ORIGINAL PAPER

Association Between Earthquake Exposures and Mental Health Outcomes in Phulpingdanda Village After the 2015 Nepal Earthquakes

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Abstract

In 2015, two strong earthquakes, as well as continuous, high magnitude aftershocks, struck Nepal. Phulpingdanda village was greatly impacted due to its lack of infrastructure and environmental remoteness. Adults from sampled households were surveyed 1-year later to examine the association between earthquake exposures and indicators of depression, post-traumatic stress disorder (PTSD), and resilience. Results showed 33% of surveyed residents screened positive for depression, 9% screened positive for severe PTSD, and 46% displayed moderate to high resilience. Additionally, participants experienced resource loss (100%), damaged home and goods (99%), and exposure to the grotesque (82%). Traumatic earthquake experiences related to personal harm were associated with symptoms of depression and PTSD and resource loss was associated with depressive symptoms. Earthquake experiences associated with less damage to home and goods, but greater exposure to the grotesque were associated with increased resilience. This research adds to our knowledge of the relationship between traumatic exposures and indicators of psychological distress and resilience following a disaster.

Keywords Nepal · Earthquake · PTSD · Depression · Resilience · Natural disaster

Introduction

Natural disasters, such as earthquakes, landslides, floods, tornadoes, and hurricanes, are a major source of event stress throughout the world (Carmassi et al. 2016; Dai et al. 2017).

Due to the magnitude of these events, there is a potential for entire communities to be substantially affected. Earthquakes represent one of the most prevalent natural disasters throughout the world and often affect populations with limited advanced warning (Hand and Pulla 2015). Characterized by widespread destruction and increased morbidity and mortality in unsuspecting populations, there is often limited infrastructure available in developing countries to address the long-term psychological effects caused by earthquakes. Furthermore, the increased prevalence of mental health distress following an earthquake presents important challenges and obstacles to health services whose main focus tends to be victims with clinically apparent physical injuries in the immediate aftermath (Diaz et al. 2006).

Greater attention should be given to mental health outcomes and support following a disaster, since adverse mental health outcomes may linger many months after an earthquake and thus can potentially outlast the physical injuries caused by the disaster itself (Carr et al. 1997). Several studies have investigated traumatic experiences in a natural disaster setting and the subsequent psychopathology in victims (Dell'Osso et al. 2011; McFarlane and Van Hooff 2009; Shrestha 2015; Wang et al. 2000). Not

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surprisingly, a wide range of effects has been observed across populations, including varying rates of posttraumatic stress disorder (PTSD), depression, and generalized anxiety (Benedek et al. 2007; Weems et al. 2010). The wide range of prevalences may be due to the variety of traumatic experiences, diversity of affected populations, varying demographics, and/or in-country infrastructure (Shinfuku et al. 1998).

Because research suggests each affected population is unique in how it reacts to a disaster, it is recommended subsequent interventions take these response factors into consideration (Harville et al. 2015). Although studies examining the mental health of communities in Nepal have increased in recent years, most research has been conducted on displaced persons, children, or those directly affected by past political violence (Kohrt et al. 2011; Luitel et al. 2015; Thapa and Hauff 2005; Tol et al. 2010). Since the last major earthquake in Nepal occurred in 1934, there is limited knowledge on the extent to which earthquakes affect mental health in Nepali populations. In general, however, the last twenty years has seen more mental health research in developing countries as these communities are more likely to be adversely affected by natural disasters (Desjarlais et al. 1995). In addition to studying adverse mental health outcomes, measuring resilience as an indicator of stable mental health functioning has become increasingly important in assessing the ability to recover after a disaster, especially in developing countries (Kapucu and Liou 2014).

In 2015, two powerful earthquakes struck large areas of South Asia with the majority of the impact seen throughout the country of Nepal. The 7.8 magnitude earthquake struck Nepal on April 25th and killed nearly 9000 people and injured nearly 22,000 (Basnyat et al. 2015). Hundreds of thousands of people became homeless when entire villages were destroyed across many of the country's 75 districts. Continued aftershocks occurred at intervals of 15–20 min with one aftershock reaching a magnitude of 6.7 on April 26th. On May 12th, a second earthquake with a magnitude of 7.4 occurred, followed minutes later by a magnitude 6.3 aftershock. This earthquake directly led to at least 153 deaths and more than 3200 injuries. Overall, more than 3.5 million people were displaced (Basnyat et al. 2015). Due to the paucity of mental health research in developing countries, there is a lack of understanding of the extent to which earthquake exposures are associated with mental health outcomes (Jha and Shakya 2015). Therefore, the objective of this research was to characterize specific earthquake exposures in a heavily impacted village in Nepal and to understand the associations between these specific exposures and symptoms of depression and PTSD, as well as indicators of resilience in the community one-year following the natural disaster.

