**Stair climbing and mortality: A prospective cohort study from the UK Biobank**

**Electronic supplementary material (ESM)**

* **Additional information regarding the extraction of physical activity data.**
* **ESM Table 1.** Description of variables included from UK Biobank Data Showcase.
* **ESM Table 2.** Cross-tabulation of stair climbing categories at baseline and the repeated assessment.
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**Additional information regarding the extraction of physical activity data:**

Physical activity was assessed by self-report, using an adapted version of the International Physical Activity Short Form questionnaire. The participants reported the number of days engaging in bouts of walking, moderate, and vigorous intensity physical activity lasting for more than 10 minutes in a typical week. Therefore, the information contained in this covariate did not overlap daily frequency of stair climbing. Total weekly physical activity was then defined as metabolic equivalents (METs) in minutes/week (MET-minutes/week) calculated as the sum of walking (3.3 METs), moderate (4.0 METs) and vigorous activities (8.0 METs). Following the IPAQ-SF guidelines for data processing, time spent walking and doing moderate or vigorous activity was truncated at 180 minutes/day all cases with incomplete responses or missing information for number of days, duration or reporting > 960 minutes of physical activity per day were excluded. More information can be found at:

The IPAQ Group. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ) – Short and Long Forms Contents. 2005

**ESM Table 1.** Description of variables included from UK Biobank Data Showcase.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item** | **UK Biobank Field ID(s)** | **Measurement item(s)** | **Definition/data coding** | **Notes** |
| Accommodation | n\_670\_0\_0 | (Questionnaire) Type of accommodation lived in | House = 0  Flat = 1 | http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=670 |
| Alcohol | Combinations of n\_20117\_0\_0 & n\_1558\_0\_0 | (Questionnaire) self-reported drinking status and drinking frequency | Never = n\_20117\_0\_0 == 0 |  |
| Previous = n\_20117\_0\_0 == 1 |
| Current, <3times/week = 2 if n\_20117\_0\_0 == 2 & (n\_1558\_0\_0 == 3 | n\_1558\_0\_0 == 4 | n\_1558\_0\_0 == 5 |
| Current, ≥3times/week = 3 if n\_20117\_0\_0 == 2 & (n\_1558\_0\_0 == 1 | n\_1558\_0\_0 ==2 |
| Anorexia, bulimia or other eating disorder | n\_20002\_0\_0 – n\_20002\_0\_28 | (Interview) self-reported anorexia/bulimia/other eating disorder | if `x'==1470 |  |
|
|
| Attendance/disability/mobility allowance | N\_ 6146  \_0\_0 | (Questionnaire) self-reported attendance, disability or mobility allowance | Attendance allowance =1  Disability living allowance = 2  Blue badge =3 | http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=6146 |
| Birthday | n\_34\_0\_0 & n\_52\_0\_0 | (Registry, updated by participant) year and month of birth | Date set to 15th for all participants |  |
| Body mass index | n\_21001\_0\_0 | Measured height and weight | 18.5-24.9 kg/m2 (Normal weight) =0  25-29.9 kg/m2 (Overweight) =1  ≥30 kg/m2 (obese)=2 | http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=21001 |
| Cancer at baseline | n\_2453\_0\_0 | (Questionnaire) self-reported cancer | If ‘x’==1 | http://biobank.ctsu.ox.ac.uk/crystal/coding.cgi?id=6 |
