# Trajectories of Neighborhood Cohesion in Childhood, and Psychotic and Depressive Symptoms at Age 13 and 18 Years

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**Objective:** Exposure to adverse social environments has been associated with psychotic and depressive symptoms in adolescence in cross-sectional studies, but the longitudinal relation is unclear. This study examined whether longitudinal trajectories of exposure to adverse social environments across childhood are associated with psychotic experiences and depressive symptoms in adolescence.

**Method:** Data on participants from the Avon Longitudinal Study of Parents and Children (ALSPAC) were used to estimate longitudinal trajectories of childhood exposure to neighborhood cohesion (NC), discord (ND), and stress (NS) using latent class growth modeling. Logistic regression was used to examine the association between these trajectories and psychotic experiences and depressive symptoms at 13 and 18 years of age, adjusting for maternal psychopathology, participant sociodemographic and socioeconomic characteristics, and area-level deprivation.

**Results:** A dose-response association was observed between higher NS and the odds of psychotic experiences at 13 years (medium NS, adjusted odds ratio [aOR] 1.25, 95% CI 1.05–1.49; high NS, aOR 1.77, 95% CI 1.30–2.40), whereas high levels of ND predicted psychotic experiences at 18 years (aOR 1.50, 95% CI 1.10–2.07). High levels of NC (aOR 1.43, 95% CI 1.02–1.71) and NS (aOR 1.55, 95% CI 1.07–2.26) were associated with increased odds of high depressive symptoms at 18 years in a dose-response fashion.

**Conclusion:** Prolonged and more severe exposure to adverse social environments is associated with greater odds of developing psychotic and depressive symptoms in late adolescence.

**Key words:** neighborhood social cohesion, psychotic experiences, depressive symptoms, Avon Longitudinal Study of Parents and Children (ALSPAC), cohort study

**J Am Acad Child Adolesc Psychiatry 2017;56(7):570–577.**

Children and adolescents living in deprived neighborhoods appear to experience worse mental health outcomes than their peers from more affluent areas,[1,2] including more internalizing[3-6] and psychotic[7] symptoms and greater mental health service use.[8] These findings echo studies of adults that have shown that rates of clinical disorders such as schizophrenia[9-11] and depression[12-15] are higher in more deprived environments. In adults, other aspects of the social environment (i.e., beyond deprivation) including low levels of social cohesion (i.e., the set of shared norms, trust, and networks within a community[16]) have been linked to schizophrenia[10,17-19] and depression risk.[15,20-23] Studies also have shown that individuals with schizophrenia report greater cumulative lifetime exposure to social disadvantage (e.g., having lower levels of education and employment, experiencing greater social isolation, living in more deprived environments) compared with general population controls.[24] However, very few studies have investigated whether neighborhood social cohesion is associated with mental health problems in adolescence. Although there is some evidence to support this possibility for depressive[3,4,6] and psychotic[7] symptoms, only 2 studies have used longitudinal data.[3,7] Furthermore, only one of these examined whether repeated exposure to neighborhood social cohesion affected later adolescent mental health outcomes,[3] finding an association between persistent childhood exposure to low social cohesion and depressive symptoms in adolescence, which is consistent with what is observed for schizophrenia in adults.[24] This has not been replicated for adolescent depressive symptoms and has not been tested for adolescent psychotic experiences.

Given this limited evidence, we investigated whether trajectories of neighborhood social cohesion were associated with psychotic experiences and depressive symptoms at 13 and 18 years of age in a large general population birth cohort. We hypothesized that more severe and prolonged exposure to low neighborhood social cohesion would be associated with greater psychotic and depressive symptoms in adolescence and that these effects would persist after adjustment for individual- and other neighborhood-level characteristics.

Supplemental material cited in this article is available online.

## METHOD

### Sample

The Avon Longitudinal Study of Parents and Children (ALSPAC) is a birth cohort study of children born to women in Avon (Bristol, UK)

from April 1, 1991 through December 31, 1992. A total of 14,541 women (87% of those invited and 72% of those eligible) and 13,988 children who were alive at 1 year of age (99.5% of all livebirths, N = 14,062) were recruited into the study and followed from pregnancy onward through self-report questionnaires and clinic visits. All participating mothers gave informed written consent before recruitment. More details on recruitment, sample representativeness, and follow-up assessments have been published elsewhere.[25]

In this study, we included all children with complete data on psychotic experiences and depressive symptoms at 13 and 18 years of age who had exposure data available at 1 or more time points. For twins (n = 404; 2.62% of ALSPAC sample), only 1 (i.e., the first born) was included to minimize bias risk estimates owing to shared genetic and environmental exposures. The ALSPAC ethics and law committee and the local research ethics committees gave ethics approval for this study.

