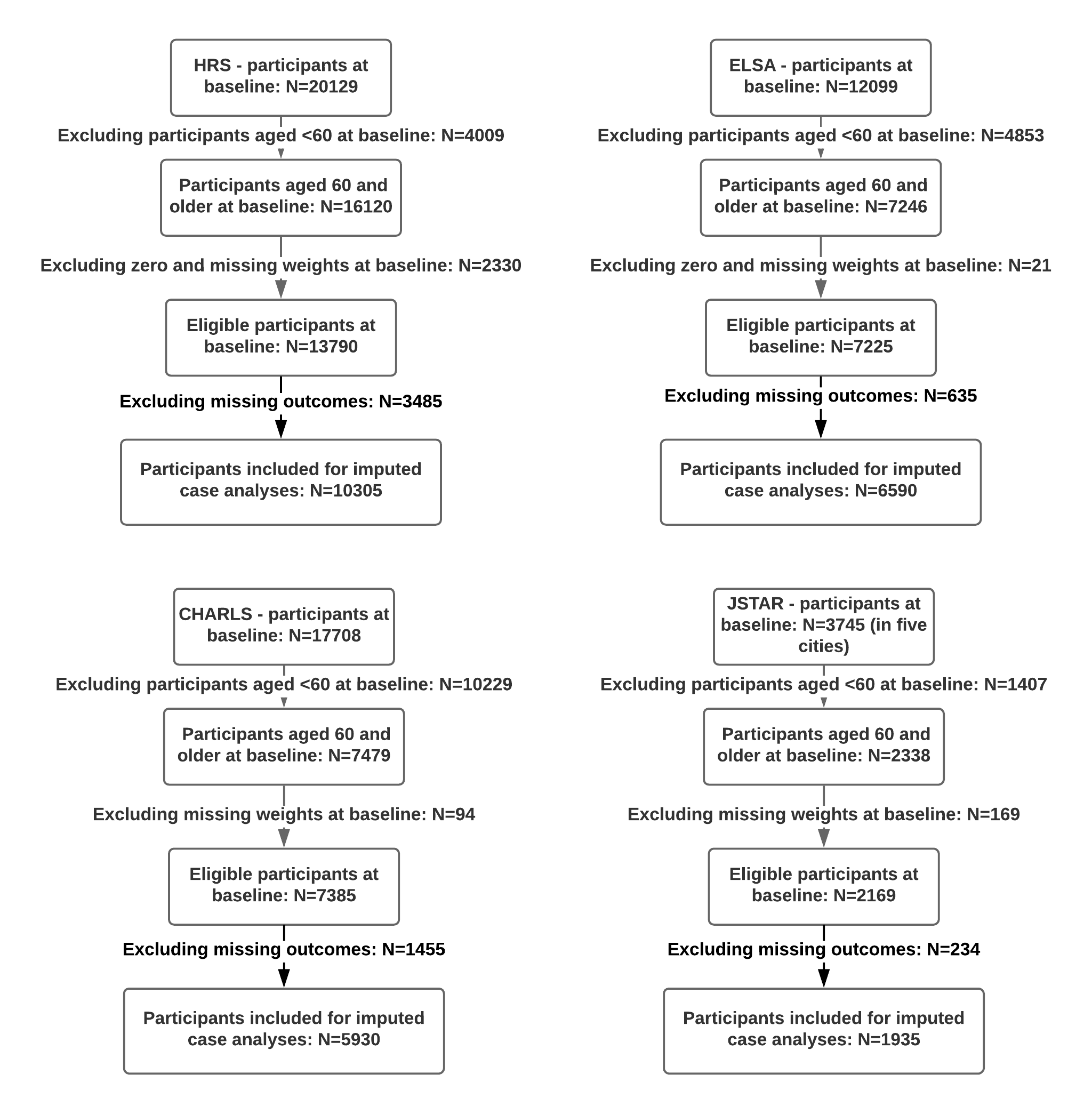
# **Supplementary Material**

**Figure S1 Procedures of sample selection**

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**Table S1 Indicators of healthy ageing index and harmonising strategies**

