Schizophrenia Research 172 (2016) 46–53

Contents lists available at ScienceDirect

Schizophrenia Research

journal homepage: www.elsevier.com/locate/schres

Childhood trauma as a risk factor for the onset of subclinical psychotic experiences: Exploring the mediating effect of stress sensitivity in a cross-sectional epidemiological community study

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ARTICLE INFO

Article history:
Received 16 December 2015
Received in revised form 31 January 2016
Accepted 3 February 2016
Available online 10 February 2016

Keywords:
Childhood trauma
Stress sensitivity
Subclinical psychotic experiences
Extended psychosis phenotype
Path modeling

ABSTRACT

Childhood trauma is a risk factor for the onset of schizophrenic psychosis. Because the psychosis phenotype can be described as a continuum with varying levels of severity and persistence, childhood trauma might likewise increase the risk for psychotic experiences below the diagnostic threshold. But the impact of stressful experiences depends upon its subjective appraisal. Therefore, varying degrees of stress sensitivity possibly mediate how childhood trauma impacts in the end upon the occurrence of subclinical psychotic experiences.

We investigated this research question in a representative community cohort of 1500 participants. A questionnaire, comprising five domains of physical and emotional neglect, as well as physical, emotional, and sexual abuse, was used to assess childhood trauma. Based on different symptoms of subclinical psychotic experiences, we conducted a latent profile analysis (LPA) to derive distinct profiles for such experiences. Path modeling was performed to identify the direct and indirect (via stress sensitivity) pathways from childhood trauma to subclinical psychotic experiences.

The LPA revealed four classes — unaffected, anomalous perceptions, odd beliefs and behavior, and combined anomalous perceptions/odd beliefs and behavior, that – except for sexual abuse – were all linked to childhood trauma. Moreover, except for physical abuse, childhood trauma was significantly associated with stress sensitivity. Thus, our results revealed that the pathways from emotional neglect/abuse and physical neglect to subclinical psychotic experiences were mediated by stress sensitivity.

In conclusion, we can state that subclinical psychotic experiences are affected by childhood traumatic experiences in particular through the pathway of a heightened subjective stress appraisal.

1. Introduction

Much evidence has been found for the influence of environmental factors that increase the risk for the onset and impact on the course of psychosis (van Os et al., 2010). A possible link between environmental risk factors and psychosis is distress from subjectively perceived stressful events in persons with a heightened vulnerability for psychotic experiences (Gibson et al., 2014; Phillips et al., 2007).

In this respect childhood trauma has received much interest. In light of several meta-analyses, including case–control, prospective, and cross-sectional studies, childhood trauma has been endorsed on a broad empirical basis as a potential risk factor for the onset of *schizophrenic psychosis* (Holtzman et al., 2013; Matheson et al., 2013; Varese et al., 2012; Wigman et al., 2012; Schäfer and Fisher, 2011).

As the occurrence of a psychosis phenotype can be characterized as a continuum with differing levels of severity and persistence (Rössler et al., 2007; Wigman et al., 2011), childhood trauma might be likewise a potential risk factor for *subclinical psychotic experiences*, i.e. long before a schizophrenic disorder is diagnosed (Kessler et al., 2010). Such psychotic experiences below the diagnostic threshold for schizophrenia and other psychotic disorders are quite prevalent in the general population (Rössler et al., 2013a; Rössler et al., 2014; Rössler et al., 2013b; Rössler et al., 2007; van Os et al., 2000; Wiles et al., 2006) even across socio-culturally different countries (Loch et al., 2011). A review of 61 incidence and prevalence studies of population rates for subclinical symptoms revealed a median prevalence rate of 7.2% and a median annual incidence rate of 2.5%, albeit with significant variation in those rates (Linscott and van Os, 2013).

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http://dx.doi.org/10.1016/j.schres.2016.02.006
0920-9964/

Here, we aimed to investigate the impact of environmental factors on the development of psychotic symptomatology, focusing especially on the pathways from childhood trauma to subclinical psychotic experiences in adulthood related to increased stress sensitivity. One advantage of using a continuum model is that the grading of levels in symptomatic severity and persistence mirrors reality much better than do categorical measures, which are accompanied by a loss of information.

However, recent research has cautioned that, at the lower end of the spectrum, homogeneous subsets of individuals exist with certain profiles of subclinical psychotic experiences (Tabak and de Mamani, 2013). Therefore, our study sought to determine whether different subgroups of subclinical psychotic experiences exist and whether childhood trauma is linked to those subgroups in adulthood. In a previous study we already confirmed the link between childhood adversities and subclinical psychotic experiences (Rössler et al., 2014). Here we wanted to explore how various forms of childhood trauma and heightened stress sensitivity influence those subclinical psychotic experiences subgroups and to examine whether stress sensitivity acts as a mediator within the pathway(s) between childhood trauma and subclinical psychotic experiences.

