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ORIGINAL CONTRIBUTION

Prevalence and predictors of posttraumatic stress disorder and depressive symptoms among child survivors 1 year following the Wenchuan earthquake in China

Liu-hua Ying · Xin-chun Wu · Chong-de Lin · Chuansheng Chen

Abstract The purpose of this study was to estimate the prevalence rates of probable posttraumatic stress disorder (PTSD) and depression and to explore potential risk factors among child and adolescent survivors 1 year following the 2008 Wenchuan earthquake. 3052 participants were administered the Child PTSD Symptom Scale, the Center for Epidemiologic Studies Depression Scale for Children, and the earthquake experience scale. Results indicated that the prevalence rates of probable PTSD and depression were 8.6 and 42.5 %, respectively. Demographic variables (i.e., age and gender) and most aspects of earthquake experiences (i.e., direct exposure, close ones' exposure, fear for the safety of close ones, prior exposure to trauma, living location, and house damage, with the exception of type of housing) made unique contributions to PTSD and depressive symptoms. In addition, the moderating effect of gender on the relationships between age and PTSD and depressive symptoms was significant. In conclusion, depression was a more common psychological response than was PTSD among child survivors 1 year following the Wenchuan earthquake. Age and gender were risk factors for both PTSD and depressive symptoms. Furthermore, older female survivors exhibit more severe PTSD and depressive symptoms. Additionally, several aspects of earthquake experiences (i.e., direct exposure, close ones' exposure, fear for the safety of close ones, prior exposure to trauma, living location, and house damage) was also important for the development and maintenance of PTSD and depressive symptoms.

Keywords Posttraumatic stress disorder symptoms · Depression · Child · Risk factors · Wenchuan earthquake

Introduction

On 12 May 2008, an earthquake with a magnitude of 8.0 on the Richter scale occurred in Wenchuan, a county in Sichuan province of southwestern China. The earthquake was considered as the most devastating natural disaster that had occurred in China since the 1976 Tangshan earthquake. According to official state statistics, the Wenchuan earthquake caused 69,277 deaths and 374,643 injuries. In addition, 17,923 were listed as missing, and 4.8 million victims were left homeless [1].

Posttraumatic stress disorder (PTSD) is often considered as the most frequently reported adverse psychological sequelae among child and adolescent earthquake survivors [2–6]. For example, Giannopoulou et al. [7] found that the prevalence rate of PTSD 6–7 months after the 1999 Athens earthquake was 35.7 % among youths aged 9–17 years. Fan et al. [8] reported that the prevalence rate of PTSD was 15.8 % among 2, 250 adolescents (with mean age of 14.6 years, SD = 1.3) 6 months after the Wenchuan earthquake. Liu et al. [4] showed that the prevalence rates of PTSD at 6 months and 12 months after the Wenchuan earthquake were 11.2 and 13.4 %, respectively. In addition to PTSD symptoms, child survivors of traumatic events

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usually experience comorbid depression. Previous studies reported that the prevalence rates of depression ranged from 14.5 to 40.8 % among child survivors of the Wenchuan earthquake [4, 8–12]. In sum, there were great variations in the prevalence rates of earthquake-related PTSD and depression across studies. This variability could be attributed to the differential impact of earthquakes in different countries, the timing of psychiatric assessment, and the diversity of research methodologies employed [12, 13].

