

Supplementary File

Supplementary Table 1. Genetic correlations between educational attainment, intelligence, and income.

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Supplementary Table 1. Genetic correlations between educational attainment, intelligence, and income.

Trait1	Trait2	r_g (se)	Z	P	FDR
Educational attainment	Intelligence	0.69 (0.01)	49.56	<0.001	<0.001
Income	Educational attainment	0.81 (0.01)	74.39	<0.001	<0.001
Income	Intelligence	0.63 (0.02)	34.70	<0.001	<0.001

Supplementary Table 2. Genetic correlations between the three factors and the 13 mental disorders.

Trait1	Trait2	rg (se)	Z	P	FDR
EA	ADHD	-0.53 (0.02)	-28.18	<0.001	<0.001
EA	Alcohol dependence	-0.45 (0.06)	-7.87	<0.001	<0.001
EA	Anorexia nervosa	0.25 (0.03)	9.06	<0.001	<0.001
EA	Anxiety disorder	-0.31 (0.09)	-3.44	<0.001	0.002
EA	ASD	0.21 (0.03)	7.32	<0.001	<0.001
EA	BD	0.11 (0.02)	6.42	<0.001	<0.001
EA	Insomnia	-0.33 (0.02)	-16.60	<0.001	<0.001
EA	MDD	-0.13 (0.02)	-7.22	<0.001	<0.001
EA	OCD	0.24 (0.04)	5.79	<0.001	<0.001
EA	Panic disorder	-0.11 (0.04)	-2.61	0.010	0.017
EA	PTSD	-0.26 (0.05)	-5.42	<0.001	<0.001
EA	Schizophrenia	0.01 (0.02)	0.74	0.461	0.485
EA	Tourette syndrome	-0.14 (0.03)	-4.16	<0.001	<0.001
Income	ADHD	-0.52 (0.02)	-23.13	<0.001	<0.001
Income	Alcohol dependence	-0.48 (0.07)	-6.98	<0.001	<0.001
Income	Anorexia nervosa	0.16 (0.03)	4.92	<0.001	<0.001
Income	Anxiety disorder	-0.36 (0.12)	-3.08	<0.001	0.005
Income	ASD	-0.03 (0.04)	-0.84	0.401	0.446
Income	BD	0.01 (0.02)	0.65	0.513	0.513
Income	Insomnia	-0.35 (0.03)	-13.36	<0.001	<0.001
Income	MDD	-0.27 (0.02)	-11.96	<0.001	<0.001
Income	OCD	0.14 (0.05)	2.70	0.007	0.014
Income	Panic disorder	-0.08 (0.05)	-1.57	0.117	0.154
Income	PTSD	-0.45 (0.06)	-7.90	<0.001	<0.001
Income	Schizophrenia	-0.15 (0.02)	-7.30	<0.001	<0.001
Income	Tourette syndrome	-0.14 (0.04)	-3.24	0.001	0.003
Intelligence	ADHD	-0.41 (0.03)	-15.00	<0.001	<0.001
Intelligence	Alcohol dependence	-0.29 (0.06)	-4.84	<0.001	<0.001
Intelligence	Anorexia nervosa	0.10 (0.04)	2.76	0.006	0.064
Intelligence	Anxiety disorder	-0.15 (0.09)	-1.73	0.083	0.390
Intelligence	ASD	0.20 (0.04)	5.43	<0.001	<0.001
Intelligence	BD	-0.07 (0.02)	-3.15	<0.001	<0.001
Intelligence	Insomnia	-0.17 (0.03)	-6.37	<0.001	<0.001
Intelligence	MDD	-0.06 (0.02)	-2.72	0.006	0.017
Intelligence	OCD	0.06 (0.05)	1.21	0.226	0.140
Intelligence	Panic disorder	-0.13 (0.05)	-2.52	0.012	0.141
Intelligence	PTSD	-0.19 (0.05)	-3.60	<0.001	0.061
Intelligence	Schizophrenia	-0.25 (0.02)	-11.51	<0.001	<0.001
Intelligence	Tourette syndrome	-0.04 (0.04)	-0.91	0.361	0.350

ADHD: attention-deficit/hyperactivity disorder; ASD: autism spectrum disorder; BD: bipolar disorder; EA: educational attainment; MDD: major depressive disorder; OCD: obsessive-compulsive disorder; PTSD: posttraumatic stress disorder.

