Risk Perception and Awareness about Earthquake among Residents in Dhaka

By

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Abstract

Dhaka is one of the most earthquake prone cities in the world due to its high population density and rapid urbanization. Recently, the gendered dimensions of disasters have been attracting significant scholarly attention. Few other studies examine the difference of attitudes and perceptions depending on gender, age, education, and casualty awareness. A number of studies have been conducted worldwide (chapter 1) and reported in the literature addressing knowledge on seismic risk perception and willingness to take action to reduce seismic risk but there have been few studies on residents of Dhaka. The purpose of these cross-sectional studies is to assess the seismic risk perception and preparedness levels about earthquake among residents of Dhaka. This study also tries to examine and make the comparison about the risk perception and preparedness level between different groups of gender, age and level of education about adult (chapter 2) as well as a group of high school students (chapter 3). Questionnaires are developed, and several data collections are done about adult as well as a group of high school students through doing surveys.

There are many studies that explore risk perception willingness in many countries, but only a few studies deal with Bangladesh. Paul and Bhuiyan (2010) deals with Bangladeshi people's risk perception of the earthquake which survey is done almost 8 years ago. There have a lot of changes in Bangladesh within 8 years due to economic, education and lifestyle modification.

Compared to Paul and Bhuiyan (2010) study in which the primary source of data was collected by face to face interviews with selected residents, in the first survey (chapter 2), the data have gathered by the randomly questionnaire survey. Whenever there is face to face interviews, the interviewer might have some expectation or biases which may be the limitation of the previous study. The first study (chapter 2) is done to overcome this limitation and focus on current knowledge of people on risk perception of the earthquake and its preparedness. This research also tries to investigate the difference between past and present level of knowledge on the earthquake. Also in the second survey (chapter 3), the quantitative research is done to determine the risk perception, actual knowledge and preparedness levels adapted by high school students in the Savar, Dhaka region with respect to earthquake as a natural disaster and to identify the factors that influence their knowledge and perceptions.

The first survey shows that female respondents have much more risk perception and preparation about earthquake than male; younger people have higher knowledge about earthquake preparedness and less educated people are at higher risk of unpreparedness than educated people. In the second survey, it is found that female students' preparation, participation and communication with family are more frequent than those of male students. Female students are found to be more likely to learn about disaster than male one. Higher grade students have more awareness but less preparedness about earthquake than the younger ones.

This research concludes by noting that public awareness on seismic risk perception and mitigation is poor and their knowledge on basic theory and emergency response must be improved.

Table of Contents

Chapter 3. Students' risk perception and awareness

Chapter 4. Conclusion

List of figures

Chapter 1. Introduction

Chapter 2. Adults risk perception and awareness

Chapter 3. Students' risk perception and awareness

List of tables

Chapter 1

Introduction

1. Overview

Natural disasters represent a severe problem, particularly for most of the developing countries wherever they repeatedly cause a high number of fatalities, have an effect on a huge portion of the population, and incur substantial social and long-run developmental losses. Natural disasters are a major concern in all over the world. Over the development of the last era, natural disasters have killed (Figure 1-1) as many individuals as the two World Wars combined (Cohen and Werker 2008; Bureau 2017). Over the year 1980-2016, about 10,500 stated natural disasters have resulted in around 2.4 million deaths.

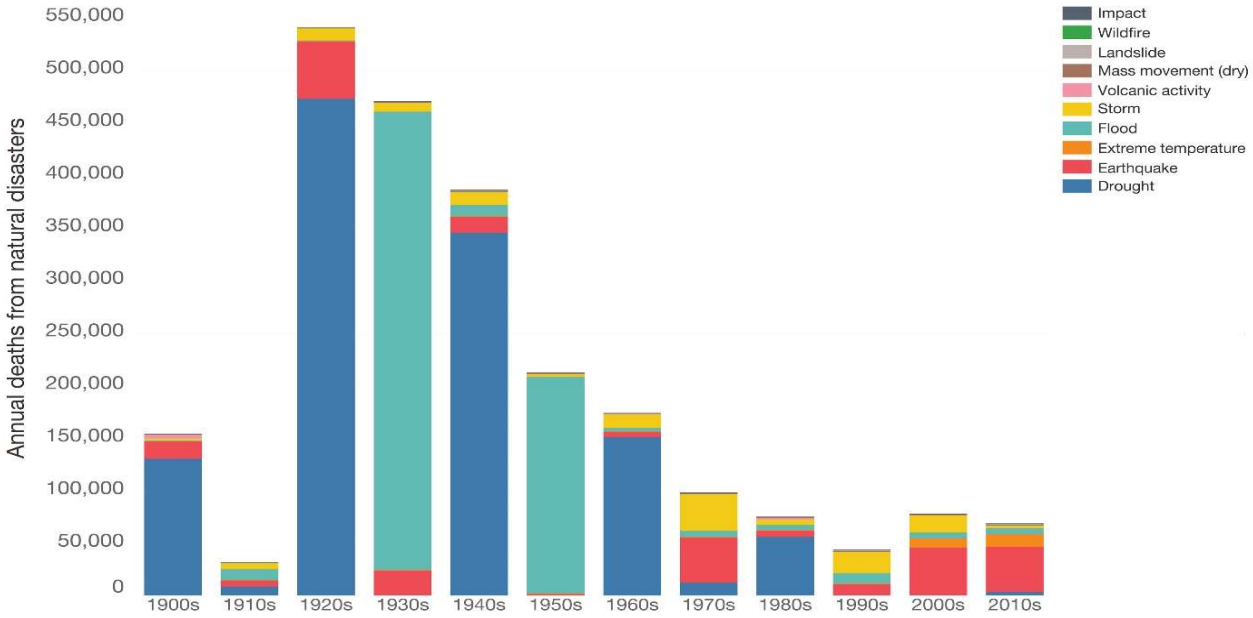

Figure 1-1. Annual global number of deaths from natural disasters per decade, 1900-2015
Source OFDA/CRED International Disaster Database – Université Catholique de Louvain – Brussels – Belgium.

Earthquakes is accounted for the largest number of the 10,373 lives lost in disasters last year, while extreme weather events are accounted for most of 61.7 million people affected by natural hazards, according to analysis of 281 events recorded by the Centre for Research on the

Epidemiology of Disasters (CRED) in its EM-DAT (International Disaster Database) (Figure 1-2) (CRED 2018a).

In 2017, EM-DAT (Figure 1-3) data indicates that 318 natural disasters have occurred and affected 122 countries. The impact of these natural disasters have resulted in 9,503 deaths and 96 million people affected. The human impact of natural disasters in 2017 is much lower than the last 10 years on average, where events with extremely high mortality have occurred, such as the 2010 earthquake in Haiti (225,570 deaths) and 2008 Nargis Cyclone in Myanmar (138,400 deaths). The year with the highest economic losses was 2011, mainly due to the earthquake/tsunami in Japan (Crunch 2018). All over the world, for the policymakers the natural disaster risk reduction has become an important priority (Raschky 2008). For these reasons, there are decrease of reported deaths during these natural disasters worldwide that indicate improvement of natural disaster mitigation even though such extreme weather events have become more frequent and sympathetic (Raschky 2008). However, high-income countries have mostly driven this downward trend in fatalities, while low-medium income countries have fallen behind. Thus, among the priorities on the global development agenda of the developing countries, mitigation of natural disaster become the most important along with the efforts of local government and NGOs dedicated to the cause.

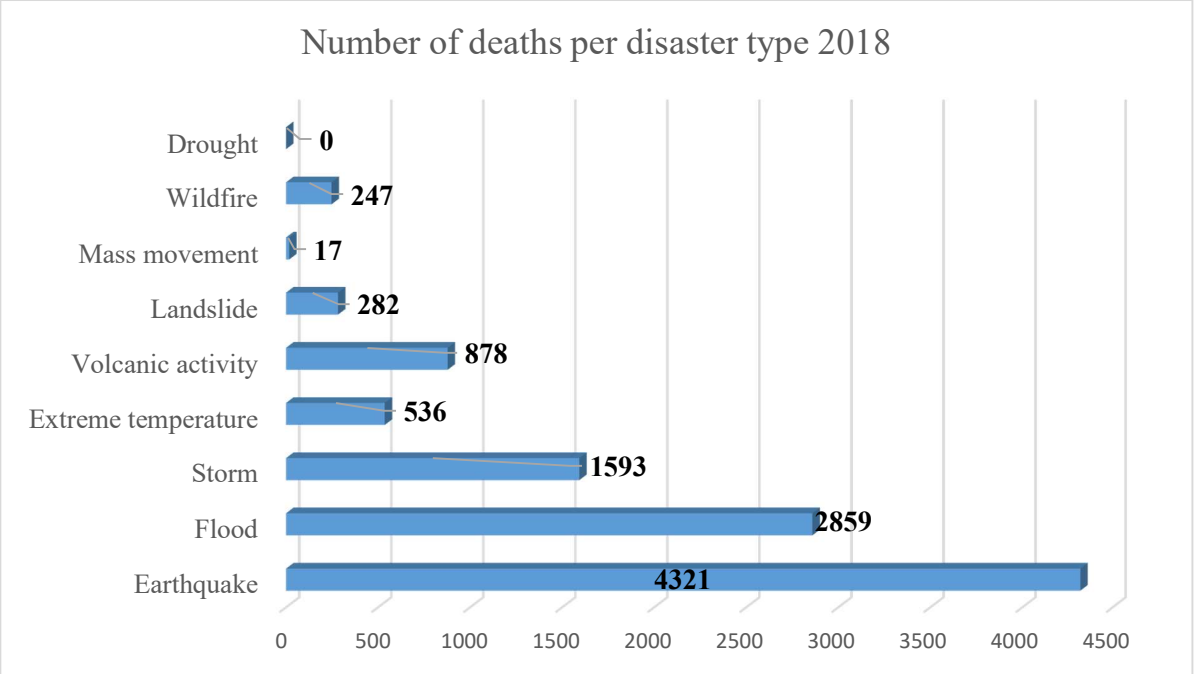

Figure 1-2. Number of deaths per disaster type in 2018
Source UNSIDR, 2018

In general, EM-DAT classifies disasters according to the type of hazard that triggers them. Disasters occur when natural hazards – storms, earthquakes etc. – have impact on vulnerable people. Vulnerabilities arise (and increase) for many reasons, including population growth, urban development in risk-prone locations, land use changes, environmental degradation, weak governance, poverty and inequality, and climate change (Figure 1- 4) (UN ISDR and CRED 2018).

Globally in the city-level analysis, International organization Maplecroft (2016) flag the populations of three South Asian cities among the 10 most exposed cities to natural hazards. These include the major garment producer Dhaka in Bangladesh (ranked 5th most exposed), the rapidly growing tech hubs of Kolkata (6) and Delhi (9) in India, Manila, Philippines (1), Tokyo, Japan (2), Jakarta, Indonesia (3), Dongguan, China (4), Osaka, Japan (7), Mexico City, Mexico (8) and Sao Paolo, Brazil (10) complete the list (Figure 1-5) (Maplecroft 2016).

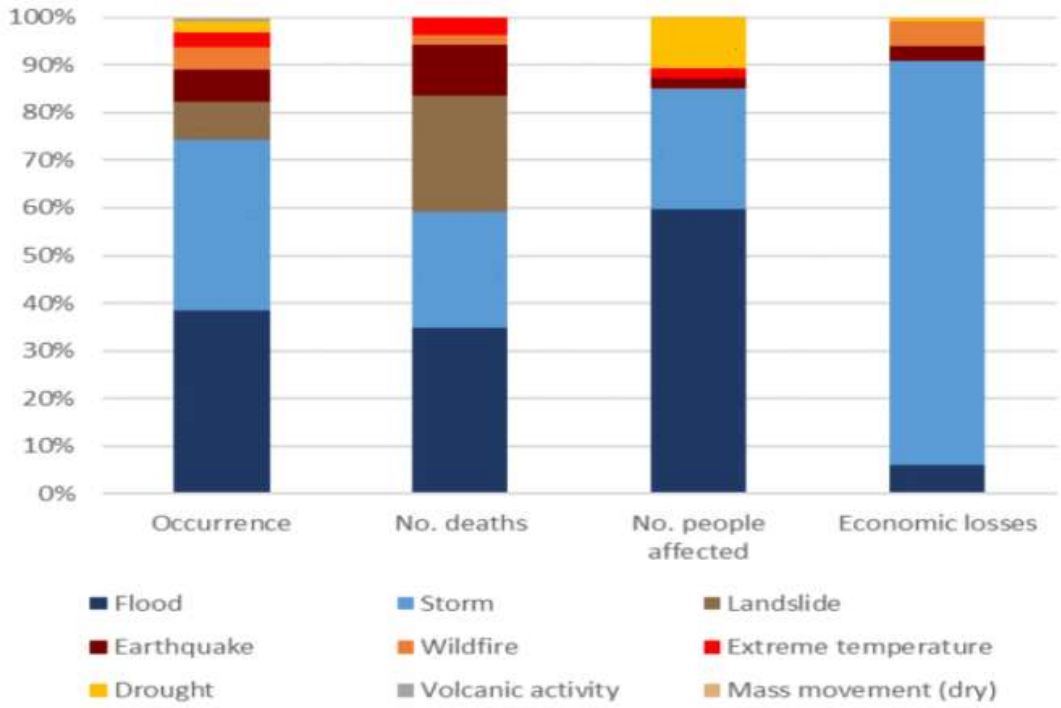

Figure 1-3. Share by disaster type for 2017
Source EM-DAT, 2018

2. Background

Out of 173 countries on world risk index ranking of the world, Bangladesh has ranked as number 5 (CRED 2018b). All the year round, Bangladesh experiences a wide spread of losses to the people and property because of frequently occurring floods, earthquake, river erosion, cyclone etc. Bangladeshi peoples are affected by a lot of natural hazards which is estimated about 10 million people annually (Luxbacher 2011). Bangladesh is highly vulnerable to natural hazards because of its geographical location, land characteristics, plenty of rivers and the monsoon climate. In Global Climate Risk Index during 1991 to 2010 Bangladesh is considered as the most vulnerable countries to disasters (Harmeling 2011). Based on future risk and vulnerability, Maplecroft (2016) provides an index on climate vulnerability of 107 countries in 2016. Floods, cyclone, tidal surges, earthquakes, river erosion, fire, water logging, infrastructure collapse, droughts etc. occur frequently in all the year round in Bangladesh. In Bangladesh 80% of the residents are potentially exposed to floods, earthquakes and droughts, and more than 70% to storms. The country experiences severe disaster almost every year, and vast area of the land mass is flooded with water. Following the devastating cyclones of 1970 and 1991, Bangladesh has made significant efforts to reduce its disaster vulnerability and is today considered a global leader in coastal resilience due to

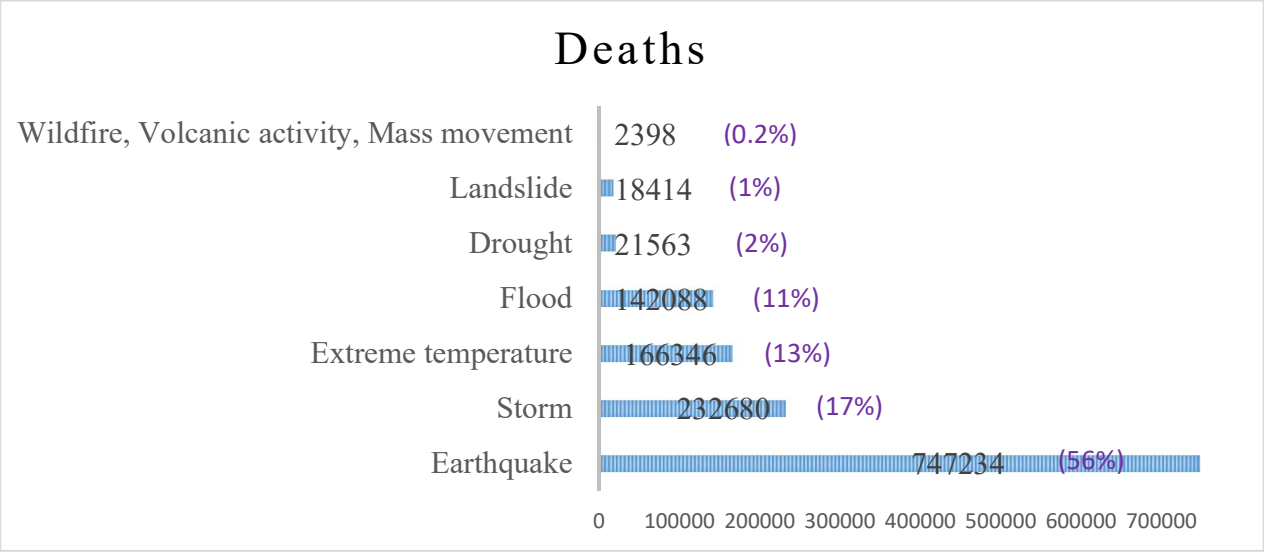

Figure 1-4. Number of deaths per disaster type 1998-2017
Source EM-DAT, 2018

its significant long-term investments in protecting lives. The World Bank assists Bangladesh in Disaster Risk Management programs through effective disaster risk reduction and post-disaster

response systems to reduce existing risks, avoid new risks and response better to disasters (The World bank 2018). Although the disaster occurs frequently, Bangladesh is now better managing flood and cyclone than before, but nothing about earthquake. Because when massive earthquakes with magnitudes between 7.0 and 8.7 on the Richter scale occurred in this country in the years of eighteenth century, at that time Dhaka city was less developed and populated. Therefore, the destruction was less. For these reasons the government has less initiatives about earthquake. Presently, Dhaka residents always feel shakes during the earthquakes with low to moderate magnitude which have been happening in Bangladesh and nearby("Earthquake Track" 2017).

