Proceedings of 14th IOE Graduate Conference
Peer Reviewed
Year: 2023 Month: December Volume: 14
ISSN: 2350-8914 (Online), 2350-8906 (Print)

A Study of Household Earthquake Preparedness in Dhangadhi Sub-Metropolitan City

Narendra Badu [a], Hari Darshan Shrestha [b]

[a, b] *Department of Civil Engineering, Pulchowk Campus, IOE, Tribhuvan University, Nepal*
[a] narendrabadu4@gmail.com, [b] harishrestha@pcampus.edu.np

Abstract
Nepal is a seismically active region that has witnessed several devastating earthquakes in the past, and lack of preparedness was found to be one of the main reasons for such an impact. Since the Gorkha earthquake in 2015, Nepal has made significant efforts at the policy level; however, the previous study shows that the level of household preparedness is inadequate despite good knowledge of earthquake risk. Therefore, the primary objective of this study was to explore the factors affecting household earthquake preparedness among households in Dhangadhi sub-metropolitan city. The primary source of data for this study was collected from 100 households in the city through a closed-ended questionnaire survey.This study utilized a two-step random sampling method for the selection of households, and questionnaires were administered through face-to-face interviews under three domains: socio-demographic information, earthquake preparedness, and the health belief model. The relationship between the dependent and independent variables was determined by implementing a chi-square test and a logistic regression test. The survey results suggest insufficient household earthquake preparedness. Univariate analysis suggests that among socio-demographic factors, education level, length of residence, and house ownership are significant predictors of household earthquake preparedness. Similarly, perceived susceptibility, perceived benefits, and perceived barriers appear to be significant determinants of preparedness. This study suggested that interventions for enhancing household earthquake preparedness should focus on decreasing perceived barriers, increasing perceived benefits, and making people aware of their susceptibility to earthquake hazards.

Keywords
Earthquake, Household preparedness, Factors

1. Introduction

Earthquakes are one of the destructive geological hazards that take place unexpectedly and have the potential to cause significant negative consequences for human society, such as physical loss, economic loss, psychological issues, and social problems [1]. In the past few years, the impact of the earthquake has been more severe, especially in developing countries, due to a rise in population density, accelerated urbanization, and increased industrialization [2]. Nepal is one of the most seismically active countries due to its location in the central Himalaya and has a longstanding history of devastating earthquakes [3]. The first documented earthquake corresponds to the year 1223 A.D., and since 1255 A.D., Nepal has experienced 19 earthquakes with severe impacts, along with several light and moderate earthquakes annually [4].

In Nepal, the effects of earthquakes have been observed to be more severe due to a lack of earthquake-resilient design and construction and a lack of earthquake preparedness, as seen in the recent devastating Gorkha earthquake of 2015, which took the lives of 8790 people and injured over 22,300, affecting over 8 million people [5]. Since the devastating Gorkha earthquake in 2015, the government of Nepal has undergone several policy reforms.The New Disaster Risk Reduction and Management Act 2017 has been enacted, which has been more proactive in terms of disaster risk reduction [3]. Similarly, the National Building Code for seismic design has been updated, guidelines for masonry structures have been developed, and an earthquake contingency plan has been prepared. In addition, preparedness plans have been developed by different municipalities and districts for disasters. However, the level of household earthquake preparedness still remains lows despite of efforts of governments and I/NGOs. Maharjan and Shrestha (2017) conducted study on household preparedness in Kathmandu Valley and found that despite having a good understanding of earthquake risks, low level of household earthquake preparedness was found [6]. Similarly, K.C. (2022) carried study in Kathmandu metropolitan city to assess the preparedness preparedness of household members and analyze the efforts of stakeholders in increasing the coping resources of the people and found that despite the experienced the devastating effect of 2015 Gorkha earthquake, the preparedness level was low [7]. The findings of the previous studies on household earthquake preparedness reveal that despite the efforts to educate and disseminate information about earthquake preparedness, households have not implemented the preparedness strategies.This suggested that having sufficient knowledge for preparation does not guarantee people will implement self-proactive measures; their decision to engage in particular behaviors is governed by their beliefs, attitudes, values, and perception along with some external factors[8].

In recent times, the number of seismic events has increased in western Nepal, and if seismic activity of higher magnitude or several quakes of smaller magnitude occur, it could result in massive casualties, high mortality rates, infrastructure damage, disruption of services, etc., and this may lead to

public panic and chaos. Hence, in order to anticipate and mitigate the impacts of earthquakes, there is a need for effective preparation to cope with them. Since different communities may have different reasons and ways to engage themselves in preparedness activities and existing programs that treat everyone the same way may not be effective in encouraging people to prepare for an earthquake [9]. Hence, it is important to identify factor associated household earthquake preparedness in order to enhance the preparedness for future earthquake.

