

Supplementary Online Content

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eMethods. Supplemental Methods

eResults. Supplemental Results

eTable 1. Baseline Characteristics of Cases and Controls With Complete and Missing Data

eTable 2. BIC and Entropy Values for Each GBTM Model

eTable 3. Model Fit Statistics for Each Final GBTM Model

eTable 4. Proportion of Cases and Controls Assigned to Each Trajectory Group for Each Model

eTable 5. Post-diagnosis Logistic Regression Models for Psychotic and Nonpsychotic SMI With *Upward Mobility* and *Urban-Rural Movement* of the Reference Groups

eReferences

This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods. Supplemental Methods

Exposure variables

For each year, we estimated SAMS-level socioeconomic deprivation and population density. Population density was calculated by the number of people within each SAMS according to the Register of the Total Population, divided by its size (i.e., people per square kilometer). Socioeconomic deprivation was derived from four measures: proportion of individuals with income below the national mean (from the Longitudinal Integration Database for Health Insurance and Labour Market Studies [LISA]); proportion receiving social benefits; proportion unemployed; and neighbourhood crime rate i.e., total number of criminal convictions (from the National Register of Criminal Convictions) divided by population size.

Covariates

Parental and covariate information was obtained from linked registers (Register of the Total Population; National Patient Register; STATIV, the migration register; LISA; and the family linkage register). Biological parental history of SMI included both psychotic disorders and bipolar disorders or mania irrespective of psychotic symptoms, and was defined as a binary variable (at least one parent ever having been diagnosed with SMI vs. both parents never having been diagnosed with SMI). Parental migrant status was also coded as a binary variable (at least one foreign-born parent vs. both Swedish-born parents). Parental disposable income at birth was categorised into quintiles, relative to the parental income of all other people born in Sweden in that year. Parental income quintile was based on combined parental income where linkage to both the mother and father was available, or on a single caregiver otherwise. For people who were later adopted, we used the adopted parental income at participant birth rather than that of the biological parents. Regarding the number of residential moves, these can only be detected when there is a change of SAMS from one year to the next. Therefore, both moves that occur within the same SAMS and multiple moves within a year cannot be captured.

Group-based trajectory modelling

Group-based trajectory modelling (GBTM) was conducted to identify latent trajectory groups for area-level deprivation index and population density. GBTM is a contemporary statistical approach to finite mixture modelling which identifies clusters of individuals that follow a similar trajectory of some variable over time.¹

A Stata package for estimating GBTMs was used for the analyses.² Both exposures were modelled by the censored normal distribution, with minimum and maximum values specified at 0.5 and 5.5 respectively outside of the observed range of values [1 to 5, for each quintile].¹

For each model, we established the optimal number of trajectory groups present in the sample for deprivation and population density separately. To begin with, all groups were modelled by polynomial functions of the highest order (cubic), starting with a two-group model. The number of groups was iteratively increased by one until the value of the Bayesian Information Criterion (BIC) was maximally reduced, with lower scores indicating a better model fit.³ However, using a single statistical criterion may not necessarily lead to the best model specification. Thus, as per previous studies,^{1,4,5} we took into consideration the following to guide model selection: (a) close correspondence between the estimated probability of group membership and the proportion of the sample assigned to that group based on the maximum posterior probability assignment rule; (b) average posterior probability (AvePP) values of group membership for individuals assigned to each group to be >0.7; (c) relatively tight 95% confidence intervals around the average posterior probabilities; (d) entropy as a marker of classification accuracy; (e) odds of correct classification according to the posterior probabilities of group membership for each group to be >5; (f) each group to have sufficient sample size; and (g) an inclination towards models with greater simplicity.

