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Posttraumatic Stress Disorder and Psychiatric Comorbidity among Adolescent Earthquake Survivors: a Longitudinal Cohort Study

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Abstract

Although posttraumatic stress disorder (PTSD) is highly comorbid with psychiatric disorders, little longitudinal research has been conducted to determine the potentially causal links. This study aimed to investigate the prevalence and comorbidity patterns of posttraumatic stress disorder symptoms and psychiatric symptoms among adolescents exposed to the 2008 Wenchuan earthquake in China and to examine the bidirectional prospective associations between PTSD symptoms and other psychiatric symptoms. A sample of 1573 adolescent survivors (45.8% male; mean age at initial survey was 15.0 years, SD = 1.3) completed a battery of standardized measures assessing symptoms of PTSD, depression, panic disorder, generalized anxiety disorder (GAD), separation anxiety disorder (SAD), social phobia, conduct disorder, and attention deficit hyperactivity disorder at 6 and 18 months post-earthquake. Among participants with PTSD symptoms, 91.9 and 94.0% had at least one comorbid psychiatric disorder at 6 and 18 months post-earthquake, respectively; however, among those without PTSD symptoms, 54.3 and 50.4% had at least one psychiatric disorder. PTSD symptoms were more likely to co-occur with subtypes of anxiety or depression symptoms than with behavior problems. Participants who were screened as having PTSD comorbid with depression or SAD at 6 months were less likely to recover from PTSD over time. Longitudinal analyses showed that symptoms of depression, GAD and SAD predicted increases in PTSD symptoms. In turn, PTSD symptoms predicted increases in GAD and panic disorder symptoms. Overall, our results support causal hypotheses of PTSD comorbidity. Specific multi-modal assessments and treatments targeting to both PTSD and its comorbidity disorders are warranted.

Keywords Posttraumatic stress disorder · Comorbidity · Adolescence · Natural disasters · Longitudinal studies

Introduction

Exposure to major disasters is associated with elevated risk of various mental health problems (Foa et al. 2006; Norris et al. 2002). Posttraumatic stress disorder (PTSD) is one of the most studied disorders, affecting approximately one in seven trauma-exposed children and adolescents (Alisic et al. 2014). PTSD commonly co-occurs with other psychiatric conditions (Brady et al. 2000). The National Survey of Adolescents, a community study of more than 4000 US adolescents, found that 72% of adolescents diagnosed with PTSD had depression or substance abuse (Kilpatrick et al. 2003). Post-disaster studies of children and adolescents with PTSD have also reported similar findings (Adams et al. 2015; Fan et al. 2011; Goenjian et al. 2001; Goenjian et al. 1995; Kar and Bastia 2006; Lai et al. 2015; Scheeringa and Zeanah 2008; Yang et al. 2011). For example, Fan et al. (2011) studied 2081 adolescent survivors at 6 months after the Wenchuan earthquake and found that among 329 individuals screened as clinical PTSD 84% had comorbid anxiety, 55% had comorbid depression and 50% had comorbid anxiety and depression.

Comorbid disorders have adverse impacts on the treatment and prognosis of adolescents with PTSD (Lai et al. 2013). Understanding patterns of PTSD comorbidity is crucial for post-disaster mental health intervention. Prior studies examining PTSD comorbidity have primarily focused on internalizing disorders, with a special emphasis on depression and anxiety (Fan et al. 2011; Goenjian et al. 1995, 2000; Lai et al.

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2015). Recent evidence suggests a link between PTSD and externalizing disorders such as conduct disorder and attention deficit hyperactivity disorder (ADHD) (for conduct disorder see a review by Bernhard et al. 2016; for ADHD see a review by Spencer et al. 2016). In a sample of 70 preschool children following Hurricane Katrina, one study reported that 88.6% individual with PTSD had at least one comorbid disorder, with oppositional defiant disorder and separation anxiety disorder (SAD) being most common (Scheeringa and Zeanah 2008). However, the comorbidity patterns of PTSD, affective disorders and behavior problems among adolescent survivors remain poorly understood.

Possible etiological mechanisms underlying comorbidity of PTSD and other psychiatric conditions could be that these disorders are involved in the cause and/or maintenance of one another, or that there are some common contributing factors to these disorders (Brady et al. 2000; Stander et al. 2014). Trauma is a common risk factor for both PTSD and other psychiatric disorders. Trauma types, the severity of trauma exposure, and prior trauma experiences significantly predict various post-disaster mental health problems (Comer et al. 2014; Crum et al. 2017; Furr et al. 2010; Norris et al. 2002). Some specific subpopulations (female, socially disadvantaged students etc) are more vulnerable to post-disaster psychological conditions (Furr et al. 2010; Norris et al. 2002). In china, the number of children in the family is an important indicator for socioeconomic status. In general, a family with higher level of SES has fewer children. After the Wenchuan earthquake, several studies indicated that children with siblings reported more PTSD, depression, and anxiety than those who was only child (Fan et al. 2011; Zhang et al. 2012).

