



Risk of psychiatric disorders in offspring of parents with a history of homelessness during childhood and adolescence in Denmark: a nationwide, register-based, cohort study

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Summary

Background Children and adolescents from deprived backgrounds have high rates of psychiatric problems. Parental and social factors are crucial for children's healthy and positive development, but whether psychiatric morbidity is associated with parental social marginalisation is unknown. We aimed to analyse the association between mother's and father's history of homelessness and the offspring's risk of psychiatric disorders, including substance use disorder, during childhood and adolescence.

Methods We did a nationwide, register-based cohort study of 1 072 882 children and adolescents aged 0–16 years, who were living or born in Denmark between Jan 1, 1999, and Dec 31, 2015. Parental homelessness was the primary exposure, data on which were obtained from the Danish Homeless Register. The Danish Civil Registration System was used to extract the population and link offspring to parental information, and the outcome, psychiatric disorders in the offspring, was obtained from the Danish Psychiatric Central Research Register and the Danish National Patient Register. We analysed the association between parental history of homelessness and risk of psychiatric disorders in offspring by survival analysis using Poisson regression and incidence rate ratios (IRRs), adjusted for year and offspring characteristics, and additionally adjusted for parental factors (age at offspring's birth and parental psychiatric disorders).

Findings 17 238 (2%) offspring had either one or two parents with a history of homelessness, and 56 330 (5%) children and adolescents were diagnosed with any psychiatric disorder during the study period. The incidence of any psychiatric disorder was 15·1 cases per 1000 person-years (95% CI 14·4–15·8) in offspring with at least one parent with a history of homelessness, compared with 6·0 per 1000 person-years (95% CI 6·0–6·1) in those whose parents had no such history (IRR 2·5 [95% CI 2·3–2·7] for mother homeless, 2·3 [2·2–2·5] for father homeless, and 2·8 [2·4–3·2] for both parents homeless, after adjustment for year and offspring characteristics). This risk remained elevated after additional adjustment for factors including parental psychiatric disorders. IRRs in offspring were increased for most specific psychiatric disorders, with the highest risk for attachment disorder when both parents had a history of homelessness (IRR 32·5 [95% CI 24·6–42·9]) and substance use disorder when only the mother had a history of homelessness (6·9 [4·9–9·7]). In offspring whose mothers had a history of both homelessness and a psychiatric disorder, 35·9% (95% CI 27·1–44·8) had been diagnosed with a psychiatric disorder by the age of 15 years.

Interpretation Parental homelessness was associated with an increased risk of psychiatric disorders in offspring during childhood and adolescence. These findings have important implications for public health and policy because they suggest a need for improvement in the support of socially marginalised families to help prevent psychiatric illness in offspring.

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Introduction

Children and adolescents from socially marginalised families have severe health problems compared with those from higher socioeconomic backgrounds.¹ In a report² from the UK, half of adult mental health problems were estimated to begin before the age of 14 years. Emotional influence and social support from parents have been acknowledged as important factors in child mental health and development.^{3,4} Social determinants are suggested to be among the biggest influences of children's health.²

Homelessness has been linked to severe health problems and excess mortality.^{5,6} Additionally, in a review⁶ from 2014, it was stated that rates of homelessness have increased in countries in the European Union during the past 5 years, with young people, women, and families accounting for a higher proportion of people who are homeless than previously.

Children living without a home or who have mothers who were formerly homeless have been found to have more psychiatric problems than housed children from low-income backgrounds.^{7–9} Additionally, substance use

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Research in context

Evidence before this study

We searched PubMed in June 17, 2017, with no restrictions set for papers with the search terms "homeless*" in combination with "parent*" OR "child*" OR "father-child relations" OR "mother-child relation" OR "parent-child relation" OR "adolescence" OR "family" AND "mental disorders" OR "mental health" OR "substance-related disorders" OR "alcohol-related disorders" OR "child psychiatry". All terms except from homeless were chosen as major topics in the search function to search for the most relevant articles. Furthermore, studies identified from the reference lists of the included articles were used. Titles and abstracts were reviewed and potentially relevant papers were read. We included original research and reviews from high-income countries that addressed homelessness in relation to adverse child and adolescent psychiatric outcomes. Studies, primarily from the USA, but also a few from Europe, have suggested that being homeless is associated with higher rates of psychiatric problems in children and adolescents, but the literature has been inconsistent. This inconsistency could be explained by small study samples, demographic differences, cross-sectional designs, residual confounding, and absence of comparison groups. Thus, greater clarity is needed on the association between homelessness and children's risk of psychiatric disorders based on prospective and population-based studies with adjustment for psychiatric family history. Furthermore, studies of whether a mother's or father's history of homelessness is linked to offspring's psychiatric morbidity are scarce.

Added value of this study

This is the first nationwide register-based cohort study with prospectively collected data and up to 16 years' follow-up, studying both the mother's and father's history of homelessness and its association with offsprings' risk of psychiatric disorders, including substance use disorder, during childhood and adolescence. We found an association between both mother's and father's homelessness and offspring's risk of any and most specific psychiatric disorders, including after adjustment for parental psychiatric disorders, and we noted a higher risk associated with maternal than paternal homelessness. The highest excess risk in the offspring of specific psychiatric disorders was found for attachment and substance use disorder.

Implications of all the available evidence

This study adds a new perspective by focusing on the mother's and father's history of homelessness as a social determinant. Parental history of homelessness can be seen as an important long-lasting indicator of susceptibility to psychiatric illness in offspring besides from that associated with parental psychiatric disorders. Our findings suggest a need for increased political focus on the risk of severe child and adolescent psychiatric morbidity associated with parents' social marginalisation. Better support for the socially marginalised families is needed to improve the children's lives and reduce adverse consequences in the longer term. Future prospective studies focusing on the causes of homelessness are needed to guide prevention of homelessness in practice.

problems (ie, use of recreational drugs, alcohol, and other psychoactive substances) are prevalent in homeless adolescents.¹⁰ However, findings have been inconsistent, for example, for specific psychiatric disorders and age groups,^{7,11–13} with some studies showing no differences between children in homeless families versus low-income housed families.^{14,15} The effect of homelessness on children's health is difficult to measure,¹¹ and there were methodological limitations in previous studies (eg, small sample sizes, and absence of comparison groups and adjustment for confounders).^{7,11} Research into the associations between social determinants (including parental homelessness) and child psychiatric illness are scarce,^{2,7,8,13} especially studies outside the USA. We aimed to analyse the risk of any and specific psychiatric disorders during childhood and adolescence in individuals whose parents had a history of homelessness.