In addition, a number of potentially confounding variables must be taken into account as control variables when examining potential associations between childhood trauma and subclinical psychotic experiences. Studies have inconsistently found that subclinical psychotic experiences are linked to male gender and younger age (Calkins et al., 2014; Spauwen et al., 2003; Rössler et al., 2012; Rössler et al., 2015).

Thus, we aimed to analyze in exploratory analyses (i) whether childhood trauma impacts on the occurrence of *subclinical* psychotic experiences as it is known with respect to diagnosable psychotic disorders, (ii) whether this impact might be different for different types of trauma and (iii) different subgroups of psychotic experiences, and (iv) whether this impact is possibly mediated by individual stress sensitivity.

2. Methods

2.1. Study design and sampling

This epidemiological study was conducted as part of the Zurich Programme for Sustainable Development of Mental Health Services, a research program with nine sub-projects (www.zinep.ch).

As a first step in the epidemiology survey, we used a computer-assisted telephone interview (CATI) to screen 9829 Swiss participants, aged 20 to 41 years, who were representative of the general population of the canton of Zurich. The Symptom Checklist—27 (SCL-27) (Hardt et al., 2004) served as our screening instrument. Participants were randomly chosen through the residents' registration offices for the canton. Residents without Swiss nationality were excluded. The overall response rate was 53.6%. Reasons for non-response were no telephone connection, reaching only a telephone answering machine, incorrect telephone number, communication impossible, unavailability during the study period, or refusal by the target person or a third party. In cases where potential subjects were available by telephone the response rate was 73.9%.

In a second step, we randomly selected 1500 subjects from the initial screening sample for comprehensive face-to-face interviews (response rate: 65.2%) that were conducted by trained and experienced clinical psychologists. All subjects who completed the semi-structured interviews were subsequently asked to complete various questionnaires. The sample pool was divided into two subsamples focusing on either personality disorders (N = 680) or psychosis (N = 820); we used the latter group for the current study. All assessments were completed between August 2010 and September 2012.

Our stratified-sampling procedure included 60% high-scorers (i.e., scoring below the 75th percentile of the global severity index (GSI) for the SCL-27) and 40% low-scorers (i.e. below the 75th percentile of the GSI). This design was chosen to enrich the sample pool with subjects at higher risk for mental disorders. Such a two-phase procedure – initial screening and comprehensive interviews with a stratified subsample – is fairly common in epidemiological research (Dunn et al., 1999). The study design has been explained in further detail by Ajdacic-Gross et al. (2014).

The ethics committee of the canton of Zurich (KEK) approved the ZInEP Epidemiology Survey as fulfilling all requirements for legal and private data protection. It was designed to be in strict accordance with the declaration of Helsinki of the World Medical Association as revised in 2008. All participants gave written informed consent.

The ZInEP epidemiological survey was funded by a private foundation certified by the cantonal health authorities. The foundation had no further role in the experimental design; the collection, analysis, and interpretation of data; the writing of this report; or the decision to submit this paper for publication.

2.2. Measures

Because no consistent description is available for what actually constitutes subclinical psychotic experiences, we examined the data collected via different questionnaires about a variety of related symptoms that might present in a community sample.

We used the following psychopathological instruments and questionnaires as indicators for subclinical psychotic experiences:

- The Structured Interview for Assessing Perceptual Anomalies (SIAPA) (Bunney et al., 1999). There, perceptual and attentional anomalies such as hyper-alertness and poor selective attention to external stimuli are evaluated. The SIAPA focuses on auditory, visual, tactile, olfactory, and gustatory modalities. For the ZInEP Epidemiology Survey the SIAPA was adapted as a self-report questionnaire. Reliability and validity of the original interview form are good (Bunney et al., 1999).
- The German version (Klein et al., 1997) of the brief form of the Schizotypal Personality Questionnaire (SPQ-B) (Raine and Benishay, 1995), contains 22 items and measures three factors of schizotypy, namely “cognitive-perceptual” (SPQ-cog: paranoid ideation, illusionary perception), “interpersonal” (SPQ-int: lack of close friends, social withdrawal, anhedonia), and “disorganized” (SPQ-dis: eccentric behavior, odd mannerisms). Internal consistency and test–retest reliability of the subscales are high (Raine and Benishay, 1995).
- The Paranoia Checklist (PARA) (Freeman et al., 2005) is a self-report instrument with 18 items. Each item assessing a feature of paranoid and suspicious thoughts is rated separately for frequency (PARA-fre), degree of conviction (PARA-con), and distress (PARA-dis). We used the German translation by Lincoln et al. (2009). Internal consistency of the PARA is good and convergent validity has also been provided (Freeman et al., 2005; Lincoln et al., 2009).
- Two psychosis subscales, namely the schizotypal signs scale (STS) and the schizophrenia nuclear symptom scale (SNS) were derived from the Symptom Checklist—90—R (Derogatis, 2000; Schmitz et al., 2000). Since the SCL-90-R original syndrome structure has been questioned we used factor-analytic methods to rearrange the original syndromes “paranoid ideation” and “psychoticism” (Rössler et al., 2007). According to the SCL90-R manual, the six-item subscale “paranoid ideation” is characterized by projective thoughts, hostility, suspiciousness, grandiosity, centrality, fear of loss of autonomy and delusions. The subscale “psychoticism” (10 items) included items indicative of a withdrawn, isolated, schizoid life style as well as items representing symptoms of psychosis and schizophrenia such as hallucinations and thought broadcasting. The factor analyses revealed fairly consistent patterns. The first factor regularly included paranoid ideation items as well as the items “feeling lonely even when with people” and “never feeling close to another person” from the original psychoticism subscale. This factor addresses social and interpersonal deficiencies with reduced capacity for close relationships as well as

