

# Prevalence and Predictors of Post-Traumatic Stress Disorder and Depression Among Survivors Over 12 Years After the Bam Earthquake

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**Purpose:** The Bam earthquake was one of Iran's worst natural disasters. As a reason of limited sample size, prevalence and risk factors of PTSD and depression were still unclear after a huge earthquake in Bam.

**Patients and Methods:** A total of 1500 participants selected from the survivors by multi-stage sampling. Instruments included the demographic questionnaire, the PTSD Checklist-Civilian Version and the Beck Depression Inventory-2. Bivariable and multivariable logistic regressions were used to analyze the data.

**Results:** The prevalence rates of PTSD and depressive symptoms were 38.7% (n = 581) and 40.1% (n=597), respectively. The most commonly occurring symptoms of PTSD were distress at reminders (73.7%), fear of recurrence (70.3%) and sleep disturbance (68.4%). Age (OR=1.5, 95% CI= [1.03, 1.74], P < 0.001) and being injured (OR=1.68, 95% CI= [1.09, 2.61], P=0.02) are positive risk factors of PTSD. The risk factors for depressive symptoms were old age (OR= 1.46, 95% CI= [1.02, 1.64], P < 0.001), female gender (OR=1.42, 95% CI=[1.14, 1.77], P=0.002), and death of work colleagues (OR=4.03, 95% CI= [1.54, 6.54], P=0.005).

**Conclusion:** Professional and effective mental health services should design programs in order to aid the psychological wellbeing of the population focusing on older adults, females, those who lost work colleagues, and those who lost their family members.

**Keywords:** Bam, earthquake, epidemiology, depression, PTSD, risk factors

## Introduction

Earthquakes are considered to be one of the most threatening, destructive, and uncontrollable natural disasters.<sup>1</sup> Depending on the severity of the earthquake, its consequences can be catastrophic and sometimes cause homelessness, bereavement, and imperative issues associated to mental health.<sup>2</sup>

On December 26, 2003 at 5:26 am, an earthquake with the magnitude of 6.5 Richter struck the city of Bam in Kerman province located in southeast of Iran.<sup>3</sup> According to official statistics, the earthquake left more than 26,000 dead and 30,000 injured.<sup>4</sup> As a result of this horrific earthquake, about 90% of homes and more than half of the administrative offices were completely or partially destroyed.<sup>3</sup>

Most studies have shown the increase of various psychological disorders, such as post-traumatic stress disorder, substance abuse, depression, sleep disturbances, and anxiety disorders after facing a trauma.<sup>5-7</sup> Meanwhile, post-traumatic stress disorder (PTSD) is the most common type of post-disaster mental illness.<sup>8,9</sup> Studies conducted on the basis of similar natural disasters have shown that populations

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exposed to earthquakes suffer from long-term symptoms of post-traumatic stress disorder (PTSD), depression, and other common disorders.<sup>10</sup> Post-Traumatic Stress Disorder (PTSD) refers to a delayed but long-term psychiatric stress disorder, due to a traumatic exposure and it is considered to be the most common negative psychological response among the survivors after an earthquake<sup>11</sup> and may continue several years after the earthquake.<sup>12</sup>

In a study by Eivazi et al conducted 18 months after the Bam earthquake on 422 people of Bam and Kerman, the prevalence of post-traumatic stress disorder in Bam was 66.7% (59% severe and moderate, 7.7% mild) and statistically there was not any significant correlation between the sex and age groups of respondents in the suffering of post-traumatic stress disorder.<sup>13</sup> In a study by Farhoudian and colleagues about 8 months after the same earthquake, the prevalence of partial and full PTSD was 20.2% and 51.9%, respectively, and the difference in the prevalence rate of men and women was not statistically significant.<sup>14</sup>

Several researches have been done on the survivors of the earthquake after a short time ranging from a few months to few years, but there are not any demographic studies on the survivors of the Bam earthquake at a long period of 12 years after the earthquake.

