Age at Migration and Future Risk of Psychotic Disorders Among Immigrants in the Netherlands: A 7-Year Incidence Study

Wim Veling, M.D., Ph.D.

Hans W. Hoek, M.D., Ph.D.

Jean-Paul Selten, M.D., Ph.D.

Ezra Susser, M.D., Dr.P.H.

Objective: The purpose of this study was to examine whether the increased risk for developing a psychotic disorder among immigrants is related to their age at the time of migration.

Method: In a 7-year first-contact incidence study, immigrants to the Netherlands and Dutch citizens, ages 15–54 years, who made a first contact with a physician for a suspected psychotic disorder were identified. Diagnostic interviews were administered, and DSM-IV diagnoses were determined by consensus between two psychiatrists. A comprehensive municipal registration system provided the denominator, including information on ethnicity and age at the time of migration.

Results: Lower age at the time of migration was associated with a higher incidence of psychotic disorders among immigrants. People who migrated between the ages of 0 and 4 years had the most elevated risk for psychotic disorders compared with the risk among Dutch citizens (age- and sex-adjusted incidence rate ratio=2.96, 95% confidence interval [CI]=2.10–4.17), and the risk gradually decreased with older age at migration (adjusted incidence rate ratio for migration at 5–9 years, 10–14 years, and >29 years, respectively: 2.31 [CI=1.61–3.29], 1.51 [CI=1.02–2.25], and 1.00 [CI=0.58–1.72]).

Conclusions: The adverse influence of migration on the risk for psychotic disorders is most prominent in early life, suggesting that this is an important period in the etiology of the illness.

Over recent decades, strong and remarkable associations between the incidence of psychotic disorders and international migration have been reported in well-designed epidemiological studies (1, 2). These findings pertain to particular immigrant groups in several countries (3). The most replicated and robust findings are with regard to immigrant populations in the United Kingdom and the Netherlands. Among the African Caribbean and black African populations in the United Kingdom, a more than fourfold increased risk has been found (4). In the Netherlands, relative risks between 2 and 4 have been reported for Moroccan, Surinamese, and Antillean migrants (5). The present study focuses on the effect of age at the time of migration on the risk for psychotic disorders. The term immigrant is used to describe those individuals who migrated to the Netherlands; the children of these immigrants are referred to as second-generation citizens. It is important to note that these terms also refer to individuals who are members of ethnic minority groups, since ethnic minority status may be relevant to their risk for psychotic disorders (6, 7).

To our knowledge, there has not been a study conducted in the United Kingdom or the Netherlands examining whether age at the time of migration is associated with risk for psychotic disorders. It is crucial to determine the relevant timing of exposure in order to find the causes of the excess risk among immigrants and to increase our understanding of the etiology of psychosis. In this first-contact incidence study, we investigated the relationship between age at migration and the incidence of psychotic disorders among immigrant groups in The Hague.

Method

Identification of Case Patients

Through a first-contact incidence study conducted over a 7-year period (1997–1999 and 2000–2005), we sought to identify and diagnose every citizen of The Hague, ages 15–54 years, who made a first contact with a physician for a possible psychotic disorder. The study methods are discussed in detail elsewhere (5, 8). Briefly, the criteria for possible psychosis were similar to those used in the World Health Organization ten-country study (9). There was extensive collaboration with local general practitioners, psychiatrists, and psychiatry residents in an effort to identify every possible case. In the first 2 years, the diagnostic protocol was used primarily for research purposes (8). The study was approved by the local ethics committee, and all patients who were interviewed provided written informed consent. In the other years, the protocol was used to identify patients for inclusion in an early-psychosis treatment service. Patients were interviewed by Dutch psychiatry residents using the Comprehensive Assessment of Symptoms and History, a semistructured diagnostic interview (10). Relatives of patients were interviewed by trained

nurses using the Interview for the Retrospective Assessment of the Onset of Schizophrenia and Other Psychoses (11). A certified interpreter was available to assist in the administration of the diagnostic instruments when necessary. In addition, the psychiatry residents requested detailed clinical information from the patients' physicians. Based on the diagnostic interviews and clinical information, the residents compiled a narrative history of each patient's illness, including the date of onset. If the first psychotic symptoms in an immigrant patient occurred prior to migration, he or she was excluded from the study. For patients who refused to complete a full diagnostic interview, a history was determined using anonymized clinical information. For all patients, two psychiatrists made a consensus DSM-IV diagnosis on the basis of the narrative history. Patients were included in the study if they were diagnosed with schizophrenia, schizophreniform disorder, schizoaffective disorder, brief psychotic disorder, delusional disorder, psychotic disorder not otherwise specified, bipolar disorder with psychotic features, or depressive disorder with psychotic features.

