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Post-Traumatic Stress Disorder, emotional and behavioral difficulties in children and adolescents two years after the 2012 earthquake in Italy: an epidemiological cross-sectional study.

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Abstract:	<p>Earthquakes have been associated with a range of psychopathologies in children and adolescents. While many studies focused on Post-Traumatic Stress Disorder (PTSD), only a few studies focused on both PTSD and emotional/behavioral difficulties. This cross sectional study aimed at exploring the prevalence of PTSD, internalizing and externalizing symptoms, as well as their predictors among children and adolescents survivors 2 years after the earthquake that hit Northern Italy in 2012. A total of 682 children and adolescents (9-14 years) from two districts with different degree of impact were recruited and administered an exposure questionnaire, the UCLA PTSD Index for DSM-IV, and the Strengths and Difficulties Questionnaire (SDQ). 1129 parents were assessed through the Symptom Checklist-90 (SCL-90). The estimated prevalence of "likely PTSD" in the earthquake zone was 1.9% (4.4% near the epicenter) and the total PTSD score was significantly higher than in the control zone. 14.9% of children and adolescents had a borderline/abnormal SDQ total difficulties score. In the affected area, 87.5% of children and adolescents with a probable PTSD also had a SDQ total score in the borderline/abnormal range. Earthquake exposure variables, lifetime events such as illness/death of a relative, and parental psychopathology were significant predictors of child/adolescent psychological difficulties.</p> <p>Despite some limitations, this study highlights that children and adolescents in the most affected areas may exhibit PTSD symptoms two years after disasters, often in comorbidity with other behavioral/emotional difficulties. As family psychopathology and lifetime stressful events are the most significant predictors, interventions with a whole-family approach after earthquakes are needed.</p>
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Original contribution

Post-Traumatic Stress Disorder, emotional and behavioral difficulties in children and adolescents two years after the 2012 earthquake in Italy: an epidemiological cross-sectional study.

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ABSTRACT

Earthquakes have been associated with a range of psychopathologies in children and adolescents. While many studies focused on Post-Traumatic Stress Disorder (PTSD), only a few studies focused on both PTSD and emotional/behavioral difficulties. This cross sectional study aimed at exploring the prevalence of PTSD, internalizing and externalizing symptoms, as well as their predictors among children and adolescents survivors 2 years after the earthquake that hit Northern Italy in 2012. A total of 682 children and adolescents (9-14 years) from two districts with different degree of impact were recruited and administered an exposure questionnaire, the UCLA PTSD Index for DSM-IV, and the Strengths and Difficulties Questionnaire (SDQ). 1129 parents were assessed through the Symptom Checklist-90 (SCL-90). The estimated prevalence of “likely PTSD” in the earthquake zone was 1.9% (4.4% near the epicenter) and the total PTSD score was significantly higher than in the control zone. 14.9% of children and adolescents had a borderline/abnormal SDQ total difficulties score. In the affected area, 87.5% of children and adolescents with a probable PTSD also had a SDQ total score in the borderline/abnormal range. Earthquake exposure variables, lifetime events such as illness/death of a relative, and parental psychopathology were significant predictors of child/adolescent psychological difficulties. Despite some limitations, this study highlights that children and adolescents in the most affected areas may exhibit PTSD symptoms two years after disasters, often in comorbidity with other behavioral/emotional difficulties. As family psychopathology and lifetime stressful events are the most significant predictors, interventions with a whole-family approach after earthquakes are needed.

Keywords: children, adolescents, PTSD, trauma, earthquake, parental psychopathology

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6 Italy is one of the most seismically active countries in Europe. In the last 20 years, many severe
7 earthquakes struck different areas of Italy, including regions such as Marche, Umbria, Abruzzo and
8 Emilia-Romagna. On May 20 and 29, 2012, two earthquakes measuring 5.9 and 5.8 on the Richter scale
9 hit the province of Modena (Emilia-Romagna), killing 27 people and causing severe damages to
10 buildings. Several hundred citizens were injured and 15.000 local resident displaced. Many families lived
11 in tent cities from May until October-November 2012, with the earthquake swarm continuing for several
12 months.