The Information available on the effects of PTSD are most often as the result of researches carried out in developed countries<sup>15</sup> and are obtained in accordance with the cultural, political, and geographical conditions of those regions and may not be generalized to other countries; therefore, it seems crucial and compulsory for such study to be investigated in line with people's culture of Iran in order to provide a flawless representation of the psychological problems that would arise after disasters. Furthermore, people of the countries with low income per capita standards and weak social security and support systems are more vulnerable to the aftereffects of large-scale natural disasters such as major earthquakes as it creates further economic burden in terms of medical expenses, homelessness, and lower work productivity as the result of PTSD.<sup>16</sup> Thus, it is important to understand the impact of natural disasters on individuals, especially who are looking after others in vulnerable populations.

Having the basic information about epidemiology of the most common post-earthquake psychological disorders not only adds to existing knowledge but also can be used to estimate the severity of psychological complications and to identify and provide effective service to the

traumatized people. The goal of this investigation was to conduct an epidemiological study on survivors of the Bam earthquake 12 years after the earthquake, determining the prevalence and description of PTSD symptoms and depression among 16 years and older survivors in relation to demographic factors as well as determining the risk factors associated with PTSD and depression among participants.

## Materials and Methods

Twelve years after the Bam quake in fall 2015, just months prior to 13th anniversary of the disaster this population-based, descriptive-analytic, cross-sectional study was conducted. The subjects of this study were people with the age of 16 years and over who resided in the city of Bam at the time of the earthquake. To achieve consistent results and due to the importance of having reliable data, by referencing the similar research of Eivazi et al, a 59% prevalence of post-traumatic stress disorder and type one error rate of 5% were estimated.<sup>13</sup> The sample size of the research was calculated using the Cochran formula to be 1500 subjects from the survivors of the Bam earthquake that were selected by multi-stage sampling; clustering and systematic sampling.

## Participants

A trained inquiring team comprising a psychologist and an associated person for acquiring the necessary training were sent to relevant areas and after receiving formal consent they attempted to collect information from the respondents. According to the authority's classifications of urban areas, the city of Bam was divided into 10 clusters and five clusters were randomly selected and then systematically from all main streets, one street was selected and at each side of the street, 10 persons (each house one person) filled the questionnaire. This research was carried out by a door-to-door approach (home visit). From each house, a member who was over 16 years old resided in Bam at the time of earthquake and those with the day and month of their birth closest to the day and month of the interview date were selected as participant.

Individuals suffering from mental disability, dementia, or psychosis were excluded from sampling. An initial questionnaire containing demographic characteristics on gender, age, marital status, education level, and traumatic characteristics about home loss, deaths of family, friends, relatives, and work colleagues, having limb-threatening injury and surgery, and being trapped under the rubble was completed.

This research was proposed via the office of Vice Chancellor for Research and was approved by the Research Council of Bam University of Medical Sciences with the approval number of 94/17. Written informed consent was obtained from every single participant to enroll in the study. The age of consent for this type of study is 16 years without parental consent. All procedures performed in this study were in accordance with the 1964 Helsinki Declaration and its later amendments.

## Instruments

The next part of our study looked at PTSD and depressive symptoms. The PTSD Checklist-Civilian Version (PCL-C) was used to assess the PTSD symptoms.<sup>17</sup> The PCL-C is a self-report 17 item symptom scale developed by the Behavioral Science Branch of American PTSD research center according to DSM-IV in 1994 for evaluating the experience of ordinary people after trauma in normal life. The PCL-C is composed of three dimensions: the first (criterion B) dimension is re-experiencing of the traumatic events; the second dimension (criterion C) is scheduled avoidance of trauma-relevant stimuli and numbing of general responsiveness and the third dimension (criterion D) comprises symptoms of hyper-arousal. Individuals would rate each item from 1 (“not at all”) to 5 (“extremely”) to indicate the degree to which they have been bothered by that particular symptom over the past month. Internal consistency has been demonstrated to be strong for the PCL total symptom score (Cronbach’s  $\alpha = 0.97$ ) and for symptom group B, C, and D scores (Cronbach’s  $\alpha = 0.92$ – $0.93$ ).

