



## Childhood family environment predicting psychotic disorders over a 37-year follow-up – A general population cohort study

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### ABSTRACT

**Background:** Childhood adverse effects and traumatic experiences increase the risk for several psychiatric disorders. We now investigated whether prospectively assessed childhood family environment per se contributes to increased risk for psychotic disorders in adulthood, and whether these family patterns are also relevant in the development of affective disorders.

**Methods:** We used the Young Finns Data ( $n = 3502$ ). Childhood family environment was assessed in 1980/1983 with previously constructed risk scores: (1) disadvantageous emotional family atmosphere (parenting practices, parents' life satisfaction, parents' mental disorder, parents' alcohol intoxication), (2) adverse socioeconomic environment (overcrowded apartment, home income, parent's employment, occupational status, educational level), and (3) stress-prone life events (home movement, school change, parental divorce, death, or hospitalization, and child's hospitalization). Psychiatric diagnoses (ICD-10 classification) over the lifespan were collected up to 2017 from the national registry of hospital care. Non-affective psychotic disorder and affective disorder groups were formed.

**Results:** Frequent stress-prone life events predicted higher likelihood of non-affective psychotic disorders ( $OR = 2.401$ ,  $p = 0.001$ ). Adverse socioeconomic environment or emotional family atmosphere did not predict psychotic disorders. Only disadvantageous emotional family atmosphere predicted modestly higher likelihood of affective disorders ( $OR = 1.583$ ,  $p = 0.013$ ).

**Conclusions:** Our results suggest that childhood family environment and atmosphere patterns as such contribute to the risk for developing adulthood mental disorders with relative disorder specificity. The results emphasize the importance of both individual and public health preventive initiatives, including family support interventions.

### 1. Introduction

There is a great body of evidence suggesting the relevance of childhood adversities in the pathogenesis of psychotic disorders (Barnes et al., 2021; Bentall et al., 2014; Misiak et al., 2017; Varese et al., 2012). In particular, previous reviews have pointed out the quality of parent-child relationship such as hostility, coldness, or criticism toward the

child (Barnes et al., 2021) or parents' deviant communication to their child (Bentall et al., 2014) in the development of psychotic disorders. Second, reviews have suggested a role of socioeconomic adversities such as family poverty (Jarvis, 2007) or parents' lack of college-level education (Oh et al., 2022). Third, reviews have emphasized the role of stressful life events such as separation from a parent (Bentall et al., 2014) or traumatic events like abuse or neglect (Misiak et al., 2017) in

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the onset of psychoses.

To the best of our knowledge, the studies with the longest follow-ups have been the Northern Finland 1966 Birth Cohort study showing that parental divorce or single-parenthood did not predict psychotic disorders (Mäkikyrö et al., 1998); the Concordia Project with a 30-year follow-up showing that low socioeconomic circumstances of a neighborhood predicted higher risk for schizophrenia (Hastings et al., 2020); and the Christchurch Health and Development Study with a 35-year follow-up showing that bullying victimization predicted higher psychotic symptomatology (Boden et al., 2016).

Despite a high number of studies, previous research literature still includes substantial gaps. First, a majority of the studies have been cross-sectional, or included relatively short follow-ups limiting their ability to increase our understanding of full developmental pathways of psychotic disorders. Understanding the development of psychotic disorders requires following long-term trajectories over different developmental transitions. Many follow-ups may have covered age periods not optimal for tracking development of non-affective and affective psychoses; for example, a three-year follow-up of hallucinations in childhood, although childhood-onset psychoses may relate to different pathogenetic mechanisms than adulthood-onset psychoses (Driver et al., 2013). Second, a majority of studies have retrospectively evaluated childhood circumstances using adulthood self-reports, instead of using prospective assessments of childhood environment. Retrospective assessments can be biased and although not found to associate with significant risk of false positives, they do include a substantial rate of false negatives (Hardt and Rutter, 2004).

Third, the few studies with follow-ups from childhood to adulthood have examined single and detached factors of family environment that either have a relatively low prevalence in the general population (e.g. different forms of abuse), or cover only a small piece of childhood circumstances (bullying victimization, non-desired pregnancy, social isolation, low socioeconomic circumstances, or single-parenthood). This limitation also applies to results from register-based studies which cannot take into account social factors (parenting practices, parents' life satisfaction, etc.) not included in these administrative records. Evidence has, however, suggested that a cumulative risk plays much stronger role than a risk consisting of a single adversity (McKay et al., 2021).

Finally, a recent review pointed out that the results have not provided evidence to compare whether a certain quality of childhood environment predicts one mental disorder more strongly than other disorders (McKay et al., 2021). The associations of childhood environments with different psychiatric diagnoses have been mostly examined in different datasets (e.g., childhood emotional adversities predicting mood disorders in one dataset; and childhood emotional adversities predicting psychoses in another dataset). Thus, possible specificity vs. non-specificity of childhood risk factors for psychotic disorders (when compared to other severe mental disorders) has remained uncertain.

Taken together, to the best of our knowledge, no previous study has (i) capitalized on a population-based sample with a prospective follow-up from childhood to adulthood, (ii) included a comprehensive assessment of childhood risk factors, and (iii) examined the specificity of childhood risk factors for psychotic disorders vs. other severe mental disorders within a same dataset.

Thus, we investigated whether prospectively assessed domains of childhood family environment (i.e., stress-prone life events, adverse socioeconomic circumstances, and disadvantageous emotional family atmosphere) predict non-affective psychotic disorders in adulthood. We had population-based data with a 37-year follow-up from childhood to middle age. We repeated the analyses for subjects with severe affective disorders that had required hospital care (in this same sample). This was done to investigate whether risk factors in childhood family environment are general, or rather specific to psychotic disorders (i.e., whether the risk factors are similarly relevant in the pathogenesis of non-affective psychotic disorders and severe affective disorders).