For testing the assumption of causal relationships between PTSD and other psychiatric disorders, prospective-longitudinal data are needed. Findings of depression and/or anxiety predicting later PTSD among adolescent survivors have been reported (Goenjian et al. 2011, 2000; Ying et al. 2012; Zhang et al. 2012). Yet, longitudinal studies on PTSD that include assessment of internalizing and externalizing disorders are rare. Recently, a 5-year longitudinal survey of 1829 detained youth reported that ADHD and conduct disorder predicted PTSD among males whereas GAD predicted PTSD among females after detention (Abram et al. 2015). To the best of our knowledge, no prospective study has examined bidirectional relationships between PTSD and different internalizing and externalizing disorders among adolescent disaster survivors.

The current study was conducted with adolescents exposed to the Wenchuan earthquake, who were assessed at 6 and 18 months after the earthquake. The Wenchuan earthquake was one of the most severe natural disasters in China history, and resulted in 69,227 deaths, 18,222 missing people, and 374,176 injuries. The first aim of the current study was to investigate the prevalence rates and comorbidity patterns of PTSD symptoms and internalizing/externalizing problems. Our second aim was to examine the bidirectional longitudinal associations between PTSD symptoms and comorbid psychiatric symptoms. We hypothesized that internalizing and externalizing problems would be highly prevalent among participants with PTSD. We also hypothesized that PTSD would predict and be predicted by internalizing and externalizing problems over time.

Method

Participants

Participants were 1573 students from the Wenchuan Earthquake Adolescent Health Cohort (WEAHC) study (Fan et al. 2017). The cohort was established in Dujiangyan, a city which is 21 km from the epicenter and was one of the most severely affected regions, with 3069 deaths, 429 missing, and 4388 injuries in the earthquake. Participants were recruited from one junior high school and one senior high school in Dujiangyan. Details of the study design and sampling procedure are described elsewhere (Fan et al. 2017). Of these students, 45.8% were male and the mean age was 15.0 years at baseline. Students in this sample were severely affected by the Wenchuan earthquake. The details of demographics and earthquake exposure variables are presented in Table 1.

Procedure

Students' psychiatric symptoms were initially assessed at 6 months after the earthquake, and then followed up four times at intervals of 6 months. Yet, their internalizing (i.e., depression and different types of anxiety) and externalizing (i.e., conduct problems and ADHD) symptoms were fully assessed only at 6 (T6mon) and 18 months (T18mon) post-earthquake. The current study used data from these two time points. Of the 1573 target participants, 232 adolescents did not complete the survey at T18mon. The response rate was 85.3%. Chi-square test indicated that males ($\chi^2 = 11.55$, $p < 0.01$), grade 10th students ($\chi^2 = 7.06$, $p < 0.05$), and students who directly witnessed the disaster ($\chi^2 = 6.55$, $p < 0.05$) were more likely to drop out. In order to avoid possible bias, expectation maximization algorithm with all the studied variables as covariates was used to impute the missing data.

The WEAHC study was approved by the Human Research Ethics Committee of South China Normal University. Data were collected using self-report questionnaires in the classroom setting during school days, with supervision and assistance of psychological professionals from South China Normal University. Written informed consent and parental permission were obtained from all participants at each assessment.

Table 1 Demographics and earthquake exposure of adolescent survivors by PTSD status at T6mon and T18mon

Variable	Total ($n = 1573$) %	T6mon			T18mon		
		No PTSD ($n = 1276$) %	PTSD ($n = 297$) %	Adjusted odds ratio (95% CI)	No PTSD ($n = 1391$) %	PTSD ($n = 182$) %	Adjusted odds ratio (95% CI)
Sex							
Male	45.8	48.0	36.4	1.0	46.5	40.1	1.0
Female	54.2	52.0	63.6	1.7(1.3–2.3)**	53.5	59.9	1.3(1.0–1.9)
Grade at baseline							
7th grade	13.7	14.9	8.8	1.0	14.2	10.4	1.0
10th grade	86.3	85.1	91.2	1.5(0.9–2.3)	85.8	89.6	1.1(0.7–1.9)
No. of children in the family							
1	82.8	83.2	81.5	1.0	84.0	73.6	1.0
≥ 2	17.2	16.8	18.5	1.0(0.7–1.5)	16.0	26.4	1.9(1.3–2.7)**
Residence location							
Urban	55.8	57.1	50.2	1.0	56.9	47.3	1.0
Rural	44.2	42.9	49.8	1.3(1.0–1.7)	43.1	52.7	1.4(1.0–1.9)
Family member injured or killed/missing							
No	73.3	77.0	57.2	1.0	75.4	57.1	1.0
Injured	13.9	11.6	23.6	2.4(1.7–3.4)**	12.8	22.0	2.0(1.3–3.0)**
Killed/missing	12.8	11.4	19.2	1.9(1.4–2.8)**	11.8	20.9	2.1(1.4–3.1)**
House damage							
No	30.4	31.7	24.6	1.0	31.7	20.3	1.0
Moderate	27.3	27.3	27.3	0.9(0.6–1.3)	26.9	30.2	1.4(0.9–2.3)
Severe	42.3	41.0	48.1	0.8(0.6–1.2)	41.4	49.5	1.5(0.9–2.3)
Property loss							
No	42.7	45.6	30.3	1.0	44.0	33.0	1.0
Moderate	35.8	34.8	40.1	1.6(1.1–2.2)**	34.9	42.9	1.2(0.8–1.8)
Severe	21.5	19.6	29.6	1.9(1.3–2.9)**	21.1	24.2	0.9(0.6–1.5)
Directly witnessed the disaster							
No	38.6	42.5	21.9	1.0	41.0	20.3	1.0
Yes	61.4	57.5	78.1	2.4(1.8–3.3)**	59.0	79.7	2.5(1.7–3.7)**