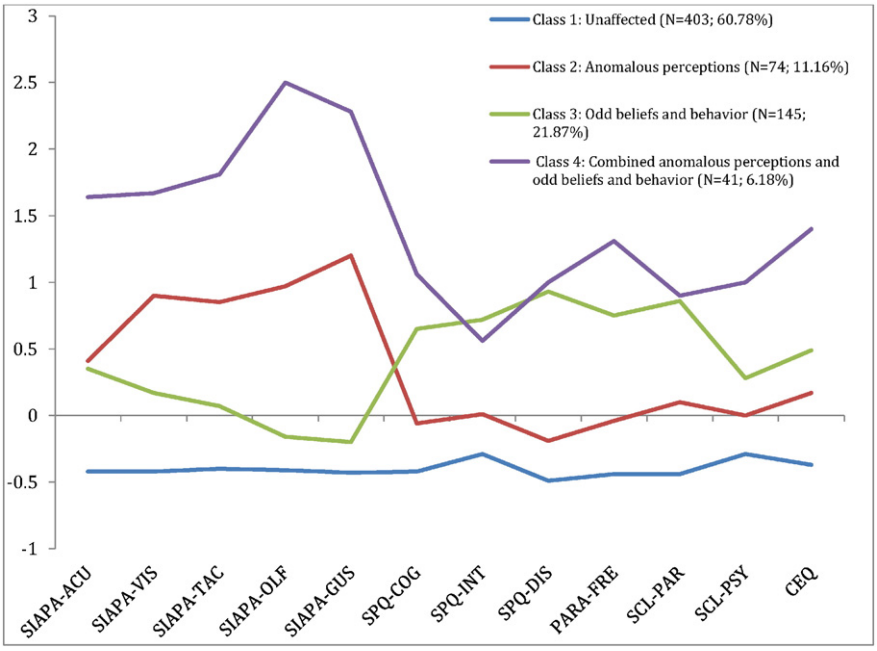

Fig 1. Latent profile analysis: Empirically derived classes of subclinical psychotic experiences in a Swiss community sample; Class 1: unaffected, Class 2: anomalous perceptions, Class 3: odd beliefs and behavior, and Class 4: combined anomalous perceptions/odd beliefs and behavior.

ideas of reference, odd beliefs and suspiciousness or paranoid ideation. As such this factor is reminiscent of criteria required for a diagnosis of a "schizotypal personality disorder". It will be referred to hereafter as the STS subscale. The second factor mostly included the first four items of the SCL subscale "psychoticism" — delusions of control, auditory hallucinations, thought-broadcasting and thought-intrusion, and thus represents attenuated forms of the nuclear symptoms of schizophrenia. We referred to it as the SNS subscale.
The modification of those two psychosis subscales has been further detailed previously (Rössler et al., 2007). Since their introduction, those two new subscales of subclinical psychosis, i.e. STS and SNS, have been replicated and applied in other independent samples (Breetvelt et al., 2010; Rössler et al., 2011).

- As a measure of fantasy proneness we used the Creative experiences questionnaire (CEQ) (Merckelbach et al., 2001). The instrument shows substantial correlations with standard measures of fantasy proneness and schizotypy. The instrument demonstrates adequate test–retest stability and internal consistency (Merckelbach et al., 2001).

Stress sensitivity (SS) was operationalized using the following instruments:

- We assessed perceived stress with the 10-items Perceived Stress Scale (PSS; Cohen et al., 1983; Grässel et al., 2007).
- The 10-item negative affect subscale of the Positive and Negative Affect Scale (PANAS-N; Watson et al., 1988) measured negative affect.