Once the optimal number of groups had been chosen, we reduced the order of the polynomial function for each trajectory group from cubic to zero-order, until the highest order polynomial for each group reached statistical significance at $P < .05$. The final trajectory model was thus determined, and each individual was then classified to a trajectory group based on the maximum posterior probability assignment rule.

eResults. Supplemental Results

Sample characteristics – missing data

Complete data were available for 1,949,374 individuals (97.5% of cohort). A higher proportion of potential cases (5.7%; eTable 1a) were missing exposure or covariate information than potential controls (2.4%; eTable 1b). Cases and potential controls with missing data were more likely to be men, children of migrants, have a parental history of SMI, have more disposable income, and be born into more deprived and densely populated quintiles (all $p < .001$; eTable 1a, eTable 1b).

eTable 1a. Baseline Characteristics of Cases with Complete and Missing Data

	Missing Data	Complete Data	χ^2	df	P Value
Total N (row %)	1,603 (5.7%)	26,729 (94.3%)	-	-	-
Sex					
Male	862 (53.8%)	11,356 (42.5%)	78.6	1	<.001
Female	741 (46.2%)	15,373 (57.5%)			
Parental migrant status					
Swedish born	981 (61.2%)	20,965 (78.4%)	349.0	2	<.001
Swedish born, no parents	6 (0.4%)	0 (0.0%)			
Migrant:	616 (38.4%)	5,764 (21.6%)			
Other Europe	256 (16.0%)	2,621 (9.8%)			
Asia	9 (0.6%)	90 (0.3%)			
N. Africa & Middle East	65 (4.1%)	490 (1.8%)			
Sub-Saharan Africa	20 (1.2%)	142 (0.5%)			
Mixed	231 (14.4%)	2,322 (8.7%)			
Other	35 (2.2%)	99 (0.4%)			
Parental history of SMI					
None	1,310 (81.8%)	23,370 (87.4%)	46.0	2	<.001
One	244 (15.2%)	2,885 (10.8%)			
Both	49 (3.1%)	474 (1.8%)			
Parental disposable income at birth					
1 (Lowest quintile)	635 (39.6%)	6,104 (22.8%)	239.0	4	<.001
2	280 (17.5%)	5,743 (21.5%)			
3	224 (14.0%)	5,188 (19.4%)			
4	215 (13.4%)	4,900 (18.3%)			
5 (Highest quintile)	249 (15.5%)	4,794 (17.9%)			
Deprivation at birth					
1 (Lowest quintile)	164 (11.6%)	3,910 (14.6%)	73.1	4	<.001
2	205 (14.5%)	4,827 (18.1%)			
3	258 (18.2%)	5,359 (20.1%)			
4	281 (19.8%)	5,693 (21.3%)			
5 (Highest quintile)	510 (36.0%)	6,940 (26.0%)			
Population density at birth					
1 (Lowest quintile)	78 (5.5%)	2,382 (8.9%)	81.6	4	<.001
2	134 (9.4%)	3,268 (12.2%)			
3	200 (14.1%)	4,415 (16.5%)			
4	325 (22.9%)	6,843 (25.6%)			
5 (Highest quintile)	682 (48.1%)	9,821 (36.7%)			
Diagnosis (ICD-10)					
Non-psychotic bipolar disorder	552 (34.4%)	13,782 (51.6%)	177.5	1	<.001
Psychotic disorder:	1,051 (65.6%)	12,947 (48.4%)			
Schizophrenia (F20) or schizoaffective disorders (F25)	272 (17.0%)	2,942 (11.0%)			
Affective psychosis (F30-33)	256 (9.7%)	3,369 (12.6%)			
Bipolar psychosis (F30-31)	61 (3.8%)	1,153 (4.3%)			
Depressive psychosis (F32-33)	95 (5.9%)	2,216 (8.3%)			
Other non-affective psychosis (F2X)	623 (38.9%)	6,636 (24.8%)			

Abbreviations: df, degrees of freedom; SMI, severe mental illness; N. Africa, North Africa

Note: Data are presented as n/N (%) for categorical variables, where n is the number of participants within that category and N is the total number for whom data is available for that particular characteristic.

