JMMIHS Vol 7 issue 1, 2021, 93 - 105

MENTAL HEALTH RISK AND ASSOCIATED FACTORS IN THE AFTERMATH OF THE 2015 EARTHQUAKE IN NEPAL: A SYSTEMATIC LITERATURE REVIEW

Gonzalez RN[1], Regmi P[1*], Aryal N[1], Akudjedu T[1]

[1]Faculty of Health and Social Sciences, Bournemouth University, UK

†**Corresponding author: Pramod R. Regmi**, Lecturer in International Health, Faculty of Health and Social Sciences, Bournemouth University, UK

Email: pregmi@bournemouth.ac.uk

https://doi.org/10.3126/jmmihs.v7i1.43155

ABSTARCT

Background: In 2015, Nepal was struck by two massive earthquakes with magnitudes over the 7.0 Richter Scale, imposing short- and long-term mental health risks. This review aims to: (a) evaluate mental health risk among the earthquake survivors; and, (b) identify factors that influence it.

Methods: The following databases: Scopus and PubMed were searched to identify studies published from 2015 to July 2020 on the mental health risk among the Nepali populations. Inclusion criteria were: (a) primary research related to mental health after the 2015 earthquakes in Nepal, (b) English language articles, (c) access to full-text literature, and (d) studies conducted on the general population of Nepal. Exclusion criteria were: (a) newspaper articles or other forms of popular media, (b) grey records and reviews or, (c) studies carried out among patients in a clinical setting. Key features and risk of bias factors were extracted from each study to obtain necessary characteristics for further analysis of results.

Results: The initial search produced 134 articles, however, a total, 14 studies fulfilled the inclusion criteria and were explored for this review. Ten of these articles were obtained from established databases, and four additional studies were obtained from other sources. Findings indicate that post-traumatic stress was mostly present among earthquake survivors with rates varying from 4.9% to 51%. Mental health risks for children and adolescent were mostly high with rates greater than 23% across studies. However, the adult prevalence rate for mental health

risk was lower than that of children and adolescents, with most rates across studies lower than 20%. Socio-demographic factors (such as gender and age) and methodological

heterogeneities such as variations in study design and mental health tools used to assess rates were associated factors that potentially influenced the findings.

Conclusion: Mental health risks are present among earthquake survivors in Nepal. Various factors have been identified as potential mental health risk rate influencers including sex, with females presenting as the higher at-risk group for mental health relative to males. Methodological issues such as a wide range of mental health assessment instruments employed across studies can potentially impact rates.

Keywords: Mental health; anxiety; post-traumatic stress disorder; earthquake; Nepal

INTRODUCTION

On April 25 2015, Nepal was struck by an earthquake with a magnitude of 7.8 Richter Scale epicenter in Gorkha district. Seventeen days later, just 140 km away from the previous epicenter, another earthquake of 7.3 magnitudes occurred at Dolakha district[1]. These two major earthquakes killed nearly 8,700 people[2]and injured about 25,200 individuals[3]. Many became homeless, and entire villages along with public and private health facilities of the most affected regions were destroyed.[3]

Trauma after natural disasters such as an earthquake has far-reaching consequences. It affects normal lifestyles and imposes short- and long-term impacts on all aspects of health and wellbeing[4]. After a traumatic event, a series of reactions such as anxiety, stress, and depression can be experienced[5]. Large scale disasters can result in post-traumatic stress disorder (PTSD)[6] and symptoms such as numbness or increased attentiveness can be experienced weeks after the disaster[7]. Psychological support is therefore crucial for at least a year following such catastrophes; however, population response to a disaster is not the same[8, 9].

Furthermore, there is variation in the rates of incidence and distribution of mental health problems following earthquakes. For example, after the earthquake in Haiti, 55% of the survivors reported symptoms of depression while 40% experienced anxiety symptoms[10]. Similarly, about 30 months after the 2005 earthquake in Pakistan, the prevalence rate for PTSD was 41.3% across the general population[11].Studies in other settings such as Turkey, China,

Haiti, Pakistan, and Armenia reported mental health rates ranging between 4.1% to 67.07% for adults and 2.5% to 60% for children[10, 11, 12.]

The disparity in reports relating to post-earthquake mental health rates can be attributed to additional factors such as methodological heterogeneitiesin study design relating to sample size, use of different mental health assessment tools and socio-demographic variations including age, gender andurbanicity[12, 13, 14.] A study by Jia and colleagues[15] suggested that the older population is at risk of mental health illnesses after earthquakes while Liu and colleagues[16] indicated children and adolescents are more susceptible. However, cut-off scores for both populations can result in inflation on prevalence estimates by categorizing expected distress as more or less severe[17].

Nepal's mental health problems have been identified to be most prevalent among females, Dalit caste, the older population, those who live in poverty, and have been exposed to previous traumatic events[13, 17, 18.] Findings show that rates can fluctuate between different locations and factors such as the interval between earthquake and study time can impact findings[19]. Moreover, it would be crucial to report additional contextual indicators that would be attributed to the population, to have accurate interpretations of prevalence findings.

Nepal, with a population of approximately 28.5 million people, and with more than 100 earthquakes registered at a magnitude of 4 or over since 2015[20]has emerged from a decade-long of conflicts[21]. Despite the hardships, Nepal has made progress in trying to improve the health status and living standards of its people. However, physical problems are addressed consequently, and mental health-related issues remain largely unrecognised[22, 23]. Mental health in Nepal after any disaster is among the least assessed, recorded, and prioritized; therefore, data is limited[24].

Mental health studies in Nepal have increased in recent years; however, much of the research has been conducted on refugees, children, or past political violence[17, 18]. Although various studies focus on different predictors, there is no single dominant determinant that influences earthquake-induced mental health prevalence rates[12]. It is crucial to explore all risk factors involved in studies to have a better knowledge of the rates to inform and impact health policies and planning. Against this background, this review aims to:(a) assess the mental health risk

among the general population in Nepal; and, (b) identify socio-demographic and methodological factors that can influence rates.