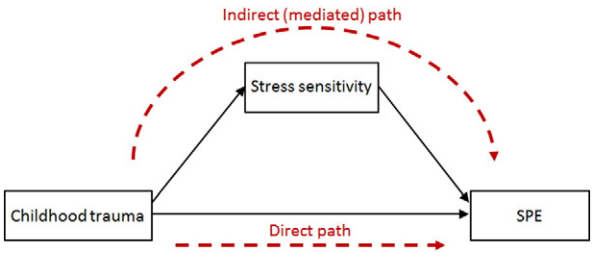

Fig. 2. Conceptual model of the association between childhood trauma and subclinical psychotic experiences, directly and indirectly, as mediated by stress sensitivity.

- The 12-item Screening Scale for Chronic Stress (SSCS) (Schulz et al., 2004) was developed to cover chronic stress in various domains of daily life, such as work overload, worries, lack of social recognition, or work discontent.

Because of a strong positive association between scores of PSS and PANAS-N ($r = .63$, $p < .001$) and SSCS ($r = .76$, $p < .001$) as well as between significant scores of PANAS-N and SSCS ($r = .61$, $p < .001$), we averaged these three z-scores into one SS score for more parsimonious analyses.

- Childhood trauma was assessed with the short-form of the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994): The CTQ is a well-known retrospective measure of child abuse and neglect and consists of 28 items divided into a control scale named denial and the five domains emotional abuse (EA), emotional neglect (EN), sexual abuse (SA), physical abuse (PA), and physical neglect (PN). We used the German adaptation (Wingenfeld et al., 2010). For the present study we focused on the five domains as well as on the total score from these five subscales. Internal consistency of the different domains is high and test–retest reliability is good. The CTQ showed good convergent and discriminant validity and is considered to be a sensitive and valid screening questionnaire for childhood trauma (Bernstein et al., 1994; Wingenfeld et al., 2010).

As a proxy for familial liability we asked the respondents whether any member of their core family (i.e. first- and/or second-degree relatives) currently suffers or have ever suffered from schizophrenia/psychotic disorder, depression, or bipolar disorder (Binbay et al., 2012).

2.3. Statistical considerations

The current analyses were carried out in three steps.
First, a latent profile analysis (LPA) was used to identify distinct patterns of subclinical psychotic experiences among the total study sample. LPA identifies homogeneous groups of individuals based on similarities of symptom patterns. Fit indices were used to compare multiple class solutions. Accordingly, starting with a single class solution, we tested solutions with increasing numbers of classes. We evaluated the relative

Table 1
LPA fit statistics for the tested class solutions.

	1 class	2 classes	3 classes	4 classes	5 classes
AIC	21,295.533	19,792.826	19,191.950	18,890.402	18,739.196
BIC	21,403.456	19,959.206	19,416.789	19,173.699	19,080.951
Sample-adjusted BIC	21,327.255	19,841.730	19,258.037	18,973.672	18,839.648
Entropy	na	.899	.882	.898	.901
Parametric BLRT	na	2 v 1 H0 log-likelihood value = −10,623.767 p < .001	3 v 2 H0 log-likelihood value = −9859.413 p < .001	4 v 3 H0 log-likelihood value = −9545.975 p < .001	5 v 4 H0 log-likelihood value = −9382.201 p < .001
N for each class	C = 663	C1 = 508 C2 = 155	C1 = 429 C2 = 162 C3 = 72	C1 = 403 C2 = 74 C3 = 145 C4 = 41	C1 = 129 C2 = 385 C3 = 80 C4 = 38 C5 = 31

Note: AIC = Akaike information criterion, BIC = Bayesian information criterion, BLRT = Bootstrapped Likelihood Ratio Test, and na = not applicable.

fit of different models using the Bootstrapped Likelihood Ratio Test (BLRT; McLachlan and Peel, 2000), the Bayesian information criterion (BIC), the sample-size-adjusted BIC (BIC-A), the Akaike information criterion (AIC; McLachlan and Peel, 2000), and the entropy measure (Ramaswamy et al., 1993). Significant BLRT values suggest that a model is preferable (Nylund et al., 2007) over a solution with k − 1 classes. Lower values of BIC, AIC and BIC-A for a given model indicate an improved model fit. Entropy was considered as a measure of classification accuracy. Solutions with one or several classes including less than 5% of all participants were rejected.

Second, distributions of socio-demographic variables, indicators of childhood trauma and stress sensitivity across the empirically derived classes of subclinical psychotic experiences were examined. Associations with categorical variables were tested using Chi-square statistics and One-way-analyses of variance (ANOVA) were used to test for mean differences in continuous variables. In case of an overall significant effect bivariate multinomial regressions with changing reference categories were conducted to test for differences in categorical variables between classes and Bonferroni post-hoc tests were conducted for continuous variables.

