

Testing Ødegaard's selective migration hypothesis: a longitudinal cohort study of risk factors for non-affective psychotic disorders among prospective emigrants

E. van der Ven^{1,2*}, C. Dalman^{3,4}, S. Wicks^{3,4}, P. Allebeck⁵, C. Magnusson^{3,4}, J. van Os^{1,6} and J. P. Selten^{1,2}

¹Maastricht University, School for Mental Health and Neuroscience, Maastricht, The Netherlands

²Rivierduinen Psychiatric Institute, Leiden, The Netherlands

³Public Health Epidemiology, Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden

⁴Centre for Epidemiology and Community Medicine, Stockholm County Council, Sweden

⁵Social Medicine, Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden

⁶Department of Psychosis Studies, King's College London, King's Health Partners, Institute of Psychiatry, London, UK

Background. The selection hypothesis posits that the increased rates of psychosis observed among migrants are due to selective migration of people who are predisposed to develop the disorder. To test this hypothesis, we examined whether risk factors for psychosis are more prevalent among future emigrants.

Method. A cohort of 49321 Swedish military conscripts was assessed at age 18 years on cannabis use, IQ, psychiatric diagnosis, social adjustment, history of trauma and urbanicity of place of upbringing. Through data linkage we examined whether these exposures predicted emigration out of Sweden. We also calculated the emigrants' hypothetical relative risk compared with non-emigrants for developing a non-affective psychotic disorder.

Results. Low IQ [odds ratio (OR) 0.5, 95% confidence interval (95% CI) 0.3–0.9] and 'poor social adjustment' (OR 0.4, 95% CI 0.2–0.8) were significantly less prevalent among prospective emigrants, whereas a history of urban upbringing (OR 2.3, 95% CI 1.4–3.7) was significantly more common. Apart from a non-significant increase in cannabis use among emigrants (OR 1.6, 95% CI 0.8–3.1), there were no major group differences in any other risk factors. Compared to non-emigrants, hypothetical relative risks for developing non-affective psychotic disorder were 0.7 (95% CI 0.4–1.2) and 0.8 (95% CI 0.7–1.0), respectively, for emigrants narrowly and broadly defined.

Conclusions. This study adds to an increasing body of evidence opposing the selection hypothesis.

Received 21 March 2014; Revised 23 June 2014; Accepted 2 July 2014; First published online 1 August 2014

Key words: Epidemiology, migration, psychosis, risk factor, selection hypothesis.

Introduction

The consistent observation of an increased incidence of non-affective psychotic disorder (NAPD) among immigrants (Cantor-Graae & Selten, 2005; Bourque *et al.* 2011) has been attributed to the stress of adaptation to a new environment precipitating the disorder in those who are genetically at risk (van Os *et al.* 2010). Ødegaard proposed an alternative explanation (1932) based on his findings of an increased risk for schizophrenia among Norwegian-born immigrants in Minnesota. He suggested that this phenomenon was caused by negative selection, i.e. their disturbed

personalities prevented them from efficiently integrating in their native country and encouraged them to emigrate.

However, Rosenthal *et al.* (1974) showed that adoptees born to a biological parent with a schizophrenia spectrum disorder were less likely to emigrate than adoptees without such a genetic predisposition. Using data from Danish national registries, Pedersen *et al.* (2011) found that a parental history of bipolar disorder (BD) was positively associated with a risk of future emigration from Denmark, whereas a parental history of schizophrenia or a personal history of mental illness was not. They further reported an association between emigration and the degree of urbanization of the place of birth, but this did not apply to Danes aged 17–26 years, the most relevant group for the selection hypothesis.

Another study demonstrated that the increased rates of schizophrenia among Surinamese immigrants in

* Address for correspondence: E. van der Ven, Rivierduinen Mental Health Institute, GGZ Leiden, Sandifortdreef 19, 2333 ZZ Leiden, The Netherlands.

