

## Original Article

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# The relationship between childhood trauma, psychotic symptoms, and cognitive schemas in patients with schizophrenia, their siblings, and healthy controls: results from the EU-GEI study

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**Abstract**

**Background.** The relationship between childhood trauma (CT) and psychotic symptoms in patients with schizophrenia (SCZ), and subthreshold psychotic experiences in non-clinical populations is well-established. However, little is known about the relationship between subtypes of trauma and specific symptoms in patients, their siblings, and controls. It is also not clear which variables mediate the relationship between trauma and psychotic symptoms.

**Methods.** Seven hundred and forty-two patients with SCZ, 718 of their unaffected siblings and 1039 controls from three EU-GEI sites were assessed for CT, symptom severity, and cognitive schemas about self/others. CT was assessed with the Childhood Trauma Questionnaire, and cognitive schemas were assessed by The Brief Core Schema Scale.

**Results.** Patients with psychosis were affected by CT more than their siblings and controls in all domains. Childhood emotional abuse and neglect were more common in siblings than controls. CT was related to negative cognitive schemas toward self/others in patients, siblings, and controls. We found that negative schemas about self-mediated the relationship between emotional abuse and thought withdrawal and thought broadcasting. Approximately 33.9% of the variance in these symptoms was explained by the mediator. It also mediated the relationship between sexual abuse and persecutory delusions in SCZ.

**Conclusions.** Our findings suggest that childhood abuse and neglect are more common in patients with schizophrenia than their siblings and healthy controls, and have different impacts on clinical domains which we searched. The relationship between CT and positive symptoms seems to be mediated by negative cognitive schemas about self in schizophrenia.

**Introduction**

Childhood trauma (CT) has been found to be causally related to an increased risk of a wide range of psychiatric disorders (Grilo & Masheb, 2002; Kendler et al., 2000; Nelson et al., 2002). The prevalence of CT among adults with psychotic disorders greatly exceeds that of the general population (Read, van Os, Morrison, & Ross, 2005). Overall lifetime exposure to sexual or physical abuse ranges from 12% to 85% across studies depending on the characteristics of study populations and definition of abuse (Bendall, Jackson, Hulbert, & McGorry, 2008; Kilicaslan et al., 2017; Üçok & Bıkmaz, 2007).

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Positive psychotic symptoms have been particularly related to CT in patients with schizophrenia (SCZ) (Ross, Anderson, & Clark, 1994; Üçok & Bıkmaz, 2007). Although some studies reported an association of negative symptoms with childhood abuse and neglect (Uyan, Baltacıoğlu, & Hocaoglu, 2022; Van Dam et al., 2015; Vila-Badia et al., 2022), others found no relationship in patients with psychosis (Şahin et al., 2013; Üçok & Bıkmaz, 2007; Werbeloff et al., 2021). Although little is known about the relationship between specific types of trauma and specific symptoms, there is some evidence that type of trauma is related to type of psychotic symptoms. For example, emotional abuse was reported as related to auditory hallucinations and delusions of thought reading in first-episode schizophrenia (Üçok & Bıkmaz, 2007); and sexual abuse was found related to more severe Schneiderian symptoms, particularly with 'commenting voices' in individuals with high risk for psychosis (Şahin et al., 2013). In a recent meta-analysis, it has been reported that while three types of childhood abuse were associated with positive symptoms, there is also a weak association between physical and emotional abuse and negative dimension as well as emotional and physical neglect and negative dimension (Alameda et al., 2021).

Studies investigating CT histories in patients with SCZ and their siblings report more CT in patients compared to siblings (Barrigón et al., 2015; Heins et al., 2011). In a recent meta-analysis, it has been reported that all kinds of childhood abuse and neglect were related to three subtypes of schizotypy, and strongest relationship was found between emotional abuse and schizotypal symptoms in non-clinical populations (Toutountzidis, Gale, Irvine, Sharma, & Laws, 2022).

Despite the population attribution risk from exposure to CT has been reported as 33% (Varese et al., 2012), it is not clear why some individuals with history of CT develop psychotic symptoms or a disorder and others do not. Therefore it is relevant to examine mediating factors in relationship between trauma and psychotic symptoms. Negative cognitive schemas about the self and others are proposed as one of the potential pathways from trauma to psychotic symptoms. Cognitive schemas can be described as broad, self-perpetuating, maladaptive styles of thinking that originate from repetitive relational experiences, and unmet psychological needs with significant others in childhood and adolescence (Young, Klosko, & Weishaar, 2003). In adulthood, they become 'trait-like' due to the presence of strong emotions and evolve into component parts of the self and others. Once formed, these structures are the lenses by which we view the world (Rafaeli, Bernstein, & Young, 2010). They may be involved in the evolution of psychotic experiences, for example, by influencing the content of hallucinations and/or delusional beliefs.

The negative cognitive schemas of self and others have been observed in people with psychosis (Alameda et al., 2021; Sundag, Ascone, de Matos Marques, Moritz, & Lincoln, 2016; Taylor et al., 2014). CT are also one of the contributing factors to negative evaluations of self and others, and were found related to negative schemas in patients with psychosis (Cui et al., 2020; Van Dam et al., 2015) their siblings, and healthy people (Boyda, McFeeters, Dhingra, & Rhoden, 2018; Fisher, Appiah-Kusi, & Grant, 2012; Jaya, Ascone, & Lincoln, 2018; Sellers, Emsley, Wells, & Morrison, 2018). In a recent meta-analysis (Alameda et al., 2020), it has been reported that there is solid evidence of mediation between childhood abuse and psychosis by negative cognitive schemas about the self, the world, and others both in studies conducted in clinical samples

and in the general population. To the best of our knowledge, only Hardy et al. (2016) reported about the mediating role of cognitive schemas in relationship between specific CT and specific positive symptoms in patients with schizophrenia. They found that the relationship between childhood emotional abuse and persecutory delusions was mediated by negative cognitive schemas about others.

We aimed to compare the history of subtypes of abuse and neglect and to analyze the relationship between history of trauma and specific positive symptoms in a large sample of patients with schizophrenia, their siblings and healthy controls. We also examined the relationship between cognitive schemas about self, and others and psychotic symptoms. We hypothesized that the childhood trauma would be more common both in patient and sibling groups compared to controls. We also expected that negative cognitive schemas were more common, and would mediate the relationship between childhood trauma and psychotic symptoms in patients.

## Methods

### Study sample

The study population consisted of 742 patients diagnosed with schizophrenia spectrum disorders according to the DSM-IV-TR (average duration of illness since age of first contact with mental health services = 9.9 years), 718 of their unaffected siblings, and 1039 controls from the general non-clinical population, who enrolled in the Work-package 6 (WP6) of the European Network of National Schizophrenia Networks Studying Gene-Environment Interactions (EU-GEI) (European Network of National Networks studying Gene-Environment Interactions in Schizophrenia (EU-GEI), 2014; Guloksuz et al., 2019; van Os et al., 2020) from September 2010 to September 2014 in Turkey. The diagnosis of schizophrenia spectrum disorder was later confirmed by the Operational Criteria Checklist for Psychotic and Affective Illness (OPCRIT) (McGuffin, Farmer, & Harvey, 1991). Unrelated controls with no lifetime psychotic disorder were recruited from the same population as the cases. Sibling group was stipulated to include all consenting unaffected siblings, without stratification for socioeconomic variables. Additional exclusion criteria for the siblings were having a previous diagnosis of any psychotic disorder or previous use of anti-psychotic medication for any reason. Sibling with an age difference of >5 years with the patients were also excluded. The exclusion criteria for all participants included a diagnosis of psychotic disorder due to another medical condition, a history of head injury with loss of consciousness, and intelligence quotient <70.