Methods

Data sources and study participants

The population in this cohort study comprised children and adolescents living or born in Denmark between Jan 1, 1999, and Dec 31, 2015. The Danish Civil Registration System,¹⁶ which contains data since 1968,

was used to establish the study population. This register contains information on vital status, date of birth, country of origin, sex, and the personal identification number (civil registration system number) assigned to all Danish residents. The civil registration system number makes accurate linkage between registries and linkage to parents possible. We excluded children and adolescents with an unknown mother or father.

Parental history of homelessness was the main exposure, data on which were collected from the Danish Homeless Register, established on Jan 1, 1999.¹⁷ The register covers dates for all contacts with homeless shelters in Denmark, which are covered by the Act on Social Services 110, and states that the municipal council should offer temporary accommodation to people with specific problems who need support and who either have no home or are not able to stay in their home. Women with children who have experienced violence or threats of violence are not covered by this register. A parent was defined as having a history of homelessness from the date of first homeless shelter contact since 1999 and onwards.

Information on parental psychiatric disorders was obtained from the Danish Psychiatric Central Research Register,¹⁸ which contains data on all psychiatric inpatient admissions in Denmark since 1969 and outpatient

contacts from 1995. We also collected data from the Danish National Patient Register,¹⁹ which contains information on all somatic inpatient hospital contact, including psychiatric diagnoses given at the somatic wards, since 1977 and outpatient contacts from 1995. We defined psychiatric diagnoses according to the 10th revision of the International Classification of Diseases (ICD-10),²⁰ which has been used in Denmark since 1994 and ICD-8,²¹ used in 1969–93.

We used two covariates of parental psychiatric disorders. We defined the overall covariate as any psychiatric disorder, which included substance use disorder, from the first date of diagnosis since 1969 and onwards. We defined a specific hierarchical covariate according to mutually exclusive categories with the first mentioned regarded as the most severe based on the hierarchical ICD-10 system: organic disorder; substance use disorder; schizophrenia or bipolar disorder;

	At least one parent with a history of homelessness			No parents with a history of homelessness		
	Offspring with any psychiatric disorder in childhood and adolescence	Person-years*	Incidence (per 1000 person-years; 95% CI)	Offspring with any psychiatric disorder in childhood and adolescence	Person-years*	Incidence (per 1000 person-years; 95% CI)
All	1714	113 839	15.1 (14.4–15.8)	54 616	9 051 089	6.0 (6.0–6.1)
Offspring's sex						
Girl	601	55 698	10.8 (10.0–11.7)	19 765	4 453 363	4.4 (4.4–4.5)
Boy	1113	58 141	19.1 (18.1–20.3)	34 851	4 597 726	7.6 (7.5–7.7)
Offspring's country of origin						
Denmark and other high-income countries	1480	77 397	19.1 (18.2–20.1)	51 724	8 256 325	6.3 (6.2–6.3)
Low-income and middle-income countries	234	36 443	6.4 (5.7–7.3)	2892	794 764	3.6 (3.5–3.8)
Mother's age at offspring's birth (years)						
<25	680	36 956	18.4 (17.1–19.8)	9629	1 172 059	8.2 (8.1–8.4)
25–34	817	59 231	13.8 (12.9–14.8)	35 937	6 279 247	5.7 (5.7–5.8)
≥35	217	17 652	12.3 (10.8–14.0)	9050	1 599 783	5.7 (5.5–5.8)
Father's age at offspring's birth (years)						
<25	341	17 025	20.0 (18.0–22.3)	4906	539 246	9.1 (8.9–9.4)
25–34	837	55 533	15.1 (14.1–16.1)	32 685	5 497 418	6.0 (5.9–6.0)
≥35	536	41 281	13.0 (11.9–14.1)	17 025	3 014 425	5.7 (5.6–5.7)
Mother's psychiatric disorder†						
Organic disorder	26	750	34.7 (23.6–50.9)	213	12 138	17.6 (15.3–20.1)
Substance use disorder	304	12 949	23.5 (21.0–26.3)	1881	118 898	15.8 (15.1–16.6)
Schizophrenia or bipolar disorder	40	1419	28.2 (20.7–38.4)	514	28 039	18.3 (16.8–20.0)
Single and recurrent depressive disorder	129	6130	21.1 (17.7–25.0)	3200	224 245	14.3 (13.8–14.8)
Neurotic, stress-related, and somatoform disorder	210	8783	23.9 (20.9–27.4)	3601	300 766	12.0 (11.6–12.4)
Personality disorder	51	1708	29.9 (22.7–39.3)	653	49 842	13.1 (12.1–14.2)
Behavioural and emotional disorder including hyperkinetic disorder	24	1152	20.8 (14.0–31.1)	380	22 998	16.5 (14.9–18.3)
Other mental disorders	18	1147	15.7 (9.9–24.9)	642	73 897	8.7 (8.0–9.4)
No psychiatric contact	912	79 802	11.4 (10.7–12.2)	43 532	8 220 266	5.3 (5.3–5.4)
Father's psychiatric disorder†						
Organic disorder	37	1809	20.5 (14.8–28.2)	241	16 951	14.2 (12.5–16.1)
Substance use disorder	546	27 821	19.6 (18.1–21.3)	2151	161 980	13.3 (12.7–13.9)
Schizophrenia or bipolar disorder	28	1795	16.6 (10.8–22.6)	242	22 889	10.6 (9.3–12.0)
Single and recurrent depressive disorder	47	3038	15.5 (11.6–20.6)	988	84 920	11.6 (10.9–12.4)
Neurotic, stress-related, and somatoform disorder	85	5297	16.1 (13.0–19.9)	1553	143 227	10.8 (10.3–11.4)
Personality disorder	24	1569	15.3 (10.3–22.8)	300	24 691	12.2 (10.9–13.6)
Behavioural and emotional disorders including hyperkinetic disorder	25	1201	20.8 (14.1–30.8)	435	28 281	15.4 (14.0–16.9)
Other mental disorders	17	891	19.1 (11.9–30.7)	334	35 542	9.4 (8.4–10.5)
No psychiatric contact	905	70 419	12.9 (12.0–13.7)	48 372	8 532 606	5.7 (5.6–5.7)

Data are n, unless otherwise specified. *Do not add up to total in some cases because of rounding. †Mother's and father's specific psychiatric disorders were included as two time-dependent variables with mutually exclusive groups, and in order of hierarchy.

