

Evaluation of The Current Level of Knowledge of The Residents of Dhaka City Regarding Earthquake Hazard

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Abstract

An earthquake is a sudden disaster that is not possible to predict. This impulsive behavior makes it very dangerous for humankind. Precautionary measures are immense for reducing damage. The first step of preventive measures for an earthquake is raising awareness. Dhaka City has a high earthquake risk due to its large population and urbanization. Researchers have said that an earthquake in this zone can be fatal, resulting in heavy casualties with structural damage. For this reason, proper awareness is essential for the residents of this area. The aim of this study is to find out the current knowledge level of the residents of Dhaka City about Earthquake risk of this city. Online questionnaire was used to collect data from random residents of Dhaka. Survey data indicates that many people lack Knowledge of what to do before and during an earthquake. Especially school and college-going students are unaware of the essential things to do during an earthquake incident. Many people still don't know the importance of a seismic-resistant building system and are unprepared for a seismic event. This study brings these aspects together to learn about the knowledge level, which can help policymakers raise awareness among this city's residents.

Keywords: Awareness; Dhaka City; Disaster; Earthquake; Knowledge; Risk.

1 Introduction

The Earth's hard outer layer occasionally experiences abrupt and fleeting tremors from natural processes. These unexpected trembling, often known as earthquakes, are caused by different things that influence the Earth's crust. According to the United States Geological Survey (USGS), earthquakes occur due to the movement of tectonic plates along fault lines[1].



Tectonic plates are the primary cause of earthquakes. Faults or fractures split numerous plates that make up the surface of the Earth. The interior of the Earth contains molten material beneath these plates. These molten materials may migrate and shift because of natural factors, altering the plates. One plate may subduct beneath another, causing seismic vibrations that eventually appear as earthquakes. In addition, critical natural events like volcanic eruptions, landslides, glacier movements, thermal radiation, and related phenomena can also contribute to seismic activity.

An earthquake can cause significant damage and destruction in multiple ways. The shaking of the ground can lead to the collapse of buildings and infrastructure, resulting in loss of life and injuries[2]. Additionally, earthquakes can trigger landslides and avalanches, further damaging structures and obstructing transportation routes [3]. Ground shaking may also cause liquefaction, where saturated soil temporarily loses strength and behaves like a liquid, damaging buildings, and underground utilities. Furthermore, powerful earthquakes under the ocean can generate tsunamis, massive ocean waves that can inundate coastal areas and cause widespread devastation [3]. Fires can also be ignited by broken gas lines and electrical wires, exacerbating the damage caused by an earthquake[2].

For people, communities, and governments to reduce possible hazards and lessen the effects of these natural disasters, earthquake awareness is essential. First and foremost, Knowledge enables people to comprehend the dangers of earthquakes and adopt the appropriate safety measures to safeguard their lives and property (USGS, 2021). It teaches people about earthquake-resistant construction methods and building retrofitting strategies[3]. Furthermore, earthquake awareness promotes preparedness by educating people about the appropriate actions to take during and after an earthquake, such as "Drop, Cover, and Hold On" during shaking and knowing evacuation routes (CDC, 2022). Awareness campaigns emphasize the importance of creating emergency kits and developing family or community response plans, including designated meeting points [4]. Community-level Knowledge is crucial for creating a preparedness culture because it promotes cooperation and coordination among many stakeholders, such as local government, companies, schools, and emergency response agencies [3]. To communicate vital information before, during, and after an earthquake, communities can build early

warning systems and communication networks by increasing awareness [5]. Earthquake's awareness also extends to engineering, urban planning, and emergency management professionals. These individuals can contribute to designing safer infrastructure, implementing building codes and standards, and developing effective response strategies. Governments have a crucial role in raising Knowledge of earthquakes through funding research, monitoring systems, and public awareness campaigns. These programs promote a safety-conscious culture, increase public awareness of earthquake risks, and help politicians make well-informed decisions [3]. Government financing and assistance for earthquake research also promote early warning system development, hazard assessment, and prediction [5].