Finally, we used class membership as the categorical dependent variable in a series of bivariate and mediated multinomial logistic regression path models. Thereby the unaffected class (Class 1) served as reference category. In bivariate analyses multiple tests were performed for the four CTQ subscales of CTQ that were considered for final modeling, which might have inflated the rate of Type I error. Therefore, p-values were corrected using the Bonferroni method by dividing the p-value (<0.05) by 4. Accordingly, a CTQ subscale was identified as relevant for final modeling if its p-value was below the cutoff of .0125 (i.e. .05/4). Then, we examined overall childhood trauma and its subtypes as well as stress sensitivity as predictors of class membership and controlled for education (age and sex were not bivariately associated with subclinical psychotic experiences). For stress sensitivity we looked at its direct effect as well as its role as mediator between childhood trauma and subclinical psychotic experiences as visually represented in Fig. 2. According to the recommendations of Preacher and Hayes (2008) we conducted separate path analyses for each type of childhood trauma that was significantly associated in bivariate analyses while including the other types as covariates in the same model (see Table 4). This enabled us to estimate the effect of each type of childhood trauma separately while accounting for interrelationships between types (Preacher and Hayes, 2008). Indirect effects were estimated via multiplying two parameter estimates from 1.) a single distal direct effect from childhood trauma dimension to the mediating variable (stress sensitivity), and 2.) from the mediating variable to class membership using the MODEL CONSTRAINT command in MPlus. Probabilities of both direct and indirect were provided by unstandardized estimates as well as odds ratios (OR) with 95% confidence intervals (95% CI). ORs (and 95% CI) of

Table 2
Distributions of subscales for CTQ, socio-demographic variables, and stress sensitivity among the four derived classes of subclinical psychotic experiences.

		Class 1: unaffected	Class 2: anomalous perceptions	Class 3: odd beliefs/behavior	Class 4: combined	Group comparisons	
		Mean ± SD (%)	Mean ± SD (%)	Mean ± SD (%)	Mean ± SD (%)	p-Value	Pairwise tests
Demography	Gender female	52.11	54.05	48.97	68.29	0.178	
	Age	31.78 ± 6.78	31.22 ± 7.50	30.95 ± 6.47	31.59 ± 6.35	0.625	
	High educational degree	65.76	54.79	56.25	43.90	0.010	C1 > C3,C4
History of childhood trauma (CTQ)	CTQ-total	32.09 ± 8.59	33.00 ± 6.84	39.34 ± 12.23	38.63 ± 15.05	<0.001	C1 < C3,C4 C2 < C3,C4
	Emotional abuse	6.83 ± 2.67	6.85 ± 2.16	9.42 ± 4.21	9.79 ± 4.71	<0.001	C1 < C3,C4 C2 < C3,C4
	Emotional neglect	8.48 ± 3.65	9.05 ± 3.32	11.15 ± 4.66	10.36 ± 4.41	<0.001	C1 < C3,C4 C2 < C3
	Physical abuse	5.47 ± 1.29	5.29 ± 0.77	6.15 ± 2.44	6.42 ± 2.70	<0.001	C1 < C3,C4 C2 < C3,C4
	Physical neglect	6.07 ± 1.86	6.68 ± 2.24	6.89 ± 2.20	7.16 ± 2.39	<0.001	C1 < C3,C4
	Sexual abuse	5.49 ± 2.00	5.36 ± 1.29	5.87 ± 2.41	6.08 ± 3.45	0.113	
Stress sensitivity	Composite index of perceived stress, negative affect, & chronic stress (z-scored)	−0.35 ± 0.72	0.07 ± 0.69	0.65 ± 0.83	0.89 ± 0.76	<0.001	C1 < C2,C3,C4 C2 < C3,C4
Familial liability	Depression	24.57	22.97	31.03	31.71	0.341	
	Schizophrenia	2.98	4.05	5.52	4.88	0.558	
	Bipolar disorder	2.48	1.35	2.76	4.88	0.718	

Table 3
Raw estimates of associations between predictor variables and class membership of subclinical psychotic experiences.