Methods

Participants

Enrollment for this study was conducted in Phulpingdanda village in the Sindhupalchowk district, approximately 100 km away from the initial epicenter in the Gorkha district (Fig. 1). Sindhupalchowk was one of the worst affected districts as a result of continuous, high magnitude aftershocks, overall lack of infrastructure, and environmental remoteness (i.e. difficult terrain, long distance from paved highways, etc.). Study investigators reached out to a village spokesperson to establish collaborative relationships, discuss the study, and solicit participation from villagers. Households were identified by the village spokesperson and invited to interview. The sampling area consisted of 209 households, according to the spokesperson, but this number could not be independently verified. All adults, aged 18–85 who experienced the 2015 Nepal earthquakes and were available to be interviewed within each convenience-sampled household, were invited to participate in this study. Data were analyzed separately for children and adolescents, aged 8–17 (Schwind et al. 2018).

Procedures

Ethical approval to conduct this research was obtained from the Nepal Health Research Council (Reg. No. 250/2015), the Augusta University Institutional Review Board (Protocol # 850582), and the Maine Medical Center Research Institute Institutional Review Board (Protocol # 958976). Field data collection occurred approximately 12 months after the initial earthquake. All subjects were provided a consent form in the Nepali language. The literacy rate in the Central Development Zone was estimated to be approximately 64% (Center for Bureau Statistics 2014). Because it was likely that a significant number of respondents would have difficulty fully understanding written material, the consent form was also read aloud by the interviewers in a private location. If the participants consented in written and oral form, they were asked to complete a questionnaire through an interview process. Particular attention was paid to subject privacy, cultural sensitivity, and local traditions.

Each questionnaire included a translated Nepali version of the Beck Depression Inventory-II (BDI-II), PTSD Checklist-Civilian Version (PCL-C), Brief Resilience Scale (BRS), and the Traumatic Exposure Severity Scale (TESS), as well as basic demographic and household questions. When selecting the screening tools for the current study, the research team did not have access to published,

Fig. 1 Map of study area relative to the April 2015 Gorkha earthquake epicenter in Nepal
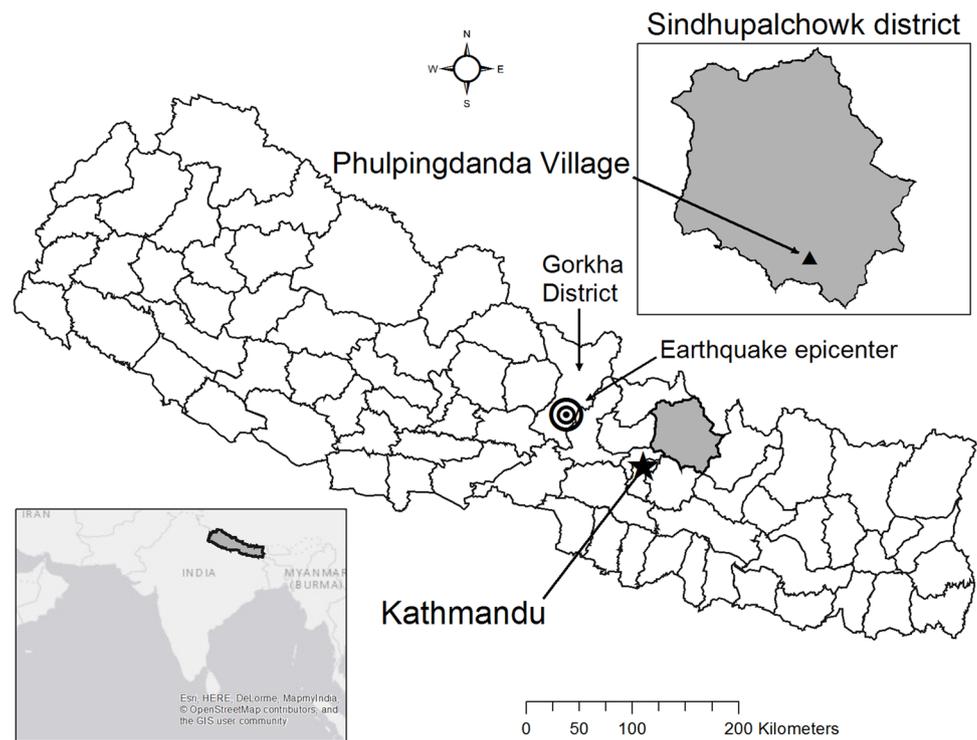
validated instruments available in the Nepali language. Therefore, validated English screening tools were selected and translated by a bilingual legal and public health expert in Nepal. An additional bilingual person outside of the research team then established the equivalence of the English- and Nepali-language versions through blind back translation. All subjects were offered lessons in Skills for Psychological Recovery (SPR) (Berkowitz et al. 2010) by trained interventionists. SPR is a Tier 2 intervention designed to support individuals with mild to moderate subclinical levels of distress during the recovery phase of a disaster and is intended for use with survivors from 2 months to more than 1-year post-disaster. SPR was created after Hurricane Katrina in the United States and has been implemented in multiple post-disaster responses, including the 2009 Bushfires in Victoria, Australia (Forbes et al. 2010).