Recently, several reviews of the research literature have summarized and identified a series of risk factors associated with the vulnerability to develop PTSD and depressive symptoms among child and adolescent survivors of natural disasters [13–16]. Among these risk factors, pre-existing child characteristics (e.g., gender, age, and prior exposure to traumatic events) have been well studied. Many studies found that girl survivors of disasters had a greater risk than boy survivors to develop PTSD and depressive symptoms [8, 17–19], although some studies did not find significant gender differences [18, 20]. With regard to the association between age and PTSD symptoms, the results have been inconsistent across studies. Some studies indicated that age was not significantly related with PTSD after traumatic events [19, 21], whereas other studies showed that older children had more severe symptoms than did younger children [4, 22, 23]. In a recent meta-analysis, Trickey et al. [16] concluded that age's main effect was close to zero, but it may play a moderating role in the relationship between gender and PTSD. Specifically, being female was a stronger risk factor in older children and adolescents than in younger children. In addition to gender and age, prior exposure to traumatic events is also a pre-trauma characteristic that can contribute to earthquake survivors' vulnerability. Previous studies suggested that exposure to a traumatic event may make individuals vulnerable to the negative effects of subsequent traumas, creating more intense posttraumatic stress [24–27].

The severity of PTSD and depression is also linked to objective characteristics of the traumatic event (earthquake) such as house damage, witnessing the disaster, and death/injuries of family members. Those individuals with greater exposure usually have higher levels of PTSD and general psychopathology [28, 29]. For example, previous studies indicated that PTSD and depressive symptoms were associated with severe house damage [19, 30, 31] and death of family members [23]. Even more important than objective elements of traumatic events were individual's subjective experiences (e.g., the perception of threat and fear) in determining posttraumatic response [32]. For example, Roussos et al. [5] examined the impact of both objective and subjective factors on PTSD symptoms of schoolchildren, and found that perceived threat to safety explained more variance in PTSD symptoms than objective measures of trauma severity, such as injury, the severity of house damage, or proximity to the epicenter.

Finally, post-trauma living environment (i.e., living condition and relocation) is also a potential risk factor for PTSD and depressive symptoms. Earthquake may render local communities uninhabitable. The survivors who suffered from severe house damage had to be relocated to temporary shelters or prefabricated houses within an earthquake region. Findings of previous studies suggested that those survivors living at prefabricated and temporary houses had more severe traumatic stress symptoms than survivors living in permanent houses [33, 34]. Additionally, in severely affected communities, survivors were also dispersed to new locations and became isolated from one another. Those who were relocated tended to display greater PTSD and depressive symptoms [14, 35]. For instance, Kılıç et al. [35] found that in a sample of survivors (the mean age of 38.9 years, SD = 16.3) of the 1999 earthquake in Turkey, the relocated group had significantly higher rates of PTSD than a non-relocated group of survivors, but the rates of depression were similar. However, in regression analyses, relocation status predicted depression but not traumatic stress.

Based on this literature review, the purposes of the present study were: (1) to estimate the prevalence rates of probable PTSD and depression among child survivors 1 year following the 2008 Wenchuan earthquake and (2) to explore potential risk factors (e.g., age, gender, past trauma experience, and earthquake exposure severity) of PTSD and depressive symptoms.

Methods

Participants and procedure

Data in the present study were collected as part of a large-scale longitudinal study on psychological adjustment among child survivors following the Wenchuan earthquake. In the present study, 3052 child survivors (53.5 % female) were randomly selected from 20 primary and secondary schools in the counties of Wenchuan and Maoxian, the two areas most severely affected by the earthquake. Their age ranged from 8 to 19 years (mean = 13.31, SD = ±2.27 years). Under the supervision of trained individuals with a degree in psychology, participants took about an hour to complete three confidential questionnaires (ID-coded without their names appearing on the questionnaires) in their classroom: the Child PTSD Symptom Scale (CPSS) [36], the Center for Epidemiologic Studies Depression Scale for Children (CES-DC) [37, 38], and the earthquake experience scale.

This project was approved by the local education authorities (i.e., County Departments of Education), school principals, and the Research Ethics Committee of Beijing Normal University. Students were provided with a description of the research being conducted and were informed that participation was voluntary and they had a right to decline to participate in the study. Very few students declined, yielding a response rate close to 100 %. Given that this study was initiated partly to help children cope with the aftermath of the earthquake, participants were told that school psychologists or teachers were available to provide psychological/counseling services they might need.

