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Post-Traumatic Stress Disorder after Disaster and Mass-Casualty Incidents in Developed and Developing Countries: A Meta-Analysis Study

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Abstract

Objective: Disasters impact global health, with Post Traumatic Stress Disorder (PTSD) being a significant early consequence. Countries differ in their response to disasters and health management, affecting PTSD prevalence. This study aims to compare PTSD prevalence in developed and developing countries and investigate its trends post-COVID-19 compared to other mass-casualty incidents.

Method: This study was conducted using systematic review and meta-analysis methods regarding the prevalence of PTSD in the world. Accordingly, all the English language articles published from the beginning of 2010 to the end of 2024 were extracted from the Scopus, Web of Science, PubMed, Cochrane Library, and Google Scholar databases and were investigated. Data analysis was done by random effects model, meta-regression, I^2 index, and Egger test using the STATA (ver. 17) software.

Results: One hundred and eight studies, with a total sample size of 498,796, were included in the meta-analysis. The prevalence of PTSD in developed countries at various intervals after exposure to disaster was as follows: 26.3% (1-3 months), 44.5% (4-6 months), 11.1% (7-12 months), 24.0% (13-24 months), and 22.0% (25-36 months). In developing countries, the corresponding prevalence rates were 26.0%, 25.2%, 30.4%, 21.4%, and 20.9%, respectively. PTSD prevalence in men was slightly higher in developing countries compared to developed countries, but the difference was minimal.

Conclusion: More than one-fifth of disaster-exposed populations develop PTSD, with no significant prevalence difference between developed and developing countries. PTSD prevalence was higher in men from developing countries, but no significant gender differences were found otherwise. Prompt diagnostic and therapeutic interventions are essential globally to mitigate PTSD's impacts.

Key words: *Developed and Developing Countries; Disaster; Meta-Analysis; Mass-Casualty Incident; Post-Traumatic Stress Disorder; Prevalence*

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In today's world, numerous mass casualty events happen, including pandemics and disasters leading to emergencies, and often demand medical support and pre-hospital attention (1). Every year, a large number of natural and artificial disasters, such as earthquakes, floods, storms, climate changes, chemical accidents, forest fires, wars, and disease pandemics occur in the world. Disasters affect society's health, economic, social, and psychological conditions. They can lead to food crises, water scarcity, spread of diseases, lack of access to healthcare services, and human death (2-4). Mental health is one of the aspects that are affected by disasters. After disasters, people are exposed to mental disorders due to the loss of family, shelter, economic assets, and social status. One most common disorder among these is post-traumatic stress disorder (PTSD). PTSD is a psychological imbalance after exposure to traumatic events that leads to avoidant behavior and makes people irritable (5).

The lifetime prevalence of PTSD in the United States is between 3.4% and 26.9%, the one-year prevalence is between 2.3% and 9.1%, and the point prevalence is between 8.0% and 56.7% (6). The Australian prevalence of PTSD in males is 8.2%, and in females, it is 16.1% (7). After the Wenchuan earthquake in China, the prevalence of PTSD in Mianzhu city, with the most serious havoc, was 86.2%. Also, since February 24, 2022, after the Ukraine war started, there has been an increased risk of disorders such as depression, anxiety, post-traumatic stress disorder, and physical injuries (8, 9). Additionally, after the spread of the COVID-19 pandemic around the world (2020), the prevalence of PTSD was estimated at 26.9% among health workers, 23.8% among infected patients, and 19.3% among the general population (10). Some studies announced that the prevalence of PTSD was higher in high-income countries like France, Germany, Spain, the United States, and Italy than in low or middle-income countries such as Peru, Lebanon, South Africa, Romania, and Mexico (11). Some well-known risk factors for PTSD include being female, smoking and addiction, past psychiatric diseases, chronic illnesses, a low-income status, becoming trapped in earthquake incidents, and having awful experiences in childhood (12). The side effects of PTSD vary and include heavy costs imposed on the society; limited functionality of humans; impaired neurocognitive function; and diminished activities at home, at work, or in relationships with other people (13). Various review studies have been conducted on the prevalence of PTSD after exposure to traumatic events (14). However, these studies are often conducted on specific incidents in limited areas and at the national level (15-17). Also, in recent years, the COVID-19 pandemic has affected the mental health of societies and the prevalence of PTSD in different ways in all countries of the world, both developed and developing (18). Considering the review studies on the prevalence of PTSD after disasters, this study was conducted to update estimates about the prevalence of this phenomenon in the world, separating developed and developing countries. In case of differences in prevalence in these countries, future studies will investigate the factors affecting them. It is worth mentioning that this study examined the prevalence of PTSD after the COVID-19 pandemic and compared it with other mass events to determine the role of this pandemic in the increase or decrease of PTSD. Accordingly, this study was conducted to investigate and compare the prevalence of PTSD in developed and developing countries and also to compare its prevalence after the COVID-19 pandemic with its prevalence following other mass events using a systematic review and meta-analysis method.

Materials and Methods

This study was conducted using systematic review and meta-analysis methods to investigate and compare the prevalence of PTSD in developed and developing countries based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (19).

Search Strategy

Two trained researchers conducted independent searches through articles, using search methods, in the Scopus, Web of Science, PubMed (including Medline), Cochrane Library, and Google Scholar international scientific databases. It included articles published since the beginning of 2010 to the end of 2024. The keywords of post-traumatic stress disorder, PTSD, prevalence, proportion, disaster, incident, crisis, catastrophe, mass casualty, nuclear disaster, radiation accident, earthquake, tsunami, hurricane, flood, tornado, storm, terrorist attack, wildfire, COVID-19, pandemic disease, war, and explosion were searched in the title, abstract and keywords of the articles using OR and AND operators in singular and compound forms.

Inclusion and Exclusion Criteria

Studies were included if: 1- Prevalence of PTSD was investigated in the study 2- Prevalence was assessed after exposure to disasters 3- Prevalence was assessed in the entire exposed population (aiming to estimate the prevalence in the whole population) 4- Prevalence was directly reported or the data required for estimation was presented in the article, 5- The study was of high quality, 6- The study (abstract or main text) was published in English. Studies were excluded if 1- They were conducted using the case-control method or were clinical trials, qualitative, systematic reviews, case reports or case series, and letters to the editor (the prevalence in the total population was not reported); 2- The study was conducted on special population groups such as pregnant women (It cannot report the prevalence in the entire population); 3- The study lacked the desired quality.

Quality Assessment

Quality assessment of articles was done using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist. This checklist has 22 parts and 33 sub-parts, which investigate compliance with the principles of writing and implementation in the title, implementation method, findings, limitations, and conclusions. Scoring is such that if each subset complies with that criterion, it will get a score of one, and if it does not, it will get a score of zero. Therefore, the maximum score that can be obtained is 33. In this study, articles that scored less than 50% had poor quality, between 50% and 75% had medium quality, and more than 75% were placed in the high-quality category (20).

Selection of Studies

3846 articles were extracted by searching the databases. At first, the references of the articles were entered into the Endnote (ver. X8) software, and duplication checks were done. 1642 articles were removed due to duplication. Then, the titles of the articles were reviewed, and 1492 unrelated titles were removed. After that, the full text of 712 articles was received, and 604 articles that lacked the required data and did not meet the inclusion criteria were excluded. In the next stage, the articles underwent quality assessment, and 108 articles with the desired quality (medium and high quality) were included in the meta-analysis process (Figure 1).