Thus, the main objective of this study is to determine the factors associated household earthquake preparedness in Dhangadhi sub-metropolitan city which can serves as baseline data for different stakeholder working for earthquake risk reduction to enhance household earthquake preparedness.

2. Literature Review

Earthquake risk reduction involves the development and application of policies, strategies, and practices with the aim of reducing the potential damage and loss related to earthquakes [10]. The most commonly identified measures for minimizing earthquake risk include engineering solutions, land use planning, an early warning system, and earthquake preparedness [9]. Since the first three measures required considerable time and financial resources, preparedness is considered one of the most effective measures for developing countries due to limited resources. Earthquake preparedness is a series of activities and measures taken by various stakeholders with the aim of reducing the loss of life and livelihood due to disaster and improving the post-disaster response. The various stakeholder groups include households, organizations, communities, governments, etc., and their activities differ from each other. Among the above stakeholder groups, preparedness at households are most crucial for earthquake preparedness, as affected areas often face challenges in receiving adequate relief supplies due to geographic isolation resulting from damage to local infrastructure and limited access to resources and functions caused by the impact on a large area [11, 12].

Household earthquake preparedness is preventive action taken by the household in order to enhance its coping capacity and resilience to recover from the effects of quakes. It involves developing knowledge and skills, making plans for minimizing an earthquake's consequences, stockpiling emergency supplies and equipment, and putting emergency mitigation measures into action [9]. Well prepared household contribute to more efficient response by the government by enabling it to focus on the restoration of public services and infrastructure. Due to the significance of household earthquake preparedness, government of different countries has priorities household earthquake preparedness however, the findings of previous studies on household earthquake preparedness reveals low household preparedness [13].

In the past few years, the focus of the study of disaster preparedness has shifted toward determining the factors associated with preparedness in order to enhance household preparedness for disaster. The majority of studies have considered the socio-demographic factor, cognitive factor, organizational factor, and societal factor for household earthquake preparedness.[14, 15, 16, 17, 1, 12].

Oral et al. (2015) conducted a study in Turkey to evaluate the impact of prior earthquake experience on earthquake preparedness and found experience to be a significantly associated with earthquake preparedness [17]. Onuma et al. (2016) illustrated that households with low income and education were less prepared for disaster due to limited financial resources to take preparedness action and low awareness regarding disaster risk[12]. Augustine et al. (2019) conducted disaster preparedness study in Afghanistan to explore the preparedness level and various factor that contribute to their preparedness and found monthly income has significant association with preparedness [14]. Cvetković et al. (2019) in their study found older people had taken more steps of earthquake preparedness than younger people [13]. Ozdemir et al. (2021) found that the house owner has taken more steps of preparedness then their counterparts. In addition to socio-demographic variables, several cognitive model and theory has been developed to determine the factor motivating people to adopt preparedness behavior. Some of the most recently used models are Theory of Planned Behavior, Protection Motivation Theory and the Health Belief Model [18].

The Health Belief Model (HBM) is a behavioral theory developed in the late 1950s that analyzes the decision-making process that individuals use to adopt health protective behaviors [1]. This model evaluates why people do not apply preventive health behaviors and finds out the reasons behind their implementation or failure. This theory is not limited to the health sector; it has been applied in different sectors [1]. Studies have supported the idea that differences in household preparedness behaviors are correlated with beliefs about preparedness and that treating disasters as health threats can determine preparedness behaviors [19]. This theory consists of several constructs: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy [1, 19]. This theory believes that chance of adaptation to earthquake preparedness is higher if people find themselves susceptible to earthquakes, believe that it may result in serious consequences, and believe that the preparedness action would be beneficial to them overcoming the barrier, as well as if they are capable of taking such action[19].

3. Research Methodology

This research study is a cross-sectional mixed-methods research design that uses both qualitative and quantitative data. This study utilized a qualitative approach to determine the factors associated with household earthquake preparedness through a literature review, key informant interviews (KIIs), and a quantitative approach to determine factors significantly associated with household earthquake preparedness using a closed-ended questionnaire through a household survey.