Table 1: Characteristics of parents and offspring with any psychiatric disorder by parental history of homelessness

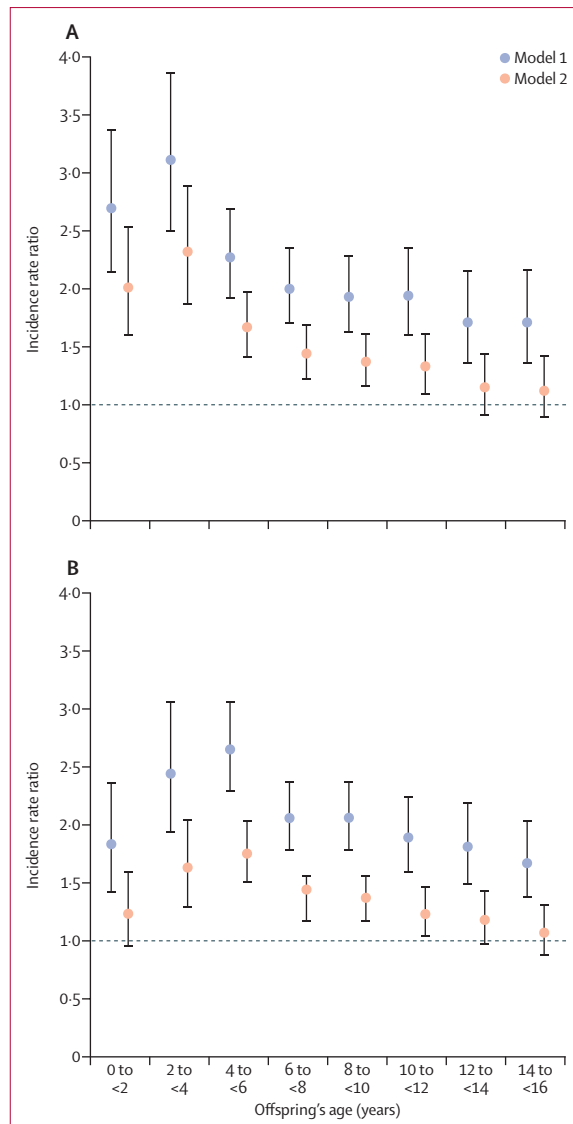


Figure 1: Incidence rate ratios of first occurrence of any psychiatric disorder during childhood and adolescence according to mother's (A) or father's (B) history of homelessness compared with no history of homelessness by offspring's age

Parental history of homelessness begins on the first date of a homeless shelter contact since 1999 until the end of study. Model 1 is adjusted for calendar year, offspring's sex, offspring's country of origin, and the other parent's history of homelessness. Model 2 is further adjusted for parental age at offspring's birth and parental psychiatric disorders, which were included as two time-dependent variables with mutually exclusive groups, in order of hierarchy.

single and recurrent depressive disorder; neurotic, stress-related, and somatoform disorder; personality disorder; behavioural and emotional disorder; other mental disorders; and no psychiatric contact (see codes in appendix p 1). Thus, we defined a parent as having a psychiatric disorder from the first date of the specific diagnosis from 1969 onwards, but shifted to a category of another disorder from the date of receiving a psychiatric diagnosis higher in the hierarchy than the first one and

onwards. The hierarchical covariate was used because of the long follow-up period for parental psychiatric disorders. We regarded the later received diagnoses to be the most influential to the offspring's risk of psychiatric disorders unless the disorder was less severe than the previous one (according to the hierarchical ICD-10 system). Shifts to disorders higher in the hierarchy than first diagnoses were possible until the end of the study or censoring, whichever came first. Thus, for the main analyses we used two key covariates: maternal and paternal history of homelessness; and, for adjustment and two interaction analyses, the two psychiatric covariates (overall or hierarchical). We used both covariates to elaborate on the influence of parental psychiatric disorders on the association between parental homelessness and offspring's risk of psychiatric disorders in two interaction analyses. The hierarchical covariate also has limitations as no clear cut can be made between the severity of the specific disorders and thus, we presented data using both covariates in the interaction analysis. For the interaction analyses, the comparison group was defined as parents with neither a homeless shelter contact during the study period, nor a psychiatric contact since 1969.

Permission to use the data was obtained from the Danish Data Protection Agency (2012-58-0004), the National Social Appeals Board, the National Health Data Authority, and the National Board of Health. No ethical permission was required for this study under Danish law.

Outcomes

The main outcome was any psychiatric disorder, which included substance use disorder during childhood and adolescence (with maximum age of 16 years because of the length of study period). We obtained this information from the Danish Psychiatric Central Research Register¹⁸ and the Danish National Patient Register,¹⁹ which was defined according to the ICD-10.²⁰ Furthermore, the following 14 specific selected psychiatric diagnostic groups were used as secondary outcomes: substance use disorder, psychosis, affective disorder, anxiety and obsessive-compulsive disorder, eating disorder, mental retardation, developmental disorder, autism spectrum disorder, attention-deficit hyperactivity disorder, oppositional defiant disorder and conduct disorder, attachment disorder, tics and Tourette's disorder, other developmental disorders, and a group of other mental disorders (appendix p 1).