Mental health burdens can negatively impact all individuals, directly or indirectly. It is responsible for the largest proportion of the burden of disease[25]. Furthermore, by identifying mental health risk and exploring factors that can be of impact, evidence can be presented in bringing knowledge on the growing issue and its importance. Nepal is at risk of a major earthquake in the future[26], therefore, this literature review can add to the limited data on the general population's mental health rates. The identification of variables that are of influence in the 2015 earthquake in Nepal can educate and assist researchers in the further exploration of the topic. Ultimately, initiatives for better mental health preparation and recovery can be specifically developed for the Nepali population.

METHODS

The systematic literature review condensed all chosen articles[27]on mental health risk in the aftermath of the 2015 earthquake in Nepal. Additionally, methodological tools and related study determinants were synthesized for further appraisal.

Study inclusion and exclusion criteria

We established inclusion and exclusion criteria to guide the selection of articles in the final review[28, 29]. Inclusion criteria were: (a) primary quantitative research related to any type of mental health risk after the 2015 earthquakes in Nepal, (b) English language articles, (c) access to full-text literature, and (d) studies conducted on the general population of Nepal. Exclusion criteria for this study are: (a) newspaper articles or other forms of popular media, (b) grey records and reviews or, (c) studies carried out among the patients in a clinical setting.

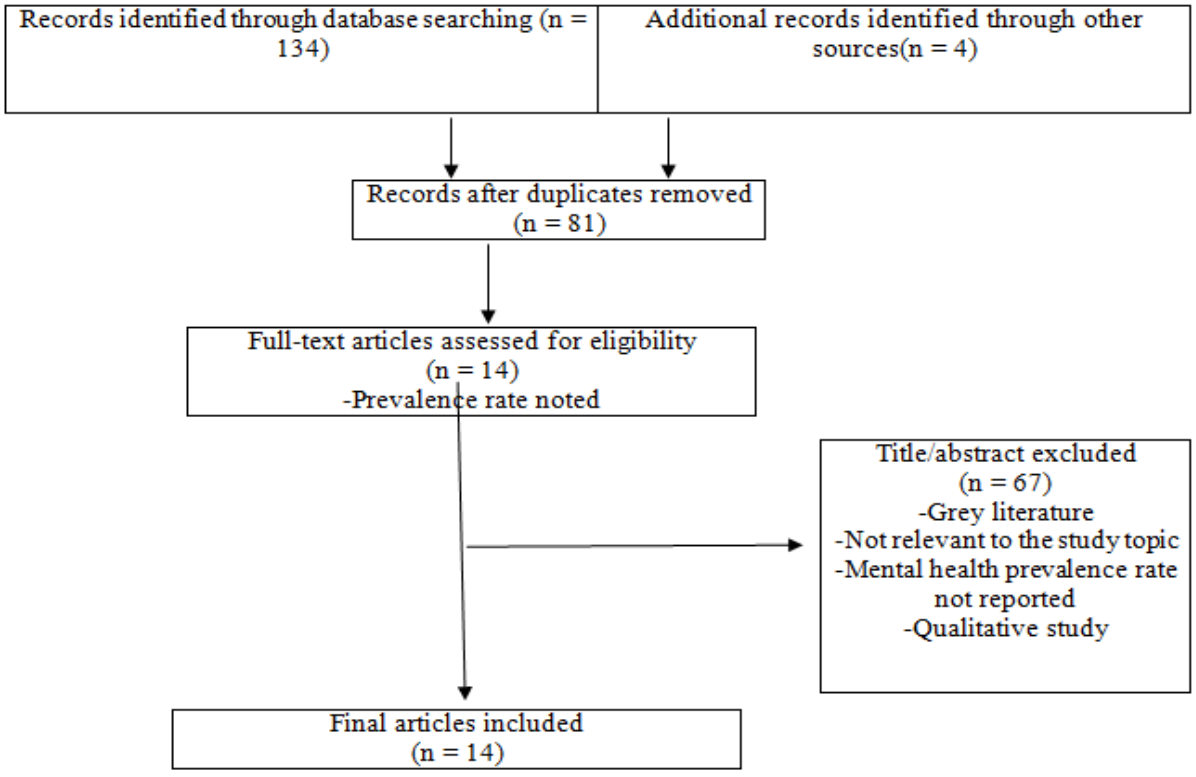
Search terms and search strategy

The search incorporated electronic components where two major databases: Scopus and PubMed were searched. Thus, keywords, Boolean operators, and truncation were used to search for relevant articles. These search terms were revised according to the specificities of the database. The search terms: ("mental health" OR anxiet* OR depres* OR "post-traumatic

stress disorder") was combined with the words (earthquake* or disaster*). These search terms were combined with the name of the country (Nepal*). Articles were searched by title and/or abstract and reference lists from identified studies were looked over for relevant published articles.

The online search generated 134 articles; additionally, four articles were identified through other sources such as Google Scholar. Duplicates were removed which reduced the number of articles to 81. The titles and abstracts of these 81 studies were screened, and 67 were excluded because they were either not relevant to the topic, did not present prevalence rates, grey literature, or qualitative studies. As such, 14 studies fulfilled the study criteria and were included for the review. PRISMA checklist was used, and a flow diagram (see Fig. 1) is presented to explain different phases of the article selection as described in the PRISMA guidelines.

Figure 1: Flow diagram for identification and selection of studies



Data extraction and quality appraisal

Data extraction tables were created using the Guidance to Community Preventive Services[30]as a template. Appraisal on the eligibility of the studies included in the review was conducted and key features were extracted from each study which includes the following: author/year, study design, study location, the distance between the study site and the earthquake epicenter, setting, sample size by age group, population, and mental health prevalence's among survivors. Articles that met the eligibility criteria were independently reviewed by two reviewers. Any disagreements were discussed in detail between all four authors. The key features of the included studies for the review are shown in Table 1. A second data extraction table was developed which presents the risk of bias as appropriate for this study include the following: study, sample process, sample size calculation, sex, tools to assess mental health, questionnaire type, validation of questionnaire, the illiteracy rate among survivors, tools validated in Nepali population, and the interval between research and disaster. The risk of bias table for the included studies is shown in Table 2. Furthermore, additional data were extracted from the articles that include occupations, response rate, population density and ethnicity.

