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Associations between childhood living circumstances and schizophrenia: a population-based cohort study

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Objective: It has been suggested that household crowding may constitute an enviromental risk factor for schizophrenia. The present population-based cohort study explores the associations of childhood family size and living conditions to schizophrenia.
Method: The cohort comprised people born at Helsinki University Central Hospital from 1924 to 1933, who went to school in the city and were still living in Finland in 1971. Prospectively gathered data from birth and school health records of these 7086 individuals were collected and linked to the Finnish Hospital Discharge Register.
Results: Ninety-eight cases of schizophrenia were identified in the cohort. Number of siblings at school start was significantly associated with schizophrenia when adjusted for sex and age of mother. Number of siblings was negatively correlated with body mass index at age 7. Childhood household crowding, defined as number of people per room, and total number of rooms in household were not significantly associated with schizophrenia.
Conclusion: Our study indicates that the total number siblings in household during childhood is of greater importance than childhood number of inhabitants per room. Subjects who originated from families with many children had been leaner, which may imply that childhood nutritional factors partly is the mediating factor between number of siblings and schizophrenia. Other possible underlying mechanisms of the associations found include infectious and psychological factors.

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Key words: cohort studies; schizophrenia; crowding; family characteristics; nuclear family

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Introduction

Schizophrenia is a severe psychiatric syndrome with a 1-month prevalence of 1.3% in the Finnish adult population (1). Published data indicate that an array of adverse biological factors are related to the subsequent development of schizophrenia (2). These include infections during the second trimester of pregnancy (3), small size at birth (4) and a variety of obstetric complications (5). In addition, environmental factors during early life have also been associated with schizophrenia; being from a large sibship (6) and being born or raised in an urban area are risk factors for developing psychosis later in life (7). Lewis et al. (8) found in a Swedish cohort study that men raised in a city rather than a rural area had a relative risk of 1.65 for being diagnosed with schizophrenia by age 22–23. In the United States, Kendler et al. (9) reported that people with non-affective psychosis were five times more likely to have been raised in a large metropolitan than in a rural area. Similarly, in the Netherlands van Os et al. (10, 11) found that individuals born in the highest category of the three-level urban exposure were twice as likely to develop schizophrenia.

One possible explanation for the consistent association between birth and upbringing in an urban area and subsequent development of

schizophrenia is household crowding (10, 11). Early observations indicated that less rooms per housing unit (12), more people per household and more people per room (13) were related to psychiatric hospital admission. In a more recent clinical sample of inner-city schizophrenics the single most powerful predictive sociodemographic variable was overcrowding, defined as people per room (14).

Household crowding is associated closely with socioeconomic status. Existing evidence, however, does not support an association between socioeconomic status in childhood and development of schizophrenia. The classic study by Goldberg and Morrison (15) found that the social class distribution of the fathers of schizophrenics did not differ from that of the general population, which indicates that the excess of schizophrenics in the lowest socioeconomic group may be more the result of a downward drift than of a socioeconomic causative factor. This original finding has been supported by more recent cohort studies (4, 17).

Consequently, even if current household crowding is associated to hospital admission and schizophrenia, this may reflect the social downward drift and be unrelated to causative mechanisms. It is thus of interest whether, before the outbreak of the disease, schizophrenia subjects have been exposed to household crowding in childhood.

We have assembled a cohort of 7086 men and women who were born at Helsinki University Central Hospital during 1924–33 and for whom there are, among other data, information on early living conditions. The aim of this study is to assess the association between household crowding at birth and in childhood and lifetime risk of developing schizophrenia.

Material and methods

We studied a sample of men who were born at the Helsinki University Central Hospital between 1924 and 1933, went to school in the city of Helsinki, and were still resident in Finland in 1971. All babies born at the University Central Hospital have a birth record and all children attending school have a school health record. In Finland, attendance at public primary schools has been compulsory since 1921. For this study, city-dwelling children who went to primary schools of the City of Helsinki (pop. 221 524 in 1933) were included. Both birth and school health records were available for 8580 city-resident children.

As we have described previously, we used the birth and school health records to trace 7086 subjects who still lived in Finland in 1971 (18, 19). At that time a unique personal identification number was assigned to all residents by the Finnish Population Register.

As reported previously, data were extracted from birth records (20). Using the father's occupation, the subjects were grouped according to a social classification used by the Central Statistical Office of Finland (21). Overall 78% of the fathers were labourers and 10% were classified as lower middle class. Together these constitute the lower social class as opposed to the upper social class, which is subdivided into upper middle class (2%) and self-employed (2%). The social class of 8% could not be classified.

