

# Prevalence and Influencing Factors of Post-Traumatic Stress Disorder Among Survivors in the Hard-Hit Areas Ten Years After the Wenchuan Earthquake: A Cross-Sectional Study

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**Background:** Post-traumatic stress disorder (PTSD) is common psychological distress after natural disasters, which is persistent. Chronic PTSD leads to a heavy disease burden. The purpose of this study is to explore the prevalence and influencing factors of chronic PTSD among survivors in the hard-hit areas ten years after the Wenchuan earthquake.

**Materials and Methods:** A cross-sectional survey was conducted on residents aged 16 or above in hard-hit areas through a multi-stage sampling approach ten years after the Wenchuan earthquake. The items of the questionnaire included demographic characteristics and earthquake exposure factors, and the PTSD Checklist-Civilian Version (PCL-C) was used to evaluate the PTSD of the respondents.

**Results:** A total of 1039 complete questionnaires were obtained. The median age of 1039 respondents was 60 years, 63.2% of whom were female, 70.2% were illiterate or had received primary education, and 58% had an annual household income of less than 20,000 yuan (US\$ 2871.3). The rate of PTSD was 9.1% (95/1039). After controlling for confounding factors, it was found that higher income level and education level, and moving to concentrated rural settlement (CRS) after the earthquake might be protective factors for the long-term mental health of survivors in the hard-hit areas, and the loss of immediate families in the earthquake was an important risk factor.

**Conclusion:** Even though ten years have passed since the Wenchuan earthquake, the survivors in the hard-hit areas still have a serious mental disorder. The local government and health-care institutions should take appropriate measures to improve the mental health of residents.

**Keywords:** Wenchuan earthquake, natural disaster, mental health, post-traumatic stress disorder, PTSD

## Introduction

In recent decades, the frequency and scale of natural disasters are increasing because of urbanization, environmental degradation, and intensified climate change. The number of natural disasters in 2000–2009 was three times that of 1980–1989.<sup>1</sup> Since 1990, about 204 million people worldwide have been affected by natural disasters every year.<sup>2</sup> Natural disasters not only cause casualties but also leave psychological trauma to survivors, which might be persistent.<sup>3</sup> Therefore, coping with natural disasters requires not only treatment of the wounded, control of infectious diseases,

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restoration of infrastructure and reconstruction of housing, but also attention to the psychological health of survivors.

On May 12, 2008, an earthquake measuring 8.0 on the Richter scale struck Wenchuan in Sichuan Province of China, affecting 237 counties in the provinces of Sichuan, Gansu, and Shaanxi, with a total stricken area of 252,000 km<sup>2</sup>.<sup>4</sup> By the deadline for September 11, 2008, Wenchuan earthquake had caused 69,226 deaths, 374,643 injuries, 17,923 missing.<sup>5</sup> In the hard-hit rural areas of Sichuan Province, the number of collapsed houses was estimated at 826,700, with a construction area of 12,403 hectares.<sup>6</sup> After the Wenchuan earthquake, the Chinese government quickly launched a large-scale relief operation to treat the wounded, provide temporary shelter and relief supplies to the victims, and control infectious diseases.<sup>7</sup> With the reconstruction work gradually on track, the mental health of survivors has become a priority for post-disaster recovery.

Anxiety, depression, post-traumatic stress disorder (PTSD) and other psychological troubles were common among Wenchuan earthquake survivors.<sup>5,8,9</sup> PTSD is a common psychological disorder after disasters,<sup>10,11</sup> mainly manifested in re-experiencing, avoidance, negative alterations in mood and cognition, and hyper-arousal.<sup>12</sup> Some people can recover within 6 months, while others may develop chronic PTSD for several years or even a lifetime.<sup>12</sup> Chronic PTSD leads to considerable disease burden, social and occupational disorders, other mental and physical diseases, and increase the risk of suicide.<sup>3</sup> Therefore, it is necessary to pay attention to the prevalence and influencing factors of chronic PTSD among Wenchuan earthquake survivors.