eTable 1b. Baseline Characteristics of Controls with Complete and Missing Data

	Missing Data	Complete Data	χ^2	df	P-Value
Total N (row %)	48,278 (2.4%)	1,922,645 (97.6%)	-	-	-
Sex					
Male	25,667 (53.2%)	988,977 (51.4%)	56.2	1	<.001
Female	22,611 (46.8%)	933,668 (48.6%)			
Parental migrant status					
Swedish born	24,738 (51.2%)	1,569,959 (81.7%)	36120.0	2	<.001
No parents	215 (0.5%)	0 (0.0%)			
Migrant:	23,325 (48.3%)	352,686 (18.3%)			
Other Europe	8,157 (16.9%)	134,698 (7.0%)			
Asia	674 (1.4%)	11,381 (0.6%)			
N. Africa & Middle East	4,163 (8.6%)	57,971 (3.0%)			
Sub-Saharan Africa	1,226 (2.5%)	12,030 (0.6%)			
Mixed	7,674 (15.9%)	128,990 (6.7%)			
Other	1,431 (3.0%)	7,616 (0.4%)			
Parental history of SMI					
None	45,826 (94.9%)	1,855,592 (96.5%)	351.2	2	<.001
One	2,124 (4.4%)	58,651 (3.1%)			
Both	318 (0.7%)	8,402 (0.4%)			
Parental disposable income at birth					
1 (Lowest quintile)	21,926 (45.4%)	349,746 (18.2%)	25001.8	4	<.001
2	5,903 (12.2%)	392,081 (20.4%)			
3	4,738 (9.8%)	396,446 (20.6%)			
4	5,263 (10.9%)	396,520 (20.6%)			
5 (Highest quintile)	10,448 (21.6%)	387,852 (20.2%)			
Deprivation at birth					
1 (Lowest quintile)	6,575 (18.1%)	325,250 (16.9%)	1468.3	4	<.001
2	6,405 (17.7%)	385,915 (20.0%)			
3	6,499 (17.9%)	408,007 (21.2%)			
4	6,253 (17.2%)	392,588 (20.4%)			
5 (Highest quintile)	10,533 (29.0%)	410,874 (21.4%)			
Population density at birth					
1 (Lowest quintile)	1,664 (4.6%)	186,742 (9.7%)	4938.1	4	<.001
2	2,684 (7.4%)	263,918 (13.7%)			
3	5,119 (14.1%)	357,602 (18.6%)			
4	9,752 (26.9%)	501,047 (26.1%)			
5 (Highest quintile)	17,047 (47.0%)	613,336 (31.9%)			

Abbreviations: *df*, degrees of freedom; SMI, severe mental illness; N. Africa, North Africa

Note: Data are presented as n/N (%) for categorical variables, where n is the number of participants within that category and N is the total number for whom data is available for that particular characteristic.

eTable 2. BIC and Entropy values for each GBTM model

GBTM Model	Number of groups	Trajectory shapes ¹	BIC ² (N = 53458)	Entropy
Pre-diagnosis				
Deprivation index	2	3 3	1088555.60	0.952
	3	3 3 3	1018370.68	0.927
	4	3 3 3 3	991944.95	0.881
	5	3 3 3 3 3	962733.96	0.888
	6	3 3 3 3 3 3	946422.17	0.892
	7	3 3 3 3 3 3 3	935287.13	0.889
	Population density	2	3 3	895372.91
	3	3 3 3	785929.67	0.966
	4	3 3 3 3	730076.31	0.963
	5	3 3 3 3 3	698446.89	0.951
	6	3 3 3 3 3 3	658228.22	0.997
	6	3 3 3 3 3 2	658222.88	0.997
	7	3 3 3 3 3 3 3	637800.97	0.999
Post-diagnosis				
Deprivation index	2	3 3	362520.44	0.933
	3	3 3 3	314466.08	0.900
	4	3 3 3 3	281664.03	0.902
	5	3 3 3 3 3	254769.32	0.894
	6	3 3 3 3 3 3	236391.98	0.895
	7	3 3 3 3 3 3 3	223849.18	0.901
	8	3 3 3 3 3 3 3 3	214890.99	0.891
	Population density	2	3 3	333258.02
	3	3 3 3	286080.21	0.905
	4	3 3 3 3	249670.07	0.906
	5	3 3 3 3 3	240956.39	0.901
	6	3 3 3 3 3 3	234651.92	0.887

Note: Bold denotes the final trajectory model chosen for each time period and for each period.

¹Trajectory shapes; 2 = quadratic; 3 = cubic.