(Email: e.vanderven@rivierduinen.nl)

The Netherlands could not solely be explained by selective migration, considering that their relative risk remained increased compared to native Dutch presuming that the entire Surinamese population had emigrated, while in fact only one third did (Selten *et al.* 2002). Furthermore, a study in Uganda showed that aspirations regarding emigration, not active planning to emigrate, were associated with increased delusional ideation (Lundberg *et al.* 2007).

None of the above studies included information on an array of important factors associated with increased risk for NAPD, such as impaired social adjustment, low intellectual ability or cannabis use. We tested the hypothesis of selective migration by examining whether previously identified risk factors for psychotic disorders are more prevalent among Swedish men who emigrate later in life. Previous studies have found twofold increased risks for schizophrenia in Swedish immigrants in New York State (Malzberg, 1962) and in Scandinavian migrants, including Swedes, in Denmark (Cantor-Graae *et al.* 2003).

Since emigrants are lost to follow-up, we also estimated their hypothetical relative risk for developing NAPD after emigration.

Method

Subjects

The study population consisted of 49321 Swedish males conscripted nationwide during 1 year, 1969–1970, for compulsory military training. Over 98% of the cohort was aged between 18 and 20 years. Two to three percent of the men were excused conscription owing to a severe physical or mental handicap. During this conscription year the conscripts completed questionnaires on sociodemographic background, upbringing, school and work adjustment, psychiatric history, and on the use of alcohol, tobacco and drugs. Trained psychologists conducted structured interviews with all conscripts, and referred those suspected of a psychiatric disorder to a psychiatrist for diagnostic evaluation. Psychiatric diagnoses were coded according to the Nordic version of the International Classification of Diseases – 8 (ICD-8; WHO, 1967). Thirty-two (0.1%) subjects with a diagnosis of a psychotic disorder at conscription and 677 (1.4%) foreign-born subjects were excluded from this study. Permission to perform the study was granted by the Stockholm Regional Ethical Review Board and the Swedish Data Inspection Board.

Exposures

First, we selected six exposures that have been reported to increase the risk for NAPD among members of this

cohort: low IQ (David *et al.* 1997); ‘poor social adjustment’ (Malmberg *et al.* 1998); ‘disturbed behaviour’ (Zammit *et al.* 2010); cannabis use (Andreasson *et al.* 1987; Zammit *et al.* 2002); non-psychotic psychiatric diagnosis at conscription (Lewis *et al.* 2000); and urban upbringing (Lewis *et al.* 1992). Second, since exposure to a trauma may be a cause of both emigration and psychotic symptomatology (Bhui *et al.* 2003), we added parental death and history of physical abuse to the list of exposures. We included parental history of a NAPD as well as BD as proxies of genetic liability, because of the partially shared genetic aetiology of these disorders (Lichtenstein *et al.* 2009) and for comparability with results presented by Pedersen *et al.* (2011).

IQ was measured using verbal, visuo-spatial, general knowledge and mechanical reasoning tests. Total sum scores were set off against the scores of a conscript cohort of the previous year and standardized into a normal distribution with nine bands (<74, 75–81, 82–89, 90–95, 96–104, 105–110, 111–118, 119–126, >126). Social adjustment was measured using four Likert-type questions inquiring about friendships, presence of a steady girlfriend and sensitivity to others. There were four or five possible answers to each question. For example, answers to the question ‘Do you think you are more sensitive than other people?’ included ‘yes, much more’, ‘yes, somewhat more’, ‘about average’, ‘no, somewhat less’ or ‘no, much less’. The first two answers were considered as presence of a symptom, i.e. ‘more sensitive than other people’ (Malmberg *et al.* 1998). A composite score of social adjustment was calculated as the sum of the quantified variables (range 0–11). ‘Disturbed behaviour’ was measured using items on running away from home, misconduct at school, truancy and contact with police or social services. The selection of these items was based on a previously conducted factor analysis (Zammit *et al.* 2010). A composite score of ‘disturbed behaviour’ was similarly derived from the sum of the variables (range 0–9).