At present, there are many researches on the mental health of Wenchuan earthquake survivors. However, the prevalence and risk factors of PTSD found in these studies are also different due to the differences in research sites, research time and measurement tools. The prevalence of PTSD ranged from 8.0% to 86.2%,<sup>13</sup> while the risk factors mainly include demographic characteristics (such as gender, age, income, and so on).<sup>8,14-16</sup> and earthquake exposure factors (such as loss of houses or property, injury, death of relatives, and so on).<sup>14,17-19</sup> Moreover, most of these studies were conducted in the early period after the earthquake. With the passage of time, the evidence of survivors' PTSD gradually decreases. Given the severe consequences of chronic PTSD, it is necessary to measure the current mental health of survivors of the Wenchuan earthquake and take interventions. More importantly, there

is no research on the association between house reconstruction and mental health after the earthquake. The purpose of this study is to investigate the prevalence of chronic PTSD and its influencing factors among survivors in the hard-hit areas of the Wenchuan earthquake 10 years later and to provide evidence for local government and medical institutions to make decisions. To our knowledge, this is one of the few studies focusing on the long-term psychological consequences of the Wenchuan earthquake and the first to explore the association between post-earthquake reconstruction models and mental health.

## Materials and Methods

### Study Design and Participants

A cross-sectional survey was conducted in three seriously hit counties (Wenchuan, Shifang, and Mianzhu) by the Wenchuan earthquake between May and June 2018, ten years after the disaster. In July 2009, the Ministry of Finance of China released a list of 51 county-level administrative districts severely affected by the Wenchuan earthquake, of which 39 were in Sichuan Province.<sup>20</sup> The 39 hard-hit counties (cities, districts) include 6 districts (located in cities), 6 county-level cities and 27 counties (located in rural areas). In the first stage of sampling, we randomly selected Mianzhu (county-level city), Shifang (county-level city) and Wenchuan (county) from these 39 hard-hit counties (cities, districts). Mianzhu, which has 21 towns under its jurisdiction, is 18 kilometers away from the epicenter of the Wenchuan earthquake, with an earthquake intensity of IX–X. As of July 24, 2008, 11,396 people were dead or missing and 36,468 injured in the area. Shifang, which has 14 towns under its jurisdiction, is 28 kilometers away from the epicenter of the Wenchuan earthquake, with an earthquake intensity of VIII–XI. As of July 24, 2008, 6,142 people were dead or missing and 31,990 injured in the area. Wenchuan, which has 12 towns under its jurisdiction, is located at the epicenter of the Wenchuan earthquake with an earthquake intensity of IX–XI. As of July 24, 2008, 23,871 people were dead or missing and 34,583 were injured in the area. In the second stage, four towns were randomly selected from each county: Mianzhu (Fuxin, Hanwang, Zundao, Jinhua), Shifang (Hongbai, Jiandi, Luoshui, Yinghua), Wenchuan (Shuimo, Xuankou, Yinxing, Yingxiu). In the third stage, two villages were randomly selected from each town. Because Mianzhu, Shifang, and Wenchuan are located in Longmen Mountains, the terrain is steep and the villagers

live scattered. It is impossible to randomly select survivors who distributed at the bottom, middle, or top of the mountains. Therefore, we adopted a more feasible convenience sampling in the final stage. In the villages, we divided the investigators into 4 groups and went to different directions to conduct household surveys. According to the calculation of sample size, we plan to survey at least 46 residents in each village. All data were collected through face-to-face interview by questionnaires, and all investigators were trained before the survey.

Residents who experienced the Wenchuan earthquake and were aged 16 or above at the time of the interview met the inclusion criteria. While, residents who have both of the following characteristics were excluded: (1) with mental health impairments diagnosed by doctors before the earthquake include schizophrenia, mania, depression, anxiety, etc. (2) still receiving mental health treatment before the earthquake.