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16 It is well established that exposure to earthquakes leads to an increased prevalence of emotional and
17 psychological disorders [1-5] also in children and adolescents. Post-Traumatic Stress Disorder (PTSD) is
18 one the most common sequelae in youths exposed to earthquakes [6-8], although the actual prevalence is
19 still unclear. Previous cross-sectional studies [9-13] showed that 4.5% to 95% of children and adolescents
20 may have symptoms of PTSD after earthquakes.

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24 Great individual differences have been found in trajectories of posttraumatic responses in adults and
25 youths [14-16], evidencing that while most individuals experience a natural recovery process, a
26 substantial percentage of people may have persistent posttraumatic reactions, due to chronic or delayed
27 onset symptoms [17-22]. After the Wenchuan earthquake, Zhang and colleagues [8] found that the
28 prevalence rates of PTSD in children were 1.3%, and 1.6% at 12 and 18-month follow-up times,
29 respectively. Jia and colleagues [20] did not find any significant change in the prevalence of PTSD
30 (decreasing from 12.4% to 10.7%) in child survivors at 15 and 36 months after the same earthquake.
31 Goenjian and colleagues [23] studied PTSD symptoms among children 18 months after the 1988
32 earthquake in Armenia: PTSD rates were respectively 95%, 71% and 26% in the three cities at increasing
33 distances from the epicenter. 20 months after the 1999 Turkey earthquake, the prevalence of PTSD was
34 39% [24]. Dell'Osso and colleagues [21] found a PTSD diagnosis in 30.7% of the adolescents 21 months
35 after a major earthquake in Italy.

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6 Potential predictors of PTSD after disasters have been extensively investigated [19]. Consequences may
7 vary depending on demographic factors such as gender and age [7, 27-30], peritraumatic and disaster-
8 related (e.g., severity of disaster exposure, proximity to the epicenter, personal injuries, loss of loved
9 ones, severe injury of family members, destruction of property/home, and displacement), and post-
10 disaster psychosocial variables (e.g., social support)[6,27,31]. Recent studies also highlight the
11 interdependence between parental psychopathology and posttraumatic symptoms in children and
12 adolescents after a disaster [32-34]. While there is agreement on many risk factors for PTSD, conflicting
13 results have been reported for others (e.g., age) [35] and little is known about factors that may make
14 children and adolescents more vulnerable to disorders after years from the disaster.

15
16 In addition to PTSD, emotional and behavioral difficulties (e.g., fears, depressed mood, conduct
17 problems) having an impact on everyday functioning (e.g., peer relationships, capacity to perform
18 academically), are important outcome domains for children and adolescents, regardless of diagnosis of
19 PTSD, being predictive of an increased risk for future internalizing and externalizing disorders. Recent
20 studies show that earthquakes might have a delayed impact on the psychosocial functioning of children
21 and adolescents [20]. *However, only a few studies focused on these variables [36] and comorbidities with*
22 *PTSD remain poorly understood.* Given the impact on children's development [37], and the relevant
23 personal and social costs, it is of primary importance the recognition and the treatment of these long term
24 psychological difficulties. A better understanding of these symptoms and their predictors will ensure that
25 the most appropriate resources are provided to children [38].

26
27 The primary purpose of this cross-sectional study was therefore to investigate the prevalence of PTSD,
28 PTSD symptoms and other behavioral, emotional, conduct problems among children and adolescents two
29 years after the exposure to the 2012 earthquake in Italy. The secondary aim was to examine potential
30 predictors of these long term symptoms in order to improve interventions to reduce vulnerability and
31 psychological difficulties in youth after natural disasters.