1.1 Flood

Flood becomes a regular feature in riverine Bangladesh. Every year, around 21 percent of land is flooded during monsoon season; however, in severe situation this figure shot up to more than 60 percent of total land (Dewan, Nishigaki, and Komatsu 2003). There are two types of flood which occur in Bangladesh: annual floods (barsha) and low frequency floods of high magnitude

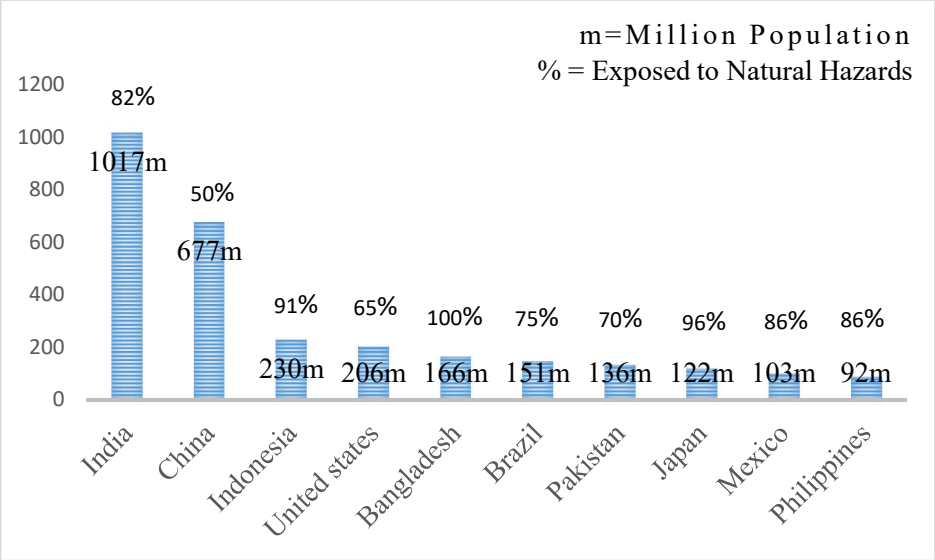

Figure 1- 5. The 10 populations most exposed to natural hazards
Source Verisk Maplecroft, 2016

(bonna). While the annual floods are essential and desirable for overall growth of the Bangladesh delta and the economy, the low frequency floods such as those that occurred in 1974, 1984, 1987, 1988, and 1991 are destructive and cause serious danger to lives (Chowdhury 1988; Brammer 1990).

Among natural disasters in Bangladesh, flood is the preeminent one. Every year a large portion of the country becomes flooded due to heavy rainfall and spilling water from the major rivers. It is observed that each year's highest flood record has been broken by the subsequent years and, simultaneously, damage from floods has been surpassed by the following year's damage. The effects of flood are manifold in Bangladesh since flood water remains long time onto the land. For example, all means of communication via roads, railways, highways, and even runways become paralyzed due to flooding. It causes widespread damage to crops, stored food grains, domestic animals, homesteads, development infrastructures, and human lives. People remain maroon in water without having food and drinking water until relief arrives. Chronic flooding tests the capacity of the Bangladeshi government to response to these disasters. The factors that contribute to these calamitous inundations are varied and complex and some of these are natural, like heavy monsoon downpour, melting snows in the Himalayas, and geophysical instabilities in the northern regions. But some of the factors that responsible for floods are human works such as deforestation and unplanned development works. Table 1-1, shown that from 1954-2017, 15 floods occur and every flood covers lowest 19% to highest 75% area in total area of Bangladesh. Bangladesh has implemented flood control and drainage projects since the 1960s. The objectives were to enable and persuade people, communities, agencies and organizations to be prepared for floods and take action to increase safety and reduce damage. The goal was to alert people on the eve of a flood event (Hossain 2018). Presently, Bangladesh is now better managing flood and reducing death.

While floods have been endemic to the climate and hydrological systems in South Asia, their increasing magnitude and frequency in recent times is a matter for serious concern. An analysis, carried out based on CRED/EM-DAT data highlights that flood occupies 35% of all natural disasters in South Asia (Figure 1-6)(Guha-sapir et al. 2016). Among the Asian countries China is the most frequently affected country by floods followed by India. The other eight of the top ten flood affected countries are Indonesia, Philippines, Bangladesh, Iran, Thailand, Sri Lanka, Vietnam and Pakistan in descending order. Except China and Iran, all these countries are located in South and South-east Asian Regions. The 5-year average flood statistics of last 30 years show that flood frequency is increasing in all these countries (Figure 1-7)(Dutta and Herath 2004). It appears from several case studies or researches that roles and responsibilities of different actors are more clearly defined and thus improved the flood management system. Flood management tools are used well than before by the local residents. There is better communication by using

internet/mobile and more public participation in flood mitigation by using flood management tools (early warning systems). There is improvement of flood management system by preparing flood modelling, developing flood management maps, better communicating and implementing different policies (Hossain 2018).

Table 1-1. Major Floods, 1954-2010 in Bangladesh

Source (Dewan, Nishigaki, and Komatsu 2003) and by author

Year	Flooded area (km^2)	Percentage of total area	Number of deaths
1954	36920	25	112
1955	50700	34	129
1956	35620	24	NA
1962	37440	25	117
1963	43180	29	NA
1968	37300	25	126
1970	42640	28	87
1971	36475	24	120
1974	52720	35	1987
1984	28314	19	553
1987	57491	38	1657
1988	77700	52	2379
1998	100000	68	1050
2004	87000	56	1200
2017	56300	37	799
NA: Not Available			

1.2 Cyclone

Bangladesh is one of the most cyclone prone countries in the world. Cyclones and tidal surges have repeatedly distressed lives and property in coastal and island portion of Bangladesh. During the last 100 years, Bangladesh has experienced 53 major cyclones. Basically, on average, in Bangladesh specially the coastal area faces one severe cyclone in every three years (Ahamed, Rahman, and Faisal 2012). Bangladesh is especially vulnerable to cyclones because of its location at the triangular shaped head of the Bay of Bengal, the sea-level geography of its coastal area, its high population density and the lack of coastal protection systems. During the pre-monsoon

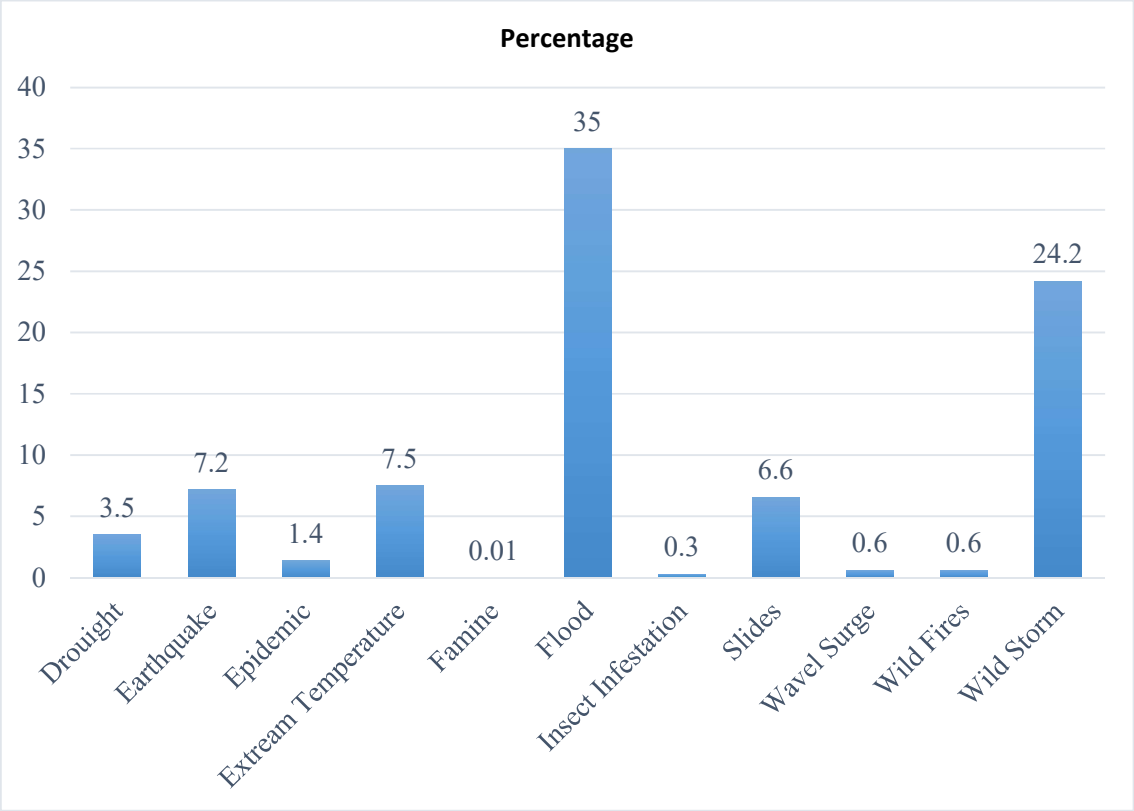

Figure 1-6.Natural disaster in South Asia (1975-2015)
Source (Guha-sapir et al. 2016)

(April–May) or post-monsoon (October–November) seasons, cyclones frequently hit the coastal regions of Bangladesh. The Bangladesh coast is the most hazardous coast in the world in terms of the number of people who suffer from various types of cyclone and cyclonic surges every year (Table 1-2). About 40% of the total global storm surges are recorded in Bangladesh (Murty 1984).

Table 1- 2. Major cyclones in Bangladesh

Source (Ahamed, Rahman, and Faisal 2012) and by author

Serial No.	Year of Occurrence Velocity	(Km/h)	Number of Death	Serial No.	Year of Occurrence Velocity	(Km/h)	Number of Death
1.	1822	_	40000	**18.**	1965	-	12000
2.	1872	-	270	**19.**	1965	200	870
3.	1876	_	400000	**20.**	1966	-	850
4.	1897	-	175000	**21.**	1967	130	128
5.	1911	-	120000	**22.**	1969	-	175
6.	1917	-	70000	**23.**	1970	222	500000
7.	1919	_	40000	**24.**	1971	110	11000
8.	1926	-	606	**25.**	1973	122	183
9.	1941	-	7000	**26.**	1983	122	1043
10.	1958	-	12000	**27.**	1983	136	300
11.	1960	-	11446	**28.**	1985	154	11069
12.	1960	210	8149	**29.**	1988	160	5708
13.	1961	145	11468	**30.**	1990	-	150
14.	1961	145	10466	**31**	. 1991	235	145000
15.	1962	200	50000	**32.**	1997	225	126
16.	1963	201	11520	**33.**	2007	200	3406
17.	1965	161	19970				

Bangladesh is now fully covered by mobile telecommunication networks and distributing cyclone warning messages via mobile phones. Bangladesh has significantly improved its pre- and post-cyclone early warning and evacuation systems and health services and has introduced a

cyclone preparedness program for primary school children. Apart from early warning systems, other measures such as cyclone shelters and coastal embankments have contributed to reduce death rates in Bangladesh.

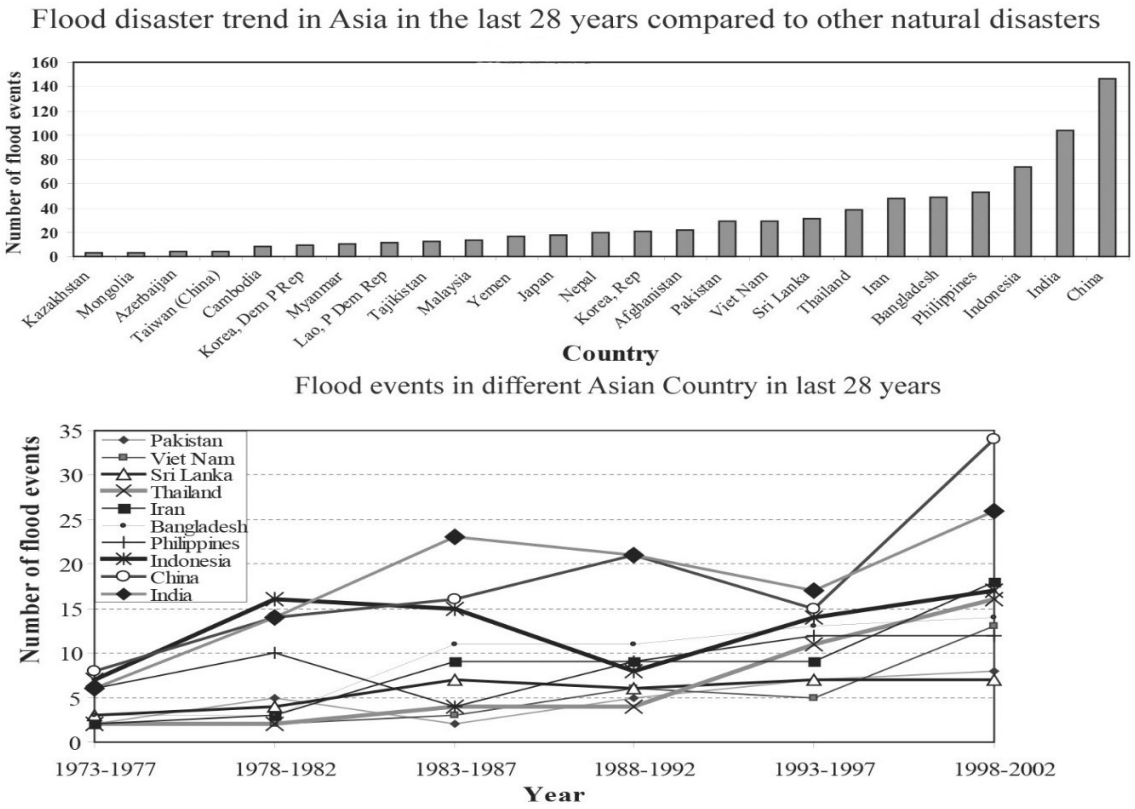

Figure 1-7. Flood trend in most frequently flood affected 10 countries in Asia

Source (Dutta and Herath 2004)

1.3 Earthquake

As the capital city of Bangladesh, Dhaka is facing the extraordinary level of urbanization because of higher population growth and migration of people from the rural areas. As a result, the urbanization rate is increasing without proper planning guidelines and regulations. Buildings are designed and constructed without proper enforcement, which may cause extensive damage in future earthquakes.

There are significantly improvement of cyclone and flood preparedness program, early warning and evacuation systems but nothing much about earthquake. Walking through the streets of Dhaka paints a picture of a city with significant structural vulnerabilities – where poor construction standards, lack of enforcement, and poor maintenance turn many buildings into potential hazards (Reinecke and Donaghey 2015). When a building in Savar collapsed in 23rd April 2013 – killed over 1,129 people, injured thousands more (2000+) and rescued 3,553, it was a

Figure 1-8. Before and after collapse of Rana Plaza building
Source Internet

wakeup call for Bangladesh (Figure 1-8) (Reinecke and Donaghey 2015). The collapse was not triggered by an earthquake, it was the result of catastrophic structural failure, but it was a glimpse into what could happen in the event of a major earthquake. Dhaka is one of the world's most populated cities, with a population of about 18 million people. Cities like Dhaka, which are susceptible to major earthquakes, have not experienced a major shake in more than one generation. Historical seismic catalogues have revealed that Bangladesh has been affected by earthquake disasters since ancient times (Islam, Jameel, and Jumaat 2011). Records show that large earthquakes have previously ravaged the country and the neighboring region several times over the last 450 years (Bilham 2004).Two major earthquakes that caused severe damage in areas adjacent to the epicenters were in 1885, known as the Bengal Earthquake, and in Srimangal in 1918. In addition, 20 major earthquakes have occurred in Bangladesh, and surrounding areas in

the eighteenth and nineteenth century. Almost six earthquakes with magnitudes between 7.0 and 8.7 on the Richter scale have been experienced in the seventeenth and eighteenth century (Bilham 2004). Recently in Bangladesh earthquakes and tectonic activity are found to be increased (Table 1-3). Recent earthquakes with low to moderate magnitude and very close to Dhaka are certainly

Table.1-3 List of few significant earthquakes (6.0 to 7.2 Magnitude) in Dhaka, Bangladesh (1997-1918)

Date	Epicenter	Magnitude(Richter Scale)
1997-11-21	42 km from Saiha, Mizoram, India	6.1
1997-05-08	10 km from Karīmganj, Assam, India	6.0
1984-12-30	22 km from Silchar, Assam, India	6.0
1984-05-06	5 km from Churāchāndpur, Manipur, India	6.0
1964-01-22	38 km from Hakha, Chin, Myanmar	6.2
1958-03-22	59 km from Mawlaik, Sagain, Myanmar	6.0
1957-07-01	22 km from Kakching, Manipur, India	6.2
1956-02-29	39 km from Mawlaik, Sagain, Myanmar	6.2
1955-12-14	61 km from Bāndarban, Chittagong, Bangladesh	6.2
1950-08-15	20 km from Maibong, Assam, India	6.0
1938-08-16	30 km from Falam, Chin, Myanmar	7.0
1930-07-02	17 km from Lakhipur, Assam, India	7.1
1923-09-09	19 km from Kishorganj, Dhaka, Bangladesh	6.8
1918-07-08	5 km from Netrakona, Dhaka, Bangladesh	7.2

the indications of its earthquake source and vulnerability. In addition, micro-seismicity data also supports the existence of at least four earthquake source points in and around Dhaka (Ansary 2005; Hussain, Islam, and Ahmad 2010; Islam, Jameel, and Jumaat 2011).

Tectonically, Bangladesh lies in the north-eastern Indian plate near the edge of the Indian craton and at the junction of three tectonic plates: the Indian plate, the Eurasian plate and the Burmese micro-plate (Figure 1-9). In broad terms, Bangladesh is an earthquake-prone country; its northern and eastern regions in particular are known to be subjected to earthquakes of magnitudes greater than 5 on the Richter scale. The geo-tectonic set-up of the country, which is located along two of the planet's active plate boundaries, suggests high probabilities of damaging after earthquakes and the possibility of rarer but extraordinarily large earthquakes that can cause damage far from their epicenters. The juxtaposition of the Himalayan orogeny along with its syntaxes and the convergent Burma Arc plate boundary are located in northeast and east of the Bangladesh, respectively. This is why this land is particularly, vulnerable to high-magnitude earthquake events.

