### Appendix tables

Appendix table 1: Variable mapping showing matched variables in HSE 2018 and the Census microdata and any adaptations to variables necessary to make them equivalent.

| Characteristic | Census 2011 microdata | Census value | Census label | New value | New Label |
|----------------|-----------------------|--------------|--------------|-----------|-----------|
| Age            | AGEC                  |              |              |           |           |
|                | 1 0-4 year olds       | (Missing)    | 16-18 year olds | 17.5      |           |
|                | 2 5-9 year olds       | (Missing)    | 25-29 year olds | 27.5      |           |
|                | 3 10-15 year olds     | (Missing)    | 30-34 year olds | 32.5      |           |
|                | 4 16-18 year olds     | 17.5         | 16-18 year olds | 17.5      |           |
|                | 5 19-24 year olds     | 22           | 19-24 year olds | 22        |           |
|                | 6 25-29 year olds     | 27.5         | 25-29 year olds | 27.5      |           |
|                | 7 30-34 year olds     | 32.5         | 30-34 year olds | 32.5      |           |
|                | 8 35-39 year olds     | 37.5         | 35-39 year olds | 37.5      |           |
|                | 9 40-44 year olds     | 42.5         | 40-44 year olds | 42.5      |           |
|                | 10 45-49 year olds    | 47.5         | 45-49 year olds | 47.5      |           |
|                | 11 50-54 year olds    | 52.5         | 50-54 year olds | 52.5      |           |
|                | 12 55-59 year olds    | 57.5         | 55-59 year olds | 57.5      |           |
|                | 13 60-64 year olds    | 62.5         | 60-64 year olds | 62.5      |           |
|                | 14 65-69 year olds    | 67.5         | 65-69 year olds | 67.5      |           |
|                | 15 70-74 year olds    | 72.5         | 70-74 year olds | 72.5      |           |
|                | 16 75-79 year olds    | 77.5         | 75-79 year olds | 77.5      |           |
|                | 17 80-84 year olds    | 82.5         | 80-84 year olds | 82.5      |           |
|                | 18 85-89 year olds    | 87.5         | 85-89 year olds | 87.5      |           |
|                | 19 90+                | F=93.0       | 90+ year olds |           |           |
|                |                       | M=92.4       |              |           |           |
| Sex            | SEX                   |              |              |           |           |
|                | 1 male                | 0            | male         |           |           |
|                | 2 female              | 1            | female       |           |           |
| Ethnicity      | AGGETHUK113           |              |              |           |           |
|                | 1 White               | 1            | White        |           |           |
|                | 2 Mixed/multiple ethnic groups | 4 | Mixed/multiple |           |           |
|                | 3 Asian/Asian British: Indian | 3 | Asian |           |           |
|                | 4 Asian/Asian British: Pakistani | 3 | Asian |           |           |
|                | 5 Asian/Asian British: Bangladeshi | 3 | Asian |           |           |
|                | 6 Asian/Asian British: Chinese | 3 | Asian |           |           |
|                | 7 Black/African/Caribbean/Black | 3 | Asian |           |           |
|                | 8 British: African     | 2            | Black        |           |           |
|          | ECOPUK1   |
|----------|-----------|
| Unemployed |           |
| 9        | Black/African/Caribbean/Black British: Black Caribbean |
| 10       | Black/African/Caribbean/Black British: Other Black |
| 11       | Other ethnic group |
|          |           |
| Student  |           |
| 1        | Econ. Active (excl. Students), Employee, Part-time |
| 2        | Econ. Active (excl. Students), Employee, Full-time |
| 3        | Econ. Active (excl. Students), Self-employed with employees, Part-time |
| 4        | Econ. Active (excl. Students), Self-employed with employees, Full-time |
| 5        | Econ. Active (excl. Students), Self-employed no employees, Part-time |
| 6        | Econ. Active (excl. Students), Full-time |
| 7        | Unemployed(2) Economically Active Full-time |
| 8        | Students, In Employment Economically Active Full-time |
| 9        | Students, Unemployed(2) |
| 10       | Economically Inactive, Retired |
| 11       | Economically Inactive, Student Economically Inactive, Looking after home/family |
| 12       | Economically Inactive, Permanently sick/disabled |
| 13       | Economically Inactive, Other |
| 14       | Economically Inactive, Other |
|          |           |
|          |           |

