**Intelligence and neuroticism in relation to depression and psychological distress: Evidence from two large population cohorts**

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**Supplementary material**

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| **S1 Table*.*** *Demographic, clinical, and cognitive differences between full GS:SFHS and UK Biobank cohorts and samples within this study* | | | | |
|  | GS:SFHS | | UK Biobank | |
|  | Full sample  (N = 24,084) | Complete cases  (N = 19,200) | Full sample  (N ~ 500,000) | Complete cases  (N = 90,529) |
| Age | 47.64 (15.41)  N = 24,080 | 47.16 (14.97) \* | 56.53 (8.09)  N = 501,863 | 56.64 (8.13) \* |
| Sex (% female) | 59%  N = 24,080 | 59% | 54%  N = 501,863 | 52% |
| MDD (%) | 13%  N = 21,398 | 13% | 33%  N = 103,596 | 33% |
| Neuroticism | 3.87 (3.17)  N = 21,385 | 3.84 (3.16) | 3.82 (2.91)  N = 502,490 | 3.46 (2.86) \* |
| GHQ score | 16.01 (8.86)  N = 21,191 | 15.93 (8.81) | - |  |
| PHQ score | - | - | 1.59 (2.07)  N = 502,490 | 1.36 (1.91) \* |
| Wechsler Digit Symbol Substitution Task | 72.23 (17.22)  N = 21,264 | 72.31 (17.09) | - | - |
| Mill-Hill Vocabulary Test | 30.06 (4.76)  N = 21,120 | 30.06 (4.76) | - | - |
| Weschler Logical Memory Test I & II | 30.70 (8.48)  N = 21,522 | 31.01 (8.04) \* | - | - |
| Verbal Fluency Test | 22.73 (11.17)  N = 24,080 | 25.68 (8.10) \* | - | - |
| Reaction time | - | - | 559.65 (118)  N = 497,647 | 564.00 (119.87) \* |
| Visual memory | - | - | 4.15 (3.40)  N = 497,860 | 4.04 (3.21) \* |
| Verbal-numerical reasoning | - | - | 5.98 (2.16)  N = 165,498 | 6.09 (2.14) \* |
| SIMD | 3909.66 (1846.91)  N = 21,146 | 3903.82 (1851.91) | - | - |
| Townsend Score | - | - | -1.29 (3.09)  N = 501,863 | -1.37 (2.84) \* |
| Abbreviations: GS:SFHS, Generation Scotland: the Scottish Family Health Study; MDD, Major Depressive Disorder ; GHQ, General Health Questionnaire; PHQ, Patient Health Questionnaire; SIMD, the Scottish Index of Multiple Deprivation  With the exception of sex and MDD, values represent Mean (SD).  N.B. The UK Biobank samples do not include any individuals who have also taken part in GS:SFHS (N = 147)  \* Significantly different to the full sample, using a one-sample *t* test, *p < .05* | | | | |

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| **S2 Table**. **Results of a MCMC generalized linear mixed model from GS:SFHS predicting odds ratios of MDD status, *p* value, upper and lower 95% confidence intervals and the Deviance Information Criterion** | | | | | | |