PTSD, posttraumatic stress disorder; *T6mon*, 6 months post-earthquake; *T18mon*, 18 months post-earthquake

**, $p < 0.01$

Measures

Demographics Adolescents reported their age, gender (0 = male, 1 = female), grade (0 = 7th, 1 = 10th), location (0 = urban, 1 = rural), and the number of children in the family (0 = one child, 1 = more than one child) at T6mon.

Earthquake Exposure Adolescents' experience and the degree of exposure to the earthquake was measured at T6mon. In order to reduce recall bias, only objective aspects of exposure to the earthquake were assessed by four most studied questions in previous studies. These included: 1) death, disappearance and/or injury of family members (1 = death of family members, 2 = disappearance of family members, 3 = serious injury of family members, 4 = moderate injury of family members, 5 = none of the above); 2) house damage; 3) property loss other than house damage; and 4) direct witness of tragic scenes. Responses of the last three items were made on the 5-point scale ranging from 1 for "the lowest level of exposure" to 5 for "the highest". Because some response categories were hardly selected, the four items were recoded. Death, disappearance, and/or injury of family members was recoded as "no", "injury" or "death or disappearance". House damage and property loss were recoded as "no", "moderate" or "severe". Direct witness of tragic scenes was recoded as "yes" versus "no".

Posttraumatic Stress Symptoms The PTSD Self-rating Scale (PTSD-SS) was used to measure the severity of PTSD symptoms over the past six months (Liu et al. 1998). The PTSD-SS includes 24 items, with each item scoring from 1 (none) to 5 (very severe). The scores on all the items were summed to give a total score. A cut-off score of 50 was used to indicate probable clinical PTSD (Liu et al. 1998). The PTSD-SS has demonstrated satisfactory test-retest reliability, internal consistency and construct validity in Chinese adolescents (Liu et al. 1998). In the present sample, Cronbach's α was 0.94 at T6mon and 0.95 at T18mon.

Depressive Symptoms The Depression Self-Rating Scale (DSRS) was used to measure adolescents' depressive symptoms over the previous week (Birleson 1981). This scale consists of 18 items on a 3-point scale (0 = never, 1 = sometimes, 2 = most of the time), with a higher total score indicating higher levels of depressive symptoms. A total score of 15 was used to indicate clinically significant depression (Su et al. 2003). The DSRS has been reported to have good reliability and validity among Chinese adolescents (Su et al. 2003). In the present sample, Cronbach's α was 0.80 at T6mon and 0.82 at T18mon.

Subtypes of Anxiety Symptoms The Screen for Child Anxiety Related Emotional Disorders (SCARED) was used to assess symptoms of panic disorder (PD, 13 items), generalized anxiety disorder (GAD, 9 items), separation anxiety disorder (SAD, 8 items), and social phobia (SP, 7 items) (Birmaher et al. 1997). Respondents rated each item on a 3-point scale. According to the Chinese norm, cut-off scores for PD, GAD, SAD, and SP were 8, 9, 7, and 9, respectively (Su et al. 2008). The SCARED has been demonstrated to have good reliability and discriminative validity in Chinese adolescents (Su et al. 2008). In the present sample, the internal consistency of SCARED subscales were good (Cronbach's α at T6mon: PD = 0.85, GAD = 0.81, SAD = 0.70, SP = 0.80; Cronbach's α at T18mon: PD = 0.87, GAD = 0.85, SAD = 0.72, SP = 0.86).

