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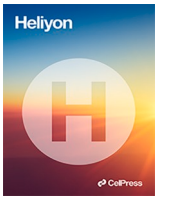

Review article

Post-traumatic stress disorder in medical workers involved in earthquake response: A systematic review and meta-analysis

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ABSTRACT

Introduction: Medical workers involved in responding to the earthquake are exposed to frightening scenes and witness dead bodies and severely injured moaning people, predisposing them to multiple mental health consequences. This study was aimed to determine the prevalence of Post-Traumatic Stress Disorder (PTSD) after earthquakes among medical workers using a systematic review and meta-analysis.

Materials and methods: The review study was performed following PRISMA guidelines, and the study's protocol was registered in PROSPERO with the code CRD42022333069. The data resources of Google Scholar, Science Direct, Web of Science, PubMed, and Scopus were searched to specify the related studies. To perform meta-analysis, the random effects model was utilized, and the I^2 index was considered to assess heterogeneity between studies. The STATA software was used for data analysis.

Results: In the initial data resources search, 1399 articles were identified. From these articles, 13 were finally chosen for meta-analysis and quality assessment. The meta-analysis results indicated that the prevalence of post-earthquake PTSD among medical workers involved in the earthquake response was 16.37% (95% CI: 11.63–21.11, $I^2 = 97.33\%$, $p = 0 < 0.001$).

Conclusion: The medical workers involved in response to the earthquake have a relatively high risk of PTSD in the short and long term. Therefore, medical workers involved in response to disasters should undergo screening for mental health disorders before and after disasters and receive the necessary training with regard to stress management, psychological resilience, and how to express their feelings and emotions.

1. Introduction

Natural disasters, especially earthquakes, often wreak havoc and ensue vast casualties and economic loss [1]. Earthquake is one of the most frightening, calamitous, and uncontrollable disasters [2,3]. Therefore, search and rescue, as immediate priorities, are immediately performed by professional teams after an earthquake [4]. Casualties caused by disasters may have negative impacts on

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rescuers who witness vast terrifying sceneries that affect them unconsciously [5]. Also, medical workers involved in the earthquake response who provide emergency medical services in the early stages of disasters are exposed to horrific scenes, including dead bodies, critically injured victims, and moaning people; therefore, these workers are more vulnerable to occupational tensions than others [6].

Health care workers engaged in response to disasters frequently witness heart-wrenching situations, predisposing to the risk of Post-Traumatic Stress Disorder (PTSD), depression, and other psychological disorders [7]. Earthquakes predispose survivors to numerous mental health conditions, such as anxiety, depression, suicide, and PTSD [8]. As a matter of fact, PTSD, which is caused by calamitous events, is considered one of the very common psychiatric disorders after disasters such as earthquakes [9]. Studies conducted on the quality of life and psychological status of medical workers after earthquakes have denoted a high prevalence of PTSD [10–11]. A research in Iran indicated that the prevalence of PTSD in the aid workers participating in an airplane crash rescue operation was 25% [12]. In another study, the rate of PTSD in rescue workers was reported to be 17.1% [13]. Also, another study showed that the prevalence of PTSD in emergency medical technicians involved in the 2016 Taiwan earthquake response was 12.7% [14].

According to the literature, PTSD can result in other mental disorders, including substance abuse, and anxiety disorders [15], interfere with the daily life performance, compromise a person's health performance, and finally, increase the risk of mental health disorders and physical diseases [16]. Therefore, the psychological consequences of disaster response can advance towards chronic mental illnesses, and as a result, negatively influence one's job performance [17]. Several studies have investigated the rate of post-traumatic stress disorders in a group of health care professionals involved in the earthquake response engaged in earthquake response [10–11]. However, we did not find any detailed study on the overall prevalence of PTSD among these individuals. Consequently, the present systematic review and meta-analysis aims to determine the overall prevalence of PTSD among the medical workers participating in earthquake response. Probably, the findings of this study can be used in disaster management planning, especially in phases of response and recovery.

2. Materials and methods

To conduct this review, we used the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines [18]. The review's protocol was also registered at the International Prospective Register for Systematic Reviews (PROSPERO) with the code CRD42022333069.