32 33 34 35 **Methods**

36 *Participants*

37 To select the sample, the Province of Modena was divided in three different areas: an "earthquake area"
38 (EA), including the plain zones of the Province most affected by the earthquake (N = 14.278 subjects
39 aged 9-14 years); a "control area" (CA) including plain zones and the hills towns/communities less
40 directly affected by the earthquake, with no damages to buildings or individuals due to the disaster (N =
41 19.825); a "mountain area" (N= 3.358). The last one was excluded from this study because of different
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6 environmental/socio-demographic characteristics and because it was exposed to other earthquakes in the
7 same time period.

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9 Sampling was performed in order to include about 2% of the population and to respect a priori fixed ratio
10 of 1.5 students living in EA every 1 student living in CA. Subjects were recruited in primary and
11 secondary schools, with schools randomly selected from the comprehensive School Regional Office
12 register, published by the Italian Ministry of Education.

13
14 Overall, 682 children and adolescents attending ten different schools were included in the study. Subjects
15 had a mean age of 11 ± 1.4 y (range: 9-14 y); 349 (51.2%) were males and 333 (48.8%) females. 638
16 (94.7%) had an Italian nationality and 36 (5.3%) had a different nationality. 431 (63%) subjects were
17 living in EA and 251 (37%) in CA.

18
19 Parents of 639 students (93,7%) agreed to provide information on their psychological status. 1162 parents
20 were interviewed, 721 of which living in the EA area. Females were 52.9%, with a mean age of 43y
21 (± 5.7).

22 23 24 25 26 27 *Procedure*

28 The present study was approved by the Ethical Committee of the Province of Modena (Protocol N.
29 268/12). In this cross-sectional study, data collection was conducted two years after the earthquake. The
30 interviewers included trained child psychiatrists and psychologists. Prior to the assessment, the School
31 Principal and the School Board were asked to give their authorization. Moreover, every parent received a
32 detailed description of the study and gave a written informed consent. The procedure of the study was
33 explained to students; only who gave his/her personal consent was enrolled. Subjects who met the criteria
34 for a probable PTSD were referred to the Child Neuropsychiatric Services of the province of Modena for
35 further assessment and treatment.

36 37 38 39 40 41 42 *Measures*

43 Children and adolescents were administered an assessment protocol including:

44 - *an exposure questionnaire* created ad hoc to collect, besides demographic data, information on the
45 degree of exposure to the earthquake and exposure to lifetime traumatic events not related to the
46 earthquake (occurring before or after the earthquake) through simple questions requiring dichotomous
47 answers;

48 - *the UCLA Posttraumatic Stress Disorder Reaction Index (PTSD-RI)* for DSM-IV [39]. A short
49 instrument to screen for trauma exposure and DSM-IV PTSD symptoms, appropriate for children and
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6 adolescents age 7-17 who have experienced any type of trauma. It is one of the most widely used and
7 extensively studied assessment instruments for childhood PTSD [40]. It can be administered orally or
8 completed as a self-report. This version had 20 items scored on a 5 points Likert Scale. It allows for
9 calculation of the severity of symptoms on each cluster (B, C, and D) and a total severity score [39].
10 Chronbach's alphas fall in the range of .90 for internal consistency across versions and with test-retest
11 reliability at .84 [41]. The PTSD-RI Scoring Sheet is used to tabulate a total score, and a cut-off >38 is
12 valid to have a probable PTSD. The cut-off of 38 has a sensitivity of 0.93 and specificity of 0.87 in
13 detecting PTSD [42]. Total scores in the range of 20's and 30's indicate sub-clinical PTSD. A cutoff score
14 of ≥ 3 was used to estimate the rate of clinically significant PTSD symptom clusters. As this questionnaire
15 was not validated in the Italian version; translation into Italian followed published guidelines, including
16 the use of independent back translation [23].

17
18 - the *Strengths and Difficulties Questionnaire* (SDQ) [43] Italian version [44]. The instrument is suitable
19 to screen psychological conditions in children and adolescents. The 25 items of the SDQ are divided into
20 5 subscales of 5 items each, which measure emotional symptoms, conduct problems,
21 hyperactivity/inattention, peer relationship problems and prosocial behavior. Taken together (with the
22 exception of prosocial behavior), these symptoms provide a total score for mental health difficulties.
23 Items are rated using a 3 point Likert. Normative data for the Italian population are available [44-46] and
24 the Italian version has good psychometric properties [44].