With a total size of 1,47,610 square kilometers, Bangladesh is a significant country in terms of geography and geology in the South Asian region. Its length and width are 820 kilometers north to south and 600 kilometers east to west. Several disastrous natural disasters, including floods, droughts, tropical cyclones, tornadoes, thunderstorms, extreme rainfall, tidal bores, intense summer heat, etc., frequently hit this region, which is located between 24°0'0" N latitude and 90°0'0" E longitude. Bangladesh is often hit by storms that originate in the Bay of Bengal 16 times every ten years. But recently, Bangladesh has been in danger from an "earthquake" that is even more deadly. Bangladesh, located in a seismically active region, is vulnerable to earthquakes and their potential impacts. The country has experienced several significant earthquakes, highlighting the importance of understanding seismic hazards and implementing appropriate measures for earthquake resilience. Bangladesh lies in a tectonically complex area where the collision of the Indian and Eurasian plates gives rise to seismic activity (USGS, 2021). The country is near the boundary between the Indian and Burmese plates, with numerous active faults running through its territory. When examining Bangladesh's earthquake history, one significant problem stands out: there is a dearth of Knowledge about earthquakes. Though some evidence is there, the information is insufficient to know the magnitude and intensity of those earthquakes. Even while there is some data, it is not enough to determine the extent and impact of those earthquakes. Although their magnitudes are unclear, there is evidence of catastrophic earthquakes in Sylhet, Chittagong, and Dhaka.

A devastating earthquake in 1762 caused at least 200 fatalities and was felt throughout the Bengal and Arakan regions. It also severely devastated significant portions of Dhaka, Chittagong, and Myanmar [6]. Reports claim that the 1765 earthquake was so strong that it permanently submerged 155.40 square kilometers of land near Chittagong and raised the shoreline of Foul Island by 2.74 m and the northwest coast of Chedua Island by 6.71 m above sea level. Five hundred people died because of the earthquake in Dhaka [7]. The 1812 Dhaka earthquake that struck Dhaka in April severely damaged several homes and other buildings in Tejgaon [8]. One of the worst earthquakes ever was the Bengal earthquake in July 1885. Between July 21 and September 5, 1885, eleven aftershocks were caused by the tremor [9]. The earthquake had a Richter scale magnitude of 7. One of the deadliest and most severe earthquakes ever recorded, the Great Indian Earthquake, occurred on June 12, 1897 [10]. The quake took place about 200 km north of Dhaka, on the western edge of the Shillong Plateau. The Bangladesh Geological Survey reported at least 465 earthquakes of small to moderate magnitude between 1971 and 2006 [11]. Although damaging earthquakes have not occurred frequently, there is still a great potential for enormous destruction and damage [12]. In recent decades, Bangladesh has witnessed destructive earthquakes. The 2003 earthquake in northeastern Bangladesh caused widespread damage and claimed hundreds of lives [13].

Similarly, the 2013 Rangpur earthquake resulted in significant structural damage to buildings and infrastructure [7]. A severe earthquake that had its epicenter 745 kilometers (km) northwest of Bangladesh on April 25, 2015, rattled Dhaka, Chittagong, Barisal, Rajshahi, Dinajpur, Rangpur, and other areas of the nation [10]. According to the US Geological Survey (USGS), an earthquake occurred on January 4, 2016, around 33 kilometers (20 miles) northwest of Imphal, the state capital of Manipur, in northeast India, close to the border with Myanmar and Bangladesh. Around 5:05 am, while most city residents were still asleep, Dhaka and its surrounding areas began to experience severe tremors. Following the jolts, terrified individuals fled their homes and flocked to the neighboring highways [14].

Dhaka, the capital of Bangladesh, is highly vulnerable to earthquakes due to various factors; Dhaka is excessively susceptible to earthquake calamity. First off, Dhaka city has a very high population density. Second, secondary hazards, such as fires that start in gas

and power lines, are anticipated to be far more deadly following an earthquake. Thirdly, most high-rise residential buildings and many garment factory buildings were constructed not only in violation of building rules but also encroached upon streets and other public places. Due to the blockage of roads caused by the fall of these buildings, rescue efforts would be significantly hampered.

This case study aims to determine the current knowledge level among Dhaka City dwellers regarding earthquake hazards. This data can help know the current status of Knowledge that can be used for the smooth operation of awareness-raising programs.

2 Methodology

This research includes a case study on the current knowledge level of the residents of Dhaka City regarding Earthquake incidents. As an earthquake is a sudden incident, awareness is the first step of precautionary measures. Identifying current knowledge level is important for policy makers and engineers to create awareness among people.

