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ORIGINAL ARTICLE

Prevalence of post-traumatic stress disorder among adolescents after the Wenchuan earthquake in China

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Background. The Wenchuan earthquake was a catastrophic earthquake in China. The aim of this study is to explore longitudinally the rates of post-traumatic stress disorder (PTSD) and depression in adolescents after the Wenchuan earthquake, and to identify independent predictors of PTSD.

Method. PTSD and depression symptoms among adolescents at 6, 12 and 18 months after the Wenchuan earthquake were investigated using the PTSD Checklist Civilian Version and the Beck Depression Inventory (BDI). Subjects in this study included 548 high school student survivors in a local boarding high school.

Results. The rates of PTSD symptoms were 9.7%, 1.3% and 1.6% at the 6-, 12- and 18-month follow-ups, respectively. BDI scores were found to be the best predictor of severity of PTSD at 6, 12 and 18 months. Gender was another variable contributing significantly to PTSD at 6 and 12 months after the earthquake. In the 12-month follow-up, home damage was found to be a predictor of severity of PTSD symptoms. Being a child with siblings was found to be a predictor of severity of PTSD symptoms at 12 and 18 months after the earthquake.

Conclusions. PTSD symptoms changed gradually at various stages after the earthquake. Depression symptoms were predictive of PTSD symptoms in the 18-month follow-up study. Other predictors of PTSD symptoms included female gender and being a child with siblings. The results of this study may be helpful for further mental health interventions for adolescents after earthquakes.

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Key words: Adolescents, China, depression, earthquakes, post-traumatic stress disorder.

Introduction

At 14.28 hours (Beijing time) on 12 May 2008, a catastrophic earthquake measuring 8.0 on the Richter scale struck Wenchuan, Sichuan, China. Official figures stated that 69 227 were confirmed dead and 374 643 injured, with 17 923 listed as missing. The earthquake spread about 100 000 km², destroyed almost 6.5 million homes and affected approximately 46 million people, left about 15 million people evacuated from their homes and led to about 5 million people living in temporary shelters. The direct economic losses estimated officially were reported at 123.8 billion dollars. Official figures stated that there were 316 after-shocks which were more than 4.0 on the Richter scale until 30 June 2010 (http://www.csi.ac.cn/sichuan/index080512001.htm; website in Chinese).

A few studies have reported increased post-traumatic stress disorder (PTSD) among adolescents after earthquakes (Goenjian *et al*. 2005; Roussos *et al*. 2005; Wu *et al*. 2009; Liu *et al*. 2010*b*). PTSD may arise in the weeks or months after an earthquake (Neria *et al*. 2008), and often co-occurs with depression (Salcioglu & Basoglu, 2008). Although there are several longitudinal studies regarding the prevalence and risk factors of PTSD among children or adolescents following the Wenchuan earthquake (Chen, 2010; Liu *et al*. 2011*a*, *b*; Yang *et al*. 2011; Ye *et al*. 2011), few had a measure of depression considering the high prevalence of depression in earthquake survivors. Further studies need to explore the relationship between PTSD and depression.

China's one-child policy, which limits couples to have one child, was established by Chinese leader

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Deng Xiaoping in 1978 to limit population growth in China. As a result, most children born thereafter were only-children. A previous study among 2250 adolescents found that only-child participants were less likely to have PTSD and depression symptoms than child-with-sibling participants 6 months after the Wenchuan earthquake in China (Fan *et al*. 2011). However, further studies with a longitudinal design on the demographic risk factors of PTSD in adolescents with a Chinese culture background are needed.

Research has shown inconsistent findings on the relationship of trauma-related factors (e.g. injury to self, family member injury or death, home damage, property damage, direct exposure to the earthquake) and the severity of PTSD symptoms in adolescents. Roussos *et al*. (2005) found that after the Ano Liosia earthquake in Greece of 1999, PTSD was positively associated with house damage, but not with the death or injuries of family members in adolescents. A recent Wenchuan earthquake study indicated that home damage, as well as injury to self and family member injury were risk factors of PTSD in adolescents (Ma *et al*. 2011). In another 1-year follow-up study, only parent injury and severe property damage were found as risk factors for PTSD (Liu *et al*. 2010*b*). Further follow-up studies are needed to better identify the relationship of trauma-related factors and PTSD.

