1.8228	1.8758	0.0000	0.0000
air_pollution_PC1	0.0288	0.0249	0.0327	1.0292	1.0252	1.0333	0.0000	0.0000
greenspace_PC1	-0.0196	-0.0242	-0.0150	0.9806	0.9761	0.9852	0.0000	0.0000
number_sex_partners	0.0089	0.0010	0.0169	1.0090	1.0010	1.0170	0.0269	0.0299
sex_age_first	-0.2055	-0.2155	-0.1956	0.8142	0.8061	0.8224	0.0000	0.0000
chronotypeDefinitely an 'evening' person	0.2809	0.2495	0.3123	1.3243	1.2833	1.3666	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.0589	0.0118	0.1061	1.0607	1.0118	1.1119	0.0214	0.0242
chronotypeDefinitely a 'morning' person	0.1517	0.1142	0.1893	1.1638	1.1209	1.2083	0.0000	0.0000
nap	0.4070	0.3892	0.4248	1.5023	1.4758	1.5293	0.0000	0.0000
sleep_hours_categorical<7 hours	0.2942	0.2769	0.3115	1.3421	1.3190	1.3655	0.0000	0.0000
sleep_hours_categorical>9 hours	0.2698	0.2421	0.2976	1.3098	1.2740	1.3466	0.0000	0.0000
family_visit_freq	0.2321	0.1958	0.2684	1.2613	1.2163	1.3079	0.0000	0.0000
religious_groupYes	-0.0485	-0.0702	-0.0268	0.9527	0.9322	0.9736	0.0000	0.0000
facial_agingAbout your age	0.2514	0.2333	0.2696	1.2859	1.2627	1.3094	0.0000	0.0000
facial_agingOlder than you are	0.6617	0.5312	0.7922	1.9381	1.7010	2.2083	0.0000	0.0000
skin_colorLight olive	-0.0398	-0.0618	-0.0178	0.9610	0.9401	0.9824	0.0005	0.0006

Table S56. Obesity

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBrown	0.0886	0.0228	0.1545	1.0927	1.0230	1.1670	0.0083	0.0099
skin_colorVery fair	0.0945	0.0657	0.1234	1.0992	1.0679	1.1313	0.0000	0.0000
skin_colorDark olive	0.1560	0.1015	0.2105	1.1688	1.1068	1.2342	0.0000	0.0000
skin_colorBlack	0.1430	0.0356	0.2504	1.1538	1.0363	1.2846	0.0091	0.0104
sun_protection_use	-0.2310	-0.2582	-0.2039	0.7937	0.7725	0.8155	0.0000	0.0000
fish_oil_supplementsYes	-0.1849	-0.2025	-0.1672	0.8312	0.8166	0.8460	0.0000	0.0000
folate_supplementsYes	-0.0017	-0.0529	0.0496	0.9983	0.9484	1.0508	0.9484	0.9484
glucosamine_supplementsYes	-0.0164	-0.0364	0.0036	0.9837	0.9642	1.0036	0.1086	0.1161
multivitamin_supplementsYes	-0.0871	-0.1057	-0.0684	0.9166	0.8997	0.9339	0.0000	0.0000
pack_years_prop	0.2291	0.2216	0.2366	1.2575	1.2481	1.2669	0.0000	0.0000
smoking_statusPrevious	0.2312	0.2148	0.2475	1.2601	1.2396	1.2808	0.0000	0.0000
smoking_statusCurrent	-0.1572	-0.1839	-0.1305	0.8545	0.8320	0.8777	0.0000	0.0000
IPAQ_activity_group	-0.5334	-0.5647	-0.5021	0.5866	0.5685	0.6053	0.0000	0.0000
education_years	-0.3311	-0.3504	-0.3117	0.7182	0.7044	0.7322	0.0000	0.0000
hshld_income	-0.4560	-0.4875	-0.4245	0.6338	0.6141	0.6541	0.0000	0.0000
ethnicityAsian	-0.3032	-0.3600	-0.2465	0.7384	0.6977	0.7816	0.0000	0.0000
ethnicityBlack	0.7685	0.7156	0.8214	2.1565	2.0454	2.2737	0.0000	0.0000