²BIC = Bayesian information criterion (for the total number of participants).

eTable 3a. Model fit statistics for the final pre-diagnosis deprivation GBTM model groups

	Pre-diagnosis deprivation trajectory group					
	1	2	3	4	5	6
Estimated group probability	20.30	22.44	18.91	19.35	7.87	11.13
Posterior probability of group membership (95%CI)	20.34 (20.01-20.66)	22.07 (21.75-22.39)	18.91 (18.59-19.23)	19.44 (19.09-19.79)	8.02 (7.81-8.23)	11.22 (10.99-11.46)
AvePP value	0.973	0.930	0.922	0.970	0.927	0.918
OCC	138.9	46.6	51.0	133.9	145.3	88.3

Abbreviations: AvePP = average posterior probability; OCC = odds of correct classification.

eTable 3b. Model fit statistics for the final pre-diagnosis population density GBTM model groups

	Pre-diagnosis population density trajectory group					
	1	2	3	4	5	6
Estimated group probability	7.98	14.37	19.13	28.57	22.00	7.95
Posterior probability of group membership (95%CI)	8.01 (7.78-8.24)	14.36 (14.07-14.65)	19.05 (18.72-19.39)	28.42 (28.05-28.79)	22.22 (21.87-22.57)	7.93 (7.70-8.17)
AvePP value	0.993	0.986	0.980	0.978	0.991	0.967
OCC	1543.5	418.4	210.5	111.8	367.2	335.5

Abbreviations: AvePP = average posterior probability; OCC = odds of correct classification.

eTable 3c. Model fit statistics for the final post-diagnosis deprivation index GBTM model groups

	Post-diagnosis deprivation trajectory group						
	1	2	3	4	5	6	7
Estimated group probability	13.66	17.55	19.23	21.68	24.60	1.96	1.32
Posterior probability of group membership (95%CI)	13.67 (13.37-13.96)	17.18 (16.87-17.50)	19.19 (18.85-19.53)	21.33 (21.00-21.67)	24.71 (24.35-25.07)	2.28 (2.16-2.39)	1.64 (1.54-1.74)
AvePP value	0.990	0.966	0.986	0.970	0.993	0.955	0.985
OCC	629.8	135.1	292.2	118.5	434.3	916.9	3819.4

Abbreviations: AvePP = average posterior probability; OCC = odds of correct classification.

eTable 3d. Model fit statistics for the final post-diagnosis population density GBTM model groups

	Post-diagnosis population density trajectory group				
	1	2	3	4	5
Estimated group probability	16.96	15.86	26.77	38.98	1.44
Posterior probability of group membership (95%CI)	16.77 (16.47-17.08)	15.63 (15.33-15.93)	26.20 (25.85-26.55)	39.38 (38.96-39.81)	2.02 (1.92-2.12)
AvePP value	0.986	0.958	0.946	0.989	0.957
OCC	359.2	123.7	49.6	142.2	1082.0

Abbreviations: AvePP = average posterior probability; OCC = odds of correct classification

eTable 4. Proportion of cases and controls assigned to each trajectory group for each model.

	Controls	Psychotic disorder	Non-psychotic bipolar disorder	χ^2	<i>df</i>	<i>P-value</i>
Pre-diagnosis Deprivation Index						
Trajectory 1 (<i>least deprived</i>)	22.72%	17.76%	17.99%	365.0	10	<.001
Trajectory 2	23.48%	20.96%	21.80%			
Trajectory 3	18.00%	19.27%	20.35%			
Trajectory 4 (<i>most deprived</i>)	17.64%	22.71%	19.50%			
Trajectory 5 (<i>strong upward mobility</i>)	7.88%	7.68%	8.03%			
Trajectory 6 (<i>moderate upward mobility</i>)	10.28%	11.62%	12.32%			
Pre-diagnosis Population Density						
Trajectory 1 (<i>least densely populated</i>)	9.01%	6.49%	7.39%	468.2	10	<.001
Trajectory 2	15.30%	12.30%	14.53%			
Trajectory 3	20.00%	17.87%	18.61%			
Trajectory 4	28.65%	27.33%	29.59%			
Trajectory 5 (<i>most densely populated</i>)	20.01%	27.54%	20.66%			
Trajectory 6 (<i>urban-rural movement</i>)	7.04%	8.47%	9.22%			
Post-diagnosis Deprivation Index						
Trajectory 1 (<i>least deprived</i>)	14.89%	12.20%	12.65%	420.2	12	<.001
Trajectory 2	18.95%	15.74%	16.53%			
Trajectory 3	20.09%	17.84%	18.85%			
Trajectory 4	21.16%	21.94%	22.45%			
Trajectory 5 (<i>most deprived</i>)	21.59%	28.21%	27.05%			
Trajectory 6 (<i>downward drift</i>)	1.88%	2.66%	1.44%			
Trajectory 7 (<i>upward mobility</i>)	1.44%	1.41%	1.02%			
Post-diagnosis Population Density						
Trajectory 1 (<i>least densely populated</i>)	18.03%	14.55%	17.13%	90.4	8	<.001
Trajectory 2	15.93%	15.83%	15.72%			
Trajectory 3	26.50%	27.99%	26.16%			
Trajectory 4 (<i>most densely populated</i>)	38.07%	40.03%	39.75%			
Trajectory 5 (<i>urban-rural movement</i>)	1.47%	1.59%	1.23%			