|  |  |  |
| --- | --- | --- |
| Variables | Categories | Scores |
| Verbal Memory - 10 words immediate recall | 0-10 | 0-2=0 |
| 3-4=25 |
| 5-6=50 |
| 7-8=75 |
| 9-10=100 |
| Verbal Memory - 10 words delayed recall | 0-10 | 0-2=0 |
| 3-4=25 |
| 5-6=50 |
| 7-8=75 |
| 9-10=100 |
| Orientation - date naming- month | 0.incorrect | 0=0 |
| 1.correct | 1=100 |
| Orientation - date naming- day of month | 0.incorrect | 0=0 |
| 1.correct | 1=100 |
| Orientation - date naming- year | 0.incorrect | 0=0 |
| 1.correct | 1=100 |
| Orientation - date naming- day of week | 0.incorrect | 0=0 |
| 1.correct | 1=100 |
| ADL: some diff. in dressing | 0. No | 0=100 |
| 1. Yes | 1=0 |
| ADL: some diff. in bathing, shower | 0. No | 0=100 |
| 1. Yes | 1=0 |
| ADL: some diff. in eating | 0. No | 0=100 |
| 1. Yes | 1=0 |
| ADL: some diff. in get in/out bed | 0. No | 0=100 |
| 1. Yes | 1=0 |
| ADL: some diff. in using the toilet | 0. No | 0=100 |
| 1. Yes | 1=0 |
| ADL: some diff. in taking medications | 0. No | 0=100 |
| 1. Yes | 1=0 |
| ADL: some diff. in shop for grocery | 0. No | 0=100 |
| 1. Yes | 1=0 |
| ADL: some diff. in prepare hot meal | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Some diff. in get up from chair | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Some diff. in climb several flat stairs | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Some diff. in reach/extend arms up | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Some diff. in stoop/kneel/crouch | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Some diff. in lift/carry 10lbs | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Some diff. in pick up a dime | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Grip strength (kg) – Left hand | kg (quintiles) | 1=0 |
| 2=25 |
| 3=50 |
| 4=75 |
| 5=100 |
| Grip strength (kg) – Right hand | kg (quintiles) | 1=0 |
| 2=25 |
| 3=50 |
| 4=75 |
| 5=100 |
| CES-D score\* | 0-8 (quintiles) | 0=100 |
| 1-3=75 |
| 4-5=50 |
| 6-7=25 |
| 8=0 |
| CES-D score\*\* | 0-30 (quintiles) | 0-6=100 |
|  |  | 7-13=75 |
|  |  | 14-20=50 |
|  |  | 21-26=75 |
|  |  | 27-30=0 |
| Self-reported life satisfaction | 0. Very satisfied | 0=100 |
| 1. Satisfied | 1=75 |
| 2. Somewhat satisfied | 2=50 |
| 3. Unsatisfied | 3=25 |
| 4. Very unsatisfied | 4=0 |
| High blood pressure | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Diabetes | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Cancer | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Lung disease | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Stroke | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Heart problem | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Psychological problem | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Arthritis | 0. No | 0=100 |
| 1. Yes | 1=0 |
| Participations in social activities | 0.No | 0=0 |
| 1. Yes | 1=100 |

