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Research report

The impact of the catastrophic earthquake in China's Sichuan province on the mental health of pregnant women

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ABSTRACT

Background: On May 12, 2008, a magnitude 8.0 earthquake struck China's southwestern Sichuan province. Recent studies have identified mental health problems among the survivors, but little is known about the impact of the Sichuan earthquake on the mental health of pregnant women in the area. The main objective was to assess the impact of the Sichuan earthquake on the mental health of pregnant women in earthquake stricken areas.
Methods: During November 2009 and January 2010, 311 pregnant women were interviewed. Symptoms of PTSD were measured using IES-R, while symptoms of antenatal depression were measured using EPDS.
Results: The prevalence rate of PTSD symptoms was 12.2% (95% CI, 9.0–16.4). The rate of major depression was 40.8% (95% CI, 35.5–46.4). Living through an earthquake has been significantly correlated with PTSD but no significant correlation has been found with depression. The perceived stresses of pregnancy are significantly correlated with both depression and PTSD.
Limitations: Lack of long term follow up data and comparison group from non earthquake struck area.
Conclusions: 18 months after the Sichuan earthquake, the incidence of depression and PTSD were still quite high among pregnant women in the earthquake stricken areas. Depression was more common than PTSD. Living through an earthquake has been significantly correlated with PTSD but not with depression.

1. Background

Over the years, the subject of the mental health of survivors of natural disasters has attracted much attention from researchers (Van Griensven et al., 2006; Chou et al., 2003; Wang et al., 2000; Cao et al., 2003). Some studies have found that women are more sensitive to disasters and traumatic events than men and are therefore more likely to be affected by PTSD and other mental health problems (Irmansyah et al., 2010; Karamustafalioglu et al., 2006; Kessler et al., 1995; Salcioglu et al., 2003; Wang et al., 2009a). Mental health challenges during pregnancy including depression and anxiety, not only adversely affect women's health during the postpartum period (Sayil et al., 2006), but also impact infants' nutritional status, susceptibility to childhood diseases (Rahman et al., 2004) and temperament (Misri et al., 2004; Yang et al., 2009). Mental health challenges during pregnancy can also lead to an increased risk for the children of emotional or cognitive problems over the long term (Hay et al., 2008; Talge et al., 2007). Little research has been done to examine the impact of natural disasters on pregnant women's mental health and/or birth outcomes. A study (Glynn, et al., 2001) of 40 pregnant women affected by an earthquake in United States found that the earthquake was rated as more stressful by women who

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were early on in their pregnancies when compared to women who were later on in their pregnancies. Stress experienced early in pregnancy was also associated with shorter gestational periods.

One study (Chang et al., 2002) in Taiwan that assessed 171 pregnant women who lived through the 1999 earthquake there revealed that women's overall health was significantly correlated with the experience of starvation. Fears about the negative impact of the earthquake on pregnancy, as well as the death of relatives were also significantly correlated with the health of the pregnant women in earthquake stricken areas. Finally, this study found that death of a spouse was significantly correlated with low-birth weight neonates.

Two studies (Xiong et al., 2008, 2010) on the impact of Hurricane Katrina involving 301 pregnant women examined the risk of PTSD and depression on mental health and birth outcomes. Both studies found that levels of PTSD and depression increased in relation to the severity of the experience of the hurricane. While the two studies reported that low birth weights and preterm births were higher in women with more severe hurricane exposure, the birth outcomes were not significantly correlated with PTSD or depression.

On May 12, 2008, a magnitude 8.0 earthquake struck northwestern Sichuan province of China. The Sichuan earthquake killed 69,227 and injured 374,643 people. It left 17,923 people missing and millions homeless (State Council Information Office of China, 2008). Recent follow-up studies into the mental health of survivors of the Sichuan earthquake found that the prevalence of PTSD ranged from 9.4% to 45.5% (Kun et al., 2009; Wang et al., 2009a). However, little is known about the impact of the Sichuan earthquake on the mental health of pregnant women in the earthquake stricken areas. This study intends to fill this gap and identify the long-term impact of the earthquake on the mental health (including depression and PTSD) of pregnant women.