Classification of Ethnicity

The municipality of The Hague classifies ethnicity according to a citizen's country of birth and the country of his or her parents' birth. Dutch ethnicity is assigned to citizens who are Dutch-born and whose parents were also born in the Netherlands (hereafter referred to as Dutch citizens).

If a citizen was born abroad, he or she is assigned to the ethnicity of the people born in the same country. A Dutch-born citizen is considered a second-generation citizen if at least one of his or her parents was born abroad. If the parents were born in different foreign countries, the offspring's assignment to a particular group is determined by the mother's country of birth.

Population Data and Neighborhood Characteristics

On January 1, 2005, the city of The Hague had 472,087 inhabitants, of whom 45.2% were immigrants or second-generation citizens. Four ethnic groups were sufficiently large to be assessed separately for this study: immigrants from Surinam, the Netherlands Antilles, Turkey, and Morocco. Other immigrants were classified as either other non-Western or Western (from western, southern, or northern Europe; the former Yugoslavia; the United States; Canada; Australia; or New Zealand). Population data for the 7-year study period, including ethnicity, age, sex, and exact date of migration to the Netherlands, were derived from a comprehensive municipal population register. The municipal authorities also provided scores ranking the socioeconomic level of all 42 neighborhoods; based on which, we classified the neighborhoods as having a high, medium, or low socioeconomic level. The two neighborhoods with the highest proportion of ethnic minorities (average=82.6%) were classified as having a high ethnic density, whereas the other neighborhoods were classified as having a low ethnic density (see reference 12).

Statistical Analyses

For all analyses, the STATA statistical software program, version 9.0 (StataCorp, College Station, Tex.), was used. Incidence rate ratios and 95% confidence intervals (95% CIs) were calculated using Poisson regression analysis.

First, only immigrants were included in the analyses. In order to investigate whether age at the time of migration was related to the incidence of psychotic disorders among immigrants, the continuous measure of age at migration was entered in a Poisson regression model as a predictor of the incidence of psychotic disorders. Incidence rate ratios pertaining to age at migration, with age 0 as a reference, were calculated separately for male and female immigrants and for the specific countries and regions of origin. Analyses were adjusted for age at first contact with a phy-

sician for a suspected psychotic disorder (and also adjusted for sex in the second analysis) and tested for statistical significance using chi-square tests. Several additional analyses of immigrants were conducted to address potential bias. Because the peak onset of psychotic disorders is in adolescence and early adulthood, immigrants who migrate in childhood have a longer risk period after migrating than those who migrate as adults. This may lead to an apparent relationship between age at migration and the risk for psychotic disorders. We therefore stratified the immigrant patient sample according to several 5-year current age ranges, based on age at first contact with a physician for a possible psychotic disorder, and tested age at migration as a predictor of the incidence of psychotic disorders among individuals who made a first contact in the same age range. To investigate the potential confounding effects of neighborhood characteristics, the mean age at migration was compared between immigrant case patients across different categories of neighborhood ethnic density and neighborhood socioeconomic levels. Information on age at migration was missing for 35 (12.8%) immigrant case patients. In a sensitivity analysis, the mean age at migration for the total immigrant population at risk was imputed for these 35 cases. The association between the continuous variable of age at migration and incidence of psychotic disorders among immigrants was then recalculated.

Second, comparisons were made between immigrants and Dutch citizens. Age at the time of migration was divided into the following categories: 0–4 years, 5–9 years, 10–14 years, 15–19 years, 20–24 years, 25–29 years, and >29 years. Age- and sex-adjusted incidence rate ratios of psychotic disorders were computed for immigrants in each migration category, with incidence of psychotic disorders among Dutch citizens as the reference. To rigorously test the likelihood of selective migration as a result of early manifestations of a predisposition to psychotic disorders, the incidence rate ratio was calculated for those who migrated before the age of 1 year in comparison to the incidence rate among Dutch citizens. To explore whether the event of migration itself contributed to the increased risk for psychotic disorders among immigrants or whether long-term experience of ethnic minority status was the relevant exposure, we compared the incidence of psychotic disorders among second-generation citizens, immigrants who migrated before the age of 5 years, and Dutch citizens.