3.1 Study area and Participants

The study area Dhangadhi sub-metropolitan city is located in Kailali district, which ranks third in terms of the spatial distribution of total relative seismic risk [20]. This city is one of the economic hubs of western Nepal, where major earthquakes have not been experienced since 1505 A.D., and further stress has been added by the Gorkha earthquake of 2015, which shifted unreleased built-up pressure toward the west [4]. This municipality is at high risk of earthquakes due to old structures that are not resilient to earthquakes, non-compliance of building codes, rapid unmanaged urbanization, and rapid population growth [21].

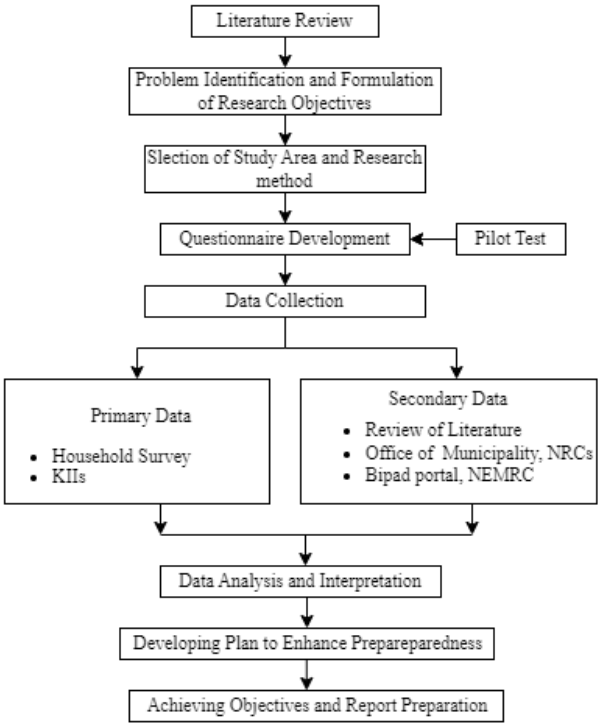

Figure 1: Research Methodology

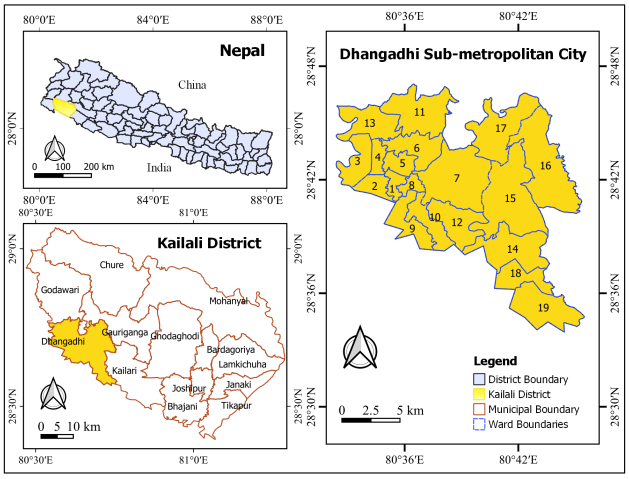

Figure 2: Location map of study area

The study utilized a stratified, two-stage non-probability sampling method. The primary sampling unit was the ward, and the second sampling unit was households. The wards 1, 2, 3, 4,5, and 8 were selected purposefully, considering population density, increasing population and urbanization in discussion with key informants for the study, and households were then selected within the ward using the convince sampling method. The sample for each ward was allocated based on the proportion of households. Data was collected using a closed-ended questionnaire in July 2023, and one adult member from each household was interviewed. A total of 100 household surveys were conducted in Dhangadhi city. Written consent was obtained prior to the survey, and the questionnaire was administered, which took about 20 minutes to complete.

3.2 Measures

3.2.1 Earthquake Preparedness (Dependent variable)

Household earthquake preparedness was measured by 24 items based on previous studies [1, 2, 17]. These included eight questions related to material preparedness, seven questions related to mitigation measures, another five questions related to skill and knowledge, and the last four questions related to emergency planning.

3.2.2 Socio-demographic Variables (Independent variables)

The socio-demographic variables for the study included 15 questionnaires based on prior studies on household earthquake preparedness. This included multiple-choice questionnaires that included data regarding demography such as age, gender, education, family structure, employment status, house structure, length of residence, house ownership, monthly income, and marital status [1, 2]. In addition, it included a yes-or-no questionnaire that included the presence of children and elderly people in the house. Similarly, past experience with earthquakes was assessed by asking about experience with damaging earthquakes.