2. Methods

2.1. Study design and participants

This study was a randomized sampling cross-sectional survey based on hospital. It was supported by the *Disaster Relief Project of the Ministry of Science and Technology* and was approved by the institutional review board of the *School of Social Development and Public Policy* at Beijing Normal University. The study took place in Mianzhu County, located about 30 km away from the epicenter. The Sichuan earthquake killed 11,117 and injured 37,209. 251 people were left missing, and over 180,000 households destroyed in Mianzhu County (MianZhu Bureau of Statistics, 2009).

Data were collected in the Mianzhu People's Hospital and the Mianzhu Maternal and Child Health Hospital, where nearly 70% of the pregnant women in this county receive antenatal care and post-delivery services. This study collected data in November 2009, and in January 2010. Each period of data collection lasted for two weeks. Altogether, 351 pregnant women agreed to participate in the interview and 311 PTSD and depression assessments were completed. All of the participants were pregnant after the earthquake. Oral informed consent was obtained from all participants.

2.2. Main outcome measures

2.2.1. Symptoms of post-traumatic stress disorder (PTSD)

PTSD symptoms were assessed using the Impact of Event Scale-Revised (IES-R) (Weiss and Marmar, 1997) a self-assessment instrument widely used to measure traumatic stress. The IES-R includes 22 items to measure three major PTSD symptom clusters: 1) intrusive, 2) avoidance, and 3) hyper-arousal symptoms. IES-R measures are similar to the DSM-IV criteria for PTSD issued by American Psychiatric Association (American Psychiatric Association, 1994; Chang et al., 2003) and have good psychometric properties (Creamer et al., 2003). The Chinese version of the IES-R has been found to have satisfactory psychometric properties, comparable to the original English version (Chen et al., 1991, 2005; Wu and Chan, 2003).

In this study, each participant was asked to indicate the frequency of their distress (a modification of the standard instructions) using 4 rather than the standard 5 response options which themselves were modified (0 = not at all, 1 = seldom, 3 = sometimes, 5 = often). The internal consistency coefficient (Cronbach's alpha) for the whole scale of the current study was 0.95. Subscale scores were calculated as the mean response of all items in the specific subscale, and a total score was calculated as the mean response across all items. A cutoff score of 2.0 across all items of the IES-R was used by early study (Chan et al., 2011).

2.3. Depression

Depression was assessed using the Edinburgh Postnatal Depression Scale (EPDS). The EPDS is a 10-item self-rating instrument, with each item scored on a 4-point scale. The highest and lowest scores are 0 and 30, respectively. A Chinese version of the EPDS was tested in Hong Kong and in Sichuan, China. It demonstrated good reliability and validity and a cutoff point score of $\geq$10 has been recommended (Lee et al., 1998; Wang et al., 2009b). The EPDS has been used in other Chinese studies and has been found reliable in measuring prenatal and postnatal women's depression (Lau et al., 2010a, 2010b; Lee et al., 2004). The internal consistency coefficient (Cronbach's alpha) of the EPDS in this study was 0.77.

2.4. Risk factors measures

The severity of earthquake exposure was rated using a 12 event self-assessment scale, which was adapted from a prior hurricane exposure scale based on DSM-IV A-1 and A-2 criteria for PTSD (Goenjian et al., 2001), and has been used to assess earthquake exposure in 1999 Earthquake in Ano Liosia, Greece (Goenjian et al., 2005). Events included; 1) injury in the earthquake, 2) trapped by the earthquake, 3) helped with earthquake relief work, 4) had relatives trapped in earthquake, 5) witnessed people who were trapped, 6) witnessed people being injured, 7) saw people die, 8) heard about relatives or friends who were injured or killed, 9) experienced the death of a family member since the earthquake, 10) lost family agricultural income, 11) lost family commercial income, 12) lost home. Experiencing one of these items was scored as 1, so the highest score was 12.

Perceived Pressures of pregnancy were rated using an 11-item self-assessment scale which was a short-form of Pregnancy

Pressure Scale (PPS) developed by Zhanghui Chen et al., and the Cronbach's alpha coefficient was reported to be 0.84 (Chen, et al., 1991). It contains 3 subscales: 1) pressure from identification of the parents role; 2) pressure from the concerns of maternal and child health; 3) pressure from the change of the body shape or physical activities. The scale measured the perceived stresses of major pregnancy-related events using a 4-point Likert scale from 1 (none or little) to 4 (high). The mean score was used as an index of perceived stress. The perceived pressure was also classified into two categories: (1) *little or no stress (score lower than 3)* and (2) *stressful (score 4)*. Possible stressful experiences included; fears about significant people disliking the baby, concerns about reduced leisure time with a baby, fears about the safe delivery of the baby, anxiety about birth defects, fears about complications during delivery, fears about pain during delivery, concern about changes in body shape, fears about competence as a mother, fears about the negative impact of the baby on the marital relationship, concerns about providing a healthy living environment for the child, and other pregnancy-related stresses.