| Model | Variables | Odds Ratio | Lower  95% CIs | Upper  95% CIs | *p* value | DIC |
| 1.0 | Neuroticism | 3.62 \*\*\* | 3.29 | 4.03 | < 1.00x10ˉ⁴ | 12428.30 |
|  | Age | 1.19 \*\*\* | 1.16 | 1.23 | < 1.00x10ˉ⁴ |  |
|  | Age² | 1.00 \*\*\* | 1.00 | 1.00 | < 1.00x10ˉ⁴ |  |
|  | Sex (M) | .0.58 \*\*\* | 0.58 | 0.66 | < 1.00x10ˉ⁴ |  |
| 1.1 | *g* | 0.96 \*\*\* | 0.91 | 1.01 | < 0.12x10ˉˉˉ | 13784.89 |
|  | Age | 1.20 \*\*\* | 1.16 | 1.24 | < 1.00x10ˉ⁴ |  |
|  | Age² | 1.00 \*\*\* | 1.00 | 1.00 | < 1.00x10ˉ⁴ |  |
|  | Sex (M) | 0.37 \*\*\* | 0.32 | 0.44 | < 1.00x10ˉ⁴ |  |
| 1.2 | Neuroticism | 3.68 \*\*\* | 3.33 | 4.09 | < 1.00x10ˉ⁴ | 12421.57 |
|  | *g* | 1.08 \*\*\* | 1.01 | 1.14 | < 1.54x10ˉ² |  |
|  | Age | 1.19 \*\*\* | 1.15 | 1.23 | < 1.00x10ˉ⁴ |  |
|  | Age² | 1.00 \*\*\* | 1.00 | 1.00 | < 1.00x10ˉ⁴ |  |
|  | Sex (M) | 0.59 \*\*\* | 0.50 | 0.68 | < 1.00x10ˉ⁴ |  |
|  | N\*G | 1.04 \*\*\* | 0.99 | 1.09 | < 0.12x10ˉˉˉ |  |
| 1.3 | Neuroticism | 3.61 \*\*\* | 3.28 | 4.00 | < 1.00x10ˉ⁴ | 12397.53 |
|  | *g* | 1.12 \*\*\* | 1.05 | 1.18 | < 2.05x10ˉ⁴ |  |
|  | SIMD | 0.99 \*\*\* | 0.99 | 1.00 | < 1.00x10ˉ⁴ |  |
|  | Age | 1.19 \*\*\* | 1.15 | 1.22 | < 1.00x10ˉ⁴ |  |
|  | Age² | 1.00 \*\*\* | 1.00 | 1.00 | < 1.00x10ˉ⁴ |  |
|  | Sex (M) | 0.60 \*\*\* | 0.52 | 0.69 | < 1.00x10ˉ⁴ |  |
|  | N\* *g* | 1.04 \*\*\* | 0.99 | 1.09 | < 0.10x10ˉˉ⁴ |  |
| Abbreviations: MCMC, Markov Chain Monte Carlo; GS:SFHS, Generation Scotland: the Scottish Family Health Study; MDD, major depressive disorder; DIC, Deviance Information Criterion; *g*, General Intelligence; SIMD, Scottish Index of Multiple Deprivation | | | | | | |

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| **S3 Table**. **Results of a MCMC generalized linear mixed model from GS:SFHS predicting beta coefficients of psychological distress (GHQ), *p* value, upper and lower 95% confidence intervals and the Deviance Information Criterion** | | | | | | |
| Model | Variables | …….β…….. | Lower  95% CIs | Upper  95% CIs | *p* value | DIC |
| 2.0 | Neuroticism | -0.51 x10ˉ⁵ | -0.50x10ˉ⁵ | -0.53 x10ˉ⁵ | < 1.00x10ˉ⁴ | 47987.62 |
|  | Age | -0.02 x10ˉ⁵ | -0.01x10ˉ⁵ | -0.02 x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
|  | Age² | - 0.00 x10ˉ⁵ | -0.00x10ˉ⁵ | -0.00 x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
|  | Sex (M) | - 0.03 x10ˉ⁵ | -0.06x10ˉ⁵ | -0.01 x10ˉ⁵ | < 1.66x10ˉ² |  |
| 2.1 | *g* | -0.09 x10ˉ⁵ | -0.10x10ˉ⁵ | -0.08 x10ˉ⁵ | < 1.00x10ˉ⁴ | 52975.92 |
|  | Age | -0.03 x10ˉ⁵ | -0.02x10ˉ⁵ | -0.03 x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