The aims of this study were: (1) to explore longitudinally the rates of PTSD and depression in adolescents after the Wenchuan earthquake; and (2) to identify independent predictors of PTSD symptoms in the longitudinal study.

Method

Study population

The survey was conducted in a boarding high school (grades 11–12) at 6, 12 and 18 months after the Wenchuan earthquake. This high school is located only 10 km away from the epicentre of the Wenchuan earthquake, and was severely damaged during the earthquake. The students were not dispersed to other schools outside of the county after the earthquake. The school provided dormitories for the students who needed to stay in school. After the earthquake, these students studied and lived in temporary houses for 15 months until the school was rebuilt. This school was selected for two reasons: (*a*) the school is a public school with common characteristics of all local schools so that the characteristics of the students were representative of and comparable with all students in this district; and (*b*) the principals, teachers and students in this school were willing to participate in the study.

We chose students from grade 11 for this study so that all the participants could be followed up before they graduated from high school. A total of 746 students from grade 11 were followed up in this study. Of the sample, 737 (98.8%) students finished questionnaires at 6 months after the earthquake. In the 12-month follow-up, 685 (91.8%) students finished questionnaires. In the 18-month follow-up, 563 (75.5%) students finished questionnaires. In the end, 548 (73.5%) students completed all the measures. All students were Chinese Han. Consent was obtained from the school administration and the participants. This study was approved by the Human Ethics Committee of Sichuan University.

Measurements

The measuring instruments for traumatic stress consisted of two parts. The first part of the survey was to assess demographic characteristics, trauma characteristics, and personal and family history. Trauma characteristics were measured by a self-reported scale and included injury to self, number of family member injury or death, extent of damage to home and property, etc.

The second part was to measure the symptoms of PTSD and depression. PTSD was assessed using the PTSD Checklist-Civilian Version (PCL-C) (Blanchard *et al*. 1996), which is a self-report 17-item symptom scale that corresponds to Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) criteria (APA, 2000), and is commonly used when a clinical interview is not feasible (Dobie *et al*. 2002). Total score ranges from 17 to 85, and a cut-off score of 50 has been used to classify whether an adolescent has clinically significant PTSD symptoms or not (Jia *et al*. 2010; Liu *et al*. 2010*b*). The PCL-C has been shown to have high internal consistency (Cook *et al*. 2005), and has been commonly used with adolescents (Garrison *et al*. 1995; Cuffe *et al*. 1998; Elklit, 2002; Barnes *et al*. 2005; Calderoni *et al*. 2006; Liu *et al*. 2010*b*). Cronbach's α coefficient of the PCL-C in the present study ranged from 0.891 to 0.894.

The Beck Depression Inventory (BDI) was used to assess the severity of depression (Beck *et al*. 1961). The Chinese version of the BDI has been validated, showing good convergent validity and reliability (Shek, 1991). The BDI consists of 21 items, and each item is scored 0–3. The total score ranges from 0 to 63 (total score $\leqslant$4 points: no depression; 5–13 points: mild depression; 14–20 points: moderate depression; $\geqslant$21 points: major depression) (Wang *et al*. 1999, 2006). A total score of 14 was used as a cut-off point of depressive symptoms in this study (Wang *et al*. 2006). Cronbach's α coefficient of the BDI ranged from 0.811 to 0.912 in the present study.

Translation and back-translation of these instruments followed previously published guidelines

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Table 1. *Characteristics of subjects* ($n = 548$)

Variables	Total sample			
	Mean	(S.D.)	*n*	(%)
Demographic and personal history characteristics				
Age, years	16.86	(0.58)		
Gender, female			311	(56.8)
Mother education, 1–5[a]	2.01	(0.72)		
Father education, 1–5[a]	2.20	(0.74)		
Only-child, yes			438	(79.9)
Number of family members	3.84	(1.43)		
Living in school, yes[b]			499	(91.1)
History of psychiatric illness			4	(0.7)
Family history of psychiatric illness			18	(3.3)
Previous trauma experience			92	(16.8)
Trauma characteristics				
Injury to self			37	(6.8)
Family member injury			86	(15.7)
Extent of damage to home, 1–5[c]	3.08	(1.26)		
Extent of damage to property, 1–5[c]	2.64	(1.16)		
Exposure directly			211	(38.5)

S.D., Standard deviation.