Co-investigators and interviewers jointly reviewed the entire questionnaire item-by-item. The research team collected data over a two week period. The two interviewers spoke the native language, had past field research experience, and underwent intensive training to standardize interviewing skills and reduce interviewer bias. Interviewers used a structured interview format with each participant and read all options listed under each question. Study investigators supervised subject interviewing and checked the data for completeness and formatting. All subjects who tested positive for symptoms of severe depression and/or

PTSD were provided the contact information of a clinical practitioner for follow-up intervention if desired.

Measures

Demographic Data

Sociodemographic variables, including age, gender (male/ female), marital status (married/other), primary religion (Hindu/Buddhist/other), ethnicity (Upper caste/Relatively advantaged Janajatis/Disadvantaged Janajatis/other), education (any/none), occupation (agriculture/other), monthly household income in Nepali rupees ($\leq$ 10K/> 10K), and household size (three or less/four to five/greater than six people) were measured in all participants.

Earthquake Exposures

In order to quantify earthquake exposures, the Traumatic Exposure Severity Scale (TESS) was utilized (Elal and Slade 2005). This 24-item questionnaire determined whether the respondent experienced each item during or shortly after the earthquake (yes/no) [TESS Occurrence: TESS-OS] and how distressing this item was for them (e.g., 1 = not at all to 5 = extremely; TESS Distress: TESS-DS). The items were divided into the following categories: resource loss (six questions), damage to home and goods (three questions), personal harm (five questions), concern for others (six questions), and exposure to the grotesque (four questions).

Within each category, the mean number of occurrences for each participant was calculated. Among those participants who reported exposure occurrence, the mean level of distress caused by the exposures within each category was also calculated. If the respondent did not have an exposure occurrence, they were assigned a score of 0 for distress.

Mental Health Outcomes

For all participants, resilience, as well as symptomatology associated with depression and PTSD were measured. The Beck Depression Inventory-II (BDI-II) was used to quantify depression symptomatology (BDI-II; Beck et al. 1996) and validated as an accurate tool for measuring depression (Osman et al. 1997). The BDI consists of 21 items, scored on a 4-point scale, that measure the presence and severity of a somatic or cognitive symptom of depression. The item ratings are summed across individuals and sums can range from 0 to 63. Total scores for depression were categorized as follows: 0–13: minimal depression, 14–19: mild depression, 20–28: moderate depression and 29–63: severe depression. These categories were collapsed into 2 groups for multivariable analysis: Minimal/Mild (0–19) and Moderate/Severe (20–63) to improve statistical efficiency due to sparse cell counts.

PTSD symptomatology was measured with the PTSD Checklist-Civilian Version (PCL-C), a 17-item measure based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (Weathers et al. 1994). Each item is rated on a 5-point Likert scale ranging from $1 =$ not at all to $5 =$ extremely. A total PTSD score was calculated by summing the values for each item, resulting in totals ranging from 17 to 85. Total scores for PTSD were categorized as follows: less than 30: mild to no PTSD symptomatology, 30 to 49: moderate PTSD symptomatology and 50 or higher: severe PTSD symptomatology. These categories were collapsed for multivariable analysis: moderate to no PTSD symptomatology (17–49) and severe PTSD symptomatology (50–85), based on previous research in Nepal where total scores of 50 or above were indicative of probable PTSD (Thapa and Hauff 2005).

Resilience was measured using the Brief Resilience Scale (BRS) (Smith et al. 2008), which consists of 6 items with responses scored on a 5-point Likert scale ranging from $1 =$ strongly disagree to $5 =$ strongly agree. A total resilience score was calculated by reverse coding three of the items (questions 2, 4 and 6) and calculating the mean of all six items, with a higher score indicating greater resilience. Resilience scores were categorized into two groups for multivariable analysis: resilience scores less than 3 were considered low resilience and scores of 3 or greater were considered high resilience.