Total possible score range is from 17 to 85. It is recommended that when the instrument is used as a continuous measure, a cut-off score of 50 is optimal for making the diagnosis of full PTSD and the score of 38–50 is diagnosed as partial PTSD.<sup>18</sup> PTSD symptom pattern that defined by the presence (endorsed as 2 or greater) of at least 1 B item (questions 1–5), 3 C items (questions 6–12), and at least 2 D items (questions 13–17). Weathers et al set the Cut-off score of 50 as the optimum predictor of post-traumatic stress disorder. They diagnosed resulted the sensitivity of 0.82 and specificity of 0.83 with this cut off. Furthermore, their internal consistency coefficient was 0.96 for the whole scale. The checklist also correlates strongly with other measures of PTSD, such as the Mississippi Scale (0.93) and the Impact of Event Scale (0.90).<sup>19</sup>

To review the validity and reliability of this list with the results obtained from the questionnaire; on 117 subjects Goodarzi calculated the Cronbach’s alpha coefficient

scale at 0.93, which proves its good reliability among Iranian population. Also, the validity factor and coefficient were 0.87 and 0.73, respectively.<sup>20</sup>

To investigate the severity of depression, the Beck Depression Inventory-2 (BDI-II) was used in this study.<sup>21</sup> The Beck Depression Inventory includes 21 items that assess mood over the past 2 weeks. The items in this questionnaire include four options and are scored on a scale of zero to three, so the total score may vary between zero and 63. Beck’s classification of the severity of depression on this scale was asymptomatic (0–9), mild depression (10–18), moderate depression (19–29), and severe depression (30–63).<sup>22</sup> In the Iranian population, the Beck Depression Inventory-2 has high internal consistency ( $\alpha = 0.92$ ) and has good reliability and validity over the time.<sup>23,24</sup> We considered cut-off scale of 18 to study the population affected by this terrible earthquake. This cut-off scale was previously used in other studies.<sup>24</sup>

## Statistical Analysis

We carried out t-tests and chi-square tests to evaluate differences in continuous and discrete demographic variables, respectively. The dependent variable in these two logistic regressions was a dichotomous variable. The total scores of PCL-C and BDI-II were divided into two parts according to cut points. Bivariable (univariate) and multivariable logistic regressions were performed to identify independent predictors of PTSD and depression status. Variables with P-value less than 0.2 in the bivariable logistic regression were entered into the multivariable regression model.<sup>25</sup> Multicollinearity between predictor variables was assessed using variance inflation factor<sup>26</sup> and no multicollinearity was detected. The final model was selected based on the likelihood ratio test and lowest Akaike’s Information criteria value through a backward selection approach. Potential interaction effects were significant at the significance level of 0.1 and therefore were not included in the final model. As a sensitivity analysis of final model, step-wise forward selection result was compared to backward selection model. Crude and adjusted odds ratio (OR) with 95% confidence interval were reported. The level of significance was set at 0.05 (two-tailed). All analyses were performed using the Statistical Package for Social Science (SPSS) – version 20 for Windows.

## Results

The respondent’ characteristics and comparison of female and male are shown in Table 1. Their average age was 40.16 years

**Table I** The Comparison of Demographic Variables and PTSD and BDI Scores Between Male and Female

Variables	Total (n=1500)	Female (n=787, 52.5%)	Male (n=713, 47.5%)	P-value
Age (years) (mean; SD)	40.16 (13.61)	39.99 (12.75)	40.32 (14.37)	0.646
Education				
Illiterate and primary	770 (51.32)	406 (56.93)	364 (46.31)	<0.001*
Diploma	608 (40.51)	249 (34.92)	359 (45.62)	
University	122 (8.11)	58 (8.13)	64 (8.11)	
Marriage status				
Married	1317 (87.83)	648 (90.92)	669 (85)	<0.001*
Single	136 (9.12)	29 (4.11)	107 (13.62)	
Divorce/Widow	47 (3.12)	36 (5)	11 (1.41)	
Psychiatry characteristics				
BDI score	15.55±15.14	14.29±14.59	14.89± 14.86	0.105
PTSD score	45.68±11.74	44.97±12.10	45.31±11.93	0.249
Re-experience	14.09±3.94	14.05±3.99	14.07±3.97	0.823
Avoidance	18.45±4.58	18.21±4.73	18.32±4.66	0.303
Hyperarousal	13.07±3.85	12.93±3.87	13.22±3.82	0.146