2.1 Study Area

Dhaka city was chosen as the study area that is shown in Figure 1. Dhaka is the capital city of Bangladesh. It is situated at 23.8041° N, 90.4152° E. The primary reason of choosing this area is due to the heavy population and structures of this area. Previous research suggests that Dhaka is in high red alert zone of a massive earthquake hazard. That is why this study focused mainly on the Dhaka city and the knowledge level of the residents of this city.

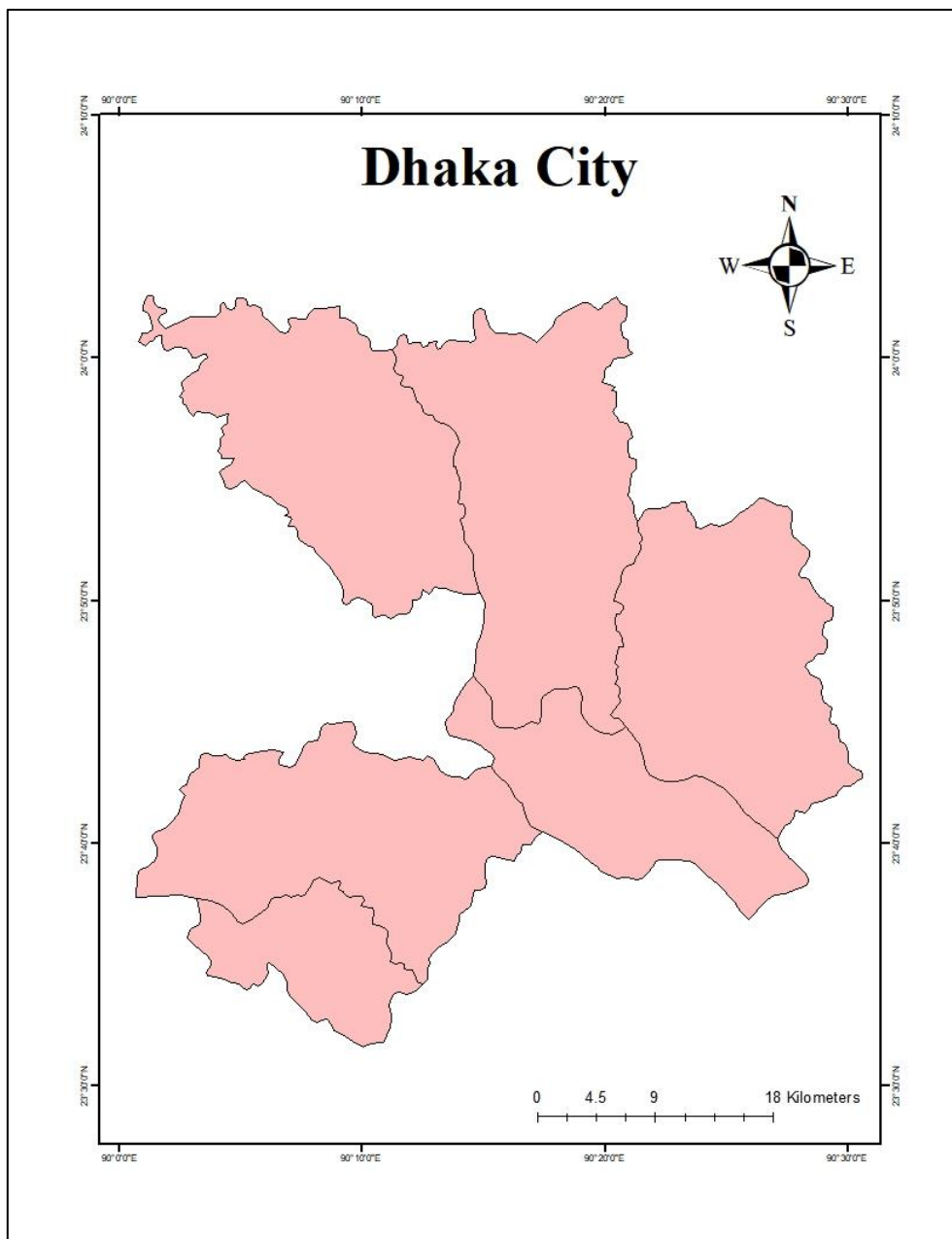


Figure 1: Study Area

2.2 Data Collection

For this study, the questionnaire was done with the help of google forms. This questionnaire was fully online and only provided to the residents of Dhaka City. This survey was fully anonymous. A questionnaire was shared with the people on different online platforms. One submission per participant was strictly imposed to maintain the

integrity of this survey. The sample size was calculated using Yamane's formula (Yamane, 1967).

$$n = \frac{N}{1 + N(e^2)} \dots \dots \dots (1)$$

where, n = sample size, N = total population of the study area, e = error tolerance.