Data Analysis

The numbers and percentages of exposures and outcomes endorsed by the surveyed participants were determined by simple counts of the occurrences and distress associated with traumatic experiences, as well as the occurrence of symptoms related to depression, PTSD, and resilience by utilizing the recommended scoring methods of the aforementioned screening tools described above. A variety of descriptive statistics were used to characterize the associations between sociodemographic variables and traumatic experiences with measured mental health outcomes. For relationships between independent, two-group categorical variables and mental health scores, a student's t test for differences between two means was used. If there were more than two groups, an ANOVA F-test was used followed by a post hoc analysis (Bonferroni procedure) if a significant association was observed. The association between the mean scores of earthquake-related traumatic experiences (TESS subscales) and the categories of depression, PTSD, or resilience was also determined using t-tests. Finally, to understand the relationships between PTSD and depression with resilience, a Spearman correlation coefficient was calculated. For multivariable analysis, logistic regression was used to examine the relationship between TESS Occurrence/ Distress scores (primary independent variables) and depression, PTSD and resilience (dichotomized dependent variables) after adjusting for demographic and socioeconomic covariates. For all models, a statistical method for variable selection suggested by Hosmer and Lemeshow was performed (Hosmer Jr and Sturdivant 2013). Variables associated with the outcome having a p-value < 0.25 on the Wald test progressed to the next stage of modeling. Backward manual elimination methods were used for all covariates. If the removal of a variable caused other variables' coefficients to change by more than 10%, then the variable was retained. Odds ratios and corresponding confidence intervals for both the TESS Occurrence and Distress scales in relation to each mental health outcome were constructed for each model. Furthermore, interaction terms were added to the regression models to test whether resilience was a modifier of the relationship between TESS Occurrence/ Distress scores and depression and PTSD symptomatology. All statistical analyses were two-tailed and conducted using STATA statistical software (Stata Corp. Version 15.0, College Station, TX) and performed on de-identified data. Significance level was set at 0.05. All authors certify their responsibility for the manuscript.

Results

A total of 153 households, yielding 238 study participants, were consented and sampled for this research. Fifteen (6%) participants were excluded from analyses due to incomplete

responses on questions associated with the measurement of the mental health outcomes. Non-responses on exposure variables were noted and these subjects were retained in the analyses. After exclusions, 223 (94%) participants were included in the final sample. The majority of respondents were married (80%) and female (65%) with an average age of 45.1 years (Table 1). The largest representation of study

subjects in each category was: Hindu religion (80%), agriculture occupation (83%) and upper caste (43%). The next most commonly reported ethnicities were relatively advantaged Janajatis (24%) followed by disadvantaged Janajatis (21%). Slightly more than half of the subjects reported their education level as illiterate, received no formal education or offered no response (54%), while the remainder reported at least some primary, secondary, or other education (46%). A little more than half (57%) of the subjects reported a monthly household income of less than 10,000 Nepali rupees (approximately 100 USD), and the largest proportion of households were made up of 4–5 individuals (41%).

When questioned about earthquake exposures and associated distress, the mean scores on the TESS Occurrence and Distress scales were 10.1 (standard deviation (SD) = 3.3) and 39.2 (SD = 15.1) out of a potential maximum score of 24 and 120, respectively (Table 2). Almost all of the study participants (n = 222, ~ 99.6%) reported some level of 'resource loss' across six questions. Subsequently, it was the category with the highest reported occurrence (mean = 4.6; SD = 0.9) and distress (mean = 17.5; SD = 4.4). In this category, most participants reported 'yes' when asked if they had to spend the night somewhere other than their home (n = 218; 98%) or needed shelter after the earthquake (n = 219; 98%). However, fewer subjects reported needing clothes after the earthquake (n = 43; 19%). When responding to questions about 'damage to home and goods', nearly all (n = 221; 99%) reported losing movable goods in the earthquake, while fewer participants (n = 92; 41%) reported having to relocate due to the structural instability of their home. Additionally, 'damage to home and goods' had the second highest distress score (mean 8.1; SD = 3.6).

Out of the five item-groupings of traumatic experiences, the lowest reported occurrence and distress was 'personal harm' indicating the study participants and their immediate families suffered from minimal physical injuries and its associated distress, on average. In this category, 69 (31%) participants indicated they were buried under rubble or trapped for a period of time; however, only 37 (17%) reported they were physically injured in the earthquake. Fifteen (7%) participants lost at least one immediate family member as a result of the disaster, but 96 (43%) reported

Table 1 Demographics of sampled participants in Phulpingdanda, Sindhupalchowk District, Nepal (N = 223)