Table S56. Obesity

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	0.0761	-0.0225	0.1747	1.0791	0.9777	1.1909	0.1305	0.1375
ethnicityOther	0.2086	0.1292	0.2880	1.2319	1.1379	1.3337	0.0000	0.0000

Table S57. Dyslipidemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
alcohol_freqOnce or twice a week	-0.0779	-0.1022	-0.0536	0.9250	0.9028	0.9478	0.0000	0.0000
alcohol_freqDaily or almost daily	-0.1180	-0.1443	-0.0917	0.8887	0.8656	0.9124	0.0000	0.0000
alcohol_freqThree or four times a week	-0.1351	-0.1601	-0.1101	0.8736	0.8521	0.8957	0.0000	0.0000
bread	-0.0369	-0.0512	-0.0226	0.9638	0.9501	0.9776	0.0000	0.0000
cereal	-0.1643	-0.1777	-0.1509	0.8485	0.8372	0.8599	0.0000	0.0000
never_eat_dairyYes	-0.1378	-0.1827	-0.0929	0.8713	0.8330	0.9113	0.0000	0.0000
never_eat_eggsYes	0.0208	-0.0216	0.0633	1.0211	0.9786	1.0654	0.3358	0.3689
never_eat_sugarYes	0.0260	0.0076	0.0445	1.0264	1.0076	1.0455	0.0059	0.0082
partial_fiber_score	-0.1091	-0.1250	-0.0933	0.8966	0.8825	0.9109	0.0000	0.0000
poultry	0.1743	0.1566	0.1921	1.1905	1.1695	1.2118	0.0000	0.0000
processed_meat	0.1597	0.1434	0.1760	1.1731	1.1542	1.1924	0.0000	0.0000
red_meat	0.1741	0.1573	0.1909	1.1902	1.1704	1.2103	0.0000	0.0000
salt	0.0636	0.0456	0.0817	1.0657	1.0466	1.0851	0.0000	0.0000
body_size_10yrs_oldThinner	0.0425	0.0263	0.0588	1.0434	1.0266	1.0605	0.0000	0.0000
body_size_10yrs_oldPlumper	0.1370	0.1162	0.1578	1.1468	1.1232	1.1709	0.0000	0.0000
height_10yrs_oldShorter	0.0651	0.0470	0.0832	1.0673	1.0481	1.0868	0.0000	0.0000

Table S57. Dyslipidemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
height_10yrs_oldTaller	-0.0554	-0.0719	-0.0388	0.9461	0.9306	0.9619	0.0000	0.0000
maternal_smokingYes	0.0941	0.0763	0.1120	1.0987	1.0792	1.1185	0.0000	0.0000
mobile_phone_2yrsYes, use is now less frequent	0.1037	0.0682	0.1392	1.1093	1.0706	1.1494	0.0000	0.0000
mobile_phone_2yrsI didn't use a mobile phone two years ago	-0.0025	-0.0646	0.0597	0.9975	0.9374	1.0615	0.9378	0.9378
mobile_phone_2yrsYes, use is now more frequent	0.0079	-0.0102	0.0260	1.0079	0.9899	1.0263	0.3834	0.4097
employedYes	-0.0942	-0.1113	-0.0772	0.9101	0.8947	0.9257	0.0000	0.0000
unemployedYes	0.0944	0.0423	0.1466	1.0990	1.0432	1.1579	0.0004	0.0007
accommodation_typeMobile or temporary structure (i.e. caravan)	0.0302	-0.1653	0.2258	1.0307	0.8476	1.2533	0.7617	0.7817
accommodation_typeA flat, maisonette or apartment	0.0164	-0.0093	0.0422	1.0166	0.9907	1.0431	0.2115	0.2427
gas_hob_heatYes	-0.0106	-0.0257	0.0046	0.9895	0.9746	1.0046	0.1711	0.2022
hshld_parentsYes	0.1371	0.0865	0.1878	1.1470	1.0903	1.2065	0.0000	0.0000
hshld_partnerYes	0.0521	0.0351	0.0691	1.0535	1.0357	1.0716	0.0000	0.0000
hshld_siblingsYes	0.0588	-0.0272	0.1448	1.0606	0.9731	1.1558	0.1804	0.2100
hshld_vehicles	0.0960	0.0675	0.1246	1.1008	1.0698	1.1327	0.0000	0.0000