3.2.3 Health Belief Model (Independent variables)

The Health Belief Model questionnaire developed and validated by Inal et al. (2017) in Turkey was used with modifications [19] and the final questionnaire contains 27 questions under six constructs: perceived susceptibility (5), perceived severity (3), perceived benefits (3), perceived barrier (6), self-efficacy (5), and cue to action (5). This questionnaire was assessed on a 5-point Likert scale, which ranges (1-5) from "strongly disagree" to "strongly agree". The overall reliability of questionnaire found acceptable using Cronbach's alpha coefficient (> 0.7).

3.3 Data Analysis

In the earthquake preparedness questionnaire, a score of 1 was given for each answer of "yes" and a score of 0 for each answer of "no," and the summation of the scores was termed the preparedness score, as previously used in disaster preparedness studies at the household level [1, 15, 17]. The household were classified into preparedness level by converting activities they have performed into five category with the help of LIPI/UNESCO/ISDR (2006) by normalizing the total score into 100 shown in Table 1. Similarly, for determining the factor associated with household earthquake

preparedness, the prepared and highly prepared category was merged and termed as "prepared" while remaining category was termed as "unprepared".

Table 1: Table for classification of Household based on preparedness activities

Percentage	Activities	Categories
Below 40	0-9	Not Prepared
40-54	10-12	Less Prepared
55-64	13-15	Almost Prepared
65-79	16-18	Prepared
Above 80	19-24	Very Prepared

The Chi-squared test was used for determining the dependency of categorical socio-demographic variables, while univariate logistic regression was used for the continuous health belief model variable. The multivariate logistic regression model was assessed for the variables that were significant in univariate analysis for household earthquake preparedness based on enter approach. The statistical analysis was performed by the free and open source statistical software JASP version 17.3.0.

4. Results

4.1 Household Earthquake Preparedness

The study found a moderate level of household earthquake preparedness, with a mean score of 12.34 out of 24 and a standard deviation of 4.40. The level of preparedness ranges from a minimum preparedness score of 5 to a maximum preparedness score of 22. The majority of respondents (35%) fell under the not prepared category for earthquakes at the household level, where they have adopted less than 10 activities. Similarly, the data revealed that only 15% of households were highly prepared for earthquakes, and a similar percentage of respondents fell under the prepared group, while 19% of households were almost prepared. Furthermore, 16% of households were less prepared for earthquakes. The overall findings indicate that only 30% of households demonstrated adequate preparedness for earthquakes, while the majority, constituting 70%, exhibited a lower level of adaptation to earthquake preparedness measures. .

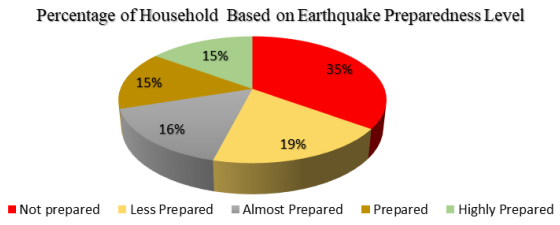

Figure 3: Graphical representation of household earthquake preparedness level

The breakdown of household earthquake preparedness shows a difference in adaptation of household earthquake preparedness measures, as some items were mostly followed by others. On comparing the adaptation of the preparedness component of household earthquakes with reference to taking more than 50% of the measures at home. The result reveals that the majority of households (55%) had implemented the skill and knowledge component of preparedness, while mitigation measures were the least implemented (26%), followed by emergency planning (27%). Similarly, material preparedness is the second most commonly adopted component of household earthquake preparedness (49%). The study found that secured food for 3 days was the most commonly applied preparedness measure, and a battery-powered radio kept at home was the least commonly applied measure among material preparedness. Similarly, the majority of respondents have stored heavy objects on the floor, while few have fastened tall furniture. In the skill and knowledge category, training on first aid was the least implemented measure, while knowledge of emergency communication centers was the most implemented measure. Among the four emergency planning measures, the majority of households know the route and location of open spaces, while few households have practiced or drilled for earthquakes.

