ORIGINAL RESEARCH

Related Factors Associated With Earthquake Inpatient Mortality

Sijia Liu, MD; Chengqi He, MD

ABSTRACT

Objectives: To date, we have only limited evidence of the determinants of earthquake inpatient mortality-related factors. This study is among the first to explore related factors of inpatient deaths using data from multiple hospitals and multiple earthquakes.

Methods: We included and retrospectively analyzed data on 32,976 earthquake inpatients in the West China Earthquake Patients Database. Of these, we analyzed the records of 284 patients who died during hospitalization. We collected 12 dichotomous variables with reference to previous reports: patients' age (both ≤ 15 years and ≥ 65 years), gender, prehospital treatment, intensive care unit (ICU) admission, the presence of severe traumatic brain injury (TBI), trunk injury, severe poly-trauma, crush syndrome, multiple-system organ failure (MSOF), infection, and cardiac/respiratory disease. We performed multivariate logistic regression analysis to explore independent related factors of mortality.

Results: Ultimately, we identified severe TBI, MSOF, old age (≥ 65 years), ICU admission, crush syndrome, and cardiac/respiratory disease as independent mortality-related factors. Severe TBI was the greatest risk factor of inpatient death (ods ratio [OR], 31.913, 95% confidence interval [CI], 20.484-49.720), followed by MSOF (OR 30.905, 95% CI, 21.733-43.947).

Conclusion: To reduce earthquake inpatient mortalities, the related factors analyzed in this study should be prioritized in future inpatient earthquake response strategies.

Key Words: earthquake, mortality, related factors

Fatal earthquakes have become a frequent occurrence. Understanding the related factors associated with earthquake inpatient death will help reduce mortality among patients hospitalized after an earthquake.[1] Previous studies have discussed different related factors of earthquake inpatient mortalities. These studies each analyzed 1 or 2 different related factors, such as young age (≤15 years),[2] old age (≥65 years),[3,4] gender,[5] prehospital treatment,[6] and admission to an intensive care unit (ICU).[2] Additional related factors include the presence of a severe traumatic brain injury (TBI),[1] trunk injury,[6,7] severe poly-trauma,[8] crush syndrome,[9] multiple-system organ failure (MSOF),[1] infection,[1] or cardiac/respiratory disease.[10,11] However, there are very few epidemiological studies that analyze multiple related factors of earthquake inpatient deaths after drawing from related factors in previous studies. We selected patients from the West China Earthquake Patients Database, which holds the prehospital, emergency, inpatient, and discharge information of inpatients from 4 earthquakes (see online Supplemental Appendix 1) that have taken place over the past 11 years in west China. This database is managed by Sichuan University's emergency medical rescue base, and at the time of writing, held 36,604 patient records from 701 hospitals. The data set has previously been used to study single factors, such as age, crush syndrome, and infection for the prognostic evaluation of earthquake victims. As it is difficult to standardize the data in studies concerning earthquake casualties, the results of single factor analyses typically have many potential confounding factors. Therefore, we conducted an unprecedented multi-factor analysis study with the aim of showing the true effect of the related factors on inpatient deaths studied previously.

METHODS

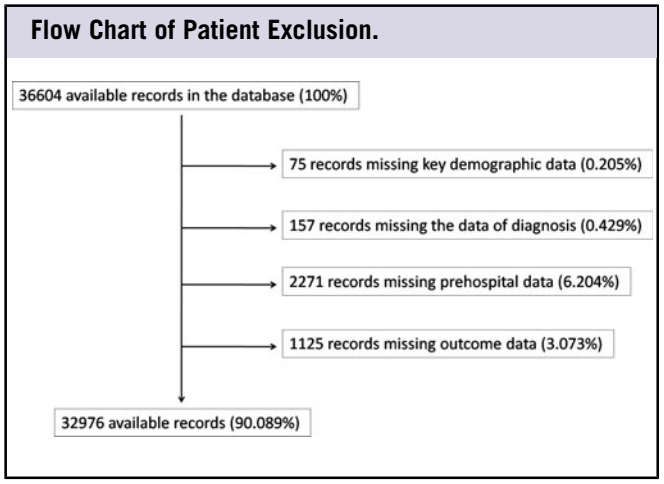
The Institutional Review Board (IRB) of West China Hospital, Sichuan University approved this study. Taking informed consent was unnecessary as this study used an already existing data base as obtained through the informed consent of the IRB.