Table S57. Dyslipidemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
own_or_rentPay part rent and part mortgage (shared ownership)	0.0372	-0.0858	0.1601	1.0379	0.9178	1.1737	0.5531	0.5830
own_or_rentRent - from local authority, local council, housing association	0.1699	0.1369	0.2028	1.1852	1.1467	1.2249	0.0000	0.0000
own_or_rentLive in accommodation rent free	0.1061	0.0269	0.1853	1.1120	1.0273	1.2036	0.0086	0.0118
own_or_rentRent - from private landlord or letting agency	0.0940	0.0540	0.1340	1.0986	1.0555	1.1434	0.0000	0.0000
own_or_rentOwn with a mortgage	0.0293	0.0123	0.0463	1.0297	1.0124	1.0474	0.0007	0.0011
townsend_deprivation_index	0.0307	0.0222	0.0391	1.0311	1.0225	1.0399	0.0000	0.0000
psychiatrist_visit_mental_health Yes	0.1136	0.0919	0.1354	1.1203	1.0962	1.1450	0.0000	0.0000
risk_takingYes	0.0606	0.0442	0.0769	1.0624	1.0452	1.0800	0.0000	0.0000
tiredness_freq	0.2165	0.1980	0.2349	1.2417	1.2190	1.2648	0.0000	0.0000
unenthusiasm_freq	0.2125	0.1845	0.2406	1.2368	1.2026	1.2720	0.0000	0.0000
fast_driving	0.0505	0.0251	0.0758	1.0518	1.0254	1.0788	0.0001	0.0002
gymYes	-0.0942	-0.1104	-0.0780	0.9101	0.8955	0.9250	0.0000	0.0000
LTPA	-0.1407	-0.1579	-0.1235	0.8687	0.8539	0.8838	0.0000	0.0000

Table S57. Dyslipidemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
sedentary	0.2443	0.2315	0.2571	1.2767	1.2605	1.2932	0.0000	0.0000
air_pollution_PC1	-0.0036	-0.0071	-0.0001	0.9964	0.9930	0.9999	0.0461	0.0581
greenspace_PC1	0.0062	0.0019	0.0104	1.0062	1.0019	1.0104	0.0043	0.0064
number_sex_partners	0.0088	-0.0030	0.0205	1.0088	0.9970	1.0207	0.1363	0.1636
sex_age_first	-0.0724	-0.0798	-0.0650	0.9302	0.9233	0.9371	0.0000	0.0000
chronotypeDefinitely an 'evening' person	0.1006	0.0743	0.1270	1.1059	1.0771	1.1354	0.0000	0.0000
chronotypeMore an 'evening' than a 'morning' person	0.0350	0.0118	0.0581	1.0356	1.0118	1.0599	0.0050	0.0071
chronotypeDefinitely a 'morning' person	0.0334	0.0090	0.0579	1.0340	1.0091	1.0596	0.0098	0.0131
nap	0.1473	0.1309	0.1636	1.1587	1.1399	1.1778	0.0000	0.0000
sleep_hours_categorical<7 hours	0.0700	0.0536	0.0863	1.0725	1.0551	1.0901	0.0000	0.0000
sleep_hours_categorical>9 hours	0.1575	0.1296	0.1854	1.1706	1.1384	1.2038	0.0000	0.0000
family_visit_freq	0.0994	0.0667	0.1321	1.1045	1.0690	1.1412	0.0000	0.0000
religious_groupYes	-0.0360	-0.0573	-0.0147	0.9646	0.9443	0.9854	0.0011	0.0017
facial_agingAbout your age	0.0402	0.0232	0.0572	1.0410	1.0234	1.0588	0.0000	0.0000
facial_agingOlder than you are	0.2227	0.1468	0.2987	1.2495	1.1581	1.3481	0.0000	0.0000
skin_colorLight olive	0.0079	-0.0098	0.0255	1.0079	0.9902	1.0258	0.3834	0.4097