According to Macrotrends, Dhaka city's current population growth rate is 3.26%, which concludes that the current population of Dhaka city is approximately 23,210,000 [16].

With an error tolerance of 0.05, the total number of samples required is 399.99 or 400.

So, for this survey total of 410 survey data was considered.

2.3 Data Analysis

This is a preliminary study regarding the knowledge level of the residents of Dhaka City. For data analysis, Microsoft Excel was used. Obtained survey data were analyzed to check the percentage of responses to each question asked. Demographic data such as Age, Gender, Educational Qualification, and Occupation were also collected.

3 Results

3.1 Demographic Profile

By observing the demographic profile of the participants, it was seen that most were young (Age group 16-30) shown in **Figure 2** and they were primarily male shown in **Figure 3**. A vast number of participants live in the Dhaka North City Corporation shown in **Figure 4**. The **Figure 5** and **Figure 6** shows that most of the participants are graduates or running undergraduate students. Their demographic profile is given below,

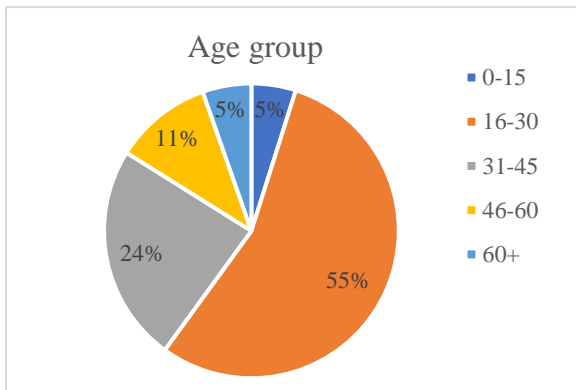


Figure 2: Percentage of participants' age group

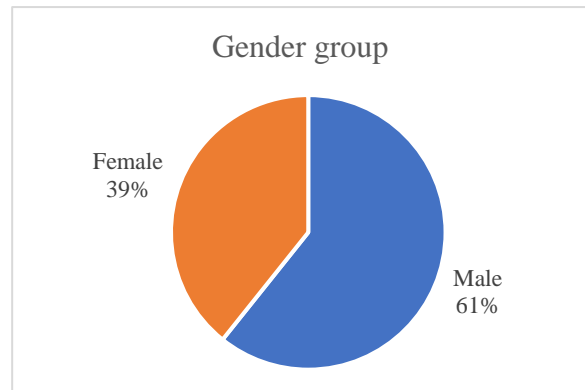


Figure 3: Percentage of participants' gender

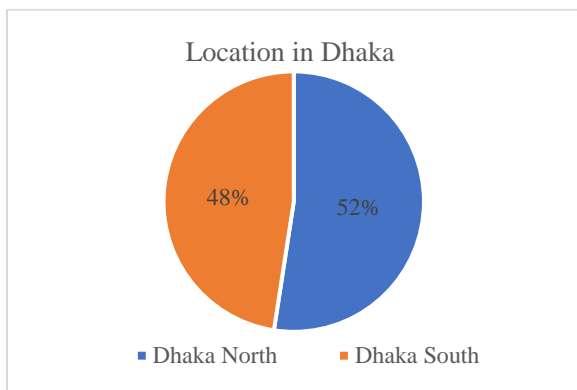


Figure 4: Location of participants in Dhaka City

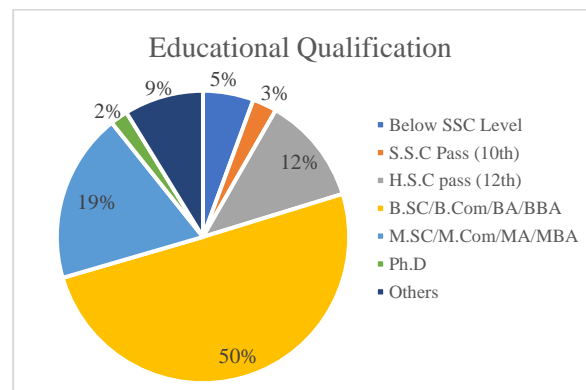


Figure 5: Educational qualification of participants

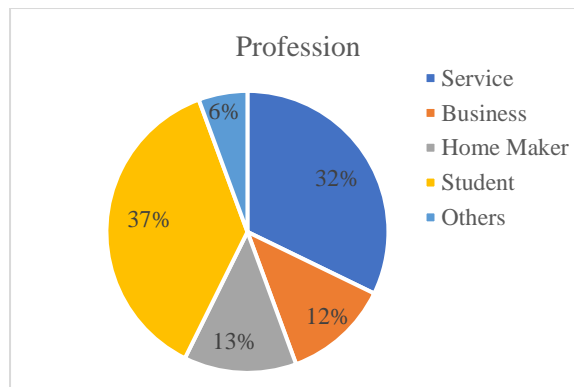


Figure 6: Profession of participants

3.2 Knowledge regarding Earthquake

The questionnaire had different questions that give insight into a participant's self-realization, Knowledge about what to do during an event, Knowledge regarding the after-

event scenario, etc. These will provide an overview of the current situation of the knowledge level of the residents of Dhaka city.

3.2.1 Self-Realization

- 1. Felt an earthquake:** In this segment, a total of 77% (316 participants) answered Yes, 13% (55 participants) answered No, and 10% (39 participants) responded Maybe.
- 2. Previously attended earthquake awareness programs:** 31% (127 participants) answered Yes to this question. Other 69% (283 participants) said that they have never participated in any earthquake awareness program or session that can increase their knowledge.
- 3. Personal Confidence regarding knowledge level:** 13% (53 participants) think they have excellent Knowledge of earthquakes. 40% (163 participants) thinks they have good Knowledge, 35% (145 participants) think they have a fair level of Knowledge, and 12% (49 participants) think they have poor Knowledge regarding earthquake hazard.