Characteristic	n (%)
Age (mean, sd)	45.1 (16.6)
Gender	
Male	78 (35.0)
Female	145 (65.0)
Marital status	
Married	179 (80.3)
Other	44 (19.7)
Religion	
Hindu	179 (80.27)
Buddhist	32 (14.35)
Other	12 (5.4)
Ethnicity	
Upper caste	95 (42.8)
Relatively-advantaged Janajatis	54 (24.3)
Disadvantaged Janajatis	46 (20.7)
Other	27 (12.2)
Education	
Illiterate/none/no response	121 (54.3)
Primary or higher	102 (45.7)
Occupation	
Agriculture	184 (82.5)
Other	39 (17.5)
Monthly household income (in Nepali rupees)	
≤ 10K or no response	128 (57.0)
> 10K	95 (43.0)
Household size	
≤ 3	76 (34.1)
4–5	91 (40.8)
≥ 6	56 (25.1)

Table 2 TESS occurrence and distress scales by dimension

Dimension	n (%)	TESS Occurrence			TESS Distress		
		M	SD	Range	M	SD	Range
Resource loss (6 questions)	222 (100%)	4.6	0.9	0–6	17.5	4.4	0–29
Damage to home and goods (3 questions)	221 (99%)	2.1	0.9	0–3	8.1	3.6	0–15
Personal harm (5 questions)	92 (41%)	0.6	0.8	0–4	2.8	3.4	0–19
Concern for significant others (6 questions)	130 (58%)	1.3	1.4	0–5	5.4	5.9	0–22
Exposure to the grotesque (4 questions)	182 (82%)	1.6	1.1	0–4	6.1	4.9	0–20
Total score	223 (100%)	10.1	3.3	1–19	39.2	15.1	4–85

losing a more distant relative (*i.e.*, aunts, uncles, cousins, grandparents, etc.) in the earthquake. Under the category 'concern for significant others', 66 (30%) indicated there was a period of time when they knew a loved one was buried under the rubble, but could not reach them and 79 (35%) were uncertain about the welfare or location of a loved one. The last category about which study participants were queried was 'exposure to the grotesque', which encompassed rescue attempts and witnessing the gruesome aspects of a real-life disaster. Almost half (n = 100; 45%) were involved in rescue work and experienced the odor of dead bodies in the days following the earthquake (n = 98; 44%).

Examining mental health screening outcomes, 74 participants (33%) were classified as displaying mild to severe depression symptomatology (Table 3). The mean score on the Beck Depression Inventory was 10 points (SD = 8). The highest scoring statements included 'loss of interest in sex' (mean = 0.81; SD = 1.15) and 'pessimism' (mean = 0.77; SD = 0.84). The lowest scoring statement was 'suicidal thoughts or wishes' (mean = 0.09; SD = 0.40). For post-traumatic stress disorder, 97 (44%) participants displayed moderate signs of PTSD symptomatology and 20 (9%) displayed severe signs of PTSD. The mean score on the PCL-C was 33 points (SD = 11). The highest scoring statements included 'suddenly acting or feeling as if a stressful experience were happening again' (mean = 2.94; SD = 1.27), and 'repeated, disturbing memories, thoughts, or images of a stressful experience from the past' (mean = 2.71; SD = 1.07). The lowest scoring statement was 'trouble remembering important parts of a stressful experience from the past' (mean = 1.10; SD = 0.44). Fourteen (6%) participants had both severe PTSD and moderate to severe depression combined. The mean resilience score on the BRS was 2.9 points with a

standard deviation of 1.07. Of the six BRS questions, the highest scoring statement was 'I tend to bounce back quickly after hard times' (mean = 2.96; SD = 1.21). The lowest scoring statement was 'I usually come through difficult times with little trouble' (mean = 2.86; SD = 1.07). There was a negative, significant correlation between depression and resilience ($r_s = -0.4890$, p < 0.001), and a negative, significant correlation between PTSD and resilience ($r_s = -0.2967$, p < 0.001).

Demographic and socioeconomic factors associated with depression included age, gender, marital status, ethnicity, and education (Table 4). As age increased, the mean depression score also increased (p = 0.017). Females were more likely to have a higher mean depression score than males (p = 0.043). Individuals who were married had a lower mean depression score compared to those who were classified as other (p = 0.008). Among ethnic groups, those in the 'other' category, including Dalit, disadvantaged non-Dalit Terai caste groups, and religious minorities, were more likely to report higher levels of depression compared to other groups (p = 0.019), with a statistically significant difference between 'other' and 'relatively advantaged Janajatis' confirmed through a post hoc test. Those who were illiterate, had little education, or did not respond to the education question were more likely to have a higher depression score compared to those participants with at least a primary level of education (p < 0.001). Demographic and socioeconomic factors associated with PTSD and resilience included both gender and education. Females were more likely to report higher PCL-C scores (p = 0.013) and lower BRS scores (p = 0.015) compared to their male counterparts. Illiterate individuals or those with very little education were more likely to experience higher PCL-C scores (p < 0.001) and lower BRS scores (p < 0.001) compared to individuals who had received a primary or higher level of education.