Table S57. Dyslipidemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
skin_colorBrown	0.0080	-0.0533	0.0694	1.0081	0.9481	1.0719	0.7972	0.8075
skin_colorVery fair	0.0151	-0.0110	0.0412	1.0152	0.9890	1.0420	0.2571	0.2906
skin_colorDark olive	0.0652	0.0128	0.1176	1.0674	1.0129	1.1248	0.0148	0.0189
skin_colorBlack	-0.0865	-0.1926	0.0196	0.9171	0.8248	1.0198	0.1101	0.1363
sun_protection_use	-0.0058	-0.0317	0.0201	0.9942	0.9688	1.0203	0.6580	0.6843
fish_oil_supplementsYes	0.0284	0.0137	0.0432	1.0288	1.0138	1.0441	0.0002	0.0003
folate_supplementsYes	-0.0656	-0.1111	-0.0201	0.9365	0.8948	0.9801	0.0047	0.0068
glucosamine_supplementsYes	-0.0221	-0.0392	-0.0050	0.9781	0.9616	0.9950	0.0111	0.0147
multivitamin_supplementsYes	-0.0207	-0.0372	-0.0043	0.9795	0.9635	0.9957	0.0137	0.0178
pack_years_prop	0.1555	0.1481	0.1629	1.1683	1.1596	1.1770	0.0000	0.0000
smoking_statusPrevious	0.1176	0.1027	0.1324	1.1248	1.1082	1.1416	0.0000	0.0000
smoking_statusCurrent	0.2579	0.2348	0.2811	1.2943	1.2646	1.3246	0.0000	0.0000
IPAQ_activity_group	-0.2401	-0.2580	-0.2223	0.7865	0.7726	0.8007	0.0000	0.0000
education_years	-0.1198	-0.1364	-0.1031	0.8871	0.8725	0.9020	0.0000	0.0000
hshld_income	-0.1647	-0.1865	-0.1429	0.8482	0.8299	0.8668	0.0000	0.0000
ethnicityAsian	0.3367	0.2881	0.3853	1.4003	1.3339	1.4701	0.0000	0.0000
ethnicityBlack	-0.4374	-0.4922	-0.3825	0.6457	0.6113	0.6822	0.0000	0.0000

Table S57. Dyslipidemia

Exposure	Beta	Beta 2.5% CI	Beta 97.5% CI	Hazard Ratio	HR 2.5% CI	HR 97.5% CI	P-value	FDR
ethnicityMixed	-0.0456	-0.1359	0.0448	0.9554	0.8729	1.0458	0.3220	0.3588
ethnicityOther	0.0562	-0.0172	0.1295	1.0578	0.9830	1.1383	0.1332	0.1623

Table S58. Explained variation and C-index across multivariable models in English UK Biobank participants (excluding cases within 5 years of recruitment)