**Note:** \*P value significant at <0.05 level of significance.

**Abbreviations:** PTSD, post-traumatic stress disorder; BDI, Beck Depression Inventory.

(SD=13.61 ranging from 16 to 90 years); 47.5% were male and 52.5% female. There were no significant differences between female and male in PTSD and depression score.

The findings showed that 38.7% (n = 581) of the respondents were PTSD patients and 26.7% (n = 400) of them were partial PTSD patients. The prevalence of PTSD according to PTSD severity and threshold with PTSD together was also 34.6% (n=519). The mean scores of PLC-C, re-experiencing, avoidance, and hyperarousal were 45.31 ± 11.93 (range: 17–85), 14.07 ± 3.97 (range: 5–25), 18.32 ± 4.66 (range: 7–35), and 13.07 ± 3.85 (range: 5–25), respectively. [Figure 1](#) shows the role of each symptom item of PCL-C in PTSD score. The most commonly occurring symptoms were as follows: distress at reminders (73.7%), fear recurrence (70.3%), sleep disturbance (68.4%), and irritable (68.3%). The least commonly occurring symptoms were being easily started (54.8%), hypervigilance (56.86%), avoid activity (57.8%), and physiologic reactivity (60.73%).

[Table 2](#) shows the result of bivariable logistic regression analysis and the effect of demographic and earthquake-related variables on PTSD and depression scores. As observes, for PTSD, all variables had P-value smaller than 0.2 except education status, losing house, and death of work colleagues. For depression, all variables had P-value smaller than 0.2 except education status and losing house.

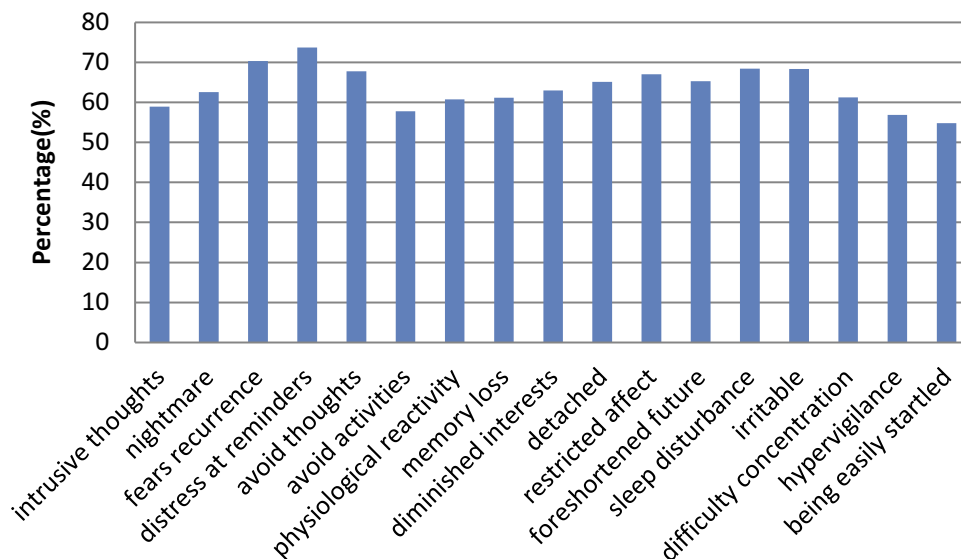
[Table 3](#) shows the result of multivariable logistic regression analysis of the contribution of predictors in

predicting PTSD and depression. As observes, the people who had been injured in the earthquake were 1.68 times more likely to report scores above the cut-off for PTSD compared with participants without injury (OR=1.68, 95% CI=[1.09, 2.61, P=0.02]). The chance of reporting scores above the cut-off for PTSD increased 1.5 (OR=1.5, 95% CI= [1.03, 1.74], P < 0.001) times more for each year increasing in age.