2.1. Search strategy

The initial search to find relevant studies in this review was carried out in the scientific data resources of Science Direct, Google Scholar, Web of Science, PubMed, and Scopus. In order to compile search strategies for various databases, valid keywords were utilized as follows: "Health Personnel", "Healthcare Worker*", "Medical Worker*", "Medical staff", "Health Care Professional*", "rescue worker*", "Medical Rescue Worker*", "Healthcare Provider*","acute post-traumatic stress disorder", "PTSD", "delayed-onset post-traumatic stress disorder", Post Traumatic Stress Disorder*", "posttraumatic stress disorder", "posttraumatic neuroses", "chronic post-traumatic stress disorder", "Natural Disaster*", and "Earthquake*". Operators and search fields were used to conduct the searches without considering a time limit until the end of May 2022. Search strategies used in various databases are summarized in Table 1.

2.2. Inclusion/exclusion criteria

All studies on the prevalence of post-earthquake PTSD in medical staff involved in the earthquake response until the end of May 2022 were included. The daily life performance of people is disrupted by PTSD, and this disorder is related to a decrease in health performance and an increase in mental and physical disorders [7]. The target population in this study was the entire medical staff who provided medical services to earthquake victims both in the field and in the hospital. Case reports, reviews, interventional studies, letters to editors, and studies on the rate of PTSD among populations other than medical staff involved in the earthquake response were

Table 1
The search strategies used in various databases.

Database	Search strategies
PubMed	((“Healthcare Provider*” OR “Healthcare Worker*” OR “Health Personnel” OR “Medical Worker*” OR “Medical staff” OR “Health Care Professional*” OR “rescue worker*” OR “Medical Rescue Worker*” OR “Health Care Provider*”) AND (“Post Traumatic Stress Disorder*” OR “posttraumatic stress disorder” OR PTSD OR “posttraumatic neuroses” OR “acute post-traumatic stress disorder” OR “chronic post-traumatic stress disorder” OR “delayed-onset post-traumatic stress disorder”) AND (“Natural Disaster*” OR Earthquake*))
Scopus	(((ALL (“Health Care Provider*“) OR ALL (“Healthcare Provider*“) OR ALL (“Health Personnel”) OR ALL (“Healthcare Worker*“) OR ALL (“Medical Worker*“) OR ALL (“Medical staff”) OR ALL (“Health Care Professional*“) OR ALL (“rescue worker*“) OR ALL (“Medical Rescue Worker*“)) AND (ALL (“Post Traumatic Stress Disorder*“) OR ALL (“posttraumatic stress disorder”) OR ALL (“chronic post-traumatic stress disorder”) OR ALL (“delayed-onset post-traumatic stress disorder”) OR ALL (“posttraumatic neuroses”) OR ALL (PTSD) OR ALL (“acute post-traumatic stress disorder”)) AND (ALL (“Natural Disaster*“) OR TITLE-ABS (Earthquake*))))
Web of science	(((TS=(“Health Care Provider*“) OR TS=(“Healthcare Provider*“) OR TS=(“Health Personnel”) OR TS=(“Healthcare Worker*“) OR TS=(“Medical Worker*“) OR TS=(“Health Care Professional*“) OR TS=(“Medical staff”) OR TS=(“rescue worker*“) OR TS=(“Medical Rescue Worker*“)) AND (TS=(“posttraumatic stress disorder”) OR TS=(PTSD) OR TS=(“posttraumatic neuroses”) OR TS=(“Post Traumatic Stress Disorder*“) OR TS=(“chronic post-traumatic stress disorder”) OR TS=(“delayed-onset post-traumatic stress disorder”) OR TS=(“acute post-traumatic stress disorder”)) AND (TS=(“Natural Disaster*“) OR TS=(Earthquake*))))