Author/year	Study design	Study areas	Distance between the study site and the epicenter	Sample size by age group	Population	Mental health prevalence among survivors
Acharya et al.[31]	cross-sectional	Kathmandu District	not reported	School-age, 7-17 years: 371; Adolescent, 13-16 years: 429	children and adolescents	PTSD 51%
Adhikari et al.[32]	cross-sectional descriptive	Nuwakot District	80 km	20-39: 127; 40-59: 113; 60 and more: 51	adults	PTSD 24.1%
Bhandari et al.[33]	cross-sectional	Kathmandu District	76 Km	Up to 25: 78; 26-35: 93; 36-45: 78; 46-55: 35; More than 55: 20	adults	18.1% Moderate Anxiety; 21.7 % Moderate Depression; 16.1 % Mild Anxiety; 21.1% Mild Depression; 12.5% Severe Anxiety; 13.5 % Severe Depression

Dahal et al.[34]	cross-sectional	Dhading District	not reported	18-35: 304; 36-59: 180; 60 and above: 51	adults	PTSD 18.5%
Kane et al.[35]	needs assessment	Kathmandu, Gorkha and Sindhupalchowk,	not reported	16-34; 35-54; 55 and above sample size not reported	adults	Depression 34%; Anxiety 33.8%; PTSD 5.2%
Kvestad et al.[4]	clinical trial	Bhaktapur District	not reported	not reported	adults	PTSD 24%
Mishra et al.[36]	cross-sectional	Kathmandu Metropolitan City	not reported	12-14: 55; 15-19: 85	adolescents	PTSD: 27.1%
Schwind et al.[37]	cross-sectional	Phulpingdanda Village in the Sindhupalchowk District	100 Km	8–12; 13–17 sample size not reported	children & adolescent	PTSD 4.84%; Depression 3.23%
Schwind et al.[38]	cross-sectional	Phulpingdanda Village in Sindhupalcho-wk District	100 Km	≤ 34; 35-54; ≥ 55 sample size not reported	adults	Depression 33%; PTSD 9%

Sharma et al.[20]	cross-sectional descriptive	Sukla Gandaki Municipality, Tanahu District	not reported	15-30: 119; 31 45: 88; >45: 93	adults	Anxiety 12.7%; PTSD 10%; Depression 8%
Sharma et al.[26]	cross-sectional	Dhading and Chitwan District	not reported	≤15: 228; ≥16: 181	children and adolescents	PTSD 43.3%; Depression 38.1%
Sharma et al.[39]	cross-sectional descriptive	Gorkha District	not reported	Below 18: 26; 18-60: 151; Above 60: 143	adults	Anxiety 21.18%; Depression 21.09%; PTSD 22.31%; Stress 16.76%
Silwal et al.[40]	cross-sectional	District Sindhupalchok and Kathmandu	not reported	< 13 years: 311; 13-15: 471; > 15 years: 11	children and adolescents	PTSD 39.5% Sindhupalchok; 10.7% Kathmandu Depression Sindhupalchok 40.4%; 23.2% Kathmandu
Thapa et al.[1]	cross-sectional descriptive	Bhumlichaur area of Gorkha District	not reported	18-30: 101; 31-50: 61; 51-65: 23; >65: 13	adults	Borderline Anxiety 52.5%; Significant Anxiety 20%; Borderline Depression

						20%; Significant Depression 8%; PTSD 27%

Study	**Sampling process**	**Sample size calculation**	**Sex**	**Tools to assess mental health**	**Questionnaire type**	**Validation of the questionnaire**	**The illiterate rate among survivors**	**Tools validated in Nepali population**	**The time interval between research and disaster**
Acharya et al.[31]	random	standard	Male: 384; Female: 416	Trauma exposure questionnaire and Child PTSD scale (CPSS)	interviewer-administered questionnaire	yes	not reported	yes	12 months
Adhikari et al.[32]	random	standard	Male: 166; Female:	PTSD checklist-5 was used to measure PTSD	interviewer-administ	not reported	50.52%	yes	10 months

			125	according to DSM-5 criteria (PCL-5)	ered question naire				
Bhandari et al.[33]	not random	standard	Male: 138; Female: 166	Beck Anxiety Inventory (BAI); Beck Depression Inventory (BDI)	an interview er-administ ered and self-administ ered question naire	yes	not reported	no	7-10 months
Dahal et al.[34]	not random	standard	Male: 288; Female: 247	Post-traumatic stress disorder checklist civilian version (PCL-C)	interview er-administ ered question naire	not reported	23.55%	not reported	9 months

Kane et al.[35]	random	standard	Male: 213; Female: 300	(Hopkins Symptom Checklist-25); post-traumatic stress disorder (PTSD Checklist-Civilian)	interviewer-administered questionnaire	no	21.30%	no	4 months
Kvestad et al.[4]	random	standard	Male: not included; Female: 558	Impact of Event Scale-Revised (IES-R)	interviewer-administered questionnaire	no	36.70%	no	20 months
Mishra et al.[36]	random	standard	Male:62; Female: 78	Post-Traumatic Stress Disorder CheckList-5 (PCL-5) of DSM-V criteria	self-administered questionnaire	not reported	not reported	not reported	1-4 months
Schwind et al.[37]	not random	arbitrary	Male: 27; Female:	Depression Rating Scale for Children; Child PTSD	interviewer-administ	not reported	59.68%	no	12 months