Behavior Problems Subscales of conduct problems and hyperactivity-inattention from the Strengths and Difficulties Questionnaire (SDQ) were used to assess conduct disorder and ADHD symptoms over a period of 6 months (Du et al. 2008). Each subscale contains 5 self-rated questions scoring from 0 to 2. According to the Chinese norm (Du et al. 2008), cut-off scores for conduct disorder and ADHD subscales were 5 and 7, respectively. The SDQ has been widely used worldwide for the screening of child internalizing/externalizing problems. In the present sample, the internal consistency of CD and ADHD subscales were acceptable (Cronbach's α at T6mon: CD = 0.63, ADHD = 0.65; Cronbach's α at T18mon: CD = 0.65, ADHD = 0.68).

Statistical Analysis

McNemar's test was performed to compare the difference in prevalence of PTSD at T6mon and T18mon. Adjusted odds ratios (ORs) measuring associations of PTSD at two time points with demographics and earthquake exposure were obtained from two logistic regressions into which all variables were entered simultaneously. Concurrent and longitudinal associations of PTSD with other psychiatric disorders were examined using 2 sets of logistic regressions. The first controlled for demographics and earthquake exposure. To reveal the unique relationships of PTSD to other disorders, the second further controlled for all other psychiatric disorders. For the longitudinal analyses, baseline outcome variable was also controlled.

To assess whether PTSD comorbid with other disorders at T6mon were associated with PTSD persistence, another two sets of logistic regressions were conducted with the group of PTSD recovery as reference. The PTSD persistence was defined as participants having probable clinical PTSD at both time points, and the recovery PTSD was defined as participants having probable clinical PTSD at T6mon but not at T18mon. All analyses were conducted using SAS statistical software, version 9.0 (SAS Institute, Inc.; Cary, North Carolina).

Results

In the sample, the prevalence rates of probable PTSD were 18.9 and 11.6% at T6mon and T18mon, respectively. Chi-square test showed that the prevalence declined significantly over time ($\chi^2 = 47.60$, $p < 0.01$). Multiple logistic regressions were used to examine the risk factors of PTSD symptoms at T6mon and T18mon with demographics and earthquake exposure variables as independent variables. As shown in Table 1, female (OR = 1.7, 95% CI =1.3–2.3), death or injury of family members(OR = 1.9, 95% CI = 1.4–2.8 for death or missing; OR = 2.4, 95% CI = 1.7–3.4 for injury), property loss(OR = 1.6, 95% CI = 1.1–2.2 for moderate; OR = 1.9, 95% CI = 1.3–2.9 for severe), and direct witness of tragic scenes (OR = 2.4, 95% CI = 1.8–3.3) were associated with greater odds of PTSD at T6mon. Non-only-children (OR = 1.9, 95% CI = 1.3–2.7), death or injury of family members (OR = 2.1, 95% CI = 1.4–3.1 for death; OR = 2.0, 95% CI = 1.3–3.0 for injury) and direct witness of tragic scenes (OR = 2.5, 95% CI = 1.7–3.7) were associated with elevated odds of PTSD at T18mon.

Among participants with PTSD symptoms, 91.9 and 94.0% had at least one comorbid psychiatric disorder at T6mon and T18mon, respectively; however, among participants without PTSD, 54.3 and 50.4% had at least one comorbid psychiatric disorder at T6mon and T18mon, respectively (OR = 9.57, 95% CI = 6.2–14.7 for T6mon; OR = 15.3, 95% CI = 8.2–28.4 for T18mon). The rates of comorbidity of PTSD were relatively stable during 18 months post-earthquake.

The concurrent comorbidity between PTSD and other psychiatric symptoms is presented in Table 2. PTSD more often co-occurred with subtypes of anxiety or depression than with behavior problems. After adjustment of demographics and earthquake exposure variables, elevated odds of depression, subtypes of anxiety, and behavior problems were observed in adolescents with PTSD at both time points. After further adjustment for all other symptoms, depression was no longer related to PTSD at T6mon, social phobia was no longer related to PTSD at T18mon, and behavior problems were no longer related to PTSD at both time points. The overlap of depression, anxiety, and behavior problems at T6mon and T18mon by PTSD status is illustrated in Fig. 1. As we can see, the most common comorbid profiles were PTSD comorbid with depression, anxiety and behavior problems, PTSD comorbid with depression and anxiety, as well as PTSD comorbid with anxiety.

The associations of T6mon PTSD comorbid conditions and PTSD persistence are presented in Table 3. Participants were more likely to have PTSD comorbid with depression, panic disorder, GAD, or SAD in persistence group than in recovery group after controlling for demographics and earthquake exposure. When all other disorders were further controlled, PTSD comorbid with depression (OR = 2.0, 95% CI = 1.1–3.5) and PTSD comorbid with SAD (OR = 1.8, 95% CI = 1.0–3.1) at T6mon were remained significantly associated with PTSD persistence.