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s).
| Has a degree or equivalent | |
|---------------------------|--|
| 10 | No academic or professional qualifications |
| 11 | Level 1 (0-4 GCSE, O level, or equivalents) |
| 12 | Level 2 (5+ GCSE, O level, 1 A level, or equivalents) |
| 13 | Apprenticeship |
| 14 | Level 3 (2+ A levels, or equivalents) |
| 15 | Level 4+ (degree, postgrad, professional quals) |
| 16 | Other (vocational/foreign/outside UK quals) |
| -9 | Not applicable |

| Self-reported general health | HEALTH |
|-----------------------------|--|
| 1 | Very good |
| 2 | Good |
| 3 | Fair |
| 4 | Bad |
| 5 | Very bad |

| Deprivation | IMDQUINTE |
|-------------|--|
| 1 | Least deprived |
| 2 | Second least |
| 3 | Intermediate |
| 4 | Second most |
| 5 | Most deprived |
| -8 | unknown |

| Econ. Active (excl. Students), Self-employed no employees, Part-time | 0 | Not a student |
| Econ. Active (excl. Students), Self-employed no employees, Full-time | 0 | Not a student |
| Econ. Active (excl. Students), Unemployed | 0 | Not a student |
| Economically Active Full-time Students, In Employment | 1 | Student |
| Economically Active Full-time Students, Unemployed | 1 | Student |
| Economically Inactive, Retired | 0 | Not a student |
| Economically Inactive, Student | 1 | Student |
| Economically Inactive, Looking after home/family | 0 | Not a student |
| Economically Inactive, Other | 0 | Not a student |
| Has a degree or equivalent | |
| 10 | No academic or professional qualifications |
| 11 | Level 1 (0-4 GCSE, O level, or equivalents) |
| 12 | Level 2 (5+ GCSE, O level, 1 A level, or equivalents) |
| 13 | Apprenticeship |
| 14 | Level 3 (2+ A levels, or equivalents) |
| 15 | Level 4+ (degree, postgrad, professional quals) |
| 16 | Other (vocational/foreign/outside UK quals) |
| -9 | Not applicable |

| Self-reported general health | HEALTH |
|-----------------------------|--|
| 1 | Very good |
| 2 | Good |
| 3 | Fair |
| 4 | Bad |
| 5 | Very bad |

| Deprivation | IMDQUINTE |
|-------------|--|
| 1 | Least deprived |
| 2 | Second least |
| 3 | Intermediate |
| 4 | Second most |
| 5 | Most deprived |
| -8 | unknown |

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s).

Amies-Cull B, et al. BMJ Open 2022: 12:e060892. doi: 10.1136/bmjopen-2022-060892
| Variable name | HSE value | HSE label | New value | New Label |
|---------------|-----------|-----------|-----------|-----------|
| Age16g10      | 1         | 0-1 year olds | (Missing) |
|               | 2         | 2-4 year olds | (Missing) |
|               | 3         | 5-7 year olds | (Missing) |
|               | 4         | 8-10 year olds | (Missing) |
|               | 5         | 11-12 year olds | (Missing) |
|               | 6         | 13-15 year olds | (Missing) |
|               | 7         | 16-19 year olds | 18       |
|               | 8         | 20-24 year olds | 22.5     |
|               | 9         | 25-29 year olds | 27.5     |
|               | 10        | 30-34 year olds | 32.5     |
|               | 11        | 35-39 year olds | 37.5     |
|               | 12        | 40-44 year olds | 42.5     |
|               | 13        | 45-49 year olds | 47.5     |
|               | 14        | 50-54 year olds | 52.5     |
|               | 15        | 55-59 year olds | 57.5     |
|               | 16        | 60-64 year olds | 62.5     |
|               | 17        | 65-69 year olds | 67.5     |
|               | 18        | 70-74 year olds | 72.5     |
|               | 19        | 75-79 year olds | 77.5     |
|               | 20        | 80-84 year olds | 82.5     |
|               | 21        | 85-89 year olds | 87.5     |
|               | 22        | 90+ year olds | F=93.0, M=92.4(1) |
| Sex           | 1         | Male   | 0        | male |
|               | 2         | Female | 1        | female |
|               | 3         | Refused | (Missing) |
|               | 4         | Don't know | (Missing) |
|               | 5         | Not applicable | (Missing) |
| Ethnicity     | 1         | White | 1        | White |
|               | 2         | Black | 2        | Black |
|               | 3         | Asian | 3        | Asian |
|               |           | Mixed/multiple ethnic background | 4        | Mixed/multiple Any other group |
|               | 5         | Any other ethnic group | 5        | Any other group |
|               | 6         | Refusal | (Missing) |
|   | Activb2 |   |
|---|---------|---|
| 7 | Don't know | (Missing) |
|   | Going to school or college full-time |   |
| 1 | In paid employment or self-employed | 0 unemployed |
| 2 | Doing unpaid work for family business | 0 unemployed |
| 3 | Waiting to take up paid work already obtained | 0 unemployed |
| 4 | Looking for paid work/ Govt. training scheme Intending to look for work, but temporary sickness Permanently unable to work, long-term sickness | 1 Unemployed Not Not Not |
| 5 | Retired from paid work | 0 unemployed |
| 6 | Looking after home or family Doing something else (specify) | 0 unemployed |
| 95 | No answer/refused | (Missing) |
| -9 | Don't know | (Missing) |
| -1 | Not applicable | (Missing) |