25
26 In addition to the SDQ for their children, parents were administered the *Symptom Checklist-90-R* [47-48],
27 Italian version [49]. It is a relatively brief (90 items) self-report psychometric designed to assess a broad
28 range of psychological problems and symptoms of psychopathology (according to the DSM-IV-TR).
29 Primary symptom dimensions include: Somatization, Obsessive Compulsive Disorder, Interpersonal
30 Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism. Each
31 item is rated on a 5 points Likert Scale. The cutoff for the Global Severity Index is 63.

32
33 For children attending primary schools, questionnaires followed an interviewer-administered procedure;
34 for secondary school children/adolescents and for parents, questionnaires were self-completed.

35 36 37 38 39 40 41 42 43 44 45 46 47 *Statistical analysis*

48 Kolmogorov-Smirnov tests were used to test the hypothesis that the distribution of the Child PTSD and
49 SDQ scores were normal. Means, standard deviations, frequencies and percentages were used for
50 descriptive data analysis. To evaluate differences in groups at bivariate level, t-tests were used for
51 continuous variables, and Chi-square tests for categorical variables. Pearson's correlation coefficients
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were used to examine the relationship between PTSD scores, SDQ scores and demographic variables, earthquake related factors, lifetime stressful events, parental psychopathology and psychological symptoms. Finally, multiple linear regression models including variables most significantly associated to the outcomes at the bivariate level were run for total PTSD score and SDQ-total difficulties score. Statistical analyses were performed using IBM SPSS Statistics package ver. 25. For all statistical tests, a $p < 0.05$ was considered to be statistically significant.

Results

As reported in Table 1, there was no significant difference between the two districts with respect to age, gender or nationality. Students living in the EA reported significantly higher rates of earthquake-related stressful experiences ($p < 0.001$). 73.7% of children had to **leave their house** due to serious damages, about 20% had the **house destroyed**, more than 30% experienced **serious injuries or the death of relatives/close friends**, and 4.2% was **personally injured**. Earthquake related stressful events tend to cluster, with about half of the students in the affected area experiencing **two or more earthquake-related stressful events**.

Table 1 – Sample characteristics (N=682)

	CONTROL AREA N=251 (36.8%)	EARTHQUAKE AREA N=431 (63.2%)	P
Sex, N (%)			
Male	128 (51.0%)	221 (51.3%)	
Female	123 (49.0)	210 (48.7%)	0.94
Age, y			
mean± SD	11±1.30	11±1.50	
range	9-14	9-14	0.99
School level, N (%):			
Primary	68 (27.1%)	160 (37.1%)	

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secondary (I level)	183 (72.9%)	271 (62.9%)	0.007
Nationality, N (%):			
Italian	238 (95.2%)	400 (94.3%)	0.361
Other	12 (4.8%)	24 (5.7%)	
Stressful Events related to earthquake			
No	202 (80.2%)	50 (11.6%)	<0.001
Yes	49 (19.5%)	380 (88.4%)	
Displacement			
Displacement	5 (2.0%)	317 (73.7%)	<0.001
Family involved in the earthquake			
Family involved in the earthquake	34 (13.6%)	338 (79.3%)	<0.001
Damaged house			
Damaged house	0	82 (19.1%)	<0.001
Personally injured			
Personally injured	4 (1.60)	18 (4.2%)	0.063
Relatives' injured			
Relatives' injured	5 (2.0%)	60 (14.0%)	<0.001
Friends injured			
Friends injured	18 (7.2%)	133 (30.9%)	<0.001
Death of family members or friends			
Death of family members or friends	0	49 (11.4%)	<0.001
Lifetime stressful events			
No	156 (62.2%)	285 (66.3%)	0.16
Yes	95 (37.8%)	145 (33.7%)	
Moved from another area			
Moved from another area	2 (0.8%)	14 (3.3%)	0.041
Serious disease of a family member			
Serious disease of a family member	48 (19.1%)	52 (12.1%)	0.012
Divorce of parents			
Divorce of parents	9 (3.6%)	15 (3.5%)	0.952