Across levels of depression, there were significantly more 'yes' responses to 'resource loss' (p = 0.002) and 'personal harm' (p = 0.018) from those classified as having moderate to severe depressive symptoms as compared with those reporting only minimal to mild depression scores (Table 5). For the traumatic exposure category 'personal harm,' there were significantly more 'yes' responses from subjects who were classified as having severe PTSD compared to those with mild to moderate PTSD (p = 0.012) (Table 6). For all exposure categories, the mean number of 'yes' responses was greater for those with severe PTSD symptoms compared to mild to moderate PTSD symptoms. When examining the association between traumatic exposure categories and resilience, 'damage to home and goods' and 'exposure to the grotesque' were statistically significant (Table 7). For the traumatic exposure category 'damage to home and goods,' there were significantly more 'yes' responses from subjects who were classified as having low resilience compared to

Table 3 Screening outcomes in the sampled population

Clinical Outcome	n (%)
Depression symptomology	
Minimal (≤ 13)	149 (66.8)
Mild (14–19)	44 (19.7)
Moderate (20–29)	28 (12.6)
Severe (≥ 30)	2 (0.9)
Post-traumatic stress disorder symptomology	
Mild to none (≤ 29)	106 (47.5)
Moderate (30–49)	97 (43.5)
Severe (≥ 50)	20 (9.0)
Resilience symptomology	
1–1.99	13 (5.8)
2–2.99	107 (48.0)
3–3.99	14 (6.3)
4–4.99	82 (36.8)
5	7 (3.1)

Table 4 Demographic and socioeconomic factors associated with mental health outcomes of depression, PTSD, and resilience

Characteristic	Depression		PTSD		Resilience	
	Mean	SD	Mean	SD	Mean	SD
Age						
≤ 34 years old	7.9*	7.9	31.4	10.2	3.0	1.1
35–54 years old	10.3	7.8	33.5	10.8	3.0	1.1
≥ 55 years old	11.8	8.1	33.0	10.6	2.8	1.1
Gender						
Male	8.5*	7.3	30.3*	8.6	3.2*	1.1
Female	10.8	8.3	34.0	11.3	2.8	1.1
Marital Status						
Married	9.3*	7.7	32.1	10.4	2.9	1.1
Other	12.9	8.8	35.2	10.8	2.9	1.1
Religion						
Hindu	10.4	8.0	33.2	10.7	2.9	1.1
Buddhist	8.0	5.8	30.3	7.4	2.9	1.0
Other	9.25	12.4	30.8	14.5	3.04	1.1
Ethnicity						
Upper caste	10.0*	7.5	32.2	11.4	2.8	1.1
Relatively advantaged Janajatis	8.0	7.7	33.6	10.5	3.2	1.1
Disadvantaged Janajatis	10.2	7.9	32.0	9.7	2.8	1.0
Other	13.9	9.4	34.3	8.9	2.9	1.1
Education						
Illiterate/none/no response	12.3*	8.1	34.9*	10.9	2.7*	1.0
Primary or higher	7.2	7.0	30.0	9.4	3.1	1.1
Occupation						
Agriculture	9.8	7.9	32.8	10.6	2.9	1.1
Other	10.9	8.8	32.2	10.2	3.0	1.1
Monthly household income						
≤ 10 k (NR) or no response	10.8	8.1	33.1	10.7	2.9	1.1
> 10 k (NR)	8.9	7.8	32.1	10.4	3.0	1.0
Household size						
≤ 3 members	10.3	7.9	32.5	10.4	3.0	1.1
4–5 members	9.7	7.4	32.6	10.5	2.9	1.0
≥ 6 members	10.0	9.1	33.1	11.0	2.9	1.1

*$p < 0.05$ as determined through t-test or ANOVA F-test where applicable

Table 5 TESS Occurrence subscale measures by depression categories in adults

Dimension	Minimal to mild depression symptomatology (n = 193)			Moderate to severe depression symptomatology (n = 30)		
Event-related variables	M	SD	Range	M	SD	Range
Resource loss**	4.5	0.9	0–6	5.0	0.7	4–6
Damage to home and goods	2.1	0.9	0–3	2.2	0.8	1–3
Personal harm*	0.5	0.8	0–3	0.9	1.1	0–4
Concern for significant others	1.3	1.3	0–5	1.4	1.6	0–4
Exposure to the grotesque	1.6	1.2	0–4	1.3	0.92	0–4