| n\_20001\_0\_0 – n\_20001\_0\_5 | (Interview) self-reported cancer excluding non-melanoma skin cancer | If ‘x’ != . & ‘x’ != 1060 | ‘x’ != 1061 | ‘x’ != 1062 | ‘x’ != 1073 | http://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=40006 |
| http://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=40013&nl=1 |
| s\_40006\_0\_0 – s\_40006\_31\_0 | (Cancer Registry) Any cancer-type (C-D48) excluding non-melanoma skin cancers (ICD-10; C44, ICD-9; 173) |  |  |
| COPD | ts\_42016\_0\_0 | (Algorithmically defined outcomes) | If ‘x’ < assessment date | http://biobank.ctsu.ox.ac.uk/crystal/refer.cgi?id=4125 |
| COPD from self-report or hospital admission EHR |
| Country | n\_54\_0\_0 | (Automatically acquired at participant consent) UK Biobank assessment centre |  |  |
| Chronic/degenerative neurological problem | n\_20002\_0\_0 – n\_20002\_0\_28 | (Interview) self-reported chronic/degenerative neurological problem, Parkinson’s disease, dementia/Alzheimer’s/cognitive impairment, motor neuron disease, myasthenia gravis, multiple sclerosis, other demyelinating disease (not multiple sclerosis) | if `x'==1258 | `x'==1259 | |  |
| `x'==1260 | `x'==1261 | |
| `x'==1262 | `x'==1263 | |
| `x'== 1397 |
| Chronic immunological or sistemic diseases | n\_20002\_0\_0 – n\_20002\_0\_28 | (Interview) self-reported rheumatoid arthritis, vasculitis, giant cell/temporal arteritis, polymyalgia rheumatica, Wegners granulmatosis, microscopic polyarteritis, polyartertis nodosa, systemic lupus erythematosis/sle, sjogren's syndrome/sicca syndrome, dermatopolymyositis, dermatomyositis, polymyositis, scleroderma/systemic sclerosis, chronic fatigue syndrome, antiphospholipid syndrome | if `x'==1464 | `x'==1372 | `x'==1376 | `x'==1377 | `x'==1378 | `x'==1379 | `x'==1380 | `x'==1381 | `x'==1382 | `x'==1383 | `x'==1480 | `x'==1481 | `x'==1384 | `x'==1482 | `x'==1564 | Individuals reporting; sarcoidosis, connective tissue disorder, Raynaud’s phenomenon/disease not excluded |
| Allergy/hypersensitivity/anaphylaxis variables are not considered |
| Chronic respiratory diseases (not including COPD) | n\_20002\_0\_0 – n\_20002\_0\_28 | (Interview) self-reported bronchiectasis, interstitial lung disease, asbestosis, pulmonary fibrosis, fibrosing alveolitis/unspecified alveolitis, respiratory failure | if `x'==1114 | `x'==1115 | `x'==1120 | `x'==1121 | `x'==1122 | `x'==1124 |  |
| Individuals reporting; other respiratory problems, sleep apnea, pleurisy, pneumothorax, spontaneous pneumothorax/recurrent pneumothorax, pleural plaques (not known asbestosis), pleural effusion not excluded as these are not chronic or not debilitating |
|  |
| Respiratory infection, pneumonia, lung abscess, empyema not included as individuals with these conditions are unlikely to attend the examination center |
| Chronic widespread pain | n\_2956\_0\_0 | (Questionnaire) | if `x'==1 | doi: 10.1007/s11657-015-0252-1 |
| "Have you had pains all over the body for more than 3 months?" |
| CVD at baseline | n\_42000\_0\_0 | (Algorithmically defined outcomes) | ICD-10: | http://biobank.ctsu.ox.ac.uk/crystal/refer.cgi?id=461 |
| n\_ 42006\_0\_0 | myocardial infarction, stroke, ischaemic stroke, subarachnoid haemorrhage, brain haemorrhage | MI: I21, I22, I23, I24.1, I25.2 | http://biobank.ctsu.ox.ac.uk/crystal/refer.cgi?id=462 |