Supplementary Table 3. Causal associations between educational attainment, intelligence, and income.

Exposure	Outcome	Method	b (se)	OR [95% CI]	N_IV	Q_P	I ²	Egger_intercept	P_pleiotropy	P
EA	Income	IVW	0.689 (0.015)	1.99 [1.94-2.05]	460	<0.001	0.528	NA	NA	<0.001
EA	Income	WM	0.647 (0.018)	1.91 [1.84-1.98]	460	NA	NA	NA	NA	<0.001
EA	Income	MR-Egger	0.761 (0.059)	2.14 [1.91-2.40]	460	<0.001	0.526	-0.001	0.209	<0.001
EA	Intelligence	IVW	0.773 (0.022)	2.17 [2.07-2.26]	460	<0.001	0.568	NA	NA	<0.001
EA	Intelligence	WM	0.750 (0.025)	2.12 [2.01-2.22]	460	NA	NA	NA	NA	<0.001
EA	Intelligence	MR-Egger	0.797 (0.088)	2.22 [1.87-2.64]	460	<0.001	0.568	0	0.773	<0.001
Intelligence	EA	IVW	0.407 (0.026)	1.50 [1.43-1.58]	78	<0.001	0.882	NA	NA	<0.001
Intelligence	EA	WM	0.314 (0.019)	1.37 [1.32-1.42]	78	NA	NA	NA	NA	<0.001
Intelligence	EA	MR-Egger	0.461 (0.114)	1.59 [1.27-1.98]	78	<0.001	0.881	-0.001	0.624	<0.001
Intelligence	Income	IVW	0.364 (0.027)	1.44 [1.36-1.52]	78	<0.001	0.773	NA	NA	<0.001
Intelligence	Income	WM	0.325 (0.024)	1.38 [1.32-1.45]	78	NA	NA	NA	NA	<0.001
Intelligence	Income	MR-Egger	0.520 (0.117)	1.68 [1.34-2.12]	78	<0.001	0.767	-0.004	0.173	<0.001
Income	Intelligence	IVW	0.690 (0.040)	1.99 [1.84-2.16]	89	<0.001	0.650	NA	NA	<0.001
Income	Intelligence	WM	0.630 (0.039)	1.88 [1.74-2.03]	89	NA	NA	NA	NA	<0.001
Income	Intelligence	MR-Egger	0.637 (0.179)	1.89 [1.33-2.69]	89	<0.001	0.650	0.001	0.763	<0.001
Income	EA	IVW	0.633 (0.027)	1.88 [1.79-1.98]	85	<0.001	0.805	NA	NA	<0.001
Income	EA	WM	0.545 (0.027)	1.72 [1.63-1.82]	85	NA	NA	NA	NA	<0.001
Income	EA	MR-Egger	0.889 (0.125)	2.43 [1.90-3.11]	85	<0.001	0.795	-0.005	0.039	<0.001

EA: educational attainment; IVW: inverse variance weighted; WM: weighted median; OR: odds ratio; CI: confidence interval; N_IV: number of instrumental variables; Q_P: Cochran's P-value of heterogeneity analysis.

Supplementary Table 4. Causal effects of the three factors on the mental disorders in the Multivariable MR analysis.