- 4. Preparedness for an event:** Among the 410 participants, 15% (60 participants) answered that they were prepared for an earthquake event. 49% (200 participants) said that they were not prepared. 28% (115 participants) were unsure about their current preparedness level and answered Maybe. The remaining 9% (35 participants) didn't know their preparedness level.
- 5. If their house has a risk of damage during an earthquake:** 32% (131 participants) think that they live in a house with a significant risk of damage. 27% (110 participants) believe their house is strong enough to withstand an event. 31% (127 participants) were not sure about the seismic performance of their house and answered maybe. 10% (42 participants) answered that they don't know about the chance of damage to their house during an event.
- 6. If Dhaka City has a high risk during an earthquake event:** 66% (272 participants) think that the risk of an earthquake in Dhaka City is high. 13% (52 participants) disagreed with this statement and answered no. 14% (58 participants) answered Maybe as they are unsure about the earthquake risk in Dhaka. 7% (28

participants) don't know about the risk level of Dhaka regarding an earthquake event.

3.2.2 Preparedness before an incident

- 1. Availability of first aid kit/emergency medical supplies at home:** 38% (156 participants) have first aid kit/emergency medical supplies at their home in case of an emergency created by any significant earthquake incidents. 62% (254 participants) don't have any first aid kits ready for an earthquake incident.
- 2. Availability of emergency exit at home:** 24% (97 participants) have an emergency exit for emergencies such as earthquakes. 70% (285 participants) have no emergency exit. 7% (28 participants) were unsure about the exits in their homes and answered maybe.
- 3. Availability of Evacuation route:** Among the respondents, 16% (65 participants) answered that their area has an evacuation route. 51% (208 participants) live in areas without an evacuation route. 19% (78 participants) answered maybe. 14% (59 participants) don't know about the availability of an evacuation route in their area.
- 4. Availability of Urban emergency shelter:** 9% (38 participants) answered that they have an urban emergency shelter for an earthquake event in their area. 83% (342 participants) answered that they don't have any nearby urban emergency shelter. 7% (30 participants) are unsure about the location of the nearby urban emergency shelter.