Participants were asked to assess the quality of their marital and family relationships on a 10-point scale, from 1 (very poor) to 10 (very good).

Other socio-demographic and health behavior data were collected as part of this experiment included: participants' ages (18–24 years, 25–29 years, ≥30 years), ethnicity (Han/minority), living situation (city/village), marital status (married/other), level of education (primary school or lower, middle school, high school, college or above), parity (primigravida/others), monthly family income, whether the pregnancy was planned (yes/no), the stage of gestation (<12 weeks, 12–28 weeks, >28 weeks), quality of sleep (poor, fair, good), smoking history (yes/no) and their history of alcohol use (yes/no) .

2.5. Data analysis

Statistical analysis was performed with SPSS 17.0 (SPSS Inc, Chicago, IL). The descriptive analyses of the data were performed first for demographic characteristics (age, gender, marital status, levels of education, average household income), smoking and drinking behaviors, earthquake exposure indicators and outcome variables (PTSD symptoms and major depressive symptoms). Chi-square tests, bivariate correlate analysis were performed to examine the correlation between outcome variables and independent variables and socio-demographic factors. Multivariate logistic regression using a stepwise procedure was employed to identify both predictors of PTSD symptoms and antenatal depression. Finally, multivariate logistic regression using a stepwise procedure was performed to identify and predict the effect of each earthquake experience on PTSD and the effect of each pressure event on depression. All estimates were accompanied by a 95% confidence interval.

3. Results

Most (80.1%) of the participants were at home or nearby when the earthquake struck. The mean age of the participants was 25.1 (min = 18.5, max = 42.0; standard deviation [SD] = 4.9) and 84.2% were 18–29 years old. Almost all of the participants (95.8%) were married, or cohabiting, and 87.9% completed at least high school. Most participants (81.7%) had a family monthly income lower than 435 USD. More than half (55.3%) of the pregnancies were planned, 41.2% were primigravida and most of these (94.4%) were in the second or third trimester. Almost all of the women (96.4%) never smoked, and 91.9% had no history of drinking. About half (48.4%) of the participants reported that they slept well. The participants' mean score on the 11-item self-assessment perceived pressures of pregnancy scale was 4.48 (min = 0, max = 11; SD = 3.1), and nearly half (47.9%) had a score equal to or more than 5.

3.1. Prevalence of PTSD and depression

A cutoff score of ≥2.0 across all items of the scale was used to derive an estimate of the rate of clinically significant PTSD symptoms (Chan et al., 2011). According to this criterion, the overall prevalence of PTSD symptoms was 12.2% in the area surveyed (95% Confidence Interval [CI], 9.0–16.4). The EPDS cutoff point recommended by the validity study was a score of ≥10. According to this criterion, the prevalence of major depressive symptoms was 40.8% (95% CI, 35.5–46.4).

3.2. Predictors of PTSD symptoms and depressive symptoms

Tables 1 and 2 show the bivariate correlate analysis of variables. PTSD symptoms were significantly correlated with the stresses of pregnancy, severity of earthquake experience, age, family monthly income, education, and parity. Major depressive symptoms were significantly correlated to the quality of family relationships, the stresses of pregnancy, age, stage of pregnancy/gestation, as well as the quality of sleep.

Table 3 shows the final results of multivariate logistic regression analyses for predicting variables of PTSD symptoms and major depressive symptoms. As shown in the table, significant predictive variables for PTSD symptoms included age, severity of earthquake experience and the stresses of pregnancy. The risks of PTSD symptoms grew with the increased pregnancy-related stress (OR, 1.19; 95% CI, 1.07–1.32; $p = 0.001$) and increased severity of earthquake experience (OR, 1.80; 95% CI, 1.43–2.26; $p < 0.001$).Women aged between 18–24 years old had lower risks of experiencing PTSD symptoms than women who were 30 years of age or older (OR, 0.10, 95% CI, 0.03–0.31; $p < 0.001$).