			35	Symptom Scale	ered question naire				
Schwind et al.[38]	not random	standard	Male: 78; Female: 145	Beck Depression Inventory-II (BDI-II); PTSD Checklist-Civilian Version (PCL-C); Traumatic Exposure Severity Scale (TESS)	interview er-administ ered question naire	not reported	54%	no	12 months
Sharma et al.[20]	not random	arbitrary	Male: 108; Female 192	PTSD Checklist Civilian Version (PCL-C); The Hopkins Symptoms Checklist-25 (HSCL-25)	intervie wer-administ ered question naire	yes	30%	yes	2 months
Sharma et al.[26]	random	standard	Male: 182; Female:	Child Posttraumatic Stress Scale	interview er-administ	yes	not reported	yes	12 months

			227	(CPSS); Depression Self Rating Scale (DSRS)	ered question naire				
Sharma et al.[39]	not reported	standard	Male: 124; Female: 196	Hopkins Symptoms Checklist for anxiety and depression; PTSD checklist-civilian version	self-administered question naire	not reported	12%	not reported	2-5 months
Silwal et al.[40]	not random	standard	Male: 435; Female: 458	Child Posttraumatic-Stress Disorder Scale (CPSS); Depression Self Rating Scale (DSRS)	self-administered question naire	yes	not reported	yes	not reported

Thapa et al.[1]	not reported	standard	Male: 74; Female: 124	Self-Reporting Questionnaire (SRQ); PTSD8; Hospital anxiety and depression scale (HADS)	self-administered questionnaire	not reported	not reported	not reported	14 months

RESULTS

(i) Description of studies

The search found 134 articles: 75 from Scopus, 59 from PubMed, and four additional articles from searching other sources such as Google Scholar. In total, 14 articles were included in the literature review. A total of 12 studies were either cross-sectional, one study was a clinical trial, or one was a needs assessment. Furthermore, a total of 5176 respondents of all age ranges participated in the studies, with 2279 males and 2897 females (see Table 1).

Most of the studies (12 out of 14) were population-based studies conducted in the community and two studies were conducted in schools. The calculation of sample size was standard in 12 studies and arbitrary in two. Distance between the study site and the earthquake epi-centre was not reported on 10 studies; however, four studies stated the distance which ranged between 76km-100km (see Table 1).

Furthermore, the sampling process was random for six studies, convenient for six, and two studies[1, 39]did not report the sampling process. On validation of questionnaires, five studies stated that the questionnaires were validated; two studies stated no validation and seven studies did not report on it (see Table 2). As for mental health instruments, five studies validated tools used while six did not and three studies did not report about it.

(ii) Mental health risk

All 14 studies in the review assessed mental health prevalence. However, some studies focused on PTSD, while others had a combination of PTSD, anxiety, and depression. Sharma and colleagues[39]was the only study that focused on the prevalence rate of stress in addition to anxiety, depression, and PTSD.

The prevalence of PTSD in the aftermath of the 2015 earthquake ranged between 4.9%[37]to 51% [31]. However, both high and low prevalence rates for PTSD came from the children and adolescent population. The adult prevalence rate for PTSD ranged from 5.2% [35]to 43.3%[39]. Five studies focused on anxiety. Bhandari and colleagues[33]reported prevalence rates of 18.1% for moderate anxiety, 16.1% mild anxiety, and 12.5% severe anxiety, Kane and colleagues[35]reported

33.8%, Sharma and colleagues[20] 12.7%, Sharma et al.[39]21.18%, and Thapa et al.[1] reported 52.5% for borderline anxiety and 20% for significant anxiety. Furthermore, eight studies focused on depression prevalence rates. Bhandari and colleagues[33]divided the severity of depression into moderate, mild, and severe with rates of 6.1%, 21.1% and 13.5%. Sharma and colleagues[20]reported a rate of 8%, Sharma et al.[26]38.1%, Kane et al.[35]34%, Schwind et al.[37] 3.23%, Schwind et al.[38]33%, Sharma et al.[39]21.09%,Silwal et al.[40]40.4% and 28.2% for a comparison between Sindhupalchok and Kathmandu district. Lastly, Thapa et al.[1]reported 20% for borderline depression and 8% for significant depression.

Most of the studies were cross-sectional; as a result, they are prone to certain biases. Acharya et al.[31]stood out with the highest prevalence percentage (51%) on PTSD in comparison to all rates. Schwind et al.[37]also stood out as the study had the lowest prevalence rate among all findings for both PTSD (4.84%) and depression (3.23%). This could be because of the low sample size with only 62 participants; 27 males and 35 females.

(iii) Tools used to assess mental health risk

This review found that the included studies used different tools to assess mental health risk among participants. Six studies did not validate the instruments in the Nepali language while three studies did not report about it. Moreover, seven studies[20, 32, 34, 35, 36, 38, 39] used post-traumatic stress disorder (PTSD Checklist-Civilian). Three studies[26, 31,40]used the Child PTSD Scale (CPSS) and three other studies[20, 35, 39]used the Hopkins Symptoms Checklist (see Table 2). Many of the studies used more than one tool to assess mental health; therefore, the response rate through different questionnaires may vary. However, no agreement can be made on a valid instrument for global mental health research with adults or children[17].

(iv) Socio-demographic characteristics of the study population

Illiteracy rate among survivors

The lowest illiteracy rate was 12%[39]and the highest was 59.68%[37] (see Table 2). Four studies [4, 20, 34, 35]reported illiterate rates between 20% and 37%. Mental health risks among these particular studies were both high and low. Three studies had illiterate rates of 50.5%, 54% and 59.7%;

however, two of the three studies reported one of the lowest mental health prevalence rates for PTSD in the review. Adhikari and colleagues[32]reported 24.1% while Schwind et al.[37]reported

4.84% for PTSD and Schwind et al.[39]reported 9%; however, a high depression rate was reported in Schwind et al.[37]and Schwind et al.[38]studies. Six studies[1, 26, 31, 33, 36, 40]did not report illiterate rates.

Time interval between research and earthquake

The time interval between research and earthquake was noted among 13 studies except in one study [40]. Four studies [26, 31, 37, 38] had a 12-month interval; however, mental health risks were both high and low therefore no conclusion could be made.