Exposure	Outcome	Method	b (se)	OR [95% CI]	N_IV	Q_P	I ²	Egger_intercept	P_pleiotropy	P
EA	ADHD	IVW	-0.333 (0.018)	0.72 [0.69-0.74]	457	<0.001	0.517	NA		<0.001
EA	ADHD	WM	-0.300 (0.020)	0.74 [0.71-0.77]	457	NA	NA	NA		<0.001
EA	ADHD	MR Egger	-0.249 (0.070)	0.78 [0.68-0.89]	457	<0.001	0.515	-0.001	0.217	<0.001
EA	Alcohol dependence	IVW	-0.286 (0.042)	0.75 [0.69-0.82]	460	<0.001	0.238	NA		<0.001
EA	Alcohol dependence	WM	-0.216 (0.060)	0.81 [0.72-0.91]	460	NA	NA	NA		<0.001
EA	Alcohol dependence	MR Egger	-0.069 (0.173)	0.93 [0.66-1.31]	460	<0.001	0.236	-0.003	0.197	0.689
EA	Anorexia nervosa	IVW	0.364 (0.077)	1.44 [1.24-1.67]	458	<0.001	0.463	NA		<0.001
EA	Anorexia nervosa	WM	0.418 (0.093)	1.52 [1.27-1.82]	458	NA	NA	NA		<0.001
EA	Anorexia nervosa	MR-Egger	0.539 (0.311)	1.71 [0.93-3.16]	458	<0.001	0.463	-0.002	0.561	0.084
EA	Anxiety disorder	IVW	-0.056 (0.020)	0.95 [0.91-0.98]	454	0.425	0.011	NA		0.005
EA	Anxiety disorder	WM	-0.070 (0.030)	0.93 [0.88-0.99]	454	NA	NA	NA		0.021
EA	Anxiety disorder	MR Egger	-0.084 (0.085)	0.92 [0.78-1.09]	454	0.413	0.011	0	0.743	0.326
EA	ASD	IVW	0.192 (0.036)	1.21 [1.13-1.30]	460	<0.001	0.464	NA		<0.001
EA	ASD	WM	0.166 (0.043)	1.18 [1.08-1.29]	460	NA	NA	NA		<0.001
EA	ASD	MR Egger	0.338 (0.145)	1.40 [1.06-1.86]	460	<0.001	0.463	-0.002	0.297	0.020
EA	BD	IVW	0.323 (0.066)	1.38 [1.21-1.57]	463	<0.001	0.666	NA		<0.001
EA	BD	WM	0.300 (0.069)	1.35 [1.18-1.55]	463	NA	NA	NA		<0.001
EA	BD	MR Egger	0.538 (0.265)	1.71 [1.02-2.88]	463	<0.001	0.665	-0.003	0.400	0.043
EA	Insomnia	IVW	-0.154 (0.013)	0.86 [0.84-0.88]	458	<0.001	0.465	NA		<0.001
EA	Insomnia	WM	-0.154 (0.016)	0.86 [0.83-0.88]	458	NA	NA	NA		<0.001
EA	Insomnia	MR Egger	-0.114 (0.050)	0.89 [0.81-0.98]	458	<0.001	0.464	-0.001	0.403	0.024
EA	MDD	IVW	-0.175 (0.028)	0.84 [0.79-0.89]	461	<0.001	0.737	NA		<0.001
EA	MDD	WM	-0.179 (0.026)	0.84 [0.79-0.88]	461	NA	NA	NA		<0.001