3.2.3 During an incident

- 1. Knows how to turn off gas connection:** 58% (236 participants) answered that they know how to do so. 31% (128 participants) don't know how to turn off the gas connection. 11% (46 participants) are unsure about this, and they answered maybe.
- 2. Knows how to turn off electricity connection:** 72% (295 participants) answered that they know how to do it. 21% (85 participants) don't know how to turn off the electricity connection. 7% (30 participants) are unsure about this, and they answered maybe.

- 3. The first thing to do during an incident:** 22% (89 participants) answered they would go to a safe place and protect themselves and wait. 15% (61 participants) said they would rush to leave their house as soon as possible. 50% (206 participants) said they would take cover under heavy furniture or beams. 6% (23 participants) will rush to the smallest room of the building. 2% (10 participants) will do none of the options available, and 5% (21 participants) have no idea what to do during an incident.

3.2.4 After an incident

- 1. What to do after a disaster event:** 19% (78 participants) would regret the losses and take some of the responsibility for not being aware of earthquake disasters. 28% (115 participants) would do nothing as the scenario will be out of their control. 26% (107 participants) will ask everyone for training regarding earthquake resistance building systems and join the reconstruction of their area. 27% (110 participants) cannot imagine the scenario right now.

3.2.5 Knowledge of buildings

- 1. The main reason for a building collapse during an earthquake:** 15% (63 participants) think that bad quality of construction materials results in a building collapse during an incident. 26% (105 participants) think lack of Knowledge regarding seismic resistant building system is the main culprit. 19% (78 participants) think homeowners who don't want to spend extra on a seismic-resistant building system are the main reason. 30% (125 participants) think the main reason is the lack of awareness regarding the importance of seismic resistant building among the homeowners. 4% (15 participants) think poor maintenance of houses is the reason, and 6% (24 participants) have no idea about this issue.
- 2. If tall buildings are safer during an earthquake or not:** 17% (70 participants) think tall buildings will perform better during an earthquake than short buildings. 49% (201 participants) think otherwise. 20% (80 participants) think there is no relationship between building height and the damage it will sustain. 14% (59 participants) don't have any idea regarding this issue.

3. Sustainability of a Seismic resistant building system during a significant incident: 28% (115 participants) think that seismic-resistant building systems are enough to withstand any earthquake in Dhaka City. 39% (159 participants) think otherwise. 22% (92 participants) are unsure about the performance of seismic-resistant building systems. 11% (44 participants) don't know about the performance of seismic-resistant buildings during an earthquake.

4 Discussion

This study aims to gain insight into the current Knowledge of residents of Dhaka City regarding an earthquake incident. The survey data shows that although many participants (77%) have felt an earthquake in their lifetime, only a few (31%) have attended any earthquake awareness program. Many participants also said that their knowledge regarding what to do in earthquake incidents is not up to the mark. Also, almost half of the participants answered that they were unprepared for an earthquake in their area. The lacking of their preparedness can also be seen in the percentage of participants having emergency medical supplies (38%), emergency exits (24%), evacuation routes (16%), and an emergency urban shelter (9%). Although the participants have answered that most of them know how to turn off gas (58%) and electricity (72%) connections and also during an event, most of them will try to take cover and wait (50%), most of them answered that they would try to rush out of their home which is discouraged. Several participants also lack Knowledge of seismic resistant building systems and the relationship between the height of a building with the earthquake incident. By analyzing the responses of participants of age groups 0-15, it was seen that most respondents (75%) have answered about rushing outside in an event rather than taking cover. This shows the lack of Knowledge regarding earthquakes among the younger people of this city.

5 Conclusion

This study focuses on the knowledge level of the residents of Dhaka City regarding an earthquake. Being an online based survey, this study has mostly young adult participants. Although most of the participants are graduates, they still lack their current knowledge level as well as disaster preparedness. Most of them have never participated in any

earthquake awareness program. Special care should be given to the younger generation about their earthquake awareness. Schools and colleges should organize seminars, Workshops, and Earthquake drills to create more awareness regarding earthquakes. People, especially homeowners, should be made aware of the importance of an earthquake-resistant building system. Emergency shelters, Evacuation routes, and emergency exits should be implemented. Also, only 410 participants were surveyed for this study so for a better output, bigger sample size should be taken into account.

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