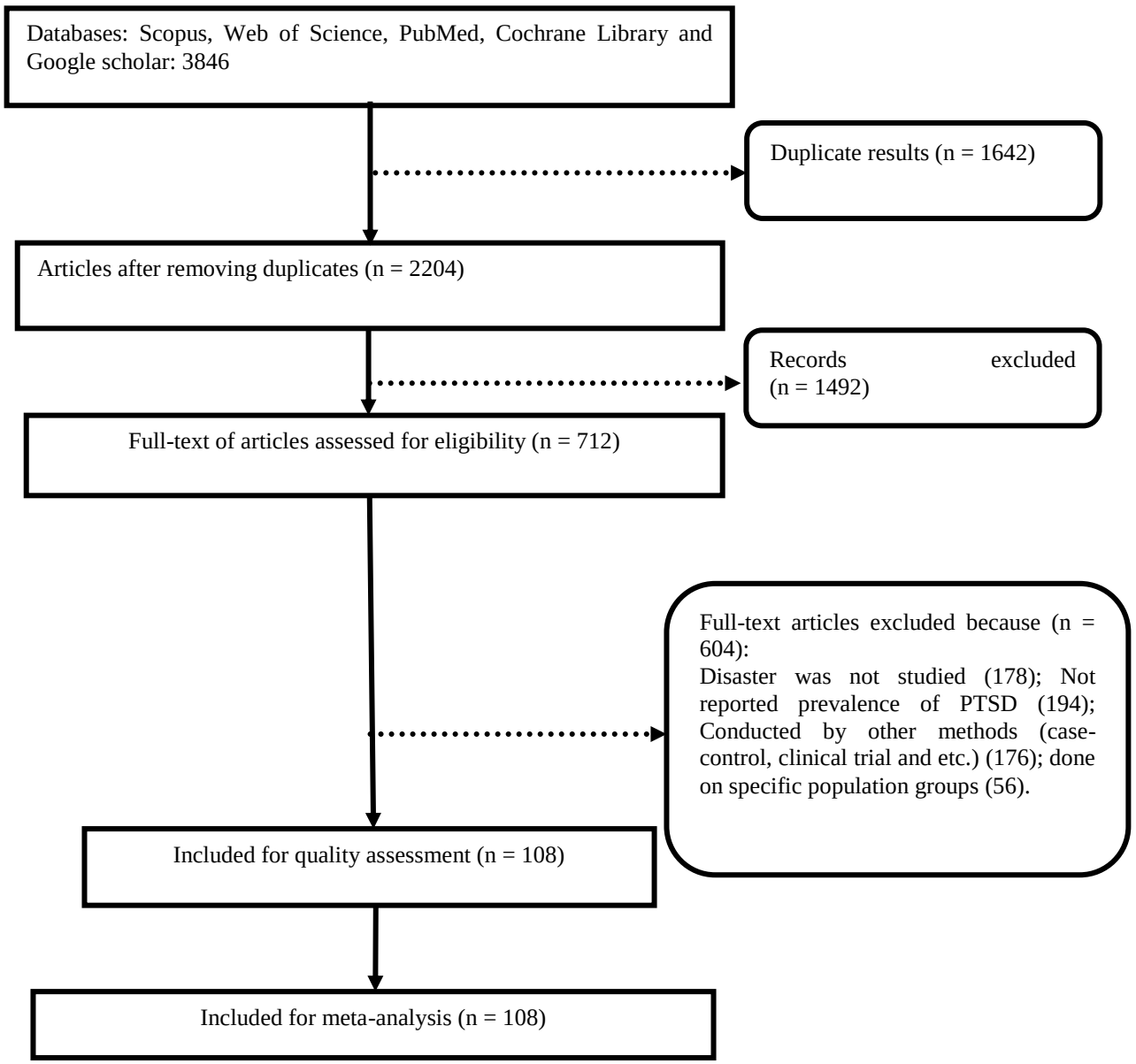

Figure 1. PRISMA 2020 Flow Diagram of Study Selection for Post-Traumatic Stress Disorder Prevalence after Mass-Casualty Incidents

Extracting the Data

First, the full text of the articles was independently reviewed by two researchers (F.Z., S.D.). After reviewing the text of the articles and considering the inclusion and exclusion criteria, if the articles were rejected by these two people, the reason was stated, and if there was a disagreement between them, the article was evaluated by a third researcher (A.K.). The required information included name of the first author, place of the study, year of the study, type of disaster, type of questionnaire used, age of participants in the study, time elapsed since the disaster, sample size, prevalence of PTSD in the total population, and the ratio of male and female in study sample were extracted using a checklist.

Statistical Analysis

Statistical data analysis was done for heterogeneous studies using the random effects model and for homogeneous studies using the fixed effects model in meta-analysis. The heterogeneity of studies was investigated using the meta-regression test, Cochrane test, and I^2 index, and publication bias was examined through the Bag and Egger test by the STATA (ver. 17) software.

Results

A total of 108 studies (21-121)] with a sample size of 498,796 people, conducted between 2010 and 2024 on the prevalence of PTSD among people exposed to disasters and mass-casualty incidents, were included in the systematic review and meta-analysis process. Among these, 41 studies, with a sample size of 324,854 people, were carried out in developed countries, and 67 studies, with a sample size of 173,942, were conducted in developing countries. The disasters and incidents investigated in these studies include: earthquakes (69 studies), the COVID-19 pandemic (10 studies), hurricanes (seven studies), floods (six studies), storms (five studies), terrorist bombings (four studies), tornados (three studies), explosions (three studies) and war (one study). Studies carried out in developed countries investigated the effects of earthquakes (19 studies), the COVID-19 pandemic (eight studies), hurricanes (seven studies), floods (three studies), terrorist bombings (three studies), and explosions (two studies), and in developing countries they examined the effects of earthquakes (50 studies), the COVID-19 pandemic (two studies), floods (three studies), storms (five studies), terrorist bombings (one study), tornadoes (three studies), explosions (one study) and war (one study). The duration of follow-up after disasters was between 1 and 36 months, and the age range of the people studied was between 10 and 80 years. The Characteristics of the reviewed articles are presented in Table 1.

Table 1. Characteristics of Studies Included in the Meta-Analysis of Post-Traumatic Stress Disorder Prevalence after Mass-Casualty Incidents

Author	Year of Study	Country	Type of Disaster	Questionnaire	Age	Duration of Follow-up (Month)	Sample Size	Quality Assessment
Sun *et al.* (21)	2021	China	COVID-19	PCL-5	18-60	1-3	45456	High
Georgieva *et al.* (22)	2021	UK, Belgium, Netherlands Bulgaria, Rep Czech, Finland India, Latvia, Poland, Romania, Sweden	COVID-19	DSM-5	18-80	1-3	9543	High
Rousset *et al.* (23)	2021	Italy	COVID-19	SPAN	14-70	1-3	15267	High
Al-Mutawa *et al.* (24)	2021	UAE, Kuwait, Saudi Arabia, Oman, Qatar, Bahrain	COVID-19	IES-R	18-65	4-6	946 9099 909 1383	High