\* CES-D scores for HRS and ELSA \*\* CES-D scores for CHARLS and JSTAR

**Table S2 Correlation between HAIs across waves in HRS, ELSA and CHARLS**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **HRS** | **Wave 7** | **Wave 8** | **Wave 9** | **Wave 10** | **Wave 11** | **Wave 12** |  |
| **Wave 7** | 1.000 |  |  |  |  |  |  |
| **Wave 8** | **0.811** | 1.000 |  |  |  |  |  |
| **Wave 9** | 0.769 | **0.792** | 1.000 |  |  |  |  |
| **Wave 10** | 0.732 | 0.771 | **0.792** | 1.000 |  |  |  |
| **Wave 11** | 0.697 | 0.720 | 0.773 | **0.820** | 1.000 |  |  |
| **Wave 12** | 0.652 | 0.693 | 0.709 | 0.788 | **0.812** | 1.000 |  |
| **ELSA** | **Wave 1** | **Wave 2** | **Wave 3** | **Wave 4** | **Wave 5** | **Wave 6** | **Wave 7** |
| **Wave 1** | 1.000 |  |  |  |  |  |  |
| **Wave 2** | **0.847** | 1.000 |  |  |  |  |  |
| **Wave 3** | 0.803 | **0.835** | 1.000 |  |  |  |  |
| **Wave 4** | 0.773 | 0.797 | **0.844** | 1.000 |  |  |  |
| **Wave 5** | 0.756 | 0.763 | 0.811 | **0.845** | 1.000 |  |  |
| **Wave 6** | 0.720 | 0.737 | 0.790 | 0.821 | **0.841** | 1.000 |  |
| **Wave 7** | 0.694 | 0.670 | 0.750 | 0.776 | 0.800 | **0.848** | 1.000 |
| **CHARLS** | **Wave 1** | **Wave 2** | **Wave 4** |  |  |  |  |
| **Wave 1** | 1.000 |  |  |  |  |  |  |
| **Wave 2** | **0.685** | 1.000 |  |  |  |  |  |
| **Wave 4** | 0.680 | **0.738** | 1.000 |  |  |  |  |

**Table S3 Scale reliability coefficients for the HAI at each wave in HRS, ELSA and CHARLS**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Cronbach’s α** | **Wave 1**  **(7 in HRS)** | **Wave 2**  **(8 in HRS)** | **Wave 3**  **(9 in HRS)** | **Wave 4**  **(10 in HRS)** | **Wave 5**  **(11 in HRS)** | **Wave 6** | **Wave 7** |
| **HRS** | 0.819 | 0.831 | 0.832 | 0.833 | 0.840 | 0.836 | - |
| **ELSA** | 0.815 | 0.827 | 0.829 | 0.831 | 0.847 | 0.851 | 0.840 |
| **CHARLS** | 0.849 | 0.834 | - | 0.858 | - | - | - |

**Table S4 Comparison of predictive performance between phenotypic frailty and HAI by Area Under Curves (AUCs) in each study**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Studies** | **AUCs** | **Standard Errors** | **95%CIs** | **P-values** |
| **US (N=1837)** |  |  |  |  |
| PF-Criterion | 0.676 | 0.011 | (0.655 to 0.698) | 0.410 |
| HAI | 0.687 | 0.012 | (0.662 to 0.711) |  |
| **England (N=3548)** |  |  |  |  |
| PF-Criterion | 0.671 | 0.010 | (0.651 to 0.690) | 0.177 |
| HAI | 0.684 | 0.011 | (0.664 to 0.705) |  |
| **China (N=3015)** |  |  |  |  |
| PF-Criterion | 0.628 | 0.025 | (0.580 to 0.678) | 0.166 |
| HAI | 0.589 | 0.031 | (0.528 to 0.649) |  |

**Figure S2 Empirical Receiver Operating Characteristic (ROC) curves of phenotypic frailty and HAI in the US (N=1837), England (N=3548) and China (N=3015)**