## 2. Material and methods

### 2.1. Participants

The participants come from the Young Finns Study (YFS) that is an on-going prospective follow-up study. The YFS started in 1980 (baseline measurement) and the participants have been followed over a 37-year prospective follow-up (1983–2017). The sampling was designed to include a population-based sample of non-institutionalized Finnish children, representative with regard to sex (male vs. female), rural vs. urban environment, and Eastern vs. Western regions in Finland. The sample consisted of six age cohorts (born in 1962, 1965, 1968, 1971, 1974, or 1977). The sample at the baseline study (1980) included altogether 3596 participants.

The sampling was conducted by five Finnish universities with medical schools (i.e., Universities of Helsinki, Turku, Tampere, Oulu, and Kuopio). More specifically, subjects were invited from the university cities (50 %) and from rural municipalities (50 %). Such rural municipalities were selected that (i) were within 200 km distance from the respective university, (ii) had an approximately similar industrial structure, and (iii) had a sufficient number of children belonging to the age cohorts under investigation. In addition to the university cities, two rural municipalities were selected from the regions of Helsinki, Turku, Tampere, and Oulu; and four rural municipalities from the region of Kuopio (to ensure Eastern vs. Western representativeness). Thereafter, the girls and boys (born in 1962, 1965, 1968, 1971, 1974, or 1977) living in each municipality were retrieved from the population register of the Social Insurance Institution and put in a random order. Altogether 4320 subjects were invited, and 3596 of them participated in the baseline study. The design of the YFS is described with further details elsewhere (Akerblom et al., 1985; Raitakari et al., 2008).

The study was conducted in accordance with the Declaration of Helsinki. All procedures involving human subjects/patients were approved by the ethical committees of all Finnish Universities with a medical faculty (Universities of Helsinki, Turku, Tampere, Kuopio, and Oulu). All the participants or their parents (if participants aged <18 years) provided informed consent before participation.

In this study, we included all the YFS participants who had data available on age, sex, childhood family environment in 1980 or 1983 (participants were 3–18 years old), and psychiatric diagnoses until 2017 (participants were 40–55 years old). The final sample size was 3502 participants.

### 2.2. Measures

#### 2.2.1. Psychiatric diagnoses

Participants' psychiatric diagnoses over their lifespan were collected up to 2017 from the Care Register for Health Care (also known as the Finnish Hospital Discharge Register) (<https://thl.fi/en/web/thlfi-en/statistics-and-data/data-and-services/register-descriptions/care-register-for-health-care>). In the register, diagnoses were given in accordance with the diagnostic classification that was prevailing at that time (ICD-8, ICD-9, or ICD-10). ICD-diagnoses were converted to DSM-IV diagnoses, and this conversion is described elsewhere (Sormunen et al., 2017). Diagnoses were grouped into the following categories: (1) non-affective psychotic disorders, (2) substance-related disorders, (3) affective disorders (mood and anxiety disorders), and (4) personality disorders. Participants with many psychiatric diagnoses were categorized into only one of the groups in the following priority order: non-affective psychoses (DSM-IV 295, 297, 298), personality disorders (DSM-IV 301), affective disorders (mood and anxiety disorders, DSM-IV 296, 300, 311), and substance-related disorders (DSM-IV 291, 303, 292, 304, 305). The register is found to cover most psychiatric diagnoses (Sund, 2012) and has been used also previously for research purposes (Suvisaari et al., 1999).

### 2.2.2. Childhood family environment

Childhood family environment was assessed with three cumulative scores: (1) stress-prone life events, (2) disadvantageous emotional family atmosphere, and (3) adverse socioeconomic environment. All the questionnaires related to childhood environmental characteristics were fulfilled by a parent (mostly mother) in 1980. In case there were missing values in 1980, we imputed them using data from the closest possible follow-up point (in 1983).

The cumulative scores were formed in accordance with previous studies of this dataset (Elovainio et al., 2015; Juonala et al., 2016; Pulkki-Råback et al., 2015). The predictive validity of the cumulative risk scores is excellent as they are proved to predict higher risk for cardiovascular health and diseases (Juonala et al., 2016; Pulkki-Råback et al., 2015), diabetes (Pulkki-Råback et al., 2017), self-reported depressive symptoms (Elovainio et al., 2015), self-reported sleep problems (Talvitie et al., 2019), for example.

The cumulative risk score of stress-prone life events included the following factors: number of change of residence (a continuous response), number of change of school (a continuous response), parental divorce (whether parents living together or had separated), mother's or father's death (yes/no), mother's or father's hospitalization within the past 12 months (number of days in hospital, ranging from "1 = no days" to "5=more than 30 days"), and child's hospitalization due to sickness or accident (yes/no). All the items were assessed with questionnaires presented for the parents. Each item was first standardized by age cohort (i.e.,  $M = 0$ ,  $SD = 1$  within each age cohort); this standardization was done because it is possible that participants in different age cohorts had encountered a slightly different number of school changes. Then, we calculated a mean score of the standardized items.

The cumulative risk score of adverse socioeconomic environment included the following factors: parents' occupational status (1 = upper-grade non-manual worker, 2 = lower-grade non-manual worker, 3 = manual worker manual worker), parents' educational level (1 = academic level, 2 = high school or occupational school, 3 = comprehensive school), family income (1 = >100,000 Finnish mark, 8 = <20,000 Finnish mark), unstable employment situation (1 = at least one parent was unemployed or in a long-term sick leave, 0 = other employment situations), and over-crowded apartment (family size in relation to number of rooms at home). All the items were assessed with questionnaires fulfilled by the parents. Each item was standardized by age cohort (i.e.,  $M = 0$ ,  $SD = 1$  within each age cohort), and we calculated a mean score of the standardized items.