| n\_42008\_0\_0 n\_42010\_0\_0 |  | Subarachnoid haemorrhage: I60 |  |
| n\_42012\_0\_0 |  | Intracerebral haemorrhage: I61 |  |
|  |  | Cerebral infarction: I63 |  |
|  |  | Stroke, not specified as haemorrhage or |  |
|  |  | Infarction: I64.X |  |
|  |  |  |  |
|  |  | ICD-9: |  |
|  |  | MI: 410, 411, 412.X, 429.79 |  |
|  |  | Subarachnoid haemorrhage: 430.X |  |
|  |  | Intracerebral haemorrhage: 431.X |  |
|  |  | Occlusion of cerebral arteries: 434.X |  |
|  |  | Cerebral thrombosis: 434.0 |  |
|  |  | Cerebral embolism: 434.1 |  |
|  |  | Cerebral artery occlusion, unspecified: 434.9 |  |
|  |  | Acute, but ill-defined, cerebrovascular disease: 436.X |  |
| s\_41270\_0\_0 ts\_41280\_0\_0 s\_41271\_0\_0 ts\_41281\_0\_0 | (Hospital In-patient data) | ICD-10: | http://biobank.ctsu.ox.ac.uk/crystal/field.cgi?id=41270 |
| Angina, heart failure | Angina (I20): I20.0, I20.1, I20.8, I20.9 |
|  | Heart failure (I11, I13, I50): I50.0, I50.1, I50.9, I11.0, I11.9, I13.0, I13.2, I13.9) |
|  | ICD-9: |
|  | Angina: 4139 |
|  | Heart failure: 4280, 4281, 4289 |
| Date lost to follow-up | ts\_191\_0\_0 | (multiple sources) date which a person is believed to be lost to follow-up |  | http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=191 |
| Date of attending UK Biobank assessment centre | ts\_53\_0\_0 | (Acquired at UK Biobank Reception) | Wales = if `x'== 11003 | `x'==11022 | `x'==11023 | http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=54 |
| Scotland = if `x'== 11005 | `x'==11004 |
| England = if none of the above satisfied |
| Date of Death | ts\_40000\_0\_0 | (Death register) date of death |  |  |
| Depression | n\_20002\_0\_0 – n\_20002\_0\_28 | (Interview) self-reported depression | If ‘x’== 1286 | Not including post-natal depression |
| Diabetes (excluding gestational diabetes) | n\_2443\_0\_0 | (Questionnaire) self-reported diabetes | If ‘x’==1 & n\_4041\_0\_0 (gestational diabetes) !=1 |  |
| N\_6153\_0\_0 – n\_6153\_0\_3 (women) | (Questionnaire) self-reported Insulin user | If ‘x’==3 |
| n\_6177\_0\_0 – n\_6177\_0\_2 (men |
| n\_20002\_0\_0 – n\_20002\_0\_28 | (Interview) self-reported diabetes | if ‘x’== 1220 | |
| ‘x’== 1222 | ‘x’==1223 |
| n\_30750\_0\_0 | (Biochemistry) HbA1c | If ‘x’ ≥48 mmol/l |
| Duration of moderate activity | n\_894\_0\_0 | (Questionnaire) minutes of moderate activity on a typical day | IPAQ data processing | http://biobank.ndph.ox.ac.uk/showcase/showcase/docs/ipaq\_analysis.pdf |
| Duration of vigorous activity | n\_914\_0\_0 | (Questionnaire) minutes of vigorous activity on a typical day | IPAQ data processing | http://biobank.ndph.ox.ac.uk/showcase/showcase/docs/ipaq\_analysis.pdf |
| Duration of walks | n\_874\_0\_0 | (Questionnaire) minutes of walking on a typical day | IPAQ data processing | http://biobank.ndph.ox.ac.uk/showcase/showcase/docs/ipaq\_analysis.pdf |
| Education | n\_6138\_0\_0 - n\_6138\_0\_5 | (Questionnaire) self-reported qualifications | College/University degree = if `x'== 1 | 7 answering options |
| A/AS/O/GCSE/CSE/NVQ/HND/HNC/Other professional qualifications = if `x'== 2 | `x'== 3 | `x'== 4 | `x'== 5 | `x'== 6 | structure which accounts for all |
| No qualifications= if `x'== -7 | Original categories do not have a clear ordinal |
| Employment | n\_6142\_0\_0 - n\_6142\_0\_0 | (Questionnaire) self-reported 'current situation' | Employed = if `x'== 1 |  |