Ethics approval for this study was obtained from the Institutional Review Board (IRB) of West China Hospital in Sichuan University. Before the interview, the investigator explained the purpose, content and required time of the investigation and obtained the verbal consent of each participant. Verbal informed consent was approved by IRB because of the high rate of illiteracy among the rural population in Sichuan Province. A guardian's consent was sought before investigating survivors under the age of 18. Participants were also informed that they could choose not to answer any questions in the questionnaire and they were free to withdraw from the study at any time during data collection.

## Measures

Survey items included demographic information, earthquake exposure and mental health.

Demographic information included gender, age, ethnicity (Han/Qiang/Tibetan/others), education (illiteracy/primary school/junior high school and above), occupation (unemployed/peasant/others), annual household income (RMB 0–5,000/RMB 5,000–20,000/RMB 20,000–50,000/RMB 50,000 and above), purchasing any kind of medical insurance (including new rural cooperative medical insurance, medical insurance for urban workers, medical insurance for urban residents, and commercial insurance) (Yes/No), playing mahjong-a common recreational activity in rural areas of Sichuan Province (Yes/No), drinking alcohol (Yes/No), moving to concentrated rural settlement (CRS)

after the earthquake (Yes/No). CRS refers to moving to a new concentrated settlement after the earthquake.

Earthquake exposures were the follows: (1) house damage in the earthquake (collapsed/not collapsed), (2) property loss in the earthquake (<80%/≥80%), (3) buried or injured in the earthquake (Yes/No), (4) witnessing the injury or death in the earthquake (Yes/No), (5) relatives injured during the earthquake (Yes/No), (6) immediate families disabled during the earthquake (Yes/No), (7) immediate families died during the earthquake (Yes/No). In this study, immediate families refer to parents, spouse and children.

Symptoms of PTSD were assessed using the PTSD Checklist-Civilian Version (PCL-C).<sup>21</sup> This 17-item self-administered questionnaire is based on Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) diagnostic criteria B, C, and D for PTSD.<sup>22</sup> It is often used when a clinical interview is not feasible.<sup>23</sup> Respondents were asked to indicate the extent of each symptom correlated with the earthquake on a scale from 1 (not at all) to 5 (extremely). Total score ranges from 17 to 85, and an adult with a score of 38 or greater was classified as having probable PTSD.<sup>24,25</sup> Evidence shows that the English and Chinese versions of PCL-C have good validity, reliability and accuracy in screening PTSD.<sup>14,26</sup> The Internal consistency (Cronbach's Alpha coefficient) of the PCL-C in our study was 0.89.

## Sample Size

A previous study showed that the PTSD prevalence was 8.8% in the hard-hit areas 3 years after the Wenchuan earthquake.<sup>25</sup> In addition, a systematic review found that the prevalence of PTSD among survivors gradually decreased within four years after the Wenchuan earthquake.<sup>4</sup> The sample size was calculated on the basis of an assumed PTSD prevalence ( $p$ ) of 5% in the hard-stricken areas, 0.05 for alpha (significance level) and 0.27p for allowable error. The initially estimated sample size was 1000. However, we increased the primary sample size by 10% to avoid the loss caused by missing visits. Thus, our minimum sample size was 1,100 subjects, with 46 people from each village.

## Quality Control

All investigators were health-care professors or medical graduate students from West China Clinical Medical College and West China School of Public Health of Sichuan University and received strict training before the investigation. To make sure the quality of the data, each response has been reviewed

for questionnaire completeness and logicity. Moreover, double data entry was done by two persons and the consistency of the entered data was cross-checked on EpiData.

## Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics, version 25 (IBM Corp). Frequencies and percentages were used to describe categorical data. Because the age in this sample did not follow a normal distribution, we used median and interquartile range to describe it. Univariate analyses were performed using Pearson  $\chi^2$  test by default except for cases better suited for the Fisher exact test owing to a small expected number of observations less than 5. To control all the potential influencing factors of PTSD symptoms and improve the effect of model fitting, all variables with  $P < 0.20$  in univariate analysis were included into the multivariate logistic regression model, and then the “enter method” was used for multivariate analysis. All  $P$  values were 2-sided, and statistical significance was defined as  $P \leq 0.05$ . Missing data were deleted from the analyses.

## Results

From May to June 2018, we approached 1104 individuals in 24 hard-hit villages, 1054 of whom took part in the questionnaire survey and 1039 complete questionnaires were obtained (Figure 1). Their median age was 60 years (range, 16–92). Among the 1039 people, 63.2% were female, 92.8% were Han ethnic group, 70.2% were illiterate or had received primary

education, 58% had an annual household income of less than 20,000 yuan (US\$ 2,871.3), 82.2% had their houses collapsed in the earthquake, and 8.2% (85/1039) lost their parents, spouse or children in the earthquake. Symptoms of PTSD were reported to be 9.1% (95/1039). See Table 1 for details.

On univariate analysis, the symptoms of PTSD were found to be significantly associated with gender, age, education, occupation, annual household income, insurance, drinking status, injury status of family in the earthquake, and death status of immediate families in the earthquake (Table 1).

In multivariate analysis, education above primary school level (OR, 0.48; 95% CI, 0.24–0.95), annual household income of 20,000 and above (OR, 0.41; 95% CI, 0.24–0.72), and moving to CRS after earthquake (OR, 0.58; 95% CI, 0.34–0.97) were associated with lower prevalence for symptoms of PTSD. At the same time, the death of immediate families during the earthquake (OR, 5.86; 95% CI, 3.12–10.96) was associated with higher prevalence for symptoms of PTSD (Table 2).

## Discussion

Ten years after the Wenchuan earthquake, a cross-sectional study was carried out to explore the prevalence and influencing factors of PTSD among adult survivors. The results show that even 10 years have passed since the Wenchuan earthquake, the prevalence of PTSD among adult survivors is still very high, at 9.1%. High education level, high income

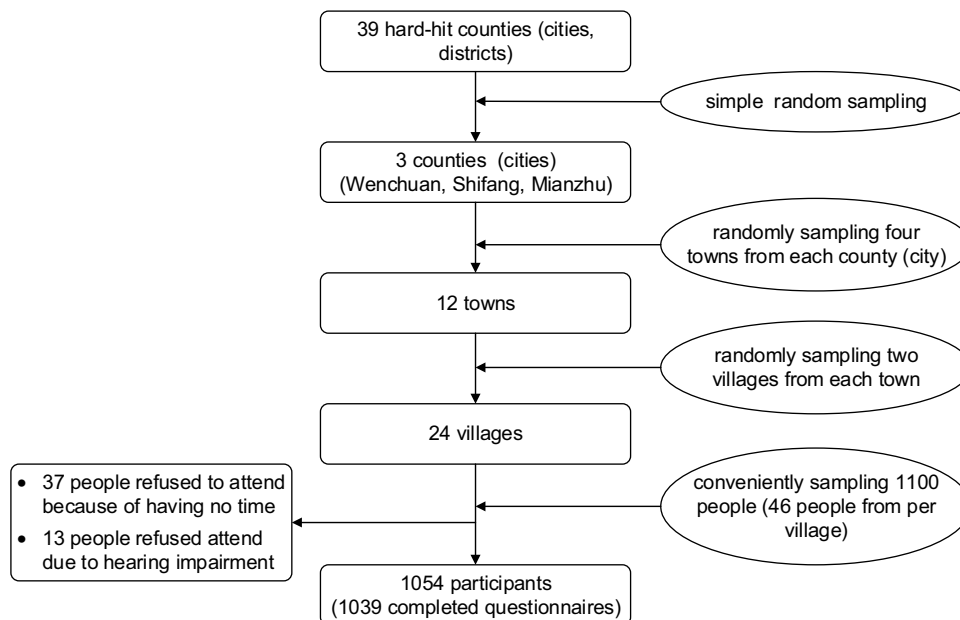


Figure 1 Flow chart of sampling stages.