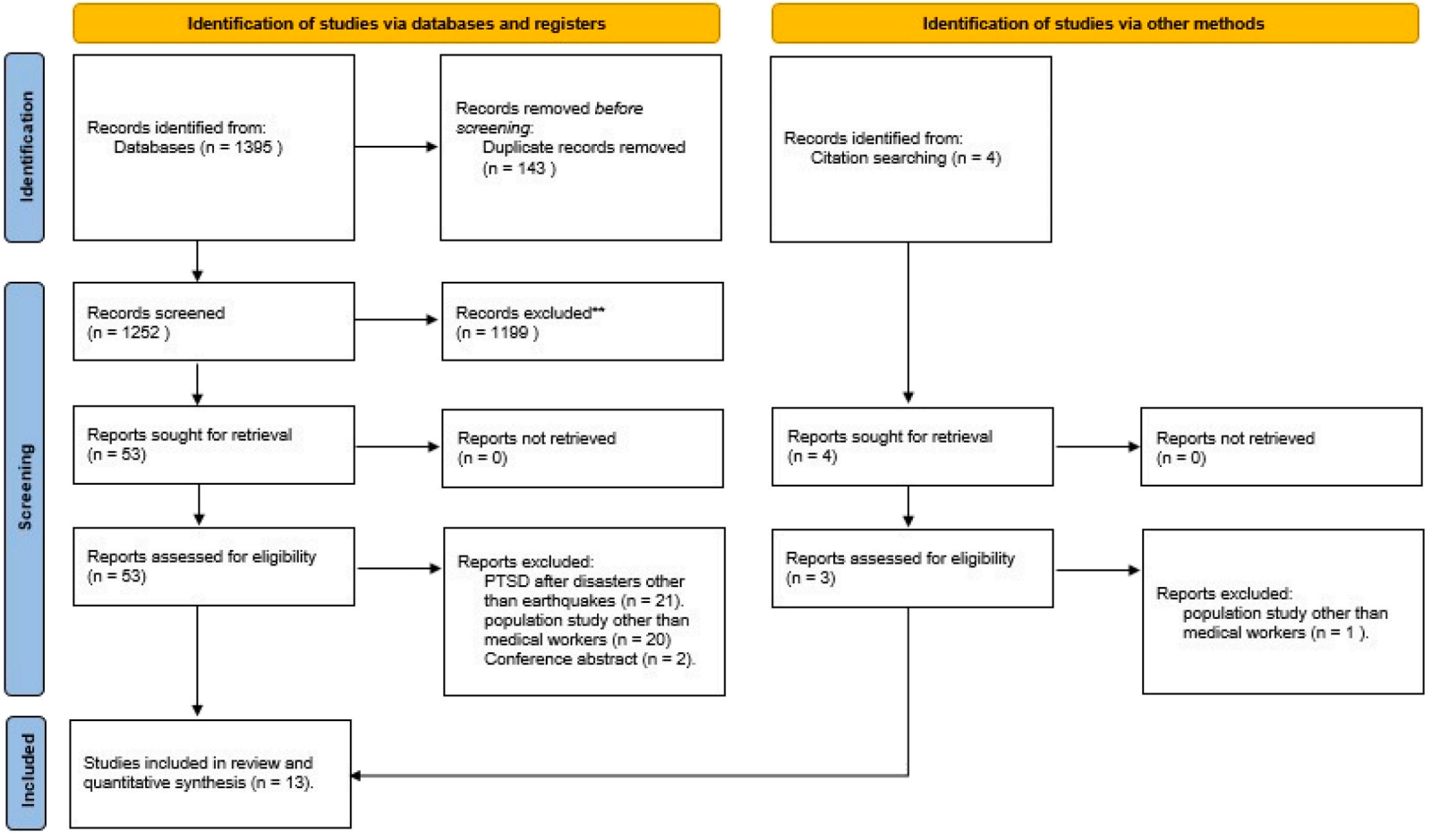

Fig. 1. Flowchart of PRISMA-based study selection.

excluded.

2.3. Selection of studies

Initially, Endnote 8 software was used to record all the studies identified during the primary search. Then duplicates were omitted, leaving 1256 studies (titles and abstracts) to be screened. Afterwards, two researchers were requested to independently read 53 potentially relevant studies. In the end, 13 final studies were selected for meta-analysis.

2.4. Quality assessment and data extraction

To qualify the final chosen studies, the Appraisal tool for Cross-Sectional Studies (AXIS) tool [19] was utilized. This instrument's score ranges from 0 to 20. After study selection, two researchers (ST and SG) independently reviewed the final studies, and any disagreement between researches was determined by including a third researcher (AS). As well, the two researchers (ST and SG) independently analyzed each study and gathered the data required into a pre-prepared checklist, involving the sample size, the studied population's mean age, first author's name, medical workers' occupational status, the number of women and men, instruments used to determine PTSD, and the prevalence of PTSD. Moreover, the disagreements between these items were settled by including a third person (AS).