| Ethnicity | n\_21000\_0\_0 | (Questionnaire) amalgam of sequential branching questions | White = if `x'==1 | `x'==1001 | `x'==1002 | `x'==1003 |  |
| Other = if above not satisfied |
| Fruit/vegetable intake (servings/week) | n\_1289\_0\_0 n\_1299\_0\_0 n\_1309\_0\_0 n\_1319\_0\_0 | (Questionnaire) self-reported frequency of cooked vegetable intake, salad/raw vegetable intake, fresh fruit intake, dried fruit intake | Less than one = 0.5 | Included as part of diet pattern variable |
| Otherwise, number of reported tablespoons (vegetables) and pieces (fruit) as reported |
|  |
| General health | n\_2178\_0\_0 | (Questionnaire) Self-perceived overall health rating | Poor = 4 |  |
| Healthy diet pattern | Derived for this dataset | Composite of self-reported fish, fruit/vegetable and processed/red meat intake | 1 if meeting 2 of the 3 food item targets | Fish: >=2 servings/week, including 1 with oily fish: https://www.nhs.uk/live-well/eat-well/eight-tips-for-healthy-eating/ |
| 0 if not meeting 2 of the targets | Fruit/vegetables: >=5 servings/day: <https://www.nhs.uk/live-well/eat-well/5-a-day-what-counts/> + doi: 10.1016/S2468-2667(18)30200-7 |
|  |  |
|  | Processed/red meat intake: <= 3 servings of red meat/week & <=1 serving of processed meat/week: https://www.ncbi.nlm.nih.gov/pubmed/30467019 + doi: 10.1016/S2468-2667(18)30200-7 |
| Hypertension | n\_6150\_0\_0 – n\_6150\_0\_3 | (Questionnaire) self-reported High Blood Pressure | If ‘x’==4 |  |
| N\_6153\_0\_0 – n\_6153\_0\_3 (women) | (Questionnaire) self-reported blood pressure medication | If ‘x’==2 |
| n\_6177\_0\_0 – n\_6177\_0\_2 (men |
| n\_4080\_0\_0 n\_4079\_0\_0 | Measured (manual or automated) systolic and diastolic BP | If SBP≥140 | DBP≥90 |
| n\_93\_0\_1 n\_94\_0\_1 |
| n\_20002\_0\_0 – n\_20002\_0\_28 | (Interview) self-reported hypertension, essential hypertension | if ‘x’==1065| ‘x’==1072 |
| Income | n\_738\_0\_0 | (Questionnaire) Average total household income before tax | <£18.000 = 0  £18,000–51,999 = 1  >£52,000 = 2  Missing = 3 | http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=738 |
| Liver failure/cirrhosis | n\_20002\_0\_0 – n\_20002\_0\_28 | (Interview) self-reported liver failure/cirrhosis, primary biliary cirrhosis, alcoholic liver disease / alcoholic cirrhosis | if `x'==1158 | `x'==1506 | `x'==1604 |  |
| Marital status | Combinations of n\_709\_0\_0 and n\_6414\_0\_0 - n\_6414\_0\_4 | (Questionnaire) self-reported individuals (including yourself) living in household and relation to those individuals | Not married/living with partner = if n\_709\_0\_0 == 1 |  |
| Married/living with partner = if n\_709\_0\_0 >1 & n\_6414\_0\_0 - n\_6414\_0\_4 == 1 |
|  |
| No. of days/week walking | n\_864\_0\_0 | (Questionnaire) days of ≥10-minute walking in last week | IPAQ data processing | http://biobank.ndph.ox.ac.uk/showcase/showcase/docs/ipaq\_analysis.pdf |
| No. of days/week moderate physical activity | n\_884\_0\_0 | (Questionnaire) days of ≥10-minute moderate activity in last week | IPAQ data processing | http://biobank.ndph.ox.ac.uk/showcase/showcase/docs/ipaq\_analysis.pdf |
| No. of days/week vigorous physical activity | n\_904\_0\_0 | (Questionnaire) days of ≥10-minute vigorous activity in last week | IPAQ data processing | http://biobank.ndph.ox.ac.uk/showcase/showcase/docs/ipaq\_analysis.pdf |