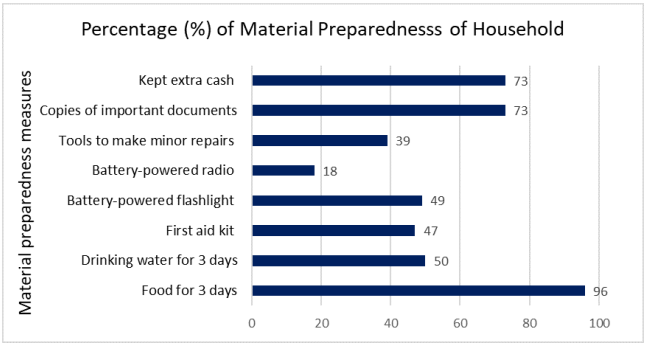

Figure 4: Percentage of material preparedness of household for earthquake

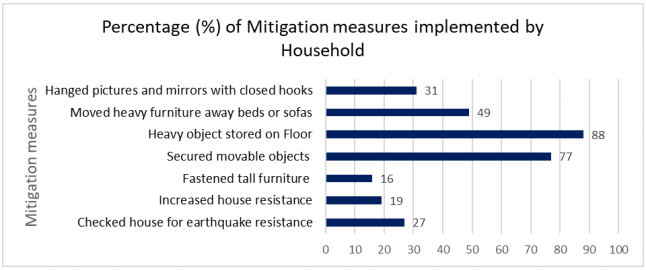

Figure 5: Percentage of household implement mitigation measure for earthquake

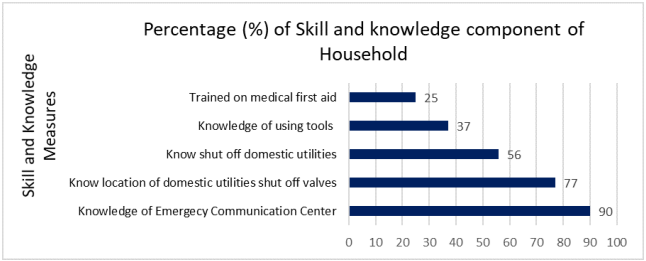

Figure 6: Percentage of Skill and Knowledge measure implemented by household for earthquake

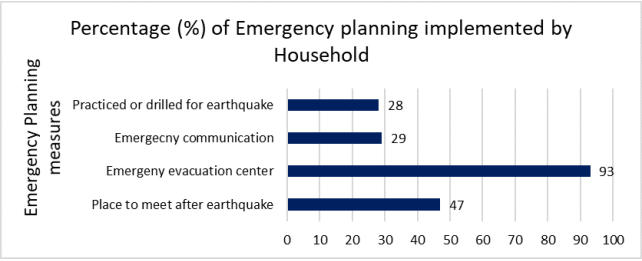

Figure 7: Percentage of household implemented emergency planning for earthquake

Table 2: Factors associated with household earthquake preparedness: Result of Chi-square test

Factor	Group	Participant	P-value
Gender	Male	58	0.082
	Female	42	
Age	18-30	43	0.307
	30-40	42	
	Above 40	15	
Education	Primary	18	< 0.001*
	Secondary	27	
	Higher secondary	30	
	University	25	
Employment	Employed	63	1
	Unemployed	37	
Family structure	Nuclear	36	0.220
	Joint	64	
Marital status	Married	72	1
	Unmarried	28	
House Type	Cement-bonded brick/ stone structure	62	0.345
	RCC structures	38	
House Ownership	Owner	75	0.023 *
	Rental	25	
Length of Residence	Less than 15 years	59	0.006*
	More than 15 years	41	
Monthly Income	less than 20000	6	0.387
	20000-40000	69	
	above 40000	25	
Presence of elderly people	Yes	55	0.38
	No	45	
Presence of Children	Yes	75	0.131
	No	25	
Past experience	Yes	24	0.385
	No	76	

∗represent factor significant to household earthquake preparedness

4.2 Factor Affecting Household Earthquake Preparedness

The study found preparedness for the earthquake had a significant relationship with education level ($P < 0.01$), house ownership ($P < 0.05$) and length of residence ($P < 0.05$) (Table 1). Experience with earthquakes, the presence of elderly people and children, monthly income, and house structure were found to be insignificant to household earthquake preparedness on the Chi-square test Table 2.

The univariate logistic regression analysis showed that perceived susceptibility, perceived benefits, and perceived barriers were significantly associated with earthquake preparedness (Table 3).

Table 3: Factors associated with household earthquake preparedness: result of logistic analysis

Factor	Odds Ratio (95% CI)	p-value
Perceived Susceptibility	1.348 (1.144-1.589)	< 0.001 *
Perceived Severity	1.198 (0.971-1.479)	0.093
Perceived Benefits	1.39(1.038 -1.862)	0.027*
Perceived Barrier	1.127(1.004-1.264)	0.042 *
Self-efficacy	1.081(0.954-1.225)	0.219
Cue to Action	1.044(0.932-1.171)	0.456

On analyzing multivariate logistic regression, only education status and perceived susceptibility were significant predictors of household earthquake preparedness (Table 4).