All interviews were conducted by a research team, who received specific training for the use of standardized assessments. The complete details of the entire study and procedures were in accordance with the Declaration of Helsinki. Written informed consent was obtained from each participant. This study was approved by the Medical Ethics Committee of Ankara University, Ankara, Turkey (approval #07-302-15).

### Measures

All the measures were applied to all groups, except for the Structured Interview for Schizotypy-Revised (SIS-R) (Vollema & Ormel, 2000), which was given only to siblings and healthy

controls, and OPCRIT (McGuffin et al., 1991) which was applied only to patients.

Childhood adversity was evaluated using the Short Form of Childhood Trauma Questionnaire (CTQ) (Bernstein et al., 2003) which measures childhood emotional, physical and sexual abuse, and physical and emotional neglect. The scale also demonstrated a good test–retest reliability over 2–6 months (intra-class correlation 0.88) (Bernstein et al., 1994). The participants were asked to respond by considering their experiences of abuse and neglect before age 18. We calculated five subscale scores for different kinds of CT. We used the predefined cut-off scores to dichotomize each group for each kind of abuse/neglect which was used in the study that evaluated the validity and reliability of the Turkish version (Şar, Öztürk, & İlikardeş, 2012) and then compared to frequency of each abuse/neglect type among three groups. We also analyzed dose–response relationships by using mean scores of CTQ subscales. The cut-off was set at >7 for emotional abuse, >5 for physical and sexual abuse, >12 for emotional neglect, and >7 for physical neglect.

Severity of positive and negative symptoms of the patients was evaluated by the OPCRIT (McGuffin et al., 1991). OPCRIT evaluates both severity and frequency of symptoms. We analyzed only severity scores in this study. Items are scored on a 6-point scale, rating severity of the experience from ‘absent’ to ‘severe’. Clinical assessment of subclinical psychotic symptoms and negative symptoms was completed in the siblings and healthy controls with the SIS-R, a semi-structured interview originally developed by Kendler, Lieberman, and Walsh (1989), and revised by Vollema and Ormel (2000). SIS-R consists of 20 schizotypal symptoms (like introversion, magical thinking, restricted affect, dysfunction in leisure time activities, and referential thinking) and 11 schizotypal signs (like flatness of affect, oddness, rapport, and amount of speech). Positive schizotypy covers symptoms like referential thinking, illusions, and suspiciousness (in total six items). Negative schizotypy contains the symptoms like social isolation, social anxiety, introversion, and restricted affect (in total eight items). Each item was scored on a four-point scale. We calculated SIS-R total score, SIS-R positive, and SIS-R negative symptom scores.

We used The Brief Core Schema Scale (BCSS) (Fowler et al., 2006) which was developed to provide a theoretically coherent self-report assessment of schemata concerning self and others in psychosis. The BCSS have 24 items concerning beliefs about the self and others that are assessed on a five-point rating scale. The scales assess four dimensions of self and other evaluation: negative-self, positive-self, negative-other, and positive-other. There are six items to assess each domain.

### Statistical analyses

The normality of data distribution was assessed using the Kolmogorov–Smirnov test (for all,  $p > 0.05$ ). In cases where the normality assumption was rejected by the Kolmogorov–Smirnov test, an approximately normal distribution was considered based on the following criteria: (1) Skewness and kurtosis values within the range of  $\pm 2$  (George, 2011; Tabachnick, Fidell, & Ullman, 2013). (2) Confirmation through visual inspection resembling a bell-shaped curve (Tabachnick et al., 2013).

For datasets of the variables that did not meet the normality criteria, a data transformation process, including the logarithmic (lg) function with a base of 10 (due to positively skewed data), was applied. Thus, the mean scores of CTQ subscales for

emotional, physical, and sexual abuse were transformed. Additionally, the scores for SIS-R positive, negative, and total subtests, along with the negative-self score of the BCSS, which were included in the correlation analyses within the sibling and control groups, as well as in group comparisons, underwent the same transformation process. However, as this non-negative data included zero values, the lg10 transformation was applied with an adjustment for zero values.

After the transformations, an approximately normal distribution was achieved for all scores, except for the CTQ abuse scores of siblings and controls. Since the CTQ abuse scores of patients did not display excessive skewness and/or kurtosis; an approximately normal distribution was achieved after transforming the CTQ abuse scores in patients.

The differences in frequency distributions for each type of CT history among the three groups were examined using a Pearson chi-square ( $\chi^2$ ) test. An independent samples *t* or *F* test (or Robust-Brown Forsythe (RBF) test for asymptotically *F* distributed) was employed to analyze continuous variables with a normal distribution. Additional multiple comparisons of one-way analysis of variance (ANOVA) were conducted with the Tukey HSD (Honestly Significant Difference) or Tamhane’s *T2* tests, based on the assumption of whether the variances are homogeneously distributed or not. While, in datasets where the transformation process did not yield an approximately normal distribution (due to the CTQ abuse subscores of siblings and controls), a non-parametric Kruskal–Wallis test was employed for the group comparisons. We aimed to compare the mean scores of CTQ subscales among study groups using one-way ANOVA or Kruskal–Wallis test. Furthermore, we conducted cross-sectional group comparisons by the CT status (or the history of CT type) using the independent samples *t* test. The OPCRIT subscores were compared for the SCZ group, while the SIS-R subscale scores were compared for the siblings and controls. A Pearson correlation analysis was utilized to examine the associations between CT and cognitive schema scores. Finally, we conducted a mediation analysis to examine whether the association between childhood emotional abuse and overall positive symptom severity (including OPCRIT subscores of total positive symptoms, persecutory delusions, thought withdrawal, thought broadcasting, and thought echo) was mediated by the negative cognitive schema about self in the SCZ group. Additionally, we performed the same mediation analysis to test our hypothesis regarding the association between the subscore of CTQ sexual abuse and persecutory delusions, mediated by the negative cognitive schema about self.

To establish mediation, four steps were tested as follows: (1) intervention is related to the outcome (direct effect), (2) intervention is related to the mediator, (3) the mediator is related to the outcome when it is controlled for intervention, and (4) when the analysis is controlled for the mediator there is no direct effect (for full mediation) or a weaker direct effect (for partial mediation) of the intervention on the outcome. The mediation analyses were performed by the PROCESS macro for SPSS (Hayes & Rockwood, 2017), which estimated a 95% percentile bootstrap confidence interval (CI) for indirect effects based on 5000 bootstrap samples. Also, a proportion of variance explained by the mediator was calculated by dividing the total indirect effect by the total effect. Additional assumptions of linearity of regression slopes among variables proposed in the models and multicollinearity were tested and provided before the mediation analysis.