| Non-oily Fish intake (servings/week) | n\_1339\_0\_0 | (Questionnaire) self-reported frequency of non-oily fish intake | Never = 0 | Included as part of diet pattern variable |
| 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 |
| Oily Fish intake (servings/week) | n\_1329\_0\_0 | (Questionnaire) self-reported frequency of oily fish intake | Never = 0 | Included as part of diet pattern variable |
| 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 |
| Primary cause of death | s\_40001\_0\_0 | (Death register) underlying/primary cause of death |  | http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=40001 |
| Processed meat (servings/week) | n\_1349\_0\_0 | (Questionnaire) self-reported frequency of processed meat intake | Never = 0 | Included as part of diet pattern variable |
| 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 |
| Psychological or psychiatric problems | n\_20002\_0\_0 – n\_20002\_0\_28 | (Interview) self-reported schizophrenia, mania/bipolar disorder/manic depression, deliberate self-harm/suicide attempt, post-traumatic stress disorder | If ‘x’== 1289 | ‘x’== 1290 | |  |
| ‘x’== 1291 | ‘x’== 1469 |
|  |
| Red meat (servings/week) | n\_1369\_0\_0 | (Questionnaire) self-reported frequency of beef, lamb/mutton and pork intake | Never = 0 | Included as part of diet pattern variable |
| n\_1379\_0\_0 | less than once a week = 0.5 |
| n\_1389\_0\_0 | Once a week = 1 |
|  | 2-4 times a week = 3 |
|  | 5-6 times a week = 5.5 |
|  | Once or more daily = 7 |
| Salt consumption | N\_1478\_0\_0 | (Questionnaire) self-reported frequency of adding salt to the food, not including salt used in cooking. | 1 = never/rearely | <http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=1478> |
| 2 = sometimes |  |
| 3 = Usually | Those selecting the option “prefer not to answer” in the questionnaire were considered as missings and excluded. |
| 4 = Always |  |
| Screen time | n\_1070\_0\_0 & n\_1080\_0\_0 | (Questionnaire) self-reported time-use of tv-viewing and non-occupational PC-use, h/day | TV-viewing = 0.5 if `x'== 'less than 1h' |  |
| PC-use = 0.5 if `x'== 'less than 1h' |
| Sex | n\_31\_0\_0 | (Registry, updated by participant) |  |  |
| Sleep duration | n\_1160\_0\_0 | (Questionnaire) self-reported hours of sleep/day | Sleep duration = 8 if `x'==’missing’ |  |
| Smoking | n\_20116\_0\_0 | (Questionnaire) self-reported smoking-status |  |  |
| Stair climbing | n\_943\_0\_0 | (Questionnaire) "At home, during the last 4 weeks, about how many times a DAY do you climb a flight of stairs? (approx 10 steps)" | Never = 0  1-5 flights/day=1  6-10 flights/day=2  11-15 flights/day=3  ≥16 flights/day=4 | http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=943 |
| Statins use | n\_20003\_0\_0 – n\_20003\_0\_47 | (Interview) self-reported use of statins | Atorvastatin, Fluvastatin, Pravastatin, Rosuvastatin, Simvastatin | https://www.nhs.uk/conditions/statins/ |
| Substance abuse/dependency | n\_20002\_0\_0 – n\_20002\_0\_28 | (Interview) self-reported alcohol dependency, opioid dependency, other substance abuse/dependency | if `x'==1408 | `x'== 1408 | |  |
| `x'== 1410 |
| Townsend | n\_189\_0\_0 | Townsend deprivation index calculated immediately prior to participant joining UK Biobank. Based on the preceding national census output areas. Each participant is assigned a score corresponding to the output area in which their postcode is located. |  |  |