Death of a family member	58 (23.1%)	69 (16.0%)	0.022
Family member seriously injured	15 (6.0%)	27 (6.3%)	0.874
Hospital admission	17 (6.8%)	40 (9.3%)	0.256
Personally seriously injured	4 (1.6%)	7 (1.6%)	0.970

Post-traumatic stress disorder

Two years after the earthquake, **1,9% of children and adolescents living in the EA met the criteria for a probable PTSD diagnosis**, while in CA the observed prevalence was 0.4% (p=0.099). The prevalence rate increased with the decreasing distance to the epicentre: in Finale Emilia – a town very close to the epicentre of the first earthquake - 4.4% of children and adolescents had a likely PTSD diagnosis, a prevalence which is significantly higher than those observed in the other EA municipalities (p=0.051).

The mean total PTSD score observed in the EA sample was 15.62 (SD: 9.52), higher than in the CA (p<0.001). Students living in the exposed area also showed significantly higher scores of hyper-arousal, avoidance and re-experiencing symptoms, all above the symptom cutoff (see table 2).

Table 2 – UCLA PTSD scores in CA and EA (N= 682)

UCLA PTSD score	CONTROL AREA (N=251)	EARTHQUAKE AREA (N=431)	P
Total score	11.08±7.50	15.62±9.52	<0.001
Reexperiencing score	1.97±2.57	4.02±3.83	<0.001
Avoidance score	3.94±3.51	5.78±4.27	<0.001
Hyperarousal score	5.16±2.92	5.87±3.43	<0.010

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6 *PTSD and risk factors*
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8 Although higher rates of probable PTSD were observed in females (2.3% vs 1.4% in boys, $p=0.431$) and
9 adolescents (2.2% vs 1.3% in children; $p=0.474$) living in EA, they were not statistically significant.
10 Instead, a likely PTSD diagnosis was significantly associated to earthquake-related stressful experiences,
11 especially to the **death of a loved one** ($p=0.001$) and, with regard to lifetime stressful events, to **personal**
12 **severe accidents** ($p=0.014$).
13

14 No significant differences were found in the total PTSD score with regard to gender and age. However,
15 girls in the EA had significantly higher scores in **re-experiencing cluster symptoms** (4.47 ± 3.93 vs
16 3.59 ± 3.69 in boys; $p=0.018$).
17

18 Predictors of higher PTSD total scores in EA were experiencing earthquake related stressors ($p<0.001$)
19 and lifetime **stressful events** ($p<0.001$). The PTSD total score significantly increased **with the number**
20 **of stressful events** ($p<0.001$): in fact, students in the affected area experiencing 4 or more stressful events
21 (related and not-related to the earthquake), showed a PTSD total score of 21.45 ± 9.51 , indicating a
22 probable sub-clinical PTSD.
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24 As reported in table 3, among the earthquake related events, the most significant predictors of higher
25 PTSD scores were **personal injuries** ($p=0.001$), the **death of relatives/close friend** ($p=0.003$), having
26 seen **people severely injured** ($p=0.026$). Among lifetime stressful events, the illness ($p=0.001$) or the
27 death of a family member ($p=0.003$) and **moving from another country** ($p=0.004$).
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37 Table 3 UCLA PTSD total score according to exposure and lifetime stressful events in children and
38 adolescents living in the EA (N=431)
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	PTSD score (mean±SD)		P
	In EA subjects		
Events related to earthquake	No	Yes	
Any	10.56±8.13	16.30±9.51	<0.001
Displacement	13.65±9.20	15.34±8.67	0.135
Family involved in the earthquake	13.55±9.92	16.25±9.35	0.017
Damaged house	15.35±9.65	16.83±8.94	0.206
Personally injured	15.27±9.34	22.90±10.19	0.001
Relatives injured	15.22±9.27	18.17±8.89	0.026