The cumulative risk score of disadvantageous emotional family atmosphere included the following factors: emotional distance between the child and parent, parental intolerance toward the child, strict discipline toward the child, parental life dissatisfaction, mother's or father's mental disorder (no/yes), and mother's or father's frequent alcohol intoxication (not merely alcohol use but becoming "1 = never"; "8 = daily"). Each item was standardized by age cohort (i.e.,  $M = 0$ ,  $SD = 1$  within each age cohort), and we calculated a mean score of the standardized items. The single domain variables correlated strongly with the cumulative risk score ( $r = 0.449$ – $0.581$ ,  $p < .001$ ), indicating good internal consistency. Also, the scores measuring parenting practices are shown to correlate with child's lower self-esteem (including child's perceptions of parental support) (Heinonen et al., 2003), indicating good convergent validity. All these factors were assessed with questionnaires fulfilled by the parents, and are described with further details in **Supplementary Methods**.

The total cumulative risk score was calculated by summing up the three childhood risk scores (i.e., the scores assessing stress-prone life events, disadvantageous emotional family atmosphere, and adverse socioeconomic environment). The total cumulative risk score was calculated in two ways: (1) a simple sum of the three risky domains, and (2) a total cumulative risk score where each of the three risk scores were equally weighted, i.e., each of the three risk scores was first standardized (mean = 0,  $SD = 1$ ) and then the standardized risk scores were summed up. The

**Table 1**

Descriptive statistics of the study variables (in the sample of the main analyses).

	M (SD)	Frequency (%)
Age (in 2017)	47.3 (4.96)	
Sex (Female)		1792 (51.2)
Stress-prone life events		
Movement to a new residence		927 (26.5)
Change of school		521 (14.9)
Parental divorce		505 (14.4)
Parental death		132 (3.8)
Mother's hospitalization (> 5 days)		231 (6.6)
Father's hospitalization (> 5 days)		116 (3.4)
Child's hospitalization		1410 (40.5)
Adverse SES environment		
Overcrowded apartment (> 2 people / room)		651 (18.6)
Parental unstable employment		133 (3.8)
Parents' low occupational status (manual worker)		1362 (39.3)
Low level of home income (lowest 25 %)		734 (21.2)
Parents' low educational level		1192 (34.1)
Disadvantageous emotional family atmosphere <sup>1</sup>		
Mother's mental disorder		54 (1.5)
Father's mental disorder		38 (1.1)
Parental life satisfaction		340 (10.0)
Parental intolerance toward the child		348 (10.0)
Insignificance of the child		345 (10.0)
Strict discipline toward the child		329 (9.8)
Frequent mother's alcohol intoxication ( $\geq 2$ times/week)		49 (1.4)
Frequent father's alcohol intoxication ( $\geq 2$ times/week)		453 (13.1)
Psychiatric diagnoses <sup>2</sup>		
Non-affective psychotic disorders		72 (2.1)
Affective disorders		119 (3.4)

Note: In the analyses, we used continuous and standardized scores of the childhood factors.

<sup>1</sup> Assessed with questionnaires presented for the parents. <sup>2</sup> Diagnoses were collected from the Care Register for Health Care.

latter variable was calculated because some researchers have used cumulative risk scores where each domain is equally weighted (Pulkki-Råback et al., 2015). We used the two variables to examine sensitivity/stability of the results when using slightly differently encoded variables.

### 2.2.3. Additional covariates

In additional analyses, we controlled also for social adjustment in childhood (in 1980) that was assessed with parent-rated questionnaires. To summarize, parents responded to questions related to their child's hyperactivity, worry about their child becoming a "problem child", and disruptive behavior (e.g., fighting, pushing, or hitting other children; using swear words; and receiving complaints from other children and parents). For further details, see **Supplementary Methods**. Social adjustment was controlled for as a potential confounder because social adjustment is found to modify parenting practices toward the child (Verhoeven et al., 2010) and because genetic risk for schizophrenia is found to correlate with social adjustment in childhood (Ensink et al., 2020).

Further, in another additional analysis, we controlled for educational level in adulthood (in 2011) (1 = comprehensive school, 2 = occupational school or high school, 3 = academic level). Educational level was controlled for as it is shown to be one of the most important buffering factors against a variety of psychiatric disorders (Erickson et al., 2016).

### 2.3. Statistical analyses

First, we investigated Spearman correlations between the risk scores of childhood family environment. Logistic regression analyses were used to investigate the associations of childhood psychosocial environment (in 1980/1983) with non-affective psychotic disorders over the lifespan

**Table 2**

The results of logistic regression analyses, when predicting non-affective psychotic disorders by childhood family environment (Model 1) or cumulative childhood risk score (Model 2).