Seven studies[20, 32, 33, 34, 35, 36, 39] reported intervals less than 10 months. The mental health risk was similar, as rates were high, ranging between 12% and 21%. However, three studies[32, 35, 36] had higher rates reported. Adhikari et al.[32]reported 24.1% for PTSD while Mishra et al.[36]reported 27.1%. Kane et al.[35]reported 34% for depression and 33.8% for anxiety; however, PTSD had a rate of 5.2% among earthquake survivors.

Two studies[1, 4]had a longer time interval between research and disaster in comparison to previous studies mentioned with 20 and 14 months' time intervals (see Table 2). PTSD prevalence rate among these studies was similar as rates for Kvestad et al.[4]was 24% and Thapa et al.[1]reported a rate of 27% among earthquake survivors. Kvestad et al.[4]did not evaluate depression and anxiety in comparison to Thapa et al.[1].

Study location

The majority of studies were limited to one district while others included two or three districts. Kathmandu and Sindhupalchowk district had the highest number of studies. Five studies[31, 33, 35, 36, 40]were conducted in the Kathmandu district. Four studies[35, 37, 38, 40] were from the Sindhupalchowk district.

Mental health risk in Kathmandu and Sindhupalchowk districts were high among all mental health disorder. They both are located at a distance of 100 km or less from the earthquake epicenter (see Table 1). However, Schwind et al.[37]reported low rates for children and adolescents

for depression and PTSD in comparison to studies conducted in both districts. Additionally, Kane et al.[35]reported a low rate for PTSD similar to Schwind et al.[37]however, the study was conducted on the adult population.

Population density

Six studies in the review[32, 33, 34, 37, 38, 40]reported population density to be rural. Seven studies[1, 4, 20, 26, 35, 36, 39] did not report and one study[31]carried out its research in both urban and suburban settings. Prevalence rates of mental health risk among the rural areas were both high and low.

Gender disparities

Fourteen studies but one[4]measured the prevalence of mental health risk in both males and females. Kvestadand colleagues[4] carried out a study on females only. Two studies[32, 34] had more males than females; while the remaining had more females. Eleven studies[1, 20, 26, 32, 33, 34, 35, 36, 38, 39, 40] found prevalence rates to be higher in females compared to males among all mental health risks.

Sample size by age group

Of the fourteen studies in the review, one study[4]did not report on sample size by age group. Another study[35]classified the age groups but did not report the sample size for each. Five studies[26, 31, 36, 37, 40] focused on the children and adolescent population while the rest focused on the adult population. Therefore, age mostly ranged around 18 years and older. However, the age ranges for two studies[20, 35] varied as Kane and colleagues[35]had adult participants aged 15 years or over and Sharma[20]had adult participants with an age of 16 years or above. Furthermore, the different sample sizes among the age range can have a minor effect on the final finding (see Table 1).

Children and adolescents had the highest rates of mental health risks with rates of 51%, 27.1%, 43.3%, 39.5% and 10.7% for PTSD (see Table1). As for depression, rates for this population were 40.4%, 23.2% and 38.1%. However, Schwind and colleagues[37]reported low rates for these two health disorders in comparison to the other studies with percentages of 4.8% for PTSD and 3.2% for depression.

Ethnicity

Four studies[1, 4, 20, 26] did not report on ethnicity and one study[34] reported but did not present the number. Eight studies[31, 32, 33, 34, 35, 36, 39, 40] had a *Bharamn/Chettri* majority, while six studies[32, 35, 36, 37, 38, 40] reported *Janajati* as participants pick of ethnicity. No rates on mental health risks were reported for ethnicity.

Occupations

Seven studies[1, 4, 32, 33, 35, 37, 38] reported similar occupations from participants such as farming, homemaker, service holder, business and laborer. Three studies[31, 34, 39] did not report the participant's occupations.

The common occupation among all participants in the review was agriculture with 885 participants. However, three studies reported high numbers for this occupation in comparison to the other studies with 345[4], 291[35] and 184[38] participants. No rates on mental health risks were reported for occupation.

DISCUSSION

The review analyzed 14 studies (one clinical trial, one needs assessment, and 12 cross-sectional studies). Findings suggest that mental health risk is present within the general population following the 2015 earthquake in Nepal. PTSD, in particular, is reported across all studies reviewed with rates ranging between 4.84% and 51%. However, only a few studies specifically evaluated the prevalence of other mental health disorders in relation to the 2015 earthquakes in Nepal.

While prevalence rates varied among the Nepali population, the gender difference was evident among both children and adults. Eleven out of 14 studies in the review found that female shad higher mental health risks in comparison to males. This finding is in agreement with studies conducted in Pakistan, China, and Italy where females experienced greater levels of psychological problems after traumatic events, in particular PTSD symptoms[41,42,43,44]. A possible interpretation for this finding would be the relatively lower reported odds of using positive coping strategies among women, their strong perception of threat, and their strong ability to recall more often; therefore, they interpret disasters more negatively[41, 45]. On the other hand, men face the issue and try to solve it by de-emphasising[12]. Thus, genetics, biological factors, and

traditional roles in society play a big part in how both males and females deal with the exposure of stress after traumatic events such as natural disasters including an earthquake[12].

Furthermore, with more than half of the included studies conducted among the adult population, findings imply that the risk of mental health disorders is more prevalent among adults. However, sample sizes, in particular, small sample size can compromise the internal and external validity of a study, as a result, influencing research findings [46].Findings are in line with previous studies which reported high levels of PTSD among middle-aged and older adults[9, 11]. However, in a study conducted in Hanshin-Awaji Japan, a decrease in PTSD symptoms was reported among the population older than 60 years of age[47]. As for children and adolescents, in a study conducted in the 2008 Sichuan (China) earthquake, the prevalence rate for PTSD was estimated to be 12.4% among survivors[15]. In comparison to our findings, children and adolescents presented higher PTSD prevalence rates than adults with rates in the 25% range, except in one study that presented a rate of 4.84% for PTSD and 3.23% for depression[37]. However, it could be argued whether four studies are optimal to warrant this interpretation. Children and adolescents may not possess the mental maturity that adults or the older population possess when dealing with traumatic events; thus, such difference is a contributing factor to mental health risks when comparing populations.