Table 4: Factors associated with household earthquake preparedness: result of multi-variate logistic analysis

Factor	Odds Ratio (95% CI)	p-value
Perceived susceptibility	1.263 (1.032-1.557)	0.024*
Perceived Benefit	1.101 (0.78-1.555)	0.585
Perceived Barrier	1.042 (0.897-1.21)	0.594
Secondary level	3.728 (0.334-41.653)	0.285
Higher Secondary	5.303 (0.461-61.026)	0.181
University	18.766 (1.607-219.212)	0.019 *
Owner	5.391 (0.889-32.676)	0.067
More than 15 years	2.253 (0.734-6.912)	0.156

5. Discussion

5.1 Discussion

This study found moderate level of household earthquake preparedness and determined the factors influencing household earthquake preparedness based on socio-demographic variables and HBM in Dhangadhi sub-metropolitan city. The study found that education level was significantly related to earthquake preparedness. Respondents with higher education levels were found to be more prepared than those with lower education levels, which corresponds to the finding of Onuma et al. (2018). Higher education provides an opportunity for people to get better and greater information and resources, which allows them to get a detailed understanding of the risk associated with

earthquakes [12]. This led them to acquire the necessary measures of preparedness. Similarly, house ownership was significantly associated with earthquake preparedness where the house owner had taken more steps toward earthquake preparedness than the renter, which was similar to the finding of Oral et al. (2015). The reason behind the low preparedness of households living in rented houses is due to the fact that they see rented houses as temporary situations and investment in rented houses as a waste of limited available sources. Further, they do not prioritize preparedness for disaster during the selection of rented houses as their priority, as mentioned by K.C. (2022) during the study of earthquake preparedness in Kathmandu city [7]. Similarly, restrictions on activities such as fixing high furniture, limited space for storage, and easily available materials at door steps were reasons behind the low preparedness of renters for earthquakes. In contrast to this, house owners took more preparedness measures due to their emotional attachment to their place of residence and high risk to their assets, despite the preparedness costs. The length of residence was another factor associated with preparedness. People who lived longer than 15 years were more prepared than their counterparts. The increase in length of residence also increased the person's experience of assessing their preparedness for hazards through exposure to events and information on preparedness and mitigation programs [14]. Further, with the increase in residence period, people also accumulate resources and develop a stronger attachment to their place, which ultimately leads households to engage in preventive measures to reduce potential damages from hazards.

The experience of previous destructive earthquakes and their damaging consequences led people to make efforts toward preparedness out of fear of their injuries and the suffering they had faced. However, the findings contradict the results of a previous study where Oral et al. (2015) found past experience with disasters was significantly associated with earthquake preparedness [17]. The respondents who experienced previous earthquakes may have experienced little or no loss from the event, and those who did not experience direct damage such as loss of family members or property as a result of a disaster tend to be less prepared [12]. The reason for their lack of preparedness is their optimism that previous impacts did not affect me and that subsequent impacts will also have no impact. Similarly, the study found no association between gender, age, employment status, and marital status with household earthquake preparedness, similar to the finding of a study conducted by Rostami-Moez et al. (2020) [1]. Some of the prior studies found that older people have more knowledge due to experience with prior earthquakes, which increases their familiarity with earthquake-associated risk and motivates them to participate in preventive measures for future events. Contrary to this, younger people have a lower perception of disaster, and their focus is on immediate issues such as careers and lower preparedness, while adults have been found to engage themselves in preparedness measures due to their responsibility to care for family members[12].

Some of the previous studies have shown gender is an influencing factor in household earthquake preparedness due to their societal roles and responsibilities[12, 13]. However, the results suggest no association between earthquake preparedness and gender. This suggests that males and females have equal access to resources. This can be justified by the education status of the municipality [22]. Further, there is easy accessibility to information sources for different age groups, such as the internet, television, and newspapers, so no difference has been seen in terms of age. The previous study conducted by Chen et al. (2019) revealed a significant association between the presence of school-age children at home and household earthquake preparedness [15]. Households with more members, especially children at home, engaged more in preparing for disaster because the presence of children motivated adults to protect children through preventive measures, and children also brought information regarding household preparedness from school. However no such result were found in this study, there were no difference in earthquake preparedness in term of presence of children, the study by Tuladhar et al. (2013) found the most of student did posses correct knowledge of disaster and their mitigation measures [23] and did not contributed to household earthquake preparedness.