## Measurements

*Exposures.* The main exposure variables were maternally reported trajectories of neighborhood social cohesion (NC), discord (ND), and stress (NS). These were identified empirically, as reported by the mother by questionnaire during pregnancy, at 8 months postpartum, and when the child was approximately 2, 3, 5, 7, and 10 years old. At each wave, mothers were asked the same set of questions about their relationship with neighbors and the overall rating of the neighborhood. From 2 years of age onward, mothers were asked about the quality of the built and social environment (Table S1, available online). All questions were rated on Likert scales. We conducted exploratory factor analysis when the child was 2 years old (the earliest wave at which all neighborhood items were asked), which led to the identification of 3 neighborhood constructs (i.e., NC, ND, and NS) based on visual inspection of the scree plot (Figure S1, available online). Items loaded distinctively onto each factor, with very little cross-loading (Table S2, available online). This allowed us to create a sum score for each participant's exposure to NC, ND, and NS at each wave, derived by summing participant item responses for all items that loaded above 0.4 on a given factor. In a sensitivity analysis, we obtained the same factor structure when the child was 10 years old, providing evidence of good reliability of the neighborhood constructs during childhood (data available from the authors). Using neighborhood data at each wave, we estimated longitudinal exposure trajectories for each construct using latent class growth modeling (LCGM). Full details are provided in the Statistical Analyses section.

*Outcomes.* Data on psychotic experiences and depressive symptoms were collected at 13 and 18 years of age during clinic assessments (psychotic experiences at the 2 time points, depressive symptoms at 13 years) and by postal questionnaires (depressive symptoms at 18 years). The Psychotic-Like Symptoms Interview (PLIKSI) is a semistructured interviewer-rated screening assessment composed of 12 questions derived from the Diagnostic Interview Schedule for Children Version IV[26] and the Schedule for Clinical Assessment in Neuropsychiatry,[27] which aims to detect delusions, hallucinations, and intrusive thoughts. From the interview total score, we derived a binary variable indicating whether symptoms were absent or suspected or definite. Participants whose psychotic experiences could have been attributed to sleep problems or fever were considered as not having a psychotic experience.[28,29] The Short Moods and Feelings Questionnaire (S-MFQ) is a 13-item questionnaire developed to screen for depressive symptoms in childhood and adolescence. Questions are recorded on a Likert scale ("not true," "sometimes," "true") scored from 0 to 2. We used a cutoff score of at least 11 to denote the presence of depression.[30-32] The tetrachoric correlation coefficients between these 2 outcome variables (PLIKSI and S-MFQ) at each time point were low (0.3 and 0.4 for 13 and 18 years, respectively).

*Other Variables.* We measured several potential confounders, including child gender and ethnicity (white versus non-white), any flu infection during pregnancy (yes versus no), maternal and paternal age, maternal social class (manual versus non-manual), highest academic qualification (vocational, secondary, or degree or higher), marital status (single, married, or divorced, separated, or widowed), and number of house moves reported in the 3 years before pregnancy (0, 1–2, 3–4, ≥5). We also measured childhood exposure to stressful life events (any versus none) from a battery of mother-reported answers on stressful life events when the child was 1 year, 2 years, 3 years 6 months, and 5, 6, 7, and 9 years old. In addition, we controlled for trajectories of maternal depression using data collected during pregnancy, at 8 weeks and 8 months postpartum, and when the child was approximately 2, 3, 5, 6, 8, and 11 years old. Maternal depression was rated using the 10-item Edinburgh Postnatal Depression Scale,[33] which estimates depressive symptoms in the previous week, rated on a 4-point Likert scale ("never" to "yes, most of the time/quite often"). Total scores were dichotomized (no symptoms versus probable depression) using a validated cutoff of 13.[33-35] Trajectories were estimated using LCGM (see below for details of the modeling procedure). A 2-class latent trajectory solution (never had depression versus always had depression) provided the best fit (Figure S2, available online), which we subsequently used to control for maternal depression. We included a measurement of neighborhood deprivation during pregnancy, measured with quintiles of the Townsend Deprivation Index.[36] The Townsend index is an indicator of material deprivation at the neighborhood level derived from 4 census variables (proportions of households without a car, overcrowded houses, households not occupied by owner, and persons unemployed). In our data, the Townsend index was positively correlated with measurements of ND and NS and negatively correlated with measurements of NC (Table S3, available online).

The ALSPAC website contains details of all the available data in a fully searchable data dictionary (http://www.bris.ac.uk/alspac/researchers/data-access/data-dictionary/).

## Statistical Analyses

*Latent Class Growth Modeling.* We classified participants into distinct exposure trajectories for childhood exposure to each neighborhood construct (NC, NS, and ND), based on exposure scores at each available wave, using LCGM (user-written Stata command traj).[37] To identify the optimum number of trajectories, we jointly inspected the Bayesian information criterion parameter and posterior probabilities distributions (values > 70% indicating good model fit) and assigned participants to their most likely trajectory. To assess trajectory fit, we assessed the difference in Bayesian information criterion scores between 2 models, as suggested in the literature.[38] The difference in Bayesian information criterion scores was multiplied by 2, with values from 0 to 2 indicating low evidence of model improvement, values from 4 to 6 indicating moderate evidence, values from 6 to 10 indicating strong evidence, and values higher than 10 indicating very strong evidence.[38]

*Neighborhood Characteristics, Psychotic Experiences, and Depressive Symptoms.* We ran 3 logistic regression models for each exposure and outcome combination: a univariable model (model I), a multivariable model adjusted for all confounders (model II), and a final model with additional mutual adjustment for the other neighborhood constructs (model III).

*Missing Data.* We included participants with complete outcome data at 13 years of age (psychotic experiences, n = 6,455; S-MFQ, n = 4,426) and 18 years of age (psychotic experiences, n = 6,378; S-