Outcome	C-index model 1	C-index model 3	C-index model 4	C-index model 5	R^2 model 1	R^2 model 3	R^2 model 4	R^2 model 5	Cases	Sample
Vascular dementia	0.8296	0.8710	0.8825	0.8932	0.7911	0.8814	0.9066	0.9246	971 - 1,369	345,892 - 429,290
Emphysema, COPD	0.6841	0.8444	-	0.8688	0.3469	0.8491	-	0.9022	9,634 - 16,722	292,549 - 428,960
All-cause dementia	0.8113	0.8424	0.8607	0.8653	0.7432	0.8236	0.8710	0.8803	2,935 - 5,525	283,842 - 428,969
Alzheimer's disease	0.8192	0.8401	0.8723	0.8772	0.7626	0.8164	0.8948	0.9035	1,966 - 2,597	359,352 - 429,218
Lung cancer	0.6919	0.8345	0.8356	0.8379	0.3765	0.8373	0.8423	0.8524	1,971 - 3,320	283,856 - 428,415
Chronic liver diseases	0.6184	0.7956	-	0.8143	0.1565	0.7571	-	0.7995	1,191 - 1,879	284,814 - 427,787
Parkinson's disease	0.7641	0.7843	0.7957	0.7962	0.6061	0.6723	0.7048	0.7069	1,872 - 2,391	343,950 - 428,413
Osteoporosis	0.7531	0.7809	0.7923	0.8182	0.5703	0.6572	0.6914	0.7711	4,895 - 8,751	282,622 - 421,327
Chronic kidney diseases	0.7296	0.7770	-	0.7984	0.4945	0.6542	-	0.7267	8,786 - 15,533	290,833 - 426,083
All-cause mortality	0.7136	0.7615	0.7637	0.7733	0.4506	0.6201	0.6271	0.6604	13,718 - 24,307	274,613 - 429,482
Esophageal cancer	0.7238	0.7613	0.7625	0.7682	0.4622	0.5897	0.5992	0.6152	804 - 937	368,768 - 429,115
Macular degeneration	0.7508	0.7605	0.7726	0.7729	0.5671	0.5956	0.6455	0.6466	5,264 - 6,328	364,431 - 427,431
Liver cancer	0.7019	0.7561	-	0.7733	0.3968	0.5889	-	0.6907	616 - 699	378,717 - 429,295
Type II diabetes	0.6180	0.7494	0.7806	0.8281	0.1558	0.5553	0.6543	0.7804	6,664 - 12,357	269,063 - 401,020
Cerebrovascular diseases	0.7122	0.7429	0.7462	0.7526	0.4396	0.5427	0.5527	0.5742	9,131 - 11,873	337,877 - 419,024
Ischemic heart disease	0.6837	0.7238	0.7396	0.7506	0.3431	0.4712	0.5215	0.5566	20,864 - 35,125	270,260 - 417,016
Rheumatoid arthritis	0.6343	0.7130	0.7249	0.7301	0.2026	0.4492	0.4882	0.5043	2,650 - 3,414	346,885 - 424,044
Leukemia	0.7008	0.7115	0.7200	0.7370	0.3971	0.4307	0.4557	0.5300	1,177 - 1,210	414,717 - 428,692
Pancreatic cancer	0.6915	0.7101	0.7261	0.7298	0.3755	0.4380	0.4890	0.5034	1,112 - 1,159	414,154 - 429,309
Osteoarthritis	0.6420	0.6786	-	0.6946	0.2233	0.3323	-	0.3825	26,856 - 32,905	312,863 - 372,852
Colorectal cancer	0.6572	0.6686	0.6944	0.6962	0.2628	0.3014	0.3844	0.3891	4,027 - 4,268	402,653 - 425,559
Prostate cancer	0.6606	0.6683	0.7497	0.7501	0.2826	0.3041	0.5522	0.5537	6,117 - 7,009	166,238 - 189,212
Lymphoma	0.6499	0.6550	-	0.6776	0.2366	0.2505	-	0.3239	1,447 - 1,745	356,850 - 427,840
Ovarian cancer	0.5970	0.6445	0.6712	0.6748	0.1054	0.2384	0.3200	0.3277	615 - 753	194,157 - 233,717
Breast cancer	0.5329	0.5618	0.6509	0.6585	0.0129	0.0467	0.2538	0.2759	3,981 - 5,467	159,366 - 222,053

Model 1: age, sex. Model 3: age, sex, exposome. Model 4: age, sex, exposome, polygenic risk scores (PRS; including genetic principal components, and genotyping batch). Model 5: age, sex, exposome, PRS, known clinical risk factors specific to each outcome. Model 2 was not run in these sensitivity analyses. For diseases, the PRS for that specific disease was added. For all-cause mortality, all PRS for all other diseases in this table were added. If a PRS was not available for a particular outcome, then model 4 was not calculated for that outcome (and a dash is shown) but model 5 was still calculated excluding any PRS information. Cases and sample sizes are shown as ranges due to varying levels of missing data across variables used in the different models.