Results

During the study period, 273 immigrants, 119 second-generation citizens, and 226 Dutch citizens made a first contact with a physician for a suspected psychotic disorder. The sociodemographic characteristics of these case patients as well as the corresponding total population at risk are presented in Table 1.

Analyses Restricted to Immigrant Groups

Among immigrants, older age at the time of migration was associated with a lower incidence rate of psychotic disorders. The age- and sex-adjusted incidence rate ratio was 0.96 (95% CI=0.94–0.97) for the continuous measure of age at migration among immigrants (χ^2=27.03, df=1, p<0.0005). This can be interpreted to mean that the incidence rate decreased by a ratio of 0.96 with every year the age at migration increased. Or, put more simply, this means that younger age at migration predicted higher incidence of psychotic disorders. Stratified analyses showed that younger age at migration was a statistically significant predictor of higher incidence of psychotic disorders

TABLE 1. Sociodemographic Characteristics of Immigrants, Second-Generation Offspring, and Dutch Citizens (Ages 15–54 Years) in The Hague[a]

Characteristic	Case Patients (N=618)[b]		Total At-Risk Population (N=1,870,016)[c]	
	N	%	N	%
Male	436	70.6	951,870	50.9
Age at the time of migration (years)[d]				
0–4	44	18.5	53,399	7.3
5–9	36	15.1	63,663	8.6
10–14	29	12.2	70,844	9.6
15–19	52	21.8	105,968	14.3
20–24	34	14.3	134,551	18.3
25–29	23	9.7	122,726	16.7
>29	20	8.4	185,084	25.1
Ethnicity				
Dutch	226	36.6	988,869	52.9
Surinamese				
Immigrant	57	9.2	158,142	8.5
Second-generation citizen	37	6.0	34,714	1.9
Netherlands Antillean				
Immigrant	17	2.8	38,224	2.0
Second-generation citizen	4	0.6	5,500	0.3
Turkish				
Immigrant	37	6.0	100,712	5.4
Second-generation citizen	18	2.9	15,750	0.8
Moroccan				
Immigrant	68	11.0	73,122	3.9
Second-generation citizen	23	3.7	11,054	0.6
Other non-Western				
Immigrant	72	11.7	162,402	8.7
Second-generation citizen	25	4.0	68,429	3.7
Western				
Immigrant	22	3.6	104,740	5.6
Second-generation citizen	12	1.9	108,358	5.8

[a] Differences in the distribution of sex, age, age at the time of migration, and ethnicity among case patients relative to the total at-risk population were statistically significant (all p values <0.05).
[b] Data pertain to individuals who made a first contact with a physician for a suspected psychotic disorder during the study period (1997–1999 and 2000–2005). The mean age for case patients was 27.5 years (SD=8.2).
[c] Data indicate cumulative person years. The mean age for the total at-risk population was 34.5 years (SD=10.8).
[d] Data were missing for 35 immigrant case patients.

among both male (age-adjusted incidence rate ratio: χ^2=21.57, p<0.0005) and female (age-adjusted incidence rate ratio: χ^2=5.68, p<0.02) immigrants. As presented in Table 2, this association pertained to each of the four immigrant groups. There was a nearly significant association for immigrants from other non-Western countries, and no association was found for immigrants from Western countries.

In the analysis stratified by age at first contact with a physician, younger age at the time of migration was associated with higher incidence of psychotic disorders among immigrants who made a first contact when they were <39 years old (Table 3). This association was statistically significant for immigrants who made a first contact when they were <29 years old. In the three oldest age groups, from 40–54 years, the number of case patients was very small for each age range, and there was no evident association.