Study Design

This study used the West China Earthquake Patients Database's patient characteristics and outcomes to screen suspected mortality related factors of hospitalized patients.

https://doi.org/10.1017/dmp.2020.125 Published online by Cambridge University Press

FIGURE 1



Selection of Participants

After excluding 3628 missing data (Figure 1), we analyzed the remaining 32,976 cases in our study. Of these, we analyzed the records of the 284 patients who died during hospitalization.

Key Variables

Using the available information from the West China Earthquake Patients Database, we collected data on 12 dichotomous variables with reference to previous reports,[1-11] which we labeled: pediatric patient, geriatric patient, gender, prehospital treatment, ICU admission, severe TBI, trunk injury, severe poly-trauma, crush syndrome, MSOF, infection, and cardiac/respiratory disease. We defined these dichotomous variables as follows: (1) *Pediatric patient* means a patient younger than or equal to 15 years old; (2) *Geriatric patient* means a patient older than or equal to 65 years old; (3) *Gender* means whether the patient was male or female; (4) *Prehospital treatment* means that the earthquake patient received primary medical treatment by health-care providers before being transferred to any hospital; (5) *ICU admission* means that the patient was admitted to the ICU, including adult ICU, neonatal ICU, pediatric ICU, or other intensive care wards, while hospitalized; (6) *Severe TBI* was defined as a single head injury resulting from an external mechanical force due to the earthquake, along with a Glasgow Coma Score of 8 or below[1]; (7) *Trunk injury* was defined as a single chest or abdomen injury, judged by radiological examination (eg, a computed tomography scan or magnetic resonance imaging); (8) *Severe poly-trauma* means that more than 1 anatomical area or organ is severely traumatized, with an Injury Severe Score (ISS) greater than or equal to 15 points; (9) *Crush syndrome* refers to a severe shock-like condition that follows the release of a large body part, such as a limb, after a prolonged period of mechanical compression. Crush syndrome is characterized by hypovolemic shock, hyperkalemia, and renal failure; (10) *MSOF* refers to a clinical syndrome in which 2 or more organ failures occur simultaneously or sequentially. MSOF often follows trauma, major surgery, severe infection, and so on; (11) *Infection* refers to a microorganism of disease as diagnosed by clinicians, according to clinical symptoms, laboratory examination, or radiological examination; (12) *Cardiac/respiratory disease* refers to an inpatient's diagnosis such as underlying cardiac/respiratory disease, pre-existing cardiac/respiratory conditions, and acute cardiac/respiratory disease, and is classified using a modified CDC Natural Disaster Morbidity Surveillance instrument.[2]

The main outcome variable was in-hospital death, and included death taking place in a hospital's emergency department, and death during hospitalization. As a result, mortality was defined as the ratio of death to the total number of patients in each of the 12 aforementioned variables.

Statistical Analysis

Measurement data with normal distributions were described by a mean ± standard deviation. Measurement data with nonnormal distributions were described by medians (25% quartiles, 75% quartiles). Enumeration data were constructed using composition ratios. Frequency counts and percentages were evaluated for all related factors (ie, variables). To reveal any association between a given variable and a case fatality, we performed a Chi-squared (χ^2) test for trends. We constructed logistic regression analysis to determine the independent related factors of earthquake inpatient death. We calculated adjusted odds ratio (OR) estimates with 95% confidence intervals (CI) from the logistic regression analysis. We set the threshold for statistical significance at $P < 0.05$ for all analyses. This analytic process was conducted using SPSS statistics 17.0 software (SPSS Inc., Chicago, IL).

RESULTS

The mean (standard deviation) age was 45.03 (21.39) years for survival, and 54.95 (24.24) years for death. The median (25% quartile, 75% quartile) days before admission were 7 (2, 14) days for survival, and 4 (2, 12) days for death.

The frequency of factors used in the study is presented in Table 1. The death cases contained a greater percentage of severe TBI, MSOF, cardiac/respiratory disease, crush syndrome, ICU admission, prehospital treatment, and age (both ≤15 years and ≥65 years) compared with the survival cases (P-value < 0.05).