**Table 1** Characteristics of 1039 Survivors and Univariate Analysis

Characteristics	Total (N=1039) No. (%)	PTSD (N=95) No. (%)	Non-PTSD (N=944) No. (%)	P value
Gender				
Male	382	23 (24.2)	359 (38.0)	0.008
Female	657	72 (75.8)	585 (62.0)	
Age				
<60 years	512 (49.3)	37 (38.9)	475 (50.3)	0.035
≥60 years	527 (50.7)	58 (61.1)	469 (49.7)	
Ethnicity				
Han	964 (92.8)	85 (89.5)	879 (93.1)	0.191
Minorities	75 (7.2)	10 (10.5)	65 (6.9)	
Education				
Primary school or lower	729 (70.2)	82 (86.3)	647 (68.5)	<0.001
Higher than primary school	310 (29.8)	13 (13.7)	297 (31.5)	
Occupation				
Unemployed or peasant	737 (70.9)	80 (84.2)	657 (69.6)	0.003
Others	302 (29.1)	15 (15.8)	287 (30.4)	
Annual household income				
RMB 0–20,000	603 (58.0)	75 (78.9)	528 (55.9)	<0.001
≥RMB 20,000	436 (42.0)	20 (21.1)	416 (44.1)	
Moving to CRS after earthquake				
No	703 (67.7)	72 (75.8)	631 (66.8)	0.076
Yes	336 (32.3)	23 (24.2)	313 (33.2)	
Purchasing insurance				
No	38 (3.7)	8 (8.4)	30 (3.2)	0.018
Yes	1001 (96.3)	87 (91.6)	914 (96.8)	
Playing mahjong				
No	697 (67.1)	71 (74.7)	626 (66.3)	0.096
Yes	342 (32.9)	24 (25.3)	318 (33.7)	
Drinking alcohol				
No	799 (76.9)	82 (86.3)	717 (76.0)	0.022
Yes	240 (23.1)	13 (13.7)	227 (24.0)	
House damage in the earthquake				
Not collapsed	185 (17.8)	14 (14.7)	171 (18.1)	0.412
Collapsed	854 (82.2)	81 (85.3)	773 (81.9)	
Property loss in the earthquake				
<80%	179 (17.2)	11 (11.6)	168 (17.8)	0.126
≥80%	860 (82.8)	84 (88.4)	776 (82.2)	
Buried or injured in the earthquake				

(Continued)

**Table 1** (Continued).

Characteristics	Total (N=1039) No. (%)	PTSD (N=95) No. (%)	Non-PTSD (N=944) No. (%)	P value
No	921 (88.6)	80 (84.2)	841 (89.1)	0.153
Yes	118 (11.4)	15 (15.8)	103 (10.9)	
Witnessing the injury or death in the earthquake				
No	322 (31.0)	24 (25.3)	298 (31.6)	0.205
Yes	717 (69.0)	71 (74.7)	646 (68.4)	
Relatives injured during the earthquake				
No	695 (66.9)	54 (56.8)	641 (67.9)	0.029
Yes	344 (33.1)	41 (43.2)	303 (32.1)	
Immediate families disabled during the earthquake <sup>a</sup>				
No	1009 (97.1)	90 (94.7)	919 (97.4)	0.185
Yes	30 (2.9)	5 (5.3)	25 (2.6)	
Immediate families died during the earthquake <sup>a</sup>				
No	954 (91.8)	72 (75.8)	882 (93.4)	<0.001
Yes	85 (8.2)	23 (24.2)	62 (6.6)	

**Note:** <sup>a</sup>Immediate families refer to parents, spouse and children in this study.**Abbreviations:** PTSD, Post-Traumatic Stress Disorder; CRS, Concentrated Rural Settlement.

and moving to CRS after the earthquake might be protective factors for survivors' long-term mental health, while the loss of immediate families in earthquakes is an important risk factor for mental health.