	Adjusted for age and sex (n = 3502)			Adjusted for age, sex, and social adjustment in childhood (n = 3468)			Adjusted for age, sex, and educational level in adulthood (n = 2605)			Parental mental disorders removed from the emotional environment score, adjusted for age and sex (n = 3437)		
	OR	95 % CI	p	OR	95 % CI	p	OR	95 % CI	p	OR	95 % CI	p
<b>Models 1</b>												
Stress-prone life events	<b>2.140</b>	<b>1.365;</b> <b>3.353</b>	<b>0.001</b>	<b>2.137</b>	<b>1.355;</b> <b>3.372</b>	<b>0.001</b>	<b>2.468</b>	<b>1.293;</b> <b>4.709</b>	<b>0.006</b>	<b>2.251</b>	<b>1.418;</b> <b>3.575</b>	<b>0.001</b>
Adverse SES environment	1.019	0.717; 1.448	0.917	0.956	0.666; 1.372	0.808	0.862	0.499; 1.488	0.593	0.915	0.636; 1.316	0.632
Disadvantageous emotional family atmosphere <sup>1</sup>	1.428	0.891; 2.286	0.138	1.433	0.865; 2.372	0.162	1.295	0.630; 2.662	0.482	0.902	0.573; 1.421	0.658
Age	1.004	0.958; 1.053	0.866	0.997	0.950; 1.046	0.894	0.982	0.918; 1.051	0.603	0.998	0.951; 1.048	0.948
Sex	0.624	0.386; 1.009	0.054	0.615	0.377; 1.004	0.052	0.918	0.468; 1.802	0.804	0.614	0.376; 1.003	0.051
Social adjustment				0.974	0.650; 1.460	0.899						
Educational level							0.826	0.500; 1.363	0.454			
<b>Models 2<sup>2</sup></b>												
Total cumulative risk score <sup>3</sup>	<b>1.382</b>	<b>1.113;</b> <b>1.716</b>	<b>0.003</b>	<b>1.345</b>	<b>1.068;</b> <b>1.695</b>	<b>0.012</b>	1.308	0.928; 1.844	0.125			
Total cumulative risk score <sup>4</sup>	<b>1.384</b>	<b>1.115;</b> <b>1.719</b>	<b>0.003</b>	<b>1.348</b>	<b>1.070;</b> <b>1.698</b>	<b>0.011</b>	1.311	0.931; 1.847	0.122			

Note: Total cumulative risk scores were included as predictors in separate models.

<sup>1</sup> The emotional environment score included parental mental disorders in all the analyses except for the fourth analysis.

<sup>2</sup> Due to limited space, the effects of covariates were not reported for Models 2.

<sup>3</sup> All the three childhood domains (stress-prone life events, unfavorable SES environment, disadvantageous emotional environment) equally weighted in the total cumulative risk score.

<sup>4</sup> A simple sum of the three childhood risk scores.

(collected from the registers in 2017). In Models 1, the childhood risk scores (stress-prone life events, adverse socioeconomic environment, disadvantageous emotional family atmosphere) were added to the model simultaneously. In Models 2, the total cumulative childhood risk scores (calculated in two different ways, as described in 2.2.2) were added as predictors in separate models. We reran both Models 1 and Models 2 with different sets of covariates to examine sensitivity of the results: (i) adjusted for age and sex, (ii) adjusted for age, sex, and social adjustment in childhood (in 1980), (iv) adjusted for age, sex, and educational level in adulthood (in 2011), and (v) adjusted for age and sex, and removing parental mental disorders from the emotional environment risk score. The latter model was done because parental mental disorders reflect not only a family-environmental risk for children but also a strong genetic risk factor (Gottesman et al., 2010).

We also repeated the analyses for severe affective disorders (mood/anxiety disorders having required hospital care in this same sample). This was done to investigate whether risk factors in childhood family environment are general, or rather specific to psychotic disorders (i.e., whether the risk factors are similarly relevant in the pathogenesis of non-affective psychotic disorders and severe affective disorders).

### 3. Results

Participant drop-out was very minor: 3502 participants (97.4 % of the full sample) were included in the main analyses. The descriptive statistics of the study variables are shown in Table 1. Pairwise correlations between the three childhood risk scores were as follows: stress-prone life events and emotional family atmosphere ( $r = 0.164$ ,  $p < 0.001$ ), stress-prone life events and adverse socioeconomic environment ( $r = 0.032$ ,  $p = 0.058$ ), and emotional family atmosphere and adverse socioeconomic environment ( $r = -0.003$ ,  $p = 0.877$ ).

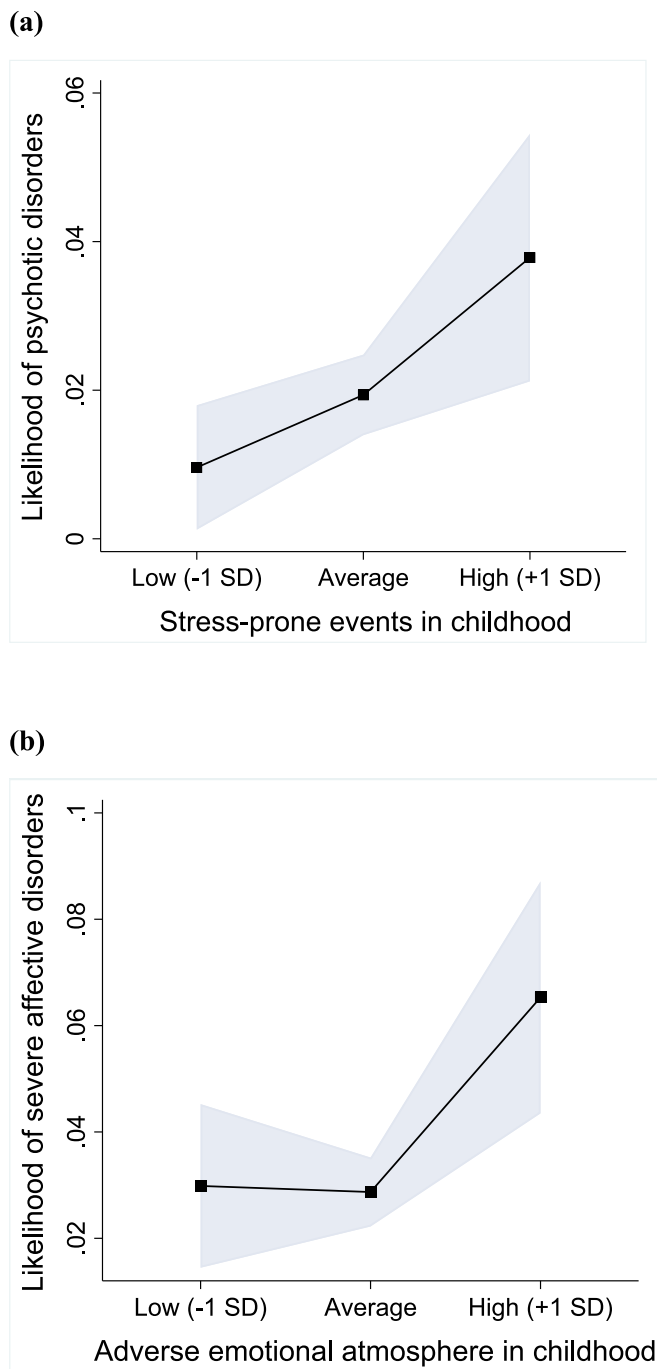
#### 3.1. Non-affective psychotic disorders as outcome