A *p*-value <0.05 (two-tailed) was considered statistically significant. However, to reduce the increased risk of a type I error

**Table 1.** Sociodemographic and clinical characteristics of patients, siblings, and controls

Variables	Group			Test statistic, <i>p</i> -values
	SCZ ( <i>n</i> = 742)	SIB ( <i>n</i> = 718)	HC ( <i>n</i> = 1039)	
Age, mean (s.d.)	33.13 (8.3)	33.31 (9.3)	33.82 (11)	RBF = 1.27, <i>p</i> = 0.28
Sex (male), <i>n</i> (%)	495 (66.7)	335 (46.7)	472 (45.4)	$\chi^2 = 90.32$ , <i>p</i> < 0.001
Education (years), mean (s.d.)	10.44 (3.9)	11.44 (4.1)	11.2 (4.1)	RBF = 11.83, <i>p</i> < 0.001
Current relationship status (single or no relationship), <i>n</i> (%)	588 (79.8)	263 (37)	391 (37.6)	$\chi^2 = 373.2$ , <i>p</i> < 0.001
Ever employed (yes), <i>n</i> (%)	594 (81.1)	623 (87)	733 (70.7)	$\chi^2 = 71.23$ , <i>p</i> < 0.001
BCSS/lg BCSS, negative self-score, mean (s.d.)	4.4 (5)/0.5 (0.4)	1.99 (2.4)/0.35 (0.32)	1.04 (1.7)/0.2 (0.27)	RBF = 185.64, <i>p</i> < 0.001
BCSS negative others score, mean (s.d.)	11.2 (5)	8.94 (3.7)	8.69 (3.7)	RBF = 29.96, <i>p</i> < 0.001
BCSS positive self-score, mean (s.d.)	11.37 (5.8)	14.34 (4.8)	13.6 (5.4)	RBF = 48.24, <i>p</i> < 0.001
BCSS positive others score, mean (s.d.)	11.58 (4.8)	10.85 (3.7)	10.98 (4.2)	RBF = 3.44, <i>p</i> = 0.03
SIS-R/lg SIS-R, positive score, mean (s.d.)	N/A	0.48 (0.4)/0.15 (0.11)	0.17 (0.2)/0.06 (0.08)	$t_{(HC/SIB)} = -18.34$ , <i>p</i> < 0.001
SIS-R/lg SIS-R, negative score, mean (s.d.)	N/A	0.52 (0.3)/0.17 (0.1)	0.2 (0.2)/0.074(0.071)	$t_{(HC/SIB)} = -20.75$ , <i>p</i> < 0.001
History of CTQ-physical abuse (yes/no), <i>n</i> (%)	207 (63)/353 (37)	103 (17)/502 (83)	113 (11.1)/901 (88.9)	$\chi^2 = 156.79$ , <i>p</i> < 0.001
History of CTQ-sexual abuse (yes/no), <i>n</i> (%)	184 (32.6)/380 (67.4)	96 (15.9)/508 (84.1)	99 (9.8)/907 (90.2)	$\chi^2 = 131.7$ , <i>p</i> < 0.001
History of CTQ-emotional abuse (yes/no), <i>n</i> (%)	239 (43.3)/313 (56.7)	131 (22.1)/461 (77.9)	148 (14.8)/850 (85.2)	$\chi^2 = 158.98$ , <i>p</i> < 0.001
History of CTQ-physical neglect (yes/no), <i>n</i> (%)	329 (58.2)/236 (41.8)	261 (44)/332 (56)	399 (39.5)/611 (60.5)	$\chi^2 = 52.05$ , <i>p</i> < 0.001
History of CTQ-emotional neglect (yes/no), <i>n</i> (%)	308 (55.2)/250 (44.8)	255(42.9)/339 (57.1)	343 (34)/665 (66)	$\chi^2 = 66.43$ , <i>p</i> < 0.001
OPCRIT-positive score, mean (s.d.)	13.65 (7.2)	N/A	N/A	N/A
OPCRIT-negative score, mean (s.d.)	3.36 (2)	N/A	N/A	N/A

Abbreviations as follows: SCZ, patients with schizophrenia; SIB, siblings; HC, healthy controls; SD, standard deviation; RBF, Robust-Brown Forsythe (for asymptotically *F* distributed); BCSS, Brief Core Schema Scales; SIS-R, Structured Interview for Schizotypy-Revised; Lg, logarithm function for transformation; CTQ, Childhood Trauma Questionnaire; OPCRIT, Operational Checklist for Psychotic Illness; N/A, not applicable.

in multiple testing (Armstrong, 2014), Bonferroni-corrected/adjusted *p*-values have been applied in the analyses of post hoc tests (involving multiple comparisons) and multiple correlations (Mørkved et al., 2020). Thus, in the case of multiple comparisons, a two-tailed *p*-value of <0.02, and for multiple correlations, a *p*-value of ≤0.001 were considered to be significant.

Additionally, a clinical significance was estimated by computing an effect size (ES) statistic by Cohen's ( $\eta_p^2$ ) (for analyzing variance) in the tests based on group comparisons. For correlations, a power value (PV) was estimated by computing an *R*-squared ( $R^2$ ) and presented with the relation size (RS) as an indicator of the ES. The thresholds for clinical significance were set at ES > 1 and RS ≥ 0.10 and were interpreted regarding Cohen's *d* statistics (Cohen, 1988) (For more details, refer to the notes in the related tables).

The Statistical Package for the Social Sciences (SPSS) version 27 was used for analysis.

**Results**

Socio-demographic and clinical characteristics of the participants are presented in Table 1.

**Comparison of childhood trauma types among study groups**

Patients with schizophrenia had higher scores in all subscales of CTQ than both their siblings and controls (for all,  $p_{corrected} < 0.001$ ). The siblings had higher scores of emotional abuse (EA) ( $p_{corrected} < 0.001$ ), physical abuse (PA) ( $p_{corrected} = 0.037$ ), sexual abuse (SA) ( $p_{corrected} = 0.015$ ), and emotional neglect (EN) ( $p_{corrected} = 0.003$ ) subscales than controls (Table 2).

**Relationship between clinical symptoms and childhood trauma**

OPCRIT total score for positive symptoms was higher in those with physical ( $t_{(331)} = -4.098, p < 0.001, ES > 1$ ), sexual ( $t_{(336)} = -2.389, p = 0.017, ES > 1$ ), and emotional abuse ( $t_{(334)} = -4.174, p < 0.001, ES > 1$ ) in patients. While physical and emotional abuse had a medium effect on the positive symptoms, sexual abuse had a small effect. There was no difference between those with and without CT in terms of OPCRIT-negative symptom score (Table 3).

Both SIS-R positive subscale and SIS-R negative subscale scores were higher in those with all kinds (except for sexual abuse in SIS-R negative subscore) of childhood abuse and neglect in siblings. In controls, both SIS-R positive and negative subscale scores were higher in those with emotional abuse. SIS-R negative scores were higher in those with emotional and physical neglect, as well as physical and sexual abuse (Table 3). Also, the SIS-R total score (lg mean: 0.06 v. 0.08) was higher in those with sexual abuse in controls ( $t_{(1003)} = -2.164, p = 0.031, Cohen's d = -0.21$  with a small ES).