[a] 1 = no schooling/illiterate/primary school; 2 = secondary school; 3 = high school; 4 = university studies; 5 = postgraduate studies and above. [b] Living in school means that the students were living in school until they graduated from the high school even after the earthquake. [c] 1 = no damage; 2 = minimal damage; 3 = moderate damage; 4 = severe damage; 5 = collapsed.

(Brislin, 1976). All questionnaires were pretested with adolescents in this school who had been exposed to the earthquake.

Statistical analyses

We used *t* tests to evaluate differences in continuous variables and χ^2 tests were used to examine associations between categorical variables. Stepwise multiple linear regression analyses were performed to identify independent predictors of PTSD symptoms. Values of $p < 0.05$ was considered to be statistically significant. Data were analysed using SPSS (version 13.0; SPSS, Inc., USA).

Results

Sample characteristics

There were no deaths of students or family members in the school during the earthquake. The age of these students was from 15 to 18 years. Approximately 80% of students were only-children. Most students (91.1%) were living in school at the time of the earthquake (Table 1).

Compared with students from one-child families, the adolescents with siblings had significantly more family members than the only-child participants [mean 4.39 (S.D. = 0.95) *v.* mean 3.70 (S.D. = 1.49), $p = 0.000$], and a higher extent of damage to property [mean 2.87 (S.D. = 1.20) *v.* mean 2.58 (S.D. = 1.14), $p = 0.019$]. Compared with the only-child participants, the adolescents with siblings were more likely to live in school (96.4% *v.* 89.7%, $\chi^2 = 3.977$, df = 1, $p = 0.046$), and had more family member injury (22.7% *v.* 13.9%, $\chi^2 = 5.146$, df = 1, $p = 0.023$).

Post-traumatic stress and depressive reactions

When a cut-off score of 50 was used for the PCL-C, a total of 53 (9.7%) student survivors were classified as subjects with PTSD symptoms in the 6-month, seven (1.3%) in the 12-month, and nine (1.6%) in the 18-month follow-ups, respectively. When a cut-off score of 14 was used for the BDI, a total of 216 (39.4%) student survivors were classified as subjects with depression symptoms in the 6-month, 202 (36.9%) in the 12-month, and 161 (29.4%) in the 18-month follow-ups, respectively.

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Table 2. *PCL-C and BDI scores of subjects at 6, 12 and 18 months after the earthquake*

				Only-child	
	Total	Male	Female	Yes	No
PTSD score					
6 months	30.46 (16.12)	25.55 (14.45)	34.20 (16.35)***	30.05 (16.05)	32.09 (16.38)
12 months	27.27 (8.14)	24.89 (6.51)	29.08 (8.79)***	26.85 (7.79)	28.94 (9.29)†
18 months	25.76 (7.80)	24.00 (6.87)	27.10 (8.19)***	25.23 (7.28)	27.88 (9.33)††
BDI score					
6 months	12.49 (7.91)	10.54 (7.34)	13.97 (8.02)***	12.36 (7.94)	12.99 (7.81)
12 months	11.82 (8.28)	9.57 (7.67)	13.53 (8.32)***	11.65 (8.15)	12.52 (8.76)
18 months	10.04 (8.40)	7.94 (7.50)	11.64 (8.71)***	9.83 (8.21)	10.88 (9.12)

Data are given as mean (standard deviation).

PCL-C, PTSD Checklist-Civilian Version; BDI, Beck Depression Inventory; PTSD, post-traumatic stress disorder.

*** Mean value was significantly different from that for males ($p < 0.001$, unpaired t test).

Mean value was significantly different from that for only-children: † $p < 0.05$, †† $p < 0.01$ (unpaired t test).

Table 2 presents the results of PTSD and depression symptoms scores at the 6-, 12- and 18-month follow-ups. Female adolescents had significantly higher scores of PTSD and depression symptoms in the 6-, 12- and 18-month follow-ups than male adolescents. Only-child adolescents had significantly lower scores of PTSD at 12 and 18 months' follow-up than child-with-sibling adolescents.