The prevalence of depression was 40.1% (n=597). Gender, age, death of work colleagues, and death of family member had significant positive effect (increasing effect) on depression. Women were 1.42 times more likely to report scores above the cut-off for depression compared with men (OR=1.42, 95% CI=[1.14, 1.77], P=0.002). For each extra year, the chance of reporting score above the cut-off for depression became 1.46 times more (OR= 1.46, 95% CI= [1.02, 1.64], P < 0.001). The people who had death of work colleagues were 4.03 times more likely to report scores above the cut-off for depression (OR=4.03, 95% CI= [1.54, 6.54], P=0.005) and increasing one more death in family member increased the chance of depression 1.15 times more (OR=1.15, 95% CI= [1.03, 1.27], P=0.032).

## Discussion

This study investigates the prevalence and determinants of PTSD and depression in survivors 12 years after an



**Figure 1** The percentage of presence for each symptom item of PCL-C.

earthquake, and to the best of the authors' knowledge, it is the first of its kind in terms of number of subjects and time-lapse after earthquake. The results showed that 12 years after the earthquake, the prevalence of PTSD (38.7%) and depression (40.1%) was very high among the population. This indicates that for the survivors of this disaster, the agonizing consequences of the earthquake have not diminished through the time.

An article published in 2001 concerning the study of psychiatric disorders in Iran showed that the rate of stress-related illnesses in Kerman province was 1.6%.<sup>27</sup> In a research by Eivazi et al, 18 months after the earthquake, the rate of severe and moderate post-traumatic stress disorder was 59%.<sup>13</sup> In another study, about 8 months after the Bam earthquake, the disorder was reported to be 59.1%.<sup>14</sup> In a study that was performed 40 days after Bam earthquake, the prevalence of PTSD was estimated to be at 81%.<sup>28</sup> As it can be seen, the rate of this disorder after the earthquake has increased considerably and has gradually decreased over time but still, even after 12 years of the earthquake, significant numbers of survivors suffer from this disorder. This illustrates the importance of psychological treatments for the affected population.

Epidemiological study conducted by Mohammadi et al 2 years before the earthquake in Kerman province showed a prevalence of major depression of 5.59%.<sup>29</sup> In a study conducted in Kerman province in 2015, 18.8% of population suffered from psychiatric disorders, of which 11.6% were probably depressed.<sup>30</sup> As one can see, the rate of depression in earthquake survivors of our study has been

shown to be much higher than the general population of the area, indicating the importance of paying attention to the psychological treatments of those people who survived an earthquake. In a survey on the survivors in the first 16 days after the Bam earthquake, 33% of people were diagnosed with depression.<sup>31</sup> Comparing those results to this research makes it further clear that after many years these people still suffer from depression.

In a systematic review of PTSD of earthquake survivors in 2016, 46 articles with the research time of up to 5 years after the earthquake, the prevalence of PTSD was highly heterogeneous, ranging from 1.20% to 82.64%. Also, the prevalence of PTSD among survivors diagnosed prior to 9 months after the earthquake (28.76%) was higher than survivors diagnosed later than 9 months after the earthquake (19.48%).<sup>32</sup> Although our study was conducted at much longer elapsed time after the earthquake, still the prevalence of PTSD was significant; however, over time it has declined in proportion to previous studies in this area. It seems that local government needs to plan more effective psychological interventions for earthquake survivors.