**Relationship between childhood trauma, cognitive schemas, and psychotic symptoms**

We found that scores of all kinds of abuse and neglect were positively correlated with the negative-self score and negatively correlated with the positive-self score of the BCSS in patients. Additionally, both emotional abuse and emotional neglect, were found correlated with the negative-other scores in patients (considering both corrected and uncorrected *p*-values). All kinds of

**Table 2.** Results of the comparison of CTQ subscale scores between groups

Study Groups	CTQ-physical abuse		CTQ-sexual abuse		CTQ-emotional abuse		CTQ-physical neglect		CTQ-emotional neglect	
	Mean (s.d.)/ MR	RBF/ $\chi^2, p$	Mean (s.d.)/ MR	RBF/ $\chi^2, p$	Mean (s.d.)/ MR	RBF/ $\chi^2, p$	Mean (s.d.)	RBF, $p \eta_p^2$ (%)	Mean (s.d.)	RBF, $p \eta_p^2$ (%)
SCZ	1.28 (0.5) MR:1302.6	$\chi^2 = 160.28,$ <b><math>p &lt; 0.001^{**}</math></b>	1.31 (0.6) MR:1278.8	$\chi^2 = 142.477,$ <b><math>p &lt; 0.001^{**}</math></b>	1.65 (0.7) MR:1379.5	$\chi^2 = 210.74,$ <b><math>p &lt; 0.001^{**}</math></b>	1.74 (0.6)	RBF = 23.21, <b><math>p &lt; 0.001^{**}</math></b> <b>0.021(2.1)</b>	2.69 (1)	RBF = 37.67, <b><math>p &lt; 0.001^{**}</math></b> <b>0.032 (3.2)</b>
SIB	1.11 (0.3) MR:1072.2		1.10 (0.3) MR:1079.3	<b><math>p &lt; 0.001^{**}</math></b>	1.34 (0.5) MR:1121.7	<b><math>p &lt; 0.001^{**}</math></b>	1.56 (0.5)		2.41 (0.8)	
HC	1.09 (0.3) MR:1015.4		1.07 (0.2) MR:1018.3		1.21 (0.4) MR: 939.2		1.55 (0.5)		2.25 (1)	
NP pairwise comparisons or multiple comparisons Tamhane		CTQ-physical abuse	CTQ-sexual abuse	CTQ-emotional abuse	CTQ-physical neglect	CTQ-emotional neglect	Mean difference	$p_{corrected}$	Mean difference	$p_{corrected}$
SCZ v. SIB	230.4	<b>&lt;0.001^{**}</b>	199.5	<b>&lt;0.001^{**}</b>	257.8	<b>&lt;0.001^{**}</b>	0.18	<b>&lt;0.001^{**}</b>	0.27	<b>&lt;0.001^{**}</b>
SCZ v. HC	287.2	<b>&lt;0.001^{**}</b>	260.5	<b>&lt;0.001^{**}</b>	440.3	<b>&lt;0.001^{**}</b>	0.19	<b>&lt;0.001^{**}</b>	0.43	<b>&lt;0.001^{**}</b>
SIB v. HC	56.8	<b>0.037</b>	61	<b>0.015</b>	182.5	<b>&lt;0.001^{**}</b>	0.009	0.98	0.15	<b>0.003^{**}</b>

**Notes.** The  $\eta_p^2$  value indicates partial eta-squared used to estimate the effect size (ES). The percentage of partial  $\eta_p^2$  is used to estimate the amount of explained variance. Partial  $\eta_p^2$  values, herein used exclusively for parametric datasets, have been interpreted in accordance with the thresholds of Cohen's *d* statistics (1988). Following that: *d*: 0.2 to partial  $\eta_p^2$ : 0.01 or 1% represents a small effect; *d*: 0.5 to partial  $\eta_p^2$ : 0.06 or 6% represents a moderate effect; *d*: 0.8 to partial  $\eta_p^2$ : 0.14 or 14% represents a large effect size. The significant  $p_{corrected}$  and ES values are shown in bold. Abbreviations as follows: SCZ, patients with schizophrenia; SIB, siblings; HC, healthy controls; MR, mean rank, SD, standard deviation; RBF, Robust-Brown Forsythe (for asymptotically *F* distributed); CTQ, Childhood Trauma Questionnaire; NP, non-parametric  $\ast \ast 0.001 \leq p < 0.01$ .

