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Socioeconomic Status at Birth Is Associated With Risk of Schizophrenia: Population-Based Multilevel Study

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Background: **Inconsistent findings obscure understanding the relationship between socioeconomic status (SES) and schizophrenia. The aim of the current study was to test the association between individual and community SES at birth and risk of schizophrenia.** ***Method*****: Population-based longitudinal follow forward study of a 13-year birth cohort (n = 71 165). Effects of individual and community socioeconomic variables were examined using multilevel regression in MLwiN.** ***Results:*** **Years of education of fathers and mothers, respectively, (0–8 vs 13+ odds ratio [OR] = 1.17, $P < .0001$; OR = 1.14, $P < .001$) lower occupational status of fathers (OR = 1.29, $P = .036$), and poorer residential area SES (OR = 1.26, $P = .012$) were risk factors for schizophrenia.** ***Conclusions:*** **Individual- and community-level SES at the time of birth are associated with an increased risk of schizophrenia.**

Key words: social causation theory/social selection theory/parental education/parental occupation/residential area/multilevel analyses

Introduction

Studies have found that people with schizophrenia are more likely to reside in areas characterized by higher social deprivation, and occupy lower socioeconomic positions.[1,2] (For additional studies see.[3]) This is particularly true for individuals at the bottom of the socioeconomic status (SES) hierarchy.[4] Other studies, contrary to expected, found an association in the opposite direction,[3,5] and yet others found only a partial association.[6] It remains an open question if this is because social deprivation is a risk factor for schizophrenia,[7,8] or whether deprivation is a consequence of schizophrenia.[5,9,10]

Although the relationship between schizophrenia and SES has received extensive attention, there are still unanswered questions. The association between the illness and SES at the time of birth is still debated. Furthermore, most previous community-level studies are limited in that they focus mainly on urbanization. Finally, to our knowledge only one previous study[11] integrated SES measures from different levels into a multilevel analysis, and no studies attempted this with SES data at the time of birth.

In a large population-based birth cohort, we tested the hypotheses that socioeconomic deprivation at birth, as measured at the individual level and community level, will be associated with an increased risk of developing schizophrenia.

Methods

Population of Study

The study was based on a population birth cohort, "The Jerusalem Perinatal Study," of people born and living in Western Jerusalem between the years 1964 and 1976,[12,13] which was linked with the National Psychiatric Case Registry (N = 71 165) in 1999, using cases reported to the registry until the end of 1997. Israel provides free psychiatric hospital care to all its citizens.

The Israeli National Psychiatric Case Registry contains a complete listing of all psychiatric hospitalizations in Israel and includes the ICD-9 diagnoses assigned at admission and discharge by a board-certified psychiatrist. Diagnoses recorded in earlier ICD codes are routinely upgraded by the registry. All inpatient mental health facilities in the country, including day hospitals, are required by law to report admissions and discharges to the registry. Reporting is monitored by a special department at the Ministry of Health that verifies compliance with reporting and consistency of the information, ensuring the completeness and correctness of the data in the registry. Through the National Psychiatric Case Registry we were able to identify all hospitalized cases

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of broadly defined schizophrenia, including schizophreniform, schizoaffective, schizotypal, delusional disorders, and nonaffective psychoses. In this study, the most recent diagnosis was used. That is the diagnosis given at last discharge or at last admission when subject was still hospitalized at the time of data merger. Registry diagnoses have shown good sensitivity and specificity when measured against research diagnosis[14] and reliability as indicated by stability of diagnosis over time.[15]

Excluded from all analyses were 1721 individuals who died before the age of 14 because it was very unlikely that they could have been diagnosed with schizophrenia before this age. Also excluded were subjects who were missing data on sex (noncases, $n = 17$), father's age at the time of birth (cases, $n = 1$; noncases, $n = 40$), and father's occupational prestige (cases, $n = 4$; noncases, $n = 588$) leaving 68 794 subjects of whom 520 were later hospitalized for schizophrenia. At the time of the database linking, the youngest individuals in the birth cohort were 21 years old and the oldest were 33 years old (mean = 26.67, SD = 3.67). The mean age at first schizophrenia admission for males was 21.54 (SD = 4.02, $n = 307$) and for females was 20.71 (SD = 4.93, $n = 213$). Incidence of schizophrenia was higher among male subjects, 0.87% compared with 0.64% among females (odds ratio [OR] = 1.37, 95% confidence interval 1.15–1.64, $P < .001$). These subjects resided within 24 geographical areas in Jerusalem[16] (each comprising a mean of 2866 people, SD = 2366, minimum = 380; maximum = 10 964). The final multilevel model employed had 3.3% missing data.