When the child first attended school the number of inhabitants in the household and the number of rooms in the home, as well as weight and height of subjects, were recorded by a school nurse. These data were extracted from the school health cards. For this study, crowding was defined as the number of people in childhood household divided with number of rooms in childhood household.

Using the unique personal identification number the individuals were linked with the Finnish Hospital Discharge Register (HDR). The HDR was founded in 1967 and covers all psychiatric and general hospitals, including private hospitals, as well as wards of community health centres. The HDR contains data on primary diagnosis and up to three subsidiary diagnoses on both discharges and deaths of inpatients. The diagnostic information of the HDR is provided by the treating physicians. The HDR has been found to be a valid and reliable tool for epidemiological research (22). Accuracy of primary diagnoses in the HDR is good; a 96.3% agreement between the HDR data and case notes has been reported in a schizophrenia sample (23). The positive predictive power of an HDR diagnosis in a broad schizophrenia spectrum is 0.93, and the positive predictive power of a schizophrenia diagnosis is 0.87, when compared to a 'gold standard' consensus diagnosis made against clinical records by two senior research psychiatrists using the Diagnostic and Statistical Manual, 3rd edition, revised (DSM-III-R), criteria (23).

Diagnoses were entered in the HDR according to the International Classification of Diseases, 8th revision (ICD-8) until 1986, according to ICD-9 using the DSM-III-R criteria between 1987 and 1995, and according to ICD-10 criteria from 1996

Table 1. Odds ratios for schizophrenia according to living circumstances at age 7 for 7086 men and women born in Helsinki, adjusted for gender

	OR (95% CI)	*P*	Joint model with mothers' age OR (95% CI)	*P*
Number of siblings	1.11 (1.02–1.21)	0.011	1.10 (1.00–1.20)	0.040
Inhabitants in household	1.12 (1.00–1.25)	0.049	1.10 (0.97–1.23)	0.126
Parity	1.09 (0.99–1.19)	0.089	1.03 (0.92–1.17)	0.581
Rooms in household	1.05 (0.81–1.35)	0.735	1.03 (0.80–1.33)	0.822
Crowding (log of inhabitants per room in household)	1.27 (0.77–2.10)	0.342	1.22 (0.74–2.01)	0.437

onwards. For this analysis, only people diagnosed with pure schizophrenia were included. People with schizophreniform disorder, schizoaffective disorder or schizotypal disorder were excluded.

In this study, any individual found in the HDR with a primary or subsidiary diagnosis as defined above until December 1996 was assigned to the schizophrenia group, which was compared with the remainder of the risk set. We used multiple logistic regression analysis to calculate odds ratios (ORs) for schizophrenia, adjusting for gender. ORs are reported with 95% confidence intervals.

Results

Ninety-eight cases of schizophrenia were identified in the cohort. When adjusted for influence of sex, higher number of siblings and higher total number of inhabitants in the household at start of primary school (age 7 years) significantly increased risk for schizophrenia (Table 1). Each additional sibling increased odds for schizophrenia with 11% and each additional inhabitant in household increased odds for schizophrenia with 12%. Number of rooms in household or crowding at school start, defined as number of household inhabitants per room, did not affect risk of later schizophrenia.

Age of mother was a confounding factor. Higher age of mother was significantly associated with schizophrenia in offspring (OR 1.03, CI 1.00–1.07, $P=0.044$). Data were therefore entered in a joint model with mothers' age (Table 1). In the joint model of mother's age, sex of offspring and number of siblings, age of mother was not associated with schizophrenia (OR 1.02, CI 0.99–1.06, $P=0.242$), but number of siblings remained statistically significantly associated with schizophrenia.

In a *post hoc* analysis it was found that body mass index (BMI) at age 7 was related to number of siblings (ANOVA: $F=17.51$, $P<0.001$). Both lower BMI at age 7 and more siblings were associated with schizophrenia in a joint analysis of sex of offspring, number of siblings and BMI (number of siblings: OR 1.10, CI 1.02–1.20, $P=0.019$; BMI: OR 0.67, CI 0.54–0.82, $P=0.0001$).

Categorized data (Table 2) indicate a linear association between risk for schizophrenia and number of household inhabitants or number of siblings at age 7. Again, no association between number of rooms at home and later schizophrenia was found in any category.

Discussion

To our knowledge this is the first study of associations between actual childhood household crowding and schizophrenia. We were not able to confirm the crowding hypothesis. Physical everyday distance between people living in same household was not associated with schizophrenia.