**Table 3.** The comparisons of the clinical subscales scores in terms of CT in the study groups

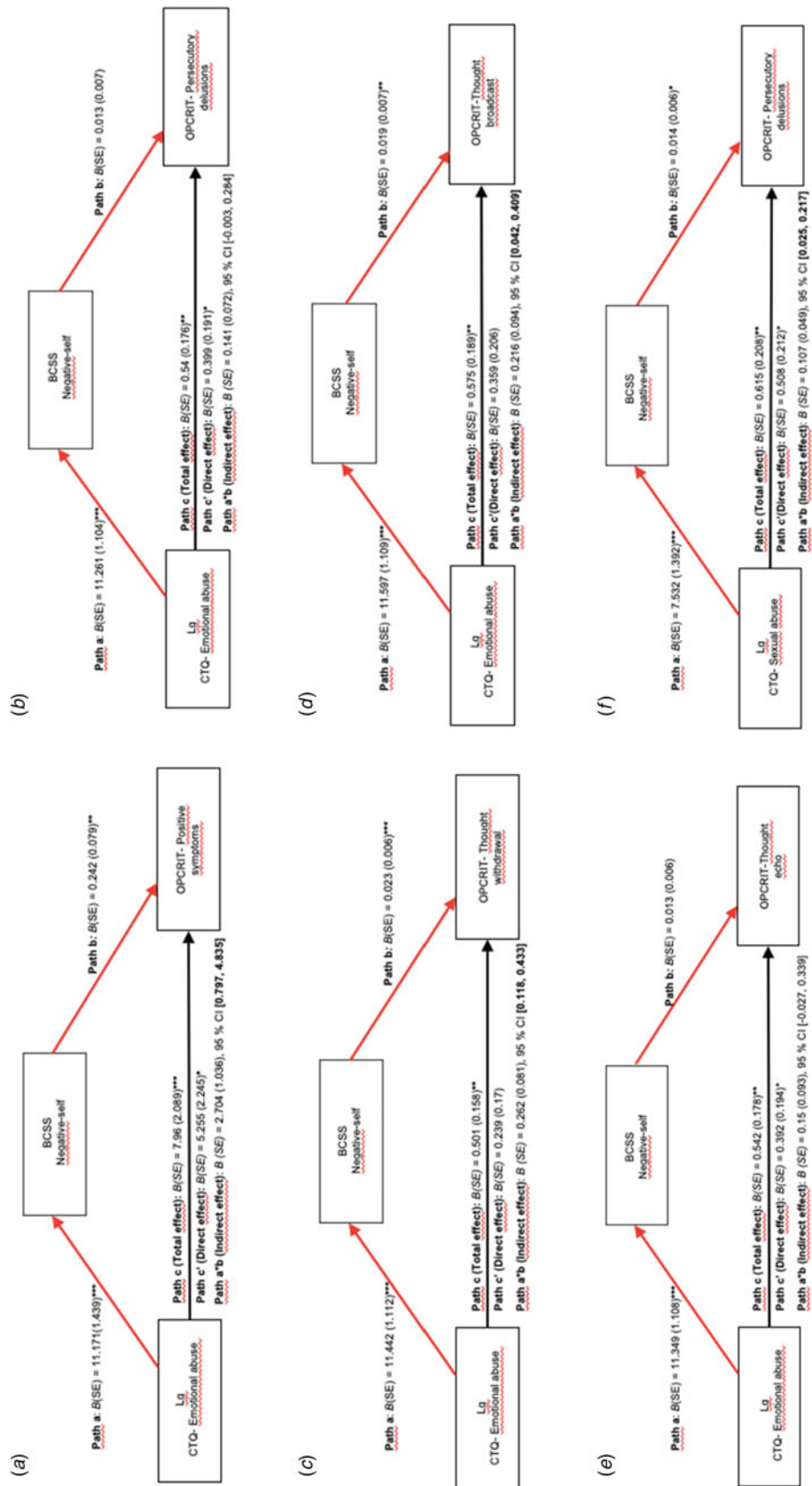
Group	OPCRIT positive (mean ± s.d.)	<i>t</i> ( <i>df</i> ), <i>p</i>	Cohen's <i>d</i>	95% CI lower to upper	OPCRIT negative (mean ± s.d.)	<i>t</i> ( <i>df</i> ), <i>p</i>	Cohen's <i>d</i>	%95 CI lower to upper
<b>CTQ-EN</b>	No	13.65 ± 6.7	<i>t</i> (333) = 1.326, <i>p</i> = 0.186	0.14 ES = 1	-0.07 to 0.363	3.11 ± 2	-0.11 ES = 1	-0.283 to 0.058
	Yes	12.64 ± 6.9				3.34 ± 2		
<b>CTQ-EA</b>	No	11.77 ± 6.7	<i>t</i> (334) = -4.174, <i>p</i> ≤ 0.001	-0.45 ES > 1, medium	-0.676 to -0.24	3.29 ± 2	0.04 ES < 1	-0.128 to 0.215
	Yes	14.88 ± 6.8				3.2 ± 2		
<b>CTQ-PA</b>	No	11.92 ± 6.5	<i>t</i> (331) = -4.098, <i>p</i> ≤ 0.001	-0.47 ES > 1, medium	-0.695 to -0.248	2.99 ± 2	0.16 ES = 1	-0.007 to 0.343
	Yes	15.15 ± 7.2				3.34 ± 2		
<b>CTQ-PN</b>	No	13.2 ± 6.9	<i>t</i> (337) = 0.256, <i>p</i> = 0.798	0.02 ES < 1	-0.186 to 0.242	3.21 ± 2	-0.01 ES < 1	-0.189 to 0.154
	Yes	13 ± 6.9				3.25 ± 2		
<b>CTQ-SA</b>	No	12.5 ± 6.8	<i>t</i> (336) = -2.389, <i>p</i> = 0.017	-0.27 ES > 1, small	-0.501 to -0.048	3.24 ± 1.9	0.01 ES < 1	-0.162 to 0.198
	Yes	14.39 ± 6.9				3.2 ± 2		
<b>SIB</b>	<b>Lg SIS-R pos. (Mean ± s.d.)</b>	<b><i>t</i>(<i>df</i>), <i>p</i></b>	<b>Cohen's <i>d</i></b>	<b>95% CI Lower to Upper</b>	<b>Lg SIS-R neg. (Mean ± s.d.)</b>	<b><i>t</i>(<i>df</i>), <i>p</i></b>	<b>Cohen's <i>d</i></b>	<b>95% CI Lower to Upper</b>
<b>CTQ-EN</b>	No	0.14 ± 0.1	<i>t</i> (587) = -4.176, <i>p</i> < 0.001	-0.35 ES > 1, small	-0.059 to -0.021	0.15 ± 0.09	-0.34 ES > 1, small	-0.052 to -0.017
	Yes	0.18 ± 0.1				0.19 ± 0.1		
<b>CTQ-EA</b>	No	0.14 ± 0.1	<i>t</i> (584) = -4.619, <i>p</i> < 0.001	-0.51 ES > 1, medium	-0.083 to -0.033	0.16 ± 0.09	-0.25 ES > 1, small	-0.048 to -0.003
	Yes	0.20 ± 0.1				0.19 ± 0.1		
<b>CTQ-PA</b>	No	0.14 ± 0.1	<i>t</i> (597) = -3.983, <i>p</i> < 0.001	-0.47 ES > 1, ≅ medium	-0.079 to -0.026	0.16 ± 0.09	-0.36 ES > 1, small	-0.061 to -0.011
	Yes	0.20 ± 0.1				0.20 ± 0.1		
<b>CTQ-PN</b>	No	0.15 ± 0.1	<i>t</i> (585) = -2.344, <i>p</i> = 0.019	-0.19 ES > 1, small	-0.041 to -0.003	0.16 ± 0.09	-0.19 ES ≅ small	-0.036 to -0.002
	Yes	0.17 ± 0.1				0.18 ± 0.1		
<b>CTQ-SA</b>	No	0.15 ± 0.1	<i>t</i> (596) = -2.389, <i>p</i> = 0.017	-0.26 ES > 1, small	-0.055 to -0.005	0.17 ± 0.1	-0.15 ES = 1	-0.039 to 0.007
	Yes	0.18 ± 0.1				0.18 ± 0.1		
<b>HC</b>	<b>Lg SIS-R pos. Mean ± s.d.</b>	<b><i>t</i>(<i>df</i>), <i>p</i></b>	<b>Cohen's <i>d</i></b>	<b>95% CI Lower to Upper</b>	<b>Lg SIS-R neg. Mean ± s.d.</b>	<b><i>t</i>(<i>df</i>), <i>p</i></b>	<b>Cohen's <i>d</i></b>	<b>95% CI Lower to Upper</b>
<b>CTQ-EN</b>	No	0.06 ± 0.08	<i>t</i> (1006) = 2.081, <i>p</i> = 0.038	0.13 ES = 1	0.0006 to 0.0217	0.07 ± 0.06	-0.14 ES = 1	-0.0201 to -0.0006
	Yes	0.05 ± 0.07				0.08 ± 0.07		
<b>CTQ-EA</b>	No	0.05 ± 0.07	<i>t</i> (996) = -2.836, <i>p</i> = 0.005	-0.29 ES > 1, Small	-0.04 to -0.007	0.07 ± 0.06	-0.42 ES > 1, ≅ medium	-0.043 to -0.016
	Yes	0.08 ± 0.09				0.10 ± 0.07		
<b>CTQ-PA</b>	No	0.06 ± 0.07	<i>t</i> (1012) = -1.051, <i>p</i> = 0.295	-0.11 ES = 1	-0.026 to 0.008	0.07 ± 0.07	-0.27 ES > 1, small	-0.033 to -0.005
	Yes	0.07 ± 0.08				0.09 ± 0.07		
<b>CTQ-PN</b>	No	0.06 ± 0.08	<i>t</i> (1008) = 1.025, <i>p</i> = 0.305	0.06 ES < 1	-0.004 to 0.015	0.06 ± 0.06	-0.17 ES ≅ small	-0.0217 to -0.003
	Yes	0.05 ± 0.08				0.08 ± 0.07		
<b>CTQ-SA</b>	No	0.06 ± 0.07	<i>t</i> (1004) = -1.378, <i>p</i> = 0.171	-0.17 ES = 1	-0.033 to 0.006	0.07 ± 0.07	-0.22 ES > 1, small	-0.031 to -0.001
	Yes	0.07 ± 0.09				0.08 ± 0.06		

**Notes.** Effect size (ES) statistics have been estimated using the Cohen's *d* statistic together with the lower and upper values of 95% confidence interval (CI). Cohen's *d* thresholds follow that: *d*: 0.2 represents a small effect; *d*: 0.5 represents a medium effect; *d*: 0.8 represents a large effect size (Cohen, 1988). The significant *p* and ES values are shown in bold. Abbreviations as follows: SCZ, patients with schizophrenia; SIB, siblings; HC, healthy controls; SD, standard deviation; ES, effect size; CI, confidence interval, OPCRIT, Operational Checklist for Psychotic Illness; SIS-R, Structured Interview for Schizotypy-Revised; CTQ, childhood trauma questionnaire; PA, physical abuse; SA, sexual abuse; EA, emotional abuse; PN, physical neglect; EN, emotional neglect; Lg, logarithm function for transformation.