EA	MDD	MR Egger	-0.075 (0.111)	0.93 [0.75-1.15]	461	<0.001	0.737	-0.001	0.355	0.498
EA	OCD	IVW	0.253 (0.064)	1.29 [1.14-1.46]	461	<0.001	0.248	NA		<0.001
EA	OCD	WM	0.213 (0.083)	1.24 [1.05-1.46]	461	NA	NA	NA		0.010
EA	OCD	MR Egger	-0.096 (0.255)	0.91 [0.55-1.50]	461	<0.001	0.245	0.005	0.158	0.706
EA	Panic disorder	IVW	-0.390 (0.160)	0.68 [0.49-0.93]	462	0.018	0.126	NA		0.015
EA	Panic disorder	WM	-0.192 (0.238)	0.83 [0.52-1.31]	462	NA	NA	NA		0.419
EA	Panic disorder	MR Egger	0.358 (0.646)	1.43 [0.40-5.07]	462	0.018	0.123	-0.010	0.233	0.580
EA	PTSD	IVW	-0.064 (0.015)	0.94 [0.91-0.97]	462	0.004	0.155	NA		<0.001
EA	PTSD	WM	-0.071 (0.021)	0.93 [0.89-0.97]	462	NA	NA	NA		<0.001
EA	PTSD	MR Egger	-0.094 (0.059)	0.91 [0.81-1.02]	462	0.004	0.155	0	0.595	0.113
EA	Schizophrenia	IVW	0.050 (0.082)	1.05 [0.90-1.23]	461	<0.001	0.812	NA		0.536
EA	Schizophrenia	WM	-0.041 (0.066)	0.96 [0.84-1.09]	461	NA	NA	NA		0.532
EA	Schizophrenia	MR Egger	0.484 (0.327)	1.62 [0.85-3.08]	461	<0.001	0.811	-0.006	0.171	0.139
EA	TS	IVW	-0.313 (0.056)	0.73 [0.66-0.82]	460	<0.001	0.275	NA		<0.001
EA	TS	WM	-0.318 (0.078)	0.73 [0.62-0.85]	460	NA	NA	NA		<0.001
EA	TS	MR Egger	-0.214 (0.224)	0.81 [0.52-1.25]	460	<0.001	0.275	-0.001	0.650	0.340
Income	ADHD	IVW	-0.280 (0.035)	0.76 [0.70-0.81]	86	<0.001	0.657	NA		<0.001
Income	ADHD	WM	-0.229 (0.036)	0.80 [0.74-0.85]	86	NA	NA	NA		<0.001
Income	ADHD	MR Egger	0.012 (0.175)	1.01 [0.72-1.43]	86	<0.001	0.645	-0.005	0.091	0.944
Income	Alcohol dependence	IVW	-0.191 (0.085)	0.83 [0.70-0.98]	88	<0.001	0.488	NA		0.024
Income	Alcohol dependence	WM	-0.101 (0.096)	0.90 [0.75-1.09]	88	NA	NA	NA		0.294
Income	Alcohol dependence	MR Egger	-0.079 (0.397)	0.92 [0.42-2.01]	88	<0.001	0.488	-0.002	0.774	0.842
Income	Anorexia nervosa	IVW	0.421 (0.119)	1.52 [1.21-1.92]	87	<0.001	0.389	NA		<0.001
Income	Anorexia nervosa	WM	0.455 (0.148)	1.58 [1.18-2.11]	87	NA	NA	NA		0.002
Income	Anorexia nervosa	MR-Egger	1.514 (0.560)	4.55 [1.52-13.62]	87	<0.001	0.361	-0.020	0.049	0.008

Income	Anxiety disorder	IVW	-0.121 (0.033)	0.89 [0.83-0.95]	87	0.932	-0.277	NA		<0.001
Income	Anxiety disorder	WM	-0.103 (0.047)	0.90 [0.82-0.99]	87	NA	NA	NA		0.028
Income	Anxiety disorder	MR Egger	0.020 (0.162)	1.02 [0.74-1.40]	87	0.931	-0.292	-0.003	0.375	0.901
Income	ASD	IVW	-0.010 (0.068)	0.99 [0.87-1.13]	88	<0.001	0.593	NA		0.884
Income	ASD	WM	0.012 (0.074)	1.01 [0.87-1.17]	88	NA	NA	NA		0.876
Income	ASD	MR Egger	0.504 (0.302)	1.66 [0.91-2.99]	88	<0.001	0.579	-0.010	0.085	0.099
Income	BD	IVW	-0.069 (0.130)	0.93 [0.72-1.20]	88	<0.001	0.767	NA		0.595
Income	BD	WM	-0.004 (0.110)	1.00 [0.80-1.24]	88	NA	NA	NA		0.973
Income	BD	MR Egger	0.820 (0.585)	2.27 [0.72-7.15]	88	<0.001	0.761	-0.017	0.123	0.165
Income	Insomnia	IVW	-0.121 (0.022)	0.89 [0.85-0.93]	88	<0.001	0.532	NA		<0.001
Income	Insomnia	WM	-0.123 (0.025)	0.88 [0.84-0.93]	88	NA	NA	NA		<0.001
Income	Insomnia	MR Egger	-0.086 (0.099)	0.92 [0.76-1.11]	88	<0.001	0.532	-0.001	0.714	0.389
Income	MDD	IVW	-0.302 (0.047)	0.74 [0.67-0.81]	86	<0.001	0.745	NA		<0.001
Income	MDD	WM	-0.228 (0.040)	0.80 [0.74-0.86]	86	NA	NA	NA		<0.001
Income	MDD	MR Egger	-0.199 (0.230)	0.82 [0.52-1.29]	86	<0.001	0.744	-0.002	0.649	0.389
Income	OCD	IVW	0.151 (0.102)	1.16 [0.95-1.42]	87	0.066	0.192	NA		0.139
Income	OCD	WM	0.216 (0.132)	1.24 [0.96-1.61]	87	NA	NA	NA		0.103
Income	OCD	MR Egger	0.220 (0.466)	1.25 [0.50-3.11]	87	0.058	0.192	-0.001	0.880	0.638
Income	Panic disorder	IVW	-0.885 (0.255)	0.41 [0.25-0.68]	87	0.293	0.072	NA		<0.001
Income	Panic disorder	WM	-0.963 (0.357)	0.38 [0.19-0.77]	87	NA	NA	NA		0.007
Income	Panic disorder	MR Egger	-1.613 (1.189)	0.20 [0.02-2.05]	87	0.278	0.067	0.014	0.532	0.179
Income	PTSD	IVW	-0.116 (0.025)	0.89 [0.85-0.93]	89	0.077	0.182	NA		<0.001
Income	PTSD	WM	-0.095 (0.034)	0.91 [0.85-0.97]	89	NA	NA	NA		0.006
Income	PTSD	MR Egger	-0.065 (0.111)	0.94 [0.75-1.16]	89	0.069	0.179	-0.001	0.637	0.559
Income	Schizophrenia	IVW	-0.382 (0.156)	0.68 [0.50-0.93]	88	<0.001	0.864	NA		0.014