Table 2 shows the 12 factors that predict earthquake inpatient death, as assessed using a univariate logistic regression analysis. MSOF was the greatest risk factor of inpatient death (OR, 80.862; 95% CI, 61.602-106.144), followed by severe TBI (OR, 32.248; 95% CI, 22.505-46.210). The significant variables in order of OR values were MSOF (OR, 80.862; 95% CI, 61.602-106.144), severe TBI (OR, 32.248; 95% CI, 22.505-46.210), ICU admission (OR, 16.128; 95% CI,

https://doi.org/10.1017/dmp.2020.125 Published online by Cambridge University Press

TABLE 1

Frequency of Factors Used in This Study

Factors		Survive		Death		χ^2	*P*-Value
		Number	%	Number	%		
Young age (age ≤ 15 years)	Yes	3664	11.2	21	7.39	4.125	0.042*
	No	29028	88.79	263	92.6		
Old age (age ≥ 65 years)	Yes	6906	21.12	122	42.95	80.032	0.000*
	No	25786	78.87	162	57.04		
Gender							
	Female	15980	48.88	127	44.71	1.967	0.161
	Male	16701	51.08	157	55.28		
ICU admission							
	Yes	973	2.97	94	33.09	815.938	0.000*
	No	31719	97.02	190	66.9		
Severe poly-trauma							
	Yes	4279	13.08	68	23.94	28.987	0.000*
	No	28413	86.91	216	76.05		
Severe TBI							
	Yes	175	0.53	42	14.78	874.997	0.000*
	No	32517	99.46	242	85.21		
Trunk injury							
	Yes	5530	16.91	54	19.01	0.882	0.348
	No	27162	83.08	230	80.98		
MSOF							
	Yes	239	0.73	106	37.32	3641.677	0.000*
	No	32453	99.26	178	62.67		
Crush syndrome							
	Yes	1006	3.07	46	16.19	156.925	0.000*
	No	31686	96.92	238	83.8		
Infection							
	Yes	4587	14.03	89	31.33	69.302	0.000*
	No	28105	85.96	195	68.66		
Cardiac/respiratory disease							
	Yes	2067	6.32	121	42.6	598.322	0.000*
	No	30625	93.67	163	57.39		
Pre-hospital treatment							
	Yes	665	2.03	12	4.22	6.723	0.010*
	No	32027	97.96	272	95.77		

Abbreviations: ICU, intensive care unit; MSOF, multiple-system organ failure; TBI, traumatic brain injury.
* $P < 0.05$.

12.495-20.818), cardiac/respiratory disease (OR, 10.998; 95% CI, 8.657-13.973), crush syndrome (OR, 6.088; 95% CI, 4.412-8.399), old age (OR, 2.812; 95% CI, 2.220-3.562), infection (OR, 2.796; 95% CI, 2.172-3.600), prehospital treatment (OR, 2.125; 95% CI, 1.186-3.807), severe poly-trauma (OR, 2.090; 95% CI, 1.599-2.750), trunk injury (OR, 1.153; 95% CI, 0.856-1.553), female patients (OR, 0.844; 95% CI, 0.667-1.066), and young age (OR, 0.633; 95% CI, 0.405-0.988).

Table 3 shows the related factors associated with earthquake inpatient death, as assessed using multivariate logistic regression analysis. Model 1 included 12 related factors: Severe TBI was the greatest risk factor of inpatient death (OR, 36.811; 95% CI, 23.205-58.395), followed by MSOF (OR, 30.760; 95% CI, 21.574-43.858). The next most significant variable in order of OR values were cardiac/respiratory disease (OR, 4.666; 95% CI, 3.311-6.576), crush syndrome (OR, 2.899; 95% CI, 1.885-4.461), ICU admission (OR, 2.382; 95% CI, 1.662-3.414), prehospital treatment (OR, 2.063; 95% CI, 1.046-4.066), old age (OR, 2.169; 95% CI, 1.626-2.893), severe poly-trauma (OR, 1.214; 95% CI, 0.859-1.715), trunk injury (OR, 0.998; 95% CI, 0.695-1.431), infection (OR, 0.835; 95% CI, 0.588-1.184), female patients (OR, 0.809; 95% CI, 0.619-1.057), and young age (OR, 0.624; 95% CI, 0.372-1.046). For cardiac/respiratory disease, old age is most likely to be a confounding factor, so we operated model 2, which deleted this variable. We compared the 2 models and found that the OR of cardiac/respiratory disease changed from 4.666 to 5.645 (change rate 20.98% > 10%),[12] suggesting that old age is part of the confounding factor of cardiac/respiratory disease. We also found there was a significant difference of the

https://doi.org/10.1017/dmp.2020.125 Published online by Cambridge University Press