**Table 4.** Results of the Pearson correlation analysis between the scores of CTQ and BCSS subscales for three study groups

CT Types	SCZ				SIB				HC				
	BCSS pos. self	BCSS pos. other	BCSS neg. self	BCSS neg. other	BCSS pos. self	BCSS pos. other	BCSS neg. self	BCSS neg. other	BCSS pos. self	BCSS pos. other	BCSS neg. self	BCSS neg. other	
<b>Lg CTQ-PA</b>	<i>r</i>	−0.119**	−0.028	0.30**	0.104	−0.102*	0.079	0.13**	0.16*	−0.163**	−0.057	0.065*	−0.049
	<i>p</i>	0.005	0.593	<b>&lt;0.001</b>	0.104	0.013	0.081	<b>0.001</b>	0.016	<b>&lt;0.001</b>	0.105	0.038	0.335
	RS	<0.30	<0.10	= 0.30	<0.10	= 0.10	<0.10	<0.30	<0.30	<0.30	<0.10	<0.10	<0.10
	<i>R</i> <sup>2</sup> (%)	0.01 (1)	N/A	0.09 (9)	N/A	0.01 (1)	N/A	0.016 (≅ 2)	0.02 (2)	0.02 (2)	N/A	0.004 (0.4)	N/A
<b>Lg CTQ-SA</b>	<i>r</i>	−0.085*	−0.104*	0.234**	0.065	−0.061	−0.052	0.104*	0.127	−0.078*	−0.02	0.031	0.015
	<i>p</i>	0.049	0.048	<b>&lt;0.001</b>	0.306	0.142	0.251	0.011	0.058	0.014	0.571	0.323	0.761
	RS	<0.10	= 0.10	<0.30	<0.10	<0.10	<0.10	= 0.10	<0.30	<0.10	<0.10	<0.10	<0.10
	<i>R</i> <sup>2</sup> (%)	0.007 (0.7)	0.01 (1)	0.05 (5)	N/A	N/A	N/A	0.01 (1)	0.016 (≅ 2)	0.006 (0.6)	N/A	N/A	N/A
<b>Lg CTQ-EA</b>	<i>r</i>	−0.139**	−0.022	0.402**	0.207**	−0.100*	0.042	0.262**	0.176*	−0.122**	−0.011	0.159**	0.033
	<i>p</i>	<b>0.001</b>	0.672	<b>&lt;0.001</b>	<b>&lt;0.001</b>	0.015	0.355	<b>&lt;0.001</b>	0.008	<b>&lt;0.001</b>	0.744	<b>&lt;0.001</b>	0.51
	RS	<0.30	<0.10	<0.50	<0.30	= 0.10	<0.10	<0.30	<0.30	<0.30	<0.10	<0.30	<0.10
	<i>R</i> <sup>2</sup> (%)	0.02 (2)	N/A	0.16 (16)	0.04 (4)	0.01 (1)	N/A	0.07 (7)	0.03 (3)	0.01 (1)	N/A	0.02 (2)	N/A
<b>CTQ-PN</b>	<i>r</i>	−0.217**	−0.061	0.181**	0.087	−0.225**	−0.11*	0.108**	0.08	−0.297**	−0.051	−0.05	−0.009
	<i>p</i>	<b>&lt;0.001</b>	0.24	<b>&lt;0.001</b>	0.171	<b>&lt;0.001</b>	0.015	<0.008	0.234	<b>&lt;0.001</b>	0.148	0.111	0.865
	RS	<0.30	<0.10	<0.30	<0.10	<0.30	<0.30	<0.30	<0.10	≤0.30	<0.10	<0.10	<0.10
	<i>R</i> <sup>2</sup> (%)	0.05 (5)	N/A	0.03 (3)	N/A	0.05 (5)	0.01 (1)	0.01 (1)	N/A	0.09 (9)	N/A	N/A	N/A
<b>CTQ-EN</b>	<i>r</i>	−0.298**	−0.144**	0.197**	0.128*	−0.338**	−0.155**	0.093*	0.122	−0.407**	−0.155**	−0.011	−0.006
	<i>p</i>	<b>&lt;0.001</b>	0.006	<b>&lt;0.001</b>	0.044	<b>&lt;0.001</b>	<b>&lt;0.001</b>	0.024	0.067	<b>&lt;0.001</b>	<b>&lt;0.001</b>	0.737	0.908
	RS	≤0.30	<0.30	<0.30	<0.30	<0.50	<0.30	<0.30	<0.30	<0.50	<0.30	<0.10	<0.10
	<i>R</i> <sup>2</sup> (%)	0.09 (9)	0.02 (2)	0.04 (4)	0.02 (2)	0.11 (11)	0.02 (2)	0.008 (0.8)	0.01 (1)	0.16 (16)	0.02 (2)	N/A	N/A

**Notes.** The values obtained through the logarithmic transformation of CTQ abuse subscale scores were used in the analyses across all groups. Furthermore, in correlation analyses conducted in the sibling and control groups (but not in the patient group), the lg 10 transformation value of the BCSS negative-self score was employed. Apart from these, all other variables were included in correlation analyses using their raw values. The percentage of partial *R*<sup>2</sup> values has been shown for only significant relationships between CTQ and BCSS subscores, and that indicates amount of explained variance by the related correlation. These significant correlations presented with the power/*R*<sup>2</sup> values are shown in bold. Abbreviations as follows: SCZ, patients with schizophrenia; SIB, siblings; HC, healthy controls; BCSS, Brief Core Schema Scales; CTQ, Childhood Trauma Questionnaire; PA, physical abuse; SA, sexual abuse; EA, emotional abuse; PN, physical neglect; EN, emotional neglect; Lg, logarithm function for transformation; N/A, not applicable. \**p* < 0.05, \*\*0.001 ≤ *p* < 0.01. Bold values represent adjusted/corrected *p* values.





abuse/neglect were correlated with negative-self-scores in siblings. Physical and emotional abuse were also related to negative-other scores in siblings (considering both corrected and uncorrected  $p$ -values). In controls, emotional and physical abuse scores were correlated to negative-self score ( $p_{\text{corrected}} < 0.001$ ;  $p_{\text{uncorr.}} = 0.038$ , respectively) (Table 4).

### Cognitive schemas as a mediator between childhood trauma and positive symptoms in schizophrenia

We tested the hypothesis that the association between CT and positive symptoms was mediated by cognitive schemas in the patient group.

First, we analyzed whether the relationship between the sub-score of CTQ-emotional abuse and the OPCRIT-total positive symptoms was mediated by the negative cognitive schema about self. The results showed a significant indirect effect of negative self-score on the association between the CTQ-emotional abuse and positive symptoms ( $B = 2.704$ ,  $\text{BootSE} = 1.036$ , 95% CI 0.797–4.835). Additionally, a weaker but still significant direct effect from the CTQ-emotional abuse subscores to positive symptoms was observed after controlling for the negative-self score of the BCSS ( $B = 5.255$ ,  $\text{BootSE} = 2.245$ , 95% CI 0.839–9.672,  $p = 0.02$ ). These results suggest a partial mediation (Fig. 1a). Approximately 33.9% of the variance in the OPCRIT-positive symptoms was explained by the mediator.

We did not find a significant indirect effect of the negative cognitive schema about self in the correlation of the CTQ-emotional abuse and severity of persecutory delusions ( $B = 0.141$ ,  $\text{BootSE} = 0.072$ , 95% CI  $-0.003$  to 0.284). (Fig. 1b).