| Walking pace | n\_924\_0\_0 | Usual walking pace | Slow pace = 1  Steady average pace =2  Brisk pace =3 | http://biobank.ndph.ox.ac.uk/showcase/field.cgi?id=924 |

**ESM Table 2.** Cross-tabulation of stair climbing categories at baseline and the repeat-assessment.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Repeat-assessment | | | | | |  |
|  |  | None | 1-5 times a day | 6-10 times a day | 11-15 times a day | ≥16 times a day | total | |
| Baseline | None | 616 | 88 | 27 | 9 | 3 | 743 | |
| 1-5 times a day | 101 | 1,032 | 745 | 125 | 48 | ,2051 | |
| 6-10 times a day | 62 | 701 | 2,844 | 1,003 | 372 | 4,982 | |
| 11-15 times a day | 17 | 124 | 1,007 | 1,048 | 610 | 2,806 | |
| ≥16 times a day | 23 | 47 | 336 | 645 | 1,181 | 2,232 | |
| total | 819 | 1,992 | 4,959 | 2,830 | 2,214 | 12,814 | |

**ESM Table 3.** Results from the age and sex-adjusted model for the associations of all-cause, cancer and cardiovascular disease mortality with flights of stairs climbed per day.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Flights of stairs (around 10) climbed per day** | | | | |
| **None**  (n=20,226) | **1-5**  (n=52,190) | **6-10**  (n=106,396) | **11-15**  (n=56,001) | **≥16**  (n=45,610) |
| **All-cause mortality** |  |  |  |  |  |
| Hazard ratio (95% CI) | 1 (reference) | 1.02 (0.95, 1.11) | 0.83 (0.77, 0.89) | 0.80 (0.74, 0.86) | 0.80 (0.73, 0.86) |
| Deaths | 1,018 | 1,967 | 3,385 | 1,714 | 1,361 |
| **Cancer mortality** |  |  |  |  |  |
| Hazard ratio (95% CI) | 1 (reference) | 0.99 (0.89, 1.09) | 0.82 (0.75, 0.90) | 0.82 (0.74, 0.91) | 0.82 (0.74, 0.91) |
| Deaths | 590 | 1,158 | 2,039 | 1,068 | 848 |
| **CVD mortality** |  |  |  |  |  |
| Hazard ratio (95% CI) | 1 (reference) | 1.12 (0.93, 1.34) | 0.91 (0.76, 1.08) | 0.83 (0.68, 1.00) | 0.81 (0.66, 0.99) |
| Deaths | 167 | 365 | 622 | 295 | 228 |

CI: Confidence Interval

**ESM Table 4.** Associations of all-cause mortality with flights of stairs climbed per day by age subgroups.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Age subgroups** | **Stair flights climbed per day** | **Hazard ratio** | **95%CI** | **Participants** | **Deaths** |
| 35-49 years | None (reference) |  |  | 3,487 | 50 |
|  | 1-5 | 1.00 | 0.73, 1.38 | 14,725 | 179 |
|  | 6-10 | 0.90 | 0.65, 1.24 | 28,722 | 271 |
|  | 11-15 | 0.95 | 0.67, 1.34 | 15,903 | 150 |
|  | ≥16 | 0.86 | 0.61, 1.23 | 13,481 | 114 |
| 50-59 years | None (reference) |  |  | 5,847 | 206 |
|  | 1-5 | 0.83 | 0.71, 0.98 | 19,822 | 518 |
|  | 6-10 | 0.83 | 0.71, 0.97 | 38,360 | 886 |
|  | 11-15 | 0.82 | 0.69, 0.97 | 18,604 | 405 |
|  | ≥16 | 0.85 | 0.71, 1.02 | 14,870 | 330 |
| ≥60 years | None (reference) |  |  | 10,892 | 762 |
|  | 1-5 | 1.08 | 0.98, 1.18 | 17,643 | 1,270 |
|  | 6-10 | 0.92 | 0.85, 1.00 | 39,314 | 2,228 |
|  | 11-15 | 0.93 | 0.84, 1.02 | 21,494 | 1,159 |
|  | ≥16 | 0.95 | 0.86, 1.05 | 17,259 | 917 |

CI: confidence Interval.

The analysis was adjusted for age, sex, ethnicity, type of accommodation (house/flat), Townsend deprivation index, education, marital status, employment, total annual income before tax, physical activity, diet pattern, salt consumption, screen time, smoking, alcohol, Body Mass Index, walking pace, depression, diabetes, hypertension, use of statins and longstanding illness, disability or infirmity.