Information on cannabis use was based on replies to questions about the most commonly used drug and the frequency of use, recorded as: once, 2–4 times, 5–10 times, 11–50 times or >50 times. The psychiatric diagnoses recorded at conscription, which included personality and psychosomatic disorder, neurosis, alcohol and substance misuse, were subsumed under the heading of non-psychotic psychiatric disorder at conscription. Replies to the question ‘Where did you live mostly while you were growing up?’ were used to define the level of urbanicity of the place of upbringing. Possible responses included ‘Greater Stockholm, Göteborg, Malmö’, ‘another town with more than 50000 inhabitants’, ‘another town with less than

50000 inhabitants', 'in the country' and 'abroad' (Lewis *et al.* 1992). Childhood trauma was considered present in case of death of a parent before conscription or if the conscript reported physical abuse to have occurred sometimes or often. Links to the parents were obtained via the Multigenerational Register (Statistics Sweden, 2010) and information on the presence of a parental history of NAPD or BD was retrieved from the Swedish National Patient Register (Ludvigsson *et al.* 2011).

This register stores information on virtually all psychiatric admissions between 1973 and 2007. Diagnoses were coded according to the Swedish version of the ICD: ICD-8 between 1973 and 1986, ICD-9 between 1987 and 1996, and ICD-10 between 1997 and 2007. NAPD was defined as schizophrenia or other non-affective psychoses (ICD-8: 295, 297, 298.20-298.99; ICD-9: 295, 297, 298C-298X; ICD-10: F20-F29). Parental family history was classified as presence of schizophrenia or other non-affective psychoses (NAPD as described above) or bipolar disorders (ICD-8: 296.10-296.30; ICD-9: 296A, 296C-296E; ICD-10: F30-F31). Diagnoses of schizophrenia (Kristjansson *et al.* 1987; Dalman *et al.* 2002; Ekholm *et al.* 2005) and BD (Sellgren *et al.* 2011) in the national patient register have shown to be of satisfactory validity for epidemiological studies.

Outcome

The main outcome was emigration. Statistics Sweden stores data on emigration and immigration from 1968. We had access to dates of emigration and immigration for each individual until the end of 2003 (Statistics Sweden, 2006). Emigration was *a priori* defined in two ways. The narrow definition included subjects who left the country after conscription and lived abroad for a period of at least 2 years before the age of 25 years. Since some men develop NAPD at a later age, we also included a broad definition referring to all individuals who lived abroad for at least 2 years during the period between conscription and the age of 40 years. Information about loss to follow-up due to death was obtained via the Cause of Death Register.

Statistical methods

We first calculated odds ratios (ORs) and their 95% confidence intervals (CIs) to measure the association between each exposure and future emigration. For ordinal exposures with more than two levels (IQ, urbanicity of place of upbringing, cannabis use) we examined dose-response relationships by calculating χ^2 statistics for linear-by-linear associations and corresponding p values for trend. We conducted multivariate logistic

regression to test whether variables were independently related to later emigration at 5% significance level. Given the large number of exposures and the skewed distribution of ordinal data, we dichotomized exposures for the purpose of multivariate logistic regression analyses, adopting the same cut-off scores as used in previous studies (Zammit *et al.* 2010). Low IQ was defined as the lowest 33% of scores *v.* the rest, cannabis use as ever *v.* never used cannabis, urban upbringing as growing up in any of the three largest cities *v.* the rest of the country, 'poor social adjustment' as the lowest 30% of scores and 'disturbed behaviour' as the highest 20% of scores on the composite variable (Zammit *et al.* 2010).