Variables

Measures of SES. The "individual-level" socioeconomic variables were fathers' and mothers' years of formal education and occupational prestige status. The latter was based on a 100-point scale ranking 220 occupations in Israel at the time.[17] "Community-level SES (area SES)" was ranked using a split of geographical statistical areas of Jerusalem into either "substandard" or "nonsubstandard" neighborhoods by combining several different indicators.[16]

Statistical Analyses

The data were first analyzed at the bivariate level, and then, to allow examining both microlevel and macrolevel effects together,[18,19] a multilevel analysis was done. Similar studies in the field have noted that data which are grouped according to neighborhoods are, in statistical terms, part of a multilevel structure, and thus multilevel modeling techniques need to be used.[11]

In keeping with studies in the field of health disparities because SES effects result primarily from the lowest scoring categories compared with the rest of the continuum,[20] measures were dichotomized.[21]

Preliminary exploratory analysis was done to choose the cutting points that best discriminated between the low and high SES groups. Based on this, 2 binary occupational prestige variables were constructed (fathers' and mothers') by dividing the cohort into lower (0: not in the workforce to 6: unskilled agricultural; construction and industrial workers—fathers 11.56% and mothers 7.18%) compared with higher (7 or more: higher skilled workers including peddlers, salesman, agents, and white-collar workers—fathers 88.44% and mothers 92.82%). Housewives ($n = 39\,608$) were not included in this ranking. In order to minimize missing cases and when it was possible, for 3092 births missing father's occupation, this variable was imputed based on the father's education by placing those with up to 8 years of education into the lower occupational group and those with 9 or more years of education into the higher occupational group. This was done as these different methods of measuring SES have been previously found to be highly correlated to each other.[22] Thus, a high level of agreement across different SES measures suggests that comparisons related to the construct of SES might be made when employing different SES measures.[23]

In a similar fashion to that employed with father's occupation, a binary variable was also constructed for the community-level SES measure comparing the lowest ranking areas ("substandard area" 29.98%) to nonsubstandard areas.

Years of parental education was scaled as a categorical variable as follows: 0–8 years (fathers 27.30%, mothers 33.90%), 9–12 years (fathers 38.11%, mothers 37.78%), and 13+ years (fathers 34.59%, mothers 28.32%).

Multilevel analyses were performed using the MLwiN software package[24] by constructing logistic regression models for binary and binomial responses with individuals (level 1) nested within 24 geographic areas (level 2). Family SES variables were used as individual-level predictors. As recommended,[25] all model estimations were calculated using the nonlinear marginal quasi-likelihood method for binomial distributions. Because level of education and occupation were highly correlated, only occupation was used in the final model. Mother's occupation was not used in the multilevel analyses due to the large number of housewives. To allow comparing our results to those of previous studies, we also performed logistic regression analyses using SPSS, which does not fully account for multilevel variables.[24,26]

Control variables included were sex of subject, subject's year of birth, and age of father at the time of birth of subject[27] dichotomized at 45 years of age (for 488 births missing father's age category was imputed from mother's age category). Another potential control variable examined was father's ethnicity, divided into Ashkenazi or European group (39.34%) and Jews of West-Asian or North-African decent (60.66%) by dividing father's country of birth using a similar classification

method as has been implemented elsewhere.[28] Ethnicity showed no effect at the bivariate level ($P = .50$) and using the current system could not be categorized in 5528 cases; therefore, it was not included in the mutlivariate analysis.

Results

Results (presented in table 1) show both the bivariate and multilevel analyses. As seen in this table, in the bivariate analyses, even after controlling for year of birth, lower educational status of fathers and mothers, lower occupational status of fathers and mothers, and poorer residential area SES were all risk factors for schizophrenia. In the multilevel analyses, residential area SES was a risk factor for schizophrenia even after controlling for individual-level SES (father's occupation) and for sex, year of birth, and father's age at the time of subject's birth. The results obtained in the logistic regression analyses (results not presented) performed to allow comparing with other studies were very similar to those obtained using MlwiN showing the same ORs for the significant schizophrenia predictors at the individual level and community level. Furthermore, it should be noted that the results were similar with and without imputation for father's age and father's occupation.