Recently the plate motions are measured in six different sites of Bangladesh including Dhaka. According to the research being jointly conducted by Lamont-Doherty Earth Observatory, Columbia University and the Department of Geology, Dhaka University, Dhaka is moving 30.6 mm/year in the direction of northeast. In addition, the rate of strain accumulation is relatively high in and around Dhaka. It may precipitate in an earthquake of magnitude 6.8 in the event of the release of accumulated strain. For these reasons, the infrastructure and life safety against seismic hazard is now a burning concern. The geographical location, land characteristics, multiplicity of rivers and the monsoon climate render Bangladesh highly vulnerable to natural hazards.

There are some studies in rural area about natural and human induced hazards such as floods, cyclones, tidal surges, tornadoes, river erosion, fire, high arsenic contents of ground water, water logging, water and soil salinity, epidemic, and various forms of pollution (Ahmadul Hassan et al. 2006). Among these events, mortality and morbidity from floods and cyclones have fallen substantially in the past 50 years, partly because of improvements in disaster management. To date, disaster policies in Bangladesh have focused on rural villages, but the rapid growth of cities has created a need for development of urban strategies for disaster management especially for earthquake (Ahmadul Hassan et al. 2006). Dhaka is under development for technical assistance to address seismic risk by the joint collaboration between the Government of Bangladesh and the World Bank through the Global Facility for Disaster Reduction and Recovery (GFDRR). The program is supporting the Government in increasing the awareness of seismic risk through a participatory approach that ensures ownership of the risk amongst government officials and

decision makers. The program emphasizes on collective problem-solving, shifting mindsets, and building consensus through multi-stakeholder thematic 'focus groups' (Marc Forni 2014).

3. Literature on risk perception and awareness of earthquake

The risk is high in Dhaka because of the natural seismicity, but also because of its poorly designed and constructed structures, unplanned urbanization, extremely dense population and poor preparation for the eventually necessary response to an earthquake. So the risk perception and awareness of people are very important points when discussing earthquake.

In past investigations, awareness of vulnerability and factors of such awareness are not considered as much as risk perception and its elements. However, Hurnen and McClure (1997) find a critical connection between earthquake awareness scores and preparation scores, which

Figure 1-9. Three tectonic plates around Bangladesh
Source (Bilham 2004)

demonstrates that those with more information about earthquakes are expected to be prepared for one (Francisco Hurnen and John McClure 1997).

Mileti and Fitzpatrick (1992) state that risk communication factors such as salience and the style and frequency of messages are also important factors in the perception of risk. In the case of Istanbul, the level of knowledge about the predicted earthquake among inhabitants is quite high. Communicated risk information that was reinforced through additional communications and/or social cues precipitated an interactive personal search for more information; personal definitions of risk and what to do emerged; and these social constructions directed how the public responded. Perceived risk has only indirectly impact on public action through information searching. This suggests that searching behavior should intervene between perception of risk and response in the theory of public risk communication (Mileti and Fitzpatrick 1992).

Nevertheless, these studies do not investigate the factors affecting knowledge about earthquake. Burningham, Fielding, and Thrush (2008) find that area of residence, experience of flooding, length of residence, tenure and social class are the factors predicting the likelihood of awareness about floods. It includes perception and social behavior dealing with hazards (floods, droughts, earthquakes, volcano eruptions, wild fires, and landslides). The review reveals that there is an impact of personal experience of a natural hazard on risk perception. The problem is often not simply a lack of awareness, but rather, assessments of local risk based on experience that underestimate the impact of rare or extreme events (Burningham, Fielding, and Thrush 2008).

Slovic et al. (2000) note that perceived risk, which refers to various kinds of attitude and judgment about a risk, is quantifiable and predictable. They argue that perceived risk could be predicted from knowledge of an item's dread and severity and closely related to a potential threat to future generations, potential for global catastrophe, personal threat and inequity. Humans perceive and act on risk in two fundamental ways. Risk as feelings refers to individuals' instinctive and intuitive reactions to danger. Risk as analysis brings logic, reason, and scientific deliberation to bear on risk management. (Slovic and Peters 2006; Slovic 2000).

Public perceptions are occasionally the product of intuitive biases and economic interests and reflect cultural values, while experts' expressions of risk are based on objective, analytic and rational risk assessments. In addition to the what real risk is, it is important how the public judge it, because people respond to the hazards they perceive and many factors , including knowledge,

perception, educational level, economic status, gender and attitude, underline those perceptions (Slovic 2000).

Disaster readiness is a multifaceted process in two ways: Firstly, it involves multiple factors on the part of the public such as trust, a belief in self-efficacy, internal control, and a sense of responsibility for self, others and for the community. Secondly, it involves multiple factors on the interface between the public, government authorities and experts, such as mutual trust, and respect, beliefs in human rights, ethics of cooperation and willingness to evaluate one's performance Fişek et al. (2003). Fişek et al. (2003) shows that the respondents have given a realistic appraisal of the risk they face in terms of the security of their zones. In the same study, 75% of the respondents have given relevant answers to the question 'What is an earthquake?', and 62% have seen the construction of their homes as the real source of danger. However, when it comes about preparing for an earthquake or mitigating the consequent damage, people have shown less, and in some cases only superficial knowledge of what to do (Fişek et al. 2003).

Tekeli-Yeşil et al. (2011) show that although the level of knowledge on earthquakes and of preparedness for residents among Istanbul are encouraging, it could be improved. The results indicates that future preparedness programs should target people with lower educational and socio-economic levels. The media are the leading source of information among the respondents. Vulnerability of earthquake of urban area is a strong influence on individuals having above average earthquake knowledge and even more on high risk perception. Socio-economic parameters (educational level, economic status, SEL of the sub-district and tenure of the home), gender and attitude score are other factors influencing greater risk perception with regard to earthquakes (Tekeli-Yeşil et al. 2011).

Adiyoso and Kanegae (2013) assess the effectiveness of disaster risk reduction (DRR) in schools by comparing students in two junior high schools regarding action taken in earthquake preparedness and major factors of disaster preparedness such as risk knowledge, risk perception, critical awareness and attitude. This study provides the evidence that a school adopting disaster risk reduction issues effectively enhanced knowledge, risk perception, critical awareness and attitude but limited in preparedness behavior. Efforts should be taken by policy makers, teachers, and other stakeholders to develop public education in schools focusing on changes in preparedness behavior (Adiyoso and Kanegae 2013).

As Dhaka city is at risk of earthquake and fire hazard, ward 29, an old part of Dhaka city has been selected for vulnerability assessment of both hazards in the study of Rahman, Ansary, and Islam (2015) and social vulnerability has been included in the assessment as it has become an important issue in the recent years. The study area is relatively more vulnerable to fire hazard than earthquake. As it is one of the most densely populated wards in Dhaka city, social factors have compounded the overall vulnerability to higher scale. Most of the buildings are vulnerable to both earthquake and fire hazard considering social impacts. Thus ideal mitigation planning to reduce risk is almost impossible here without involvement of community people. By warning them of their own risk and making them resilient through awareness programs and training, disaster risk in the study area can be reduced effectively (Rahman, Ansary, and Islam 2015).

Paul and Bhuiyan (2010) suggest that an overwhelming majority of the respondents are not prepared for a major earthquake, which is anticipated to occur in Dhaka. Multivariate analysis of survey data reveals that value of residential unit and respondents' educational levels appear as the most significant determinants of preparedness status of the respondents. This study recommends the increment of earthquake awareness and preparedness among residents of Dhaka City (Paul and Bhuiyan 2010).

Despite the fact that a few creators have discovered the relationship between hazard recognition and the taking of preventive measures, others have referenced that there is indirect connection between them.

This literature survey shows that there is critical connection between earthquake awareness and preparation, between perception of risk and behavior of the respondents. Furthermore, from the literature review, the recent earthquake risk related behavior is recognized. There is lack of information about the level of risk of Dhaka. Identification of hazards and assessment of risks and awareness of the residents of Dhaka are important steps in the process of reducing the impact of disasters. It is necessary to introduce the community based disaster management system. There is a lack of awareness, risk perception and training among the citizens particularly in men, empowering community at risk. Earthquake management system should to be established and made functional. To enable civil society actors and affected communities, it is necessary to strengthen their resilience to earthquake. It is indispensable to reduce the gap between what we know and what we do as well as to develop networks of relevant national, regional and international organizations. It is necessary to better evaluate the vulnerability and to find the ways

of reducing it. Social vulnerability is usually evaluated through surveys focusing on residential population. For the flood preparedness and cyclone, most of the NGOs are working. But there is no NGO that are dealing about earthquake which can be a vigorous threat for our country. NGOs have to work in this zone with the government. Effective monitoring committee should to be formed by the government to monitor the disaster situation. Education and improving the resident's awareness will provide hazard information to the public in a non-technical manner to make them conscious of the impacts of possible hazards. Research on earthquake risk perception and awareness is needed to understand hazards and their consequences. Survey and data collection are necessary to support research, to provide affected communities and citizens with better risk perception and awareness, to understand hazards, and to develop loss reduction methodologies. The literature survey indicates that there are a lot of gaps about the research on earthquake risk perception and awareness of Dhaka.

4. Research Question

This study investigates the factors that influence earthquake risk perception and awareness in Dhaka. This study measures the awareness and characterizes the perceptions of risks regarding earthquake in residents of Dhaka to identify the primary factors such as gender, age, educational background et. Two questionnaire surveys are completed in Dhaka. The questionnaire is with 24 questions where first part is about the demographic characteristics of the participants such as gender, age, educational background, second part is concerned about general public - risk perception of the earthquake and other hazards, and third part is about behavior analysis. Aim of this research is to find out the risk perception and awareness of earthquake in Dhaka. Based on the existing surveys, the main objective of this thesis is to empirically investigate the following research questions: (1) Whether Dhaka residents (on the basis of gender, age and education) have risk perception and awareness about the earthquake? (2) Whether high school students (on the basis of gender, age and education) have risk perception and awareness about the earthquake?

5. Study Methods

This study is similar to several theoretical frameworks of risk perception and awareness. The Social Amplification of Risk and Protection Motivation Theory (Kasperson et al. 1988; Shapira, Aharonson-Daniel, and Bar-Dayan 2018; Rogers 1975) frameworks are similar

addressing the issue of human behavior in disasters (e.g. natural hazards) and refers more to preparedness-related behavior or responses to an ongoing event and often deals with the issue of evacuation from a risk area (Shapira, Aharonson-Daniel, and Bar-Dayan 2018).

Rapid urbanization of Dhaka does not follow properly constructed structure code and materials for building construction. If a massive earthquake strikes, it may cause severe destruction. This study conducts an investigation and provides useful information on seismic risk perception and awareness of the residents of Dhaka.

The study is based on quantitative analysis. Data are collected from questionnaire surveys. This research tries to investigate the difference between past and present level of knowledge on the earthquake. This study also tries to examine and make the comparison about the risk perception and preparedness level between different groups of gender, age and level of education of adult people as well as a group of high school students.

Several data collections are done about adult and a group of high school students. The first study is on the adult group to understand how attitude, recognition and behavior differ depending on age, gender, education and casualty awareness. The second study is done on the group of high school students to analyze distinction in hazard and communication behavior in reaction to the earthquake in respect to age, gender and grade.

The aim of the questionnaire is to assess the knowledge level of the respondents on earthquake risk. Results are treated statistically, analyzed thoroughly and commented. To evaluate perception of risk and awareness of earthquake depending on gender, age and educational background, this research performs factor analysis using the independent sample t-tests, chi-square statistical analysis, frequency analysis and correlation matrix.

6. Organization of the Study

The thesis is organized in four chapters. Chapter 1 commences with introduction. It consists of background of the study (Flood, cyclone and earthquake), research questions, study methods and finally organization of the study. This literature review of risk perception and awareness of hazard will introduce the reader to the available research done on disasters. In this section also specifications for the different disaster types are done to investigate potentially different patterns between these. Chapter 2 depicts findings of the study; “Adults risk perception and awareness”. This chapter examines the difference of attitudes and perceptions depending on gender, age and

education of adults group of Dhaka residents. The questionnaire form is consisted of information on personal data, general public - risk perception of the earthquake and other hazards and behavior analysis. Chronologically, chapter 3 reflects the Students' risk perception and awareness. This section also elaborates and inspects the knowledge of high school students on seismic risk perception and their preparedness. Finally, chapter 4 consists of conclusion and recommendations of the study.

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Chapter 2

Adults risk perception and awareness

1. Introduction

1.1 Background

Bangladesh has struggled to resolve five basic needs (food including water, clothing, shelter, education including internet and healthcare including sanitation) of the people. At the same time, the country has been struggling with a variety of natural hazards, such as floods, cyclones, tidal surges and earthquakes. Presently, seismicity and safety issues have reached to highest rating in media, scientific and administrative platforms. The government in coordination with NGOs and international organizations, has done a commendable job in responding to the flood risk management and cyclone preparedness but most of the remaining major environmental incidents like earthquake are still unreachable at the point of prediction, emergency response and management due to lack of professionals, appropriate tools, research, processes and guidelines.

The geo-tectonic set-up of Bangladesh which is located along two of the planet's active plate boundaries, suggests high probabilities of damaging after earthquakes and the possibility of rarer but extraordinarily large earthquakes that can cause damage far from their epicenters (Paul and Bhuiyan 2010; Ansary 2005; Bilham 2004; Ali and Choudhury 1992) In addition, micro-seismicity data also supports the existence of at least four earthquake source points in and around Dhaka (Ansary 2005; Hussain, Islam, and Ahmad 2010; Islam, Jameel, and Jumaat 2011). Based on the record of the Geological Survey of Bangladesh, the country has experienced at least 465 earthquakes of minor-to-moderate magnitudes between 1971 and 2006 (Bilham 2004; Islam, Jameel, and Jumaat 2011). Seismic experts consider recent repeated earthquakes of low to medium magnitude as an advance warning for a massive, and potentially disastrous earthquake in the near future (Bolt 1993). Moreover, some authors argue "an earthquake is an event for which it is possible to be prepared in advance" (Turner 1976).

1.2 Literature

The gendered dimensions of disasters have been attracting significant scholarly attention (Enarson 1998; Fordham 1998; Fothergill 2000). Few other studies examine the

difference of attitudes and perceptions depending on gender, age, education, and casualty awareness (Armas 2006; Murakami, Nakatani, and Oki 2016). A number of studies have been conducted worldwide and reported in the literature addressing knowledge on seismic risk perception and willingness to take action to reduce seismic risk (Beck et al. 2012; Marincioni et al. 2012; Paradise 2006; Paul and Bhuiyan 2010; Santos-Reyes, Gouzeva, and Santos-Reyes 2014; Taghizadeh et al. 2012; Ainuddin, Routray, and Ainuddin 2014).

Vicente (2014) deals with awareness, perception and communication of earthquake risk in Portugal. The survey is carried out to assess the knowledge on seismic risk perception and awareness in the Algarve region. This study states that risk communication can influence communities to become aware of risks and it has a powerful influence on people's risk decision-making and behavior(Vicente et al. 2014).

Fernandez (2018) investigates the factors that influence fire, earthquake, and cyclone risk perception in Yangon, Myanmar. The full survey is conducted with 199 respondents. Knowledge of earthquake mitigation actions is positively related to gender (females are more likely to have more knowledge of earthquake mitigation actions than males) (Fernandez et al. 2018).

There are many studies that explore risk perception and willingness about earthquake in many countries, but only a few studies deal with Dhaka, Bangladesh. Alam E (2016) deals with Bangladesh about how local residents perceive and are prepared for earthquake and tsunami in SE (south-eastern) Bangladesh which survey is done almost 3 years ago (Alam 2016). This research uses both quantitative (i.e. questionnaire survey) and qualitative (i.e. focus group discussions and informal interviews) data collection techniques in SE Bangladesh. Chittagong is a Division located in the SE region of Bangladesh and it is the second largest city of the country. The results of data analysis suggest that the local residents have lesser level of risk perception and preparedness in absence of their direct experience of earthquakes and tsunamis.

Paul and Bhuiyan (2010) deal with Dhaka, Bangladesh about the risk perception of the earthquake which survey is done almost 8 years ago. There have a lot of changes in Bangladesh within 8 years due to economic, education and lifestyle modification (Hussain, Alam, and Davies 2017). GDP growth in 2016 is officially estimated around 7.1 percent, higher than the 5.57 percent achieved in 2010 (Hussain, Alam, and Davies 2017; Rate 2016). Industrial growth increases from 7.0 percent in 2010 to 11.1 percent in 2016 with both the export-oriented garment industries and manufacturing for the domestic market (Hussain, Alam, and Davies 2017). Paul and

Bhuiyan (2010) collect data by face to face interviews with selected residents as the primary source. Conversely, in this study, the data is gathered by the randomly questionnaire survey. Whenever there is face to face interviews, the interviewer might have some expectation or biases which may be the limitation of the previous study (Crawford 1997) . This study will overcome this limitation and focus on current knowledge of people on risk perception of the earthquake and its preparedness. In this survey, the questionnaire is explained to the respondents and delivered to the people for the spontaneous responses but there is no face to face discussions or interviews. This research will also try to investigate the difference between past (Paul and Bhuiyan 2010) and present level of knowledge on the earthquake.

It is evident that there is a very limited or no research about knowledge on seismic risk perception and awareness in the Dhaka region to establish a difference between attitudes and perceptions depending on gender, age, education and casualty awareness. Especially, no formal academic research has undertaken on this area.

