



## Familial and neighborhood effects on psychiatric disorders in childhood and adolescence



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### ABSTRACT

**Background:** More knowledge is needed on potential associations between individual-, family-, and neighborhood-level factors and psychiatric disorders in children and adolescents.

**Aims:** To examine associations between individual-, family-, and neighborhood-level factors and incident internalizing (anxiety and mood) disorders and externalizing (ADHD and conduct) disorders in children and adolescents, and to estimate the relative contributions of family and neighborhood to individual variation in these disorders.

**Method:** We performed a three-level logistic regression on all 542,195 children born in Sweden in 1992–1996, nested in 427,954 families, which in turn were nested in 8475 neighborhoods. The children were followed from 2000 to 2010 for incident internalizing and externalizing psychiatric disorders, assessed from medical records.

**Results:** 26,514 children (4.8%) were diagnosed with internalizing or externalizing psychiatric disorders. Approximately 29% of the total individual variance in internalizing disorders could be attributed to the family level, which includes both genetic and family environmental effects, and 5% to the neighborhood level. The corresponding figures for externalizing disorders were 43.5% and 5.5%, respectively. After adjustment for individual-level sociodemographic factors, high neighborhood deprivation was associated with increased risks of externalizing and internalizing psychiatric disorders (odds ratio [OR] = 1.37, 95% credible interval [CI] = 1.25–1.50 and OR = 1.34, 95% CI = 1.25–1.45, respectively), including conduct disorder (OR = 2.01, 95% CI = 1.58–2.55), anxiety disorders (OR = 1.40, 95% CI = 1.29–1.52), and mood disorders (OR = 1.21, 95% CI, 1.09–1.35). The strongest association between neighborhood deprivation and ADHD was observed in moderately deprived neighborhoods (OR = 1.31, 95% CI = 1.19–1.44).

**Conclusions:** These findings call for policies to promote mental health that consider potential influences from children's family and neighborhood environments.

**Trial registration:** Not applicable.

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## 1. Introduction

Findings from a US national survey (NCS-A) and from NHANES show that psychological distress is common in children and adolescents (Merikangas et al., 2010a, 2010b; Kessler et al., 2012). The influence of individual-level factors such as race/ethnicity and poverty on psychological disorders is well established (Samaan, 2000; Costello et al., 2001, 2003). Research into neighborhood effects dates from as early as the 1930s, when Chicago School

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researchers Faris and Dunham reported an ecological association between residence in disorganized neighborhoods and psychiatric disorders, particularly schizophrenia and substance abuse, in 30,000 adults treated in psychiatric hospitals. They found no visible pattern across neighborhoods in the distribution of affective disorders (Faris and Dunham, 1939). Although Faris and Dunham used aggregated data and could not take individual socioeconomic status (SES) into consideration, other studies have examined the influence of neighborhood SES on adult psychiatric disorders using multilevel modeling that separates neighborhood from individual effects (Lofors et al., 2006; Lofors and Sundquist, 2007). For example, investigators recently found that neighborhood deprivation is associated with psychiatric medication prescription in adults, independent of individual-level sociodemographic characteristics (Crump et al., 2011). The strongest associations were found for antipsychotics and anxiolytics, with adjusted odds ratios (ORs) of 1.40 and 1.24, respectively, comparing the highest to lowest quintiles of neighborhood deprivation. Other longitudinal studies from the UK of 8000–90,000 adults found that neighborhood effects on common psychiatric disorders were explained by household and individual socioeconomic factors, rather than being a true neighborhood effect (Weich et al., 2003, 2005). In contrast, a literature review found spatial differences in nonaffective psychoses but an apparent absence of spatiality of affective psychoses in adults (March et al., 2008). Data from UK, the Aetiology and Ethnicity in Schizophrenia and Other Psychoses (AESOP) study revealed that 23% of the variance in incidence of schizophrenia across wards could be attributed to neighborhood-level risk factors (Kirkbride et al., 2007). In addition, another study from the Bristol group and Chilean colleagues found a significant association between quality of the built environment of small geographical sectors and presence of common mental disorders in its adult residents (Araya et al., 2007).