We tested whether the association between the emotional abuse scores and the severity of thought withdrawal symptoms was mediated by the negative cognitive schema about self. The

results indicated that the indirect effect was significant on the model ( $B = 0.262$ ,  $\text{BootSE} = 0.081$ , 95% CI 0.118–0.433) while the CTQ-emotional abuse was not a significant predictor after controlling for negative-self score of the BCSS ( $B = 0.239$ ,  $\text{BootSE} = 0.17$ , 95% CI  $-0.096$  to 0.573,  $p = 0.162$ ). These results indicate a full mediation (Fig. 1c). Approximately 52.2% of the variance in the severity of thought withdrawal symptoms was accounted for by the mediator.

We examined whether the association between the CTQ-emotional abuse subscores and severity of thought broadcasting symptoms was mediated by the negative-self score. As a result, the total indirect effect was significant ( $B = 0.216$ ,  $\text{BootSE} = 0.094$ , 95% CI 0.042–0.409), but there was no significant direct effect from CTQ-emotional abuse subscore to the severity of thought broadcasting symptoms when the negative-self score of the BCSS was controlled ( $B = 0.359$ ,  $\text{BootSE} = 0.206$ , 95% CI  $-0.047$  to 0.765,  $p = 0.083$ ). These results support the full mediation effect (Fig. 1d). Approximately 37.5% of the variance in the severity of thought broadcasting symptoms was explained by the mediator.

We found that the negative-self score of the BCSS did not mediate the correlation between emotional abuse and the severity of thought echo symptoms ( $B = 0.15$ ,  $\text{BootSE} = 0.093$ , 95% CI  $-0.027$  to 0.339) (Fig. 1e).

Finally, we performed a similar analysis using the CTQ-sexual abuse subscores as the independent variable, when persecutory delusions entered as the outcome variable. As a result, the total indirect effect was significant ( $B = 0.107$ ,  $\text{BootSE} = 0.049$ , 95% CI 0.025–0.217), and there was a weaker but still significant direct effect from the CTQ-sexual abuse subscores to the persecutory delusions in the overall model ( $B = 0.508$ ,  $\text{BootSE} = 0.212$ , 95% CI 0.091–0.926,  $p = 0.017$ ). These results indicate that the association between the CTQ-sexual abuse subscore and the severity of

**Figure 1.** Continued. Mediation models with the negative cognitive schema of self as mediator in the correlations between childhood maltreatment and clinical symptom severity in the patient group. (a) The sub-score of CTQ-emotional abuse was positively related to the negative-self score of the BCSS ( $B = 11.171$ , 95% CI 8.341–14.001,  $p < 0.001$ ), (path a). The negative-self score of the BCSS was positively associated with the OPCRIT-positive symptoms ( $B = 0.242$ , 95% CI 0.086–0.398,  $p = 0.002$ ) (path b). The CTQ-emotional abuse was a weaker predictor of OPCRIT-positive symptoms when the analysis controlled for the negative-self score of the BCSS ( $B = 5.255$ , 95% CI 0.839–9.672,  $p = 0.02$ ) (path c' or direct effect). There was a significant total indirect effect (denoted by path a\*b) with a percentile bootstrap estimation approach with 5000 samples, showing the significance of the mediation effect ( $B = 2.704$ ,  $\text{BootSE} = 1.036$ , 95% CI 0.797–4.835). (b) The sub-score of CTQ emotional abuse was positively correlated with the negative-self score of the BCSS ( $B = 11.261$ , 95% CI 9.092–13.43,  $p < 0.001$ ) (path a). The negative-self score of the BCSS was not a predictor of the severity of persecutory delusions ( $B = 0.013$ , 95% CI  $-0.001$  to 0.026,  $p = 0.068$ ) (path b). The CTQ emotional abuse was a significant predictor of the severity of persecutory delusions when the analysis controlled for the negative-self score of the BCSS ( $B = 0.399$ , 95% CI 0.23–0.775,  $p = 0.038$ ) (path c' or direct effect). There was no significant indirect effect (path a\*b) of the negative-self score of the BCSS in the correlation of the CTQ emotional abuse and severity of persecutory delusions ( $B = 0.141$ ,  $\text{BootSE} = 0.072$ , 95% CI  $-0.003$  to 0.284). (c) The CTQ emotional abuse was positively related to the negative-self score of the BCSS ( $B = 11.442$ , 95% CI 9.259–13.626,  $p < 0.001$ ) (path a). The negative-self score of the BCSS was positively correlated with the severity of thought withdrawal symptoms (path b) ( $B = 0.023$ , 95% CI 0.011–0.035,  $p \leq 0.001$ ). The CTQ emotional abuse did not predict the severity of thought withdrawal symptoms when the analysis controlled by the negative-self score of the BCSS ( $B = 0.239$ , 95% CI  $-0.096$  to 0.573,  $p = 0.162$ ) (path c' or direct effect). There was a significant indirect effect (path a\*b) of the negative-self score of the BCSS on the association between the CTQ emotional abuse and severity thought withdrawal symptoms ( $B = 0.262$ ,  $\text{BootSE} = 0.082$ , 95% CI 0.111–0.436). (d) The CTQ emotional abuse was positively associated with the negative-self score of the BCSS ( $B = 11.597$ , 95% CI 9.419–13.776,  $p < 0.001$ ) (path a). The negative-self score of the BCSS was positively correlated with the severity of thought broadcast symptoms (path b) ( $B = 0.019$ , 95% CI 0.004–0.33,  $p = 0.011$ ). The CTQ emotional abuse was not a significant predictor of the severity of thought broadcast symptoms when the analysis controlled for the negative-self score of the BCSS ( $B = 0.359$ , 95% CI  $-0.047$ , 0.765,  $p = 0.083$ ) (path c' or direct effect). There was a significant indirect effect (path a\*b) of the negative-self score of the BCSS on the association between the CTQ emotional abuse and severity of thought broadcast symptoms ( $B = 0.216$ ,  $\text{BootSE} = 0.094$ , 95% CI 0.042–0.409). (e) The sub-score of the CTQ emotional abuse was positively related to the negative-self score of the BCSS ( $B = 11.349$ , 95% CI 9.172–13.527,  $p < 0.001$ ) (path a). Negative-self-score of the BCSS did not significantly correlate with the severity of thought echo symptoms ( $B = 0.013$ , 95% CI 0.000–0.027,  $p = 0.056$ ) (path a) (path b). The sub-score of the CTQ emotional abuse was a significant predictor of the severity of thought echo symptoms when the analysis controlled for the negative-self score of the BCSS ( $B = 0.392$ , 95% CI 0.012–0.773,  $p = 0.043$ ) (path c' or direct effect). There was no significant indirect effect (path a\*b) of the negative-self score of the BCSS on the association between the CTQ emotional abuse and severity of thought echo symptoms ( $B = 0.15$ ,  $\text{BootSE} = 0.093$ , 95% CI  $-0.027$  to 0.339). (f) The sub-score of the CTQ sexual abuse was positively correlated with the negative-self score of the BCSS ( $B = 7.532$ , 95% CI 4.797–10.267,  $p < 0.001$ ) (path a). The negative-self score of the BCSS was positively related to the severity of persecution delusions ( $B = 0.014$ , 95% CI 0.002–0.027,  $p = 0.027$ ) (path b). The sub-score of the CTQ sexual abuse was weakly correlated with the severity of persecution delusions when the analysis controlled for the negative-self score of the BCSS ( $B = 0.508$ , 95% CI [0.091, 0.926],  $p = 0.017$ ) (path c' or direct effect). There was a significant indirect effect (path a\*b) of the negative-self score of the BCSS on the association between the CTQ sexual abuse and severity of persecution delusions ( $B = 0.107$ ,  $\text{BootSE} = 0.049$ , 95% CI [0.025, 0.217]). The red lines in the figures represent the indirect effects (for all, path a, and path b), while paths c and c' reflect the total and direct effects, respectively. Total effect is the sum of the direct and total indirect effect. All values present unstandardized regression coefficients with standard errors in parentheses. \*  $p < 0.05$ , \*\*  $p \leq 0.01$ , \*\*\*  $p \leq 0.001$ . Abbreviations as follows: SE, standard error; Lg, logarithm function for transformation; CTQ, Childhood Trauma Questionnaire; OPCRIT, Operational Checklist for Psychotic Illness; BCSS, Brief Core Schema Scales.