2.5. Statistical analysis

The sample size and PTSD prevalence were taken from each study. Accordingly, to calculate each study's variance, binomial distribution was utilized. To combine the prevalence of PTSD reported by various studies, the weighted average was utilized, and a weight that was inversely proportional to the variance of each study was assigned to the study. The simple random effects model was used to conduct meta-analysis. To assess the degree of heterogeneity between the reviewed studies, the I^2 indices were calculated (the I^2 indices of below 25%, 25–50%, 50–75%, and over 75% representing, respectively, no, intermediate, high, and very high heterogeneities) [20]. To discern the individual effect of each study on the overall prevalence of PTSD, sensitivity analysis was used, and the Begg test was used to assess the publication bias. Also, the link between the follow-up duration, and meta-regression was used to examine the rate of PTSD. The STATA software (Ver. 14) was used to analyze the data.

3. Results

3.1. Results of literature search

In the primary literature research, 1399 papers were specified, and after eliminating duplicates, 1256 studies entered the screening stage. After screening the primary studies, 53 articles were chosen for reviewing their full texts, of which 13 studies were chosen to assess their quality. Finally, the 13 studies were meta-analyzed (Fig. 1). Overall, 5226 medical workers involved in the earthquake response were included for estimating the post-earthquake PTSD prevalence. All the studies included had employed a cross-sectional design (Table 2).

Table 2
Details of meta-analyzed studies.

First author	Year of study	location	N	Male	Female	Follow up	Prevalence of PTSD	Occupational position	Tools*
Shrestha [21]	2015	Nepal	64	39	25	2 Months	21.9%	Hospital medical professional	PCL- 5
Sakuma [22]	2015	Japan	357	40	317	14 Months	6.6%	Hospital medical workers	PCL-S
Huang [23]	2013	China	923	NR**	NR	62 Months	5.96%	rescue personnel	CAPS
Zhen [24]	2012	China	210	–	210	12 Months	30%	Red Cross nurses	TSSC
Wang [25]	2010	China	343	105	238	3 Months	19%	health care workers	IES–R
Ozen [11]	2004	Turkey	44	NR	NR	2 Months	25%	Search and Rescue Workers	CAPS
Li [26]	2022	china	2059	268	1791	11 Years	0.58%	Hospital Medical Workers	ITQ
Ma [14]	2020	Taiwan	447	418	29	1 Month	12.7%	emergency medical technicians	PCL-S
Hsiao [27]	2019	Taiwan	38	38	0	6 Months	34.2%	Emergency Medical technicians	PCL-C
Sato [28]	2012	Japan	38	3	35	16 Months	39%	Nurses	IES-R
Nieh [29]	2020	Taiwan	63	NR	NR	1 Month	17.5%	Emergency Department Personnel	DTS
						7 Months	3.2%		
Kang [30]	2015	China	303	102	201	8 Months	21.8%	Medical rescuers	PCL-C
Schenk [31]	2017	China	337	240	97	3 Months	17%	medical rescue workers	IES-R

*__PCL 5__: Post-traumatic stress disorder Checklist for DSM-5, __TSSC__: Traumatic Stress Symptom Checklist, __CAPS__: Clinician-Administered Post-traumatic stress disorder Scale, __ITQ__: International Trauma Questionnaire, __IES-R__: Impact of Event Scale-Revised, __PCL-C__: Post-traumatic stress disorder Checklist-Civilian Version, __PTSS-10__: Post Traumatic Symptom Scale, __DTS__: Davidson Trauma Scale, **__NR:__ Not Reported.