The longitudinal relationships between PTSD and other psychiatric symptoms are summarized in Table 4. After controlling for T6mon PTSD, demographics and earthquake exposure, all studied symptoms at T6mon except for social phobia and conduct problems significantly predicted PTSD at T18mon (OR from 1.8 to 2.8). After further adjustment for all other symptoms, depression (OR = 2.1, 95% CI = 1.4–3.1), GAD (OR = 1.6, 95% CI = 1.0–2.4) and SAD (OR = 1.7, 95% CI = 1.1–2.6) at T6mon still predicted PTSD at T18mon. After controlling for T6mon outcome variable, demographics and earthquake exposure, PTSD at T6mon significantly predicted depression panic disorder, GAD, and SAD at T18mon (OR from 1.5 to 2.0). When comorbidity were taken in consideration, T6mon PTSD only predicted panic disorder (OR = 1.5, 95% CI = 1.0–2.1) and GAD (OR = 1.4, 95% CI = 1.0–2.1) at T18mon.

Discussion

This is the first longitudinal study to investigate the prevalence and comorbidity patterns of PTSD and internalizing/externalizing problems and to examine the bidirectional prospective associations between PTSD and these problems among adolescent earthquake survivors. The strengths of this study included a longitudinal study design, assessment of multiple internalizing/externalizing problems and a considerable sample size.

The prevalence rates of PTSD (18.9 and 11.6% at 6 and 18 months post-earthquake, respectively) observed in the current study are consistent with those estimated in a meta-analysis of trauma exposed children and adolescents (Alisic et al. 2014). Consistent with our expectation (Goenjian et al. 2011; Lai et al. 2013; Zhang et al. 2012), the prevalence of PTSD declined significantly over time. The present results also replicate previous findings that suggest that PTSD is more common among females, non-only-children, and those having higher level of traumatic exposure (Fan et al. 2011; Goenjian et al. 2001, 1995; Zhang et al. 2012).

Adolescent survivors with PTSD are usually prone to comorbid disorders. In the current sample, the proportions of pure PTSD were 8.1 and 6.0% at T6mon and T18mon, respectively. These figures are comparable with those reported by Abram et al. (2007) among detained youths. In a community study of comorbidity of PTSD, major depression, and substance abuse/dependence, Kilpatrick et al. (2003) reported that 72% of adolescents diagnosed with PTSD had at least one comorbid diagnosis. These findings are also consistent with those regarding PTSD comorbidity among adult

Table 2 Concurrent comorbidity among adolescent survivors by PTSD status at T6mon and T18mon

Variables	T6mon				T18mon			
	No PTSD (n = 1276) %	PTSD (n = 297) %	Adjusted odds ratio [a] (95% CI)	Multivariate adjusted odds ratio [b] (95% CI)	No PTSD (n = 1391) %	PTSD (n = 182) %	Adjusted odds ratio [a] (95% CI)	Multivariate adjusted odds ratio [b] (95% CI)
Depression	21.6	53.5	3.9(3.0–5.2)**	1.4(1.0–2.0)	25.5	74.7	8.9(6.1–12.8)**	3.2(2.1–5.1)**
Anxiety disorders								
Panic disorder	17.6	68.4	9.7(7.2–13.1)**	4.0(2.8–5.7)**	17.0	75.8	16.1(10.9–23.8)**	4.7(2.9–7.7)**
GAD	23.5	67.3	6.8(5.1–9.2)**	2.2(1.5–3.1)**	21.1	71.4	9.8(6.8–14.1)**	1.7(1.1–2.8)*
SAD	11.6	43.8	5.7(4.2–7.7)**	2.5(1.8–3.6)**	9.1	42.9	7.8(5.4–11.3)**	2.2(1.4–3.5)**
Social phobia	16.6	38.7	3.4(2.5–4.6)**	1.5(1.1–2.2)*	17.2	40.1	3.6(2.5–5.1)**	1.4(0.9–2.2)
Behavioral disorders								
Conduct disorder	9.1	19.9	2.7(1.9–3.9)**	1.3(0.9–2.1)	8.6	21.4	3.4(2.2–5.1)**	1.2(0.7–2.0)
ADHD	15.4	34.7	2.9(2.2–4.0)**	1.5(1.0–2.1)	11.1	31.9	4.3(2.9–6.2)**	1.7(1.0–2.7)

PTSD, posttraumatic stress disorder; *GAD*, generalized anxiety disorder; *SAD*, separation anxiety disorder; *ADHD*, attention deficit hyperactivity disorder; *T6mon*, 6 months post-earthquake; *T18mon*, 18 months post-earthquake

*, $p < 0.05$; **, $p < 0.01$

[a] controlling for demographics and earthquake exposure variables

[b] controlling for demographics, earthquake exposure variables, and other psychiatric disorders