Author	Year of Study	Country	Type of Disaster	Questionnaire	Age	Duration of Follow-up (Month)	Sample Size	Quality Assessment
							811	
							1023	
Zhou *et al.* (25)	2020	China	Earthquake	PCL-C	10-80	1-3	1487	High
Yang *et al.* (26)	2020	China	Earthquake	PCL-C	10-80	1-3	174	High
Xi *et al.* (27)	2020	China	Earthquake	PTSD-SS	13-80	1-3	607	High
Wang *et al.* (28)	2020	China	Earthquake	CRIES-13	13-18	1-3	1983	High
Cenat *et al.* (29)	2020	North America	Earthquake	IES-R	18-80	25-36	1355	High
Qi *et al.* (30)	2020	China	Earthquake	DSM-5	12-19	7-12	1241	High
Bonsaksen *et al.* (31)	2020	Norway	COVID-19	DSM-5	10-80	1-3	24603	High
Alshehri *et al.* (32)	2020	Saudi Arabia	COVID-19	DSM-V	18-24	1-3	1374	Mild
Alatawi *et al.* (33)	2020	Saudi Arabia	COVID-19	DSM-IV	10-80	4-6	1249	High
Giesinger *et al.* (34)	2020	America	Terrorist bombings	PCL-S	10 <	13-24	63666	High
Forresi *et al.* (35)	2020	Italy	Earthquake	SCL-90	9-14	13-24	431	Mild
Karatzias *et al.* (36)	2020	Ireland	COVID-19	DSM-5	18-65	1-3	5881	High
Forte *et al.* (37)	2020	Italy	COVID-19	DSM-5	18-74	1-3	2332	High
Zuniga *et al.* (38)	2019	Mexico	Earthquake	DSM-IV	10-80	1-3	1539	High
Zhou and Wu (39)	2019	China	Earthquake	CPSS	10 <	7-12	332	High
Xiao *et al.* (40)	2019	China	Earthquake	PCL-C	13-18	25-36	867	High
Thordardottir *et al.*(41)	2019	Iceland	Earthquake	PSS-Sr	18-80	1-12	1301	High
Sharma and Kar (42)	2019	Nepal	Earthquake	CPSS	12-19	7-12	409	High
Schwind *et al.* (43)	2019	Nepal	Earthquake	PCL-C	10-80	1-3	223	Mild
Schwartz *et al.* (44)	2019	USA	Hurricane	PCL-C	10-80	7-12	2767	High
Scaramutti *et al*. (45)	2019	USA	Hurricane	PCL-C	10-80	4-6	110	Mild
Rafiey *et al.* (46)	2019	Iran	Earthquake	DSM-IV	10-87	25-36	600	High
Orengo-Aguayo *et al.* (47)	2019	USA	Hurricane	NCTSN-HART	10-80	7-12	96108	High
Maya-mondragon *et al.* (48)	2019	Mexico	Earthquake	SQD	18-80	1-3	44855	High
Marthoenis *et al.* (49)	2019	Indonesia	Earthquake	DSM-IV PTSD/PHQ-9	16-18	4-6	321	Mild
Jin *et al.* (50)	2019	China	Earthquake	CRIES / SMFQ	12-18	25-36	3962	High

Author	Year of Study	Country	Type of Disaster	Questionnaire	Age	Duration of Follow-up (Month)	Sample Size	Quality Assessment
Inoue *et al.* (51)	2019	Japan	Earthquake	SQD	65 <	1-3	580	High
Hall *et al.* (52)	2019	China	Storm	PCL-5	10-30	1-3	1876	High
Gonzalez *et al.* (53)	2019	USA	Hurricane	PCL	10-80	4-6	1294	High
Geng *et al.* (54)	2019	China	Earthquake	PTSD-SS	10-80	4-24	1573	High
Asnakew *et al.* (55)	2019	Ethiopia	Earthquake	PCL-C	15-80	4-6	830	High
An *et al*. (56)	2019	China	Tornado	CPSS	10-19	4-12	154	Mild
Adhikari Baral and Bhagawati (57)	2019	Nepal	Earthquake	PCL-5	20-80	7-12	291	High
Xu *et al.* (58)	2018	China	Earthquake	CRIES-13	10-20	13-24	1509	High
Thapa *et al.* (59)	2018	Nepal	Earthquake	PTSD8	18-80	13-24	198	High
Tang *et al.* (60)	2018	China	Earthquake	CRIES-13	10-18	4-6	5505	Mild
Su *et al.* (61)	2018	Taiwan	Earthquake	DSM-5	10-80	13-24	116	High
Shi *et al.* (62)	2018	China	Earthquake	PTSD-SS	11-18	7-24	688	High
Huang *et al.* (63)	2018	Taiwan	Explosion	DRPST	10-80	4-6	502	High
Farhood *et al.* (64)	2018	Lebanon	War	HTQ	20-80	7-12	991	High
Dahal *et al.* (65)	2018	Nepal	Earthquake	PCL-C	18-75	4-6	535	High
Acharya *et al.* (66)	2018	Nepal	Earthquake	CPSS	7-16	13-24	800	High
Tang *et al.* (67)	2017	China	Earthquake	DSM-IV	10-18	7-36	435	Mild
Seyedin *et al.* (68	2017	Iran	Flood	PTSS-10	19-73	1-3	400	High
Navarro-Mateu *et al.* (69)	2017	Spain	Earthquake	DSM-IV	18-80	7-12	412	Mild
Fujiwara *et al.* (70)	2017	Japan	Earthquake	DSM-IV	5-8	13-24	280	High
Uemura *et al.* (71)	2016	Japan	Earthquake	PCL-C	10-80	1-3	63047	High
Chowhan *et al.* (72)	2016	Malaysia	Flood	DSM-IV	18-80	1-3	208	High
Liu *et al.* (73)	2016	China	Earthquake	PCL-C	11-18	25-36	4072	High
Chowhan *et al.* (72)	2016	India	Storm	DSM-IV	6-17	25-36	100	High
Zhang *et al.* (74)	2015	China	Earthquake	PCL-C	18-80	25-36	360	High
Pan *et al.* (75)	2015	China	Earthquake	IES-R	11-16	25-36	362	Mild
North *et al.* (76)	2015	USA	Terrorist bombings	DSM-IV	10-80	25-36	373	High
Jin *et al.* (77)	2015	China	Earthquake	PCL-C	10-20	25-36	850	High

Author	Year of Study	Country	Type of Disaster	Questionnaire	Age	Duration of Follow-up (Month)	Sample Size	Quality Assessment
Idris *et al.* (78)	2015	Malaysia	Flood	CPTSD-RI	10-12	4-6	219	High
Guo *et al.* (79)	2015	China	Earthquake	IES-R	10-80	4-6	1362	High
Cofini *et al.* (80)	2015	Italy	Earthquake	DSM-IV	10-80	13-24	281	High
Cheng *et al.* (81)	2015	China	Earthquake	DSM-IV	10-80	7-12	182	High
Caramanica *et al*. (82)	2015	USA	Hurricane	PCL-17	10-80	7-12	1923	High
Adams *et al.* (83)	2015	USA	Tornado	NSA-PTSD	12-17	4-12	2000	High
Wu *et al.* (84)	2014	China	Earthquake	DSM-IV	18-68	7-12	2080	High
Tian *et al.* (85)	2014	China	Earthquake	PCL-C	12-19	25-36	4604	High
Sana and Khattak (86)	2014	Pakistan	Flood	DSM-IV	7-80	4-6	80	Mild
López-García and López-Soler (87)	2014	Spain	Earthquake	CPSS	8-12	1-12	495	High
Guo *et al.* (88)	2014	China	Earthquake	IES-R	10-80	1-36	4794	High
Flores *et al.* (89)	2014	Peru	Earthquake	PCL-C	21-80	25-36	1012	High
Chen *et al.* (90)	2014	China	Earthquake	IES-R	21-80	1-3	1039	High
Cénat and Derivois (91)	2014	USA	Earthquake	IES-R	18-80	25-36	1355	High
Adams *et al*. (92)	2014	USA	Tornado	DSM-IV	12-17	4-6	2000	High
Zhou *et al.* (93)	2013	China	Earthquake	DSM-IV	15-80	4-6	14798	High
Zhang *et al.* (94)	2013	Kenya	Terrorist bombings	DSM-IV	22-54	25-36	244	High
Yuan *et al.* (95)	2013	China	Earthquake	DSM-IV	10-80	7-12	624	High
Ying *et al.* (96)	2013	China	Earthquake	DSM-IV	8-19	7-12	3052	High
Langley *et al.* (97)	2013	USA	Hurricane	CPSS	12-18	13-24	195	Mild
Kun *et al.* (98)	2013	China	Earthquake	DSM-IV	12-80	4-6	922	High
Gokcen *et al.* (99)	2013	Turkey	Earthquake	CPTS-RI	14-14	4-6	450	High
Feder *et al.* (100)	2013	Pakistan	Earthquake	TSSC-PTSD	10-80	4-6	200	High
Carmassi *et al.* (101)	2013	Italy	Earthquake	DSM-IV	10-80	4-6	204	High
Burnett *et al.* (102)	2013	Haiti	Earthquake	PCL-C	10-40	4-6	140	Mild
Zhang *et al.* (103)	2012	China	Earthquake	PCL-C	60 <	7-12	274	High
Zhang *et al*. (104)	2012	China	Earthquake	PCL-C	15-18	4-24	548	High
Sezgin and Punamäki (105)	2012	Turkey	Earthquake	PCL-C	10-80	4-6	1253	High