persecutory delusions was partially mediated by the negative-self score of the BCSS (Fig. 1f). The mediator (negative-self score) accounted for approximately 17.3% of the variance in the severity of persecutory delusions.

## Discussion

In this study, we analyzed the frequency and severity of CT, and its relationship with clinical and cognitive variables in patients with SCZ spectrum disorder, their siblings, and controls. We found that all forms of CT are more common in SCZ compared to their siblings and controls. Emotional abuse and neglect were more frequent in siblings than in controls. We also found that all kinds of childhood trauma were related to negative cognitive schemas about self in SCZ and sibling groups.

In some of the previous studies, CT has been analyzed using two main subgroups, abuse and neglect (Grindey & Bradshaw, 2022; Sideli et al., 2022). However, it has been reported that different kinds of childhood adverse events had different influences on the hypothalamic pituitary adrenal (HPA) axis (Murphy et al., 2022). Additionally, some studies reported that individual CT domains, abuse and neglect, have different impact on clinical symptoms (Carr, Martins, Stingel, Lemgruber, & Juruena, 2013; Üçok & Bıkmaz, 2007; Üçok et al., 2015; Van Dam et al., 2015), we analyzed each type of abuse or neglect separately. We analyzed the relationship of CT with clinical variables in terms of a dose–response relationship and binary mode (absent/present) of individual subtypes.

Rates of childhood abuse/neglect in this study were in the range of previous reports (Bendall et al., 2008; Sideli et al., 2022; Üçok & Bıkmaz, 2007), although closer to the higher end. Particularly, the rate of neglect was higher than childhood abuse. However, a recent study from Turkey (Kilicaslan et al., 2017) reported an even higher rate of EN (58.5%) than ours (55.2%). As the reliability of retrospective self-reports of CT was reported before (Fisher et al., 2011), it is unlikely that our reported rates might be subject to recall bias. The SCZ group reported significantly higher rates of trauma than siblings. Per protocol, our study enrolled siblings with an age difference of maximum five years. It seems that the sibling who developed schizophrenia later was subject to more CT than other siblings who were exposed to the same household conditions during almost the same time period. On the other hand, since siblings reported higher rates of CT compared to controls, we can speculate that CT are more common in families with a member diagnosed with psychosis.

In line with the findings of previous studies (Carr et al., 2013; Ross et al., 1994; Şahin et al., 2013; Thonney, Conus, & Golay, 2021; Üçok & Bıkmaz, 2007; Werbeloff et al., 2021), we found a dose–response relationship between all domains of childhood abuse and positive but not negative symptoms in SCZ. However, in a recent meta-analysis, Alameda et al. (2021) reported a weak association between emotional and physical abuse and neglect, and negative dimensions. One of the possible explanations for the difference between our study and this meta-analysis might be the larger sample size of the meta-analysis ( $n = 6053$  for negative dimensions). It has been reported that toxic stress from CT may result in sympathetic arousal through sustained allostatic load along the interconnections of the HPA axis (Murphy et al., 2022). Such connections include limbic structures involved in memory, behavior, and emotion. Besides changes in response to external stimuli because of hyperactivation

of the HPA axis, other factors like negative cognitive schemas toward others may be responsible for the development of positive symptoms. On the other hand, the relationship between CT and both positive and negative symptoms is stronger in siblings and controls. Our findings are consistent with prior studies (Heins et al., 2011; Toutountzidis et al., 2022; Uyan et al., 2022; Van Dam et al., 2015), and as reported by others (Dong et al., 2021; Toutountzidis et al., 2022) trauma type was not associated with schizotypal symptoms. While negative symptoms are core symptoms and originate from specific biological etiology like neurodevelopmental reasons in patients with SCZ, they are less frequent and lower level in non-clinical populations. Different patterns of relationship we found between SCZ and other two groups may have originated from this.

We found that all kinds of CT were related to negative schemas of self in both SCZ and siblings. Additionally, CT was correlated to negative cognitive schemas toward others in SCZ and siblings. Our findings are in line with the findings of previous studies, which reported the relationship between CT and negative schema in patients with psychosis (Kilcommons & Morrison, 2005), and in individuals at high risk for psychosis (Appiah-Kusi et al., 2017). In a recent study, it has been reported that negative other schema fully mediated the relationship between trauma and persecutory delusions/ideas (Humphrey, Berry, Degnan, & Bucci, 2022). Our large sample size has given us the opportunity to search the mediating effect of cognitive schemas on relationship between individual types of childhood trauma and specific positive symptoms. Similar to the above-mentioned study, we found that the relationship between persecutory delusions and childhood sexual abuse was mediated by negative schemas related to self. We also found a mediating effect of negative schemas related to self on relationship between emotional abuse and Schneiderian symptoms, like thought broadcasting and thought withdrawal. Similar to our findings, mediating role of negative schemas related to self was reported as more prominent compared to other types of schemas in a recent meta-analysis (Alameda et al., 2020). Previously we reported that severity of Schneiderian symptoms was particularly related to severity of childhood trauma in patients with first-episode schizophrenia (Şahin et al., 2013). Our findings suggest that mediating role of the negative schemas about self is more prominent in delusions with bizarre content. Our findings may guide therapeutic interventions for both patients and healthy people with a history of childhood abuse. Since negative cognitive schemas have a moderating role in development of some positive symptoms, therapeutic interventions targeting to change negative schemas may help to prevent or reduce positive symptoms.

The present study has several strengths. To the best of our knowledge, the sample size is the largest among studies that included SCZ, sibling, and control groups. As our study is a part of a large international study, the scales we used to collect information are well-established and validated.

On the other hand, this study has limitations. Childhood adversities likely have differential influence on mental well-being over the developmental process; however, the CTQ does not provide information about the exact time period in which trauma has been experienced. There were more males in schizophrenia group compared to other groups, and the sex differences among groups may have an impact on exposure to different types of abuse/neglect. Also, our analyses did not take into account some potential confounding variables, such as genetic polymorphisms, premorbid adjustment. Finally, the retrospective nature of the data collection may be subject to recall bias.

In conclusion, we found that patients with psychosis were affected by childhood trauma more than their siblings and healthy controls. We also found that the impact of CT is prominent in some domains in the siblings and controls. Our findings suggest that CT has different impacts on mental health domains, and possibly on developmental processes of the central nervous system.

In future research, including the major confounding factors like premorbid adjustment level, and family history of mental disorders can increase our understanding of the interaction between CT and cognitive schemas in people with psychosis as well as non-clinical populations.

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