Income	Schizophrenia	WM	-0.266 (0.114)	0.77 [0.61-0.96]	88	NA	NA	NA		0.020
Income	Schizophrenia	MR Egger	1.014 (0.691)	2.76 [0.71-10.67]	88	<0.001	0.857	-0.027	0.041	0.146
Income	TS	IVW	-0.282 (0.111)	0.75 [0.61-0.94]	87	<0.001	0.489	NA		0.011
Income	TS	WM	-0.106 (0.129)	0.90 [0.70-1.16]	87	NA	NA	NA		0.411
Income	TS	MR Egger	0.311 (0.501)	1.36 [0.51-3.65]	87	<0.001	0.480	-0.011	0.229	0.537
Intelligence	ADHD	IVW	-0.158 (0.028)	0.85 [0.81-0.90]	78	<0.001	0.680	NA		<0.001
Intelligence	ADHD	WM	-0.113 (0.026)	0.89 [0.85-0.94]	78	NA	NA	NA		<0.001
Intelligence	ADHD	MR-Egger	-0.060 (0.124)	0.94 [0.74-1.20]	78	<0.001	0.677	-0.002	0.422	0.632
Intelligence	Alcohol dependence	IVW	-0.115 (0.055)	0.89 [0.80-0.99]	78	0.026	0.252	NA		0.035
Intelligence	Alcohol dependence	WM	-0.125 (0.072)	0.88 [0.77-1.02]	78	NA	NA	NA		0.082
Intelligence	Alcohol dependence	MR-Egger	-0.140 (0.252)	0.87 [0.53-1.43]	78	0.022	0.251	0.001	0.919	0.581
Intelligence	Anorexia nervosa	IVW	0.160 (0.109)	1.17 [0.95-1.45]	77	<0.001	0.570	NA		0.143
Intelligence	Anorexia nervosa	WM	0.130 (0.122)	1.14 [0.90-1.44]	77	NA	NA	NA		0.287
Intelligence	Anorexia nervosa	MR-Egger	0.749 (0.512)	2.11 [0.77-5.77]	77	<0.001	0.562	-0.015	0.243	0.148
Intelligence	Anxiety disorder	IVW	-0.005 (0.026)	0.99 [0.95-1.05]	76	0.531	-0.022	NA		0.833
Intelligence	Anxiety disorder	WM	-0.021 (0.036)	0.98 [0.91-1.05]	76	NA	NA	NA		0.555
Intelligence	Anxiety disorder	MR-Egger	-0.153 (0.148)	0.86 [0.64-1.15]	76	0.532	-0.036	0.004	0.316	0.306
Intelligence	ASD	IVW	0.144 (0.048)	1.15 [1.05-1.27]	78	<0.001	0.502	NA		0.003
Intelligence	ASD	WM	0.109 (0.055)	1.11 [1.00-1.24]	78	NA	NA	NA		0.048
Intelligence	ASD	MR-Egger	-0.109 (0.208)	0.90 [0.60-1.35]	78	<0.001	0.492	0.006	0.216	0.601
Intelligence	BD	IVW	-0.032 (0.096)	0.97 [0.80-1.17]	78	<0.001	0.747	NA		0.741
Intelligence	BD	WM	-0.129 (0.085)	0.88 [0.74-1.04]	78	NA	NA	NA		0.127
Intelligence	BD	MR-Egger	-0.720 (0.431)	0.49 [0.21-1.13]	78	<0.001	0.738	0.017	0.106	0.099
Intelligence	Insomnia	IVW	-0.068 (0.018)	0.93 [0.90-0.97]	78	<0.001	0.559	NA		<0.001
Intelligence	Insomnia	WM	-0.062 (0.019)	0.94 [0.91-0.98]	78	NA	NA	NA		0.001