Measurements

Posttraumatic stress disorder

Posttraumatic stress symptom level was assessed with the CPSS [36]. This 17-item self-report measure was designed to assess the severity of DSM-IV-defined PTSD symptoms in relation to the most distressing event. Children reported the presence and frequency of symptoms during the past 2 weeks on a 4-point Likert-type scale, ranging from 0 ("not at all/only at one time") to 3 ("many times a week or almost always"). The items were modified so that they were answered in reference to the Wenchuan earthquake the participants recently experienced (e.g., "feeling upset when you think or hear about this earthquake"). Total possible CPSS scores ranged from 0 to 51; subscale scores ranged from 0 to 15 for re-experiencing, 0 to 21 for avoidance, 0 to 15 for arousal, with higher scores indicating greater severity of PTSD symptoms. The original CPSS has demonstrated good psychometric properties [36]. In terms of the Chinese version, high levels of internal consistency for the total scale and three subscales have been previously reported [10, 39, 40]. The test–retest reliability of the total scale was .84 [39]. Using confirmatory factor analysis (CFA), Zang [10] found an adequate fit of a model with the three subscales [χ^2 (116, $N = 225$) = 234.89], root mean-square error of approximation (RMSEA = .070, comparative fit index = .095, normed-fit index = .094). The Cronbach's α of the scale in the present study was .86.

Depression

Children's depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale for Children [37, 38]. The CES-DC is a 20-item self-report measure for the assessment of emotional, cognitive, and behavior-related symptoms of depression. For each item, participants are instructed to assess the frequency of their reactions during the past week. All items are evaluated

with 4-point response options (0 = "not at all", 1 = "a little", 2 = "some", 3 = "a lot"). Total possible scores range from 0 to 60, with higher CES-DC scores indicating increasing levels of depressive symptoms. The CES-DC has demonstrated good psychometric properties [41]. The Chinese version of CES-DC has also been found to have good reliability and construct validity among various Chinese populations [42]. The Cronbach's α of the scale in the present study was .85.

Earthquake experience scale

Earthquake-related experience was assessed with the following items: (a) *Direct exposure* (1 item: if they were trapped or wounded in the earthquake); (b) *Close ones' exposure to earthquake-related stressors* (22 items: if they had any parents, teachers, classmates, friends, the relatives or other persons who were trapped, wounded or died during or after the earthquake); (c) *Fear for the safety of close ones*: (8 items: if they feared that parents, teachers, classmates or themselves died/were wounded during the earthquake); and (d) *House damage* (2 items: the impact of earthquake on their house and school building (none, mild, severe and totally collapsed).

In addition, we also measured *prior exposure to traumatic events*: (2 items: if they had experienced or witnessed traumatic events prior to the earthquake) and *current living condition* (2 items: living in shelters or houses, and whether relocated to other places).

Results

Demographic characteristics

Of the 3052 participants, 1420 (46.5 %) were male and 1632 (53.5 %) were female. Their age ranged from 8 to 19 years (mean ± SD = 13.31 ± 2.26 years). Earthquake-related experiences of the female and male participants are presented in Table 1.

Descriptive statistics and intercorrelations among variables

Based on the DSM-IV [43], subjects were identified as having full PTSD according to the following criteria: (a) one or more items of the intrusion subscale scored 2 or 3; (b) three or more items of the avoidance subscale scored 2 or 3; (c) two or more items of the hyper-arousal subscale scored 2 or 3. According to these criteria, the rates of intrusion, avoidance and hyper-arousal were 52.2, 14.3, and 24.4 %, respectively. The prevalence rate of *probable* PTSD was 8.6 %. In addition, Weissman et al. [37], who

Table 1 Background characteristics and earthquake-related experiences of the female and male participants ($N = 3{,}052$)