3.2. Meta-analysis findings

The post-earthquake PTSD prevalence among medical workers involved in the earthquake response was obtained 16.37% (95% CI: 11.63–21.11%, $I^2 = 97.3\%$, $p = 0 < 0.001$). The I^2 index obtained in this study (Fig. 2) indicated a very high heterogeneity among the studies. The results of meta-regression demonstrated a descending trend in the prevalence of PTSD with the increase of the follow-up duration (Fig. 3). According to the findings of sensitivity analysis test, the overall outcome (PTSD prevalence) was the same after excluding each of the studies alone (Fig. 4). Also, the Begg test (P = 0.477) revealed a negligible publication bias regarding the prevalence of post-earthquake PTSD (Fig. 5).

4. Discussion

In this review, our main objective was to estimate the post-earthquake PTSD prevalence om medical workers participated in the earthquake response. The number of meta-analyzed studies was 13, and the post-earthquake PTSD prevalence among the selected population was obtained as 16.37%. Another meta-analysis article reported a prevalence of 23.17% for PTSD among Iranian firefighters [32]. Also, the findings of another meta-analysis study indicated a 14.2% PTSD prevalence among police forces [33]. Based on the meta-analysis study conducted by Golitaleb et al., a prevalence of 50.21% was obtained for PTSD among EMS personnel [34]. Another meta-analysis study by Sahebi et al. revealed a PTSD prevalence of 13.52% in health care professionals during the Covid-19 pandemic [35]. Likewise, a meta-analysis study compared the PTSD prevalence among police officers, firefighters, and ambulance personnel; this study found a higher prevalence among ambulance personnel in comparison with the other two groups [36]. According to our observation and the evidence from prior studies, it appears that all individuals involved in emergency responses to accidents and disasters are susceptible to PTSD, so this condition can be considered a major psychological outcome among first responders to calamities. Taking into mind that first responders endure a great deal of stress in emergency situations, it is required that these people be checked for psychological problems before being recruited in such critical professions. In addition, these individuals should be