TABLE 2

Univariate Analysis of Related Factors for Earthquake Inpatient Death

Related Factors	χ^2	*P*-Value	OR	95% CI
Young age (age ≤ 15 years)	4.054	0.044*	0.633	0.405-0.988
Old age (age ≥ 65 years)	73.447	<0.001*	2.812	2.220-3.562
Female patients	2.027	0.155	0.844	0.667-1.066
ICU admission	455.847	<0.001*	16.128	12.495-20.818
Severe poly-trauma	27.733	<0.001*	2.090	1.599-2.750
Severe TBI	358.151	<0.001*	32.248	22.505-46.210
Trunk injury	0.880	0.348	1.153	0.856-1.553
MSOF	1001.521	<0.001*	80.862	61.602-106.144
Crush syndrome	120.987	<0.001*	6.088	4.412-8.399
Infection	63.638	<0.001*	2.796	2.172-3.600
Cardiac/respiratory disease	385.445	<0.001*	10.998	8.657-13.973
Pre-hospital treatment	6.415	0.011*	2.125	1.186-3.807

Abbreviations: 95% CI, 95% confidence intervals for odds ratio; ICU, intensive care unit; MSOF, multiple-system organ failure; OR, odds ratio; TBI, traumatic brain injury.
* $P < 0.05$.

TABLE 3

Multivariate Analysis of Related Factors for Earthquake Inpatient Death

Related factors	Model 1[a]				Model 2[a]			
	χ^2	*P*-Value	OR	95% CI	χ^2	*P*-Value	OR	95% CI
Young age (age ≤ 15 years)	3.200	0.074	0.624	0.372-1.046	7.019	0.008	0.503	0.302-0.836
Old age (age ≥ 65 years)	22.268	<0.001	2.031	1.513-2.726				
Female patients	2.420	0.120	0.809	0.619-1.057	3.911	0.048	0.764	0.586-0.998
ICU admission	22.325	<0.001	2.382	1.662-3.414	21.614	<0.001	2.362	1.644-3.394
Severe poly-trauma	1.207	0.272	1.214	0.859-1.715	1.118	0.290	1.206	0.852-1.708
Severe TBI	234.585	<0.001	36.811	23.205-58.395	233.599	<0.001	36.270	22.885-57.482
Trunk injury	<0.001	0.989	0.998	0.695-1.431	0.018	0.893	0.976	0.68-1.4
MSOF	358.386	<0.001	30.760	21.574-43.858	356.581	<0.001	30.481	21.379-43.457
Crush syndrome	23.453	<0.001	2.899	1.885-4.461	17.706	<0.001	2.521	1.639-3.878
Pre-hospital treatment	4.372	0.037	2.063	1.046-4.066	4.116	0.042	2.014	1.024-3.96
Infection	1.027	0.311	0.835	0.588-1.184	0.425	0.515	0.891	0.631-1.259
Cardiac/respiratory disease	77.407	<0.001	4.666	3.311-6.576	103.969	<0.001	5.645	4.048-7.874

Abbreviations: 95% CI, 95% confidence intervals for odds ratio; ICU, intensive care unit; MSOF, multiple-system organ failure; OR, odds ratio; TBI, traumatic brain injury.
[a] Model 1 includes all the related factors; Model 2 deletes the variable of old age in Model 1.

OR of the crush syndrome between model 1 and model 2. These results suggested that old age was also a confounding factor of crush syndrome.