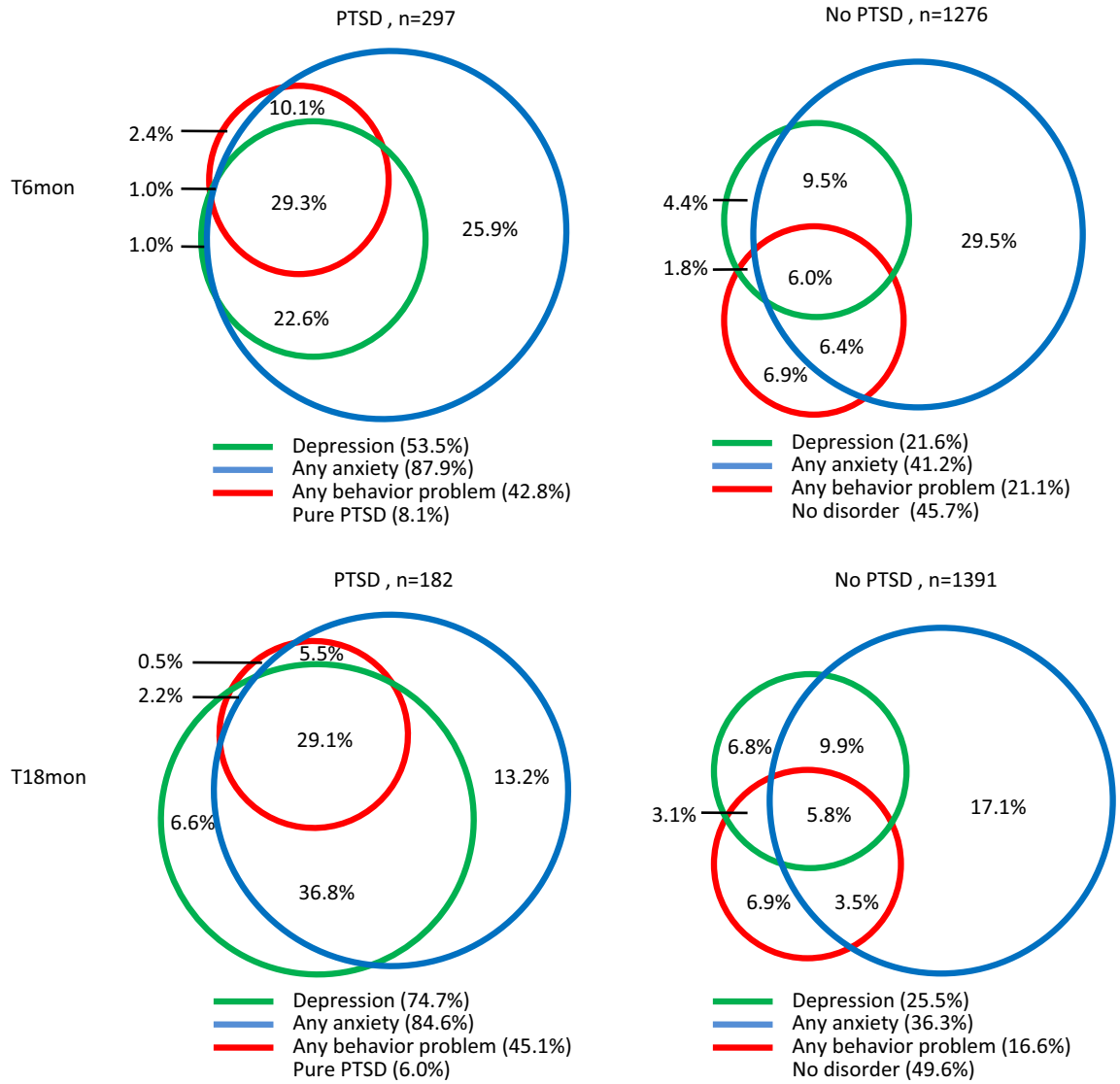

Fig. 1 Comorbid types of psychiatric symptoms among PTSD and no PTSD

samples (Brady et al. 2000). Among adolescents without PTSD symptoms, 54.3 and 50.4% of adolescents were screened as having depression, anxiety or behavioral problems at 6 months and 18 months post-earthquake, respectively. Prior trauma, high level of earthquake exposure, and concurrent negative life events may contribute to the high prevalence of mental health problems.

In accordance with previous studies (Fan et al. 2011; Goenjian et al. 2000; Kar and Bastia 2006; Lai et al. 2015; Scheeringa and Zeanah 2008; Yang et al. 2011), our results showed that PTSD was closely related to depression and subtypes of anxiety disorders, particularly GAD and panic disorder. Existing evidence also indicates an association between PTSD and behavioral problems (Bernhard et al. 2016; Spencer et al. 2016). In the current sample, we also found PTSD to be concurrently associated with conduct disorder and ADHD at both time points, after adjusting for demographics and earthquake exposure. However, after further adjustment for additional psychiatric disorders, these associations were no longer significant at both time points. This might due to depression and/or anxiety disorders mediating or moderating the relationships of PTSD with conduct disorder and ADHD, since internalizing and externalizing problems are usually comorbid among adolescents (Liu et al. 2016).