Abbreviations: *df*, degrees of freedom

eTable 5. Post-diagnosis logistic regression models for psychotic disorder and non-psychotic bipolar disorder reparametrized with *upward mobility* and *urban-rural movement* as the reference groups

Exposures	Psychotic Disorder			Non-psychotic Bipolar Disorder		
	Univariable Model	Bivariable Model ^a	Multivariable Model ^b	Univariable Model	Bivariable Model ^a	Multivariable Model ^b
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Deprivation Index						
Trajectory 1 (<i>least deprived</i>)	1.17 (0.96-1.44)	1.16 (0.94-1.42)	1.10 (0.88-1.36)	0.77 (0.61-0.99)	0.77 (0.60-0.99)	0.90 (0.69-1.16)
Trajectory 2	1.17 (0.96-1.43)	1.19 (0.97-1.46)	1.12 (0.90-1.38)	0.81 (0.63-1.03)	0.80 (0.63-1.03)	0.93 (0.72-1.21)
Trajectory 3	1.21 (0.99-1.47)	1.24 (1.01-1.51)	1.14 (0.93-1.41)	0.90 (0.70-1.14)	0.89 (0.70-1.14)	1.00 (0.77-1.29)
Trajectory 4	1.44 (1.18-1.76)	1.47 (1.20-1.79)	1.30 (1.06-1.60)	0.99 (0.78-1.27)	0.99 (0.78-1.27)	1.09 (0.84-1.40)
Trajectory 5 (<i>most deprived</i>)	1.82 (1.50-2.22)	1.81 (1.48-2.21)	1.49 (1.21-1.83)	1.17 (0.92-1.49)	1.17 (0.91-1.49)	1.25 (0.97-1.61)
Trajectory 6 (<i>downward drift</i>)	1.52 (1.19-1.93)	1.48 (1.16-1.89)	1.52 (1.18-1.95)	0.99 (0.73-1.35)	0.98 (0.72-1.34)	0.96 (0.69-1.32)
Trajectory 7 (<i>upward mobility</i>)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Population Density						
Trajectory 1 (<i>least densely populated</i>)	0.87 (0.72-1.06)	0.88 (0.72-1.08)	0.87 (0.70-1.07)	0.94 (0.76-1.18)	1.01 (0.81-1.27)	1.15 (0.91-1.45)
Trajectory 2	1.09 (0.89-1.33)	1.10 (0.90-1.35)	1.05 (0.85-1.29)	0.97 (0.78-1.21)	1.05 (0.83-1.31)	1.17 (0.92-1.47)
Trajectory 3	1.17 (0.96-1.42)	1.18 (0.97-1.43)	1.11 (0.90-1.36)	0.96 (0.77-1.20)	1.03 (0.83-1.29)	1.13 (0.90-1.42)
Trajectory 4 (<i>most densely populated</i>)	1.18 (0.97-1.43)	1.11 (0.92-1.35)	1.00 (0.83-1.23)	1.00 (0.81-1.25)	1.02 (0.82-1.27)	1.11 (0.89-1.40)
Trajectory 5 (<i>urban-rural movement</i>)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)

Abbreviation: ORs, odds ratios; ref, reference category; SMI, severe mental illness.

^a = Adjusting for deprivation index and population density trajectory membership. We also controlled for birth year and sex by matching cases and controls.

^b = Adjusting as above, and for parental migrant status, parental history of SMI, parental disposable income at birth, number of moves (birth to 14th year), and number of moves (diagnosis to end of follow-up).

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