Variables	Male ($N = 1{,}420$)		Female ($N = 1{,}632$)	
	N	(%)	N	(%)
Direct exposure				
Yes	396	27.9	465	28.5
No	1,024	72.1	1,167	71.5
Housing				
Shelter	730	51.4	954	58.5
Permanent house	690	48.6	678	41.5
Living location				
Local place	996	70.1	1,152	70.6
Other places	424	29.9	480	29.4
Prior experience of trauma				
Yes	243	29.9	219	13.4
No	1,177	82.9	1,413	86.6
Prior witnessing of trauma				
Yes	470	33.1	473	29.0
No	950	66.9	1,159	71.0
	Mean	SD	Mean	SD
Age	13.13	2.20	13.49	2.34
Close ones' exposure to earthquake-related stressors	6.09	7.62	6.81	7.94
Fear for the safety of close ones	5.54	2.75	6.30	2.35
House damage	3.79	1.29	3.94	1.22

were the developers of the CES-DC, have used the cutoff score of 15 as being suggestive of depressive symptoms in children and adolescents. According to that criterion, 1298 individuals had significant levels of depressive symptoms, and the prevalence rate of *probable* depression was 42.5 %. Among those participants with *probable* PTSD, the prevalence rate of comorbidity between probable PTSD and depression was 95.4 %.

As shown in Table 2, age and gender were positively related to PTSD ($r = .20$ and $r = -.12$) and depressive symptoms ($r = .25$ and $r = -.14$). Most measures of earthquake experiences (i.e., direct exposure, housing, close ones' exposure, fear for the safety of close ones, prior exposure to trauma events, and house damage) were significantly and positively associated with PTSD and depressive symptoms, with correlation coefficients ranging from .05 to .25. The only exception was living location, which was not associated with either PTSD or depressive symptoms.

Predictors of PTSD and depression symptoms

Two multiple regression analyses were conducted to examine the effects of demographic variables (i.e., age and gender) and earthquake experiences on PTSD and depressive symptoms. As shown in Table 3, both demographic variables (i.e., age and gender) and all and but one earthquake experiences (i.e., direct exposure, living location, close ones' exposure, fear for the safety of close ones, prior exposure to traumatic events, and house damage, with the exception of type of housing) made unique contributions to PTSD and depressive symptoms. Together, these variables accounted for 13.2 % of the variance of PTSD ($F_{(10, 3051)} = 47.23$, $P < .001$) and 13.8 % of the variance of depressive symptoms ($F_{(10, 3051)} = 49.90$, $P < .001$).

To further examine the potential moderating effect of gender on the relationships between age and PTSD and depressive symptoms, we conducted hierarchical regression analyses. Specifically, the dependent variable was PTSD or depressive symptoms. Independent variables included age and gender entered in step 1 and their interaction term entered in step 2. Age and gender were centered on their respective means to reduce the multicollinearity between main effects and the interaction term and to increase the interpretability of the beta-weights for interaction terms [44].

Results indicated that the interaction term of age and gender was significant for both PTSD and depressive symptoms (see Table 4). The interaction term accounted for additional .7 % of variance in PTSD symptoms ($F_{(1, 3048)} = 21.61$, $P < .001$), and additional .5 % of variance in depressive symptoms ($F_{(1, 3048)} = 15.12$, $P < .001$). We used the simple slopes syntax [45] to further test whether the simple slopes of the interaction were significantly different from zero. As shown in Figs. 1 and 2, the slopes of age effect on PTSD and depressive symptoms were steeper for females ($\beta = .26$, $P < .001$; $\beta = .30$, $P < .001$) than for male participants ($\beta = .10$, $P < .001$; $\beta = .16$, $P < .001$).