Prevalence rates in the review were both high and low, which can be impacted by factors such as time of interval between disaster and study. Eleven studies in the review had 12 months or fewer intervals. One study[40], did not report and two studies had greater intervals, with 20 months[4]and 14[1]months. A short or long time period can result in the underrepresentation of mental health problems[15]. PTSD cases are not observed clinically until 12 months after the disaster[48]. Therefore, it could be argued whether a longer time interval between study and disaster can affect rates. During the first few months of a traumatic event, delayed-onset PTSD can be rare in the absence of sub-threshold symptoms but rather frequent if some PTSD symptoms were present[48]. It develops within the first 1-6 months after a disastrous event; though, it can develop later[49].

With studies conducting their research within different study locations, Kathmandu and Sindhupalchowk were two common locations chosen for some of the studies. Sindhupalchowk being a rural area characterized by older populations, low levels of education, and poverty[16, 50].

Adult survivors after the Wenchuan earthquake in China found a relation in low education levels and suspected PTSD in the short and long run[12]. It can be argued that having a low educational level affects income, which is associated with poor mental health. Therefore, low awareness of health risks after an earthquake is unknown due to levels of understanding. Mental health risks in both locations were mostly high among all mental health disorders, as they both were 100 km or less from the earthquake epicenter. Kathmandu being the capital of Nepal is the most populated district in the country[51]. Sindhupalchowk was one of the most affected as a result of high magnitude aftershocks and geographical remoteness[37]. Moreover, medical relief teams were unable to reach some rural areas, taking more than four days to provide services[20]. Also, health facilities were destroyed due to damages caused by the earthquake[50], creating a more stressful situation for individuals.

Study findings in the review show that most of the survivor's illiteracy rates were both high and

low and mental health rates vary. In relation to educational levels, higher education levels enhance individual trauma understanding ability, which can improve confidence in physical and mental health recovery; thus, preventing mental health risks. Our findings are similar to the results from earthquake-hit areas in Pakistan and Iran, where a low level of education was found to be an important predictor for mental health risks11, 52, 53.

Furthermore, the use of mental health tools varied across all studies. Therefore, scores can vary from the same country with remote communities, and inequalities due to ethnic and cultural diversity37. A need to validate tools used to screen for the different health risks is crucial in the different study locations, for results to be more comparable across the populations17. Findings showed a lack of validation among instruments for mental health with only five studies using validated tools in the local language, creating a barrier to assessing the prevalence of mental health problems in low and middle-income countries17. Additionally, tools that are not validated have shown to have unsatisfactory levels of sensitivity and specificity14. Though various studies show a relation between earthquake's and mental health risks, the prevalence of adverse results can vary significantly across populations due to socio demographic and methodological differences.

It is important to note that the review had some limitations. The search was restricted to the English language articles; therefore, it isn't known or certain whether such limitation can

influence findings. There were limited studies among both children and adolescent populations when addressing earthquakes mental health impact. Finally, the search was carried out in just two databases. Thus, it is likely that we might have missed a few relevant studies. However, the review can serve as a guide and call attention to areas that may need further investigation.

RECOMMENDATIONS

The review suggests that mental health risks are present among earthquake survivors in Nepal; therefore, a feasible intervention should be introduced in the community. Findings can provide a clear intervention direction for policymakers in efforts to address specific at-risk areas and groups. Mental health services can become available through mobile health clinics, public awareness initiatives, and counseling hotlines, benefiting the countries circumstances. Above all, ongoing monitoring prevention and intervention programs are crucial for the high-risk population of earthquake survivors.

CONCLUSION

Mental health is present among earthquake survivors in Nepal. Even after about 12 months' time interval between disaster and studies, the prevalence of PTSD among the survivors was relatively high. Various factors such as gender, location, and study design accounted for variation sin the reported mental health risks. Effective intervention programs should be implemented at the community level, in particular among the vulnerable groups to reinforce psychiatric morbidity among earthquake survivors. In conclusion, this review provided important insights into mental health prevalence rates and possible associated factors that can be of impact. Even though research on Nepal's general population mental health is limited or not highly prioritized as a particular health disparity; additional national or sub-national research is needed for a more precise status of the country's mental health risk in the long term following the earthquakes.

Competing interests

The authors declare that they have no competing interests.

REFERENCES

1. Thapa P, Acharya L, Bhatta B, Paneru S, Khattri J, Chakraborty P. Anxiety, depression and post-traumatic stress disorder after earthquake. *Journal of Nepal Health Research Council* [Internet]. 2018;16(1):53-57.

2. Office for Coordination of Humanitarian Affairs. Nepal earthquake of 2015 | magnitude, death toll, aftermath, & facts. Encyclopedia Britannica [Internet]. 2015 [cited 7 November 2020]. Available from: https://www.britannica.com/topic/Nepal-earthquake-of-2015

3. Basnyat B, Tabin C, Nutt C, Farmer P. Post-earthquake Nepal: the way forward. *The Lancet Global Health* [Internet]. 2015;3(12):e731-e732.

4. Kvestad I, Ranjitkar S, Ulak M, Chandyo R, Shrestha M, Shrestha L. Earthquake exposure and post-traumatic stress among Nepalese mothers after the 2015 earthquakes. *Frontiers in Psychology* [Internet]. 2019;10.

5. Shalev A. Acute stress reactions in adults. *Biological Psychiatry* [Internet]. 2002;51(7):532-543.

6. Rosellini A, Dussaillant F, Zubizarreta J, Kessler R, Rose S. Predicting posttraumatic stress disorder following a natural disaster. *Journal of Psychiatric Research* [Internet]. 2018;96:15-22.