Statistical analysis

The follow-up of the cohort began on Jan 1, 1999, the date of birth, or date of becoming a Danish citizen, whichever came last. Each cohort member was followed up until first psychiatric diagnosis or, in the 14 diagnosis-specific subanalyses, until the first diagnosis of that specific disorder, Dec 31, 2015, the date of death, or the date of emigration from Denmark, whichever came first.

See Online for appendix

We analysed the association between parental history of homelessness and risk of psychiatric disorders in the offspring by survival analysis using Poisson regression in SAS (version 9.4). This analysis provided incidence rate ratios (IRRs), which were estimated by log-likelihood estimation, and Wald 95% CIs were calculated.

To show the unadjusted associations with any child and adolescent psychiatric disorder, we present incidence (cases per 1000 person-years) for participants' characteristics, parental characteristics, and parental homelessness and parental psychiatric disorders before offspring's birth. We used two regression models to calculate adjusted associations. Model 1 was adjusted for calendar year and the offspring's age, sex, and country of origin (Denmark and other high-income countries versus low-income and middle-income countries). Model 2 was additionally adjusted for parental factors: mother's and father's age at offspring's birth (<25 years, 25–34 years, ≥35 years) and the hierarchical covariate of parental psychiatric disorders. Both models were used with the two different psychiatric outcomes in children and adolescents: any psychiatric disorder, or specific disorders or groups. In the subanalyses with 14 specific psychiatric disorders or groups as an outcome, we noted p values that were significant after Bonferroni correction.

We calculated cumulative incidence to show the probability of an individual having any psychiatric disorder during childhood and adolescence if their mother or father had a history of homelessness and a psychiatric disorder. Because these analyses are probabilities, it was necessary to restrict information on parental psychiatric disorder and homelessness to the time before the offspring's birth.

We also examined the time of the parents' first report of homelessness in relation to the time of the offspring's birth (ie, whether it began before the year before birth, the year before birth, or from birth and onwards) and its relation to the offspring's risk of any psychiatric disorder. For this analysis, we excluded information on parental homelessness from 1999 to 2000 to obtain a more truly incident homeless population, because 1999 was the first year of the database, so it might have included long-term homeless individuals who were initially registered rather than were newly homeless. We separated the analysis according to offspring age (ie, younger than and from 5 years).

As a sensitivity analysis, we examined whether restriction of parental history of homelessness and psychiatric disorders to the time before the offspring's birth would change the risk of any psychiatric disorder or the four most prevalent specific psychiatric disorders in the cohort. Because of our definition of homelessness is broad, we did a sensitivity analysis using a more narrow definition (at least three homeless shelter contacts). In this analysis, parents with a history of homelessness were regarded more severely homeless. To check for clustering of offspring with the same mother, we restricted the

	Offspring with psychiatric disorders in childhood and adolescence	Model 1 IRR (95% CI)*	p value†	Model 2 IRR (95% CI)‡	p value‡
Any psychiatric disorder including substance use disorder (n=56 330)	..	..	<0.0001	..	<0.0001
Both parents homeless	202	2.8 (2.4–3.2)	..	1.6 (1.4–1.9)	..
Only mother homeless	647	2.5 (2.3–2.7)	..	1.6 (1.5–1.7)	..
Only father homeless	865	2.3 (2.2–2.5)	..	1.4 (1.3–1.5)	..
Neither parent homeless	54 616	1	..	1	..
Substance use disorder (n=944)	..	..	<0.0001§	..	<0.0001§
Both parents homeless	5	3.7 (1.5–9.0)	..	1.4 (0.6–3.4)	..
Only mother homeless	36	6.9 (4.9–9.7)	..	3.3 (2.3–4.7)	..
Only father homeless	33	4.0 (2.8–5.6)	..	1.7 (1.1–2.4)	..
Neither parent homeless	870	1	..	1	..
Psychosis (n=850)	..	..	<0.0001§	..	0.01
Both parents homeless	8	5.4 (2.7–1.9)	..	2.9 (1.4–5.9)	..
Only mother homeless	16	3.1 (1.9–5.0)	..	1.8 (1.1–3.0)	..
Only father homeless	13	1.6 (0.9–2.7)	..	0.9 (0.5–1.5)	..
Neither parent homeless	813	1	..	1	..
Affective disorder (n=2264)	..	..	0.14	..	0.53
Both parents homeless	5	1.6 (0.7–3.8)	..	1.0 (0.4–2.3)	..
Only mother homeless	21	1.6 (1.1–2.5)	..	1.1 (0.7–1.7)	..
Only father homeless	24	1.1 (0.8–1.7)	..	0.8 (0.5–1.1)	..
Neither parent homeless	2214	1	..	1	..
Anxiety and OCD (n=16 752)	..	..	<0.0001§	..	0.0002§
Both parents homeless	52	2.3 (1.7–3.0)	..	1.2 (0.9–1.5)	..
Only mother homeless	198	2.4 (2.0–2.7)	..	1.3 (1.1–1.5)	..
Only father homeless	265	2.1 (1.9–2.4)	..	1.2 (1.1–1.4)	..
Neither parent homeless	16 237	1	..	1	..
Eating disorder (n=2275)	..	..	0.74	..	0.38
Both parents homeless	3	0.9 (0.3–2.7)	..	0.7 (0.2–2.2)	..
Only mother homeless	15	1.2 (0.7–2.0)	..	1.1 (0.6–1.8)	..
Only father homeless	15	0.8 (0.5–1.4)	..	0.7 (0.4–1.1)	..
Neither parent homeless	2242	1	..	1	..
Mental retardation (n=5642)	..	..	<0.0001§	..	<0.0001§
Both parents homeless	37	3.4 (2.4–4.6)	..	2.1 (1.5–2.9)	..
Only mother homeless	95	2.9 (2.3–3.5)	..	1.9 (1.6–2.4)	..
Only father homeless	119	2.9 (2.4–3.5)	..	1.7 (1.4–2.1)	..
Neither parent homeless	5391	1	..	1	..
Developmental disorder (n=11 372)	..	..	<0.0001§	..	<0.0001§
Both parents homeless	57	3.7 (2.9–4.8)	..	2.2 (1.7–2.9)	..
Only mother homeless	129	2.4 (2.0–2.8)	..	1.5 (1.3–1.8)	..
Only father homeless	186	2.4 (2.1–2.8)	..	1.5 (1.3–1.8)	..
Neither parent homeless	11 000	1	..	1	..
Autism spectrum disorder (n=13 843)	..	..	<0.0001§	..	<0.0001§
Both parents homeless	23	1.1 (0.7–1.7)	..	0.8 (0.5–1.2)	..
Only mother homeless	145	2.0 (1.7–2.4)	..	1.6 (1.3–1.9)	..
Only father homeless	176	1.8 (1.5–2.1)	..	1.3 (1.1–1.5)	..
Neither parent homeless	13 499	1	..	1	..