Table S59. Explained variation and C-index across multivariable models in Scottish/Welsh UK Biobank participants (excluding cases within 5 years of recruitment)

Outcome	C-index model 1	C-index model 3	C-index model 4	C-index model 5	R^2 model 1	R^2 model 3	R^2 model 4	R^2 model 5	Cases	Sample
Vascular dementia	0.8635	0.9028	0.9047	0.9103	0.8507	0.9192	0.9233	0.9321	179	54,594
Emphysema, COPD	0.7008	0.8884	-	0.9068	0.3839	0.9150	-	0.9474	1,281	54,556
All-cause dementia	0.8244	0.8667	0.8783	0.8807	0.7747	0.8747	0.9019	0.9027	580	54,549
Lung cancer	0.7104	0.8589	0.8601	0.8602	0.4267	0.8746	0.8801	0.8837	485	54,445
Alzheimer's disease	0.8150	0.8366	0.8627	0.8647	0.7495	0.8075	0.8721	0.8733	299	54,578
Chronic kidney diseases	0.7431	0.8220	-	0.8503	0.5365	0.7854	-	0.8674	819	54,343
Chronic liver diseases	0.6713	0.8208	-	0.8357	0.3007	0.7620	-	0.8311	195	54,369
Esophageal cancer	0.7461	0.7923	0.7991	0.8046	0.5219	0.6845	0.6999	0.7172	127	54,560
Parkinson's disease	0.7839	0.7920	0.8130	0.8132	0.6731	0.6908	0.7446	0.7427	159	54,482
All-cause mortality	0.7246	0.7768	0.7761	0.7848	0.4813	0.6664	0.6662	0.6942	4,200	54,609
Type II diabetes	0.6384	0.7727	0.8093	0.8553	0.2014	0.6132	0.7023	0.8151	746	51,300
Osteoporosis	0.7333	0.7650	0.7701	0.8248	0.5185	0.5607	0.5904	0.7785	76	53,565
Macular degeneration	0.7381	0.7547	0.7599	0.7602	0.5329	0.5818	0.6063	0.6077	333	54,472
Cerebrovascular diseases	0.7169	0.7542	0.7571	0.7607	0.4633	0.5721	0.5769	0.5861	1,121	53,187
Liver cancer	0.7335	0.7524	-	0.7939	0.4555	0.5849	-	0.7309	115	54,576
Leukemia	0.7379	0.7488	0.7455	0.7640	0.5183	0.5364	0.5488	0.6226	119	54,500
Ischemic heart disease	0.6980	0.7390	0.7615	0.7701	0.3894	0.5167	0.5917	0.6134	3,428	52,827
Rheumatoid arthritis	0.6225	0.7003	0.7375	0.7474	0.1925	0.3794	0.4971	0.5505	35	53,841
Prostate cancer	0.6848	0.6872	0.7596	0.7614	0.3409	0.3503	0.5687	0.5732	604	23,688
Pancreatic cancer	0.6724	0.6830	0.7030	0.7098	0.3061	0.3346	0.3733	0.4090	170	54,581
Osteoarthritis	0.6460	0.6719	-	0.6961	0.2224	0.2871	-	0.3697	1,796	48,482
Lymphoma	0.6661	0.6629	-	0.6495	0.2772	0.2790	-	0.2556	179	54,377
Colorectal cancer	0.6572	0.6574	0.6926	0.6944	0.2590	0.2635	0.3751	0.3817	458	54,052
Ovarian cancer	0.5803	0.6132	0.6475	0.6509	0.0743	0.1588	0.2452	0.2589	97	30,155
Breast cancer	0.5345	0.5151	0.6247	0.6292	0.0100	0.0019	0.1704	0.1789	589	28,678

Model 1: age, sex. Model 3: age, sex, exposome. Model 4: age, sex, exposome, polygenic risk scores (PRS; including genetic principal components, and genotyping batch). Model 5: age, sex, exposome, PRS, known clinical risk factors specific to each outcome. Model 2 was not run in these sensitivity analyses. For diseases, the PRS for that specific disease was added. For all-cause mortality, all PRS for all other diseases in this table were added. If a PRS was not available for a particular outcome, then model 4 was not calculated for that outcome (and a dash is shown) but model 5 was still calculated excluding any PRS information. Results were calculated using linear predicted values based on model results from the English participants and outcome rates from the independent validation Scottish/Welsh sample.