For immigrant case patients who lived in neighborhoods with high or low ethnic density, respectively, the mean age

at the time of migration was 15.0 years (SD=10.1) and 15.3 years (SD=9.9). Differences in the mean age at migration among immigrant case patients across neighborhood socioeconomic levels (low, medium, high) were not statistically significant (low: mean=17.2 years [SD=18.1]; medium: mean=14.9 years [SD=10.7]; high: mean=15.1 years [SD=9.4]).

In the analysis with the overall mean age at the time of migration imputed for the missing values among case patients, age at migration remained related to the incidence of psychotic disorders among immigrants (adjusted incidence rate ratio=0.97, 95% CI=0.96–0.99; χ^2=16.63, df=1, p<0.0005).

Analyses of Immigrant Groups and Dutch Citizens

Compared with the risk of psychotic disorders among Dutch citizens, the risk among immigrants was most significantly elevated among non-Western immigrants who migrated between the ages of 0 and 4 years, and the risk

TABLE 2. Age at the Time of Migration as a Predictor of the Incidence of Psychotic Disorders Among Immigrants

Country of Origin	Incidence Rate Ratio[a]	95% CI	χ^2 (df=1)	p
All countries	0.96	0.95–0.98	27.03	0.000
All non-Western countries	0.96	0.94–0.97	28.26	0.000
Surinam	0.93	0.89–0.97	12.00	0.001
Netherlands Antilles	0.91	0.86–0.97	8.18	0.004
Turkey	0.93	0.88–0.97	10.15	0.001
Morocco	0.96	0.93–1.00	4.97	0.03
Other non-Western countries	0.98	0.95–1.01	2.32	0.13
All Western countries[b]	1.00	0.95–1.05	0.00	0.97

[a] Analyses were adjusted for age and sex; an incidence rate ratio <1 indicates decreasing incidence with increasing age at migration.
[b] Analyses included immigrants from western, southern, and northern Europe; the former Yugoslavia; the United States; Canada; Australia; and New Zealand.

TABLE 3. Age at the Time of Migration as a Predictor of the Incidence of Psychotic Disorders Among Immigrants, by Age at First Contact With a Physician

Age at First Contact With a Physician (Years)	Number of Case Patients	Incidence Rate Ratio[a]	95% CI
15–19	30	0.89	0.83–0.96
20–24	73	0.95	0.92–0.98
25–29	69	0.95	0.92–0.97
30–34	38	0.97	0.93–1.00
35–39	39	0.97	0.94–1.01
40–44	10	1.00	0.94–1.06
45–49	9	1.02	0.96–1.08
50–54	5	1.01	0.92–1.10

[a] Analyses were adjusted for sex; incidence rate ratios <1 indicate decreasing incidence with increasing age at migration.

gradually decreased among those who migrated at older ages (Figure 1). As shown in Table 4, the pattern of higher adjusted incidence rate ratios found among those who migrated at earlier ages was consistent among all non-Western immigrants and among the four specific immigrant groups, except for a relatively high incidence rate ratio among Moroccan immigrants who migrated between ages 15 and 24 years. The adjusted incidence rate ratio was significantly higher for the total number of non-Western immigrants who migrated before age 5 years than for the total number of non-Western second-generation citizens, compared with the rate for Dutch citizens, but there was considerable variation in this association across the specific immigrant groups.

Finally, the adjusted incidence rate ratio of psychotic disorders was 5.21 (95%=CI, 2.67–10.22) for those who migrated before the age of 1 year, relative to that for Dutch citizens.

Discussion

In this large incidence study, we found that younger age at the time of migration predicted a higher risk for psychotic disorders among immigrants in the Netherlands. This was found among male and female immigrants and in all large, separate immigrant groups. People who mi-grated between ages 0 and 4 years had the most elevated risk compared with the risk for Dutch citizens, and the risk decreased with older age at migration.

In most countries, the association between the incidence of psychotic disorders and age at the time of migration cannot be investigated because census data do not include age at migration. However, in the Netherlands, population data are obtained from municipal registries. Registration with municipal authorities is compulsory for all individuals residing legally in the Netherlands and is a prerequisite for obtaining essential documents and financial aid, including child allowance. The registration is comprehensive and continuously updated and includes the date of migration to the Netherlands. The date of migration was missing for only 0.1% of the immigrant population. Data pertaining to age at migration were missing for 12.8% of case patients, but when the mean age at migration for the general immigrant population (22.6 years [SD=11.4]) was imputed for these missing values, the association between the incidence of psychosis and age at migration remained substantial and statistically significant.