The risk of depression grew as the stresses of pregnancy increased (OR, 1.19; 95% CI, 1.12–1.27; $p < 0.001$) and decreased as the quality of the family relationship improved (OR, 0.84; 95% CI, 0.73–0.98; $p = 0.022$). Women who were between the 18 to 24 years old had a lower risk of depression than women who were 30 years of age or older (OR, 0.42; 95% CI, 0.20–0.90; $p = 0.025$). Unplanned pregnancy also increased the risk of depression (OR, 1.65; 95% CI, 0.96–2.85; $p = 0.070$). The severity of earthquake experience was not significantly correlated with depression (Table 3).

Since they were continuous variables, the severity of earthquake experience and the self-assessment of pregnancy-related stresses were included in the above analysis. Finally, we examined the impact of each earthquake experience and pregnancy-related stress on both the prevalence of PTSD and depression.

Table 1
The prevalence of PTSD and antenatal depression by demographic and psychosocial factors.

Characteristics (n)	PTSD n (%)	p	Depression score≥10 n (%)	p
Age				
18–24(203)	10(4.9)	0.000	74(36.5)	0.016
25–29(59)	7(11.9)		24(40.7)	
≥30(49)	21(42.9)		29(59.2)	
Marital status				
Divorced or other (13)	3(23.1)	0.266	6(46.2)	0.692
Married (298)	35(11.7)		121(40.6)	
Education				
Middle school or lower (149)	30(20.1)	0.000	61(40.9)	0.440
High school (120)	6(5.0)		53(44.2)	
College or above (37)	2(5.4)		12(32.4)	
Monthly family income(USD)				
<145(36)	12(33.3)	0.000	16(44.4)	0.932
145–290(126)	18(14.3)		49(38.9)	
291–434(92)	8(8.7)		38(41.3)	
≥435 (57)	0(.0)		24(42.1)	
Gestation stage				
≤12 weeks(17)	3(17.6)	0.496	8(47.1)	0.025
13–28 weeks(120)	12(10.0)		38(31.7)	
>28 weeks(165)	23(13.9)		78(47.3)	
Parity				
Primigravida(128)	5(3.9)	0.000	46(35.9)	0.141
Others(183)	33(18.0)		81(44.3)	
Planned pregnancy				
Planned (172)	29(16.9)	0.051	62 (36.0)	0.056
Unplanned (139)	9(6.5)		65 (46.8)	
Sleep quality				
Poor (68)	6(8.8)	0.544	22 (32.4)	0.010
Fair (82)	9(11.0)		25 (30.5)	
Good (134)	18(13.4)		64 (47.8)	
Very good (26)	5(19.2)		15 (57.7)	
Smoking history				
Non (298)	37(12.4)	0.731	122 (40.9)	0.766
Yes (11)	1(9.1)		5 (45.5)	
Alcohol use history				
Non (285)	37(13.0)	0.137	115 (40.4)	0.723
Yes (25)	1(4.0)		11(44.0)	

The multivariate logistic regression results showed that among the 12 earthquake events, only 2 earthquake events were significantly correlated with PTSD. These were witnessed people being trapped, and experienced the death of a family member since the earthquake (Table 4).

Among 11 stressful pregnancy-related events, 5 anticipated pregnancy-related stressors were included in the model for antenatal depression. These were "fears about significant people disliking the baby, concerns about reduced leisure time with a baby, fears about birth defects, fears about delivery complications, concerns about changes in body shape". Of these, only "fears about significant people not liking the baby, fears about birth defects and fears about delivery complications" were significantly correlated with depression (Table 4).

4. Discussion

The study manages to identify a long-term impact of the Sichuan earthquake on the mental health of pregnant women, which is manifested by the finding that pregnant women still show symptoms of PTSD 18 months after the earthquake. In addition, the incidence of depression symptoms is much higher than the incidence of PTSD symptoms, and the former is highly correlated with stress during pregnancy, while it does not show significant correlation with earthquake experience. These findings indicate that, in addition to the widely recognized issue of depression, PTSD comes to be another mental disorder that is suffered by pregnant women after the earthquake. Moreover, the consequences of these mental health issues, such as depression and anxiety, are serious. They not only place a negative impact on the state of health of women after delivery (Sayil et al., 2006), but also affect the new born infants in terms of their nutritional status and physical health (Rahman et al., 2004). Therefore, in general, a long-term attention should be paid to the mental health of pregnant women after such catastrophic earthquake, especially taking into account the influences of stressful events during pregnancy and earthquake experience.