Discussion

The current study, using data from a large municipal population-based birth cohort and a national registry of all psychiatric admissions, demonstrates that individual and community SES at birth are risk factors for schizophrenia. The results were fairly consistent when applying various definitions of SES.

The current study expanded the level and range of previous measures of SES used. We employed a composite community variable providing a more direct measure of SES which was based on an index of several community indicators and thus more fully describes the overall nature of the communities' socioeconomic context. These data represent the SES of the community rather than aggregate data of individual respondents, those who bore children during the study years, who were only a small fraction of the persons residing in their area. Different

Table 1. Bivariate and Multilevel Analyses of the Association between Individual SES (Level 1) and Area SES (Level 2) and Schizophrenia

	Bivariate Analyses[a]		Multilevel Analyses[b]
	Percent within Group Who Developed Schizophrenia (*N* cases/total *N*)	OR (95% CI)*P*	OR (CI) *N* = 68 794
Level 1			
Father occupational prestige (low vs high)	*N* = 68 794	1.39 (1.10–1.78)**	1.29 (1.02–1.63)*
Low (0–6 score)	1.11% (*n* = 88/7952)		
High (>6 score)	0.71% (*n* = 432/60 842)		
Mothers in paid work occupational prestige (low vs high)	*N* = 28 415	1.99 (1.29–3.05)***	
Low (0–6 score)	1.23% (n = 25/2039)		
High (>6 score)	0.57% (*n* = 151/26 376)		
Father education			
0–8 vs 13+	*N* = 64 616	1.17 (1.04–1.32)**	
0–8 vs 9–12		1.21 (0.98–1.49)	
0–8	0.95% (*n* = 168/17 639)		
9–12	0.74% (*n* = 182/24 627)		
13+	0.59% (*n* = 131/22 350)		
Mother education			
0–8 vs 13+	*N* = 64 542	1.14 (1.01–1.28)*	
0–8 vs 9–12		1.35 (1.09–1.67)**	
0–8	0.96% (*n* = 209/21 879)		
9–12	0.62% (*n* = 151/24 387)		
13+	0.64% (*n* = 117/18 276)		
Level 2—area SES			
Low vs high	*N* = 69 384	1.30 (1.09–1.56)**	1.26 (1.05–1.52)*
Substandard area	0.92% (190/20 623)		
Nonsubstandard area	0.69% (330/48 171)		

OR = odds ratio and CI = confidence interval.
[a]Controlled for year of birth.
[b]Variables included in model: father's occupation and area-socioeconomic status (SES) "substandard" definition. Adjusted for sex, year of birth, and father's age at the time of subject's birth.
*$P < .05$, ** $P < .01$, ***$P < .001$, and ****$P < .0001$.

from most previous studies and similar to a recent and wide-scale study,[29] we examined both parents occupational status. Regarding father's occupational status, the current results are consistent with findings of some previous studies[7,8,29] with an OR of similar magnitude and different from other studies that found no effects but employed small samples with fewer than 80 cases[5,9] as well as studies that used a different statistical design.[10]

To the best of our knowledge this is the first study that integrates individual-level and area-level SES at birth as risk factors of schizophrenia using a multilevel design. The multilevel analyses show that even after adjustment for father's occupation, residential area is still a significant risk factor for schizophrenia. The results thus suggest that not only is an individual affected by the SES of his/her family but also the community area in which an individual is born and the macroeconomic conditions act as additional risk factors for schizophrenia. Thus, although it may be argued that poor people may cluster in more deprived areas, the effect of the community residential area remained significant even after adjusting for individual-level variables.

The current study does not allow us to make definite conclusions as to the mechanisms at work in the relationship between SES at birth and schizophrenia. It is important to note that measures of SES as used in this study are proxy measures for factors linked more directly to schizophrenia risk.[8] Thus, there are a number of yet to be examined possible explanations as to how parental SES might pose a risk factor for schizophrenia in their offspring. While we do not know about the underlying social or biological process tapped by the 2 levels and while it was not possible to differentiate between different factors associated with lower SES which may be associated with increased risk of schizophrenia, possible relationships may be speculated upon.