The risk factors associated with long-term development of PTSD have not yet been fully elucidated whereas several patterns of disaster consequences have been observed over time. Some of the survivors recover their psychological balance through an improvement over a period of few months up to 2 years. In a longitudinal study by Bonanno et al on earthquake survivors, 29% of the samples showed chronic symptoms due to the severity of the



**Table 2** Predictors of PTSD and Depression by Bivariate Logistic Regression Analysis Among Survivors (n = 1500)

Characteristics	N (%)	PTSD		Depression	
		COR (95% CI)	P-value	AOR (95% CI)	P-value
Gender					
Male	787 (52.51)	Ref.		Ref.	
Female	713 (47.52)	1.16 (0.95, 1.43)	0.153	1.32 (1.08, 1.63)	0.008*
Age; mean(SD)	40.17 (13.63)	1.03 (1.02, 1.04)	<0.001*	1.03 (1.02, 1.04)	<0.001*
Education					
University	106(7.11)	Ref.		Ref.	
Illiterate & Primary	770 (51.31)	1.05 (0.92, 2.38)	0.443	1.03 (0.99, 2.31)	0.453
Diploma	608 (40.52)	0.94 (0.61, 1.46)	0.794	0.91 (0.59, 1.39)	0.653
Marriage status					
Divorce & Widow	47 (3.12)	Ref.		Ref.	
Married	1317 (87.81)	0.57 (0.32, 1.01)	0.055	0.49 (0.27, 0.89)	0.018*
Single	136 (9.13)	0.39 (0.19, 0.78)	0.007*	0.43 (0.22, 0.85)	0.014*
Losing house					
Yes	1276 (85.14)	Ref.		Ref.	
No	130 (8.71)	0.92 (0.64, 1.33)	0.653	0.89 (0.62, 1.29)	0.553
Death of friends and relatives					
No	477 (31.81)	Ref.		Ref.	
Yes	1023 (68.22)	1.58 (1.26, 1.99)	<0.001*	1.66 (1.32, 2.09)	<0.001*
Death of work colleagues					
No	46 (3.12)	Ref.		Ref.	
Yes	1454 (96.91)	0.89 (0.49, 1.63)	0.722	2.43 (2.13, 8.81)	<0.001*
Being injured					
No	580 (38.73)	Ref.		Ref.	
Yes	920 (61.31)	1.78 (1.44, 2.21)	<0.001*	1.79 (1.45, 2.22)	<0.001*
Having surgery					
No	862 (57.52)	Ref.		Ref.	
Yes	638 (42.51)	1.645 (1.33, 2.03)	<0.001*	0.58 (0.47, 0.72)	<0.001*
Being trapped under the rubble					
No	97 (6.51)	Ref.		Ref.	
Yes	1403 (93.52)	2.41 (1.47, 3.95)	<0.001	1.88 (1.18, 2.98)	0.008*
Death of family members; mean(SD)	1.77 (1.11)	1.09 (0.99, 1.19)	0.081	1.12 (1.02, 0.22)	0.041*

**Note:** \*P value significant at <0.05 level of significance.

**Abbreviations:** Ref, reference category; COR, crude odds ratio; AOR, adjusted odds ratio; PTSD, post-traumatic stress disorder.

exposure. A small but persistent subset of the exposed population tends to show chronic dysfunction. Moreover, 13% of the samples initially and soon after the earthquake had low level of symptoms that were developed to either depression or PTSD in 18 months. He described three factors of contextual, event, and post-event factors that affect the longevity of PTSD after disaster.<sup>33,34</sup> Therefore, a better understanding of risk factors can help prevent and treat long-term PTSD. In our study, it appears

that a percentage of people have shown a pattern of chronic symptoms that could be due to individual differences, the severity of the disaster,<sup>3</sup> the level of exposure of individuals, and post-event factors such as delayed arrival of community relief.