Author	Year of Study	Country	Type of Disaster	Questionnaire	Age	Duration of Follow-up (Month)	Sample Size	Quality Assessment
Pietrzak *et al.* (106)	2012	USA	Hurricane	PCL-C	60-100	1-3	193	High
Ali *et al.* (107)	2012	Pakistan	Earthquake	DSM-IV	10-80	25-36	300	High
Yang *et al.* (108)	2011	China	Earthquake	PCL-C	15-18	1-12	1677	Mild
Yang *et al.* (109)	2011	Taiwan	Storm	MINI-KID	12-15	4-6	271	Mild
Xu and Liao (110)	2011	China	Earthquake	PCL-C	10-80	7-12	2080	High
Wu *et al.* (111)	2011	China	Storm	IES-R	15-25	1-3	968	High
Wang *et al.* (112)	2011	China	Earthquake	DSM-IV	18-65	1-3	430	High
Naeem *et al.* (113)	2011	Pakistan	Earthquake	DSM-IV	18-76	13-24	1298	High
Meewisse *et al.* (114)	2011	Netherlands	Explosion	DSM-IV	18-80	13-24	1567	High
Ma *et al.* (115)	2011	China	Earthquake	DSM-IV	10-18	4-6	3208	High
Liu *et al.* (116)	2011	China	Earthquake	TSCC-A	8-11	4-12	130	Mild
Goenjian AK (117)	2011	Greece	Earthquake	DSM-IV	13-18	25-36	511	High
Digrande *et al.* (118)	2011	USA	Terrorist bombings	PCL-S	18-80	25-36	3271	High
Dell'Osso *et al.* (119)	2011	China	Earthquake	DSM-IV	15-25	7-12	512	High
Chen *et al.* (120)	2011	Taiwanese	Storm	DSM-IV	65 <	1-3	120	High
Bozkurt *et al.* (121)	2011	Turkey	Earthquake	CAPS	15-82	1-3	188	High
Agustini *et al.* (122)	2011	Indonesia	Flood	CPTSD-RI	11-19	25-36	482	Mild
Wang *et al.* (123)	2010	China	Flood	CAPS	16-50	1-6	48	High
McDermott *et al.*(124)	2010	Australia	Explosion	PTSD-RI	8-15	1-3	568	Mild
Cairo *et al.* (125)	2010	Peru	Earthquake	PCL-C	18-80	1-3	296	High
Bailey *et al.* (126)	2010	USA	Earthquake	PTSD-RI	18-80	1-3	200	High
Lei *et al.* (127)	2021	China	COVID-19	PCL	18-39	1-3	1593	High

According to findings of meta-analysis, the worldwide prevalence of PTSD is estimated at 26.2% within 1-3 months, 34.0% within 4-6 months, 20.6% within 7-12 months, 22.0 % within 13-24 months, and 21.0% within 25-36 months after exposure. This amount was estimated as 26.3%, 44.5%, 11.1%, 24.0%, and 20.0% in developed countries and 26.0%, 25.2%, 30.4%, 21.4%, and 20.9% in developing countries, respectively (Table 2 and Figure 2).

The meta-analysis findings regarding the global prevalence of PTSD across genders revealed notable patterns. Among men, the highest occurrence of PTSD was observed at 7-12 months post-exposure, with a prevalence of 22.4%. Conversely, the lowest prevalence, at 18.3%, was found within 1-3 months post-exposure. These trends varied based on the developmental status of the countries involved. In developed nations, men exhibited peak PTSD rates at 25-36 months post-exposure (20.8%), contrasting sharply with a low of 3.3% within 7-12 months post-exposure. In contrast, men from developing countries experienced peak PTSD prevalence at 4-6 months post-exposure (26.1%), with the lowest prevalence of 17.2% within 1-3 months post-exposure (see Figure 3). Also, the highest and lowest

prevalence of PTSD among women in the world was observed 7-12 months (35.5%) and 25-36 months (24.9%) after exposure, respectively. In women from developed countries, these extremes were observed 13-24 months (42.5%) and 25-36 months (18.0%) after exposure, and in women from developing countries, these were observed 7-12 months (36.8%) and 13-24 months (20.1%) after exposure, respectively (Table 2, Figures 3 and 4).

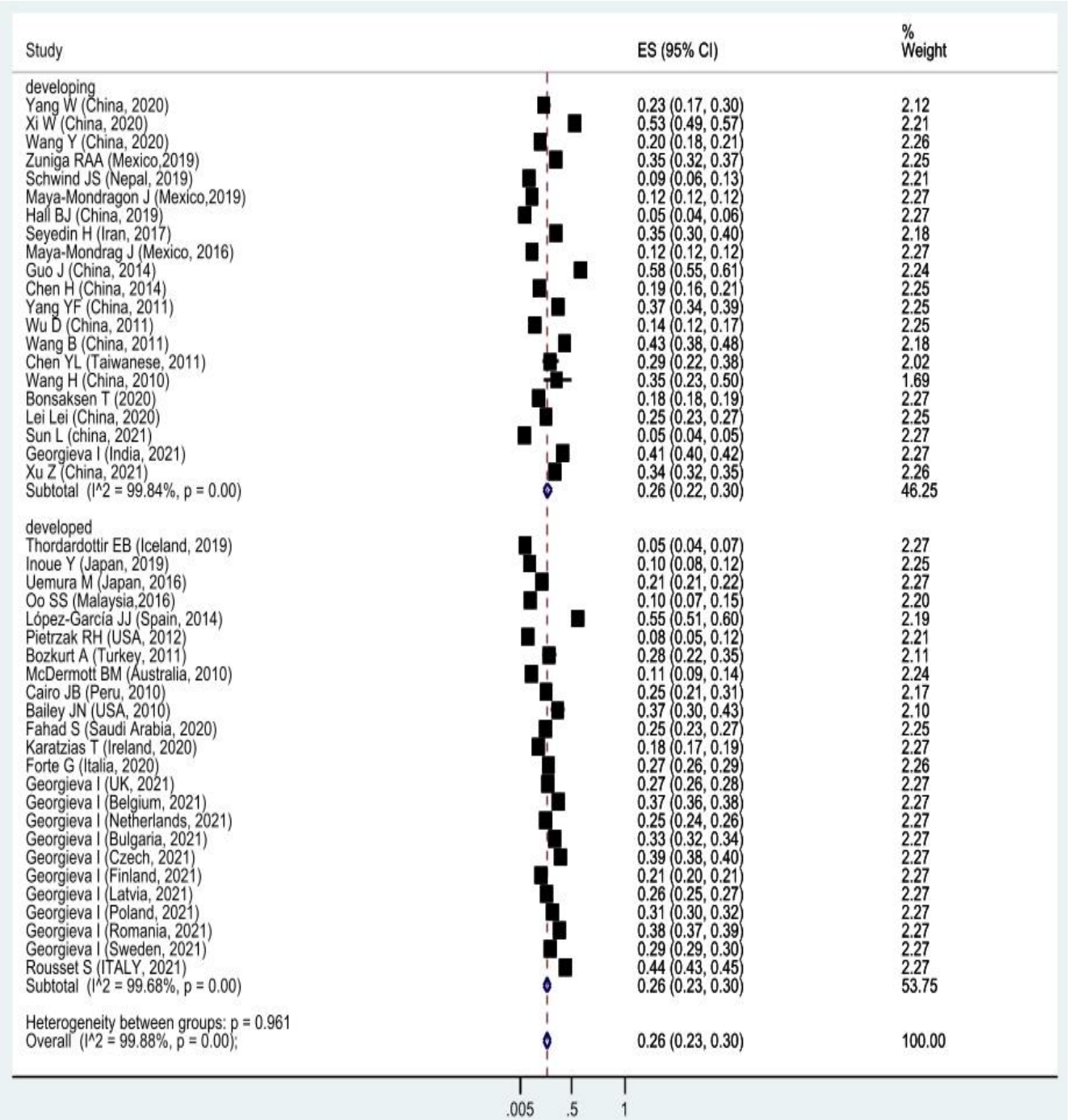

Figure 2. Forest Plots of the Prevalence of Post-Traumatic Stress Disorder in the World's Developed and Developing Countries 1-3 Months after Exposure to Disaster and 95% Confidence Interval Based on a Random Effect Model in Meta-Analysis