Selective Migration

Individuals may migrate as a result of a (genetic) predisposition to psychotic disorders, perhaps during the early, prodromal stage of illness (13). It is unlikely that selective migration explains the increased risk among immigrants compared with the risk among Dutch citizens. The risk was most markedly increased among immigrants who did not migrate on their own initiative but were brought to the Netherlands in childhood by their family.

Contrarily, individuals with a predisposition to psychotic disorders may also be less likely to migrate (e.g., when they experience psychiatric problems prior to the onset of psychosis). This is not consistent with findings of increased rates of psychotic disorders among immigrants and cannot account for the main findings in this study, since they are specific to immigrants who migrated in (early) childhood. However, if there was no selection at younger ages and positive selection at older ages, then there would be a difference between those who migrated at different ages. The analysis that was stratified for age

TABLE 4. Incidence Rate Ratios (IRRs) of Psychotic Disorders Among Non-Western Immigrants Relative to Dutch Citizens, by Generation and Age at the Time of Migration[a]

Generation	All Non-Western Countries		Surinam		The Netherlands Antilles		Turkey		Morocco		Other Non-Western Countries	
	IRR	95% CI	IRR	95% CI	IRR	95% CI	IRR	95% CI	IRR	95% CI	IRR	95% CI
Immigrant	1.95	1.63–2.33	1.77	1.32–2.36	1.69	1.03–2.76	1.38	0.98–1.96	3.43	2.62–4.50	1.82	1.39–2.37
Age at the time of migration (years)												
0–4	2.96[b]	2.10–4.17	2.76	1.63–4.66	7.10	2.63–19.16	2.51	1.03–6.12	3.57	1.93–6.61	2.01	0.83–4.89
5–9	2.31	1.61–3.29	2.47	1.46–4.16	2.77	0.69–11.19	2.46	1.15–5.23	1.91	0.85–4.32	2.04	0.90–4.60
10–14	1.51	1.02–2.25	0.74	0.27–1.98	c	c	1.15	0.47–2.80	2.40	1.18–4.87	2.49	1.35–4.60
15–19	1.85	1.35–2.53	1.63	0.80–3.30	1.11	0.35–3.48	0.87	0.39–1.96	5.38	3.37–8.60	1.47	0.83–2.58
20–24	1.40	0.96–2.03	0.43	0.11–1.74	1.39	0.52–3.74	1.44	0.71–2.92	3.16	1.62–6.16	1.26	0.62–2.56
25–29	1.14	0.71–1.83	0.77	0.19–3.13	1.76	0.44–7.09	0.63	0.16–2.55	1.71	0.63–4.60	1.22	0.63–2.38
>29	1.00	0.58–1.72	0.80	0.20–3.26	c	c	c	c	1.19	0.29–4.84	1.49	0.80–2.78
Second-generation citizen	1.82	1.43–2.32	2.34	1.63–3.34	1.92	0.71–5.17	2.39	1.47–3.89	4.11	2.65–2.38	0.91	0.60–1.38

[a] Analyses were adjusted for age and sex; Dutch citizens comprised the reference group.
[b] Differences between immigrants who migrated between the ages of 0 and 4 years and second-generation citizens were statistically significant (p<0.05).
[c] There were no cases in these categories.

at first contact with a physician for a suspected psychotic disorder is consistent with such a mechanism (Table 3), but the numbers of patients who made a first contact in the older age categories were very small.

Immigrants who migrate in adulthood have a shorter risk period than those who migrate in childhood because the onset of psychotic illness is often in adolescence or early adulthood. Selective migration of this kind is also unlikely to explain our main results. There was a strong effect of age at the time of migration among those who migrated when they were younger than 15 years old; all of these individuals went through the total risk period after migrating.

Since liability to psychotic disorders is largely genetically inherited (14), selective migration may have taken place among the parents of case patients. However, we previously reported that the parents of Moroccan patients from the present sample did not have a higher risk for psychotic disorders than the parents of Dutch patients (15), which is consistent with findings for African Caribbean parents in the United Kingdom (16). Moreover, the argument of selective migration among individuals with a predisposition to psychotic disorders is based on the idea that these individuals are unattached, have lower marriage and fertility rates, and are social outliers (17). This profile does not pertain to migrants with young children.