Discussion

In the present study, we examined the prevalence rates of *probable* PTSD and depression, as well as their potential risk factors among a large sample ($N = 3052$) of child survivors 1 year following the Wenchuan earthquake in China. Our results indicated that the prevalence rates of *probable* PTSD and depression were 8.6 and 42.5 %, respectively. In the previous review, the prevalence rates ranged from 4.5 to 95 % for PTSD and from 13.6 to 76 % for depression in child and adolescent survivors of earthquakes [13]. Even among the studies on mental health of child survivors of the Wenchuan earthquake, the prevalence rates ranged from 1.6 to 82.6 % for PTSD [4, 8–11, 19, 40, 46] and from 14.5 to 40.8 % for depression [4, 8– 12]. These inconsistent results across studies (even of the

Table 2 Descriptive statistics and intercorrelations among variables

	1	2	3	4	5	6	7	8	9	10	11	12
Age	–											
Gender	−.08**	–										
Direct exposure	.11**	−.01	–									
Housing	.06**	−.07**	.08**	–								
Living location	.14**	.01	.08**	.01	–							
Prior experience of trauma	.07**	.05**	.08**	.01	.04**	–						
Prior witnessing of trauma	.10**	.04*	.09**	−.02	.03	.29**	–					
Close ones' exposure	.20**	−.05**	.35**	.12**	.10**	.07**	.14**	–				
Fear for the safety of close ones	.11**	−.15**	.07**	.04*	−.01	.04*	.07**	.17**	–			
House damage	.29**	−.06**	.17**	.23**	.10**	.08**	.09**	.31**	.09**	–		
PTSD	.20**	−.12**	.14**	.07**	−.03	.10**	.17**	.22**	.20**	.18**	–	
Depression	.25**	−.14**	.12**	.05**	−.02	.13**	.17**	.18**	.19**	.17**	.78**	–
Mean	13.31							6.47	5.95	3.87	14.68	14.70
SD	2.28							7.80	2.57	1.26	7.92	8.52

PTSD posttraumatic stress disorder

* $P < .05$; ** $P < .01$

Table 3 Summary of regression analyses predicting PTSD and depressive symptoms

Variables	PTSD[a]			Depression[b]		
	B	SE	β	B	SE	β
Age	.42	.06	.12***	.69	.07	.18***
Gender	−1.36	.27	.09***	−1.77	.29	.10***
Direct exposure	1.08	.32	.06***	.80	.34	.04*
Housing	.25	.28	.02	.09	.30	.01
Living location	−1.32	.30	−.08***	−1.34	.32	−.07***
Prior experience of trauma	.97	.39	.04*	1.73	.42	.07***
Prior witnessing of trauma	1.88	.31	.11***	1.95	.33	.11***
Close ones' exposure	.11	.02	.11***	.08	.02	.08***
Fear for the safety of close ones	.42	.05	.14***	.40	.06	.12***
House damage	.49	.12	.08***	.42	.13	.06***

Gender variable was coded as 0 = female and 1 = male; Direct exposure was code as 0 = no and 1 = yes; Housing was coded as 0 = permanent house and 1 = temporary shelter; Living location was coded as 0 = local place, 1 = relocation to other counties or provinces. Prior experience of trauma was coded as 0 = no and 1 = yes. Prior witnessing of trauma was coded as 0 = no and 1 = yes

PTSD posttraumatic stress disorder, *B* unstandardized regression coefficients

* $P < .05$; ** $P < .01$; *** $P < .001$

[a] $F_{(10, 3051)} = 47.23$, $P < .001$, $R^2 = .132$

[b] $F_{(10, 3051)} = 49.90$, $P < .001$, $R^2 = .138$

same earthquake) may be due to one or more of the following factors: time-points of measurement following the earthquake, measures used to assess psychopathology, and possible differential impact of earthquakes in different countries [12, 13].