Intelligence	Insomnia	MR-Egger	-0.144 (0.077)	0.87 [0.75-1.01]	78	<0.001	0.552	0.002	0.309	0.063
Intelligence	MDD	IVW	-0.005 (0.044)	0.99 [0.91-1.09]	78	<0.001	0.833	NA		0.909
Intelligence	MDD	WM	-0.018 (0.033)	0.98 [0.92-1.05]	78	NA	NA	NA		0.591
Intelligence	MDD	MR-Egger	-0.648 (0.186)	0.52 [0.36-0.75]	78	<0.001	0.806	0.016	<0.001	<0.001
Intelligence	OCD	IVW	-0.047 (0.084)	0.95 [0.81-1.12]	78	0.00753	0.303	NA		0.575
Intelligence	OCD	WM	-0.058 (0.107)	0.94 [0.76-1.16]	78	NA	NA	NA		0.589
Intelligence	OCD	MR-Egger	-0.333 (0.368)	0.72 [0.35-1.47]	78	0.00718	0.297	0.007	0.427	0.368
Intelligence	Panic disorder	IVW	-0.046 (0.217)	0.96 [0.62-1.46]	78	0.034	0.238	NA		0.834
Intelligence	Panic disorder	WM	-0.021 (0.286)	0.98 [0.56-1.71]	78	NA	NA	NA		0.941
Intelligence	Panic disorder	MR-Egger	-1.387 (1.003)	0.25 [0.04-1.78]	78	0.041	0.219	0.034	0.175	0.171
Intelligence	PTSD	IVW	-0.011 (0.021)	0.99 [0.95-1.03]	78	0.041	0.229	NA		0.579
Intelligence	PTSD	WM	-0.008 (0.028)	0.99 [0.94-1.05]	78	NA	NA	NA		0.778
Intelligence	PTSD	MR-Egger	-0.262 (0.085)	0.77 [0.65-0.91]	78	0.145	0.135	0.006	0.003	0.003
Intelligence	Schizophrenia	IVW	-0.454 (0.135)	0.63 [0.49-0.83]	78	<0.001	0.890	NA		<0.001
Intelligence	Schizophrenia	WM	-0.553 (0.091)	0.58 [0.48-0.69]	78	NA	NA	NA		<0.001
Intelligence	Schizophrenia	MR-Egger	-1.640 (0.597)	0.19 [0.06-0.63]	78	<0.001	0.884	0.03	0.045	0.008
Intelligence	TS	IVW	-0.052 (0.081)	0.95 [0.81-1.11]	77	<0.001	0.433	NA		0.519
Intelligence	TS	WM	0.020 (0.096)	1.02 [0.85-1.23]	77	NA	NA	NA		0.836
Intelligence	TS	MR-Egger	0.118 (0.355)	1.12 [0.56-2.25]	77	<0.001	0.431	-0.004	0.624	0.741

EA: educational attainment; IVW: inverse variance weighted; WM: weighted median; OR: odds ratio; CI: confidence interval; N_IV: number of instrumental variables; Q_P: Cochran's P-value of heterogeneity analysis. ADHD: attention-deficit/hyperactivity disorder; ASD: autism spectrum disorder; BD: bipolar disorder; EA: educational attainment; MDD: major depressive disorder; OCD: obsessive-compulsive disorder; PTSD: posttraumatic stress disorder; TS: Tourette syndrome.