1.3 Objective

The primary objective of this research is to examine seismic risk perception among residents of Dhaka to investigate the levels of knowledge on earthquake and preparedness. The individual assessment of people about the significances of threats and rigorousness of risks is demarcated as risk perception (Paton et al. 2000; Dunn et al. 2016). So, the studies about risk awareness which can give evidence about the preparation level of vulnerable communities, are essential (Carlino, Somma, and Mayberry 2008; Perry and Lindell 2008; Parsizadeh et al. 2015; Fernandez et al. 2018). In this research as well as in Paul and Bhuiyan (2010), the investigation about risk perception and awareness on earthquake is performed. In Paul and Bhuiyan (2010), analysis about preparedness level based on gender, age, education, marital status, duration of stay in Dhaka etc. is done for general clarification only and these variables have no significant statistical relationship with respondents' preparedness status. This research is interested to know how attitude, perception and behavior differ depending on gender, age, education and casualty awareness. This research tries to examine and make the comparison of the risk perception and preparedness level between different groups of gender, age and level of education. This research focuses on the nature of environmental risk perceptions, measurement considerations, and their correlations with attitudinal (manner) and personal characteristics. This research summarizes the principal features

of risk perception of the earthquake and describes the ways of communication among local people in which hazard mitigation and emergency preparedness practices can limit the physical impacts and reduce social impacts. This research mainly focuses on behavior and awareness of the people with the risk of earthquake hazard in Dhaka.

1.4 Methods

Dhaka Division consists of 13 districts (Figure 2-1 (a-b)). In this research, 2 portions of Dhaka; Dhaka city and Manikganj suburb are mainly focused on. Manikganj is the extended area of Dhaka. These two areas are the urban centers of Dhaka Division. This paper surveys with the randomly selected 359 individual respondents who are the representative of larger population of the country and compared the data with the previous study (Paul and Bhuiyan 2010).

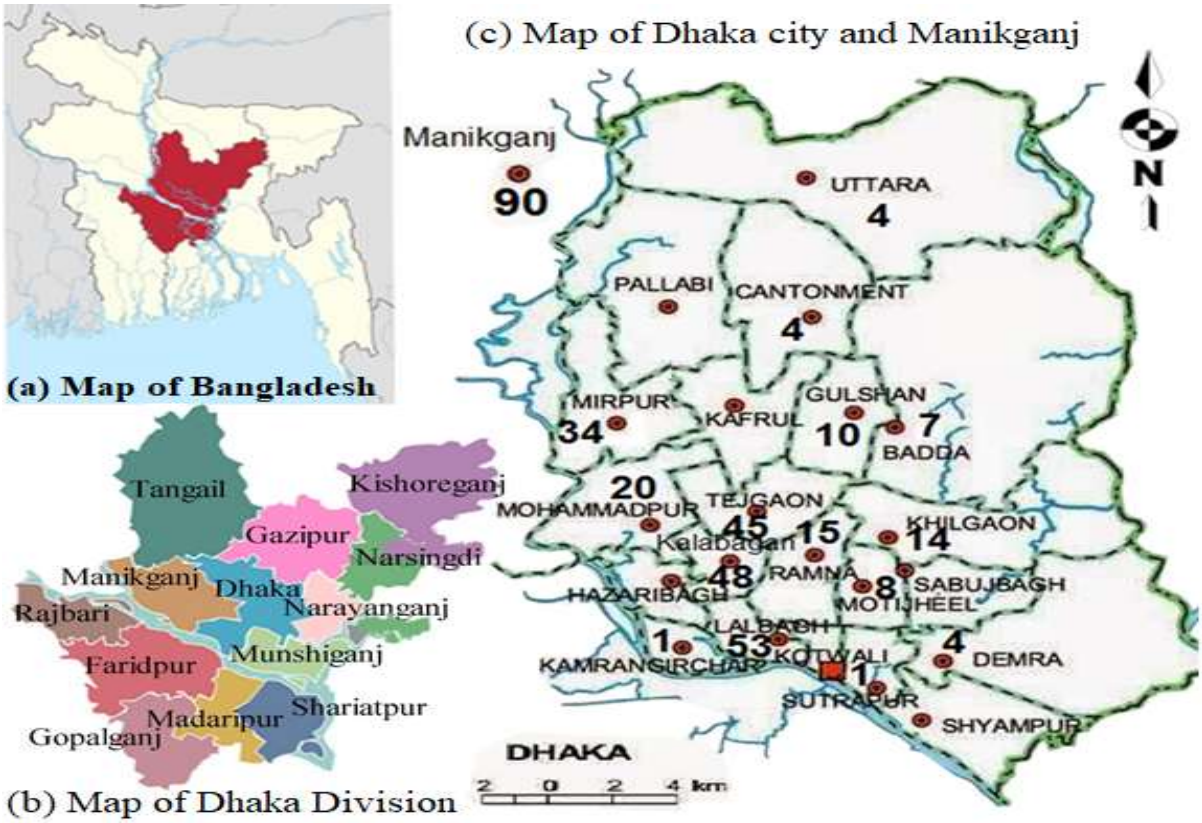
There are several factors which may affect individual's subjective assessment such as inherent factors (age, education, gender etc.) (Slovic, Fischhoff, and Lichtenstein 1982; Turner, Nigg, and Paz 1986; Dooley et al. 1992; Barnett and Breakwell 2001), external factors (information, trust etc.) (Slovic, Layman, and Flynn 1991; Slovic 1993; Liu, Huang, and Brown 1998; Siegrist and Cvetkovich 2000; Sjöberg 2001; Shrestha, Sliuzas, and Kuffer 2018) and cultural factors (societal structure, believes, habits etc.) (Bontempo, Bottom, and Weber 1997; Weber and Hsee 1998; Sjoberg 2000). The author conducts research on risk perception and risk communication related to seismic risk in Dhaka.

2. Research site and questionnaire survey

2.1 Area selection

In this research, the relevant, recommended and integrated framework for the earthquake preparedness is investigated. Field visits are done in Dhaka of Bangladesh for reconnaissance. Bangladesh is considered among the most disaster-prone countries in the world, especially in terms of urban structure vulnerability. Dhaka is chosen as a study area for several reasons. Dhaka is one of the world's most populated cities, with a population of about 18 million people. Some researchers have shown that, major cities of the country, particularly Dhaka is in great risk of

hazards even by a moderate magnitude of earthquake. (Ansary 2005; Hussain, Islam, and Ahmad 2010; Islam, Jameel, and Jumaat 2011). For these reasons Dhaka is chosen to conduct the survey.



Mohammadpur	20	Uttara	4	Cantonment	4	Mirpur	34
Sutrapur + Kotwali	2	Badda	7	Manikganj	90	Tejgaon	45
Motijheel	8	Kalabagan	48	Khilgaon	14	Ramna	15
Kamrangirchar	1	Lalbagh	53	Demra	4	Gulshan	10

Figure 2-1. Area map of Dhaka, Bangladesh.

2.2 Questionnaire

The knowledge on seismic risk perception and awareness in the Dhaka region are assessed in this research. The survey is conducted in the April-May of 2017 (Appendix 1-3), in 17 areas, where survey is carried out with 359 individuals. Figure 2-1 (c) shows the different surveyed areas and number of respondents of Dhaka. A questionnaire with 24 questions is developed focusing on three parts: first, demographic factors (such as age, education, gender and living area); second, general public - risk perception of the earthquake and other hazards and third, behavior analysis (Figure 2-2). The questionnaire form is consisted of information on personal data, residence data, basic knowledge about earthquake activity, disaster's experience, perception of respondents,

disaster preparedness, participation, awareness and behavior analysis (Vicente et al. 2014; Baytiyeh 2014; Paul and Bhuiyan 2010). All questions are designed with multiple-choice answers. The data are collected through home and sidewalk surveys to attribute properties of the earthquake to estimate the public knowledge level. At first, we have explained to the respondents about the questionnaire. The questionnaires are delivered to the people for the responses but not any face to face discussions or interviews. The people are free to respond by themselves. On the other hand, in Paul and Bhuiyan (2010), the primary source of data is face to face interviews with selected residents. In addition to the authors of this paper (Paul and Bhuiyan 2010), the questionnaire survey is administered by four trained personnel. Interviews are conducted during the daytime at weekends and in the evenings on weekdays. For example, a respondent's level of preparedness is determined by asking one question: are you prepared for a major earthquake? The answer is recorded as either prepared or not prepared.

Both studies are selected as the studies focusing on Dhaka. A structured questionnaire is developed to collect information from the respondents through survey in both studies. In both types of research, 6 questions have the similarity which include earthquake experience, their knowledge about how to turn off gas, electricity and water, their attitude toward first-aid-kit and whether they talk with all of their family members about what kind of damage an earthquake can cause to their immediate surroundings.

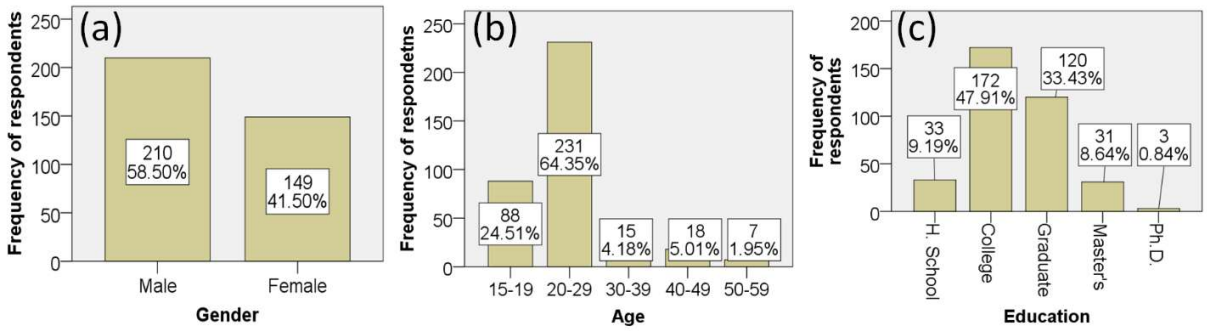


Figure 2-2. Analysis of category of respondents.

Figures 2-4 show the frequency of the respondents of 1-24 questions. Among total 359 respondents, 210 (58.5%) were males and 149 (41.5%) were females (Figure 2-2 (a)). The age of the respondents is divided into 7 categories such as 15-19, 20-29, 30-39, 40-49, 50-59, 60-69 and 70+ and in each category, 88 (24.5%), 231 (64.3%), 15 (4.2%), 18 (5%), 7 (1.9%), 0 (0.0%) and 0 (0.0%) respondents are included respectively (Figure 2-2 (b)). The education level of the respondents is divided into 7 categories such as None, Primary, High school, College, Graduate, Master's and Ph.D. and in each category, 0 (0.0%), 0 (0.0%), 33 (9.2%), 172 (47.9%), 120 (33.4%), 31(8.6%) and 3 (0.8%) respondents are included respectively (Figure 2-2 (c)). In this survey data

were collected mostly from educated respondents and this is the limitation of the study. We can suspect there are some seemingly discrepancies between the sample of this research and the real population in Dhaka. There are no statistics about the gender, age and literacy rate for the residents of Dhaka.

3. Results

3.1 Overview

Researcher uses IBM SPSS statistics to examine the data. All demographic variables are assumed as categorical variables. Frequency analysis is done to present the characteristics of the study. The main results obtaining from the survey are shown in Figures 2-3 and 2-4. In order to

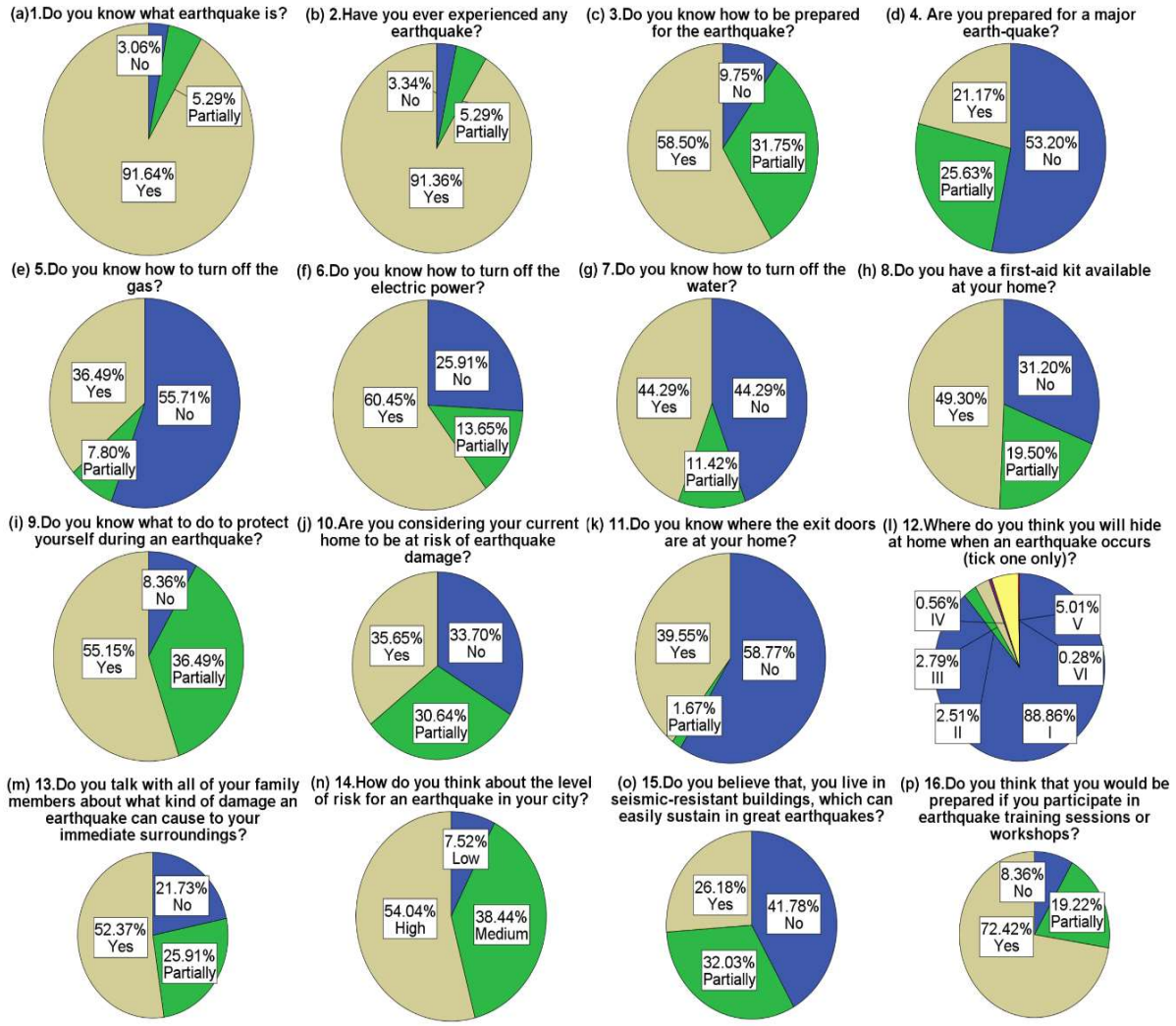


Figure 2-3. Data analysis of general public questions (primary data) for earthquake.

simplify the analysis, the results are divided into three groups, each of them is graphically treated in Figures 2-3 and 2-4 (a-d & e-h). Figure 2-3 (a) shows that 91.6% (329) of respondents know about earthquake. Figure 2-3 (b) shows that 91.4% (328) of respondents have experienced the earthquake, 5.3% (19) experienced partially and 3.3% (12) have not experienced an earthquake. From this data, it could be clearly understand that earthquake can be a hazard for Dhaka because 91.4% of respondents have experienced the earthquake at least for once. Figure 2-3 (c) indicates that 58.5% (210) of respondents know how to be prepared for the earthquake, which is really alarming for the Dhaka. On the other hand, 21.2% (76) of respondents are prepared for the major earthquake (Figure 2-3 (d)). Only 36.5% (131), 60.4% (217) and 44.3% (159) of respondents know how to turn off gas, electric power and water respectively (Figure 2-3 (e-g)). The vast majority of the respondents don't know how to shut off gas, electricity and water lines primarily to prevent other threats such as fire and overflow of water. These can cause injury and death. Figure 2-3 (h) indicates that 49.3% (177) of respondent have first-aid kit available at home. Furthermore, 55.2% (198) know what to do to protect themselves during an earthquake (Figure 2-3 (i)). Increased preparedness along with hazard awareness significantly reduces individual and community vulnerability to environmental hazards. Figure 2-3 (j) shows that 35.7% (128) of the respondents strongly and 30.6% (110) partially believe that many residential buildings in Dhaka will suffer serious structural failure during an earthquake due to construction defects, non-compliance with building codes, and violation of approved plans. Moreover, 58.8% (211) of the respondents do not know where the emergency exit door or they do not have emergency exit door (Figure 2-3 (k)). Most of the houses or companies in Dhaka don't have emergency exit because of the old design.

Figure 2-3 (l) presents the question "Where do you think you will hide at home when an earthquake occurs?". The options are: (I) Under a table or chair or bed close to the window (near the pillar); (II) In a corner in the narrow space (storage, kitchen or toilet); (III) Behind the door on the balcony; (IV) Over the bed; (V) Run to outside/ run to the elevator; (VI) Jump from the building. It is seen that 88.9% (319) of the respondents consider the statement as "(I) under a table or chair or bed close to the window (near the pillar)"; this may be regarded as a 'correct' answer. It shows the positive attitude of respondents because the publicity of the safety issues has reached to highest rating in the mass media. 52.4% (188) of the respondents (Figure 2-3 (m)) give the opinion that they usually discuss with all of their family members about what kind of damage an earthquake can cause to their surrounding after earthquake. This percentage is not sufficient and more public

awareness on earthquake is needed. In terms of knowledge about the level of risk for an earthquake in the city, 54% (194) of the respondents state that they have the risk on earthquake, as presented in Figure 2-3 (n). Figure 2-3 (o) indicates that only 26.2% (94), 41.8% (150) and 32.0% (115) respondents think that they are living in seismic-resistant buildings, not living in seismic-resistant and living in partially seismic-resistant building respectively. It is important to note that only respondents (26.2%) who live in modern apartments claim that their buildings are earthquake resistant. On the other hand, 72.4% (260) respondents think that they would be prepared for an earthquake if they can participate in earthquake training sessions or workshops (Figure 2-3 (p)). They have lack of necessary knowledge regarding the immediate actions and procedures about the earthquake that must be taken prior to and throughout the shaking duration of an earthquake.