Under HBM, perceived susceptibility is a significant factor in earthquake preparedness, which means people who find themselves susceptible to risk tend to show interest in increasing information regarding the risk and ultimately adopt preparedness measures to decrease the impacts. Similarly, people who perceived earthquake preparedness advantages over earthquake hazards were found more prepared than their counterparts. This corresponds to the concept of the HBM, which states that when a person believes that a particular action will contribute to minimizing their susceptibility to a health problem, they will prefer to adopt the measures. Further perceived barriers are also significantly associated with household earthquake preparedness. The perceived barriers, such as lack of time, knowledge, skills, finances, and religious values, discourage the people's intention to take precautionary actions, ultimately limiting them from implementing appropriate earthquake preparedness.

5.2 Practical Implementation

Education is a prime factor in household earthquake preparedness as people become more knowledgeable and aware of earthquakes and show interest in acquiring new skills. Thus, education campaigns should be designed and implemented properly to improve public knowledge, focusing on people with low education levels and residing in rental houses. Similarly, household earthquake preparedness can be improved by offering emergency training through specifically designed drill exercises or as a part of the natural education system. The study found a lack of first aid kits and corresponding knowledge in the study area. This can be addressed through the learning of first-aid techniques and the preparation of first-aid kits by making them obligatory in schools with lower and higher grades. The household should be encouraged to be equipped with a first aid kit, including instructions on individual preparedness.

Similarly, landlords can play an important role in increasing household earthquake preparedness by sharing information with tenants, emphasizing the importance of preparedness, sharing a developed evacuation plan with renter, etc. Further, the house owner can make renter familiar with the location of

shut-off utilities and how to operate them. In addition, the local government may offer resources and workshops for tenants to increase household earthquake preparedness.
The study indicated that household earthquake preparedness increased with perceived susceptibility; thus, workshops, television and radio programs, and street acts should be conducted to inform people that the area is susceptible to earthquakes and highlight the need for household earthquake preparedness. Similarly, perceived barriers and perceived benefits were found to be significant in household earthquake preparedness; thus, programs should be designed to decrease the barriers to household earthquake preparedness and increase the benefits. This can be implemented by encouraging households to adopt easy and simple measures first. When people found it easy to adopt and beneficial, they developed enough confidence to reduce the damage of earthquakes and engage in preparedness.

5.3 Limitation

There are several limitations to this study. This study is a cross-sectional study, and it cannot solve the causal relations between the variables. Thus, future studies should be conducted using new and advanced techniques to generate more scientific conclusions. Data for the study were employed from urban wards of the municipality; thus, an overall generalization of this study might be needed. Further, this study has only considered socio-demographic and cogitative dimensions affecting household earthquakes; thus, studies including other dimensions such as social and organizational are needed.

6. Conclusion

Household preparedness is one of the main components in reducing earthquake preparedness, but the study revealed that the level of household preparedness is insignificant. As western Nepal is highly susceptible to future earthquakes and a previous study suggested lack of preparedness as a major factor in increasing the impact of earthquakes, household earthquake preparedness should be prioritized to reduce the impact of future earthquakes. This study on household earthquake preparedness suggested that interventions to enhance household earthquake preparedness should be based on education, house ownership, length of residence, perceived susceptibility, perceived barriers, and perceived benefits.

References

[1] Masoumeh Rostami-Moez, Mohammad Rabiee-Yeganeh, Mohammadreza Shokouhi, Amin Dosti-Irani, and Forouzan Rezapur-Shahkolai. Earthquake preparedness of households and its predictors based on health belief model. *BMC Public Health*, 20, 4 2020.

[2] Raziye Özdemir, Cigdem Demir, and Binali Catak. Faculty members' earthquake preparedness levels and their related factors: a cross-sectional study from a university in a high-risk earthquake zone in turkey. *Journal of injury & violence research*, 13, 07 2021.

[3] Jitendra Bothara, Jason Ingham, and Dmytro Dizhur. Earthquake risk reduction efforts in nepal. In Pijush Samui, Dookie Kim, and Chandan Ghosh, editors, *Integrating Disaster Science and Management*, pages 177–203. Elsevier, 2018.

[4] Shiva Subedi and Meen Bahadur Poudyal Chhetri. Impacts of the 2015 gorkha earthquake: Lessons learnt from nepal. In Jaime Santos-Reyes, editor, *Earthquakes*, chapter 5. IntechOpen, Rijeka, 2019.