According to the stepwise logistic regression analysis (backward procedure) in the last step model, there were 6 related factors associated with earthquake inpatient death (see online Supplemental Appendix 2) and another 6 related factors (young age, gender, severe poly-trauma, trunk injury, prehospital treatment, and infection) could be removed. Similar to the findings of previous studies, severe TBI was the greatest risk factor of inpatient death (OR, 31.913; 95% CI, 20.484-49.720), followed by MSOF (OR, 30.905; 95% CI, 21.733-43.947). The next most significant of the variables in order of OR values were cardiac/respiratory disease (OR, 4.427; 95% CI, 3.259-6.014), crush syndrome (OR, 2.880; 95% CI, 1.882-4.408), ICU admission (OR, 2.369; 95% CI, 1.656-3.389), and old age (OR, 2.169; 95% CI, 1.626-2.893). The Akaike information Criterion (AIC), Bayesian Information Criterion (BIC), Cox-Snell R^2, and NagelkerkeR^2 were not largely different between models (see online Supplemental Appendix 3), which indicates that both the first step and last step models were not significantly different from each other.

DISCUSSION

Our study found 6 factors associated with earthquake inpatient death risk: old age, ICU admission, the presence of severe TBI, crush syndrome, MSOF, and cardiac/respiratory disease.

Old age was a high-risk factor. The study by Pant and Banjade[13] on the Nepal earthquake suggests that the impact

https://doi.org/10.1017/dmp.2020.125 Published online by Cambridge University Press

of the earthquake on the elderly population was not limited to personal injury, and that drug shortages and irregular inspections of post-earthquake care facilities increased the adverse consequences of chronic disease for these patients. Previous studies on the Wenchuan earthquake also reported a supply shortage of medicines and equipment in hospitals due to the destruction of infrastructure, such as road systems after the earthquake.[14]

It was not surprising that ICU admission was associated with earthquake inpatient death in this study, as ICU patients generally have higher mortality rates. Halpern et al.[15] inferred that factors associating ICU admission with death in earthquakes include the severity of the trauma, disease, the availability of blood, and appropriate antibiotics in resource-limited settings. Even so, there is limited evidence to reveal the relationship of intensive care resources and mortality in an earthquake. Further study on intensive care professionals and equipment should be done to illuminate the role of early recruitment and to help deploy critical medicine resources.

Severe TBI strongly predicted earthquake inpatient mortality. Previous studies,[16] including the study by Zhang et al.[17] on the Lushan earthquake and the study by Wen et al.[1] study on the Wenchuan earthquake, have emphasized that TBI plays an important role in predicting the death of earthquake patients. After reviewing 123 earthquake studies from 1990 to 2010, Bartels and vanRooyen[18] concluded that earthquake patients with severe TBI were "generally not saveable." Presently, however, no research has proposed an effective way to solve this problem, let alone solve it in earthquake-stricken areas with scarce medical resources.

In our study, MOSF had a high OR value, which suggested that it was also an important factor in earthquake inpatient death. The review by Bartels and VanRooyen[18] lists MSOF as the most common cause of delayed mortality in earthquake inpatients. Even in normal situations, MSOF has a very high mortality rate given the usual lack of medical resources following an earthquake, and MSOF deaths are even more prominent in earthquake inpatients. Like severe TBI, there is currently no effective program to help reduce earthquake deaths caused by MSOF. After the Wenchuan earthquake, some Chinese health-care providers proposed that patients suffering from MSOF needed to be transferred to hospitals far away from the disaster area that had sufficient medical resources.[19] This suggestion could be seen as a solution to reduce the mortality rate.

Crush syndrome was also strongly associated with earthquake inpatient death.[20] Previous studies have reported the high mortality of earthquake inpatients from crush syndrome as having a mortality rate of 13.4% after the Hanshin-Awaji earthquake[21] and 21% after the Marmara earthquake.[22] In our study, the mortality rate of earthquake inpatients from crush syndrome was 16.19%. The study by He et al.[23] on the Wenchuan earthquake reported that patients with crush syndrome had a higher mortality, which was probably related to severe complications, especially hyperkalemia. The present study also found that old age is a confounding factor of crush syndrome. Few previous studies have explored the relationship between old age and crush syndrome in earthquakes. The study by Ting et al.[24] on the Yushu earthquake reported that 1 of 7 patients with crush syndrome was an elderly person, which may relate to the risk of the elderly being easily squashed by heavy objects. Further research can be conducted in the future to explore the relationship between these 2 factors.