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Death of family member or friends	15.14±9.10	19.45±11.80	0.003
Lifetime stressful events	No	Yes	
Any	14.31±8.95	18.23±10.12	<0.001
Moved from another area	15.39±9.44	22.89±9.48	0.004
Serious disease of a family member	15.07±9.21	19.67±10.79	0.001
Divorce of parents	15.59±9.56	16.47±9.18	0.727
Death of a family member	15.04±9.11	18.70±11.02	0.003
Family member injured	15.44±9.61	18.41±7.79	0.118
Hospital admission	15.28±9.53	19.08±8.89	0.016
Personally serious injured	15.59±9.53	19.29±9.46	0.309

Behavioural strengths and difficulties (SDQ)

14.9% of children and adolescents in the EA reported psychological difficulties with a **total difficulties score in the borderline/abnormal range** (see table 4). This percentage was significantly higher than in the control zone ($p=0.045$). 20.5% of students in EA referred **conduct problems** in the borderline/abnormal range ($p=0.044$), and 15.2% had **peer problems** in the borderline/abnormal range ($p=0.001$).

The mean SDQ **total difficulties score in the EA** was 9.74 (± 5.34), higher than in the control zone (8.50 ± 5.23 ; $p=0.003$), as were subscale scores considering externalising difficulties (e.g. emotional and peer problems) (4.15 ± 3.21 vs 3.53 ± 3.02 ; $p=0.014$) and internalizing problems and referring to hyperactivity and conduct difficulties (5.59 ± 3.08 vs 4.96 ± 3.12 ; $p=0.011$). Higher total difficulties scores were associated to: experiencing **lifetime stressful events** (11.17 ± 5.71 ; $p<0.001$) or **stressful events related to the earthquake: being injured** (13.72 ± 5.66 ; $p<0.001$) or **living the loss of a loved one** (11.42 ± 6.05 ; $p=0.021$). Total difficulties scores were significantly higher in males ($p=0.014$) and in secondary school students ($p=0.003$). With regard to subscales, **girls reported higher emotional problems** (2.85 ± 2.34 ; $p<0.001$) while males higher **hyperactivity** (3.55 ± 2.04 ; $p=0.05$), **conduct problems** (2.50 ± 1.68 ; $p=0.011$), and **peer problems** (1.85 ± 1.84 ; $p=0.016$).

Table 4: SDQ scores in CA and EA (N= 680)

SDQ (self –report)	CONTROL AREA (N= 251)	EARTHQUAKE AREA (N= 429)	P
Total difficulties			
mean±SD	8.50±5.23	9.74±5.34	0.003
Normal score, n (%)	227 (90.4%)	365 (85.1%)	
border/abnormal score, n (%)	24 (9.6%)	64 (14.9%)	0.045
Emotional symptoms			
mean±SD	2.28±2.18	2.50±2.19	0.214
Normal score, n (%)	227 (90.4%)	386 (90.0%)	
border/abnormal score, n (%)	24 (9.6%)	43 (10.0%)	0.845
Conduct problems			
mean±SD	2.04±1.55	2.31±1.59	0.030
Normal score, n (%)	215 (85.7%)	341 (79.5%)	
border/abnormal score, n (%)	36 (14.3%)	88 (20.5%)	0.044
Hyperactivity			
mean± SD	2.92±2.02	3.28±2.04	0.028
Normal score, n (%)	223 (88.8%)	367 (85.5%)	
border/abnormal score, n (%)	28 (11.2%)	62 (14.5%)	0.221
Peer problems			
mean± SD	1.25±1.48	1.65±1.71	0.002
Normal score, n (%)	234 (93.2%)	364 (84.8%)	
border/abnormal score, n (%)	17 (6.8%)	65 (15.2%)	0.001
Prosocial			
mean± SD	7.20±1.77	7.03±2.02	0.27
Normal score, n (%)	206 (82.1%)	331 (77.2%)	
border/abnormal score, n (%)	45 (17.90%)	98 (22.80%)	0.129

In EA PTSD score was significantly correlated to the SDQ total score ($r=.629$, $p=0.000$). Most children who met the criteria for a probable PTSD diagnosis (7 over 8 subjects – 87,5%) also had severe SDQ total difficulties score (borderline/abnormal range). Children and adolescents who met the criteria for likely PTSD have severer total difficulties score (19.25 ± 6.30 ; $p<0.001$), emotional problems ($p<0.001$) and hyperactivity ($p<0.001$), falling all scores in the borderline/abnormal range (see table 5).