(Table 2 continues on next page)

	Offspring with psychiatric disorders in childhood and adolescence	Model 1 IRR (95% CI)*	p value†	Model 2 IRR (95% CI)‡	p value†
(Continued from previous page)					
Attention-deficit hyperactivity disorder (n=19 005)	..	..	<0.0001§	..	<0.0001§
Both parents homeless	97	4.0 (3.2–4.8)	..	2.0 (1.6–2.4)	..
Only mother homeless	289	3.2 (2.9–3.6)	..	1.9 (1.6–2.1)	..
Only father homeless	375	2.9 (2.6–3.2)	..	1.5 (1.4–1.7)	..
Neither parent homeless	18 244	1	..	1	..
Oppositional defiant disorder and conduct disorder (n=1847)	..	..	<0.0001§	..	0.0042
Both parents homeless	7	2.8 (1.3–5.9)	..	1.1 (0.5–2.3)	..
Only mother homeless	28	3.1 (2.2–4.6)	..	1.5 (1.0–2.2)	..
Only father homeless	50	3.9 (3.0–5.2)	..	1.7 (1.3–2.3)	..
Neither parent homeless	1762	1	..	1	..
Attachment disorder (n=1539)	..	..	<0.0001§	..	<0.0001§
Both parents homeless	54	32.5 (24.6–42.9)	..	6.1 (4.6–8.1)	..
Only mother homeless	98	16.0 (13.0–19.7)	..	4.2 (3.4–5.2)	..
Only father homeless	89	10.2 (8.2–12.7)	..	2.5 (2.0–3.2)	..
Neither parent homeless	1298	1	..	1	..
Tics and Tourette's disorder (n=4443)	..	..	<0.0001§	..	0.0013§
Both parents homeless	11	1.8 (1.0–3.3)	..	1.2 (0.7–2.2)	..
Only mother homeless	50	2.3 (1.7–3.0)	..	1.6 (1.2–2.2)	..
Only father homeless	65	2.1 (1.6–2.7)	..	1.4 (1.1–1.8)	..
Neither parent homeless	4317	1	..	1	..
Other developmental disorders including enuresis, encopresis (n=7716)	..	..	<0.0001§	..	<0.0001§
Both parents homeless	41	3.8 (2.8–5.2)	..	2.3 (1.7–3.1)	..
Only mother homeless	76	2.1 (1.6–2.6)	..	1.3 (1.1–1.7)	..
Only father homeless	102	2.1 (1.7–2.5)	..	1.3 (1.1–1.6)	..
Neither parent homeless	7497	1	..	1	..
Other mental disorders (n=1774)	..	..	0.0003§	..	0.28
Both parents homeless	5	2.2 (0.9–5.3)	..	1.4 (0.6–3.4)	..
Only mother homeless	14	1.7 (1.0–2.9)	..	1.1 (0.7–2.0)	..
Only father homeless	26	2.3 (1.6–3.4)	..	1.5 (1.1–2.2)	..
Neither parent homeless	1729	1	..	1	..

Data are n, unless otherwise specified. A history of homelessness was defined as a time-dependent variable with onset on the date of first homeless shelter contact during the study period and onwards. IRR=incidence rate ratio. *Model 1 was adjusted for calendar time, offspring's age, offspring's sex, and offspring's country of origin. †Overall p value for the group comparison. ‡Model 2 was adjusted for factors included in model 1 as well as parental age at offspring's birth and parental psychiatric disorders included as two time-dependent variables with mutually exclusive groups, and in order of hierarchy. §Statistically significant after Bonferroni correction.

Table 2: Poisson regression analysis of mother's and father's history of homelessness and offspring's risk of psychiatric disorder

cohort to the mother's first-born offspring in a third sensitivity analysis.

Role of the funding source

The funder of the study had no role in the study design, data collection, data analysis, data interpretation, or writing of the manuscript. The corresponding author

had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

From Jan 1, 1999, to Dec 31, 2015, 1072 882 individuals aged 0–16 years were included in the study and followed up for 9164928 person-years. 64928 (6%) of 1137810 children and adolescents had an unknown mother or father, and were therefore excluded from the study. 549972 [51%] of 1072882 individuals were boys. In all, 17238 (2%) offspring had either one or two parents with a history of homelessness during the study period. Specific numbers of offspring who had a parent with a history of homelessness and the proportion of the parents who had a psychiatric disorder are reported in the appendix (p 2). 56330 (5%) children and adolescents were diagnosed with any psychiatric disorder during the study period (table 1).

Characteristics of individuals in the cohort and their parents by parental history of homelessness are in table 1. The incidence of any psychiatric disorder was 15.1 cases per 1000 person-years (95% CI 14.4–15.8) in offspring with at least one parent having a history of homelessness compared with 6.0 cases per 1000 person-years (95% CI 6.0–6.1) in those whose parents had no such history. Independent of characteristics, an increased risk of any psychiatric disorder was found in the offspring of parents with a history of homelessness. Corresponding figures when parental history of homelessness and psychiatric disorders were restricted to the time before the offspring's birth are provided in the appendix (p 3).

Especially in the youngest age groups, the offspring of parents with a history of homelessness had higher IRRs of any psychiatric disorder than those whose parents had no history of homelessness (figure 1). For children aged 2–4 years who had a mother with a history of homelessness, the IRR was 2.3 (95% CI 1.9–2.9) after adjustment for parental psychiatric disorders.