Hypothetical risk model

In order to estimate the hypothetical relative risk for NAPD among emigrants, it is necessary to calculate the strength of the association between each exposure and the secondary outcome, i.e. risk of NAPD in non-emigrants. Presence of NAPD among conscripts was retrieved from the Swedish National Patient Register as described earlier. Using a multivariable logistic regression model we calculated the predictive value (β) of each variable with the maximum likelihood method for developing NAPD. The final set of risk factors was selected based on backward elimination ($p < 0.05$ to retain) and verified using forward selection ($p < 0.05$ to enter). Next, we composed a regression formula for emigrants and non-emigrants. According to this formula the β -weights are multiplied with the mean group prevalence of each exposure and the products added. To calculate a hypothetical relative risk for developing the disease among emigrants, the mean outcome (Y) was transformed from the logit scale by using the formula: $p = e^Y / (1 + e^Y)$ and divided by the risk estimate (p) for non-emigrants, i.e. the reference group. CIs were calculated based on the sample sizes in each group. All analyses were performed in IBM SPSS version 20 (SPSS Inc., USA).

Results

Cohort description

Sixty-nine (0.1%) of 48612 individuals emigrated before the age of 25 years and stayed abroad for at least 2 years (narrow definition of emigration). Four hundred and seventy-two (1.0%) individuals emigrated before their 40th birthday and did not return within the next 2 years (broad definition). In total, 1998 (4.1%) individuals were lost to follow-up due to death.

Table 1. Prevalence of risk factors for non-affective psychotic disorder (NAPD) according to emigrant status, narrow and broad definition, corresponding crude odds ratios (ORs) and their 95% confidence intervals (CIs)

Exposure	Non-emigrant, N	Emigrant (narrow definition), N	OR (narrow definition) (95% CI)	Emigrant (broad definition), N	OR (broad definition) (95% CI)
Lower IQ					
Absent	32275	56	1 (ref.)	397	1 (ref.)
Present	16208	13	0.5 (0.3–0.9)	74	0.4 (0.3–0.5)
>126	3154	32 ^a	1 (ref.)	78	1 (ref.)
119–126	4977			99	0.8 (0.6–0.7)
111–118	7216			98	0.5 (0.4–0.7)
105–110	8578	24 ^a	0.7 (0.4–1.2)	61	0.3 (0.2–0.4)
96–104	8351			61	0.3 (0.2–0.4)
90–95	6914			38	0.2 (0.1–0.3)
82–89	4754	13 ^a	0.4 (0.2–0.7)	19	0.2 (0.1–0.3)
75–81	2591			14	0.3 (0.2–0.5)
<74	1935			3	0.1 (0.0–0.4)
Poor social adjustment					
Absent	34261	58	1 (ref.)	334	1 (ref.)
Present ^b	12846	8	0.4 (0.2–0.8)	121	1.0 (0.8–1.2)
Fewer than three close friends ^b	3645	3	0.6 (0.2–1.8)	36	1.0 (0.7–1.5)
More sensitive than others ^b	6252	12	1.4 (0.8–2.6)	73	1.2 (1.0–1.6)
No steady girlfriend ^b	27426	34	0.8 (0.5–1.2)	263	1.0 (0.7–1.5)
Prefers small groups ^b	21841	32	1.1 (0.7–1.8)	216	1.1 (0.9–1.3)
Disturbed behaviour					
Absent	37612	54	1 (ref.)	358	1 (ref.)
Present	8254	11	0.9 (0.5–1.8)	87	1.1 (0.9–1.4)
Ever ran away from home	1633	5	2.3 (0.9–5.7)	20	1.3 (0.8–2.0)
Contact with police or social service	13706	12	0.5 (0.3–1.0)	114	0.8 (0.7–1.0)
Misconduct at school	11589	16	0.9 (0.5–1.7)	131	1.2 (1.0–1.5)
Truanted more than once/term	20417	31	1.1 (0.7–1.7)	204	1.0 (0.9–1.3)
Non-psychotic psychiatric disorder at conscription					
Absent	42445	60	1 (ref.)	419	1 (ref.)
Present (any disorder)	5230	7	0.9 (0.4–2.1)	42	0.8 (0.6–1.1)
Neurosis	2594			22	0.9 (0.6–1.3)
Personality disorder	1324			6	0.5 (0.2–1.1)
Alcohol misuse	134			1	0.7 (0.1–5.4)
Substance misuse	277			5	1.8 (0.8–4.5)