Specifically, first, the study found that the prevalence of PTSD among pregnant women was 12.2% 18 months after the earthquake. This rate was lower than PTSD rates recorded among women three months after the earthquake (Kun et al., 2009). The results indicate that although the prevalence of PTSD has already declined during the 18-month era after the earthquake, it is still a prevalent mental disorder among pregnant women.

Second, the prevalences of PTSD and depression among pregnant women are found higher after the Sichuan earthquake than Hurricane Katrina, as a previous study showed that the rates were 4.4% and 14.4%, respectively, after the hurricane (Xiong et al., 2008, 2010). In addition, the study re-

Table 2
Bivariate correlate analysis of the scores of PTSD, antenatal depression, family relationships, stresses of pregnancy and severity of earthquake experience.

	PTSD	Depression	Family relationships	Stresses of pregnancy	Earthquake experience
PTSD (n=311)	1	0.36***	−0.02	0.35***	0.56***
Depression (n=311)		1	−0.18**	0.46***	0.06
Family relationship (n=302)			1	−0.14*	0.09
Stresses of pregnancy (n=305)				1	0.10

* p<0.05.
** p<0.01.
*** p<0.001.

Table 3
Multivariable logistic regression analysis of demographic and psychosocial factors for PTSD and antenatal depression.

		PTSD OR(95% CI)	p	Depression OR(95% CI)	p
Age	Ref: ≥30				
	18–24	0.10(0.03–0.31)	0.000	0.42(0.20–0.90)	0.025
	25–29	0.35(0.09–1.34)	0.125	0.56(0.22–1.39)	0.210
Marital status	Divorced or other: married	–		–	
Education	College or above	–		–	
	Middle school or lower	1.52(0.23–9.92)	0.660	–	
	High school	0.27(0.03–2.11)	0.210	–	
Monthly family income	Ref: ≥435 USD	–		–	
	<145			–	
	145–290			–	
	291–434			–	
Pregnancy time stage	Ref: >28 weeks	–		–	
	≤12 weeks	–		–	
	13–28 weeks	–		–	
Parity	Primigravida: others	–		–	
Planning pregnancy	Planned: unplanned	–		1.65(0.96–2.85)	0.070
Sleep quality	Very good	–		–	
	Poor	–		1.47(0.48–4.54)	0.504
	Fair	–		1.57(0.78–3.16)	0.203
	Good	–		0.74(0.33–1.62)	0.445
Smoking history	Non: yes	–		–	
Alcohol use history	Non: yes	–		–	
Family relationship		–		0.84(0.73–0.98)	0.022
Stresses of pregnancy		1.19(1.07–1.32)	0.001	1.19(1.12–1.27)	0.000
Earthquake experience		1.80(1.43–2.26)	0.000	–	

veals that, the higher one scores in earthquake experience, the more likely one has PTSD symptoms, which is consistent with findings of previous studies. The only difference between this and other previous studies is that all participants became pregnant after rather than before the earthquake. In other words, the study especially indicates the long-term impact of the earthquake on pregnant women (at least 18 months since it broke out), in addition to its acute impact on women who were already pregnant at the time of the disaster. Nonetheless, further investigation is needed to determine how long the impact lasts.

Third, in the studied area, depression is found slightly more prevalent than both PTSD in the same region and the incidence of depression in Chengdu, Sichuan, which was not directly hit by the earthquake. As is reported in a previous study, the prevalences of mild depression and severe depression in Chengdu were 35.9% and 7.3%, respectively (Lau et al., 2010a). In addition, comparing with findings of relevant studies, the prevalence of depression in the studied area is also higher than that of pregnant women in other regions, such as Shanghai (4.8%) (Qiao et al., 2009) and Hong Kong (Lau et al., 2010b). In the Hong Kong study, the prevalence of mild depression was 36.5% during the second trimester of pregnancy and 32.0% during the third trimester of pregnancy. The rates were 9.9% and 7.8% for severe depression (Lau et al., 2010b). These results indicate that depression is more prevalent among pregnant women in the areas directly struck by the earthquake. However, no evidence is found showing a significant correlation between the severity of earthquake experience and depression. As a result, the high prevalence of depression among pregnant women in the earthquake area compared with other areas cannot be fully attributed to the experience of earthquake. Nonetheless, because the study find a significant correlation between participants' scoring in PTSD and depression, and previous studies have found PTSD is associated with increased rates of major depressive disorder (American Psychiatric Association, 1994), it is still possible that the earthquake indirectly results in the high prevalence of depression in the area.