One possible explanation comes from social causation theory which deals with the effect of the environment on the risk for mental disorders.[2,4] This theory attributes the relationship between SES and schizophrenia to adversity and chronic strains experienced by persons of lower SES.[3]

It may be that lower SES itself causes increased risk for the disease. For example, parents of lower SES may be burdened by everyday hardships and have fewer resources to educate their children. Furthermore, these families may live in harsher household and community environments and have poorer access to social networks and may experience social isolation. Lower SES communities may be characterized by weaker social cohesion, fewer social services, exposure to crime and delinquency, and other sources of daily stress factors.

Alternately, it may be that other factors which are associated with lower SES, acting by themselves or in combination, may be associated with the disease. For instance, diminished financial resources may limit access to adequate prenatal and postnatal care and pose nutritional deprivation during pregnancy.[30] Lower SES may also be related to schizophrenia risk by household crowding and transmission of contagious factors or harsher working conditions.

An additional possible explanation is that of personal or familial history. It is possible that personal events, such as the death of a parent, or other sources of stress may have a relationship to risk of schizophrenia. Furthermore, family psychiatric history is another possible mechanism for schizophrenia risk. It is possible that parents themselves were affected and thus transmit genetic risk to their children. As these parents drift into lower socioeconomic classes, the child with genetic risk is born into these lower classes.[31] This argument would give strength to the selection hypothesis by which genetic factors are linked to a downward drift into lower social classes.

Another possibility is that genetic factors are important causal factors in schizophrenia risk, but social factors are also important determinants in that people with predisposed disposition to schizophrenia will have overt schizophrenia following exposure to social stressors. Thus, it is possible that social causation and social selection factors work jointly in the risk for schizophrenia.[32,33] One limitation of the current study is that we did not have information on parents' psychiatric history which could have helped decipher between the mechanisms of social selection and social causation.

Another limitation is that our use of an index of community deprivation limited our ability to isolate which specific aspects of the community may be of particular importance to schizophrenia. Future studies should employ separate measures of community aspects along with combined indices of a variety of community variables.

Next, bias may have occurred as a result of individuals with schizophrenia, especially those with affective psychosis, that have not been hospitalized and therefore may not be included in the data set or individuals who were diagnosed incorrectly. However, this is unlikely because due to the severity of schizophrenia, most individuals with schizophrenia are hospitalized at some point in their lives. Furthermore, because we used the last diagnosis, it is presumed that over time an overly optimistic early diagnosis would have been changed. In addition, the Israeli law requiring reporting of all psychiatric admissions makes it unlikely that hospitalizations are missing or diagnoses incorrect in the National Psychiatric Hospitalization Case Registry.

It is also possible that the findings do not represent real differences in schizophrenia incidence, but rather a trend in diagnoses. It was not possible for us to conduct a systematic face-to-face interview with the subjects to reexamine the diagnoses found in the National Psychiatric Hospitalization Case Registry. There is a possibility that due to various social reasons, people of lower SES are given more severe diagnoses while people from higher

SES are given less severe diagnoses. However, because we included schizophrenia spectrum and used last discharge diagnosis, it is unlikely that this was a serious source of bias.

Another limitation in the current study is that at the time of data linking not all individuals have gone through the age of risk for schizophrenia. At time of follow-up, the persons included in this study ranged in age from 21 to 34 years. Using national data on a decade of all first admissions reported in Rabinowitz and Fennig,[34] we calculated that 41% of first admission males were 21 years or younger and among females 38.9%; similarly, 91.5% of first admission males were aged 34 or younger as were 87% of females. Thus, while most admissions were probably included, it would be instructive to repeat the analyses once all individuals in the cohort have passed the age of risk for schizophrenia. Furthermore, there was no way in the current study of tracking immigration in and out of the country. Finally, an additional limitation to this study is missing data on certain socioeconomic variables.

The current study examined SES at the time of birth. It would be instructive to follow the entire population cohort today to test aggregated or mediating risk when a person born into poor socioeconomic conditions remains in these conditions as opposed to a person born in the same conditions who migrates to higher socioeconomic conditions prior to illness onset.

The strengths of the current study are that it is based on an entire population birth cohort and includes various different multilevel socioeconomic measures from the time of birth. The current study is also based on a composite definition of area SES which includes various measures that effect community-level SES, thus going beyond the usual definition of urbanicity that has been formerly applied in previous studies. Furthermore, to the best of our knowledge, this is the first study to integrate individual-level SES and community-level SES measures at birth in a multilevel regression model.

In summary, the results based on data from an entire birth cohort with very complete follow forward data suggest that social deprivation of parents and neighborhoods contribute to the risk of schizophrenia.

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