Table 2 (Models 1) shows the results when predicting non-affective psychotic disorders by childhood risk scores. Adverse SES environment or disadvantageous emotional family atmosphere in childhood did not predict non-affective psychotic disorders in any model. Frequent stress-prone life events predicted higher likelihood of non-affective psychotic disorders in all the models: when adjusted for age and sex ( $OR = 2.140$ ,  $p = 0.001$ , see Fig. 1a), when adjusted for age, sex, and social adjustment ( $OR = 2.137$ ,  $p = 0.001$ ), and when adjusted for age, sex, and educational level in adulthood ( $OR = 2.468$ ,  $p = 0.006$ ) (Table 3, Models 1).

Additionally, we did the analysis so that parental mental disorders were controlled for as a separate variable (and removed from the risk score of emotional family atmosphere). The findings were replicated: stress-prone life events predicted higher likelihood of psychotic disorders ( $OR = 2.106$ ,  $p = 0.002$ ), while adverse SES environment or disadvantageous emotional family atmosphere did not predict non-affective psychotic disorders.

Next, we predicted non-affective psychoses by a total cumulative childhood risk score over all the three domains (stress-prone life events, adverse socioeconomic environment, emotional family atmosphere) (Table 2, Models 2). High total cumulative childhood risk predicted higher likelihood of non-affective psychotic disorders when adjusted for age and sex ( $OR = 1.382$ – $1.384$ ,  $p = 0.003$ ) (Fig. 2) and when adjusted also for social adjustment in childhood ( $OR = 1.345$ – $1.348$ ,  $p = 0.011$ – $0.012$ ). This association disappeared, however, when adjusted for educational level in adulthood.

Finally, as additional analysis, we repeated the main analyses so that participants with other psychiatric disorders (severe affective disorders, substance use disorders, personality disorders) were excluded from the sample. The results remained: stress-prone life events predicted higher



**Fig. 1.** Estimated likelihoods with 95 % confidence intervals of (a) non-affective psychotic disorders and (b) affective (mood/anxiety) disorders at different levels of childhood risk factors. Adjusted for age and sex.

likelihood of psychotic disorders when adjusted for age and sex ( $OR = 2.148, p = 0.001$ ), when adjusted for age, sex, and social adjustment ( $OR = 2.150, p = 0.001$ ), and when adjusted for age, sex, and educational level ( $OR = 2.544, p = 0.005$ ).

### 3.2. Severe affective disorders as outcome

Table 3 (Models 1) shows the results when predicting severe affective disorders (having required hospital care) by childhood risk scores. Stress-prone life events or adverse SES environment did not predict likelihood of severe affective disorders. Disadvantageous emotional atmosphere predicted higher likelihood of severe affective disorders when

adjusted for age and sex ( $OR = 1.583, p = 0.013$ , see Fig. 1b), when adjusted for age, sex, and educational level in adulthood ( $OR = 1.624, p = 0.041$ ), and when removing parental mental disorders from the emotional environment risk score ( $OR = 1.473, p = 0.020$ ) (Table 3, Models 1).

As an additional analysis, we reran the analysis so that parental mental disorders were controlled for as a separate variable (and removed from the emotional environment risk score). The findings were replicated again: disadvantageous emotional family environment higher likelihood of severe affective disorders ( $OR = 1.461, p = 0.023$ ), while stress-prone life events or adverse SES environment did not predict likelihood of affective disorders.

The association between emotional family environment and severe affective disorders became non-significant, however, when adjusting for social adjustment in childhood ( $OR = 1.421, p = 0.075$ , Table 3).

Next, we predicted severe affective disorders by a total cumulative childhood risk score over all the three domains (stress-prone life events, adverse socioeconomic environment, emotional family atmosphere) (Table 2, Models 2). High total cumulative childhood risk predicted higher likelihood of severe affective disorders when adjusted for age and sex ( $OR = 1.354–1.355, p = 0.001$ ), and when adjusted also for social adjustment in childhood ( $OR = 1.315–1.316, p = 0.003$ ) or educational level in adulthood ( $OR = 1.392, p = 0.005$ ) (Fig. 2).