Consistent with previous studies [8, 12, 17], our results indicated that female child survivors of the Wenchuan earthquake exhibited more PTSD and depressive symptoms than male child survivors. One possible explanation of this finding is the gender difference in neuroendocrine response, which can be induced by gender-specific cognitive appraisal and coping processes in the face of traumatic events [47]. Another potential explanation is gender-specific socialization [48] that may influence the availability and use of social support, and expectations for response and recovery [49]. In addition, our study found that age had a significant and positive relationship with PTSD and depressive symptoms. Specifically, among our subjects ranging in age from 8 to 19 years, older child and adolescent survivors had more severe PTSD and depressive symptoms than did younger survivors. Adolescent survivors had more diχfficulty in coping perhaps because they were in the midst of identity development and trauma-induced discontinuity was more likely to have a negative impact on their task of integrating past, present, and future expectations into a lasting sense of identity [50]. Furthermore, our results found that gender played a moderating role in the relationship between age and PTSD and depressive symptoms, with older female survivors showing the highest levels of PTSD and depressive symptoms. One potential explanation is that with the increase of age, female survivors are more likely to use rumination which may influence the development of PTSD and depressive symptoms [51, 52].

Table 4 Hierarchical regression models of age and gender on posttraumatic stress disorder or depressive symptoms

Variables	PTSD[a]					Depression[b]				
	B	SE	β	R^2	ΔR^2	B	SE	β	R^2	ΔR^2
Step 1				.050	.050				.076	.076
Age	.66	.06	.18***	–	–	.90	.07	.24***	–	–
Gender	−1.66	.28	−.11***	–	–	−1.99	.30	−.116***	–	–
Step2				.057	.007				.080	.005
Age × Gender	−.57	.12	−.08***	–	–	−.51	.13	−.07***	–	–

Gender variable was coded as 0 = female and 1 = male

PTSD posttraumatic stress disorder, *B* unstandardized regression coefficients

* $P < .05$; ** $P < .01$; *** $P < .001$

[a] Step 1: $F_{(2, 3049)} = 124.68$, $P < .001$; Step 2: $F_{(3, 3048)} = 88.54$, $P < .001$

[b] Step 1: $F_{(2, 3049)} = 80.07$, $P < .001$; Step 2: $F_{(3, 3048)} = 60.94$, $P < .001$
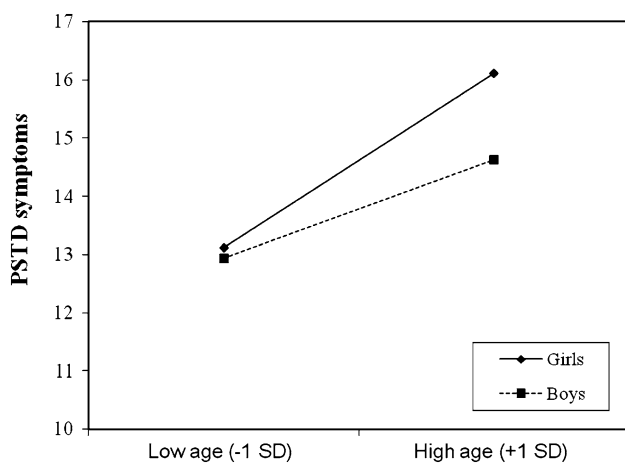

Fig. 1 Interaction of age and gender on posttraumatic stress disorder (PTSD) symptoms
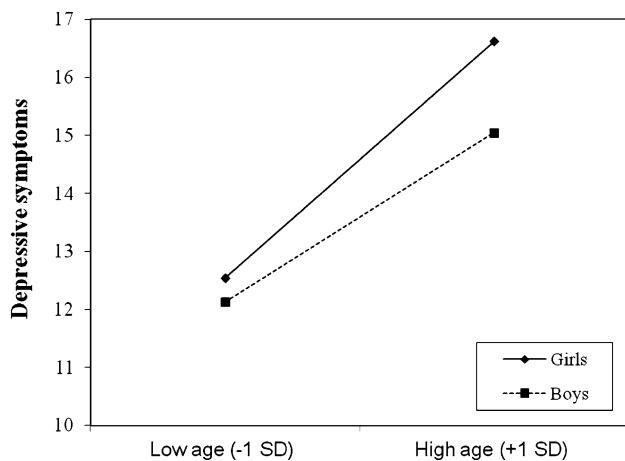

Fig. 2 Interaction of age and gender on depressive symptoms

Our results also indicated that prior exposure to traumatic events was significantly associated with the severity of PTSD and depressive symptoms. Those children with

prior exposure to trauma may suffer from long-term neurobiological changes [53–55] and develop maladaptive coping styles that increase one's vulnerability to subsequent traumatic events [56]. Thus, the finding of the present study suggests that prior experience of traumatic events should be considered while identifying vulnerable groups.