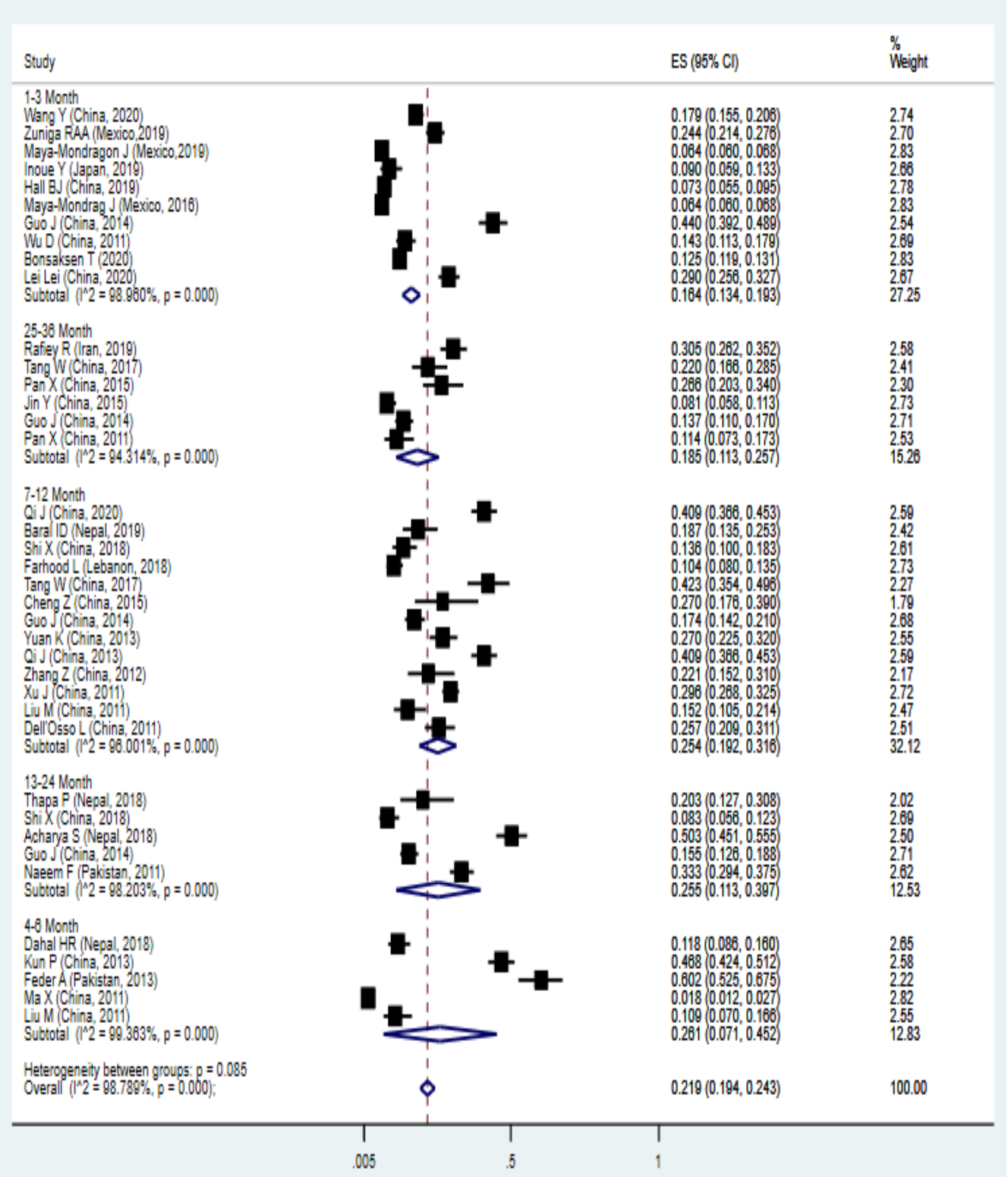

Figure 3. Forest Plots of the Prevalence of Post-Traumatic Stress Disorder in Men in Developing Countries and 95% Confidence Interval Based on a Random Effect Model in Meta-Analysis