About the other hazards (cyclones, landslide, floods etc.), in Figure 2-4 (a); it can be seen that 59.9% (215) respondents don't know the evacuation route or rescue map of their area. Outside of Dhaka, there have few evacuation routes or rescue maps but inside Dhaka, there is no evacuation route or rescue map. As can be seen in Figure 2-4 (b), only 35.9% (129) respondents believe that government and NGO conduct evacuation plan practicing program. About the question in Figure 2-4 (c), it shows that 64.6% (232) respondents of the inquired have never joined in any evacuation plans practicing program about other hazards including earthquakes. Such initiatives are fundamental to clarify the inhabitants about general concepts regarding earthquakes and how to behave during and after such an event. In contrast to what is expected, Figure 2-4 (c) shows that

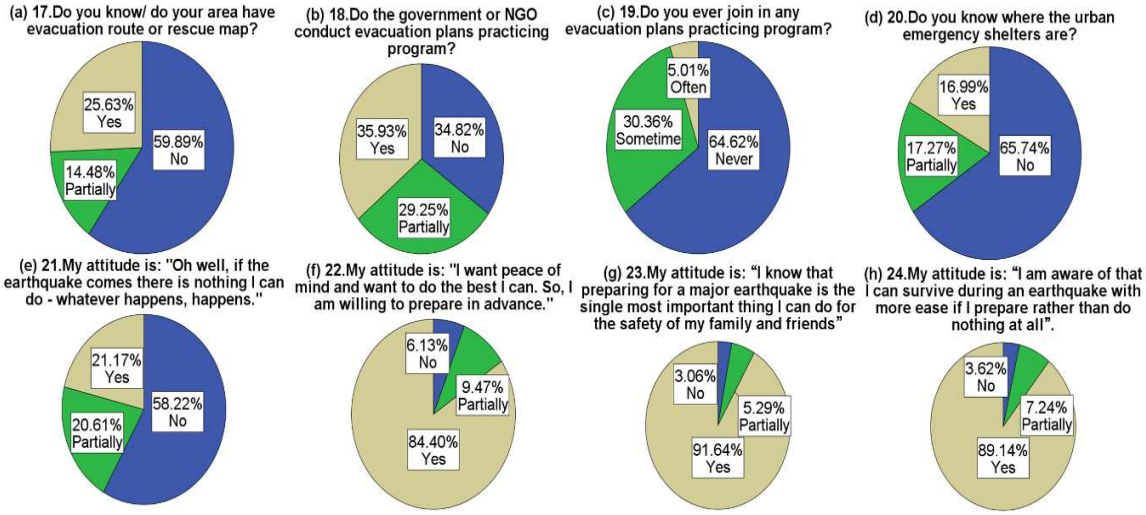


Figure 2-4. Data analysis of other hazards (cyclones, landslide, floods etc.) and behavior analysis.

only 5% (18) of participants admit that evacuation plan practicing programs have contributed to their knowledge and awareness regarding threats and risks of other hazards including earthquake. Regarding the last question in Figure 2-4 (d); 65.7% (236) of the inquired don't know where the urban emergency shelters are. There is the necessity to increase the number of shelters inside the Dhaka which will be specified on earthquake preparedness and risk reduction.

Figure 2-4 (e-h) indicates the behavior analysis or attitude of the respondents about the earthquake. Only 21.2% (76) of the respondents have agreed that there is nothing they can do if the earthquake comes but 58.2% (209) (have not agreed) of the respondents' attitude is that the information about how to be prepared for an earthquake is necessary for the preparation of Dhaka residents (Figure 2-4 (e)). As shown in Figure 2-4 (f) 84.4% (303) of the respondents' attitude is that they want peace of mind and want to do the best they can. So they are willing to be prepared in advance. This survey found that 91.6% (329) respondents (Figure 2-4 (g)) think that to be prepared for a major earthquake is the single most important thing they can do for the safety of their family and friends. Figure 2-4 (h) indicates that 89.1% (320) of the respondents think that they can survive during an earthquake with more ease if they are prepared rather than do nothing at all.

3.2 Gender

The group of questions (Figure 2-5) are aimed at figuring out the perception difference depending on gender (between male and female) of the population, first inquiring if they have (a) first-aid kit available at your home, (b) do they talk with all of your family members about what kind of damage an earthquake can cause, (c) do they live in seismic-resistant buildings, (d) attitude

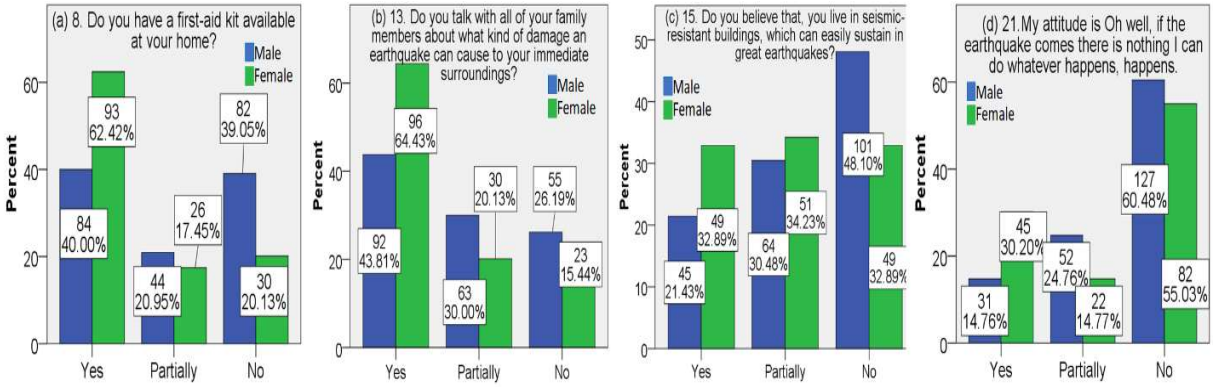


Figure 2-5. Data analysis of gender difference about risk perception and preparedness of earthquake.

is “if the earthquake comes, there is nothing they can do”. This study has found that about earthquake male participants have less preparation than female.

About the (a) first-aid kit availability, female (Yes= 62.42%) have more preparation than male (Yes= 40%). (b) Talk about the damage an earthquake can cause to their immediate surroundings; female (Yes=64.43%) talks significantly more than male (Yes=43.81%). (c) About “You live in seismic-resistant buildings, which can easily sustain in great earthquakes”; female (Yes=32.89%) believes it significantly more than male (Yes=21.43%). (d) “My attitude is: Oh well, if the earthquake comes there is nothing I can do - whatever happens, happens.” female (Yes=30.20%) believes it significantly more than male (Yes=14.76%).

The resilience and resourcefulness of female in disasters should be usefully incorporated in community-based mitigation (Maskrey 1989) and management initiatives once such capabilities are recognized to exist. This result suggests that female respondents have more risk perception and preparation about earthquake than male. Out of total 24 questions depending on gender, 4 questions (questions no. 8, 13, 15 & 21) have the most significant difference.

3.3 Age

Figure 2-1 (b) indicates the results of the survey highlighting how age affect risk perception and mitigation activities of earthquake where the highest ratios of participation are indicated in the groups of 15-19 (24.5%) and 20-29 (64.3%) among 7 categories. We can suspect there are some seemingly discrepancies between the sample of this research and the real population in Dhaka. Only these 2 categories of age are compared because in other categories there are very few respondents. Out of 24 questions, 12 questions (questions no. 5, 6, 7, 11, 12, 13, 14, 15, 17, 20, 21 & 24) have significant differences depending on 2 categories of age. Figure 2-6 shows how these 2 age categories have classified their knowledge level in this field.

Figure 2-6 (a-c) indicates that 51.14%, 77.27%, 62.50% of the 15-19 years age and 28.14%, 51.52%, 36.36% of 20-29 years age category know how to turn off the gas, electric power and water respectively. It shows that 15-19 years age category have more knowledge than 20-29 years age category. In Figure 2-6 (d) it can be seen that 53.41% of the 15-19 years age and 31.6% of the 20-29 years age category respond as “Yes” to the question whether they know where the exit doors are at their home or do not know. About the question “Where do you think you will hide at home when an earthquake occurs”; 82.955% and 91.775% of the 15-19 and 20-29 years age category

respectively respond as “Under a table or chair or bed close to the window (near the pillar)” (Table 2-1). Both age categories show the positive attitude about where to hide during an earthquake.

Table 2-1. Risk perception of the respondents during earthquake depending on age.

Questions	Percentage%	
Q16. Where do you think you will hide at home when an earthquake occurs (tick one only)?	Age 15-19	Age 20-29
I. Under a table or chair or bed close to the window (near the pillar)	82.955	91.775
II. In a corner in the narrow space (storage, kitchen or toilet)	3.409	1.732
III. Behind the door on the balcony	1.136	3.463
IV. Over the bed	2.273	0.000
V. Run to outside, run to the elevator	9.091	3.030
VI. Jump from the building	1.136	0.000
Total	100	100

Whether the respondents discuss with all of their family members on what kind of damage an earthquake can cause to their immediate surroundings or not; 73.86% and 42.86% of 15-19 and 20-29 years age category respectively respond as “Yes” (Figure 2-6 (e)). 29.55 % and 67.53 % of 15-19 and 20-29 years age category respectively respond that Dhaka is at risk for an earthquake (Figure 2-6 (f)). In response to the “Do you believe that, you live in seismic-resistant buildings, which can easily sustain in great earthquakes?” 48.86% and 19.05% of 15-19 and 20-29 years age category respectively mention that they live in seismic-resistant buildings (Figure 2-6 (g)). 43.18% and 31.82% of the 15-19 years age category and 18.18% and 12.55% of the 20-29 years age category respectively respond that their area have or they know about evacuation route or rescue

map and know where the urban emergency shelters are (Figure 2-6 (h-i)). 15-19 years age category knows more than 20-29 years age category about the rescue map and emergency shelters but the percentage of both categories is still very low. Figure 2-6 (j) indicates that 40.91% of the 15-19

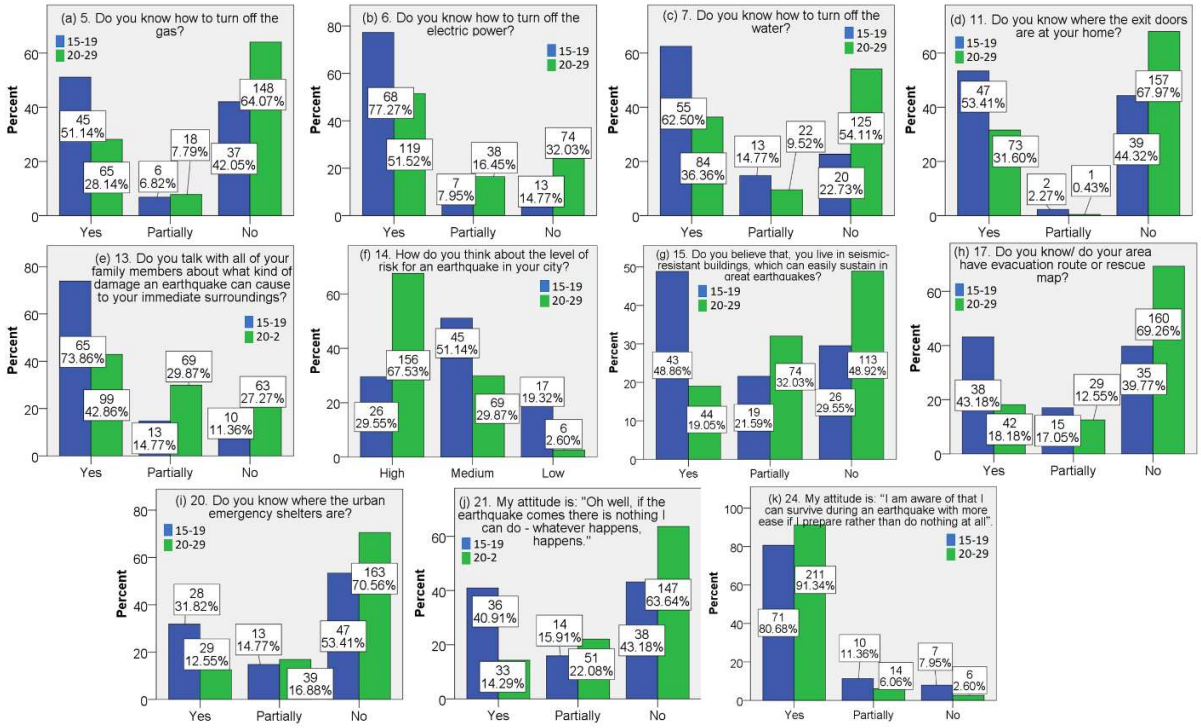


Figure 2-6. Data analysis of age difference about risk perception and preparedness of earthquake.

years age and 14.29% of the 20-29 years age category think that preparing for a major earthquake is the most important things that they can do for the safety for their family and friends. The attitude of 91.34% of the 20-29 years age category and 80.86% of the 15-19 years age category is; “I am aware of that I can survive during an earthquake with more ease if I prepare rather than do nothing at all” (Figure 2-6 (k)). All age categories like to be prepared for the major earthquake.

Figure 2-6 shows that regarding (a)-(e) and (g)-(j) questions, the mean values in 15-19 years age category are significantly higher than that of 20-29 years age category meaning that the former age category has more knowledge about preparedness of earthquake than the later. About the questions (Figure 2-6: f & k) and (Table 2-1), it shows that the 20-29 years age category has significantly higher risk perception than 15-19 years age category.

3.4 Education

Figure 2-1 (c) indicates that all respondents are literate, 172 (47.9%) and 120 (33.4%) respondents hold a college and graduate degree respectively. Minority percentage (Figure 2-1 (c)) are in other categories. For this reason, this study discourages minor categories. Figure 2-7 shows the levels of education of the participants' knowledge on earthquake and seismic risk perception. Education is one of the key variables that need to be considered when assessing the preparedness of seismic risk. Research has shown that educated people tend to implement proactive measures to seismic risk (Tekeli-Yeşil et al. 2010; Paul and Bhuiyan 2010). For example, a study which is conducted in Turkey (Tekeli-Yeşil et al. 2010) shows that well-educated people are retrofitting their houses as a proactive measure to withstand earthquakes. It suggests that preparedness programs should target less educated people (uneducated, school, college etc.) and people in high risk should increase their knowledge about the earthquake.

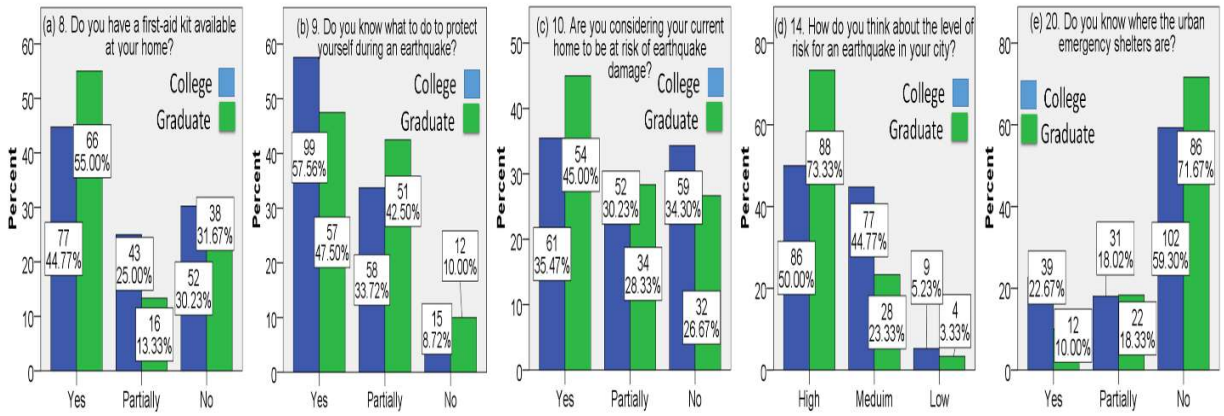


Figure 2-7. Data analysis about risk perception and preparedness of earthquake depending on education.

Figure 2-7 (a) shows that 55% respondents of graduate student and only 44.77% respondents of the college student have first-aid kit available at their home, more educated people have better preparations for the earthquake. About 57.56% of college and 47.5% of graduate students have responded as they know how to protect themselves during earthquake (Figure 2-7 (b)). In Figure 2-7 (c), the result is as follows: 45% of graduate and 35.47% of college students consider the statement as their current home is considering be at risk of earthquake damage. In Figure 2-7 (d), it shows that 73.33% of graduate and 50% of college students respond as "High" to think about the level of risk for an earthquake in their city. Higher educated respondents think that they are living in the vulnerable place. Figure 2-7 (e) shows that 71.67% of graduate and

59.30% of college students respond as “No” to know where the urban emergency shelters are. The higher education level even does not know where is the emergency shelters are. Lack of understanding about the value of nip in the bud (stop something at an early stage) and having never experienced disasters, the general public have not converted the awareness of disaster prevention into actions.

The higher education level can also contribute to increase the perception of seismic risk and consequently the required level of awareness. For example, the results of this investigation conducted on the different level of education show a great influence on earthquake risk perception (Figure 2-7). The study has found that the less educated respondents are more likely to deny the significance of scientific assessment.

3.5 Comparison with other studies

Very few studies have concerned in risk perception of earthquake in Dhaka. This study compares these data with one previous study, Paul and Bhuiyan (2010) study. Compared to Paul and Bhuiyan (2010) which is done 8 years earlier, this study differs regarding the 6 questions mentioned earlier (Figure 2-8) and there is enormous change of risk perception about the earthquake in the last 8 years.