Independent predictors of severity of PTSD

Table 3 presents the results of a stepwise multiple regression analysis of the contributive factors in predicting the severity of PTSD symptoms at 6, 12 and 18 months after the earthquake. The strongest predictors of the severity of PTSD symptoms at 6 months after the earthquake included BDI score, which accounted for 27.8% of the total variance, and gender, accounting for 2.4% of the variance. The strongest predictor of the severity of PTSD symptoms in the 12 months after the earthquake was also BDI score, which accounted for 40.6% of the total variance, and the next variable was gender, which accounted for another 1.1% of the total variance. Home damage and child-with-sibling together contributed an additional 1.2% to the variance. The most significant variables predicting the severity of PTSD symptoms in the 18 months after the earthquake included BDI score, which accounted for 45.7% of the total variance, and child-with-sibling accounting for 1.1% of the variance.

Discussion

The present study is one of the first longitudinal follow-up studies on both PTSD and depression symptoms among high school students after the Wenchuan earthquake in China. Strengths of this study include the representative high school samples and the high follow-up rate. This study should also be significant for policy making for adolescents' psychological rehabilitation after earthquakes.

In the present study, 38.5% of students reported that they were directly exposed to the severe damage of the earthquake. As there were no deaths of students or family members, so many students might endorse subjectively that they were not directly exposed to the earthquake in this study.

In previous studies, the prevalence of PTSD in children and adolescents after earthquakes has ranged from 4.5% to 95% (Salcioglu & Basoglu, 2008). Evidence has indicated that the prevalence of PTSD in adolescents was from 2.5% to 60.8% from 4 to 13 months after the Wenchuan earthquake (Liu *et al*. 2010*a*, *b*; Fan *et al*. 2011; Ge *et al*. 2011; Ma *et al*. 2011; Wang *et al*. 2011). In the present study, the prevalence of PTSD symptoms of adolescent survivors was 9.7% in the 6 months after the earthquake, which is consistent with previous studies. The prevalence of PTSD symptoms in this study declined to 1.3% at 12 months and 1.6% at 18 months after the earthquake, which is lower than found in other studies on the Wenchuan earthquake (Liu *et al*. 2010*b*). This might be due to: (1) less loss of loved ones; (2) fewer injuries; (3) timely and effective social support from the Chinese government; and (4) less negative influence of the media, as students seldom watched television in school. Evidence has indicated that viewing television images of disasters exacerbated PTSD and depression among persons directly affected by disasters (Ahern *et al*. 2002).

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Table 3. *Predictors of PCL-C scores at 6, 12 and 18 months after the earthquake using multivariate linear regression*

Variables	6 months (adjusted $R^2 = 0.300$)		12 months (adjusted $R^2 = 0.424$)		18 months (adjusted $R^2 = 0.465$)	
	β^a	Partial correlation	β^a	Partial correlation	β^a	Partial correlation
BDI score	0.493***	0.499***	0.604***	0.612***	0.671***	0.676***
Gender	0.160***	0.184***	0.103**	0.130**		0.068
Home damage		0.033	0.077*	0.100*		−0.040
Only-child		0.038	0.069*	0.091*	0.103**	0.139**
Age		−0.050		0.022		0.068
Mother education		−0.023		−0.004		−0.063
Father education		−0.021		0.042		−0.029
Number of family members		0.073		−0.031		−0.015
Living in school		−0.020		0.018		0.005
History of psychiatric illness		−0.018		0.028		0.052
Family history of psychiatric illness		0.007		−0.008		−0.024
Previous trauma experience		0.052		0.011		0.021
Injury to self		0.004		−0.011		−0.040
Family member injury		0.034		0.054		0.020
Property damage		−0.006		0.017		−0.009
Exposure to earthquake directly		0.075		0.047		0.077

PCL-C, PTSD Checklist-Civilian Version; BDI, Beck Depression Inventory.

[a] Standardized regression coefficient.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The results of this study indicated that the PTSD symptoms among high school survivors might reduce significantly 12 months after the earthquake, and increase a little at the 18 months follow-up. In a previous follow-up study in children after the Wenchuan earthquake, Liu *et al*. (2011) found that the prevalence of PTSD was increased from 11.2% to 13.4% between 6 and 12 months (Liu *et al*. 2011). Consistent with this pattern, Orcutt *et al*. (2004) found low levels of PTSD symptoms, with little increase over time, and higher levels of initial symptoms with a significant increase over time from a study of a large cohort of Gulf War veterans.