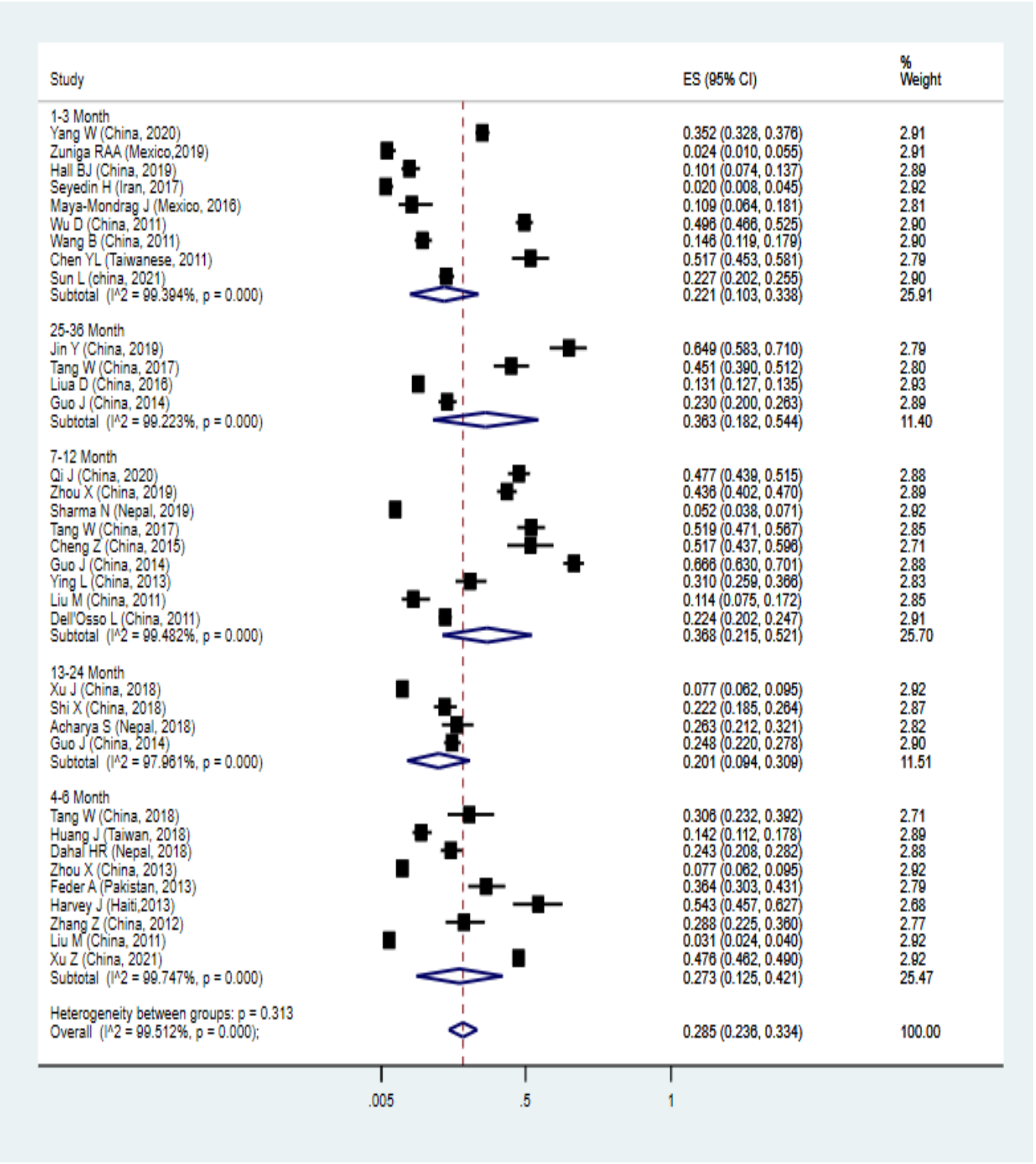

Figure 4. Forest Plots of the Prevalence of Post-Traumatic Stress Disorder in Women in Developing Countries and 95% Confidence Interval Based on a Random Effect Model in Meta-Analysis.

Table 2. Prevalence of Post-Traumatic Stress Disorder in the World, Developed and Developing Countries, in all the Population, among Men and Women

PTSD	Follow-up Duration (Month)	Number of Studies	Prevalence in the World (%)	Heterogeneity		Number of Studies	Prevalence in Developed Countries (%)	Heterogeneity	Number of Studies	Prevalence in Developing Countries (%)	Heterogeneity
Total	1-3	44	26.2 (22.7-29.7)	99.88	0.00	24	26.3 (22.5-30.0)	99.90	20	26.3 (22.5-30.0)	99.9
	4-6	35	34.0 (27.0-41.0)	99.83	0.00	16	44.5 (29.2-59.9)	99.70	19	25.2 (19.9-30.5)	99.80
	7-12	28	20.6 (12.0-30.0)	99.51	0.00	7	11.1 (8.2-14.0)	98.30	21	30.4 (23.1-37.7)	99.50
	13-24	15	22.0 (17.0-27.0)	99.33	0.00	6	24.0 (16.7-31.3)	99.00	9	21.4 (11.6-31.2)	99.30
	25-36	22	21.0 (18.0-25.0)	98.73	0.00	7	22.0 (15.0-29.0)	97.60	15	20.9 (16.5-25.3)	98.50
Men	1-3	16	18.3 (15.0-21.6)	99.24	0.00	7	19.1 (4.9-33.3)	99.40	9	17.2 (14.0-20.3)	99.00
	4-6	10	19.3 (13.5-25.0)	96.58	0.00	5	16.3 (10.1-22.4)	96.40	5	26.1 (7.1-45.2)	99.36
	7-12	15	22.4 (15.6-29.2)	98.61	0.00	2	3.3 (2.4-4.2)	-	13	25.4 (19.2-31.6)	96.00
	13-24	8	20.9 (13.9-27.8)	98.66	0.00	3	12.2 (4.8-19.5)	-	5	25.5 (11.3-39.7)	98.20
	25-36	10	19.6 (15.4-27.8)	98.79	0.00	4	20.8 (8.1-33.4)	-	6	18.5 (7.1-45.2)	94.30
Women	1-3	13	25.1 (16.4-33.9)	99.47	0.00	4	32.0 (10.8-53.2)	99.65	9	22.1 (10.3-33.8)	99.40
	4-6	16	30.6 (23.7-37.5)	98.85	0.00	7	34.9 (25.1-44.6)	99.55	9	27.3 (12.5-42.1)	99.75
	7-12	13	35.5 (23.7-47.3)	99.36	0.00	4	32.7 (8.3-57.2)	98.55	9	36.8 (21.5-52.1)	99.48
	13-24	8	31.3 (20.7-41.9)	99.47	0.00	4	42.5 (15.9-69.0)	99.70	4	20.1 (9.4-30.9)	97.96
	25-36	10	24.9 (19.0-30.0)	99.49	0.00	6	18.0 (8.4-27.6)	99.5	4	36.6 (18.2-54.4)	99.22

Publication bias was investigated using a funnel plot and Egger's test. Due to the asymmetry of the funnel plot, there is a possibility of unpublished studies in this field (Figure 5). Also, using meta-regression, the relationship between the year of the study and the prevalence of PTSD was investigated. Based on the findings, the prevalence of PTSD increased with the increase in the number of years of the study (Figure 6. A); however, when conducting meta-regression to exclude studies that were conducted during the COVID-19 pandemic, the analysis revealed that the prevalence of PTSD remained consistent regardless of the duration of the study period. It indicates that over time, there was no significant alteration in the prevalence rates of PTSD (refer to Figure 6. B).

Table 3. Prevalence of Post-Traumatic Stress Disorder in the World, Developed and Developing Countries

Disaster	Follow-up Duration (Month)	Number of Studies	Prevalence of PTSD in the World (%)	Heterogeneity		Number of Studies	Prevalence of PTSD in Developed Countries (%)	Heterogeneity	Number of studies	Prevalence of PTSD in Developing Countries (%)	Heterogeneity
COVID-19	1-3	26	24.1 (21.0-27.2)	99.50	0.00	10	21.2 (14.3-28.1)	99.50	16	27.1 (23.1-30.3)	99.40
	4-6	27	28.2 (24.1-32.3)	93.37	0.00	9	35.3 (25.1-44.4)	99.50	18	25.3 (20.2-30.4)	99.30
	7-12	28	26.2 (22.4-30.1)	99.51	0.00	7	11.2 (8.3-14.6)	99.40	21	30.2 (23.2-38.3)	99.50
	13-24	15	22.4 (17.3-27.6)	99.33	0.00	6	24.2 (17.3-31.6)	99.70	9	21.4 (12.2-31.3)	99.00
	25-36	23	22.1 (19.2-24.3)	98.50	0.00	8	22.4 (15.3 -29.6)	98.70	15	21.2 (17.3-25.4)	98.70
COVID-19	1-3	18	28.2 (21.3-36.6)	99.90	0.00	14	30.2 (26.1-34.3)	99.9	4	22.1 (8.2-36.4)	99.90
	4-6	8	54.3 (40.2-67.3)	99.70	0.00	7	56.4 (43.3-70.8)	88.1	1	34.3 (32.4-35.8)	0.00