Finally, the study reveals the associations between the selected risk factors and the outcome variables regarding both PTSD and depression. Among all the variables investigated in this study, perceived pressures of pregnancy and quality of family relationships were the only two variables that are significantly correlated with depression, with the exception of age. The results are consistent with a recent study, which revealed that life stress, lack of social support to demonstrate a significant association in multivariate analyses (Lancaster et al., 2010). Further, this study suggests that perceived stress

Table 4
Multivariable Logistic Regression Analysis of earthquake experiences for PTSD and Pressure Events for Antenatal Depression.*

Items☆	PTSD OR(95% CI)	p	Items	Depression OR(95% CI)	p
EE1	6.84(2.50–18.71)	0.000	PS1	2.95(1.31–6.67)	0.009
EE2	2.36(0.94–5.89)	0.067	PS2	1.69(0.98–2.93)	0.058
EE3	1.92(0.56–6.56)	0.300	PS4	2.43(1.08–5.50)	0.033
EE4	9.47(3.48–25.74)	0.000	PS5	1.81(1.00–3.28)	0.049
			PS7	1.66(0.96–2.88)	0.069

*Items not included in the model are not displayed in table.
☆Earthquake experience(EE)1 witnessed people being trapped, EE2 helped wit earthquake relief work, EE3 lost family agricultural income, EE4 experienced the death of a family member since the earthquake. Pregnancy stress (PS) 1 fears about significant people disliking the baby, PS2 concerns about reduced leisure time with a baby, PS4 anxiety about birth defects, PS5 fears about complications during delivery, PS7 concern about changes in body shape.

during pregnancy is closely related to the prevalence of both depression and PTSD. Specifically, high scores in terms of stress during pregnancy are associated with higher risks of depression and PTSD. As a result, these results provide clear guidelines for future interventions. First, common strategies for relieving stress during pregnancy are supposed to be useful in reducing PTSD and depression among pregnant women in the earthquake area. Second, the main focus of intervention regarding depression reduction during pregnancy should be shifted to relieving pregnant women of fears about infant development and delivery.

The government has launched a plan intended to encourage women who lost their children in the earthquake to become mothers again. Many of these women will use reproductive technology because of concerns about their age (National Population and Family Planning Commission of P.R. China, 2010). Our study reveals that PTSD symptoms were more common among elder than younger women, and more common among women who lower educated and have had multiple pregnancies, while depression during pregnancy was more common among elder women. Because women whose children were killed in the earthquake are usually older, they are supposed to face a higher risk of depression. Our results suggest that post-disaster support programs for pregnant women should not only encourage women who lost children in the earthquake to become mothers again, but should also focus on improving the mental health of pregnant women in order to support the health of these women and their children.

5. Limitations of study

As with other studies, this study had some limitations. First, it is a cross-sectional survey. The results reported in the study reflected only the status of mental health of the participants at a particular point of time. Namely, it did not reveal the change in mental status throughout the entire pregnancy, nor is it able to reveal the relationship between the change in mental status and earthquake experience. Second, the study did not introduce a comparison group from areas that were not struck by the earthquake. Accordingly, it is not possible to directly determine whether the prevalence of depression and PTSD among pregnant women in the earthquake area are higher than or similar to other regions. Third, because the data were collected 18 months after the earthquake, the results can only interpret the impact of earthquake on women who became pregnant after the earthquake. Finally, the measurement of PTSD applied in this study is a screening tool, instead of clinical diagnostic method. Therefore, the prevalence of PTSD is likely overestimated. Future research, if condition allows, should further emphasize the role of clinical diagnostic measurement when studying similar topics, so as to increase its credibility in clinical practice.

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Conflict of interest

All other authors declare that they have no conflicts of interest.

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