In terms of living conditions, our results indicated that survivors living in shelters had more severe PTSD and depressive symptoms than survivors living in houses. After controlling for the effects of demographic variables (age and gender) and other earthquake experiences, however, type of housing was no longer a significant predictor of either PTSD or depressive symptoms. This finding suggests that the relationship between types of housing and PTSD or depressive symptoms was mainly accounted for by other variables such as house damage. Additionally, we found that those children who were relocated to other counties or provinces tended to display fewer PTSD and depressive symptoms than those who continued to reside locally. This finding is inconsistent with the results of a previous study [35], which found that relocation predicted greater depression, although not traumatic stress. One possible explanation is that although relocation may initially change the survivors' social networks [35, 57], it may reduce PTSD and depressive symptoms by limiting exposure to potential reminders of the disaster [15] and obtaining more material or emotional social support from local governments and organizations [10].

Consistent with previous studies [28, 29], our results indicated that some objective aspects of the earthquake (i.e., house damage, injuries/trapped, and close ones' exposure to earthquake-related stressors) were significantly associated with the severity of PTSD and depressive symptoms. Greater exposure was associated with greater PTSD and depressive symptoms. Furthermore, our results also showed that fear for the safety of close ones was

significantly associated with PTSD and depressive symptoms. Subjective experiences such as perception of danger, threat to life or fear for the safety of close ones have been found to have an inverse relationship with adaptive coping abilities [58], which are essential to resiliency and healthy outcomes following a trauma [59].

The present study had several limitations. First, to obtain a large sample, we assessed PTSD and depressive symptoms via self-report questionnaires, rather than by clinical interviews. Although these instruments have satisfactory psychometric properties, they can overestimate the prevalence rates of these two disorders when compared to the clinical interview method [60]. Additionally, the use of 15 as the cutoff point for the CES-DC might have resulted in false-positive diagnoses for depression in non-depressed youth [61–63]. Thus, caution is needed while interpreting our results and comparing them with those from studies with different measures. Second, participants in this study were a convenient sample from 20 primary and secondary schools in the counties of Wenchuan and Maoxian, the two areas most severely affected by the earthquake. It is unknown if findings of the present study could be generalized to other adolescent survivors. Third, several potential risk factors were not included in the present study. For example, a growing body of literature indicates that trauma appraisal characteristics (e.g., fear of death, fear during tremors, dissociation, etc.) are linked to a higher risk for PTSD symptoms than any objective trauma characteristics (e.g., entrapment under rubble, death of close ones, etc.) in earthquake survivors [7, 13, 64, 65]. Such variables should be consistently included in future studies. Finally, this study had a cross-sectional design, which limited its ability to draw causal inference regarding the relationships between these risk factors and PTSD and depressive symptoms.

Despite these limitations, the present study expanded our knowledge on PTSD and depressive symptoms as well as their risk factors among child (aged 8–19 years) survivors of the Wenchuan earthquake in China. First, our findings suggested that depression may be a more common psychological response than PTSD among child survivors 1 year following the Wenchuan earthquake. Additionally, age and gender were risk factors for both PTSD and depressive symptoms. Furthermore, older female survivors exhibit more severe PTSD and depressive symptoms. Finally, several aspects of earthquake experiences (i.e., direct exposure, close ones' exposure, fear for the safety of close ones, prior exposure to trauma, living location, and house damage) were also important for the development and maintenance of PTSD and depressive symptoms. These findings should be of help for psychological service providers to understand child survivors of earthquakes and to provide them with a systematic and planned developmental intervention.

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