*$p < 0.05$. **$p < 0.01$

Table 6 TESS Occurrence subscale measures by PTSD categories in adults

Dimension	Mild to moderate PTSD symptomology (n = 203)			Severe PTSD symptomology (n = 20)		
Event-related variables	M	SD	Range	M	SD	Range
Resource loss	4.5	0.9	0–6	4.9	0.8	3–6
Damage to home and goods	2.1	0.9	0–3	2.3	0.9	1–3
Personal harm*	0.6	0.8	0–4	1.1	1.1	0–3
Concern for significant others	1.3	1.3	0–5	1.8	1.8	0–4
Exposure to the grotesque	1.6	1.2	0–4	1.7	0.9	1–4

*$p < 0.05$

Table 7 TESS Occurrence subscale measures by resilience categories in adults

Dimension	Resilience score < 3 (n = 120)			Resilience score ≥ 3 (n = 103)		
Event-related variables	M	SD	Range	M	SD	Range
Resource loss	4.6	1.0	0–6	4.5	0.9	3–6
Damage to home and goods*	2.2	0.8	0–3	2.0	0.9	0–3
Personal harm	0.6	0.9	0–3	0.6	0.8	0–4
Concern for significant others	1.3	1.3	0–4	1.4	1.4	0–5
Exposure to the grotesque**	1.4	1.2	0–4	1.8	1.1	0–4

*$p < 0.05$. **$p < 0.01$

Table 8 Adjusted odds ratio (95% confidence intervals) of earthquake exposure scales in relation to depression, PTSD and resilience categories

Measure	Depression[a]	PTSD[b]	Resilience[c]
TESS Occurrence Scale	1.19 (1.02–1.37)	1.23 (1.06–1.42)	1.00 (0.92–1.09)
TESS Distress Scale	1.05 (1.02–1.08)	1.04 (1.01–1.07)	0.99 (0.98–1.02)

[a]Adjusted for age, gender, marital status, ethnicity and household income

[b]Adjusted for gender

[c]Adjusted for gender and education status

those with high resilience (p = 0.021). For the category 'exposure to the grotesque', there were significantly more 'yes' responses from subjects who were classified as having high resilience compared to those with low resilience (p = 0.004).

Multivariable analysis showed a statistically significant relationship between depression and TESS Occurrence and Distress scores (Table 8). After adjusting for age, gender, marital status, ethnicity, and household income, the odds of depression increased approximately 19% or 5% for every one-point increase in occurrence or distress, respectively. Multivariable analysis also showed a statistically significant relationship between PTSD and TESS Occurrence and Distress scores. After adjusting for gender, the odds of PTSD increased by approximately 22% or 5% for every one-point increase in occurrence or distress, respectively. There was no statistically significant relationship between TESS Occurrence or Distress scores and resilience. Additionally,

no significant interactions between TESS Occurrence or Distress scores and resilience were observed (data not shown).

Discussion

This study examined earthquake exposures and mental health outcomes, including symptoms of depression and PTSD, as well as resilience, in Phulpingdanda village in the Sindhupalchowk district near the epicenter of the 2015 earthquakes approximately one year after the natural disaster. Our research found that 33% (n = 74) of the sampled population were positive for at least mild depressive symptoms and 9% (n = 20) had severe PTSD symptomatology. Specific earthquake exposures were associated with a variety of mental health outcomes. Depression was significantly associated with resource loss (i.e. loss of food, shelter and/ or household items) and personal harm (i.e. direct physical

injuries or dependence on others), whereas PTSD was significantly associated only with personal harm. Resilience was negatively associated with damage to home and goods, and surprisingly, was positively associated with exposure to the grotesque. Once demographic variables were taken into account, higher scores on the TESS occurrence and distress scales were observed for both depression and PTSD symptomatology.

These estimates are similar to previous reports from other countries in post-disaster settings (Basoglu et al. 2004; Neria et al. 2008; van Griensven et al. 2006). As compared with another recent study in post-earthquake Nepal, we found a similar percentage of participants displaying depression symptomatology, but a higher proportion with severe PTSD symptomatology (Kane 2017). This finding could be influenced by the proximity of the village we surveyed to the first earthquake's epicenter, as proximity to the epicenter was shown to be associated with higher PTSD rates in another study (Basoglu et al. 2004).