Finally, it is conceivable that the parental decision to migrate is influenced by early manifestations of a predisposition to psychotic disorders—such as neurodevelopmental delays, behavioral problems, or, in rare instances, a very early onset of psychotic symptoms—in offspring (18). However, these manifestations are unlikely to be problematic or even evident to a parent before the child is 5 years old. When we restricted the analysis to those who migrated before the age of 1 year, well before there could

FIGURE 1. Age- and Sex-Adjusted Incidence Rate Ratios of Psychotic Disorders Among Non-Western Immigrants to the Netherlands Relative to Ratios Among Dutch Citizens
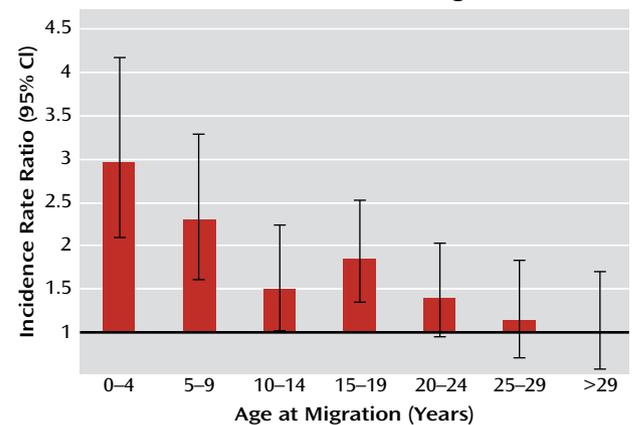
have been any precursory symptoms, the risk for psychotic disorders remained elevated.

Potential Confounding Factors

The neighborhood characteristics of ethnic density and socioeconomic status are important contextual factors that have been reported to be related to an increased risk for psychotic disorders (12, 19). These characteristics cannot explain the age-at-migration gradient presented in this study, since the mean age at the time of migration was similar among immigrant case patients in neighborhoods of both high and low ethnic density as well as across neighborhood socioeconomic levels. We could not adjust the analyses for family socioeconomic status because individual-level population data on socioeconomic status were not available. However, previous studies did not find a gradient in the relationship between the incidence of

schizophrenia and family socioeconomic status, although some reported an increased risk with regard to the lowest socioeconomic strata (20, 21). The only study conducted in the Netherlands on this issue actually found a higher socioeconomic status among incident case patients than among individuals in the general population (22). Furthermore, younger age at migration is associated with higher rather than lower socioeconomic status. Immigrants who migrated to the Netherlands as children more often speak Dutch fluently and generally have a higher degree of education and a lower rate of unemployment than those who migrated as adults (23).

Ascertainment of Case Patients

Differences in the ascertainment of case patients may have affected the results pertaining to younger age at the time of migration if immigrant case patients who migrated during infancy were more likely to be identified than those who migrated at older ages. The latter might more often prefer not to use Dutch health services. Additionally, help-seeking behaviors of immigrants may be influenced by the attitudes of their parents, and conceivably, parental influence could differ according to a patient's age at the time of migration. We cannot entirely rule out any effect of selective ascertainment, but this potential bias is unlikely to account for our findings. There was already a risk difference between those who migrated between the ages of 0 and 4 years and those who migrated between the ages of 5 and 9 years. Since all individuals in both groups migrated as young children, they all grew up in Dutch society and thus are familiar with the Dutch health care system to a similar degree. In addition, sources of treatment included general practitioners, whose services are more frequently used by non-Western immigrants than by Dutch citizens (24).

Prior Research on Age at the Time of Migration

This is the first study, to our knowledge, to show that age at the time of migration is relevant to the risk for psychotic disorders among immigrants. A Danish population register study did not find an association (25), but the majority of the immigrants in that study originated from Western regions, such as Scandinavia, other countries in Europe, Australia, and North America. In our study, most of the immigrants originated from non-Western countries, and the incidence rates of psychotic disorders were not elevated among immigrants from Western regions (5). Similar to the findings in the Danish study, among immigrants from Western regions, age at migration was not at all related to the incidence of psychotic disorders.