### Student

|   | Activb2 |   |
|---|---------|---|
| 1 | Going to school or college full-time | 1 Student |
|   | In paid employment or self-employed | 0 Not a student |
| 2 | Doing unpaid work for family business | 0 Not a student |
| 3 | Waiting to take up paid work already obtained | 0 Not a student |
| 4 | Looking for paid work/ Govt. training scheme Intending to look for work, but temporary sickness Permanently unable to work, long-term sickness | 0 Not a student |
| 5 | Retired from paid work | 0 Not a student |
| 6 | Looking after home or family Doing something else (specify) | 0 Not a student |
| 95 | No answer/refused | (Missing) |
| -9 | Don't know | (Missing) |
| -1 | Not applicable | (Missing) |

### Has a degree or equivalent

|   | topqual3 |   |
|---|---------|---|
| 1 | NVQ4/NVQ5/Degree or equiv | 1 Has a degree or equivalent |
| Variable                          | % missing |
|----------------------------------|-----------|
| age                              | 0.00      |
| sex                              | 0.00      |
| ethnicity                        | 1.28      |
| student                          | 1.28      |

| Variable                          | % missing |
|----------------------------------|-----------|
| age                              | 0.00      |
| sex                              | 0.00      |
| ethnicity                        | 0.39      |
| student                          | 0.21      |

(1) Average age for over-90s in most recent ONS mid-year estimates of the England population is 93.0 years for females and 92.4 years for males.

(2) International Labour Organisation definition: seeking work and ready to start in 2 weeks, and Waiting to start a job already obtained and available to start within 2 weeks.
Appendix table 3: Percent of missing data for the BMI variable used in HSE 2018 (BMIval2) by demographic group

| Breakdown variable | Total records | Of which percent missing |
|--------------------|---------------|-------------------------|
| **Age**            |               |                         |
| 18                 | 281           | 17.8                    |
| 22.5               | 366           | 19.4                    |
| 27.5               | 487           | 17.5                    |
| 32.5               | 581           | 18.1                    |
| 37.5               | 647           | 14.2                    |
| 42.5               | 684           | 15.8                    |
| 47.5               | 668           | 15.3                    |
| 52.5               | 686           | 17.9                    |
| 57.5               | 733           | 16.2                    |
| 62.5               | 634           | 17.5                    |
| 67.5               | 614           | 14.3                    |
| 72.5               | 625           | 20.0                    |
| 77.5               | 444           | 22.3                    |
| 82.5               | 298           | 30.5                    |
| 87.5               | 177           | 36.2                    |
| 90+                | 72            | 45.9                    |
| **Sex**            |               |                         |
| Female             | 4461          | 18.7                    |
| Male               | 3536          | 17.8                    |
| **IMD quintile**   |               |                         |
| 1 (lowest deprivation) | 1653       | 15.5                    |
| 2                  | 1707          | 18.3                    |
| 3                  | 1554          | 19.0                    |
| 4                  | 1557          | 19.1                    |
| 5                  | 1526          | 20.1                    |
Appendix table 4: Baseline population characteristics. Age given as mean (median, interquartile range). Remaining variables given as number (percent of total).