We found that lower education levels and lower-income are related to PTSD symptoms after controlling for other confounding factors. There might be two reasons for this result. First, higher education levels and higher income are protective factors for the mental health of earthquake survivors, which is supported by many researches.<sup>27–29</sup> This could be explained by the individual vulnerability. Generally, persons with high social and economic status have more social and economic resources and have stronger coping ability to disasters, thus being less affected by disasters.<sup>11</sup> A large-scale genome-based study confirms the above view. Educational attainment is related to PTSD through income, that is, individuals with higher education levels often earn more, while more income can reduce the risk of PTSD.<sup>30</sup> Hence, educational attainment and income are good predictors of chronic PTSD.<sup>31</sup> However, since our research is a cross-sectional

**Table 2** Multivariate Logistic Regression for PTSD

Characteristics	Adjusted OR <sup>a</sup> (95% CI)	P value
Education Primary school or lower Higher than primary school	Reference 0.48 (0.24–0.95)	0.034
Annual household income RMB 0–20,000 ≥RMB 20,000	Reference 0.41 (0.24–0.72)	0.002
Moving to CRS after earthquake No Yes	Reference 0.58 (0.34–0.97)	0.040
Immediate families died during the earthquake <sup>b</sup> No Yes	Reference 5.86 (3.12–10.96)	<0.001

**Notes:** <sup>a</sup>Adjusted OR were obtained from multivariate logistic regression by taking potential confounders ( $P < 0.20$ ) identified by univariate analysis. <sup>b</sup>Immediate families refer to parents, spouse and children in this study.

**Abbreviations:** PTSD, Post-Traumatic Stress Disorder; CRS, Concentrated Rural Settlement.

study, the chronological sequence between variables could not be ensured. Therefore, another reason for the above result might be that PTSD symptoms hinder the learning and working functions of survivors, resulting in lower education levels and lower-income.

A previous study has shown that post-earthquake reconstruction support is a protective factor for PTSD.<sup>32</sup> This study found that moving to CRS after the earthquake seems to be more beneficial to the mental health of survivors than in-situ reconstruction. CRS is a rural residential model proposed by the Chinese government in the context of new rural construction and urban-rural coordinated development strategy.<sup>33</sup> It brings together previously scattered households to form a compact village or community and improves public services and infrastructure to achieve sustainable development.<sup>34</sup> After the Wenchuan earthquake, some villages that were badly hit were rebuilt in this way. They were planned by professional teams (including scientific site selection, spatial layout, and housing design), and were equipped with relatively perfect public services and infrastructure (including health-care rooms, fitness venues, and elderly activity centers, and so on).<sup>6</sup> CRS not only retains the social network before the earthquake but also reduces the earthquake vulnerability, concentrating on the advantages of in-situ reconstruction and resettlement.<sup>6,35</sup> Scientific planning, better public services, and infrastructure of CRS have improved the lives

of survivors. Meanwhile, a pleasurable new environment enables survivors to avoid trauma reminders brought by the earthquake scene to a certain extent.<sup>36</sup> These advantages might be the reason why CRS plays a protective role in the mental health of survivors. Therefore, CRS seems to be a more beneficial reconstruction model for the hard-hit areas, which might be important for decision-makers involved in post-disaster reconstruction.