Table 5: SDQ score according to PTSD score in children and adolescents living in the EA (N=429)

SDQ In EA students	PTSD ≤ 37 (N=421)	PTSD > 37 (N=8)	P
Total difficulties score	9.56 \pm 5.16	19.25 \pm 6.30	<0.001
Emotional symptoms	2.43 \pm 2.14	6.13 \pm 1.80	<0.001
Behavioural problems	2.29 \pm 1.58	3.50 \pm 1.85	0.033
Hyperactivity	3.23 \pm 2.02	5.88 \pm 1.55	<0.001
Peer problems	1.61 \pm 1.68	3.75 \pm 2.25	<0.001
Prosocial	7.03 \pm 2.01	7.00 \pm 2.73	0.965

Comparing the results of self-report SDQ questionnaires to those completed by parents in the EA, we found that all the measures were/are highly correlated ($p< 0.001$ in all cases). However parents appear to overestimate emotional symptoms in their children (2.86 ± 2.21 vs 2.50 ± 2.19 ; $p=0.029$), while underestimating behavioral problems (1.91 ± 1.61 vs 2.31 ± 1.59 ; $p= 0.001$) and hyperactivity (3.09 ± 2.40 vs 3.28 ± 2.04 ; $p= 0.034$).

Parental psychopathology

Parents in the EA were seen to have a high frequency of psychopathological difficulties as recorded by SCL-90-R. 28% (208 over 721) had a global score over the cutoff, showing a level of psychopathology and mental distress significantly higher than parents living in the CA (reported by 77 over 441 subjects- 17.5%; $p<0.001$). Parents in EA had significantly higher scores than subjects living in CA for most subscales investigating different symptom dimensions. Sleep disturbances was the subscale with the maximum prevalence (45.3% in EA vs 35.0% in CA; $p<0.001$), followed by obsessive-compulsive disorders (23.1% vs 16.7%; $p=0.007$), depression (22.2% vs 11.0%; $p<0.001$), somatization (20% vs

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6 16.2%; $p=0.049$), and anxiety (18.2% vs 7.7%; $p<0.001$). Compared to fathers, mothers in EA (but not in
7 CA) had significantly higher scores in all subscales of symptoms, with the only exception of
8 anger/hostility and psychoticism.
9

10 11 12 *Predictors of PTSD and SDQ scores*

13 With a multiple linear regression we examined the contribution of the independent variables to the total
14 score on PTSD and SDQ in separate analyses. The independent variables included living in the affected
15 zone, number of stressful events earthquake-related, number of lifetime traumatic events, parental
16 psychopathology (with a clinical score over the cutoff). We did not include SDQ total difficulties score in
17 the model analysing PTSD score and vice-versa due to the significant overlap between severer PTSD
18 symptoms and total difficulties SDQ scores (models would have ended up explaining higher PTSD scores
19 with abnormal SDQ and vice-versa).
20

21 The first model with PTSD score as an outcome, explained 16.7% of the variance ($R^2=0.167$, $F=17.596$,
22 $p<0.001$). Most powerful predictors were number of lifetime trauma ($\beta=0.324$, $p<0.001$), degree of
23 earthquake exposure ($\beta=0.163$, $p<0.001$), and parental psychopathology ($\beta=0.147$, $p<0.001$).
24