7. Gersons B, Olff M. Coping with the aftermath of trauma. *BMJ* [Internet]. 2005;330(7499):1038-1039.

8. Bhandari L, Kumar Shah S, Mathias J, Raj Singh D, Paudel S, Prasad Sapkota B. Psychological distress among the adult survivors of Kathmandu Valley from Nepal's 2015 earthquake. *Sleep and Hypnosis - International Journal* [Internet]. 2017

9. Carr V, Lewin T, Kenardy J, Webster R, Hazell P, Carter G. Psychosocial sequelae of the 1989 Newcastle earthquake: III. Role of vulnerability factors in post-disaster morbidity. *Psychological Medicine* [Internet]. 1997;27(1):179-190.

10. Guimaro M, Steinman M, Kernkraut A, Santos O, Lacerda S. Psychological distress in survivors of the 2010 Haiti earthquake. Einstein [Internet]. 2013;11(1):11-14.19

11. Ali M, Farooq N, Bhatti M, Kuroiwa C. Assessment of prevalence and determinants of posttraumatic stress disorder in survivors of earthquake in Pakistan using Davidson Trauma Scale. *Journal of Affective Disorders* [Internet]. 2012;136(3):238-243.

12. Tang B, Deng Q, Glik D, Dong J, Zhang L. A meta-analysis of risk factors for post-traumatic stress disorder (PTSD) in adults and children after earthquakes. International *Journal of Environmental Research and Public Health* [Internet]. 2017;14(12):1537.

13. Brewin C, Andrews B, Valentine J. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Journal of Consulting and Clinical Psychology* [Internet]. 2000;68(5):748-766.

14. Wang X, Gao L, Shinfuku N, Zhang H, Zhao C, Shen Y. Longitudinal study of earthquake-related PTSD in a randomly selected community sample in North China. *American Journal of Psychiatry* [Internet]. 2000;157(8):1260-1266.

15. Jia Z, Tian W, Liu W, Cao Y, Yan J, Shun Z. Are the elderly more vulnerable to psychological impact of natural disaster? A population-based survey of adult survivors of the 2008 Sichuan earthquake. *BMC Public Health* [Internet]. 2010;10(1).

16. Liu M, Wang L, Shi Z, Zhang Z, Zhang K, Shen J. Mental health problems among children one-year after Sichuan earthquake in China: A follow-up study. *PLoS ONE* [Internet]. 2011;6(2):e14706.

17. Kohrt B, Jordans M, Tol W, Luitel N, Maharjan S, Upadhaya N. Validation of cross-cultural child mental health and psychosocial research instruments: adapting the depression self-rating Scale and child PTSD symptom scale in Nepal. *BMC Psychiatry* [Internet]. 2011;11(1).

18. Luitel N, Jordans M, Adhikari A, Upadhaya N, Hanlon C, Lund C. Mental health care in Nepal: current situation and challenges for development of a district mental health care plan. *Conflict and Health* [Internt]. 2015;9(1).

19. Beaglehole B, Mulder R, Boden J, Bell C. A systematic review of the psychological impacts of the Canterbury earthquakes on mental health. Australian and New Zealand *Journal of Public Health* [Internet]. 2019

20. Sharma D, Devi A, Kafle R, Singh S. Mental health impact of April 2015 earthquake of Nepal : A community based cross-sectional study [Internet]. 2017 [cited 6 November 2020];. Available from: http://file:///F:/Articles/Sharma%20et%20al.%202017.pdf

21. Singh S, Dahal K, Mills E. Nepal's war on human rights: A summit higher than Everest. *International Journal for Equity in Health* [Internet]. 2005;4(1).

22. Mishra S. Nepal's slow road to recovery, 1 year after the earthquakes. *The Lancet* [Internet]. 2016;387(10029):1709-1710.

23. Malilay J, Heumann M, Perrotta D, Wolkin A, Schnall A, Podgornik M. The role of applied epidemiology methods in the disaster management cycle. *American Journal of Public Health* [Internet]. 2014;104(11):2092-2102.

24. Government of Nepal Planning Commission. Nepal Earthquake 2015 Post Disaster Needs Assessment (PDNA). Vol. A: Key Findings [Internet]. 2015: Available from https://www.worldbank.org/content/dam/Worldbank/document/SAR/nepal/PDNA%20Volume%20A%20Final.pdf [Accessed 23 Jun. 2020].

25. Wainberg M, Scorza P, Shultz J, Helpman L, Mootz J, Johnson K. Challenges and opportunities in global mental health: A research-to-practice perspective. Current Psychiatry Reports [Internet]. 2017;19(5).

26. Sharma A, Kar N. Posttraumatic stress, depression, and coping following the 2015 Nepal earthquake: A study on adolescents. *Disaster Medicine and Public Health Preparedness* [Internet]. 2018;13(02):236-242.

27. Aveyard H, Sharp P. A beginner's guide to evidence based practice in health and social care. Open University Press [Internet]. 2017

28. Patino C, Ferreira J. Inclusion and exclusion criteria in research studies: definitions and why they matter. *JornalBrasileiro de Pneumologia* [Internet]. 2018;44(2):84-84.

29. McDonagh M, Peterson K, Raina P, Chang S, Shekelle P. Avoiding bias in selecting studies [Internet]. *Ncbi.nlm.nih.gov*. 2020 [cited 6 November 2020]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK126701/

30. Zaza S, Wright-De Agüero L, Briss P, Truman B, Hopkins D, Hennessy M. Data collection instrument and procedure for systematic reviews in the guide to community preventive services11The names and affiliations of the Task Force members are listed on page v of this supplement and at http://www.thecommunityguide.org. *American Journal of Preventive Medicine* [Internet]. 2000;18(1):44-74.

31. Acharya S, Bhatta D, Assannangkornchai S. Post-traumatic stress disorder symptoms among children of Kathmandu 1 year after the 2015 earthquake in Nepal. *Disaster Medicine and Public Health Preparedness* [Internet]. 2017;12(4):486-492.

32. Adhikari Baral I, K.C B. Post traumatic stress disorder and coping strategies among adult survivors of earthquake, Nepal. *BMC Psychiatry* [Internet]. 2019;19(1).