Psychosomatic disorder	400			5	1.3 (0.5–3.1)
Other psychiatric disorder	501			3	0.6 (0.2–1.9)
Cannabis use					
Absent	40065	53	1 (ref.)	374	1 (ref.)
Present (any use)	5210	11	1.6 (0.8–3.1)	71	1.5 (1.1–1.9)
Once	588			7	1.3 (0.6–2.9)
2–4 times	1359			15	1.2 (0.7–2.1)
5–10 times	793			13	1.9 (1.1–3.3)
11–50 times	672			8	1.4 (0.7–2.7)
>50 times	722			11	1.7 (0.9–3.2)
Urban upbringing					
Absent	37480	41	1 (ref.)	301	1 (ref.)
Present	10102	25	2.3 (1.4–3.7)	151	1.9 (1.5–2.3)
Countryside	18535	14	1 (ref.)	111	1 (ref.)
<50 000 inhabitants	14120	20	1.9 (0.9–3.7)	138	1.6 (1.3–2.1)
>50 000 inhabitants	4825	7	1.9 (0.8–4.8)	52	1.8 (1.3–2.5)
Cities	10102	25	3.3 (1.7–6.3)	151	2.5 (2.0–3.2)
Abroad	109	1	12.1 (1.6–93.2)	6	9.6 (4.1–22.3)
Indicators of childhood trauma					
Absent	33871	53	1 (ref.)	373	1 (ref.)
Present	8920	14	1.0 (0.6–1.8)	87	1.0 (0.8–1.3)
Loss of a parent	3682	5	1.0 (0.4–2.4)	33	0.9 (0.6–1.3)
Physical abuse	5715	10	1.3 (0.7–2.5)	57	1.0 (0.8–1.4)
Parental history of NAPD or BD					
Absent	44228	57	1 (ref.)	433	1 (ref.)
Present	1931	4	1.6 (0.6–4.4)	18	1.0 (0.6–1.9)
Parental history of NAPD	1324	3	1.8 (0.5–5.6)	14	1.1 (0.6–1.9)
Parental history of BD	733	2	2.1 (0.5–8.6)	6	0.8 (0.4–1.9)

Ref., Reference; NAPD, non-affective psychotic disorder; BD, bipolar disorder.

^a Due to small sample size in the group of narrowly-defined emigrants, IQ was collapsed into three bands: <90, 90–110, >110.

^b Discrepant results between the composite score of social adjustment and individual items are due to differences in the definitions (see Method section).

Table 2. Associations between exposures at conscription and prospective risk of treatment for non-affective psychotic disorder, emigration out of Sweden before age 25 years (narrow definition) and before age 40 years (broad definition)

Exposure	Outcomes					
	NAPD		Emigration (narrow definition)		Emigration (broad definition)	
	β	Adjusted OR (95% CI) ^a	β	Adjusted OR (95% CI) ^a	β	Adjusted OR (95% CI) ^a
Lower IQ	0.73	2.1 (1.7–2.5)	–1.09	0.3 (0.1–0.8)	–0.93	0.4 (0.3–0.5)
Poor social adjustment	0.82	2.3 (1.9–2.7)	–0.93	0.4 (0.2–0.9)	–0.03	1.0 (0.8–1.2)
Non-psychotic psychiatric disorder at conscription	0.86	2.4 (1.9–2.9)	–0.75	0.5 (0.1–2.0)	–0.34	0.7 (0.5–1.1)
Disturbed behaviour	0.24	1.3 (1.0–1.6)	–0.21	0.8 (0.3–1.9)	0.07	1.1 (0.8–1.4)
Cannabis use	0.41	1.5 (1.2–1.9)	0.39	1.5 (0.7–3.3)	0.26	1.3 (1.0–1.8)
Urban upbringing	0.21	1.2 (1.0–1.5)	0.64	1.9 (1.0–3.5)	0.52	1.7 (1.3–2.1)
Childhood trauma	0.20	1.2 (1.0–1.5)	0.03	1.0 (0.5–2.2)	–0.04	1.0 (0.7–1.3)
Parental history of NAPD or BD	0.89	2.4 (1.8–3.3)	0.52	1.7 (0.5–5.4)	0.07	1.1 (0.6–1.8)

NAPD, Non-affective psychotic disorder; BD, bipolar disorder; OR, odds ratio; CI, confidence interval; β , standardized regression coefficient.