| Number             | BMI up to 25 N= 2,198 | BMI over 25 N= 4,333 | Total N= 6,531 |
|--------------------|------------------------|-----------------------|----------------|
| Age (years)        | 42.5 (32.5,62.5)       | 52.5 (42.5,67.5)      | 52.5 (37.5,67.5) |
| Males              | 1,337 (60.8%)          | 2,289 (52.8%)         | 3,626 (55.5%)  |
| Ethnicity          |                        |                       |                |
| White              | 1,916 (87.2%)          | 3,828 (88.5%)         | 5,744 (88.1%) |
| Black              | 47 (2.1%)              | 131 (3.0%)            | 178 (2.7%)     |
| Asian              | 184 (8.4%)             | 288 (6.7%)            | 472 (7.2%)     |
| Mixed              | 34 (1.5%)              | 47 (1.1%)             | 81 (1.2%)      |
| Any other          | 15 (0.7%)              | 33 (0.8%)             | 48 (0.7%)      |
| IMD quintile       |                        |                       |                |
| 1 (Least deprived) | 501 (22.8%)            | 850 (19.6%)           | 1,351 (20.7%) |
| 2                  | 512 (23.3%)            | 931 (21.5%)           | 1,443 (22.1%) |
| 3                  | 433 (19.7%)            | 825 (19.0%)           | 1,258 (19.3%) |
| 4                  | 393 (17.9%)            | 867 (20.0%)           | 1,260 (19.3%) |
| 5 (Most deprived) | 359 (16.3%)            | 860 (19.8%)           | 1,219 (18.7%) |
| Self-rated health  |                        |                       |                |
| Very good          | 971 (44.2%)            | 1,238 (28.6%)         | 2,209 (33.8%) |
| Good               | 856 (39.0%)            | 1,880 (43.4%)         | 2,736 (41.9%) |
| Fair               | 259 (11.8%)            | 876 (20.2%)           | 1,135 (17.4%) |
| Bad                | 82 (3.7%)              | 253 (5.8%)            | 335 (5.1%)     |
| Very bad           | 29 (1.3%)              | 86 (2.0%)             | 115 (1.8%)     |
Appendix figure 1: Cullen-Frey plot exploring the mean-variance relationship of the model dependent BMI variable from HSE 2018, showing a marginally closer conformity with a lognormal than gamma distribution.
Appendix figure 2: Q-Q plot exploring the mean-variance relationship of the model dependent BMI variable from HSE 2018, detailing the deviation from gamma and lognormal distributions, showing a marginally closer conformity with a lognormal than gamma distribution.

Appendix figure 3: Plot of residuals between measured log-BMI in the HSE 2018 and model-based estimates.
Appendix figure 4a: Histograms of residuals of between measured and estimated log-BMI for females to with kernel density and normal plot to examine for deviation from normality.

Appendix figure 4b: Histograms of residuals of between measured and estimated log-BMI for males to with kernel density and normal plot to examine for deviation from normality.
Appendix figure 5a: Histogram of age- and sex-standardised BMI estimates for England for females, including the equivalent histogram for the HSE 2018 BMI data for comparison.
Appendix figure 5b: Histograms of age- and sex-standardised BMI estimates for England for males, including the equivalent histogram for the HSE 2018 BMI data for comparison.

Appendix figure 6a: Scatter plot of the relationship between local areas’ estimated versus reported percent of people with BMI <18.5.
Appendix figure 6b: Scatter plot of the relationship between local areas’ estimated versus reported percent of people with BMI in the normal range.
Appendix figure 6c: Scatter plot of the relationship between local areas’ estimated versus reported percent of people with BMI in the overweight range.
Appendix figure 6d: Scatter plot of the relationship between local areas’ estimated versus reported percent of people with BMI >35.