****

**Table S5 Semi-harmonising strategies for occupational measures**

|  |  |  |
| --- | --- | --- |
| Variables | Original categories | Harmonised categories |
| US (2004-2014) |  |  |
| Occupation | 0. Managerial specialty operators | I Managerial and professional specialty occupation |
| 1. Professional specialty opera. /technical sup. |
| 2. Sales | II Technical, sales and administrative support |
| 3. Clerical/administration support |
| 4. Service: private household/ clean/bldg. | III Service occupations |
| 5. Service: protection |
| 6. Service: food preparation |
| 7. Health service |
| 8. Personal service |
| 9. Farming/forestry/fishing | IV Farming, forestry and fishing occupations |
| 10. Mechanics/repair | V Precision production, craft, and repair occupations |
| 11. Construct trade/extractors |
| 12. Precision production |
| 13. Operators: machine | VI Operators, fabricators and labours |
| 14. Operators: transport, etc |
| 15. Operators: handlers, etc |
| 16. Member of armed forces | VII Others |
| 7. Retired | VIII Retired |
| 8. Unemployed | IX Unemployed |
| 9. Disabled | X Disabled |
| 10. Not in the labour force | XI Not in the labour force |
| Father’s occupation | 0. Managerial and professional specialty occupation | I Managerial and professional specialty occupation |
| 1. Technical, sales and administrative support | II Technical, sales and administrative support |
| 2. Service occupations | III Service occupations |
| 3. Farming, forestry and fishing occupations | IV Farming, forestry and fishing occupations |
| 4. Precision production, craft, and repair occupations | V Precision production, craft, and repair occupations |
| 5. Operators, fabricators and labours | VI Operators, fabricators and labours |
| 6. Unclassifiable | VII Unclassifiable |
| England (2002-2015) |  |  |
| Occupation | 0. Higher managerial occupations | I Higher managerial and professional employers |
| 1. Higher professional occupations |
| 2. Lower professional & higher technical occupations | II Lower managerial and professional employers |
| 3. Lower managerial occupations |
| 4. Intermediate | III Intermediate employees |
| 5. Employers in small organisations | IV Small employers and own account workers |
| 6. Own account workers |
| 7. Lower supervisory occupations | V Lower supervisory, craft and related employees |
| 8. Lower technical occupations |
| 9. Semi-routine occupations | VI Employees in semi-routine occupations |
| 10. Routine occupations | VII Employees in routine occupations |
| 11. Never worked | VIII Never worked |
| Father’s occupation | 0. Professional or technical | I Professional or technical |
| 1. Manager or senior official | II Manager, senior official, admin, cleric or secretarial |
| 2. Administrative, clerical or secretarial |
| 3. Running his own business | III Own business, or skilled trade |
| 4. Skilled trade |
| 5. Caring, leisure, travel or personal service | IV Service-skilled non-manual |
| 6. Sales or customer service |
| 7. Plant process or machine drivers or operation | V Service-skilled manual |
| 8. Armed forces | VI Others |
| 9. Other jobs |
| 10. Something else |
| 11. Casual jobs |
| 12. Retired | VII Retired |
| 13. Unemployed | VIII Unemployed, sick or disabled |
| 14. Sick/disabled |
| China (2011-2015) |  |  |
| Occupation\* | - | I Officials/managers/leaders or Clerk/paid workers |
| - | II Self-employed workers |
| - | III Unpaid family business |
| - | IV Others |
| - | V Only agricultural work |
| Father’s occupation | 0. Manager | I Manager |
| 1. Professional and technician | II Professional and technician |
| 2. Clerk | III Clerk |
| 3. Commercial and service worker | IV Commercial and service worker |
| 4. Agricultural, forestry, husbandry and others | V Agricultural, forestry, husbandry and others |
| 5. Production and transportation workers | VI Production and transportation workers |
| 6. Cannot be specified | VII Others |
| Japan (2006-2011) |  |  |
| Occupation\*\* | 0. Specialist and technical workers | I Highest |
| 1. Administrative and managerial workers |
| 2. Clerical workers | II Intermediate |
| 3. Sales workers |
| 4. Security workers |
| 5. Service workers | III Lowest |
| 6. Agriculture, forestry and fishery workers |
| 7. Transport and communication workers |
| 8. Production process and related workers |
| 9. Workers not classifiable by occupation | IV Others |
| 10. Unclassifiable | V Unclassifiable |
| Father’s occupation | 0. Employed (including public employee) | I Employed (including public employee) |
| 1. Executive of company or organization |
| 2. Self-employed (including self-employed farmer) | II Self-employed (including self-employed farmer) |
| 3. Assisted a self-employed person | III Others |
| 4. Worked at home |
| 5. Other (specify) |
| 6. Did not work | IV No work (including father passed away when participants was 15 years) |
| 7. Not applicable (already passed away when respondent was fifteen) |