For any psychiatric disorder, the IRR was 2.5 (95% CI 2.3–2.7) for offspring with only a mother having a history of homelessness compared with those whose parents had no such history (table 2). Similar IRRs were found if both parents or only the father had a history of homelessness, although the risk was lower if only the father had a history of homelessness than if only the mother had a history of homelessness (in fully adjusted analyses). We identified a higher risk for most of the specific disorders in offspring having one or two parents with a history of homelessness (table 2). The highest IRR was found for attachment disorder when both parents had a history of homelessness (IRR 32.5 [95% CI 24.6–42.9]). Parental history of homelessness was also associated with high risk of substance use disorders in offspring, especially in those whose mothers had a history of homelessness (6.9 [4.9–9.7]). Besides these two outcomes, the risk of psychosis, and attention-deficit hyperactivity disorder in the fully adjusted model only, were also found to be higher when only the mother had a history of homelessness than

when only the father had such a history. After adjustment for parental psychiatric disorders, an increased risk associated with parental history of homelessness was found for most of the psychiatric outcomes, but not affective disorders and eating disorders (estimates for parental psychiatric disorders in the fully adjusted model are reported in the appendix pp 4–9).

The IRRs of any psychiatric disorder in the offspring of mothers or fathers with a history of homelessness in combination with any and specific psychiatric disorders are shown in table 3. Offspring with a mother with both a history of homelessness and any psychiatric disorder had a higher IRR of 2.8 (95% CI 2.5–3.0) than those whose mothers neither had a history of homelessness, nor a psychiatric disorder. The corresponding IRR for fathers was 2.0 (95% CI 1.8–2.1). A history of maternal homelessness was associated with increased risk of any psychiatric disorder in offspring, both in those whose mothers had any psychiatric disorder (and the specific disorders; neurotic, stress-related, or somatoform disorders; or personality disorders) and in those whose mothers had no psychiatric contact, compared with offspring whose mothers had no history of homelessness (table 3). The offspring of fathers with a substance use disorder and no psychiatric contact also had higher risk of any psychiatric disorder if the father had a history of homelessness compared with those whose fathers had no such history.

Figure 2 shows the cumulative psychiatric morbidity in offspring from birth to 16 years of age according to mother's and father's history of homelessness and any psychiatric disorder prior to the offspring's birth. By the age of 15 years, the highest proportion of offspring with any psychiatric disorder were found in those with a mother who had both a history of homelessness and any psychiatric disorder (35.9% [27.1–44.8]; appendix p 10). Similar risks of having any psychiatric disorder were found in offspring when the first parental homeless shelter contact took place before 1 year before birth, in the year before birth, and after birth (appendix p 11).

Our three sensitivity analyses showed no considerable changes from the main analyses (table 2; restriction of parental covariates to the time before the offspring's birth, restriction of the homeless definition to at least three homeless shelter contacts [only higher estimates in model 1], and restriction of the cohort to include mother's first born child only; appendix pp 12–17).

Discussion

This Danish register-based cohort study is the first, to our knowledge, to show an association between parental history of homelessness and the offspring's risk of psychiatric disorders. The highest risks were found for attachment disorder and substance use disorder, and risk in offspring whose mother had a history of homelessness was higher than in those with a father who had such a history. Offspring had a particularly high risk of being

	Mother or father with a history of homelessness*		Mother or father without a history of homelessness*		p value‡
	Offspring with any psychiatric disorder in childhood and adolescence	Model 2 IRR (95% CI)†	Offspring with any psychiatric disorder in childhood and adolescence	Model 2 IRR (95% CI)†	
Mother's psychiatric disorder					
No psychiatric contact	378	1.7 (1.5–1.9)	44 066	1 (ref)	..
Primary outcome: any psychiatric disorder§	471	2.8 (2.5–3.0)	11 415	2.1 (2.1–2.2)	<0.0001
Secondary outcome: specific psychiatric disorders¶	..	..	..	..	<0.0001
Organic disorder	19	4.4 (2.8–6.9)	220	2.6 (2.3–2.9)	..
Substance use disorder	212	2.6 (2.2–2.9)	1973	2.2 (2.1–2.3)	..
Schizophrenia or bipolar disorder	23	3.4 (2.3–5.1)	531	2.7 (2.4–2.9)	..
Single and recurrent depressive disorder	56	2.3 (1.8–3.0)	3273	2.2 (2.2–2.3)	..
Neurotic, stress-related, and somatoform disorder	110	3.1 (2.6–3.8)	3701	2.0 (1.9–2.0)	..
Personality disorder	30	3.9 (2.7–5.6)	674	2.2 (2.0–2.4)	..
Behavioural and emotional disorder including hyperkinetic disorder	10	2.3 (1.3–4.3)	394	2.8 (2.5–3.1)	..
Other psychiatric disorders	11	2.4 (1.3–4.4)	649	1.5 (1.4–1.6)	..
Father's psychiatric disorder					
No psychiatric contact	426	1.7 (1.5–1.9)	48 851	1 (ref)	..
Primary outcome: any psychiatric disorder§	641	2.0 (1.8–2.1)	6412	1.7 (1.6–1.7)	<0.0001
Secondary outcome: specific psychiatric disorders¶	..	..	..	..	<0.0001
Organic disorder	30	2.3 (1.6–3.3)	248	1.9 (1.7–2.1)	..
Substance use disorder	462	2.0 (1.8–2.2)	2235	1.7 (1.6–1.8)	..
Schizophrenia or bipolar disorder	16	1.8 (1.1–2.9)	254	1.6 (1.4–1.8)	..
Single and recurrent depressive disorder	30	1.8 (1.2–2.5)	1005	1.6 (1.5–1.7)	..
Neurotic, stress-related, and somatoform disorder	55	1.8 (1.4–2.4)	1583	1.6 (1.5–1.6)	..
Personality disorder	17	2.0 (1.2–3.2)	307	1.8 (1.6–2.0)	..
Behavioural and emotional disorder including hyperkinetic disorder	21	2.9 (1.9–4.4)	439	2.2 (2.0–2.4)	..
Other psychiatric disorders	10	2.2 (1.2–4.0)	341	1.4 (1.2–1.5)	..