There are no recent studies of the relationship between immigration and the risk for psychosis in the United States. However, in one study of immigrants in the United States, the lifetime prevalence of mood and anxiety disorders was found to vary with age at the time of migration (26). Most immigrant groups had a lower prevalence than U.S.-born populations, but this advantage was generally limited to those immigrants who spent their preadolescent years outside of the United States. Although not related to psychosis, this finding supports the view that age at migration can influence psychiatric disorders among immigrants.

Possible Mechanisms

The present findings are consistent with the hypothesis that early life is an important risk period for psychotic disorders. A growing body of literature suggests that adverse social experiences in early life, such as childhood trauma (27) or parental separation (28), are related to higher risk for psychosis. With respect to migrating at an early age, both the event of migration itself and ethnic minority-related environmental exposures after migration may increase the risk for psychotic disorders. The increased rates found among second-generation citizens indicate that the latter factor plays a role. There may also be an effect of the event of migration itself. We found higher incidence rates of psychosis among immigrants who migrated before age 5 years than among second-generation citizens, but this result should be interpreted with caution because it was not consistent across immigrant groups. It is plausible that severe family stress in preparation for migration and during adjustment to the host country could influence early child development adversely. For those who migrated before the age of 1 year, there may have been an additional contribution of exposure to intrauterine maternal stress, which has been associated with increased risk for schizophrenia in some previous studies (29).

In general, early social, emotional, and cognitive development has been related to a wide variety of adult outcomes, including psychiatric problems (30). A more specific mechanism that has been proposed to explain the relationship between migration and psychotic disorders is social defeat. A recent birth cohort study among immigrants and their offspring in the Netherlands found an association between a high prevalence of behavioral problems in 1½-year-old children and unfavorable maternal immigration characteristics, including not speaking Dutch, a separated or marginalized cultural identity, and feelings of not being accepted by Dutch society (31). Growing up in a family environment with common experiences of social defeat or social exclusion has been hypothesized to increase the risk for schizophrenia by influencing dopamine function (32). It is conceivable that repeated or chronic exposure to social adversity in childhood and adolescence leads to the generation of cognitive biases and affective states that predispose an individual to symptom formation, such as paranoia and formation of persecutory delusions (7). In the developing brain, repeated adverse social experiences may lead to sensitization of the mesolimbic dopamine system, culminating in progressively greater expression of psychotic responses to social adversity over time (32, 33).

Other exposures that may be relevant to early migration and may disrupt brain development include viral infections and vitamin D deficiency (34, 35). It is important to note here the well-known age-at-migration findings with

regard to multiple sclerosis that also implicate childhood as an important risk period. Several studies have reported that individuals who are younger than 15 years at the time of migration tend to take on the multiple sclerosis risk of the individuals in the country to which they migrate, whereas those who are older than 15 years at the time of migration have a risk that is similar to that found in their country of origin (36). Both vitamin D and viral infections have been implicated as childhood environmental risk factors in multiple sclerosis (36). As yet, there is no direct evidence of a relationship between increased prenatal or childhood exposure to viral infections among immigrant groups with increased risk for psychotic disorders (7). Additionally, the vaccination status of immigrant children in the Netherlands is similar to that of Dutch children (37). Although the majority of immigrants in The Hague (including Hindustani Surinamese, Moroccan, and Turkish immigrants) do not have black skin, vitamin D deficiency is common among them (38). Both high and low neonatal vitamin D concentrations have been associated with schizophrenia in a recent report (35). Possibly, low vitamin D levels could contribute to the very high risk among those who migrated in the first year of life.

Implications and Future Research

These data suggest that the adverse influence of migration on the risk for psychotic disorders is most prominent in early life. Efforts to find the causes of the excess risk of psychotic disorders in ethnic minority populations as well as preventive approaches should include a focus on early childhood and preadolescence. Longitudinal epidemiological studies are needed to investigate when and how an ethnic minority social context is related to the onset of psychotic symptoms. In addition, mechanisms by which these factors might lead to psychosis, including epigenetic changes, should be studied (39). Further research should also examine vitamin D levels in childhood and immunological pathways to psychosis. With respect to prevention, it might be useful to develop interventions aimed at social empowerment and identity development, reducing perceptions of social defeat, and coping with growing up as an ethnic minority.

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