While several studies have suggested a link between neighborhood characteristics and adult mental health outcomes, fewer studies have examined potential neighborhood-level effects on psychopathology in children and adolescents. Furthermore, previous studies have been limited by small sample sizes, inadequate adjustment for confounding, or modeling that did not optimally distinguish individual- and family-from neighborhood-level effects. In this study, we examined the associations of neighborhood-level deprivation and family- and individual-level factors with incidence of specific internalizing and externalizing psychiatric disorders (anxiety disorders, mood disorders, attention deficit hyperactivity disorder [ADHD], and conduct disorder) in a follow-up study of children and adolescents living in Sweden. The novel contribution of this largest cohort study in the world to date (542,195 children, nested in 427,954 families, which in turn were nested in 8475 neighborhoods) is that it examines potential effects on internalizing as well as externalizing disorders at three levels (individuals, families, and neighborhoods) and is constructed from highly complete, nationwide register data that avoid bias from self-reporting.

Our aims were to: 1) examine associations of neighborhood-level deprivation and family- and individual-level factors with incident internalizing and externalizing psychiatric disorders in children and adolescents, as assessed based on in- and out-patient contacts; and 2) estimate the relative contributions of family and neighborhood to individual variation in internalizing and externalizing psychiatric disorders among children and adolescents.

## 2. Methods

The Swedish nationwide population and health care registers have exceptionally high completeness and validity, with most variables being 95–100% complete (Rosen and Hakulinen, 2005).

We used data from multiple Swedish nationwide registries, including healthcare data, which were linked using the unique individual Swedish 10-digit personal ID number assigned at birth or immigration to all Swedish residents. This ID number was replaced by a serial number in order to preserve confidentiality. The following sources were used to create our database: the Total Population Register, containing annual data on family, education level, and area of residence; the Multi-Generation Register, providing information on family relations; the Swedish Hospital Discharge Register, containing all hospitalizations for all Swedish inhabitants from 2000 to 2010; and the Outpatient Care Register, containing information from all outpatient clinics from 2001 to 2010. In the database a family consists of a maximum of two generations where people are related to each other and are registered on the same property. Each family has its own ID number. Geographic status was defined as Small Areas for Market Statistics (SAMS), which are small geographical units with boundaries defined by homogenous types of buildings as defined by Statistics Sweden. All Swedish individuals have been geocoded to these areas. There are approximately 9200 SAMS throughout Sweden, with an average population of 1000. SAMS were used as proxies for neighborhoods, as in previous research (Cubbin et al., 2006; Johnell et al., 2006).

We conducted a closed cohort study: all children born in 1992–1996 were included at the start of the study in January 2000 (when they were aged 4–8 years) and were followed up for 10 years (maximum age 18 years). The follow-up period was from January 1, 2000 until the first inpatient or outpatient psychiatric diagnosis, death, emigration, or the end of the study period on December 31, 2010. Before enrollment into the study, children and adolescents who had previously been diagnosed with any psychiatric disorder ( $n = 2225$ ) were excluded in order to remove pre-existing cases. The most common diagnoses among those excluded were “Special symptoms or syndromes, not elsewhere classified” ( $n = 1052$ , 47.3%), “Specific delays in development” ( $n = 329$ , 14.8%) and “Other behavioral and emotional disorders with onset usually occurring in childhood and adolescence” ( $n = 127$ , 5.7%). Those excluded individuals constituted approximately 8% of the total number of events. In total the study included 542,195 children born in 1992–1996, nested in 427,954 families, which in turn were nested in 8475 neighborhoods. We followed each individual until their first psychiatric diagnosis during the follow-up period, so that each individual could be counted only once as having an event.

### 2.1. Outcome variable: childhood and adolescent internalizing and externalizing psychiatric disorders

The outcome variable was a first inpatient or outpatient diagnosis of an internalizing or externalizing psychiatric disorder in childhood or adolescence. Diagnoses of psychiatric disorders were retrieved from the Hospital Discharge Register (2000–2010) and Outpatient Care Register (2001–2010). Internalizing disorders are those that children internalize, such as anxiety and mood disorders. By contrast, externalizing disorders are those that children externalize, such as ADHD and conduct disorder. Internalizing and externalizing psychiatric disorders were defined according to International Classification of Diseases (ICD)-10 codes for anxiety disorders (F40–F48 and F93), mood disorders (F30–F39), ADHD (F90), and conduct disorder (F91).

### 2.2. Independent variable: neighborhood-level deprivation

A summary index – the neighborhood deprivation index (NDI) – was calculated to characterize neighborhood-level deprivation.

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