In addition, cardiac and/or respiratory diseases were also frequently encountered in the hospital throughout the earthquake after-response. Previous reports[10,21] revealed an increased number of cardiac events and respiratory diseases following an earthquake. These cardiac events included fatal myocardial infarction, stress cardiomyopathy, heart failure, arrhythmias, hypertension, and sudden cardiac death.[2,10] The major respiratory diseases in earthquake inpatients included pneumonia, acute exacerbation of chronic obstructive pulmonary disease (AECOPD), asthma attacks, progression of lung cancer, adult respiratory distress syndrome, and pulmonary embolism.[2,21] The incidence of respiratory disease may be affected by air pollution caused by landslide disaster and waste dust.[25] Furthermore, the lack of medical personnel and equipment in the earthquake-stricken areas also led to an increase in mortality from these causes. As such, we suggest that hospitals in earthquake-prone areas should develop response plans based on realistic approaches to the problems (and limitations) they are likely to face regarding patients with cardiac and/or respiratory disease in earthquake scenarios. In addition, we also found that old age was a confounding factor of cardiac/respiratory disease. It is easy to understand that the incidence of chronic heart and lung disease and underlying heart and lung disease would be increased with advanced age. We found in this study that cardiac/respiratory disease is a related factor of inpatient death, regardless of whether old age is added to the model. Further study should be done to illuminate the degree of association between cardiac/respiratory disease and inpatient death.

Our study is subject to the following limitations. First, like some previous studies, our study dealt with incomplete records of inpatient data. We excluded 3628 cases with missing data, and, therefore, may be inaccurately estimating the importance of certain related factors of earthquake inpatient deaths. Second, we failed to consider injury mechanisms, structural factors, seismic features of earthquakes,[26] and did not account for differences in search and rescue times. All of these could be relevant factors in predicting earthquake inpatient death. Third, the 4 earthquakes included in our database each occurred in rural areas. Compared with urban areas, rural areas are characterized by low population density and low variety and volumes of medical services. Thus, casualties and factors affecting inpatient deaths may be different in urban

https://doi.org/10.1017/dmp.2020.125 Published online by Cambridge University Press

earthquakes. Finally, we only studied deaths during hospitalization and did not discuss the length of hospitalization in this study, because we were unable to gain enough information from the database. Further study on the relationship between length of stay and mortality is required.

Despite these limitations, this study is, to the best of our knowledge, among the first to explore related factors of inpatient deaths using data from multiple hospitals and multiple earthquakes.

CONCLUSIONS

To reduce the mortality of hospitalized patients after an earthquake, the related factors identified and analyzed in this study, such as old age, ICU admission, severe TBI, crush syndrome, MSOF, and cardiac/respiratory disease, should be the focal point of future earthquake response strategies regarding inpatient care.

About the Authors

Department of Rehabilitation Medicine, West China Hospital, Sichuan University (Drs Liu, He).

Correspondence and reprint requests to Cheng-qi He, Department of Rehabilitation Medicine, West China Hospital, Sichuan University, 610000 (e-mail: liusijia@wchscu.cn).

Funding

This work was financially supported by the Science Foundation of Science and Technology Department of Sichuan Province (2015JPT0026) and the Science Foundation of Sichuan University (2013SCU19020).

Conflicts of Interest

The authors declare there are no conflicts of interest.

Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.1017/dmp.2020.125.