|  | Age² | -0.00 x10ˉ⁵ | -0.00x10ˉ⁵ | -0.00 x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
|  | Sex (M) | -0.22 x10ˉ⁵ | -0.25x10ˉ⁵ | -0.20 x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
| 2.2 | Neuroticism | -0.50 x10ˉ⁵ | -0.48x10ˉ⁵ | -0.51 x10ˉ⁵ | < 1.00x10ˉ⁴ | 47795.04 |
|  | *g* | -0.05 x10ˉ⁵ | -0.06x10ˉ⁵ | -0.04 x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
|  | Age | -0.02 x10ˉ⁵ | -0.02x10ˉ⁵ | -0.02 x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
|  | Age² | -0.00 x10ˉ⁵ | -0.00x10ˉ⁵ | -0.00 x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
|  | Sex (M) | -0.94 x10ˉ⁵ | -0.06x10ˉ⁵ | -0.02 x10ˉ⁵ | < 1.58x10ˉ³ |  |
|  | N\**g* | -0.05 x10ˉ⁵ | -0.06x10ˉ⁵ | -0.04 x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
| 2.3 | Neuroticism | -0.50 x10ˉ⁵ | -0.49x10ˉ⁵ | -0.51x10ˉ⁵ | < 1.00x10ˉ⁴ | 47754.07 |
|  | *g* | -0.04 x10ˉ⁵ | -0.05x10ˉ⁵ | -0.03x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
|  | SIMD | --2.49x10ˉ⁵. | -3.15x10ˉ⁵ | -1.81x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
|  | Age | -0.02 x10ˉ⁵ | -0.02x10ˉ⁵ | -0.02x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
|  | Age² | --2.11x10ˉ⁴. | -2.61x10ˉ⁴ | -1.65x10ˉ⁴ | < 1.00x10ˉ⁴ |  |
|  | Sex (M) | --0.04.x10ˉ⁵ | -0.06x10ˉ⁵ | -0.01x10ˉ⁵ | < 5.00x10ˉ³ |  |
|  | N\**g* | --0.05.x10ˉ⁵ | -0.06x10ˉ⁵ | -0.04x10ˉ⁵ | < 1.00x10ˉ⁴ |  |
| Abbreviations: MCMC, Markov Chain Monte Carlo; GS:SFHS, Generation Scotland: the Scottish Family Health Study; GHQ, General Health Questionnaire; DIC, Deviance Information Criterion; *g,* General Intelligence; SIMD, Scottish Index of Multiple Deprivation. | | | | | | |

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| **S4 Table**. **Results of a logistic regression from UK Biobank predicting odds ratios for self-reported MDD status, *p* value, upper and lower 95% confidence intervals and the *Akaike Information Criterion*** | | | | | | |
| Model | Variables | Odds ratio | Lower  95% CIs | Upper  95% CIs | *p* value | AIC |
| 3.0 | Neuroticism | 2.39 | 2.35 | 2.43 | < 2.00x10ˉ¹⁶ | 98707 |
|  | Age | 1.17 | 1.14 | 1.20 | < 2.00x10ˉ¹⁶ |  |
|  | Age² | 1.00 | 1.00 | 1.00 | < 2.00x10ˉ¹⁶ |  |
|  | Sex (M) | 0.67 | 0.66 | 0.69 | < 2.00x10ˉ¹⁶ |  |
| 3.1 | *g* | 0.99 | 0.98 | 1.01 | < 0.39x10ˉ²¹ | 111620 |
|  | Age | 1.17 | 1.14 | 1.20 | < 2.00x10ˉ¹⁶ |  |
|  | Age² | 1.00 | 0.97 | 1.02 | < 2.00x10ˉ¹⁶ |  |
|  | Sex (M) | --0.60 . | 0.58 | 0.61 | < 2.00x10ˉ¹⁶ |  |
| 3.2 | Neuroticism | 2.40 | 2.36 | 2.44 | < 2.00x10ˉ¹⁶ | 98649 |
|  | *g* | 1.05 | 1.04 | 1.07 | < 5.29x10ˉ¹² |  |