Previous studies have shown a high percentage of PTSD symptoms in the population, including distress at reminders, sleep problems, fear recurrence, and re-experiencing the events.<sup>35,36</sup> In our study, the most

**Table 3** Predictors of PTSD and Depression by Multivariate Logistic Regression Analysis Among Survivors (n = 1500)

Characteristics	N (%)	PTSD		Depression	
		COR (95% CI)	P-value	AOR (95% CI)	P-value
Constant	1500 (100)	0.112	<0.001	0.039	<0.001
Gender					
Male	787 (52.5)	Ref.		Ref.	
Female	713 (47.5)	1.21 (0.97, 1.51)	0.093	1.42 (1.14, 1.77)	0.002*
Age; mean(SD)	40.17 (13.62)	1.51 (1.03, 1.74)	<0.001*	1.46 (1.02, 1.64)	<0.001*
Marriage status					
Divorce & Widow	47 (3.1)	Ref.		Ref.	
Married	1317 (87.8)	0.86 (0.47, 1.58)	0.618	0.78 (0.41, 1.46)	0.432
Single	136 (9.1)	0.99 (0.47, 2.09)	0.978	1.324 (0.616, 2.844)	0.472
Death of friends and relatives					
No	477 (31.8)	Ref.		Ref.	
Yes	1023 (68.2)	1.23 (0.96, 1.57)	0.103	1.22 (0.96, 1.57)	0.111
Death of work colleagues					
No	46 (3.1)			Ref.	
Yes	1454 (96.9)			4.03 (1.54, 6.54)	0.005*
Being injured					
No	580 (38.7)	Ref.		Ref.	
Yes	920 (61.3)	1.68 (1.09, 2.61)	0.02*	1.48 (0.96, 2.29)	0.078
Having surgery					
No	862 (57.5)	Ref.		Ref.	
Yes	638 (42.5)	0.94 (0.61, 1.45)	0.777	1.09 (0.71, 1.68)	0.692
Being trapped under the rubble					
No	97 (6.5)	Ref.		Ref.	
Yes	1403 (93.5)	1.61 (0.97, 2.69)	0.068	1.07 (0.66, 1.75)	0.784
Death of family members; mean(SD)	1.767 (1.1)	1.09 (0.99, 1.21)	0.071	1.15 (1.03, 1.27)	0.032*

**Note:** \*P value significant at <0.05 level of significance.

**Abbreviations:** Ref, reference category; COR, crude odds ratio; AOR, adjusted odds ratio; PTSD, post-traumatic stress disorder.

common occurring symptoms were as follows: distress at reminders (73.7%), fear recurrence (70.3%), and sleep disturbance (68.4%). That shows the PTSD symptoms, specially re-experiencing and increased arousal will continue for a long period even many years after the disaster.

Most post-earthquake studies in the world have shown that female gender is a predictor of PTSD.<sup>37,38</sup> Our study was in line with other studies in Bam after the earthquake.<sup>13,14,39</sup> In a study in Kerman province 2 years before the earthquake, the prevalence rate of PTSD in men and women across all province was 2.33% and 0.89% respectively.<sup>29</sup> The PTSD among men in the area was 3 times more than women 2 years before disaster whereas there has been a significant growth in number of women with PTSD after the earthquake. The prevalence of PTSD

in men and women after the disaster have no significant difference. The reason might be both genders endure the same stress level of earthquake.

Specific risk factors for PTSD symptoms were evaluated in this study and a total of 11 risk factors of PTSD in the survivors of earthquake were explored and it was found that being older and being injured were significantly associated with PTSD after an earthquake. The chance of suffering PTSD increased 1.5 times more by each year increasing, which is not consistent with most studies in this field.<sup>2,5,9,11,13,32,36</sup>

Yuqing Zhang in China identified the age as an effective risk factor for PTSD symptoms.<sup>40</sup> Following a post hoc analysis, He showed that participants in the 30–40 age group reported more PTSD symptoms than the other

groups. He attributed this to cultural issues in China. In the same study conducted in Azerbaijan province of Iran, the same age group (30–40) showed more psychological symptoms after the earthquake.<sup>41</sup> Like China, and based on cultural issues, it seems that these people are also bound to take care of both parents and children. As so-called the bread winner of the house and should provide shelter, food and security for them. Earthquake disrupts their ability to perform such responsibilities and has led to additional severe psychological problems in this age group. Given that this study was conducted 12 years after the earthquake, it seems that the elder people of this study were actually middle age at the time of the earthquake. Therefore, it is probable to say that the middle age group of people is more vulnerable to disaster and therefore requires further mental health care and attention after a catastrophe. But it seems that a few years after an earthquake elder are probably required further attention among the survivors.