Figure 2-8 (a) shows that 91.36% and 22.97% of the respondents in this study (blue bar, Rahman) and Paul study (green bar) respectively choose “Yes” when the respondents are asked, “Have you ever experienced any earthquake?”. Because during last 4 years (2013-2017), the citizens of Dhaka have experienced almost 30 earthquakes of 3.9 to 5.6 magnitude (“Earthquake Track” 2017). In Figure 2-8 (b-d), it indicates that as response to the questions “Do you know how to turn off the gas, electric power and water?” 36.49%, 60.45% & 43.95% in this study (blue bar) and 85.59%, 95.05 & 81.53% in Paul study (green bar) say “Yes” respectively. Figure 2-8 (e-f) also show that, about the questions “Do you have a first-aid kit available at your home?” and “Do you talk with all of your family members about what kind of damage an earthquake can cause to your immediate surroundings?” 55.49% & 39.55% in this study (blue bar) and 65.09% & 41.89% in Paul study (green bar) respond as “Yes” respectively. These differences of the results between two studies occur due to face to face (one to one) interviews of the respondent which is done in Paul study during data collection, because face to face interviews can affect the respondents’

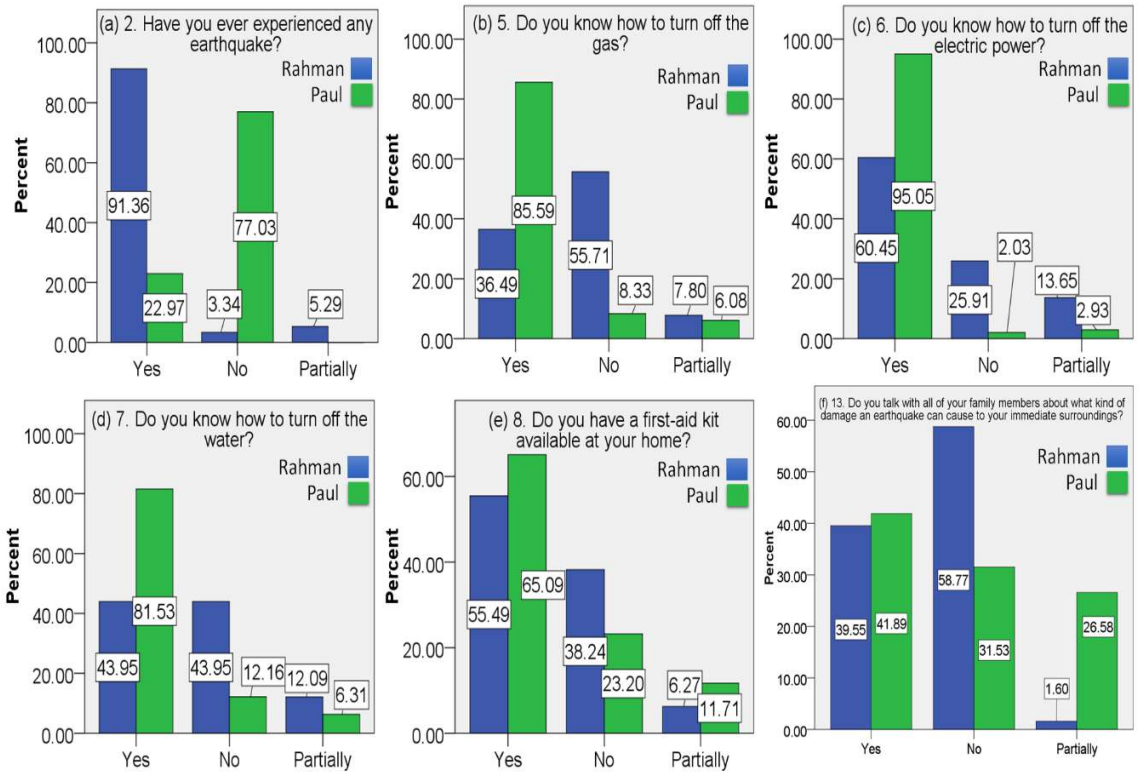


Figure 2-8. Comparison with other studies about the earthquake.

understanding and can bias his/her replies (Crawford 1997). If there is a face to face interview, the interviewer may become too sympathetic to the problem which can influence the results of interview (Crawford 1997).

4. Discussion

This research found that public awareness on seismic risk perception and mitigation is poor and their knowledge on basic theory and emergency response must be improved. This questionnaire survey has the direct impact in the improvement regarding technical, information and training matters of respondents.

This study is interested to know how approach differs depending on gender. In the gender issue (Figure 2-5), this research has found that female respondents have more risk perception and preparation about earthquake than male. This result supports the result of previous study which shows that female have more knowledge about earthquake mitigation actions than male (Fernandez et al., 2018). Male is also an important resource in terms of disaster management and recovery forces, and they are expected to take on an increasingly important role. It should be noted

that both male and female population should be improved or accomplished more regarding the disaster management. The creation of an awareness on seismic risk perception and mitigation is very much linked to the realization of a society that can withstand the challenges of disaster.

In this research, the target population is the residents of Dhaka who are 15 years of age or older. Ten questions (Figure 2-6) are asked to evaluate the participants' knowledge on seismic risk perception during an earthquake. The results show higher knowledge about earthquake preparedness for younger (15-19 years) people. Bangladesh has been working to enhance children's understanding about earthquake preparedness with the introduction of 10 new supplementary books for teaching the subject, which has been the part of the education curriculum in primary and secondary schools since 2004. Two questions are asked to assess the attitude of the risk perception of the participants toward the earthquake. In comparison between two age categories, the result shows that 20-29 years age category has higher risk perception than 15-19 years age category. But till now the seismic risk perception and preparedness about the earthquake is not sufficient for all age.

The findings of the research show that less educated people are at higher risk of unpreparedness than educated people. The analysis also indicates that less knowledge can cause less preparedness. The factor such as education has some impact on the attitude of people. Low education level can influence the attitude of being less prepared about earthquake. So, it is very important to enhance the knowledge, awareness and education of people in order to mitigate the damage from the future earthquake. More steps should be taken to improve the preparedness for the earthquake; for example need to add more lessons to the textbook in schools and colleges, government and NGOs need to organize activity for the youngsters with earthquake hazard education, discuss such issues with their parents and thus effectively encourage adult participation and preparedness in case of an earthquake. The information and education campaign toward earthquake hazards for the public should be carried out and these activities for the residents of Dhaka will help in the relief of earthquake hazards. There is still much to be done by national authorities, NGOs, supported by a governmental action, on various levels: technical courses for disaster prevention and emergency; education at schools, developing mechanisms and protocols towards natural disasters; education and publicity campaigns at city level for the general public concerning disaster reduction and knowledge of risks, awareness of disaster prevention and behavior in emergency scenarios.

In this research, comparison of this study with the Paul and Bhuiyan (2010) study is also tried. About the preparedness level of the earthquake, the analysis shows that there is some discrepancy between these two studies. The reason may be the difference of method of data collection among this study and Paul and Bhuiyan (2010) study which are done by surveys and interviews respectively.

The result of this research gives an impression to the government that the general people's risk perception, awareness and preparedness level of emergency management of the earthquake are very low and the government should take necessary steps for the improvement.

5. Conclusion

Dhaka is extremely vulnerable to earthquake. The paper has presented some results on seismic risk perception and awareness of residents of Dhaka. The respondents have insufficient knowledge about the right actions to take during an earthquake. According to the survey results, it has found that public awareness on seismic risk and mitigation is poor and their knowledge on the basic concept and emergency response must be improved.

In countries where gender discrimination is tolerated, women and girls are particularly vulnerable to natural hazards. In a study by Oxfam regarding the status of gender inequality and disaster preparedness in Bangladesh; findings show that the vulnerabilities and loss of life during disaster in Bangladesh are more common among women, the reasons are due to women's status in the society and racial discrimination against them (Oxfam 2011). But this study has found that the educated woman (female) respondents have more risk perception than man (male). However, people of Bangladesh have gained some experiences and techniques to reduce risk whereas living with hazards. Now a days every level of (educated/uneducated) women participate at family level risk reduction activities. Moreover this result is only limited for the Dhaka.

Many studies have revealed that older people seems to be less prepared and more vulnerable in the case of natural disaster, however some studies have illustrated that older people are more likely to avoid the negative psychological aspect of natural disaster (Norris and Murrell 1988). In this study, the result shows that between two age categories, older people has lower risk perception.

This study also finds that there is a positive correlations between disaster preparedness and education. Thus, educated people will have tendency for higher disaster preparedness. Importance

of relation between education level and earthquake preparedness have been emphasized by many studies; however, there are more, need to be explored regarding the impact of these two on each other.

According to public risk perception and attitude, effective risk communication can deepen our knowledge of risk and danger, enhance safety consciousness and help people to establish rational behavioral patterns of risk perception. Individual risk perception reflects different characteristics due to the effects of gender, age, education and other factors. More investigations and studies should be carried out to further identify the risk factors to provide useful suggestions for effective risk communication.

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Chapter 3

Students' risk perception and awareness

1. Introduction

Bangladesh is one of the countries which are the most disaster prone (Ali and Choudhury 1992; Paul and Bhuiyan 2010). Its capital, Dhaka, is one among the most at-risk cities for earthquake in the world with its high population density and rapid urbanization (Asif, Alam, and Ahsan 2018). The earthquake disaster risk index has placed Dhaka among the 20 most vulnerable cities in the world (Davidson et al. 2000). This has created a growing interest in the issue of disaster risk reduction among the entire population of Dhaka city(Ansary 2005; Alam, Khan, and Paul 2009). Preparedness is not just the obligation of a country's government or NGOs, yet in addition of each individual from the network (Shimazu et al. 2018; Ampaw-asiedu and Norton 2018; Yilmaz and Çaglayan 2017), including the vulnerable population of children (J. Santos-Reyes, Gouzeva, and Santos-Reyes 2014). Also, as a matter of fact, each time a calamity is happened, masses of school children are harmed and a lot of them never come back again. For example, the mass casualties of Armenia Spitak Earthquake in 1988 killed more than 17,000 students while being in schools (Chen 2003; Companion and Chaiken 2018). In 2001, during Bhuj earthquake in India, 31 teachers and 971 students died (Chen 2003). During the 2005 Kashmir Earthquake, 17,000 students died and 50,000 were injured (Tankut and Odası 2009). In 2006, an elementary school in the Philippines was covered in an avalanche and 245 children and educators were executed (Merchant 2015). Also, in 2008, more than 10,000 children were killed in the Sichuwan Earthquake of China (Acharya et al. 2014; Tuladhar et al. 2014).

In Bangladesh, the main objective of the national curriculum as well as the textbook entitled as "Bangladesh and global studies" for 9th and 10th grade is to build up the citizens with the knowledge of history, tradition, and the cultural values of the country and enrich them with a comprehensive lessons of the global events. In this textbook, Chapter 5; The Configuration of Land and the Climate of Bangladesh, Section 5.2: The Climate and Natural Disaster of Bangladesh explains the influence of climate over the people's lives and their livelihood in Bangladesh; elucidates the surmise of earthquake and its reasons; narrates situations of some countries termed as earthquake-prone regions; describes why Bangladesh is called as an earthquake prone region

and explains preparedness and necessary steps of the country in confronting the risk of earthquake. The target of the lesson is that the learners will be brought up developing a desired competence to face the problem of the society through the practice of the subject of the curriculum (Patwari et al. 2012).

The children's conceptions about earthquake vary according to the different cultures of different countries. To the best of my knowledge, there are a very few studies about the conception of children on earthquake in Bangladesh. During an incredible earthquake happened in Nepal on 25th April 2015 where the range of tremor was from 6.6 to 7.9 on the Richter scale, the residents of other South East Asian Nations including India, Bangladesh and China also felt this one and consequent earth tremors. Bangladesh was shocked twice during these tremors. At one secondary school, students become frightened when their school building began to shake. At a primary school of Mymensingh, everyone attempted to leave the building during the earthquake and at least 12 school students were accounted for to be injured (Biswas et al. 2016).Therefore, providing children with disaster education along with implementation practice is the first step towards creating a culture of preparedness and fostering responsible citizens within the community.

The gendered dimensions of disaster have contribution to people's risk perception and preparedness levels about earthquake. There are some studies that have examined the differences of attitudes and perceptions about earthquake depending on gender and education (grades)(J. Santos-Reyes, Gouzeva, and Santos-Reyes 2014).

Among a lot of studies about the high school students' risk perception worldwide, a very few studies deal about Bangladesh (Cvetković et al. 2015). The Cvetković et al. 2015 study investigates the perception and actual knowledge of secondary school students in the Belgrade region, Serbia regarding earthquake as a cataclysmic event and security danger and recognizes the components that have impact their knowledge and perceptions. The Cvetković et al. 2015 utilizes a method of surveying to recognize and describe the elements that impact secondary school students' knowledge and perceptions about earthquake.

Moreover, several studies have shown that psychological aspects of awareness of seismic hazard fluctuate depending upon the demographic factors of the population, e.g., gender, education level and so on (J. Santos-Reyes, Gouzeva, and Santos-Reyes 2014; J. R. Santos-Reyes and Gouzeva 2017). This quantitative research is done to examine the risk perception, actual knowledge and preparedness levels adapted by high school students in the Savar, Dhaka region

with respect to earthquake as a natural disaster and to identify the factors that influence their knowledge and perceptions. To reach to the authentic decisions, the researcher applies a technique of surveying the high school students to inspect the impact of demographic characteristics, such as gender, education and age(Cvetković et al. 2015; J. Santos-Reyes, Gouzeva, and Santos-Reyes 2014) on their awareness and acquaintance about earthquakes.

2. Methodology

This research is intended to explore the knowledge of high school students on seismic risk perception and their preparedness level in Savar, Dhaka. The questionnaire survey is carried out within the seven classrooms of a high school. The schools are the places where we can learn from the ground up and in the right way about what earthquake is, how it occurs, how earthquakes affect the environment, what kind of needs to be done to protect against an earthquake (US Department of Education 2010). Moreover, this is an impact study intended to examine the disaster knowledge depending on several aspects including risk perceptions, experiences about earthquake, preparedness, disaster-related knowledge (knowledge of turn off the gas, electricity & water, availability of first-aid kit, protection of themselves, risk of their home & city, and where to hide during earthquake, *etc.*), knowledge on available safety system (evacuation route or rescue map, *etc.*), behaviors of students and disaster preparedness of the families and communities. Independent sample t-tests, chi-square statistical analysis, frequency analysis and correlation matrix are performed to examine the effects of gender, grade and age on the dependent variables. In the questionnaire the answers of all questions are labeled as “Yes”, “Partially” and “No”. For the statistical analysis author divides the answers in two groups; first group includes only “Yes” whereas second group combines “Partially” and “No”.

2.1 Study area

In Bangladesh, primarily there are three categories of education system: primary, secondary and higher secondary education. The primary, secondary (high school) and higher secondary level is from grade 1 to 5, from grade 6 to 10 and from grade 11 to 12 respectively. In overall secondary education program, there are mainly three streams such as humanities, science and business, beginning from 9^{th} grade. The third public examination, named as Secondary School

Certificate (SSC) examination which is held at the end of the 10th grade, must be passed by all students looking for moving to the two-year higher secondary level.

Dhaka is vulnerable to earthquakes. The frequency of earthquake events is increasing and information from historical earthquake events suggests that Dhaka may be affected by a strong earthquake in the near future (Ansary 2005; Alam, Khan, and Paul 2009; Hussain, Islam, and Ahmad 2010; Islam, Jameel, and Jumaat 2011). For these reasons, Dhaka is chosen as an area to conduct the survey. A school near National Martyr's Monument, Nabinagar, Dhaka is chosen because it is accessible to get permission for doing the survey and this area is a rapidly growing industrial area (Figure 3-1).

2.2 Data collection

After selecting seven classrooms from selected school in Savar, questionnaires are distributed to the students and the survey is completed (Figure 3-1). The author visits each class room to provide all the necessary explanations for the questionnaire. The author visits seven class

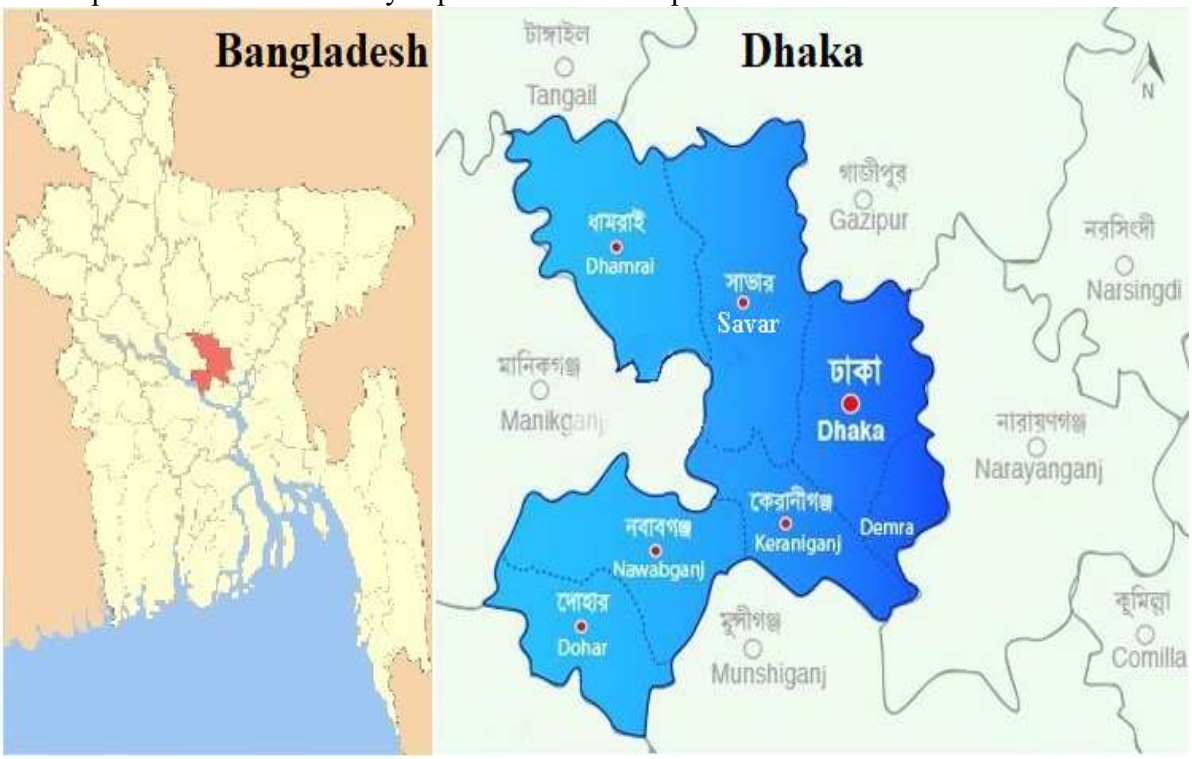

Figure 3-1 Study area map of Savar, Dhaka.

rooms, three of them are girl sections and four are boy sections. Out of seven class rooms six are in 10th grade and one boy class is in 9th grade. Only the students who attended classes on the day of survey are included in this study and the sample size of the population is 307. The response rate

is approximately 100%. The questionnaire survey is permitted from the governing body of the school.