Our previous study in 2011 (3 years after the earthquake) found that the risk factors of PTSD include injury in the earthquake, witnessing injuries or deaths, and death or missing family members.<sup>25</sup> Seven years have passed since the 2011 survey,<sup>25</sup> and the impact of the two factors of injury in the earthquake and witnessing the injury or death on PTSD in the same areas were no longer statistically significant. This seems to reflect the resilience of human beings and the healing effect of time. However, 10 years after the Wenchuan earthquake, the death of immediate families still has a strong impact on the mental health of survivors (OR, 5.86; 95% CI, 3.12–10.96). There is no dispute that family death is a risk factor for mental health.<sup>11,37</sup> Judging from the results of this study, it is one of the most lasting factors affecting mental health. Therefore, survivors with immediate families killed should be regarded as one of the most vulnerable groups, and their psychological intervention and treatment should be listed as priorities for disaster relief.

What is worth our attention is that the 9.1% prevalence of PTSD is so high that it even exceeds that of 7 years ago (the cross-sectional survey conducted in Wenchuan, Shifang, and Mianzhu in 2011 found that the population prevalence of PTSD was 8.8%).<sup>25</sup> This might be attributed to the characteristics of the sample. Since most of the young and middle-aged survivors, especially men, in the rural areas of Sichuan Province go out to work (usually in cities), 63.2% of the interviewees in this study are women, and half are aged 60 or above. Another reason for the high prevalence of PTSD in this study might be the “anniversary reaction”. “Anniversary reaction” means that the anniversary of the trauma will trigger traumatic memories more easily, and traumatic memory will induce strong stress response like the initial trauma.<sup>38</sup> This study was carried out on the 10th anniversary of the Wenchuan earthquake. During the investigation, the painful memories related to earthquake may aggravate the symptoms such as re-experience and negative emotions of the respondents. However, even with the above reasons, we could still believe that the PTSD of the survivors in the hard-hit

areas has not improved to a great extent during the 3–10 years after the Wenchuan earthquake. This conclusion is similar to the research results of Guo et al in 2016,<sup>9</sup> and also confirms that the decline rate of PTSD prevalence in post-earthquake population is from fast to slow and gradually tends to be stable.<sup>13,39</sup>

As far as we know, this is the first study to explore the association between CRS, a post-disaster reconstruction model, and the mental health of survivors. Besides, random sampling at the county, township and village levels ensures the representativeness of the villages included. Of course, several limitations of this study should be mentioned. First of all, this survey adopted a cross-sectional design, which limited the strength of causal inference of our findings. Secondly, convenience sampling was adopted in the final stage of sampling, which has some noticeable weaknesses compared with random sampling. However, we covered the whole village as much as possible during the investigation, which might improve the efficacy of these samples for scientific generalization and inference to a certain extent. Third, we failed to address other mental health problems such as depression and manic episodes in this paper, though such problems were not our research priorities. At last, PCL-C was used to evaluate PTSD in this study, and the prevalence might be higher than that of clinical diagnosis. However, because of its high internal consistency and validity, PCL-C is believed to be an effective PTSD screening tool for the population.<sup>26</sup>

## Conclusion

The current evidence shows that ten years after the Wenchuan earthquake, the prevalence of PTSD among the population in the hard-hit areas is still very high. Individual education level, family income level, post-earthquake reconstruction method, and whether or not they lost immediate families in the earthquake might be good predictors of the long-term mental health of Wenchuan earthquake survivors. The local government and health-care institutions should take appropriate measures to improve the mental health of the residents in the hard-hit disaster areas, instead of counting on time to heal all trauma. After the disaster, the residents' economic income should be guaranteed in various ways, and special attention should be paid to the mental health of families who have lost their loved ones. At the same time, CRS model could be considered for reconstruction in severely affected areas.

## Ethical Approval

The study protocol and verbal informed consent were in accordance with the ethical standards and were approved by the Institutional Review Board (IRB) of West China Hospital in Sichuan University. A guardian's consent was sought before investigating survivors under the age of 18.

## Informed Consent

Verbal informed consent was obtained from all respondents.

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## Author Contributions

All authors contributed to the study design, data analysis and discussion, drafting and/or revising the manuscript. All authors approved the final version of the manuscript, and agree to be accountable for all aspects of this work.

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## Disclosure

The authors report no conflicts of interest in this work.

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