Data are n, unless otherwise specified. IRR=incidence rate ratio. *A history of homelessness was defined as a time-dependent variable with onset on the date of first homeless shelter contact since 1999 and onwards; no history of homelessness was defined as having no homeless shelter contact during the study period. †This model was mutually adjusted for mother's or father's history of homelessness and psychiatric disorder, and additionally adjusted for calendar time, offspring's age, offspring's sex, offspring's country of origin, and parental age at offspring's birth, and the reference group was mothers or fathers who had no history of homelessness and no psychiatric contact. ‡Overall p value for the group comparison. §Any psychiatric disorder received during a hospital contact was defined as a time-dependent variable with onset on first diagnosis since 1969 and onwards. ¶Specific maternal or paternal psychiatric disorders were included as two time-dependent variables with mutually exclusive groups, and in order of hierarchy.

Table 3: Interaction analysis of mother's and father's history of homelessness and psychiatric disorders and offspring's risk of any psychiatric disorder including substance use disorder during childhood and adolescence, 1999–2015

diagnosed with a psychiatric disorder in early childhood if a parent had a history of homelessness. By the age of 15 years, around a third of the offspring who had a mother

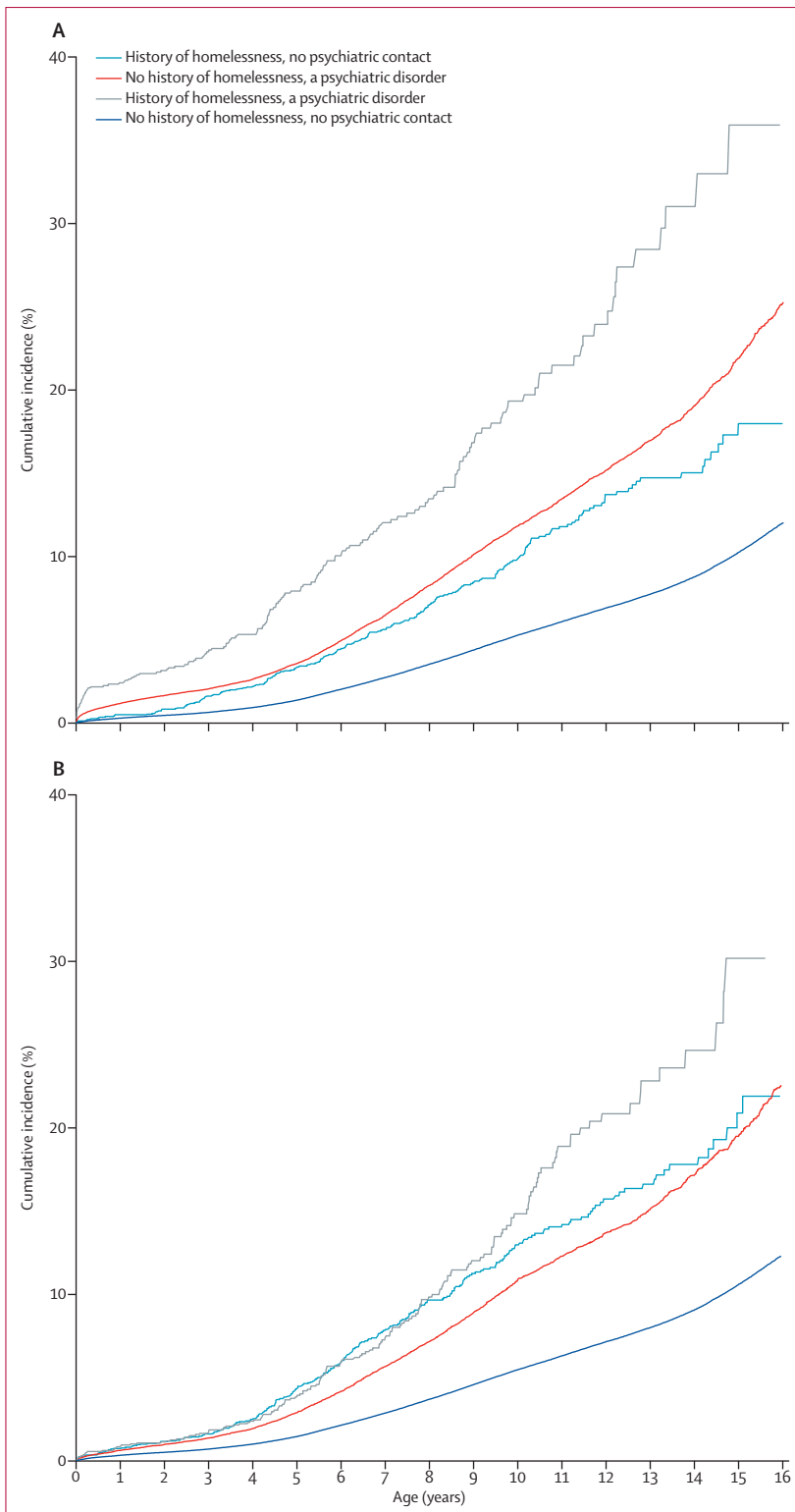


Figure 2: Cumulative incidence of psychiatric disorders during childhood and adolescence according to mother's (A) and father's (B) history of homelessness and psychiatric disorders before the offspring's birth

with both a history of homelessness and a psychiatric disorder had received a psychiatric diagnosis themselves.