As additional analysis, we repeated the main analyses so that participants with other psychiatric disorders (non-affective psychotic disorders, substance use disorders, personality disorders) were excluded from the sample. The results remained: disadvantageous emotional family atmosphere predicted higher likelihood of affective disorders when adjusted for age and sex ( $OR = 1.561, p = 0.021$ ), and when adjusted for age, sex, and educational level ( $OR = 1.695, p = 0.028$ ). Similarly to main analyses, the association disappeared when adjusted for social adjustment in childhood ( $p = 0.107$ ).

### 3.3. Additional analyses

We also did the analysis so that (a) substance use disorders or (b) personality disorders were set as the outcome variable. This was done to examine whether childhood risk factors are general, or rather specific to certain psychiatric diagnoses (i.e., whether stress-prone life events or emotional family atmosphere are equally relevant in the pathogenesis of substance use disorders or personality disorders).

The results of these analyses, however, need to be treated with caution because of our hierarchical diagnostic encoding in the hospital discharge record system. That is, participants with comorbid psychiatric disorders were categorized into only one of the diagnostic groups in the following priority order: non-affective psychoses, personality disorders, affective disorders, and substance-related disorders. Thus, in case of comorbidities, the diagnostic system is more accurate for psychotic disorders than for substance use disorders or personality disorders.

The results are shown in Supplementary Tables 1 and 2. To summarize, stress-prone life events or disadvantageous emotional environment did not predict substance use disorders. On the contrary, unfavorable SES environment in childhood predicted higher likelihood of substance use disorders when adjusted for age and sex ( $OR = 1.730, p = 0.005$ ) and when adjusted for age, sex, and social adjustment in childhood ( $OR = 1.756, p = 0.005$ ).

Regarding personality disorders, stress-prone life events or adverse SES environment in childhood did not predict personality disorders. Disadvantageous emotional family atmosphere in childhood predicted higher likelihood of personality disorders across all the models: when adjusted for age and sex ( $OR = 2.568, p < 0.001$ ), when adjusted for age, sex, and social adjustment in childhood ( $OR = 2.364, p = 0.002$ ), when adjusted for age, sex, and educational level ( $OR = 2.474, p = 0.021$ ), and when adjusted for age and sex and removing parental mental disorders from the risk score of emotional family atmosphere ( $OR = 1.904, p = 0.012$ ).

**Table 3**

The results of logistic regression analyses, when predicting affective (mood/anxiety) disorders by childhood family environment (Model 1) or cumulative childhood risk score (Model 2).

	Adjusted for age and sex (n = 3502)			Adjusted for age, sex, and social adjustment in childhood (n = 3468)			Adjusted for age, sex, and educational level in adulthood (n = 2605)			Parental mental disorders removed from the emotional score, adjusted for age and sex (n = 3437)		
	OR	95 % CI	p	OR	95 % CI	p	OR	95 % CI	p	OR	95 % CI	p
<b>Models 1</b>												
Stress-prone life events	1.279	0.850; 1.924	0.238	1.296	0.860; 1.952	0.215	<b>1.731</b>	<b>1.062;</b> <b>2.821</b>	<b>0.028</b>	1.388	0.922; 2.090	0.116
Adverse SES environment	1.269	0.966; 1.667	0.087	1.270	0.964; 1.675	0.089	1.095	0.759; 1.579	0.628	1.300	0.982; 1.721	0.067
Disadvantageous emotional family atmosphere <sup>1</sup>	<b>1.583</b>	<b>1.100;</b> <b>2.277</b>	<b>0.013</b>	1.421	0.966; 2.092	0.075	<b>1.624</b>	<b>1.020;</b> <b>2.586</b>	<b>0.041</b>	<b>1.473</b>	<b>1.063;</b> <b>2.042</b>	<b>0.020</b>
Age	0.971	0.936; 1.008	0.124	0.973	0.937; 1.010	0.152	0.973	0.929; 1.019	0.243	0.971	0.935; 1.009	0.128
Sex	0.733	0.506; 1.061	0.100	0.754	0.517; 1.100	0.143	0.957	0.605; 1.516	0.852	0.779	0.535; 1.134	0.192
Social adjustment												
Educational level							0.701	0.497; 0.988	0.042			
<b>Models 2<sup>2</sup></b>												
Total cumulative risk score <sup>3</sup>	<b>1.354</b>	<b>1.139;</b> <b>1.610</b>	<b>0.001</b>	<b>1.315</b>	<b>1.097;</b> <b>1.576</b>	<b>0.003</b>	<b>1.392</b>	<b>1.105;</b> <b>1.754</b>	<b>0.005</b>			
Total cumulative risk score <sup>4</sup>	<b>1.355</b>	<b>1.140;</b> <b>1.611</b>	<b>0.001</b>	<b>1.316</b>	<b>1.098;</b> <b>1.577</b>	<b>0.003</b>	<b>1.392</b>	<b>0.931;</b> <b>1.847</b>	<b>0.005</b>			

Note: Total cumulative risk scores were included as predictors in separate models.

<sup>1</sup> The emotional environment score included parental mental disorders in all the analyses except for the fourth analysis.

<sup>2</sup> Due to limited space, the effects of covariates were not reported for Models 2.

<sup>3</sup> All the three childhood domains (stress-prone life events, unfavorable SES environment, disadvantageous emotional environment) equally weighted in the total cumulative risk score.

<sup>4</sup> A simple sum of the three childhood risk scores.