25 Linear regression results using SDQ total difficulties score as the outcome variable, revealed increased
26 risk of mental health problems for students with lifetime traumatic events not related to the earthquake
27 ($\beta=0.219$, $p=0.000$), with a higher degree of exposure to earthquake ($\beta=0.140$, $p=0.000$), and parental
28 psychopathology ($\beta=0.137$, $p=0.000$). This model explain 10% of the variance ($R^2=0.100$, $F=9.765$,
29 $p<0.001$).
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38 **Discussion**

39 This study is one of the few on mental health of Italian children and adolescents in complex emergencies
40 [13,21, 50-51] and extends the literature examining PTSD and its comorbidities.
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42 Our results demonstrate that even after earthquakes not involving a great number of deaths, children and
43 adolescents in affected areas may have a probable PTSD diagnosis years after the traumatic event: in our
44 sample the prevalence of likely PTSD two years after the earthquake was 1.9% in students living in the
45 earthquake zone and reached 4.4% in Finale Emilia, near the epicenter.
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47 Our results give support to the hypothesis of long-lasting PTSD in children and adolescents after
48 earthquakes [8, 21], with prevalence rates varying widely.
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6 Extending the existing literature, our results evidence that 87.5% of children with a probable PTSD have
7 a SDQ total score in the borderline/abnormal range, confirming that earthquakes may have a significant
8 impact on the psychosocial functioning of children and adolescents [20].
9

10 Contrary to what hypothesized on the base of previous studies [30, 52], we did not find a higher risk of
11 PTSD among girls and we found significantly higher SDQ total difficulties scores in boys. Similarly, no
12 signs of increased symptomatology were found in primary school children or adolescents (as evidenced
13 by Cenat and Derivois [28]).
14

15 Consistently with the literature [6,31,35,53], proximity to the epicenter, personal injuries, loss of loved
16 ones, are confirmed as important risk factors for PTSD, as well as for conduct, emotional, and relational
17 difficulties. However, although the degree of exposure resulted to be an important risk factor, prior
18 traumatic events [54] and parental psychopathology [34] are the stronger predictors of long term
19 symptoms after earthquakes (as resulted from SDQ and UCLA PTSD RI).
20

21 Data of this study must be interpreted with caution and several limitations in mind. Given the cross
22 sectional nature of the study and the lack of pre-earthquake prevalence rates, no inferences can be made
23 regarding causes and effects. Moreover, as we do not have data collected in the aftermath of the
24 earthquake, we cannot distinguish between chronic PTSD and delayed onset PTSD. Similarly, we cannot
25 exclude that PTSD symptoms and SDQ difficulties are related to lifetime stressful events that occurred
26 before or after the earthquake. In addition to this, the use of self-report instruments, some of which not
27 validated in Italian, might have affected the assessment, leading to over or underestimated prevalence
28 rates.
29

30 Nevertheless our results stress the need for better clinical interventions for children and adolescents
31 exposed to earthquakes, *not limited to the first few months after the traumatic event, focused on at-risk*
32 *populations* of children and adolescents, and *having a whole family approach*, given the strong
33 association between parental and youth psychopathology. As recommended by disaster management
34 experts, a stepped care approach to intervention should be adopted, with children and adolescents at
35 highest risk of chronic distress after earthquakes receiving the most intensive treatments. This study also
36 highlight the need for *long follow-up that allow a long-term evaluation of the effectiveness of*
37 *interventions*, even in case of earthquakes with a limited number of deaths.
38

39 It is now evident that PTSD symptoms, like other psychological difficulties emerging after potentially
40 traumatic events, follow multiple, distinct trajectories [22]. Further research is needed to understand
41 psychopathological trajectories in children and adolescents after earthquakes and to clarify which factors
42 differentiate those who still have symptoms after years from the disaster from those who recover.
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6 Investigations with a longitudinal approach will expand our knowledge on these topics, ensuring that the
7 most appropriate interventions are provided to children and adolescents.
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10 **Conflict of interest**

11 No conflict of interest was declared by the authors. All persons gave their informed consent prior to their
12 inclusion in the study. Details that might disclose the identity of the subjects under study have been
13 omitted.
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