2.3 Questionnaire

This survey is conducted in March of 2018 ((Appendix 4-6)). The questionnaire is as same as the previous survey which is conducted in the April-May 2017. The questionnaire consists of three sections; the first section is the collected information about respondents' demographic characteristics, the second section gathers risk perception of earthquake as well as other hazards and the last section is about behavior analysis. In the questionnaire, there are 23 questions with the answers labeled as "yes" and "no" (Table 3-1). "Yes" is coded as one and "no" is coded as zero. Only Q16 has multiple-choice answers. The questionnaire is delivered to each class room and the researcher explains each question. Then the students provide answer of the questions naturally by themselves. If any student is unable to understand any question, the researcher explains it again to all students of that class.

3. Results

Among participated 307 students, 159 (51.79%) students are male (boys) and 148 (48.21%) students are female (girls). The age range of students is from 15 to 17 years, mean ± standard deviation [SD]: 15.37 ± 0.58 years. Out of 307 students, 209, 82 and 16 students are 15, 16 and 17 years old, respectively. 263 students are in 10^{th} grade and 44 students are in 9^{th} grade (Figure 3-2).

Analysis of the data is done with quantitative examination of the contents. The obtained results are limited to only the students' responses who participated in the survey. The analysis of the data collected from the survey is based on the application of the method of descriptive statistics, namely the determination of frequency, and calculation of percentages (Figures 3-3 & 3-4).

In Figure 3-3, Q1 and Q2 show that 80.1% and 88.6% students have known about and experienced earthquake, respectively. Majority percentage of the students has experienced earthquake. Regarding Q3 which is about knowledge on preparedness for the earthquake; 68.4% students respond as 'Yes' but about Q4 only 25.7% students are prepared for the earthquake whereas most of the students remain unprepared. Q5, Q6 and Q7 show that 44.3%, 83.7% and 62.2% students know how to turn off the gas, electric power and water supply, respectively. Q8

Table 3-1: Questionnaire survey on the knowledge of high school students about earthquake as well as other hazards

Q1. Do you know what earthquake is?
Q2. Have you ever experienced any earthquake?
Q3. Do you know how to be prepared for the earthquake?
Q4. Are you prepared for a major earthquake?
Q5. Do you know how to turn off the gas?
Q6. Do you know how to turn off the electric power?
Q7. Do you know how to turn off the water?
Q8. Do you have a first-aid kit available at your home?
Q9. Do you know what to do to protect yourself during an earthquake?
Q10. Are you considering your current home to be at risk of earthquake damage?
Q11. Do you know where the exit doors are at your home?
Q12. Do you talk with all of your family members about what kind of damage an earthquake can cause to your immediate surroundings?
Q13. Do you think the level of risk for an earthquake is high in your city?
Q14. Do you believe that, you live in seismic-resistant buildings, which can easily sustain in great earthquakes?
Q15. Do you think that you would be prepared if you participate in earthquake training sessions or workshops?
Q16. Where do you think you will hide at home when an earthquake occurs (tick one only)? I. Under a table or chair or bed close to the window (near the pillar) II. In a corner in the narrow space (storage, kitchen or toilet) III. Behind the door on the balcony IV. Over the bed V. Run to outside, run to the elevator VI. Jump from the building
About other hazards (cyclones, landslide, floods etc.)
Q17. Do you know/ do your area have evacuation route or rescue map?
Q18. Do the government or NGO conduct evacuation plans practicing program?
Q19. Do you ever join in any evacuation plans practicing program?
Q20. Do you know where the urban emergency shelters are?
About behavior analysis
Q21. My attitude is: "Oh well, if the earthquake comes there is nothing I can do - whatever happens, happens."
Q22. My attitude is: "I want peace of mind and want to do the best I can. So, I am willing to prepare in advance."
Q23. My attitude is: “I know that preparing for a major earthquake is the single most important thing I can do for the safety of my family and friends”
Q24. My attitude is: “I am aware of that I can survive during an earthquake with more ease if I prepare rather than do nothing at all”.

shows that 42.7% students don't have the first-aid-kit available at their home. About Q9, only 63.5% students know how to protect themselves during an earthquake whereas Q10 shows that majority (83.4%) of the students think that their current homes are at risk of the earthquake. As for Q11, most of the students (69.7%) don't know where the emergency exit door is or they don't have any emergency exit door. Regarding Q12, almost 70% students have never discussed with their family about kinds of damage after an earthquake to their immediate surroundings. About Q13, only 49.2% students think that the level of risk for an earthquake in Savar is high but the percentage of the students may be larger if take the Dhaka city into account. In response to Q14, 31.6%

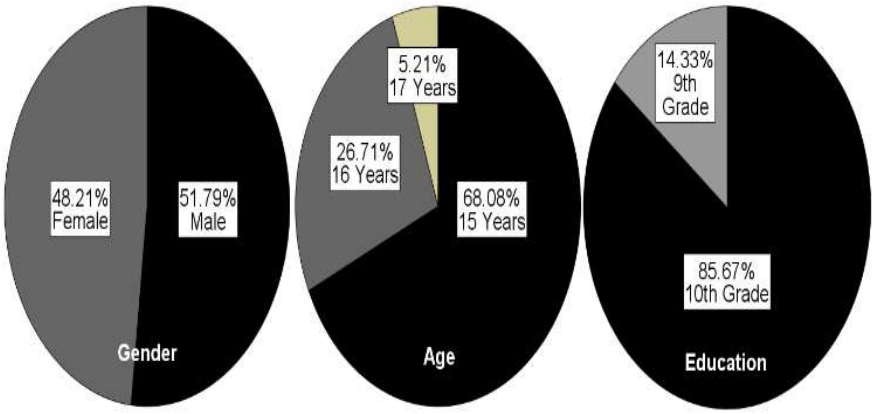

Figure 3-2 Analysis of category of high school students

students say 'yes' and they think that they live in seismic-resistant buildings but their positive response may be due to lack of knowledge about seismic-resistant. Q15 shows, 89.3% students would like to be prepared for earthquake if they have chance for training sessions or workshops.

As shown in Figure 3-3, regarding Q16 most of the students (97.4%) choose the right answer. From Q17 to Q20 are the questions about the other hazards (cyclones, landslide, floods etc.) (Figure 3-4). Q17 shows that 80.1% students remark that they don't know or they have no evacuation route or rescue map in their area. About Q18, only 38.1% students agree that the government or NGO conduct evacuation plans practicing program. Regarding Q19, 87.9% students have never joined in any evacuation plan practicing program. Q20 shows that 93.8% students don't know where the urban emergency shelters are. In Figure 3-4, from Q21 to Q24 are the questions about the behavior analysis of the students. Q21 shows that very few (6.2%) students' attitude is "Oh well, if the earthquake comes there is nothing I can do – whatever happens,

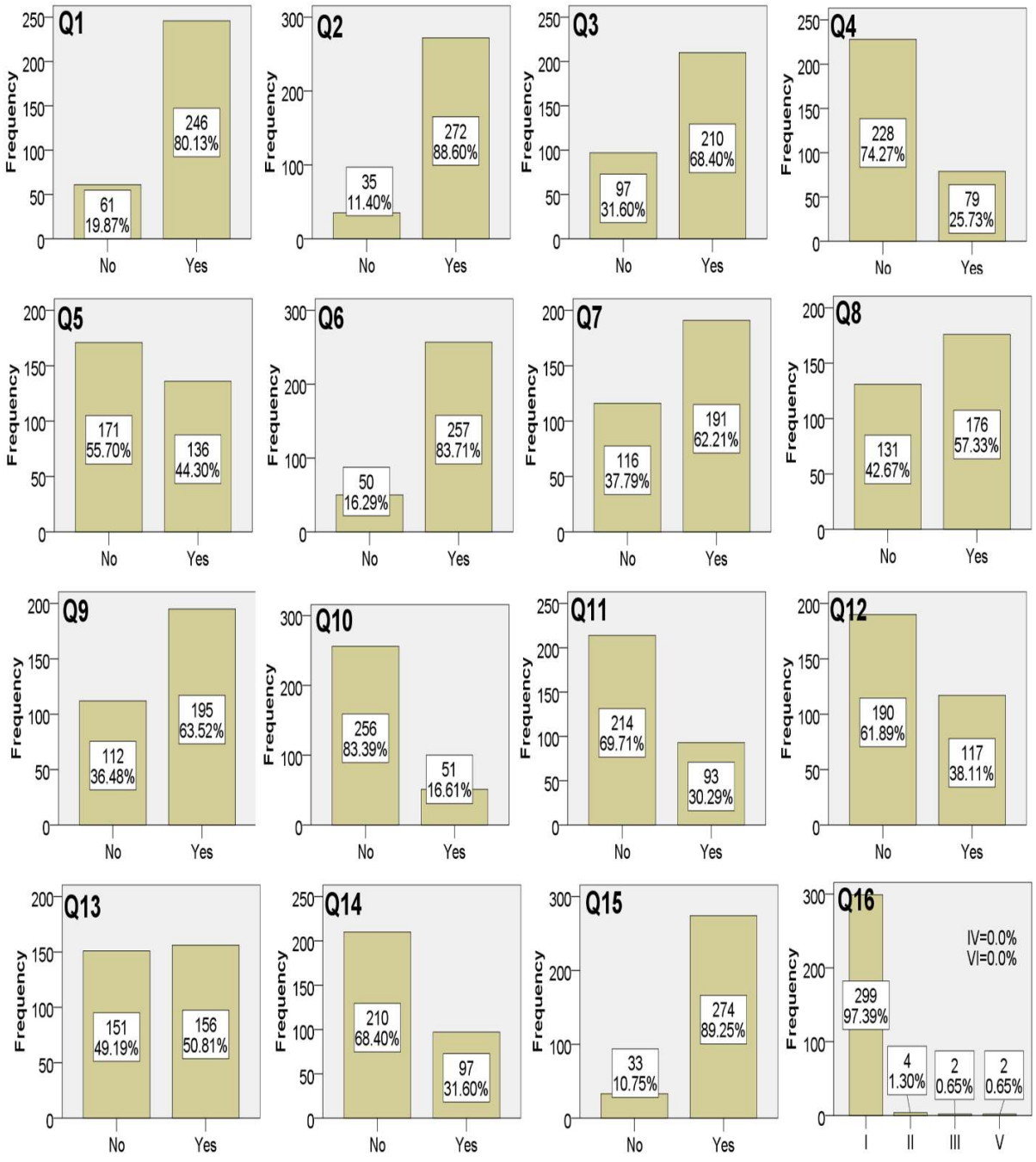

Figure 3-3. Responses of the questionnaire survey of the high school students (general public questions (primary data))

happens." About Q22, 92.8 % students' attitude is to be prepared in advance for earthquake. Q23 shows that most of the students (97.4%) know that preparing for a major earthquake is the single

most important thing which they can do for the safety of their family and friends. Regarding Q24, 97.7 % students are aware of that they can survive during an earthquake with more ease if they are prepared rather than do nothing at all. Q21 to Q24 show students' positive attitude and willingness to be prepared in advance for the earthquake.

3.1 Gender

For earthquake preparedness, it is important to learn how students from the high school take steps toward mitigation, preparedness and recovery of the earthquake. It is, therefore, important to understand their gender (male and female) dimensions about risk perception and emergency management.

Table 3-2 shows that about Q3, Q6, Q7, Q8, Q9, Q11, Q12, Q13, Q17, Q19 and Q20, the *F* values for Levene's test are with a significant (*p*) value of .000 ($p < .001$). Regarding Q3, Q8, Q9, Q11, Q12 and Q13 there are significant differences between males and females about the

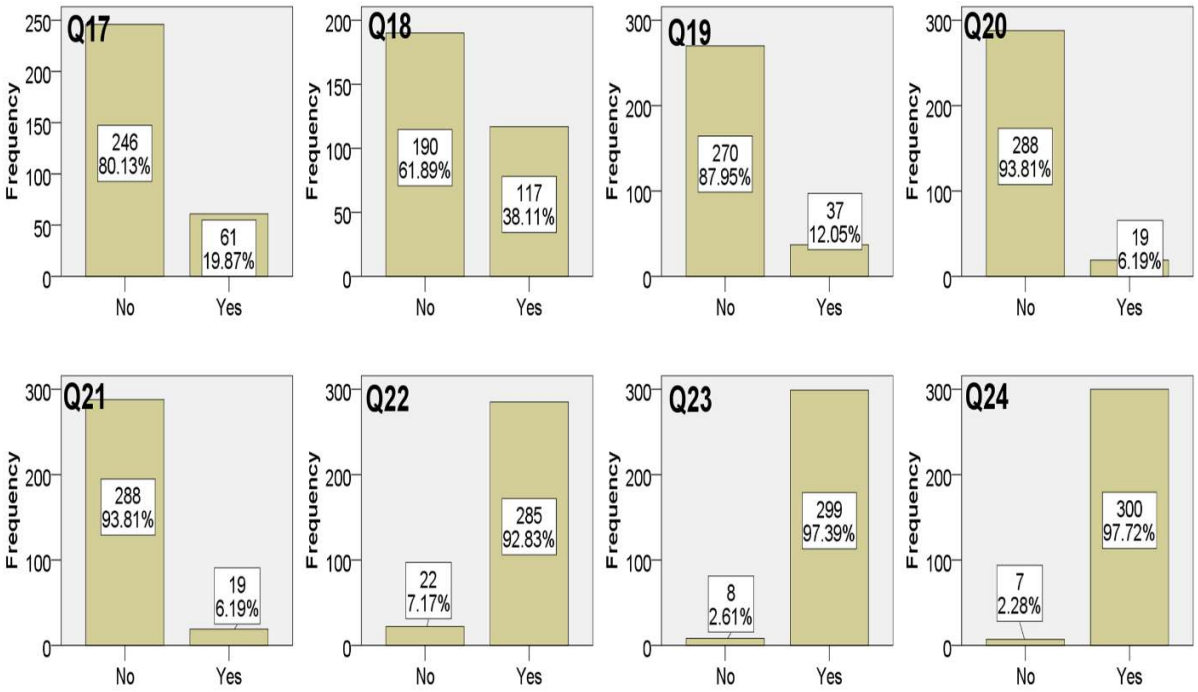

Figure 3-4. Responses of the questionnaire survey of the high school student about other hazards and behavior analysis.

knowledge to be prepared for the earthquake ($t_{294.24}$= -5.36), to have a first-aid kit available at their home ($t_{304.8}$= -2.6), what to do to protect themselves during an earthquake ($t_{303.9}$= -3.89), acquaintance about where the exit doors are at their home ($t_{259.08}$= -6.89), discussion with all of

Table 3-2: Impact of gender on risk perception of earthquake

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Q3	Equal variances assumed	103.440	0.000	-5.310	305.000	0.000	-0.270	0.050
	Equal variances not assumed			-5.360	294.240	0.000	-0.270	0.050
Q6	Equal variances assumed	32.780	0.000	2.780	305.000	0.010	0.120	0.040
	Equal variances not assumed			2.750	270.280	0.010	0.120	0.040
Q7	Equal variances assumed	55.810	0.000	5.700	305.000	0.000	0.300	0.050
	Equal variances not assumed			5.670	288.960	0.000	0.300	0.050
Q8	Equal variances assumed	15.290	0.000	-2.600	305.000	0.010	-0.150	0.060
	Equal variances not assumed			-2.600	304.800	0.010	-0.150	0.060
Q9	Equal variances assumed	45.720	0.000	-3.870	305.000	0.000	-0.210	0.050
	Equal variances not assumed			-3.890	303.900	0.000	-0.210	0.050
Q11	Equal variances assumed	159.310	0.000	-6.980	305.000	0.000	-0.340	0.050
	Equal variances not assumed			-6.890	259.080	0.000	-0.340	0.050
Q12	Equal variances assumed	27.940	0.000	-3.240	305.000	0.000	-0.180	0.050
	Equal variances not assumed			-3.230	297.240	0.000	-0.180	0.050
Q13	Equal variances assumed	0.710	0.400	-3.680	305.000	0.000	-0.210	0.060
	Equal variances not assumed			-3.680	303.830	0.000	-0.210	0.060
Q17	Equal variances assumed	31.750	0.000	2.720	305.000	0.010	0.120	0.050
	Equal variances not assumed			2.740	296.290	0.010	0.120	0.040
Q19	Equal variances assumed	57.610	0.000	3.510	305.000	0.000	0.130	0.040
	Equal variances not assumed			3.570	258.220	0.000	0.130	0.040
Q20	Equal variances assumed	26.330	0.000	2.460	305.000	0.010	0.070	0.030
	Equal variances not assumed			2.510	250.380	0.010	0.070	0.030

their family members about what kind of damage an earthquake can cause to their immediate surroundings ($t_{297.24}$= -3.23) and their thinking concerning the high level of risk for an earthquake in their city ($t_{303.83}$= -3.68); $p < .001$. The mean values indicate that about earthquake, the preparation, participation and communication with family are more frequent for females (M =0

.8243, M =0 .6486, M =0 .7432, M =0 .4797, M =0 .4730 and M = 0.6149) than the males (M =0.5535, M =0 .5031, M =0 .5346, M =0 .1384, M =0 .2956 and M =0 .4088).