|  | Age | 1.16 | 1.13 | 1.20 | < 2.00x10ˉ¹⁶ |  |
|  | Age² | 1.00 | 1.00 | 1.00 | < 2.00x10ˉ¹⁶ |  |
|  | Sex (M) | 0.67 | 0.65 | 0.68 | < 2.00x10ˉ¹⁶ |  |
|  | N \* *g* | 0.96 | 0.95 | 0.98 | < 3.44x10ˉ⁷¹ |  |
| 3.3 | Neuroticism | 2.39 | 2.35 | 2.43 | < 2.00x10ˉ¹⁶ | 98421 |
|  | *g* | 1.07 | 1.05 | 1.08 | < 2.00x10ˉ¹⁶ |  |
|  | Townsend Score | 1.04 | 1.04 | 1.05 | < 2.00x10ˉ¹⁶ |  |
|  | Age | 1.16 | 1.10 | 1.22 | < 2.00x10ˉ¹⁶ |  |
|  | Age² | 1.00 | 1.00 | 1.00 | < 2.00x10ˉ¹⁶ |  |
|  | Sex (M) | 0.66 | 0.65 | 0.68 | < 2.00x10ˉ¹⁶ |  |
|  | N \* *g* | 0.97 | 0.95 | 0.98 | < 6.80x10ˉ⁷ˉ |  |
| Abbreviations: MDD, major depressive disorder; AIC, Akaike Information Criterion; *g*, General Intelligence | | | | | | |

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| **S5 Table**. **Results of a regression from UK Biobank predicting beta coefficients of psychological distress (PHQ), *p* value, upper and lower 95% confidence intervals and the adjusted R² value for the model** | | | | | | |
| Model | Variables | ………….β | Lower  95% CIs | Upper  95% CIs | *p* value | R² |
| 4.0 | Neuroticism | -0.52 \*\*\* | -0.51 | -0.52 | < 2.00x10ˉ¹⁶ | .2933 |
|  | Age | -0.00 \*\*\* | -0.01 | -0.01 | < 0.85x10ˉ⁶¹ |  |
|  | Age² | -0.00 \*\*\* | -0.00 | -0.00 | < 3.56x10ˉ³¹ |  |
|  | Sex (M) | -0.01 \*\*\* | -0.00 | -0.03 | < 1.89x10ˉ⁵⁹ |  |
| 4.1 | *g* | -0.08 \*\*\* | -0.08 | -0.07 | < 2.00x10ˉ¹⁶ | .0420 |
|  | Age | -0.02 \*\*\* | -0.01 | -0.03 | < 2.32x10ˉ³¹ |  |
|  | Age² | -0.00 \*\*\* | -0.00 | -0.00 | < 1.31x10ˉ¹² |  |
|  | Sex (M) | -0.09 \*\*\* | -0.10 | -0.08 | < 2.00x10ˉ¹⁶ |  |
| 4.2 | Neuroticism | -0.51 \*\*\* | -0.51 | -0.52 | < 2.00x10ˉ¹⁶ | .2977 |
|  | *g* | -0.05 \*\*\* | -0.06 | -0.05 | < 2.00x10ˉ¹⁶ |  |
|  | Age | -0.00 \*\*\* | -0.00 | -0.01 | < 0.55x10ˉˉˉ |  |
|  | Age² | -0.00 \*\*\* | -0.00 | -0.00 | < 1.88x10ˉ⁴⁴ |  |
|  | Sex (M) | -0.02 \*\*\* | -0.02 | -0.00 | < 6.20x10ˉ⁹¹ |  |
|  | N\**g* | -0.02 \*\*\* | -0.03 | -0.02 | < 2.00x10ˉ¹⁶ |  |
| 4.3 | Neuroticism | -0.51 \*\*\* | -0.51 | -0.52 | < 2.00x10ˉ¹⁶ | .3045 |
|  | *g* | -0.04 \*\*\* | -0.05 | -0.04 | < 2.00x10ˉ¹⁶ |  |
|  | Townsend Score | -0.03 \*\*\* | -0.03 | -0.03 | < 2.00x10ˉ¹⁶ |  |
|  | Age | -0.00 \*\*\* | -0.00 | -0.02 | < 0.29x10ˉˉˉ |  |
|  | Age² | -0.00 \*\*\* | -0.00 | -0.01 | < 8.19x10ˉ⁵¹ |  |
|  | Sex (M) | -0.00 \*\*\* | -0.00 | -0.00 | < 1.33x10ˉ⁷¹ |  |
|  | N\**g* | -0.02 \*\*\* | -0.03 | -0.02 | < 2.00x10ˉ¹⁶ |  |
| Abbreviations: PHQ, Patient Health Questionnaire; *g*, General Intelligence | | | | | | |