33. Bhandari L, Kumar Shah S, Mathias J, Raj Singh D, Paudel S, Prasad Sapkota B. Psychological distress among the adult survivors of Kathmandu Valley from Nepal's 2015 earthquake. Sleep and Hypnosis - *International Journal* [Internet]. 2017

34. Raj Dahal H, Kumar D, Kaji Thapa D. Prevalence and risk factors of post-traumatic stress disorders among the survivors of 2015 Nepal earthquake, in Dhading, Nepal. Sleep and Hypnosis - *International Journal* [Internet]. 2017.

35. Kane J, Luitel N, Jordans M, Kohrt B, Weissbecker I, Tol W. Mental health and psychosocial problems in the aftermath of the Nepal earthquakes: findings from a representative cluster sample survey. *Epidemiology and Psychiatric Sciences* [Internet]. 2017;27(3):301-310.

36. Mishra D, Giri D, Marahatta S. Post-traumatic stress disorder and associated factors among adolescents after 2015 Nepal Earthquake. *Journal of Manmohan Memorial Institute of Health Sciences* [Internet]. 2018;3(1):45-55.

37. Schwind J, Formby C, Santangelo S, Norman S, Brown R, Hoffman Frances R et al. Earthquake exposures and mental health outcomes in children and adolescents from Phulpingdanda village, Nepal: a cross-sectional study. *Child and Adolescent Psychiatry and Mental Health* [Internet]. 2018;12(1).

38. Schwind J, Norman S, Brown R, Frances R, Koss E, Karmacharya D et al. Association between earthquake exposures and mental health outcomes in Phulpingdanda Village after the 2015 Nepal earthquakes. *Community Mental Health Journal* [Internet]. 2019;55(7):1103-1113.

39. Sharma G, Sapkota B, Sharma G, Paudel S, Lamichhane G, Adhikari M. Mental health impact of Nepal earthquke 2015 on the population of Gorkha District [Internet]. 2019 [cited 6 November 2020]. Available from:

https://scholar.google.com/citations?user=ZB04YrkAAAAJ&hl=en#d=gs_md_cita-d&u=%2Fcitations%3Fview_op%3Dview_citation%26hl%3Den%26user%3DZB04YrkAAAAJ%26citation_for_view%3DZB04YrkAAAAJ%3AWp0gIr-vW9MC%26tzom%3D300

40. Silwal S, Dybdahl R, Chudal R, Sourander A, Lien L. Psychiatric symptoms experienced by adolescents in Nepal following the 2015 earthquakes. *Journal of Affective Disorders* [Internet]. 2018;234:239-246.

41. Dai W, Chen L, Lai Z, Li Y, Wang J, Liu A. The incidence of post-traumatic stress disorder among survivors after earthquakes: A systematic review and meta-analysis. *BMC Psychiatry* [Internet]. 2016;16(1).

42. Wu Z, Xu J, He L. Psychological consequences and associated risk factors among adult survivors of the 2008 Wenchuan earthquake. *BMC Psychiatry* [Internet]. 2014;14(1).

43. Dell'Osso L, Carmassi C, Massimetti G, Stratta P, Riccardi I, Capanna C. Age, gender and epicenter proximity effects on post-traumatic stress symptoms in L'Aquila 2009 earthquake survivors. *Journal of Affective Disorders* [Internet]. 2013;146(2):174-180.

44. Zhang Z, Shi Z, Wang L, Liu M. One year later: Mental health problems among survivors in hard-hit areas of the Wenchuan earthquake. *Public Health* [Internet]. 2011;125(5):293-30

45. Olff M. Sex and gender differences in post-traumatic stress disorder: an update. *European Journal of Psychotraumatology*[Internet]. 2017;8(sup4):1351204.

46. Faber J, Fonseca L. How sample size influences research outcomes. *Dental Press Journal of Orthodontics* [Internet]. 2014;19(4):27-29.

47. Kato H, Asukai N, Miyake Y, Minakawa K, Nishiyama A. Post-traumatic symptoms among younger and elderly evacuees in the early stages following the 1995 Hanshin-Awaji earthquake in Japan. *Acta Psychiatrica Scandinavica* [Internet]. 1996;93(6):477-481.

48. Andrews B, Brewin C, Philpott R, Stewart L. Delayed-onset posttraumatic stress disorder: A systematic review of the evidence. *American Journal of Psychiatry* [Internet]. 2007;164(9):1319-1326.

49. Utzon-Frank N, Breinegaard N, Bertelsen M, Borritz M, Eller N, Nordentoft M et al. Occurrence of delayed-onset post-traumatic stress disorder: a systematic review and meta-analysis of prospective studies. *Scandinavian Journal of Work, Environment & Health* [Internet]. 2014;40(3):215-229.

50. Chan E, Kim J, Lin C, Cheung E, Lee P. Is previous disaster experience a good predictor for disaster preparedness in extreme poverty households in remote Muslim minority based community in China?*Journal of Immigrant and Minority Health* [Internet]. 2012;16(3):466-472.

51. Popay J, Roberts H, Sowden A, Petticrew M, Arai L, Rodgers M. Guidance on the conduct of narrative synthesis in systematic reviews. [Internet]. 2006 [cited 6 November

2020]. Available from: http://file:///C:/Users/user4/Downloads/download%20(1).pdf4. Population Growth Continues to Hinder Nepal's Economic Progress – Population Reference Bureau [Internet]. *Prb.org*. 2002 [cited 6 November 2020]. Available from: https://www.prb.org/populationgrowthcontinuestohindernepalseconomicprogress/

52. Galea S, Nandi A, Vlahov D. The epidemiology of post-traumatic stress disorder after disasters. *Epidemiologic Reviews* [Internet]. 2005;27(1):78-91.

53. Montazeri A, Baradaran H, Omidvari S, Azin S, Ebadi M, Garmaroudi G et al. Psychological distress among Bam earthquake survivors in Iran: a population-based study. *BMC Public Health* [Internet]. 2005;5(1).