#### 4. Discussion

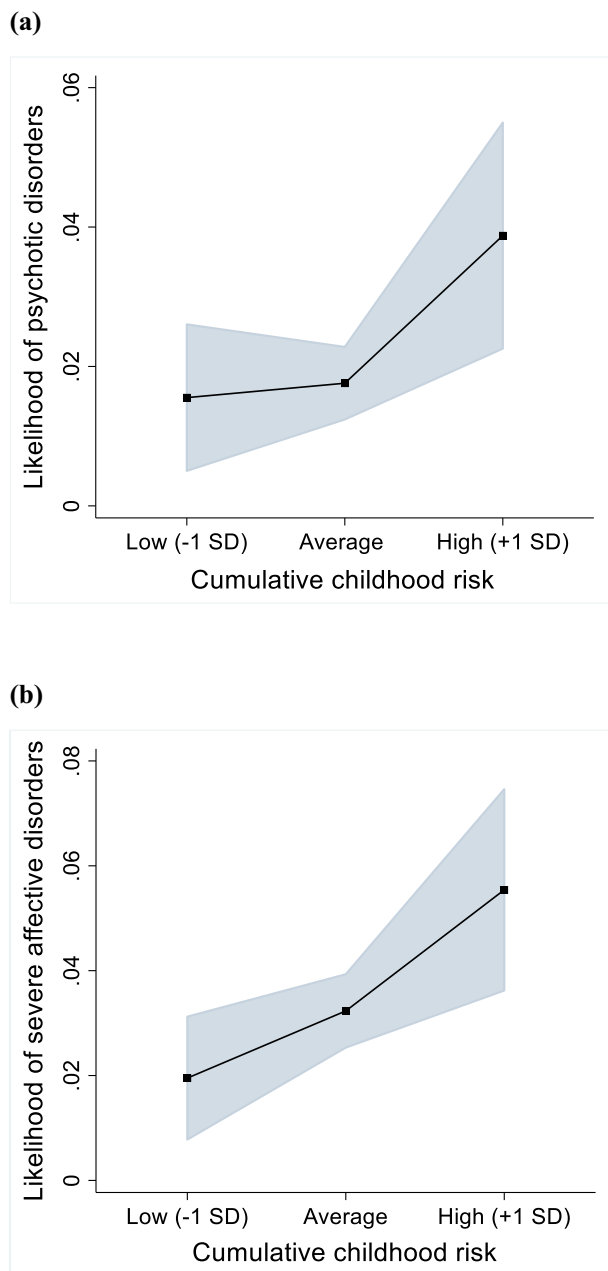
The main finding of the current study was that prospectively assessed patterns of childhood family environment predicted adulthood severe mental disorders. Childhood family environment, however, seemed to play different roles in the pathogenesis of different severe mental disorders: frequent stress-prone life events predicted higher likelihood of non-affective psychotic disorders but not severe affective disorders, while disadvantageous emotional atmosphere had a modest association with severe affective disorders but not psychotic disorders. Adverse socioeconomic environment, in turn, did not predict non-affective psychoses or severe affective disorders. Thus, it seems that not all sorts of childhood adversities play a crucial role in the development of non-affective psychoses or severe affective disorders.

In many studies, single stressful events have not predicted psychoses, such as moving home town (Keskinen et al., 2018; Newbury et al., 2020) or parental divorce (Mäkikyrö et al., 1998). In this study, an accumulation of stress-prone life events was predictive of non-affective psychotic disorders, also after considering social adjustment in childhood and socioeconomic position in adulthood. This finding is plausible in light of a recent framework, proposing that the developmental pathway from childhood stress to psychosis-proneness may be mediated by progressive biological changes: long-term exposure to stress may result in elevated peripheral inflammation, epigenetic alterations such as an upregulation of proinflammatory gene expression pathway, and microglial activation (Radhakrishnan et al., 2017). Additionally, childhood stress appears to predict a dysregulation of the hypothalamus-pituitary-adrenal (HPA) axis, and also alterations in the dopaminergic functioning of the neural reward circuit, including the mesolimbic regions and striatum (Mayo et al., 2017; van Winkel et al., 2008). The shaping roles of social environments for brain networks have been pointed out recently (Holz et al., 2020; Tost et al., 2015).

Interestingly, early emotional family atmosphere did not predict

non-affective psychoses. At first look, this finding may appear unexpected but is in accordance with previous results: a Finnish study found that emotional neglect predicted affective disorders but not psychoses (Salokangas et al., 2020). Further, it seems that associations between early emotional environment and psychoses is stronger in case-control studies than in prospective follow-up studies. Specifically, a number of case-control studies have obtained a connection between psychoses and retrospectively assessed childhood emotional adversities such as neglectful or dysfunctional parenting (McCabe et al., 2012), lower support and attachment with family (Bratlien et al., 2014). On the contrary, in prospective studies from childhood onwards, exposure to rejective parenting or social isolation did not predict psychosis proneness (Bennett et al., 2020; Steenhuis et al., 2020) or had only a modest association with psychosis risk (Fisher et al., 2013). Also, a Finnish prospective cohort study reported that there were “surprisingly few” associations between childhood psychosocial factors and psychoses in adulthood (Keskinen et al., 2018). At this point, it seems that case-control studies are prone to detect stronger associations between childhood environment and psychoses when compared to prospective cohort studies.

In accordance with most of previous evidence (Clayborne et al., 2021; Gorostiaga et al., 2019; McLeod et al., 2007a; McLeod et al., 2007b; Steele et al., 2019), we found an association between disadvantaged emotional family atmosphere and severe affective disorders. The association, however, was marginally significant and would not have sustained after correction for multiple testing. Also, stress-prone life events did not predict severe affective disorders. Previously, it has been found that early traumatic events but not normal-life stressful life events or family poverty in childhood predict affective disorders (Hovens et al., 2015; LeMoult et al., 2020). Regarding current stressful events, findings have been inconclusive whether daily stressors predict onset of depressive states (Kendler and Gardner, 2016; Seiffge-Krenke, 2000); it seems that stressful events predict depressive states only over



**Fig. 2.** Estimated likelihoods with 95 % confidence intervals of (a) non-affective psychotic disorders and (b) affective (mood/anxiety) disorders at different levels of childhood total cumulative risk score. Adjusted for age and sex.

short follow-ups (weeks or days). In our study, the follow-up from stressful events to a possible affective disorder composed 37 years.