	Class 1: unaffected	Class 2: anomalous perceptions	Class 3: odd beliefs/behavior	Class 4: combined
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
High educational degree	Ref.	0.63 (0.38–1.05)	**0.67 (0.45–0.99)**	**0.41 (0.21–0.78)**
CTQ-total (z-scored)	Ref.	1.17 (0.84–1.64)	**2.15 (1.71–2.70)**	**2.06 (1.50–2.83)**
Emotional abuse (z-scored)	Ref.	1.01 (0.70–1.46)	**2.24 (1.80–2.80)**	**2.39 (1.77–3.23)**
Emotional neglect (z-scored)	Ref.	1.20 (0.91–1.59)	**1.95 (1.59–2.39)**	**1.66 (1.20–2.31)**
Physical abuse (z-scored)	Ref.	0.74 (0.44–1.23)	**1.48 (1.21–1.81)**	**1.59 (1.22–2.09)**
Physical neglect (z-scored)	Ref.	**1.39 (1.09–1.77)**	**1.50 (1.24–1.82)**	**1.64 (1.23–2.18)**
Stress sensitivity	Ref.	**2.17 (1.54–3.04)**	**5.37 (3.94–7.32)**	**7.76 (4.85–12.43)**

OR (95% CI) = odds ratio (95% confidence interval).
Significant results are shown in bold (p-values of the four CTQ subscales remained significant at $p < .05$ after Bonferroni correction for multiplicity).
Bivariate associations between stress sensitivity and overall childhood trauma ($r = 0.26$, $p < 0.001$), emotional abuse ($r = 0.31$, $p < 0.001$), emotional neglect ($r = 0.26$, $p < 0.001$), physical abuse ($r = 0.08$, $p = 0.051$), or physical neglect ($r = 0.17$, $p < 0.001$); p-values remained significant after Bonferroni correction.

indirect effects were calculated by exponentiating the products of the unstandardized indirect effect estimates. If a 95% confidence interval did not contain the value 1.0 the effect is considered as significant at $p < .05$.

LPAs and path modeling were conducted using MPlus v6 (Muthen and Muthen, 1998–2011). All other analyses were conducted using Stata/SE 12 (StataCorp, 2011).

3. Results

The LPA yielded a four-class solution (see Fig. 1) that fitted the data significantly better than a one- through three-class solution (Table 1). Although the five-class solution was slightly superior to the four-class solution, it also produced a class with a sample size below 5.0% (4.7%) and that we rejected this solution for reasons of parsimony.

Class 1 (N = 403; 60.78%) represented the majority of participants who had overall lower subclinical psychotic experiences than the average of the total sample (i.e., having an standard deviation (SD) of approximately 0.5 below the centered group mean) (see Fig. 1). On average, Class 2 (N = 74; 11.16%) experienced more anomalous perceptions (SDs of 0.5 to 1.0 above the population mean), while odd beliefs and behavior were not higher than the population mean. By contrast, persons in Class 3 (N = 145; 21.87%) experienced more odd beliefs and behavior (0.5 to 1.0 SD above the population mean), but no increase in anomalous perceptions. Finally, Class 4 (N = 41; 6.18%) comprised participants with high anomalous perceptions (between 1.0 and 2.5 SD above the population mean) as well as those with high paranoid, psychotic, and schizotypal symptoms (>0.5 to 1.5 SD above the population mean). Accordingly, we labeled these groups as *unaffected* (Class 1), *anomalous perceptions* (Class 2), *odd beliefs and behavior* (Class 3), or *combined anomalous perceptions/odd beliefs and behavior* (Class 4).

Table 2 shows the distributions of socio-demographic factors, childhood trauma scores (both total and subscale), indexed stress sensitivity, and the familial liabilities of depression, schizophrenia, and bipolar disorder across classes. Whereas significant differences were found with regard to education, childhood trauma (except for sexual abuse), and stress sensitivity, sex, age, and familial liability did not differ across classes. For more details on pairwise comparisons please refer to Table 2.

Table 3 presents the crude ORs of all considered predictors for class membership as well as the bivariate associations between childhood trauma and stress sensitivity (in footnote). Overall childhood trauma as well as emotional abuse, emotional neglect, and physical abuse were all positively linked to Classes 3 and 4, while physical neglect was linked to Classes 2 through 4. Lower educational status was linked to Classes 3 and 4, and stress sensitivity was strongly linked to Classes 2 through 4 with increasing ORs. Except for physical abuse, childhood trauma was significantly correlated with stress sensitivity.

Table 4 summarizes the results of the mediated path analyses for overall childhood trauma, emotional abuse, emotional neglect, and physical neglect on subclinical psychotic experiences. Although it was included as a covariate in other models, we did not conduct a

Table 4
Mediation analyses for emotional abuse, emotional neglect, physical abuse, and physical neglect on classes of subclinical psychotic experiences in a Swiss community sample.