For the individual-level analysis, our results showed three most common comorbidity profiles: PTSD comorbid with depression, anxiety, and behavior problems, PTSD comorbid with depression and anxiety, and PTSD comorbid with anxiety. Using latent profile analysis of children's symptoms of PTSD, depression and anxiety, Lai et al. (2015) identified three pattern groups (no disturbance, PTSD only, and PTSD comorbid with internalizing problems) at 3–7 months after Hurricane Katrina. Furthermore, their follow-up analyses found that the PTSD comorbid with internalizing problems

Table 3 Comorbidity of PTSD and other symptoms at T6mon predicted PTSD persistence

T6mon	Persistent PTSD ($n = 103$) %	Recovery PTSD ($n = 194$) %	Adjusted odds ratio [a] (95% CI)	Multivariate adjusted odds ratio [b] (95% CI)
PTSD + depression	68.9	45.4	2.5(1.5–4.2)**	2.0(1.1–3.5)*
Anxiety disorders				
PTSD + panic disorder	75.7	64.4	2.0(1.1–3.5)*	1.2(0.6–2.4)
PTSD + GAD	78.6	61.3	2.6(1.4–4.8)**	1.9(0.9–3.7)
PTSD + SAD	54.4	38.1	2.0(1.2–3.3)**	1.8(1.0–3.1)*
PTSD + social phobia	35.7	38.1	1.2(0.7–2.1)	0.9(0.5–1.5)
Behavioral disorders				
PTSD + conduct disorder	19.4	20.1	1.0(0.5–1.8)	0.6(0.3–1.3)
PTSD + ADHD	40.8	31.4	1.6(1.0–2.8)	1.3(0.7–2.4)

PTSD, posttraumatic stress disorder; *GAD*, generalized anxiety disorder; *SAD*, separation anxiety disorder; *ADHD*, attention deficit hyperactivity disorder; *T6mon*, 6 months post-earthquake

*, $p < 0.05$; **, $p < 0.01$

[a] controlling for demographics and earthquake exposure variables

[b] controlling for demographics, earthquake exposure variables, and other comorbid conditions

group reported the highest levels of PTSD, depression, anxiety, and school problems at 14–17 months post-disaster. In a sample of 409 adults with PTSD, another study reported three patterns of comorbidity: low comorbidity, comorbid with substance dependence/depression/anxiety, and comorbid with depression/anxiety (Galatzer-Levy et al. 2013). Despite differences in samples, assessments, analyses and results, these studies suggest that PTSD comorbidity clusters into a small number of common patterns. These patterns deserve more attention, as they may have distinct differences in risk, etiology, and therapeutic response.

It is known that comorbidity is associated with worse prognosis (Angold et al. 1999). Concerning disaster-exposed children and adolescents, there has been evidence indicating that those with comorbid PTSD and internalizing problems were less likely to recover from PTSD than those with pure PTSD (Lai et al. 2013). Extending previous studies, our findings for the first time demonstrated that PTSD comorbid with

Table 4 Bidirectional longitudinal relationships between PTSD and other psychiatric symptoms

	Other psychiatric symptoms → PTSD		PTSD → other psychiatric symptoms	
	Adjusted odds ratio [a] (95% CI)	Multivariate adjusted odds ratio [b] (95% CI)	Adjusted odds ratio [c] (95% CI)	Multivariate adjusted odds ratio [d] (95% CI)
Depression	2.8(2.0–4.0)**	2.1(1.4–3.1)**	1.8(1.3–2.4)**	1.2(0.8–1.7)
Anxiety disorders				
Panic disorder	2.5(1.7–3.7)**	1.5(0.9–2.3)	2.0(1.5–2.8)**	1.5(1.0–2.1)*
GAD	2.6(1.8–3.7)**	1.6(1.0–2.4)*	2.0(1.5–2.8)**	1.4(1.0–2.0)*
SAD	2.2(1.5–3.2)**	1.7(1.1–2.6)*	1.5(1.1–2.2)*	1.1(0.7–1.7)
Social phobia	1.3(0.9–1.9)	0.9(0.6–1.3)	1.4(1.0–1.9)	1.0(0.7–1.4)
Behavioral disorders				
Conduct disorder	1.2(0.7–1.9)	0.8(0.5–1.4)	1.3(0.9–2.0)	0.8(0.5–1.3)
ADHD	1.8(1.2–2.6)**	1.3(0.9–2.0)	1.4(1.0–2.1)	0.8(0.5–1.3)