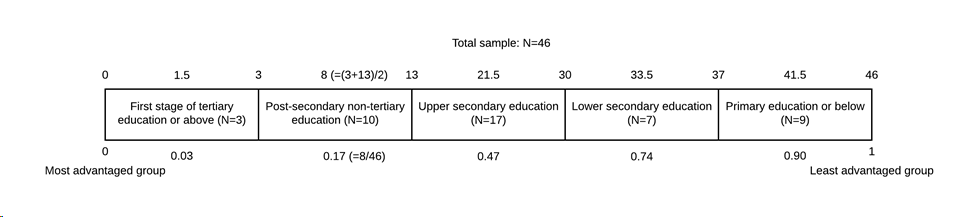
**\*** There was no occupational variable in CHARLS. A new variable was derived based on information of major employment type, working status and current position.

\*\* Occupation was re-categorised into three categories according to a new theory-based social classification in Japan, which was derived by Hiyoshi, et al (2013).

**Table S6 Percentages of missingness in socioeconomic exposures and covariates at each wave in each study**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **US** | | | | | | **England** | | | | | | | **China** | | | **Japan** | | |
| **Time-varying variables** | **Wave 7** | **Wave 8** | **Wave 9** | **Wave 10** | **Wave 11** | **Wave 12** | **Wave 1** | **Wave 2** | **Wave 3** | **Wave 4** | **Wave 5** | **Wave 6** | **Wave 7** | **Wave 1** | **Wave 2** | **Wave 4** | **Wave 1** | **Wave 2** | **Wave 3** |
| Income | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.37 | 0.86 | 2.56 | 2.71 | 2.86 | 5.95 | 2.82 | 15.76 | 30.78 | 7.32 | 29.14 | 6.29 | 6.97 |
| Wealth | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.36 | 0.86 | 2.56 | 2.71 | 2.86 | 2.62 | 2.82 | 28.57 | 53.44 | 19.05 | 5.62 | 34.22 | 87.85 |
| Occupation | 1.83 | 0.52 | 0.41 | 0.19 | 0.16 | 0.11 | 4.38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.09 | 62.33 | 61.57 | 50.85 | 3.78 | 6.20 | 6.89 |
| Age | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Marital status | 0.06 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.02 | 0.02 | 0.00 | 0.03 | 0.00 | 0.00 | 0.08 | 0.03 | 2.45 | 0.00 | 2.22 | 3.41 |
| Smoking | 0.94 | 0.87 | 0.89 | 0.85 | 0.82 | 0.89 | 1.90 | 0.07 | 0.09 | 1.33 | 2.15 | 0.10 | 0.16 | 3.63 | 26.32 | 45.71 | 4.47 | 10.73 | 4.57 |
| Drinking | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 | 0.15 | 1.45 | 17.31 | 21.72 | 21.00 | 17.87 | 20.71 | 21.28 | 7.33 | 1.06 | 0.67 | 5.76 | 2.03 | 5.11 |
| **Baseline variables** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Education | 0.01 |  |  |  |  |  | 0.17 |  |  |  |  |  |  | 0.12 |  |  | 0.46 |  |  |
| Gender | 0.00 |  |  |  |  |  | 0.00 |  |  |  |  |  |  | 0.01 |  |  | 0.00 |  |  |
| Ethnicity | 0.02 |  |  |  |  |  | 0.04 |  |  |  |  |  |  | 14.88 |  |  | - |  |  |
| Self-rated health in childhood | 5.74 |  |  |  |  |  | 49.22 |  |  |  |  |  |  | 2.69 |  |  | - |  |  |
| Father’s occupation | 19.62 |  |  |  |  |  | 1.65 |  |  |  |  |  |  | 46.58 |  |  | 28.91 |  |  |

Figure S3 Example illustrating the derivation of socioeconomic rank score using education\*



\* Steps in the calculation of the educational rank score were: the sample of interest in each country was sorted, from the most advantaged to the least advantaged group based on the classification of education; the number of cases in each educational group was counted; then a midpoint value was calculated for each category of educational group; finally each midpoint was divided by the total sample size to generate a standardised educational rank score, ranging from 0 to 1.