Outcome category (versus Class 1)	Independent variable (IV)	Effect of IV on stress sensitivity	Effect of stress sensitivity on outcome[a]		Direct effect of IV		Indirect effect estimates	
		Estimate[b]	Estimate[b]	OR (95% CI)	Estimate[b]	OR (95% CI)	Estimate[b]	OR (95% CI)
Class 2	CTQ-total	0.25***	0.80***	2.23 (1.58–3.16)	−0.02	0.98 (0.70–1.38)	0.20***	1.22 (1.10–1.34)
Class 3			1.62***	5.05 (3.66–6.97)	0.55***	1.73 (1.36–2.21)	0.40***	1.49 (1.29–1.70)
Class 4			2.02***	7.51 (4.64–12.14)	0.44*	1.55 (1.09–2.20)	0.50***	1.65 (1.34–1.95)
Class 2	Emotional abuse	0.29***	0.74***	2.10 (1.47–3.01)	−0.25	0.78 (0.48–1.25)	0.22***	1.24 (1.10–1.39)
Class 3			1.62***	5.04 (3.61–7.05)	0.31	1.37 (0.98–1.90)	0.47***	1.60 (1.37–1.84)
Class 4			1.95***	7.00 (4.22–11.61)	0.47	1.60 (0.96–2.65)	0.57***	1.76 (1.41–2.11)
Class 2	Emotional neglect	0.23***			0.04	1.04 (0.68–1.57)	0.17**	1.18 (1.07–1.30)
Class 3					0.27	1.31 (0.92–1.86)	0.37***	1.44 (1.25–1.64)
Class 4					−0.31	.74 (0.41–1.32)	0.44***	1.56 (1.28–1.83)
Class 2	Physical neglect	0.14***			0.29	1.34 (0.98–1.82)	0.11**	1.11 (1.03–1.19)
Class 3					−0.03	0.98 (0.73–1.30)	0.23***	1.26 (1.11–1.42)
Class 4					0.27	1.31 (0.85–2.01)	0.28***	1.32 (1.12–1.52)

OR (95% CI) = odds ratio (95% confidence interval).
All models are adjusted for educational status.
[a] For path models of each childhood trauma subtype, coefficients for the effects of stress sensitivity on outcome classes are the same for each model, so results from only the first model are displayed here.
[b] Estimates are unstandardized coefficients.
*** $p < 0.001$.
** $p < 0.01$.
* $p < 0.05$.

separate model with physical abuse as the main independent variable because it was not bivariately linked to stress sensitivity. As recommended by Preacher and Hayes (2008), all effect estimates are unstandardized and therefore subsequently calculated odds ratios represent the change in likelihood for a certain class (compared to Class 1) by a change of one unit of the predictor. Since all CTQ scales were z-transformed for regression modeling the estimations give information about the deviation from the population mean. According to Preacher and Hayes (2008) mediation models for each the subtypes of childhood trauma were adjusted for all remaining types as well as for education.

Accordingly, childhood trauma, emotional abuse, emotional neglect, and physical neglect were significant predictors of stress sensitivity, which, in turn, was significantly linked to subclinical psychotic experiences with increasing ORs from Class 2 through Class 4. Furthermore, overall childhood trauma, as well as emotional abuse, emotional neglect, and physical neglect individually, each of them had indirect influences on subclinical psychotic experiences mediated through the effect of higher stress sensitivity. In the mediation models none of the trauma subtypes as main independent variables was significantly related to subclinical psychotic experiences anymore (compared to bivariate models). This strongly suggested a fully mediated effect via stress sensitivity. In contrast, overall childhood trauma was both directly and indirectly linked to subclinical psychotic experiences, implying a partial mediation of this pathway through stress sensitivity.

4. Discussion

This study aimed to investigate the impact of childhood trauma on the development of subclinical psychotic experiences both directly and indirectly via the pathway of individual stress perception. Moreover, we accounted for various potential confounding factors.

Based on our LPA results, we empirically identified four different classes of subclinical psychotic experiences. Compared with Class 1, which contained the majority of the participants displaying no subclinical psychotic experiences, the other classes featured perceptual anomalies (auditory, visual, tactile, olfactory, and gustatory), odd beliefs and behavior (i.e., paranoid, psychotic, and schizotypal symptoms), or a combination of those perceptual anomalies, odd beliefs, and behavior. This was consistent with our results reported from a previous factor-analytic solution that used the same sample (Rössler et al., 2013a; Rössler et al., 2015a; Rössler et al., 2013b).

Approximately 60% of all participants displayed no or low subclinical psychotic experiences, a finding that was also common in our epidemiological studies (Rössler et al., 2013a; Rössler et al., 2015a; Rössler et al., 2013b; Rössler et al., 2007). Of the 40% who reported subclinical psychotic experiences above the sample mean, approximately 1/3 described predominantly perceptual anomalies; 1/3, odd beliefs and behavior; and 1/3, a mixture of both. These groups did not differ in age or gender but did in their educational status. Thus, persons who achieved a higher educational degree were mostly unaffected by subclinical psychotic experiences. Although we cannot say whether the respective educational status precedes subclinical psychotic experiences or is a consequence of subclinical psychotic experiences due to our cross-sectional study design; this, however, supports epidemiological findings suggesting that psychosis is linked to premorbid intellectual deficits (Muller et al., 2013) that might also apply to subclinical psychotic experiences. Missing sex differences support previous findings suggesting that such differences in psychosis manifest themselves rather at the high end of the continuum than within the sub-threshold range (Rössler et al., 2012; Rössler et al., 2015b).