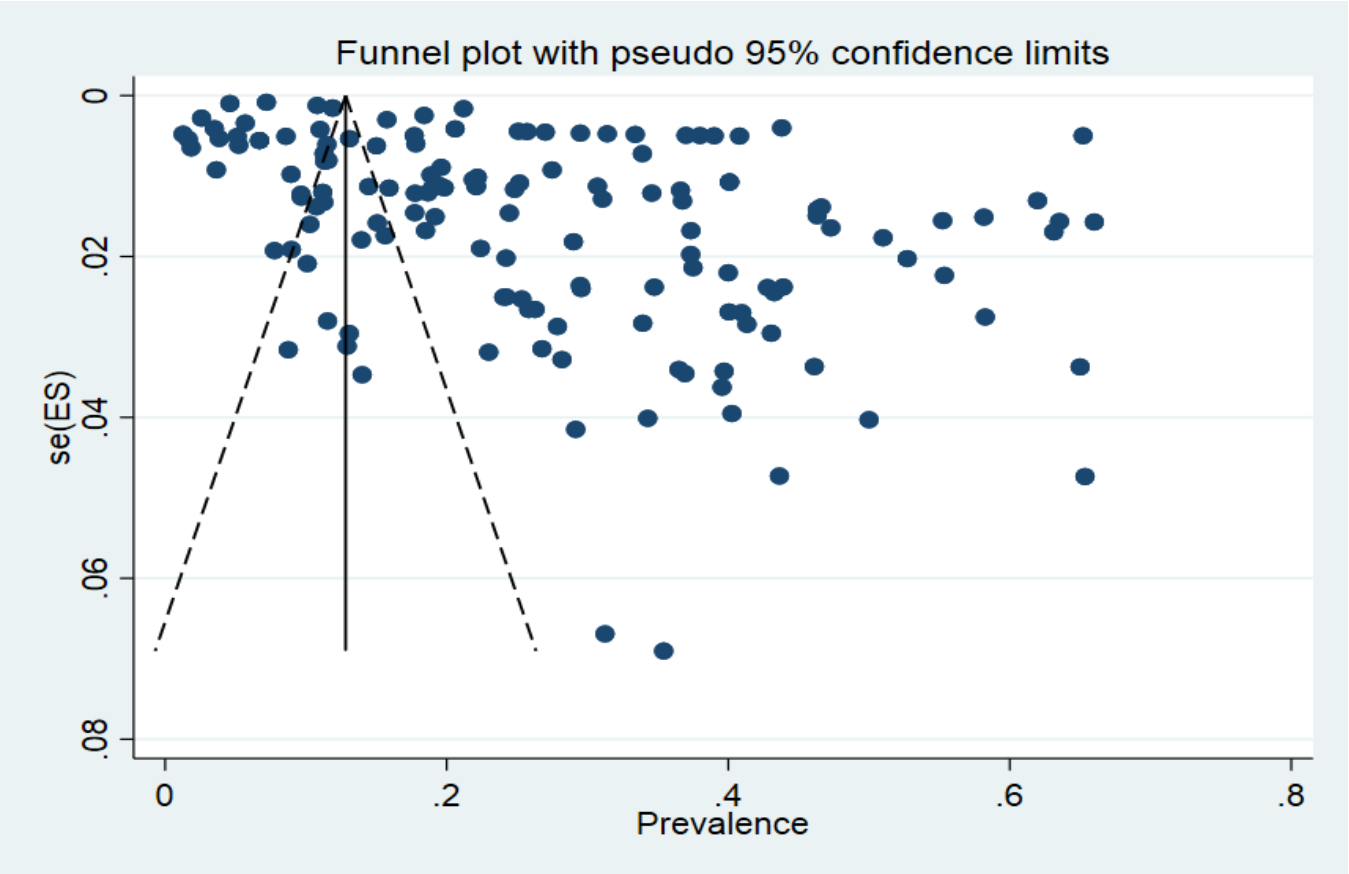

Figure 5. Funnel Plot Assessing Publication Bias in Post-Traumatic Stress Disorder Prevalence Estimates after Mass-Casualty Incidents

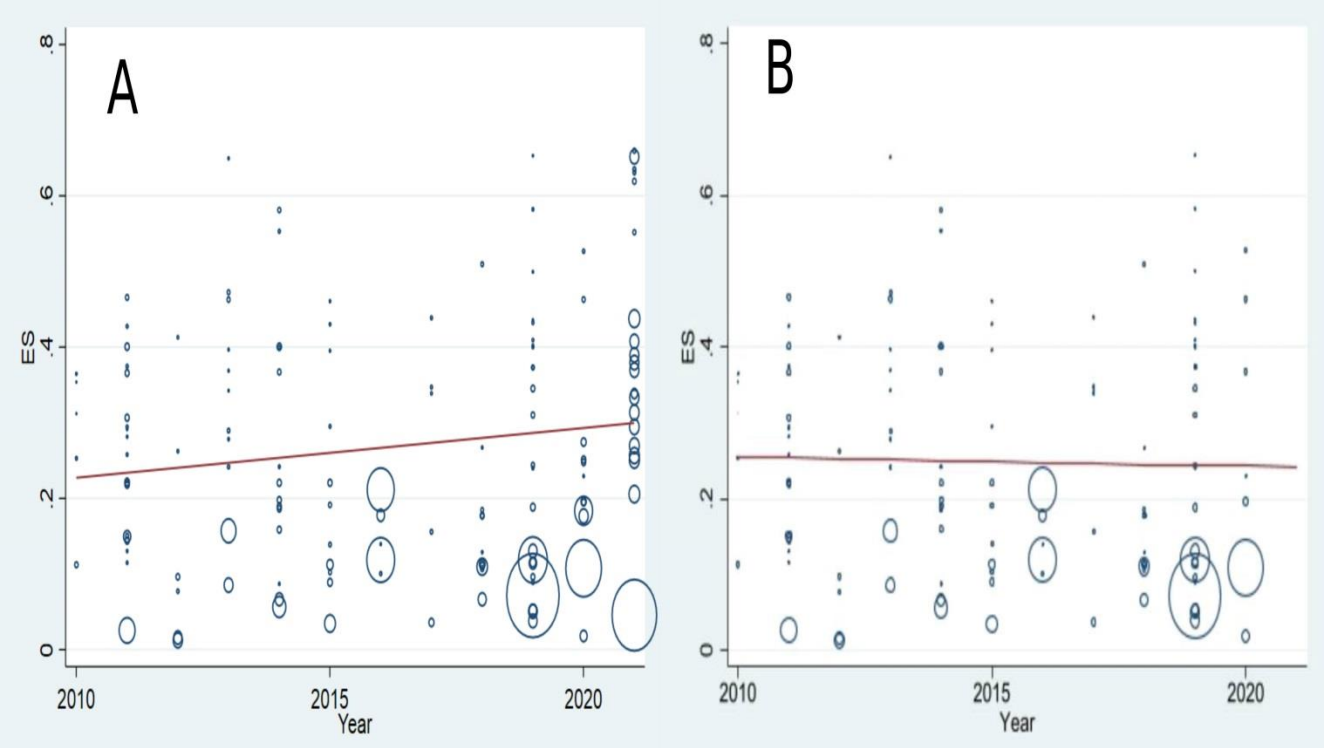

Figure 6. Meta Regression of the Prevalence Rate of Post-Traumatic Stress Disorder Based on the Study Year

A: All Disasters B: without COVID-19 Pandemic

Discussion

Multiple studies investigated the prevalence of PTSD among survivors of various disasters and mass-casualty incidents and found mixed results. The prevalence of PTSD is high across the world and among individuals who have experienced more severe traumas (128-131). It is important to note that these figures may vary depending on the studied population and the period after exposure (132-137). Therefore, this study is the first systematic review and meta-analysis to assess the combined prevalence of PTSD. It was conducted to gain a better understanding of the prevalence of PTSD in developed and developing countries in various periods after exposure to disasters.

The pooled prevalence of PTSD is similar in both developed and developing countries (26.0%) because traumatic events are universal and can occur in any country. However, there may be cultural differences in how people cope with trauma, which could lead to different levels of reported symptoms and rates of detection at different times (138, 139). The results of different studies have been different. A review study among trauma victims in the years 1995 to 1999 claimed that the risk of PTSD after exposure to traumatic events is higher in less developed countries. The reason for the higher prevalence in these countries is the fact that these countries are more exposed to armed conflict, wars, political struggles, and ethnic violence (135). However, in the present study, only six studies were included that were related to terrorist bombings and war, which were equally distributed in both groups of countries; therefore, it is difficult to generalize the findings.