^a Adjusted for all other exposures in the regression model.

Risk factors for emigration

The frequencies of each exposure and the corresponding ORs for emigration are presented in Table 1. IQ was negatively associated with emigration, whether narrowly or broadly defined. When categorized in three IQ bands for the narrow definition and in nine IQ bands for the broad definition, significant linear trends emerged between IQ and emigration ($\chi^2=11.043$, $p<0.01$ and $\chi^2=155.4$, $p<0.001$, respectively). In addition, 'poor social adjustment' was less prevalent in the group of narrowly defined emigrants (OR 0.4, 95% CI 0.2–0.8), but not in the broadly defined group. There were no significant group differences on any of the individual social adjustment variables or in frequencies of reported 'disturbed behaviour'. The prevalence of non-psychotic psychiatric disorder at the time of conscription was also similar in both groups. By contrast, emigrants were more likely to have been brought up in a city (OR 2.3, 95% CI 1.4–3.7) with an increasing odds contingent on an increasing level of urbanicity of the main residence during upbringing ($\chi^2=13.9$, $p<0.001$). This association held when using the broad definition of emigration. Cannabis use was significantly increased among individuals emigrating before age 40 years, but not among those emigrating before age 25 years, with a significant p value for linear trend ($\chi^2=7.7$, $p<0.01$). There were no significant group differences in the occurrence of parental death or physical abuse. Conscripts that emigrated were not significantly more likely to have been born to a parent with a NAPD or

BD. Multivariate analysis (see Table 2) revealed that lower IQ was the strongest negative predictor for future emigration, broadly ($p<0.001$) or narrowly ($p<0.05$) defined.

Hypothetical risk for developing NAPD

Standardized β -weights for each exposure and the concurrent OR for NAPD are depicted in Table 2. The final equation was $[-5.317+(0.728\times\text{lower IQ})+(0.820\times\text{poor social adjustment})+(0.872\times\text{non-psychotic psychiatric disorder at conscription})+(0.235\times\text{disturbed behaviour})+(0.411\times\text{cannabis use})+(0.213\times\text{urban upbringing})+(0.895\times\text{parental history of NAPD or BD})+(0.212\times\text{childhood trauma})]$. Compared to non-emigrants, this regression formula yielded relative risks for developing NAPD of 0.7 (95% CI 0.4–1.2) and 0.8 (95% CI 0.7–1.0), respectively, for emigrants narrowly and broadly defined.

Discussion

We tested the hypothesis that risk factors for NAPD are more prevalent among young Swedish males who emigrated. The results showed that a history of urban upbringing and cannabis use were more common. Although this may lend some support for the selection hypothesis, these findings were counterbalanced by the decreased prevalence of low IQ and 'poor social adjustment'. There were no major differences in the prevalence of other studied risk factors. The hypothetical risks for developing NAPD did

not differ significantly between emigrants and non-emigrants.

There are some limitations that need to be addressed. First, our estimation of a hypothetical risk was restrained by the assumption that exposures remain stable over time, which in case of cannabis use and social adjustment may well be untrue. Nonetheless, IQ is considered to be relatively stable over time and emerged as the strongest predictor of emigrant status. Second, the selection mechanisms for emigration out of Sweden may differ from those related to migration from countries afflicted by poverty, unemployment, or political turmoil. Moreover, emigration rates and selection mechanisms may change over time. However, attachment to people in one's country of birth is a universal phenomenon and the present study does not support the hypothesis that emigration is prompted by an inability to establish social relationships. Third, it is impossible to examine all psychosis risk factors for their potential to stimulate migration and we cannot rule out that other mechanisms operate before migration. Last, this study relied on self-report questionnaires for most exposures, which may have introduced errors that could result in bias, if differential.