We then found that almost all types of childhood trauma were related to subclinical psychotic experiences, with the strength of the relationship ascending in order from anomalous perceptions to odd beliefs and behavior to a combination of both syndromes. This outcome supported previous research suggesting a strong link between childhood abuse and psychotic-like experiences in adulthood, although the number of abuse experiences was associated only with unusual (= anomalous) perceptions (Samplin et al., 2013; Steel et al., 2009).

Our results also indicated that childhood trauma is differentially associated with subclinical psychotic experiences, being more likely linked with odd beliefs and behavior or the combined subtype than with perceptual anomalies alone. Those odd beliefs and behavior appear to constitute a much more pervasive psychopathology that might be characterized by severely disordered social communication, whereas perceptual anomalies might instead represent single events in the lives of affected persons. We found it surprising that, in our sample, sexual abuse was not related to subclinical psychotic experiences, possibly because of its presumably low frequency and less chronic occurrence when compared with other subtypes of childhood trauma.

Our specific study objective was to determine whether the relationships between childhood trauma and subclinical psychotic experiences resulted from a direct pathway or whether indirect effects via stress sensitivity caused those associations. Our data showed that overall childhood trauma as well as childhood trauma subtypes were indirectly linked to subtypes of subclinical psychotic experiences. Here, the strongest links were detected for the combined class, followed by the class manifesting odd beliefs and behavior. The lowest associations were found in the class with perceptual anomalies. Overall childhood trauma seemed to affect subclinical psychotic experiences equally by both direct and indirect paths, while the effects of specific childhood trauma subtypes on subclinical psychotic experiences revealed that emotional abuse, emotional neglect, and physical neglect were triggered (i.e., mediated) by stress perceptions. Thus, our findings provide evidence for a relationship between childhood trauma and subclinical psychotic experiences and also show that early exposure to stress can lead to greater sensitivity (Holtzman et al., 2012). This, in turn, might play a crucial role in that association. Animal models have suggested that this process might reflect changes in hypothalamic–pituitary–adrenal activity that stimulates expression of the circuitry and neurotransmitter vulnerability and is therefore associated with psychotic symptoms (Holtzman et al., 2013).

A major strength of this study was the use of a large epidemiological sample. Our results can therefore be generalized to individuals within the general population who, although they might have subclinical psychotic experiences, are not necessarily seeking help for mental health problems. Consequently, we can apply a broad set of measures that cover all kinds of psychopathology and include well-established instruments to assess childhood trauma and stress sensitivity.

Despite these strengths, our results must be viewed in the light of some limitations. First, we used cross-sectional data, which means that one should be careful in drawing causalities when interpreting the data. Furthermore, we assessed childhood trauma retrospectively, which may have introduced an inherent source of bias. Nevertheless, there is evidence that such retrospection is likely to underestimate rather than over-report true rates, which at worst might produce weaker associations (Hardt and Rutter, 2004). Moreover, other researchers have noted that the reliability of retrospective reports of childhood abuse in patients with psychosis remains stable over a long timespan (Dvir et al., 2013). Finally, we were unable to provide a specific measure of "familial liability". When participants reported in the interview a mental illness in first or second degree relatives, this can be only understood as indication of a genetic risk.

Overall, our findings provide support for previous research that suggests an association between childhood trauma and subclinical psychotic experiences. Therefore, an assessment of childhood trauma is indeed relevant when conducting follow-up evaluations of individuals at risk for psychosis. Finally, our results underline the role of distorted stress regulation as a possible consequence of enduring childhood trauma in the development of subclinical psychotic experiences.

Role of funding source

ZInEP was supported by a private foundation. The foundation had no further role in the experimental design; collection, analysis, and interpretation of data; writing of this report; or the decision to submit this paper for publication.

Contributors

Wulf Rössler took responsibility for the study design and also drafted and revised the manuscript. Vladeta Ajdacic-Gross took responsibility for the study design, supervised the epidemiological assessments and substantially contributed to drafting and critical revision of the manuscript. Mario Müller and Stephanie Rodgers took responsibility for the assessments and substantially contributed to drafting and critical revision of the manuscript. Helene Haker substantially contributed to drafting and critical revision of the manuscript. Mario Müller also conducted all statistical analyses.

Conflict of interest

None.

Acknowledgment

We thank the private foundation which supported ZInEP.

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