**ESM Table 5.** Confounding structure of all-cause mortality and negative control outcomes.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Total n | All-cause mortality | | |  | Lung cancer mortality | | |
|  | n deaths | Hazard ratio (95% CI) | | n deaths | Hazard ratio (95% CI) | |
|  |  |  | Age and sex adjusted model | Multivariable adjusted model |  |  | Age and sex adjusted model | Multivariable adjusted model |
| **Flights of stairs/day\*** |  |  |  |  |  |  |  |  |
| None | 20,226 | 1,018 | 1.00 (ref) | 1.00 (ref) |  | 106 | 1.00 (ref) | 1.00 (ref) |
| 1-5 times a day | 52,190 | 1,967 | 1.02 (0.94, 1.10) | 1.01 (0.94, 1.10) |  | 195 | 0.93 (0.74, 1.19) | 0.97 (0.76, 1.23) |
| 6-10 times a day | 106,396 | 3,385 | 0.82 (0.76, 0.88) | 0.91 (0.85, 0.98) |  | 295 | 0.66 (0.53, 0.83) | 0.81 (0.65, 1.02) |
| 11-15 times a day | 56,001 | 1,714 | 0.79 (0.73, 0.86) | 0.92 (0.85, 0.99) |  | 122 | 0.52 (0.40, 0.68) | 0.69 (0.53, 0.91) |
| ≥16 times a day | 45,610 | 1,361 | 0.79 (0.73, 0.86) | 0.93 (0.86, 1.02) |  | 124 | 0.67 (0.51, 0.86) | 0.91 (0.70, 1.19) |
| **Sex** |  |  |  |  |  |  |  |  |
| Female | 144,985 | 3,547 |  | 1.00 (ref) |  | 367 |  | 1.00 (ref) |
| Male | 135,438 | 5,898 |  | 1.60 (1.53, 1.67) |  | 475 |  | 1.08 (0.93, 1.25) |
| **Total weekly PA** | 280,423 | 9,445 |  | 1.00 (1.00, 1.00) |  | 842 |  | 1.00 (1.00, 1.00) |
| **BMI** |  |  |  |  |  |  |  |  |
| Normal weight | 99,371 | 2,724 |  | 1.00 (ref) |  | 270 |  | 1.00 (ref) |
| Overweight | 122,797 | 4,235 |  | 0.98 (0.93, 1.03) |  | 375 |  | 0.87 (0.74, 1.02) |
| Obese | 58,255 | 2,486 |  | 1.16 (1.10, 1.24) |  | 197 |  | 0.88 (0.72, 1.08) |
| **Ethnicity** |  |  |  |  |  |  |  |  |
| White | 268,263 | 9,192 |  | 1.00 (ref) |  | 824 |  | 1.00 (ref) |
| Asian | 4,993 | 97 |  | 0.74 (0.60, 0.90) |  | 6 |  | 0.66 (0.29, 1.49) |
| Black | 3,592 | 76 |  | 0.86 (0.69, 1.08) |  | 5 |  | 0.72 (0.30, 1.74) |
| Others/Mixed | 3,575 | 80 |  | 0.91 (0.73, 1.13) |  | 7 |  | 0.83 (0.39, 1.75) |
| **Accommodation** |  |  |  |  |  |  |  |  |
| House/Bungalow | 256,484 | 8,421 |  | 1.00 (ref) |  | 726 |  | 1.00 (ref) |
| Flat | 23,939 | 1,024 |  | 1.07 (0.99, 1.15) |  | 116 |  | 1.08 (0.86, 1.37) |
| **Townsend Deprivation index** | 280,423 | 9,445 |  | 1.02 (1.01, 1.02) |  | 842 |  | 1.04 (1.01, 1.07) |
| **Total annual income** |  |  |  |  |  |  |  |  |
| <£18.000 | 40,551 | 2,347 |  | 1.00 (ref) |  | 246 |  | 1.00 (ref) |
| £18,000–51,999 | 133,549 | 4,577 |  | 0.92 (0.86, 0.97) |  | 379 |  | 0.84 (0.70, 1.01) |
| >£52,000 | 80,635 | 1,577 |  | 0.84 (0.78, 0.91) |  | 122 |  | 0.81 (0.62, 1.06) |
| Missing | 25,688 | 944 |  | 0.89 (0.82, 0.96) |  | 95 |  | 0.93 (0.73, 1.18) |
| **Education** |  |  |  |  |  |  |  |  |
| No qualifications | 31,291 | 1,904 |  | 1.00 (ref) |  | 214 |  | 1.00 (ref) |
| Not College/University degree | 140,666 | 4,539 |  | 0.95 (0.90, 1.01) |  | 444 |  | 0.89 (0.75, 1.06) |
| College/University degree | 108,466 | 3,002 |  | 0.96 (0.90, 1.03) |  | 184 |  | 0.63 (0.50, 0.78) |
| **Marital status** |  |  |  |  |  |  |  |  |
| Not living with partner | 68,058 | 2,732 |  | 1.00 (ref) |  | 250 |  | 1.00 (ref) |
| Living with partner | 212,365 | 6,713 |  | 0.84 (0.80, 0.88) |  | 592 |  | 1.02 (0.87, 1.21) |