REFERENCES

1. Wen J, Shi YK, Li YP, et al. Risk factors of earthquake inpatient death: a case control study. *Crit Care*. 2009;13(1):R24.
2. Dulski TM, Basavaraju SV, Hotz GA, et al. Factors associated with inpatient mortality in a field hospital following the Haiti earthquake, January-May 2010. *Am J Disaster Med. 2011*;6(5):275–284.
3. Cheng HC, Nieh JH, Hsu TH, et al. Using the patient data in the Hualien earthquake to analyze the reasons of visit, the trauma injury sites and the severity. *Prehosp Disaster Med*. 2019;34(Suppl 1):s176.
4. Osaki Y, Minowa M. Factors associated with earthquake deaths in the great Hanshin-Awaji earthquake, 1995. *Am J Epidemiol*. 2001;153(2):153–156.
5. Peek-Asa C, Ramirez M, Seligson H, et al. Seismic, structural, and individual factors associated with earthquake related injury. *Inj Prev*. 2003;9(1):62–66.
6. Hai H, Ya-rong H, Xin-miao D, et al. Chief complaints associated with mortality involving civilian transport after Wen-chuan earthquake. *Eur J Emerg Med*. 2014;21(5):364–367.
7. Hu Hai, He Y, Zhang S, et al. Streamlined focused assessment with sonography for mass casualty prehospital triage of blunt torso trauma patients. *Am J Emerg Med*. 2014;32(7):803–806.
8. Gao R, Yang L, Yuan W, et al. Overview of polytrauma patients in the first 10 days after the Sichuan earthquake: a report from the No. 903 Military Hospital, Jiangyou. *Eur J Trauma Emerg Surg*. 2012;38(2):85–88.
9. Bulut M, Fedakar R, Akkose S, et al. Medical experience of a university hospital in Turkey after the 1999 Marmara earthquake. *Emerg Med J*. 2005;22(7):494–498.
10. Kloner RA. Lessons learned about stress and the heart after major earthquakes. *Am Heart J*. 2019;215:20–26.
11. Tanaka H, Oda J, Iwai A, et al. Morbidity and mortality of hospitalized patients after the 1995 Hanshin-Awaji earthquake. *Am J Emerg Med*. 1999;17(2):186–191.
12. Kernan WN, Viscoli CM, Brass LM, et al. Phenylpropanolamine and the risk of hemorrhagic stroke. *N Engl J Med*. 2000;343(25):1826–1832.
13. Pant B, Banjade S. Geriatric care post mega earthquake 2015 Nepal. *Innov Aging*. 2017;1:538.
14. Wang D, Chen L. Emergency response of the central hospital in the earthquake-stricken area. *Chin J Hosp Admin*. 2008;24(8):507–509.
15. Halpern P, Rosen B, Carasso S, et al. Intensive care in a field hospital in an urban disaster area: lessons from the August 1999 earthquake in Turkey. *Crit Care Med*. 2003;31(5):1410–1414.
16. Igarashi Y, Matsumoto N, Kubo T, et al. A systematic review of earthquake-related head injuries. *Prehosp Disaster Med*. 2019;34(Suppl 1):s171.
17. Zhang L, Zhao M, Fu W, et al. Epidemiological analysis of trauma patients following the Lushan earthquake. *PLoS One*. 2014;9(5):e97416.
18. Bartels SA, VanRooyen MJ. Medical complications associated with earthquakes. *Lancet*. 2012;379:748–757.
19. Zhu C, Ji S, Junxing K, et al. Emergency medical rescue after major earthquake: lesson from Wenchuan earthquake. *Chin J Evid-based Med*. 2012,12(4):383–392.
20. Najafi I, Safari S, Sharifi A, et al. Practical strategies to reduce morbidity and mortality of natural catastrophes: a retrospective study based on Bam earthquake experience. *Arch Iran Med*. 2009;12(4):347–352.
21. Tanaka H, Oda J, Atsushi I. Morbidity and mortality of hospitalized patients after the 1995 Hanshin-Awaji earthquake. *Am J Emerg Med*. 1999;17:186–191.
22. Bulut M, Fedakar R, Akkose S, et al. Medical experience of a university hospital in Turkey after the 1999 Marmara earthquake. *Emerg Med J*. 2005;22:494–498.
23. He Q, Wang F, Li G, et al. Crush syndrome and acute kidney injury in the Wenchuan earthquake. *J Trauma*. 2011;70(5):1213–1217.
24. Li Ting, Jiang Xieyuan, Chen Hui, et al. An epidemiological survey of orthopedic injury in 2010'sYushu earthquake. *Chin J Orthop Trauma*. 2013;6:486–489.
25. Xue Z, Yang Z, Sun H, et al. Epidemiological analysis of respiratory and intestinal infectious diseases in three counties of Sichuan: the baseline survey of Disaster Mitigation Demonstration Area in western China. *Peer J*. 2019;7:e7341.
26. Chou YJ, Huang N, Lee CH, et al. Who is at risk of death in an earthquake? *Am J Epidemiol*. 2004;160(7):688–695.