These results are important for helping to understand the development of psychiatric problems in children and adolescents growing up under difficult circumstances. Several factors might explain the link between parental homelessness and the increased risk of psychiatric disorders in offspring. Previous results have underlined that homelessness makes parenting difficult,⁹ partly due to an absence of positive parenting role models, and partly due to high rates of chronic medical conditions, untreated emotional and behavioural disorders, unstable living conditions, and histories of adverse life experiences.²² Previous studies have suggested that children living in homeless families often have poorer psychiatric outcomes than children from low-income, housed families.^{23,24} One explanation could be high rates of undiagnosed and untreated psychiatric disorders in homeless parents or an absence of adjustment for family history of psychiatric morbidity in this research.²² Pregnancy and disrupted early attachment have been suggested to be important in the development of behavioural problems in offspring.⁴ Thus, we had expected that the association would be stronger when the parent's first homeless shelter contact took place during pregnancy or after the child's birth rather than before pregnancy. However, our results suggested a consistently increased risk of psychiatric disorders in offspring independent of the time of first homeless shelter contact, perhaps suggesting that any period of homelessness, even before pregnancy, is a marker of long-lasting instability of the home environment. Previous studies have suggested that substance use disorders, anxiety, and depression in mothers can influence the offspring's risk of psychiatric problems.^{4,23,25} Our results confirmed that these maternal psychiatric disorders were associated with an increased risk of offspring having any psychiatric disorder, and we also found an increased risk for the offspring of mothers with all the other psychiatric disorders or groups. However, for mothers with neurotic, stress-related, and somatoform disorders, personality disorders, and organic disorders, the homelessness experience increased the risk further. We also found that the probability of being diagnosed with a psychiatric disorder during childhood and adolescence was highest for those with a mother who had both a history of homelessness and a psychiatric disorder before the offspring's birth. This finding might indicate that high exposure to genetic and environmental factors is associated with highest risk of psychiatric problems in offspring. However, greater surveillance and detection of health problems in families with vulnerable parents might also be a factor, especially those with psychiatric disorders. Our findings of the high risk of an individual being diagnosed with a psychiatric disorder at an early age could also support this explanation of greater

surveillance of socially marginalised families. However, it could also be the other way around: vulnerable families can be overlooked and underdiagnosed. Poverty could also explain our findings because it is also associated with excess risk of psychiatric problems in children.^{11,23} However, children of formerly homeless mothers are at elevated risk of several psychiatric problems even when compared with children of low-income, housed mothers with preclinical levels of problem behaviour.²⁶

We found associations between parental history of homelessness and an increased risk of specific psychiatric disorders in offspring. These associations are in line with previous studies of homeless children and adolescents, which showed high levels of developmental delays, conduct disorder, depression, anxiety, psychosis, mania, post-traumatic stress disorder, antisocial behaviour, attention-deficit hyperactivity disorder, and substance use disorder.^{8,10,22,27,28} Furthermore, we also found associations with autism spectrum disorders, mental retardation, tics and Tourette's disorders, and attachment disorder. This study is different from most previous studies because the majority of children in our sample were not expected to experience homelessness themselves, but were more likely to experience parental-related problems or separations from primary care givers because of their parents' homelessness. Our findings support the notion that socially marginalised families should receive special support with regard to prevention and early intervention of psychiatric problems in offspring, especially attachment disorder, which has been shown to be costly for the child, family, and society.²⁹

This study has several strengths. First, the study was based on a nationwide and almost complete cohort of children and adolescents with accurate linkage to their parents' use of public homeless shelters. Our cohort is likely to be generalisable to children younger than 16 years in other high-income countries with well-developed social support systems. Second, our study design is unique because of its prospectively collected data with long and individual lengths of follow-up. Third, data on death, emigration, and diagnoses from hospital contacts were complete, and we were able to study specific psychiatric outcomes.

Our study also had limitations. We only had access to information about homeless shelter contacts, and thus cannot know whether parents defined as having no history of homelessness had been or were currently homeless, but not using the public shelters. However, we expect the number of parents who were homeless, but not using public shelters, to be small because most homeless people in Denmark use the shelters at some point during a longer follow-up period.³⁰ Homeless shelters in Denmark are open only to adults, but, some of the children might have experienced unstable living conditions outside of shelters. Women with children would generally not be admitted to a homeless shelter in Denmark. They would instead be offered other emergency accommodation (eg, crisis

centres for women which are covered by the 109 act in the Consolidation Act on Social Services).¹⁷ Also, our definition of parental homelessness is likely to capture a range of adverse life events, including adverse childhood experiences, which can affect the risk of homelessness and the ability to care for offspring. Such factors might explain some of the increased risk of psychiatric morbidity in offspring. However, parental homelessness should be seen as an indicator of susceptibility to psychiatric illness in offspring. One study²⁸ found parental distress and recent adverse life events to be the primary predictors of the children's behaviour problems, rather than housing. We did not have information on the period after the first homeless shelter contact. Different scenarios might have taken place: some people sleep rough on the streets, others stay temporarily at the homes of friends or families, and others are offered a place to live by the municipality. We only had information from the Homeless Register since 1999 and cannot know whether people had histories of homelessness in previous years. Information on psychiatric disorders was obtained from both psychiatric and somatic hospital and outpatient services. Diagnoses from the somatic wards might be less precise; however, patients in Denmark are most often diagnosed after consultation with a psychiatric specialist. A further limitation is the possibility of residual confounding. We did not have information on other factors such as undiagnosed disorders, parenting,²⁶ adverse life-events,²⁸ actual time spent with the child, and parental emotional status.¹³ Lastly, we did not include children with no linkage to parents, who might constitute a special subgroup with a different risk profile.

In conclusion, we showed an association between mother's and father's history of homelessness and offspring's risk of any and specific psychiatric disorders during childhood and adolescence even after adjustment for parental psychiatric disorders. Risk was especially high for attachment and substance use disorder. These findings are relevant from a public health and policy perspective because they point to a need for improvement in the support of socially marginalised families. Public services could play an important role in providing the help these families need to reduce or even prevent the development of child and adolescent psychiatric problems. Moreover, research into and increased focus on the prevention of parental homelessness in high-income countries might also reduce the psychiatric morbidity in offspring.

Contributors

SFN obtained the funding and acquired the data. SFN did the literature search. All authors designed the study. SFN wrote the protocol with supervision from TML, CH, AT, and MN. SFN constructed the database and did all the statistical analyses with supervision from TML, CH, AT, and MN. All authors analysed and interpreted the data. SFN drafted the manuscript, and TML, CH, AT, and MN revised the manuscript. All authors approved the final version.

Declaration of interests

We declare no competing interests.

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