Studies have attempted to examine the complex relationships between sociodemographic factors, event exposures, social support and personality traits, and psychosocial outcomes in post-disaster settings. In this research, traumatic experiences, measured by the TESS screening tool, were more commonly noted in those with higher depression and PTSD scores. The fact that 'resource loss' was a significant variable associated with more severe depressive symptoms bears noting given the cultural and economic context in which this research was executed. Further exploration into whether resource loss is a stronger predictor for higher severity of depression and other mental health outcomes in countries already devoid of many resources could prove valuable in helping to focus investments and efforts following disasters in economically vulnerable locations. This research also identified several sociodemographic groups who were at an empirically higher risk for adverse mental health outcomes, including women, the unmarried and those who are illiterate or have no formal education. Support for these findings come from other studies where adverse psychological outcomes, such as PTSD, depression or lower resilience, were generally found to be worse for female disaster survivors, the unmarried and those with lower educational attainment (Bonanno et al. 2007; Frankenberg et al. 2013; Galea et al. 2005; Neria et al. 2008; Tang et al. 2014), although there was significant variance in these relationships across populations. The demographics observed in this particular village were skewed heavily toward females and the elderly due to an international labor migration out of rural Nepal into India, Malaysia and Middle Eastern countries in search of work (Adhikari and Hobley 2015). While these findings may not be representative of all Nepali people, we believe the demographics were representative of Phulpingdanda village, and many other rural villages across Sindhupalchowk,

since this migration pattern was observed prior to the earthquakes. Further research is needed to determine the extent to which sociodemographic characteristics may act as protective factors and potentially decrease risk or vulnerability to the development of adverse mental health outcomes following a disaster (Blaikie et al. 2014), especially in a culturally-sensitive context.

Several limitations to this research should be noted. First, the instruments utilized relied entirely on the self-reporting of signs, symptoms, and experiences and could not be verified or diagnosed by a healthcare provider. Furthermore, due to self-reporting, it is likely that the true extent of the earthquake damage was not fully recognized or captured using the TESS survey instrument. For example, only 41% of participants stated they had relocated due to the structural instability of their home and 69% stated their home was damaged in the earthquake. However, when the research team visited a year after the earthquakes, temporary shelters were still being widely used with no rebuilding efforts yet underway. It was clear the majority of the villagers had built or repurposed their temporary shelters next to their destroyed permanent homes. Because they had not relocated to makeshift camps far from their original homes, they may not have considered themselves as having had to relocate. Further research is needed to better understand the impact of temporary shelters near primary residences versus makeshift camps on the overall mental health of disaster survivors in developing countries.

Thirdly, disastrous events that occur in very poor and politically turbulent nations such as Nepal often experience one negative impact after another. Following the earthquakes in Nepal, fuel shortages caused by blocked supply routes had a large negative impact on the economics, health, and well-being of the population (Lamichhane 2015). But because of the cross-sectional nature of this research, we cannot state the mental health symptoms we measured were associated specifically with the earthquake itself, as stressful events are quite common in such rural communities where life is difficult under the best of circumstances. However, due to the strong associations we observed with certain earthquake-related exposures (i.e. resource loss and personal harm) and mental health symptomatology, it is likely the earthquake played a major role in the development of these adverse mental health conditions. Furthermore, there is a cultural bias in Nepal towards minimizing or not reporting distress or trauma, as well as recasting events and feelings as a product of karma, so it is likely our research findings underestimate the true prevalence of these mental health outcomes (Kohrt and Hruschka 2010).

In addition, previous research in Nepal has shown high rates of alcoholism in the population (Jhingan et al. 2003). Without information regarding this important comorbidity, we are not able to determine the full extent of its impact on

adverse mental health outcomes. Moreover, the generalizability of this research is limited due to our sampling area. Because we focused on one hard-hit village in Sindhupalchowk and our participants were not randomly selected from all affected individuals or households, we cannot presume our findings generalize to all communities within Nepal. Finally, many of the screening tools used in this research have not been formally validated and/or published in the Nepali language. A more extensive look through the lenses of factor analysis and cross-cultural competency is needed for the advancement and validation of mental health screening tools to be used in resource-limited countries, such as Nepal.

Due to environmental constraints seen in many developing countries, such as village remoteness and lack of healthcare infrastructure, future studies should focus on the development of rapid detection of mental health outcomes and intervention responses from a community-based perspective. Because mental health clinicians and other resources are extremely limited and mainly concentrated in the capital, Kathmandu, it would be advantageous to employ community-based interventions such as Psychological First Aid in the more immediate aftermath of disastrous events (Ruzek et al. 2007) and later, Skills for Psychological Recovery in the disaster recovery phase (Berkowitz et al. 2010).

Through the use of rapid tools to assess specific earthquake exposures and mental health outcomes in a Nepali community devastated by two major earthquakes, this research adds to our knowledge regarding the relationships between specific traumatic exposures and mental health outcomes following a natural disaster. Furthermore, findings from this research can be compared with those from other studies to elucidate the complex relationships between exposures experienced in natural disasters and mental health outcomes, universally, across various populations. Finally, this research helps to fill the current gaps in knowledge and contributes to the growing body of literature on mental health in Nepal.

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