In accordance with the study by Pedersen *et al.* (2011), we found that a personal history of mental illness does not predict emigration. Conversely, their finding of a parental history of BD as risk factor for emigration, is not supported by this study. Also contrary to their results, we observed that Swedes who had been brought up in the city were more likely to emigrate before their mid-twenties (Pedersen *et al.* 2011). This is not surprising given that individuals in urban areas are more likely to be internationally oriented and may encounter more possibilities to move abroad, especially those with a higher IQ and level of education.

On the whole, in keeping with previous studies (Rosenthal *et al.* 1974; Selten *et al.* 2002; Lundberg *et al.* 2007) our findings do not support the selection hypothesis. Rosenthal *et al.* (1974) noted that the process of emigration involves a high level of mental perseverance and planning skills. The cognitive profile required for successful emigration seems inconsistent with premorbid cognitive deficits found in some individuals developing psychosis later in life (Cannon *et al.* 2000). In fact, our findings of a higher IQ among emigrants and a higher level of social adjustment among those emigrating before age 25 years support the notion that the process of emigrating requires favourable environmental circumstances and certain individual qualities. In particular, our results are inconsistent with Ødegaard's characterization of most emigrants as socially maladjusted 'loners'.

Acknowledgements

This work was supported by the European Community's Seventh Framework Program under grant agreement no. HEALTH-F2-2009-241909 (Project EU-GEI). The authors thank Sofia Löving for preparing and matching the databases. Dr Stanley Zammit has been an invaluable help in advising on definitions and categorizations of variables in the conscript database. We also thank Dr Nan van Geloven for providing statistical guidance. Dr Clifford Cassidy gave very useful comments to a preliminary version of this manuscript.

Declaration of Interest

None.

References

- Andreasson S, Allebeck P, Engstrom A, Rydberg U (1987). Cannabis and schizophrenia. A longitudinal study of Swedish conscripts. *Lancet* **2**, 1483–1486.
- Bhui K, Abdi A, Abdi M, Pereira S, Dualeh M, Robertson D, Sathyamoorthy G, Ismail H (2003). Traumatic events, migration characteristics and psychiatric symptoms among Somali refugees – preliminary communication. *Social Psychiatry and Psychiatric Epidemiology* **38**, 35–43.
- Bourque F, van der Ven E, Malla A (2011). A meta-analysis of the risk for psychotic disorders among first- and second-generation immigrants. *Psychological Medicine* **41**, 897–910.
- Cannon TD, Bearden CE, Hollister JM, Rosso IM, Sanchez LE, Hadley T (2000). Childhood cognitive functioning in schizophrenia patients and their unaffected siblings: a prospective cohort study. *Schizophrenia Bulletin* **26**, 379–393.
- Cantor-Graae E, Pedersen CB, McNeil TF, Mortensen PB (2003). Migration as a risk factor for schizophrenia: a Danish population-based cohort study. *British Journal of Psychiatry* **182**, 117–122.
- Cantor-Graae E, Selten JP (2005). Schizophrenia and migration: a meta-analysis and review. *American Journal of Psychiatry* **162**, 12–24.
- Dalman C, Broms J, Cullberg J, Allebeck P (2002). Young cases of schizophrenia identified in a national inpatient register – are the diagnoses valid? *Social Psychiatry and Psychiatric Epidemiology* **37**, 527–531.
- David AS, Malmberg A, Brandt L, Allebeck P, Lewis G (1997). IQ and risk for schizophrenia: a population-based cohort study. *Psychological Medicine* **27**, 1311–1323.
- Eckholm B, Eckholm A, Adolfsson R, Vares M, Osby U, Sedvall GC, Jonsson EG (2005). Evaluation of diagnostic procedures in Swedish patients with schizophrenia and related psychoses. *Nordic Journal of Psychiatry* **59**, 457–464.
- Kristjansson E, Allebeck P, Wistedt B (1987). Validity of the diagnosis schizophrenia in a psychiatric inpatient register: a retrospective application of DSM-III criteria on ICD-8