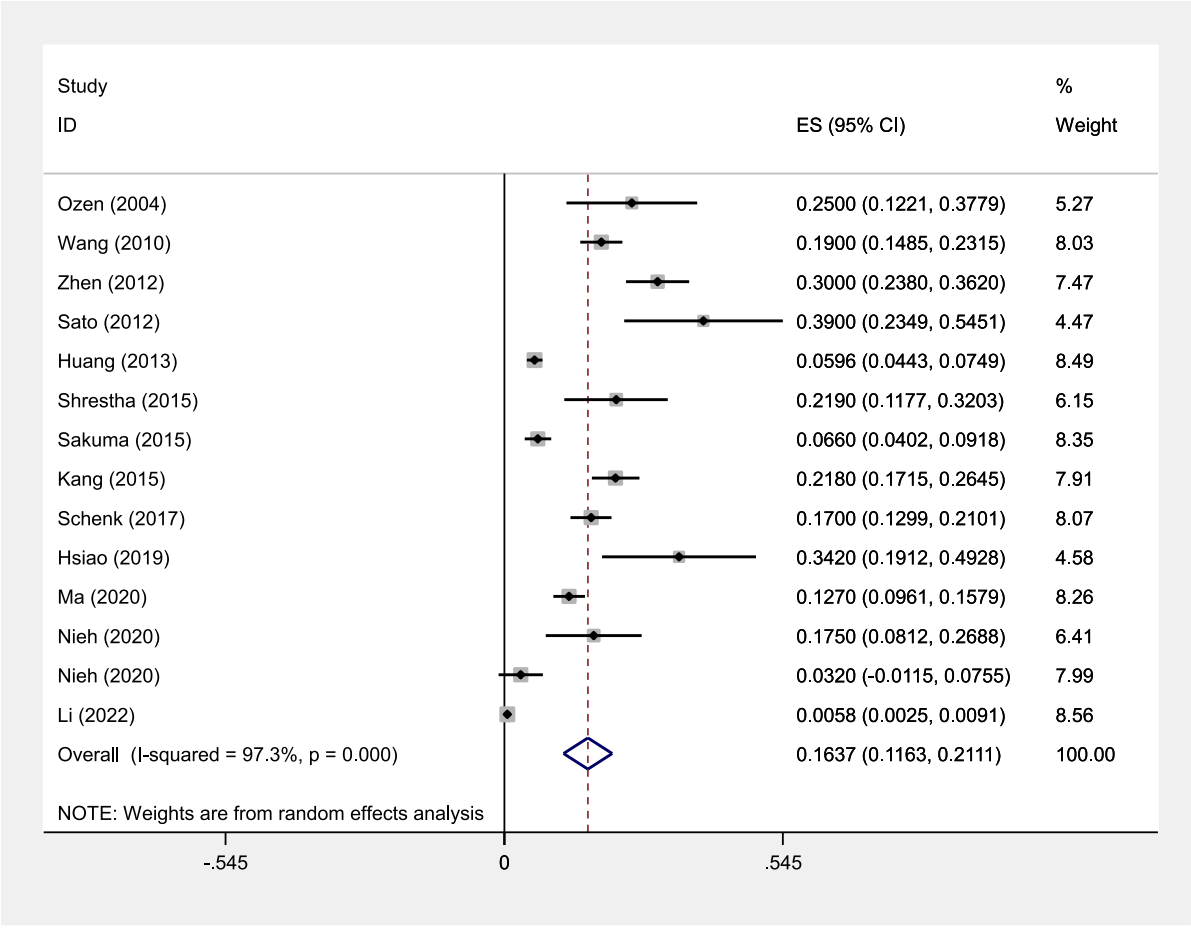

Fig. 2. Post-earthquake PTSD prevalence among medical staff participated in the earthquake response. Confidence intervals (95%) for each study alone and altogether have been provided.

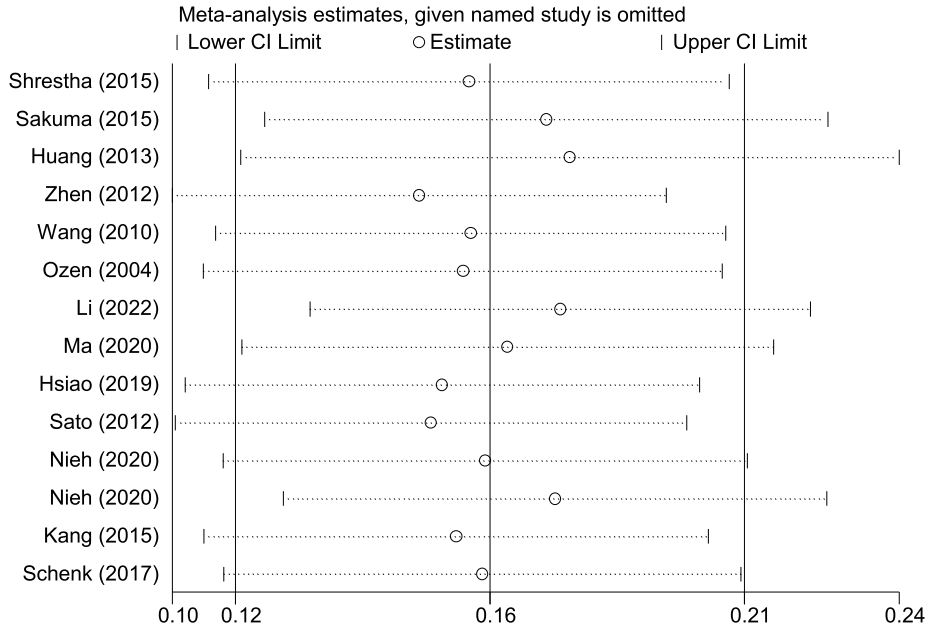

Fig. 3. Sensitively analysis for post-earthquake PTSD prevalence among medical staff participated in the earthquake response.

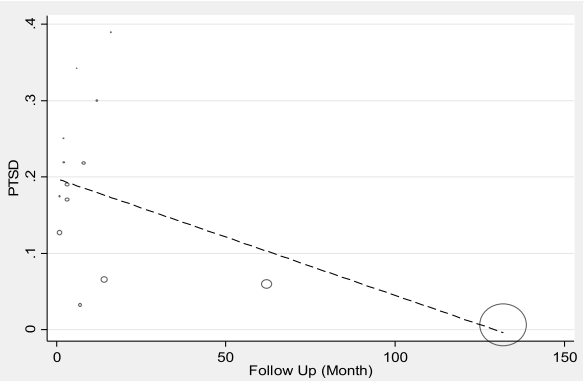

Fig. 4. The relationship between the follow-up duration and the post-earthquake PTSD prevalence among medical staff participated in the earthquake response.