Table 2. Stratified odds ratios for schizophrenia according to living circumstances at age 7 for 7086 men and women born in Helsinki, adjusted for gender

	OR (95% CI)
Number of siblings*	
0 ($n=2123$)	1.00 = baseline
1 ($n=2276$)	1.79 (0.99–3.22)
2 ($n=1118$)	1.67 (0.83–3.35)
$\geqslant 3$ ($n=1248$)	2.66 (1.44–4.92)
Inhabitants in household**	
$\leqslant 3$ ($n=1650$)	1.00 = baseline
4 ($n=1878$)	1.37 (0.73–2.57)
5 ($n=1161$)	1.43 (0.71–2.86)
6 ($n=614$)	1.69 (0.76–3.75)
$\geqslant 7$ ($n=627$)	2.34 (1.13–4.82)
Parity***	
1 ($n=3028$)	1.00 = baseline
2 ($n=1974$)	1.10 (0.66–1.83)
3 ($n=931$)	1.35 (0.73–2.47)
$\geqslant 4$ ($n=1149$)	1.55 (0.90–2.66)
Rooms in household****	
1 ($n=2794$)	1.00 = baseline
2 ($n=2519$)	0.90 (0.56–1.46)
$\geqslant 3$ ($n=692$)	1.40 (0.74–2.65)
Crowding (inhabitants per room in household)*****	
$\leqslant 1.5$ ($n=790$)	1.00 = baseline
$\leqslant 2.5$ ($n=1801$)	2.51 (0.97–6.52)
$\leqslant 3.5$ ($n=1514$)	2.12 (0.80–5.68)
$\leqslant 4.5$ ($n=1040$)	2.45 (0.89–6.70)
>4.5 ($n=773$)	2.49 (0.87–7.08)

* = data on 321 children missing.
** = data on 1156 children missing.
*** = data on 4 mothers missing.
**** = data on 1081 households missing.
***** = data on 1168 households missing.

Our analysis indicates a dose–response relation between number of inhabitants at home and subsequent schizophrenia. However, this effect was not independent of mothers' age.

The effect of number of siblings seems to be confined to schizophrenia. When heterogeneity of cases was increased by including subjects with schizoaffective disorder in a *post-hoc* analysis, the significant associations with number of siblings and number of inhabitants in household were lost.

A declining incidence of schizophrenia has been reported in Finland (24), which coincides with a gradual decrease in mean number of children in Finnish households. However, any possible effect of fewer siblings will be contaminated by the effects of simultaneous improvement in maternal care and nutrition.

The limitations of our study are that subjects who died before 1971 and subjects who never went to primary school, such as severely mentally retarded children, are excluded from our cohort. Some subjects will have been lost due to early mortality. Infant mortality was 6.5% in the period 1924–33 (25). Subjects with early-onset schizophrenia who were not hospitalized in 1971 or later will not have been included in our analysis. Thus the associations in our study are representative of a population which has reached middle age. One can assume that adverse pregnancy and childhood factors exert their maximum effect early in life (26) and thus the possible bias arising from selective loss of people who died before middle age is more likely to lead to an underestimation of the associations between early risk factors and schizophrenia than to an overestimation.

The strengths of our study include that 92% of the people originally identified through birth and school records were traced. Our findings also gain strength from the prospectively collected data and the occurrence and coverage of the national Hospital Discharge Register. In the present population and register-based study all data on risk factors for schizophrenia were ascertained before outcome was known, thus avoiding bias in case selection or bias in ascertainment of risk factor information.

Number of siblings may have nutritional, environmental and psychosocial effects. The nutritional situation of the lower classes in Finland was not good during the 1930s. About half of an average blue-collar worker's wage was spent on food, and food shortage was common in working class families with many children (27). We found that BMI at age 7 was related to number of siblings, which indicates that the nutritional status of children was lower in large families. These linked factors may both reflect nutrition and be on a causative pathway to schizophrenia.

Siblings may have a role as vectors of environmental risk factors, in particular infectious diseases. Infections may adversely affect neurodevelopment *in utero* and early infancy (28). The possible psychological effects of being raised in a large family are hard to define and remain speculative. For instance, later-born children may be treated and raised differently than the first-born.

Our study did not find a statistically significant association between high parity and schizophrenia. In Sweden, early onset schizophrenia has been associated with high parity in both a countrywide case–control study (29) and a longitudinal cohort study (30). In the Swedish studies this association was significant only for male schizophrenics to mothers with at least three previous births. A similar trend was identifiable in our study with risk of schizophrenia increasing for each previous birth (Table 2) and in the North Finland birth cohort of 1966 (31).

In conclusion, this study implies that it is the actual number of siblings, not crowding *per se*, which is associated to schizophrenia. Subjects who had been lean children with many siblings had an increased risk of schizophrenia, which may indicate a contributing role of nutritional factors. The increased risk of schizophrenia associated with city birth thus seems not to be explained by actual household crowding.

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