In previous studies, the prevalence of depression in child and adolescent survivors of earthquakes ranged from 13.6% to 76% (Salcioglu & Basoglu, 2008). In a recent Wenchuan earthquake study, the prevalence of depression was 24.5% at 6 months among adolescents after the Wenchuan earthquake (Fan *et al*. 2011). In this study, the prevalence of depression in adolescents was 39.4%, 36.9% and 29.4% in the 6, 12 and 18 months after the earthquake, respectively which is consistent with previous studies in Western children and adolescents after earthquakes (Salcioglu & Basoglu, 2008). The results of the present study indicated that a significant number of adolescents would need culture-specific interventions for depression after a deadly earthquake.

The results of the multiple regression analysis in the present study indicated that BDI scores were found to be the best predictor of severity of PTSD symptoms in the 6-, 12- and 18-month follow-ups (explaining 27.8%, 40.6% and 45.7% of the variance, respectively). The results are consistent with the high correlation between PTSD and depression in previous studies (Roussos *et al*. 2005).

Evidence has indicated that being female is a risk factor associated with PTSD (Alisic *et al*. 2011; Ma *et al*. 2011). In a study of 6–7 months after the 1999 Athens earthquake, girls reported significantly more PTSD, anxiety and depressive symptoms than boys (Giannopoulou *et al*. 2006). In a recent follow-up study, Ye *et al*. (2011) found that girls had 1.46 times higher risk than boys for PTSD after the Wenchuan earthquake. The results of the present study also demonstrated that being female was a risk factor of PTSD symptoms in the 6 and 12 months after the Wenchuan earthquake. The vulnerability of females for PTSD, also observed in the adult trauma literature, might be due to the different coping styles and socio-economic status of women and men (Gavranidou & Rosner, 2003).

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A previous Wenchuan earthquake study indicated that military first responders from only-child backgrounds had an increased risk of PTSD after deployment to the earthquake region compared with those from child-with-sibling families (Wang *et al*. 2010). However, another study among adolescents found that only-child participants were less likely to have PTSD and depression symptoms than those of children-with-siblings 6 months after the 2008 Wenchuan earthquake (Fan *et al*. 2011). In the present study, only-children were also found to be less likely to have PTSD symptoms than children-with-siblings in the 12 and 18 months after the earthquake. The results of the present study indicate that adolescents who come from multiple-child families need more specific interventions for PTSD after the earthquake. The possible reasons may include: (1) adolescents who came from multiple-child families received less support from their parents; (2) a higher extent of damage to property in multiple-child families; and (3) more family member injury in multiple-child families. Adolescents from one-child families may be educated more by their parents about how to face stress by themselves. The relationship between adolescents from one-child families and PTSD needs further study.

In the 12-month follow-up of this study, home damage was found to be a predictor of severity of PTSD symptoms, which is consistent with a previous Wenchuan earthquake study showing that house destructed was a risk factor of PTSD in Chinese adolescents (Ma *et al*. 2011). However, in another study of the Wenchuan earthquake, home damage and property loss were not related to PTSD and depression symptoms in child survivors (Fan *et al*. 2011). Further studies are needed to determine the relationship between home damage and PTSD.

The results of this 18-month follow-up study indicated the trend of PTSD and depression symptoms among high school students after the earthquake. The results of this study showed that PTSD symptoms might reach their highest level at 6 months after the earthquake, then reduce significantly at 12 months and maintain at a stable level at 18 months after the earthquake. The results of this study are consistent with previous Wenchuan earthquake studies in the long term (Yang *et al*. 2011). Authors of the present study suggest that culture-specific interventions should be provided in the early stage after an earthquake for reducing the PTSD symptoms. The effectiveness of psychological intervention on PTSD symptoms needs further study.

There are some limitations of the present study. First, as the study focused on adolescents, the results of this study may not be applicable to adults or young children. Second, the sample size is relatively small. Third, some other variables, such as secondary stressors after the earthquake, anxiety, etc, were not measured in this study.

In conclusion, the results of the present study indicated that depression symptoms were a predictor of PTSD symptoms in the 18-month follow-up study. Other predictors included being female and being a child with siblings. The PTSD symptoms may change gradually in the different stages after the earthquake. These results may help to identify adolescents with an elevated risk for PTSD symptoms after the earthquake so that they can be targeted for appropriate mental health interventions.

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Declaration of Interest

None.

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