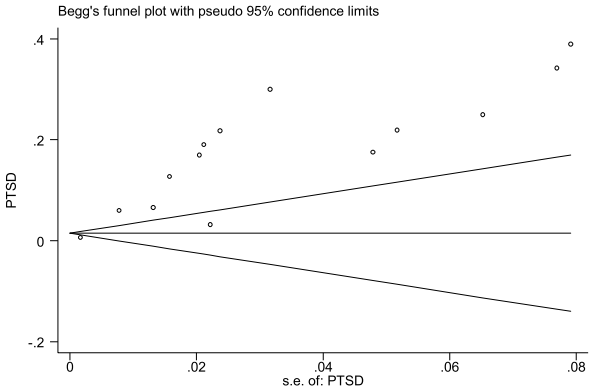

Fig. 5. Publication bias according to Begg's test for the post-earthquake PTSD prevalence among medical staff participated in the earthquake response.

regularly screened for PTSD, especially after they return from their missions. On the other hand, it is advisable to provide all first-responders with the necessary in-service training and interventions to reduce their stress, increase their psychological resilience, and finally, to reduce the risk of PTSD.

Research evidence suggests that PTSD is closely related to suicidal behaviors depending on the nature of the causative trauma [37]. Also, other studies have shown that first responders to disasters (including Emergency Medical Technicians (EMTs), firefighters, police officers, and aid workers) experience considerable job-related stress and are more prone to exhibit a variety of psychological disorders, such as PTSD and suicidal thoughts, increasing the rate of mortality among these people [38]. The results of a meta-analysis study indicated an association between increased risk of suicide and PTSD. Moreover, the major depressive disorder seems to intensify the suicide risk in people with PTSD [39]. Research findings have confirmed that people with PTSD are predisposed to life-threatening mental disorders, including suicide. Moreover, it has been found that PTSD symptoms are related to a wide range of post-disaster risk determinants, including social, cognitive, and emotional factors [40] Hence, medical workers at risk of PTSD should be timely identified after disasters via holding multiple sessions, and if necessary, they should be referred for treatment and psychological rehabilitation. Because these individuals are at risk of various psychological disorders, they have to be continuously screened to prevent the germination of suicidal thoughts and attempts. It is also suggested that responsible organizations psychologically and socially support medical workers suffering from PTSD and provide them with intermittent suitable rehabilitation programs so that they can recover their performance and return to work. On the other hand, such measures can prevent these workers' social isolation and avoid them becoming unemployed.

The results of the present study indicates that the PTSD prevalence declines with the time elapsing from earthquake occurrence. The findings of two meta-analysis studies showed a declining trend in the prevalence of PTSD over time among the survivors of earthquakes [41] and floods [42]. The findings of these studies are in good agreement with the results of the present review, reflecting a declining trend in the PTSD prevalence in survivors and medical workers after natural disasters over time. As a chronic psychological disorder, PTSD is likely to develop even long after a traumatic event, so it is suggested that medical workers be periodically and in the long-term evaluated for the occurrence of post-earthquake PTSD.

5. Conclusion

The results indicated that the medical workers involved in the earthquake response are at an elevated risk of PTSD both in the short- and long-term. It is noteworthy that PTSD is a chronic psychological disorder associated with other mental disorders including anxiety and can predispose to dreadful consequences such as suicide and death. To prevent PTSD and its associated mental disorders, medical workers involved in responding to disasters should undergo psychological screening for mental disorders before and after calamities. These individuals should also receive the necessary training for enhancing their stress management capabilities and psychological resilience and to learn how to express their feelings and emotions. On the other hand, those suffering from PTSD should receive medical treatments, as well as psychological counseling and psychosocial support.

Limitations

One of the limitations of this review was the high heterogeneity between the primary articles, which may be related to sample size, different tools, and cut-off points used by the studies. Also, because the primary studies did not report sex-stratified prevalence of PTSD, it was not applicable to separately report PTSD prevalence in men and women. Furthermore, due to the limited number of the tools employed, it was not amenable to conduct subgroup analysis based on the tools, which was another limitation of the present review.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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