| **Employment** |  |  |  |  |  |  |  |  |
| Unemployed | 97,345 | 5,284 |  | 1.00 (ref) |  | 478 |  | 1.00 (ref) |
| Employed | 183,078 | 4,161 |  | 1.11 (1.05, 1.16) |  | 364 |  | 0.94 (0.80, 1.12) |
| **Diet pattern** |  |  |  |  |  |  |  |  |
| Not meeting at least 2 targets | 84,607 | 2,994 |  | 1.00 (ref) |  | 297 |  | 1.00 (ref) |
| Meeting at least 2 targets | 195,816 | 6,451 |  | 0.94 (0.90, 0.99) |  | 545 |  | 0.91 (0.79, 1.06) |
| **Salt consumption** |  |  |  |  |  |  |  |  |
| Never/Rarely | 160,766 | 5,047 |  | 1.00 (ref) |  | 414 |  | 1.00 (ref) |
| Sometimes | 77,454 | 2,639 |  | 1.03 (0.98, 1.08) |  | 222 |  | 0.95 (0.81, 1.12) |
| Usually | 31,294 | 1,265 |  | 1.08 (1.01, 1.15) |  | 131 |  | 1.12 (0.92, 1.37) |
| Always | 10,909 | 494 |  | 1.18 (1.08, 1.30) |  | 75 |  | 1.49 (1.16, 1.92) |
| **Screen time** |  |  |  |  |  |  |  |  |
| <2h/day | 34,859 | 832 |  | 1.00 (ref) |  | 67 |  | 1.00 (ref) |
| 2–3 h/day | 54,808 | 1,433 |  | 0.98 (0.90, 1.07) |  | 119 |  | 0.96 (0.71, 1.29) |
| 3-4 h/day | 64,333 | 2,069 |  | 1.05 (0.96, 1.14) |  | 184 |  | 1.06 (0.80, 1.40) |
| 4–5 h/day | 53,213 | 1,981 |  | 1.03 (0.95, 1.12) |  | 175 |  | 0.99 (0.75, 1.32) |
| >5 h/day | 73,210 | 3,130 |  | 1.05 (0.97, 1.14) |  | 297 |  | 1.04 (0.79, 1.37) |
| **Smoking status** |  |  |  |  |  |  |  |  |
| Never | 161,366 | 4,175 |  | 1.00 (ref) |  | 155 |  | 1.00 (ref) |
| Previous | 94,361 | 3,803 |  | 1.17 (1.11, 1.22) |  | 379 |  | 3.20 (2.65, 3.88) |
| Current | 24,696 | 1,467 |  | 2.20 (2.07, 2.34) |  | 308 |  | 12.00 (9.79, 14.71) |
| **Alcohol intake** |  |  |  |  |  |  |  |  |
| Never | 9,075 | 325 |  | 1.00 (ref) |  | 21 |  | 1.00 (ref) |
| Former | 6,792 | 335 |  | 1.14 (0.98, 1.34) |  | 38 |  | 1.33 (0.78, 2.28) |
| Current,<3 times/week | 129,921 | 4,037 |  | 0.89 (0.800, 1.00) |  | 340 |  | 0.90 (0.57, 1.40) |
| Current,>=3 times/week | 134,635 | 4,748 |  | 0.89 (0.79, 1.00) |  | 443 |  | 0.96 (0.61, 1.50) |
| **Depression** |  |  |  |  |  |  |  |  |
| No | 268,173 | 9,001 |  | 1.00 (ref) |  | 803 |  | 1.00 (ref) |
| Yes | 12,250 | 444 |  | 1.16 (1.05, 1.27) |  | 39 |  | 0.96 (0.69, 1.33) |
| **Longstanding illness** |  |  |  |  |  |  |  |  |
| No | 218,192 | 6,504 |  | 1.00 (ref) |  | 595 |  | 1.00 (ref) |
| Yes | 62,231 | 2,941 |  | 1.18 (1.12, 1.23) |  | 247 |  | 1.12 (0.96, 1.31) |
| **Walking pace** |  |  |  |  |  |  |  |  |
| Slow | 8,526 | 556 |  | 1.00 (ref) |  | 43 |  | 1.00 (ref) |
| Steady average pace | 143,372 | 5,373 |  | 0.78 (0.72, 0.86) |  | 519 |  | 1.09 (0.79, 1.49) |
| Brisk pace | 128,525 | 3,516 |  | 0.74 (0.68, 0.82) |  | 280 |  | 0.91 (0.65, 1.28) |
| **Diabetes** |  |  |  |  |  |  |  |  |
| No | 269,287 | 8,599 |  | 1.00 (ref) |  | 786 |  | 1.00 (ref) |
| Yes | 11,136 | 846 |  | 1.34 (1.24, 1.45) |  | 56 |  | 0.92 (0.68, 1.23) |
| **Hypertension** |  |  |  |  |  |  |  |  |
| No | 136,693 | 3,026 |  | 1.00 (ref) |  | 280 |  | 1.00 (ref) |
| Yes | 143,730 | 6,419 |  | 1.15 (1.10, 1.20) |  | 562 |  | 1.19 (1.02, 1.38) |
| **Statin medication** |  |  |  |  |  |  |  |  |
| No | 249,910 | 7,550 |  | 1.00 (ref) |  | 658 |  | 1.00 (ref) |
| Yes | 30,513 | 1,895 |  | 0.99 (0.93, 1.04) |  | 184 |  | 1.25 (1.04, 1.49) |

\*All-cause mortality results are the same as shown in Table 2.



**ESM Figure 1.** Number of participants in each step of the inclusion and exclusion process.