- diagnoses in Stockholm county. *Nordic Journal of Psychiatry* **41**, 229–234.
- Lewis G, David A, Andreasson S, Allebeck P** (1992). Schizophrenia and city life. *Lancet* **340**, 137–140.
- Lewis G, David AS, Malmberg A, Allebeck P** (2000). Non-psychotic psychiatric disorder and subsequent risk of schizophrenia. Cohort study. *British Journal of Psychiatry* **177**, 416–420.
- Lichtenstein P, Yip BH, Bjork C, Pawitan Y, Cannon TD, Sullivan PF, Hultman CM** (2009). Common genetic determinants of schizophrenia and bipolar disorder in Swedish families: a population-based study. *Lancet* **373**, 234–239.
- Ludvigsson JF, Andersson E, Ekblom A, Feychting M, Kim JL, Reuterwall C, Heurgren M, Olausson PO** (2011). External review and validation of the Swedish national inpatient register. *BMC Public Health* **11**, 450.
- Lundberg P, Cantor-Graae E, Kahima M, Ostergren PO** (2007). Delusional ideation and manic symptoms in potential future emigrants in Uganda. *Psychological Medicine* **37**, 505–512.
- Malmberg A, Lewis G, David A, Allebeck P** (1998). Premorbid adjustment and personality in people with schizophrenia. *British Journal of Psychiatry* **172**, 308–313.
- Malzberg B** (1962). Mental disease among Swedish-born and native-born of Swedish parentage in New York State, 1949–1951. *Acta Psychiatrica Scandinavica* **38**, 79–107.
- Ødegaard Ø** (1932). Emigration and insanity. *Acta Psychiatrica Neurologica Scandinavica* (Suppl.) **4**, 1–206.
- Pedersen CB, Mortensen PB, Cantor-Graae E** (2011). Do risk factors for schizophrenia predispose to emigration? *Schizophrenia Research* **127**, 229–234.
- Rosenthal D, Goldberg I, Jacobsen B, Wender PH, Kety SS, Schulzinger F, Eldred CA** (1974). Migration, heredity, and schizophrenia. *Psychiatry* **37**, 321–339.
- Sellgren C, Landen M, Lichtenstein P, Hultman CM, Langstrom N** (2011). Validity of bipolar disorder hospital discharge diagnoses: file review and multiple register linkage in Sweden. *Acta Psychiatrica Scandinavica* **124**, 447–453.
- Selten JP, Cantor-Graae E, Slaets J, Kahn RS** (2002). Odegaard's selection hypothesis revisited: schizophrenia in Surinamese immigrants to The Netherlands. *American Journal of Psychiatry* **159**, 669–671.
- Statistics Sweden** (2006). *Historic Population Register*. Population and Welfare Statistics: Örebro.
- Statistics Sweden** (2010). *Multi-generation Register 2009: a Description of Contents and Quality*. Population and Welfare Statistics: Örebro.
- van Os J, Kenis G, Rutten BPF** (2010). The environment and schizophrenia. *Nature* **468**, 203–212.
- WHO** (1967). *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death, 1965 Revision*. World Health Organization: Geneva.
- Zammit S, Allebeck P, Andreasson S, Lundberg I, Lewis G** (2002). Self reported cannabis use as a risk factor for schizophrenia in Swedish conscripts of 1969: historical cohort study. *British Medical Journal* **325**, 1199.
- Zammit S, Lewis G, Dalman C, Allebeck P** (2010). Examining interactions between risk factors for psychosis. *British Journal of Psychiatry* **197**, 207–211.