The pooled prevalence of PTSD in the current study at the different times of 1-3 months, 4-6 months, 7-12 months, 13-24 months, and 25-36 months after exposure was found to be 26.3%, 44.5%, 11.1%, 24.0%, and 20.0% in developed countries and 26.0%, 25.2%, 30.4%, 21.4%, and 20.9% in developing countries, respectively. According to these results, the prevalence of PTSD is similar comparing developed and developing countries in the immediate three months after the trauma. However, after 4-6 months in developed countries and 7-12 months in developing countries, there is a notable peak in PTSD prevalence. Based on the findings, the highest prevalence of PTSD is observed 4-12 months after the exposure, probably because PTSD symptoms can take time to develop (136), and the 4-12 months period is when people are most likely to start experiencing symptoms. Additionally, this period may be when people are more likely to seek help for their symptoms, leading to a higher prevalence of PTSD being reported. While some long-term studies on PTSD following human-made disasters have indicated a decrease in its prevalence over time (140-142), this trend does not hold for certain minority groups and the prevalence may increase (143).

This meta-analysis indicated that the impact of COVID-19 on PTSD is likely to be more severe in developed

countries than in developing countries. The prevalence of PTSD decreased in developed countries with the elimination of COVID from analyses (PTSD 1-3 months and 4-6 months without COVID, 21.2% and 35.3% vs. 30.2% and 56.4% with COVID). However, it did not change in developing countries, perhaps because the effects of COVID-19 in these countries may be different to its effects in developed countries. The reasons for this disparity are presumably multi-faceted.

Developing countries often lack access to adequate healthcare, mental health services, and other resources that can help people cope with the psychological effects of a disaster. Additionally, many developing countries are already dealing with high levels of poverty, violence, and other forms of trauma that can increase the risk of PTSD.

people in developed countries have access to better mental health services, more resources to cope with trauma, and more support systems in place. Additionally, individuals in developed countries may be more likely to seek help for their PTSD symptoms due to greater awareness and understanding of the disorder. These countries had to implement more stringent measures to control the virus, such as lockdowns and social distancing, which can lead to increased feelings of isolation and loneliness. These measures can also disrupt daily routines, causing a disturbance to the sense of normalcy and security on which many rely. Additionally, many people in developed countries have experienced job losses or financial insecurity due to the pandemic, which can contribute to mental health issues such as anxiety and depression.

In contrast, many developing countries may not have the resources or infrastructure to implement such measures and may not be as severely impacted economically. It could mean that people in these countries are less likely to experience the same levels of stress and anxiety associated with the pandemic. Furthermore, developing countries may have more resilient communities that can better cope with adversity due to their experience with poverty and other hardships (144).

A meta-analysis study from 24 different countries during the COVID-19 pandemic up to June 2021 showed that the overall pooled estimate of PTSD prevalence was 17.52%, and Europe has the highest prevalence of PTSD (25.05%) compared to Asia (15.50%) and America (8.08%). Likewise, the pooled prevalence of PTSD according to countries' GDP was 9.88 for low-income, 17.05 for upper-middle-income, and 19.35 for high-income countries (145).

In contrast, a study in China reported that the prevalence of PTSD after one month of COVID-19 was 7.0% (146). Studies in Bangladesh reported high prevalence estimates of depression and anxiety (147). However, the high prevalence may be because the study was conducted at the beginning of the pandemic and because of the coincidence of COVID-19 with other recent events, such as cyclone 'Amphan.' In line with the study in Bangladesh, a review stated that most cases of COVID-19 are reported in low-income New York neighborhoods. Residents of these areas experience various stressors that may increase the risk of PTSD (148).

Also in line with this study, a meta-analysis showed that the prevalence of PTSD is higher in women than in men, with a pooled estimate of 26.2% for women and 21.9% for men (149). These results show that women from developed countries have a higher prevalence of PTSD than women from developing countries. In comparison, men from developed countries have a lower prevalence of PTSD than men from developing countries. These findings indicate that gender and country of origin may play an essential role in determining the likelihood of developing PTSD following a traumatic event, as reported in a meta-analysis (150).

There are a variety of factors that may contribute to why women have a higher prevalence of PTSD. One factor is that women are more likely than men to experience traumatic events, such as sexual assault, physical assault, and childhood abuse. Additionally, women may be more likely to experience multiple traumatic events in their lifetime than men. Women may also be more likely to experience longer-term or chronic trauma because they are more likely to be victims of intimate partner violence or domestic abuse. Furthermore, women may be more likely to internalize their trauma and struggle with feelings of guilt or shame, which can lead to higher levels of PTSD symptoms. Finally, there is evidence that suggests that hormonal changes during the menstrual cycle can increase vulnerability to PTSD symptoms in women (151, 152).

Limitation

While this study provides valuable insights into the prevalence of PTSD following disasters and mass-casualty incidents in both developed and developing countries, several limitations should be acknowledged:

1. Heterogeneity of Included Studies: The studies included in this meta-analysis were conducted in different countries, with varying methodologies, sample sizes, and study designs. This heterogeneity could introduce variability in the reported PTSD prevalence rates. Although statistical methods such as the random effects model and meta-regression were employed to account for this, some level of inconsistency may still exist.

2. Variability in PTSD Assessment Tools: The included studies used different PTSD assessment tools, such as DSM-IV, DSM-5, PCL-C, IES-R, and other validated instruments. While all these tools are commonly used for PTSD diagnosis, differences in their sensitivity and specificity might have led to variations in prevalence estimates across studies.

3. Lack of Data on Pre-Existing Mental Health Conditions: Many included studies did not control for pre-existing psychiatric disorders that could contribute to

PTSD symptoms following a disaster. This limitation may affect the accuracy of PTSD prevalence estimation since individuals with prior mental health issues might be more vulnerable to PTSD.

4. Differences in Healthcare Systems and Support Services: The study compares PTSD prevalence between developed and developing countries; however, it does not account for differences in mental health infrastructure, access to healthcare services, and cultural factors influencing PTSD diagnosis and treatment. Future research should explore how these factors impact PTSD outcomes.

5. Impact of the COVID-19 Pandemic: The study includes PTSD prevalence data after different types of disasters, including the COVID-19 pandemic. However, the psychological impact of COVID-19 differs from that of sudden-onset disasters (e.g., earthquakes, floods, terrorist attacks) due to prolonged exposure to stress and uncertainty. This could influence the results, making direct comparisons between pandemic-related PTSD and disaster-related PTSD more complex.

6. Lack of Longitudinal Follow-Up: The included studies examined PTSD prevalence at different time points after disaster exposure (1-36 months), but they did not necessarily track the same individuals over time. A longitudinal approach would provide more precise insights into PTSD progression and recovery patterns.

Conclusion

This study systematically analyzed the prevalence of PTSD following disasters and mass-casualty incidents in developed and developing countries, comparing PTSD prevalence trends over different timeframes and assessing the impact of the COVID-19 pandemic on this disorder. Findings indicate that more than one-fifth of individuals exposed to disasters experience PTSD, with no significant difference in the overall prevalence between developed and developing countries. However, the patterns of PTSD persistence differ, with developed countries exhibiting an earlier peak in prevalence (4-6 months' post-disaster) and a subsequent decline, whereas developing countries experience a delayed peak (7-12 months) with more prolonged PTSD symptoms. This suggests differences in mental health infrastructure, disaster response capabilities, and access to psychological interventions. Additionally, the study highlights the unique impact of COVID-19, showing that PTSD prevalence was notably higher in developed countries post-pandemic compared to other disasters, whereas in developing countries, COVID-19 did not significantly alter PTSD prevalence trends. These findings underscore the distinct nature of pandemic-related traumas compared to traumas cause by sudden-onset disasters. Gender-based differences were also observed, with PTSD prevalence being higher in women globally, particularly in developed countries, while men in developing countries exhibited slightly higher PTSD rates than their counterparts in developed nations.

Given these findings, governments and policymakers should prioritize post-disaster mental health interventions, particularly in developing countries where PTSD symptoms persist for longer periods. Strengthening mental health services, improving early diagnosis, and ensuring timely psychological support can help mitigate long-term PTSD effects and enhance community resilience in the aftermath of disasters.

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Conflict of Interest

None.

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