[5] Hemchandra Chaulagain, Dipendra Gautam, and Hugo Rodrigues. Revisiting major historical earthquakes in nepal: Overview of 1833, 1934, 1980, 1988, 2011, and 2015 seismic events. In *Impacts and Insights of the Gorkha Earthquake*. Elsevier, 2018.

[6] Sony Maharjan and Shova Shrestha. Disaster risk management: From preparedness to response in thecho of kathmandu valley, nepal. *The Third Pole: Journal of Geography Education*, page 99, 05 2018.

[7] Rodit KC. Study of earthquake preparedness in kathmandu city, nepal. *Journal of APF Command and Staff College*, 5:71–92, 11 2022.

[8] Ali Ardalan, Homa Yusefi, Narges Rouhi, Ahad Banar, and Sanaz Sohrabizadeh. Household disaster preparedness in the islamic republic of iran: 2015 estimation. *Eastern Mediterranean Health Journal*, 26:382–387, 4 2020.

[9] Julia S Becker, Douglas Paton, David M Johnston, and Kevin R Ronan. A model of household preparedness for earthquakes: How individuals make meaning of earthquake information and how this influences preparedness. *Natural Hazards*, 64:107–137, 4 2012.

[10] Benjamin. Wisner, J C Gaillard, and Ilan. Kelman. *Handbook of hazards and disaster risk reduction*. Routledge, 2012.

[11] Bruce W. Clements and Julie Ann P. Casani. 9 - earthquakes. In Bruce W. Clements and Julie Ann P. Casani, editors, *Disasters and Public Health (Second Edition)*, pages 219–243. Butterworth-Heinemann, second edition edition, 2016.

[12] Hiroki Onuma, Kong Joo Shin, and Shunsuke Managi. Household preparedness for natural disasters: Impact of disaster experience and implications for future disaster risks in japan. *International Journal of Disaster Risk Reduction*, 21:148–158, 2017.

[13] V M Cvetkovic, K Ronan, R Shaw, M Filipovic, R Mano, J Gačić, and V Jakovljevic. Household earthquake preparedness in serbia: A study of selected municipalities. *Acta Geographica Slovenica*, 59:28–42, 2019.

[14] Johny Augustine, Vivek C. Kokkammadathil, and Rajeev M. Manikoth. Disaster preparedness among households in the badakhshan province in afghanistan: A baseline evaluation study. *Asian Social Work and Policy Review*, 13:128–140, 6 2019.

[15] Chao Yi Chen, Wei Xu, Yajun Dai, Weilan Xu, Chaojie Liu, Qunhong Wu, Lijun Gao, Zheng Kang, Yanhua Hao, and Ning Ning. Household preparedness for emergency events: A cross-sectional survey on residents in four regions of china. *BMJ Open*, 9, 4 2019.

[16] Mehdi Najafi, Ali Ardalan, Ali Akbarisari, Ahmad Ali Noorbala, and Hossain Jabbari. Demographic determinants of disaster preparedness behaviors amongst tehran inhabitants, iran. *PLoS currents*, 7, 12 2015.

[17] Meltem Oral, Aynil Yenel, Elif Oral, Nazan Aydin, and Nazan Aydin. Earthquake experience and preparedness in turkey. *Disaster Prevention and Management: An International Journal*, 24:21–37, 4 2015.

[18] Esmat Rezabeigi Davarani, Mahmood Nekoei-Moghadam, Narges Khanjani, Abedin Iranpour, Mohammadreza Chashmyazdan, and Hojjat Farahmandnia. Factors related to earthquake preparedness of households based on social-cognitive theory constructs: A systematic review. *Front Public Health*, 2023.

[19] Ebru Inal, Kerim Hakan Altintas, and Nuri Dogan. The development of a general disaster preparedness belief scale using the health belief model as a theoretical framework. *International Journal of Assessment Tools in Education*, pages 146–158, 12 2017.

[20] Bipadportal. Risk info.

[21] Kailali District Disaster Management Committee. District disaster response and preparedness plan 2079, kailali. Technical report, District Disaster Management Committee, Kailali, 2022.

[22] Central Bureau of Statistics (CBS) [Nepal]. Nepal population and household census 2021. Technical report, Central Bureau of Statistics (CBS) [Nepal], 2023.

[23] Gangalal Tuladhar, Ryuichi Yatabe, Ranjan Dahal, and Netra Bhandary. Knowledge of disaster risk reduction among school students in nepal. *Geomatics*, 5, 07 2014.