Having a limb-threatening injury was a strong risk factor in this study, as earthquake survivors with injury, experienced 1.68 times more PTSD. This is understandable and consistent with several studies in this field.<sup>5,11,36,38</sup> The link between being injured and PTSD is probably related to the severity of the damage, often following a very severe earthquake that results in amputation and disability.<sup>42</sup> The onset of disability may reduce the likelihood of health-related quality of life in these people and this decrease in quality of life might lead to PTSD. People who are injured are likely to be constantly reminded of stress and anxiety.

Using logistic regression analysis, it was found that amongst basic characteristics being female, old age and amongst trauma characteristics, being injured, death of family members were associated with depression which is consistent with many studies in this field.<sup>43</sup>

Following a natural disaster, women are more affected by depression than men, previous studies have shown that women are more susceptible to threats, they are less likely to use effective coping strategies and tend to interpret natural disasters more adversely than men.<sup>2,9,11,44</sup> The relationship between age and depression in this study is consistent with the results of some studies in this area. In a study conducted in Haiti, 30 months after the earthquake, in relation to age groups, the results showed that youth and students, on one hand, and older and retired people, on the other hand, had the highest rates of depression.<sup>45,46</sup> The

higher prevalence of mental disorders in the elderly might be related to reasons such as retirement, dysfunction, and solitude of the elderly.

This study showed that bereavement is also a risk factor for depression. Furthermore, the extent of loss of family members is highly correlated with the occurrence of depression. Previous studies have shown that bereavement is a possible risk factor for subsequent psychopathology.<sup>43</sup> While bereavement can aggravate major depression in people, it's coincide with grief must also be noted because the distinction between them is important in the diagnosis and ultimately the appropriate treatment.<sup>47</sup>

On the other hand, Bereavement is a severe stressor that can trigger physical or mental disorders. People who experience an unusual or prolonged reaction to bereavement may show symptoms that are similar to depression or even PTSD.<sup>48</sup>

## Limitations and Strengths

This study did not investigate Bam's adjacent towns and rural areas for a better comparison of the results. This was a cross-sectional study showing depression and PTSD symptoms 12 years after the earthquake. Longitudinal studies are suggested to investigate changes and follow-ups. We did not have a control group in Bam for comparison that did not experience earthquake.

Issues such as sexual abuse and early life maltreatment should also be considered as risk factors for PTSD that have not been studied in this research and could be considered limitations of this study. Many researchers have identified the post-traumatic stress disorder (PTSD) as one of the main manifestations of sexual abuse injuries<sup>49</sup> and it is plausible that an earthquake of this magnitude and its subsequent social and economic insecurity could have further effects on this issue therefore advanced studies on this subject are suggested.

Despite these limitations, this study was the first epidemiological study to be performed after a long period after the disaster on the survivors of the Bam earthquake with a large sample size after 12 years and the results of this study provided important information and revealed that preparation and psychological interventions for depression and PTSD are necessary for earthquake survivors. The results display the need for facilitation of psychiatric treatment programs for survivors, particularly women, the elderly, and those who have been injured and have lost family or colleagues.



## Conclusion

Since earthquake is constantly occurring in Iran and around the world, the results of this study help people active in mental health to effectively identify vulnerable populations and thus treat them in a timely manner. Our results suggest that PTSD and depression of disaster survivors may persist over time, so the need to distribute mental health specialists to effected areas and detect and identify endangered individuals should continue even years after disaster.

This study highlights the need to investigate the catastrophic psychological consequences and risk factors of depressive symptoms and PTSD in the planning and implementation of mental health services and noted that long-term psychological support for victims of natural disasters is essential.

## Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Disclosure

The authors report no conflicts of interest in this work.

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