Our results can be placed to a wider context of discussion over decades. In the 1960–1970s, research efforts were dominated by searching for specific personality or environmental adversity factors that might underlie certain somatic diseases or mental disorders. No clear conclusion has been reached. For example, a large survey-based study found that retrospectively evaluated childhood adversities had little specificity on later psychiatric diagnoses (Kessler et al., 1997), whereas a recent Finnish study indicated that childhood risk factors may have specific connections with different mental disorders (Salokangas et al., 2020). Our study adds a piece of evidence suggesting that not all aspects of childhood family environment are equally relevant in the development of non-affective psychotic disorders and other severe mental disorders.

Some methodological issues are necessary to be taken into consideration. First, the data did not provide possibilities to examine specific psychiatric diagnoses within the categories (e.g., delusional disorder vs. schizophrenia). Second, there was heterogeneity in the age when childhood family environment was assessed (participants were 3–18 years old), which may have caused some sort of age-related bias to, for example, the frequency of stress-prone life events (as some youngest participants may not have had time to encounter certain life events). To reduce age-related bias, however, the parents of teenaged participants were advised in 1980 to focus on reporting life events in their child's early childhood. Third, although we removed parental mental disorders from the score of emotional family atmosphere in an additional analysis, the score still included factors related to parent-child relationship (e.g., emotional distance) that are commonly affected by parental mental disorders. Thus, parental mental disorders may possibly still have confounded the measurement of emotional family atmosphere. Fourth, our dataset did not include possibilities to investigate physiological or subjective stress levels in childhood, i.e., we could not ensure whether some adversities in childhood family environment resulted in more elevated stress levels than other adversities.

Finally, it is necessary to consider the reliability of the psychiatric diagnoses derived from the hospital care register. The register is found to cover as much as 93 % of schizophrenia spectrum psychoses and 97 % of psychotic disorders (Sund, 2012) as most individuals with psychoses need hospital care at some phase of their disorder course. Accordingly, the prevalence of psychotic disorders closely corresponded to previous population-based estimates: non-affective psychotic disorders had been diagnosed in 2.1 % of the participants while a population estimate of psychoses is 2.2 % (Lehtinen et al., 1990). Regarding affective disorders, 12-month estimates of depression and anxiety disorders are 6.5 % and 4.1 % in Finland, respectively (Pirkola et al., 2005). As those estimates count psychiatric cases both in inpatient and outpatient care, but our study included only affective disorders with hospital treatment periods, it is quite plausible that in our study the prevalence was somewhat lower. This is compatible with the finding that 3.4 % of our study participants had been treated in hospital for a severe affective disorder. Taken together, we conclude that it was a reliable method to utilize the Care Register for Health Care to assess participants' non-affective psychotic disorders and severe affective disorders.

## 5. Conclusion

This prospective study from childhood to adulthood, over critical phases of growth and maturation, shows that childhood family environment predicts severe mental disorders in adulthood before age 60. Some associations, such as those between emotional family atmosphere and non-affective psychoses and between stress-prone life events and severe affective disorders, were non-significant which was contrary to retrospective case-control studies, implying that psychiatric patients' retrospective self-reports may possibly slightly overestimate some family adversities in childhood. Second, our findings suggest some disorder-specificity of aspects of childhood family environment in the pathogenesis of non-affective psychotic disorders and other severe mental disorders. Thus, family interventions (with limited resources) could focus on most crucial family risk factors: in particular, the role of stress-prone life events in the development of psychoses could be paid more attention in research and in clinical practice. Third, in pediatric screening, the role of even comparatively mild adversities should not be underestimated because this study provides evidence that differences in ordinary-life childhood circumstances (in the general population) predict changes in the likelihood of severe mental disorders over life-course. Taken together, these findings support guidelines related to pediatric screening and counseling for family environment and, overall, for increasing public health initiatives in childhood to reduce adult mental diseases.

## CRediT authorship contribution statement

A.S., L.K.-J., and J.H. designed the study. L.K.-J., J.H., E.S., T.L., and O.R. contributed to data collection. A.S., H.D., J.H., and E.S. contributed to data analyses, and A.S. conducted the statistical analyses. A.S. and L.K.-J. wrote the initial manuscript draft, all the authors contributed to interpretation of the results and commented the manuscript.

## Role of the funding sources

The funding sources had no role in the design of this study and will not have any role during its execution, analyses, interpretation of the data, or decision to submit results.

## Declaration of competing interest

None.

## Data availability

The datasets presented in this article are not readily available because YFS is an ongoing follow-up study and the datasets are not anonymised, and the GDPR prevents public sharing of the data. Instead, pseudonymised datasets are possible to share on request, and requires a data sharing agreement between the parties. Requests to access the datasets should be directed to Katri Räikkönen ([katri.raikkonen@helsinki.fi](mailto:katri.raikkonen@helsinki.fi)) or Niklas Ravaja ([niklas.ravaja@helsinki.fi](mailto:niklas.ravaja@helsinki.fi)) for psychological dataset related to family environment, and to Jarmo Hietala ([jahi@utu.fi](mailto:jahi@utu.fi)) for the data on psychiatric diagnoses.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.schres.2023.06.008>.

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