PTSD, posttraumatic stress disorder; *GAD*, generalized anxiety disorder; *SAD*, separation anxiety disorder; *ADHD*, attention deficit hyperactivity disorder; *T6mon*, 6 months post-earthquake

*, $p < 0.05$; **, $p < 0.01$

[a] controlling for T6mon PTSD, demographics and earthquake exposure variables

[b] controlling for T6mon PTSD, demographics, earthquake exposure variables, and other psychiatric symptoms

[c] controlling for T6mon outcome variable, demographics and earthquake exposure variables

[d] controlling for T6mon outcome variable, demographics, earthquake exposure variables, and other psychiatric symptoms

depression or SAD at an earlier time post-earthquake contributed to PTSD persistence over time, even after controlling for all other symptoms. Individuals with depression or SAD tend to have negative cognitive or behavioral characteristics such as ruminative thinking and social withdrawal (McLaughlin and Nolen-Hoeksema 2011). These traits could interfere with one's adaptive psychological processes post-disaster, which might in turn aggravate disaster-related distressed and cause the chronicity of PTSD symptoms.

A possible explanation for comorbidity of PTSD and other disorders is that these disorders might be involved in the cause and/or maintenance of one another (Brady et al. 2000; Stander et al. 2014). To testify this assertion, studies examining bidirectional longitudinal associations between PTSD and other disorders are needed. Yet, this sort of studies is very limited to date. In the current study, depression, GAD and SAD at T6mon were found to separately predict a higher risk for PTSD at T18mon, after controlling for all other symptoms, demographics, and earthquake exposure. Conversely, PTSD at T6mon predicted increases in GAD and panic disorder symptoms. Taken together, these findings support the causal hypothesis of PTSD comorbidity (Stander et al. 2014).The findings also revealed robust mutual effects between PTSD and GAD, implying that PTSD may have a stronger etiological relation with GAD than with other internalizing/externalizing disorders. Inconsistent with our hypothesis, there was no directly longitudinal association between PTSD and behavioral problems. The reasons were not clear. It may be because youth who experienced this earthquake were less likely to present with ADHD and conduct problems than depression and other anxiety symptoms. More studies are needed to examine prospective associations of PTSD and externalizing disorders.

Implications

The results of the present study have important clinical implications. The high prevalence of PTSD and comorbid internalizing/externalizing problems highlights the need for a holistic assessment of myriad mental health problems among high risk adolescent disaster survivors. The findings indicate that PTSD had different comorbid profiles, the clinician may need to develop more flexible intervention programs to maximize clinical gains. Given that PTSD comorbid with depression or SAD at an earlier time post-disaster contribute to PTSD persistence over time, and that earlier depression, GAD, and SAD can predict later PTSD, these conditions must be given a higher priority than other psychiatric disorder and require intervention as earlier as possible. Externalizing problems such as ADHD and conduct problems are concurrently associated with PTSD, thus efforts are needed to develop programs targeting these conditions.

Limitations

Several limitations should be noted. First, participants were adolescents who were exposed to a deadly earthquake, indicating that our findings may not generalize to other types of trauma. Second, pre-disaster trauma and PTSD are important risk factors for post-disaster mental health problems. However such data is not available in this study, so we cannot control for these cofounds. Third, in order to quickly and effectively screen high risk survivors, self-administered questionnaires were used to assess adolescents' psychiatric symptoms. Although the instruments in the current study have been widely used and well validated, the prevalence may be over-estimated or under-estimated. Fourth, in evaluating adolescents' post-disaster mental health problems, an important consideration is the time frame. Several studies suggested that the prevalence of PTSD sharply declined during 18 months post-earthquake (Wang et al. 2013). The current study was conducted within this quick recovery period. It is unknown whether the findings are generalizable over a longer time frame. Finally, previous studies indicated a link between PTSD and other behavior problems such as substance abuse in Western samples of disaster-exposed adolescents (Adams et al. 2015). Among Chinese adolescents, substance abuse receives less concern in relation to behavior problems like ADHD and conduct disorder. Future research should examine comorbidity patterns and longitudinal mutual relations between PTSD and substance abuse among Chinese adolescents.

Conclusion

Despite these limitations, our study adds to our understanding of the associations between PTSD and other psychiatric disorders in youth. PTSD comorbidity clusters into a small number of common patterns. Our data suggest that adolescents who suffer from PTSD comorbid with depression or SAD are less likely to recovery from PTSD. Furthermore, the findings of longitudinal analyses support the causal hypothesis of PTSD comorbidity. Better knowledge about the pattern and mechanisms of PTSD comorbidity can contribute to the development of interventions targeting to both PTSD and its comorbidity disorders.

Compliance with Ethical Standards

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Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This study was approved by the Human Research Ethics Committee of South China Normal University and has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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