As for Q6, Q7, Q17, Q19 and Q20 there are significant differences between males and females about the knowledge on how to turn off the main switch of electric power ($t_{27.28}$= 2.75) and water supply ($t_{288.96}$= 5.67), have evacuation route or rescue map in their area ($t_{296.29}$=2.74), ever join in any evacuation plan practicing program ($t_{258.22}$=3.57) and information about where the urban emergency shelters are ($t_{250.38}$= 2.51); $p < .001$. The mean values indicate that awareness on and recovery from the earthquake as well as other hazards for females (M =0 .7770, M =0 .4662, M =0 .1351, M =0 .0541 and M =0 .0270) are lower than the males (M =0.8931, M =0 .7673, M =0 .2579, M =0 .1824 and M =0 .0943). Remaining questions show no significant differences.

3.2 Grade

A chi-square analysis is used to investigate whether there is any difference between 9th and 10th grade. Therefore, the researcher has discussed the results that indicate the current state and the impact of different grades on the knowledge and perceptions of high school students. 9th and 10th grade students are from one and six class rooms respectively. Moreover, the number of students in the 9th grade are quite low compared to 10th grade and the grade difference is only one grade (one year), so these are the limitations of this study.

Table. 3-3 Impact of grade on risk perception of earthquake

	df	N	value	10th grade	9th grade
Q4	1	307	6.190	23.1%	40.9%
Q6	1	307	9.992	81%	100%
Q7	1	307	4.954	59.7%	77.3%
Q15	1	307	5.043	90.9%	79.5%
Q17	1	307	11.361	83.3%	61.4%
Q19	1	307	8.124	90.1%	75.0%
Q20	1	307	4.907	95.1%	86.4%
Q21	1	307	4.907	95.1%	86.4%

As for Q4, Q6 and Q7, there is a significant relationship between two grades about the preparation for earthquake; χ 2 (1, N =307) = 6.190, knowledge on how to turn off the electric

power; $\chi 2$ (1, N =307) = 9.992 and how to turn off the water supply; χ 2 (1, N =307) = 4.954, p =.05. Compared to 10th grade, the 9th grade students are more likely to be prepared for the earthquake (23.1% & 40.9%), acknowledged about how to turn off the electric power (81% & 100%) and educated about how to turn off the water supply (59.7% & 77.3%) (Table 3-3).

About Q15, Q17, Q19, Q20 and Q21 there are significant differences between the grades; χ 2 (1, N =307) = 5.043, χ 2 (1, N =307) = 11.361, χ 2 (1, N =307) = 8.124, χ 2 (1, N =307) = 4.907 and χ 2 (1, N =307) = 4.907, $p < .05$ respectively. Table 3-3 shows that, 10th grade students, in comparison to 9th grade, are more likely to be prepared if they have chance to participate in earthquake training sessions or workshops, are less informed about evacuation route or rescue map, never join in any evacuation plan practicing program, are less informed about urban emergency shelters and want to do something whenever there is earthquake (90.9% & 79.5%), (83.3% & 61.4%), (90.1% & 75.0%), (95.1% & 86.4%) and (95.1% & 86.4%) respectively.

3.3 Age

In Table 3-4, correlation matrix is computed among age and 24 questions. This correlation analysis is done to determine whether there is any influence of age on the seismic risk perception of students. There is a statistically significant negative correlation between age and Q3, Q4, Q9, Q11, Q18 and Q21 which indicates that as compared to the older (16 and 17 years) students, younger (15 years) students have less knowledge about how to be prepared for the earthquake, less preparedness for a major earthquake, less awareness regarding how to protect themselves during an earthquake, less information about the exit doors at their home, less information about the conduct of evacuation plans practicing program by the government or NGO and students' negative attitude towards being prepared for an earthquake, respectively. In general, the results suggest that seismic risk perception of the students' increases gradually with increment of their age.

4. Discussion

This quantitative research has found that the risk perception, awareness and knowledge of high school students in the Dhaka region about earthquakes as well as other disasters are different on the basis of gender, grade and age.

Table 3-4 Correlation matrix of age among the variables

	Age		Age		Age		Age
Q1	-0.030	**Q7**	0.010	**Q13**	-0.060	**Q19**	-0.030
Q2	-0.050	**Q8**	-0.060	**Q14**	0.060	**Q20**	-0.050
Q3	-.18**	**Q9**	-.19**	**Q15**	-0.050	**Q21**	-.16**
Q4	-.12*	**Q10**	0.080	**Q16**	0.020	**Q22**	-0.040
Q5	-0.080	**Q11**	-.17**	**Q17**	-0.050	**Q23**	-0.040
Q6	-0.040	**Q12**	-0.110	**Q18**	-.13*	**Q24**	-0.020

Note. N=307. * $p < .05$; ** $p < .01$

A prominent number of students imagine that disaster knowledge is essential, yet just a few of students are found to have considered no importance of disaster knowledge. The investigation shows that the gender (male and female) differences have some influences on their knowledge about the seismic risk perception and awareness. Male students have more seismic risk perception and recovery about the earthquake and other hazards. At the same time female students are ready for the preparation, participation and communication about the earthquake. Other researches said that, sources of disaster information to male and female students are clearly distinct from one another. Mostly, students learn about disasters awareness from the radio, newspaper or the television advertisements. A higher number of female students appear to have been utilizing television, social media and community information as the major source of disaster information, though the male students depend more on surfing internet and sports channel (Tuladhar et al. 2014). After school female students pass most of their time at home with their mother from whom mostly they have gathered knowledge about the disasters. Also in most of the free time they watch television which can be one of the major source of gathering knowledge.

The investigation shows that most (74.3%) of the students are remained unprepared about disaster and their mitigation strategies. Although, 88.6% of the students have encountered a disaster, their assessments towards calamity adjustment and availability practices are somewhat unexpectedly surprising. Students should recognize what makes their school or community unsafe, and how might they make these places safe from catastrophes. This study has found that even though 97.4% students know that preparing for a major earthquake is the single most important thing that they can do for the safety of their family and friends, 87.9% of the students have never

joined in any evacuation plans practicing program. These results suggest that in addition to be educated about natural disasters, students ought to be proficient on what to do before, during, and after earthquake by participating in evacuation plans practicing program.

The study is also concerned to find out the level of risk perception and awareness about the earthquake and other hazards between 9th and 10th grade students of high school in Dhaka. The study shows that 9th grade students are more prepared for the earthquake than the higher grade. For the higher grade (10th grade) students, they have more awareness than that of lower grade students. When the attitude scores of the 9th & 10th grade students of the high school are examined, it can be said that the attitudes of the students are generally positive.

Regarding Q3, Q9 and Q11, there are some influences of gender and age on the knowledge about how to be prepared for an earthquake, how to protect themselves during an earthquake and information about the exit doors at their home, respectively. Moreover, as for Q4, education and age have some influences on being prepared for a major earthquake.

However, there is no proper emergency management procedure in practice. Unlike countries like Japan and USA etc., who have a specific department to work on earthquake preparedness for schools, there is no specific authority in Bangladesh to take forward earthquake preparedness for schools in the national context. While there is a large emphasis placed on education in emergencies focusing on flood prone and cyclone prone areas which are mostly in the rural areas, there is a little knowledge and impetus of any form of preparedness and risk assessment for schools in urban areas. The Government of Bangladesh should place more emphasis on earthquake specific school safety program to be specially implemented in risky areas. Schools should encourage the Government for more inputs and support for the preparedness activities including access to proper training and other facilities. The earthquake drills should be made compulsory in all schools on a monthly basis so that it is ingrained into every student and staff of actions to be taken in case the tremor strikes.

5. Conclusion

In summary, this survey shows that school education is important in enhancing knowledge and perception of earthquake. At the same time self-education and community education are essential for actions in preparedness, high contributing for perception and developing of earthquake awareness. Knowledge of the next generation is the key factor for future disaster

preparedness and responses. Hazard knowledge is particularly important for vulnerable populations such as students. Though earthquakes affect the whole community, it is the children who are affected the most. Teaching the students about how to be prepared for a major earthquake is the single most important thing that can help to reduce disaster risk and it can be the safety for themselves as well as for their family members and friends. Through the classroom lessons on disaster reduction and awareness, students can reduce some of the physical, emotional and psychological risks. And they can be prepared by themselves for earthquake by participating in evacuation plans practicing program. Bangladesh government can follow the developing countries like Philippines as a model to gather knowledge about earthquake preparedness and communication (Clarissa Camaya 2018).

In this study gender, grade and age comparisons have provided the evidence that risk perception, awareness, and recovery issues about earthquake may be effectively enhanced but limited in preparedness level. Actions should be taken by government, NGOs, teachers, policy-makers and other stakeholders to develop public education in schools focusing on changes in preparedness level. The evacuation plan practicing program should be conducted by stakeholders in all schools, so that it could be adapted as the basic guidelines of earthquake awareness. In the school education, active education should be promoted for earthquake through discussion among students and teachers, watching TV programs and associated facilities. These kinds of activities may help students to understand about the awareness of earthquake and make a good relationship with the society.

Based on the findings of this study, the research confirms that initiatives that have taken for disaster education in Bangladesh are not enough. Bangladesh government and NGOs should play more roles to provide disaster education and information to students. To accomplish this aim, school students can be motivated to gain basic knowledge on disaster reduction, adaptation, awareness, and risk perception techniques. School disaster education implies that the students learn the calamity management effectively, it makes risk perception portion to the student's life, their key advancement the way of life of disaster preparedness, which in the long term encourages the grown-ups to take successful decisions and actions. More examinations and studies should be completed to further recognize the risk factors to give helpful proposals to effective risk communication.

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Chapter 4
Conclusion

1. Summary

According to the chapters 2 and 3 it has found that female respondents including the female students have more risk perception about earthquake than the male. Moreover, less educated people are more vulnerable than educated people during an earthquake.

People in Dhaka, where disaster risk of earthquake is the most due to its high population density and rapid urbanization, are in extreme danger of earthquake. However, the study on assessment of the residents' perception of earthquake risk is very little. As discussed under various sectors and across sectors, it is clear from the study that gender, age and education have impact on the risk perception about earthquake among the people in Dhaka. Earthquake preparedness level of residents of Dhaka is still recognized to be the pending issues and unsolved problem for Bangladesh government. Dhaka may be lead to a major human tragedy if there is an earthquake with 7 or greater magnitude due to the unplanned structures of many buildings and inadequate risk perception and awareness.

The main purpose of the chapter 1 is to present and discuss findings from the literature survey. In this chapter, there is a discussion of the research findings about disaster risk perception, awareness and its inter-related issues. These include peoples' seismic risk perception and the level of knowledge as well as preparedness about earthquake depending on age, gender and education. Furthermore, in Bangladesh compared to flood and cyclone, the level of risk perception and awareness on earthquake is discussed.

Among many studies about risk perception, only a few studies deal with Bangladesh. However, Paul and Bhuiyan (2010) show the earthquake preparedness level of residents of Dhaka but there are some biases during data collection. In the chapter 2, the research aims to examine seismic risk perception and to reveal the level of knowledge on earthquake and preparedness among the residents of Dhaka. A questionnaire has developed, and data collection has done through home and sidewalk surveys. This research investigates to know how attitude, perception and behavior differ depending on gender, age, education and casualty awareness. This research tries to examine and make the comparison about the risk perception and preparedness level between different groups of gender, age and level of education. This research shows that female

respondents have much more risk perception and preparation about earthquake than males; younger people have higher knowledge about earthquake preparedness and less educated people are at higher risk of unpreparedness than educated people. Moreover, this result is only limited to Dhaka. In this chapter, the research concludes by noting that public awareness on seismic risk perception and mitigation is poor and their knowledge on basic theory and emergency response must be improved.

In chapter 3, the purpose of this cross-sectional study is to assess the seismic risk perception and preparedness about earthquake among high school students in Savar, Dhaka. The author uses a method of surveying students to identify and describe the factors that influence their knowledge and perception about earthquake. This questionnaire survey examines gender, grade and age differences in perceived risk and communication behavior in response to the earthquake. Female students' preparation, participation and communication with family are more frequent than those of male students. Female students are found to be more likely to learn about disaster than male ones. Higher grade students have more awareness but less preparedness about earthquake than the younger ones. Students' hazard awareness increases positively with increment of their age. This research concludes that, high school students are vulnerable to earthquake due to the lack of a seismic education program.

Through these questionnaire surveys it is found that female are more likely to be knowledgeable than male but overall evaluation shows that there is lack of seismic risk education regardless of female or male, young or old, educated or uneducated, adult or high school students. Therefore, current risk perception and preparedness about earthquake in Bangladesh are weak and inadequate to deliver disaster risk reduction. In order to provide effective arrangements, governments in Bangladesh must integrate disaster risk reduction initiatives so that underlying risk factors can be addressed.

2. Policy Recommendation

Even advance technology cannot prevent the earthquake but in order to minimize the loss of lives and property it is high time to be much more concerned about the probable impending of earthquake. For the earthquake it is important to understand all the possibilities of risk reduction to classify them. Also, pre-earthquake awareness through a post-earthquake response plan,

containing drill of the concerned workforces in several roles is considered essential for immediate and effective response after an earthquake occurrence.

Dhaka city, considering its high population density and unplanned structures of many buildings, should be in the seismic risk mapping. In this city, there should be standard building codes and more importantly their implementation. The owner of the building should to check their buildings and retrofit it. Government must introduce large gathering or shelter area during or after earthquake and their routes nearby. These shelter areas construction must be earthquake resistant community buildings like schools, hospitals, community centers and madrasas. Every citizen must know how to turn off main switch of gas, water and electricity. Everyone should to prepare a first-aid box and fire extinguishers as well as exercise the plan for disaster prevention and rescue regularly. It is necessary to increase communication, interaction and discussion within the family members, friends and neighbors about the earthquake mitigation, risk perception and preparation. To stimulate public awareness, brochures, posters, games, calendars, announcements (radio and television) and even entertainment program about seismic risk perception should be used. Most of the Bangladeshi people watch television or listen radio about the cricket game. Therefore during any match, the government should have plan to convey some commercial about risk perception and awareness of earthquake, what to do if an earthquake hits, where to get shelter, where to call for help so that male aside of female could gather the knowledge about earthquake risk perception. It is necessary to increase the communication of male with the family as well as with the community regarding disaster activities and teach them about earthquake preparedness and awareness. In the education activities, there is a need to arrange free discussion between male and female about the earthquake preparedness, mitigation and emergency response. Moreover, it is necessary to educate or motivate the uneducated people about earthquake preparedness and awareness. Non-governmental organization should to be more cooperative with the government about the disaster mitigation, preparedness, prevention and post-disaster management. More information or activities about the disaster related topics and rescue drills should be included in the curriculum of every education level. Based on the findings of this study that female respondents have more risk perception and preparation about earthquake than male as well as less educated people are at higher risk of unpreparedness than educated people, the research confirms that initiatives that have taken for disaster education in Bangladesh are not enough. Rather, Bangladesh

government and NGOs should pay more attention to disadvantages or less advantages group namely male and less educated people.

Bangladesh is a one of the developing countries in the world. The recommendations should be followed from some other developing counties such us Philippines, Indonesia, India etc.

The Disaster Risk Reduction and Management Act of 2010 strengthens the Philippines' implementation of actions and measures for direction and mitigation in catastrophes as well as it is a very important step towards achievement of an enhanced response program for disaster risk reduction. Philippines serves as one of the primary border regions for the tectonic plates of over half of the world, thereby affecting millions of people living in these areas. In reality, there is usual difficulty that the countries situated here have to confront with earthquakes and even tsunamis. Republic Act (RA) 10121, known as the Philippine Disaster Risk Reduction and Management Act of 2010", was enacted on 27 May 2010. This law paved the way for the institutionalization of the proactive Disaster Risk Reduction and Management or "DRRM" approach, which is the "systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster." As such, the Philippine Government, through the National Disaster Risk Reduction Management Council (NDRRMC) has formulated several memorandums, guidelines, and protocols that call for a more efficient and effective mitigation of, preparedness for, response to, and recovery from earthquake and tsunami disasters. Bangladesh government can follow some recommendation from Philippines earthquake risk perception and awareness. Currently, the Philippine Government recognizes the following eleven (11) Emergency Response Clusters, and their respective lead agencies (Williams 2010) ibid.:

1. Search, Rescue, and Retrieval Operations Protocol
2. Emergency Telecommunications
3. Health [Health (Public Health and Medical],Water, Sanitation and Hygiene (WASH), Nutrition, Mental Health and Psychosocial Support (MHPSS)]
4. Law and Order Operations Protocol
5. Camp Coordination and Camp Management
6. Internally Displaced Persons Protection
7. Food and Non-Food Items Operations Protocol
8. Logistics Operations Protocol

9. Education Operations Protocol
10. Management of the Dead and the Missing
11. International Humanitarian Assistance

A community at risk needs to understand its risks in order to determine how to mitigate them and how to respond to emergency situations. The technical basis comes from integration of all the geological, structural, and sociological data to plan for a realistic potential disaster (NEES 2004). Most often, public policy is developed in response to public demand. The public is capable of making and influencing controversial (i.e., expensive) policy decisions, but only if people are sufficiently knowledgeable about the underlying issues, alternative solutions and their implications (NEES 2004).

3. Future study

Bangladesh is extremely at risk about the earthquake. The occurrence of earthquakes cannot be prevented. Rather, lessening loss of lives and assets all that could be done by making a prediction and issuing a warning for the earthquake. However, exact prediction is not always possible but preparation for an earthquake will reduce the loss of life and the property. Present research findings for demographic factors provide the evidence of different pictures in two areas of Dhaka division. More research should be done on different groups of people and in all districts of the Dhaka division about risk perception and awareness of earthquake. Also, future research should focus on earthquake shelter, guidelines for building construction, coordination among government and non-governmental organizations, preparation of disaster action plans and rescue map related to earthquake and citizens' behavioral, normative and control beliefs about earthquake preparedness. Following these kind of research outcomes, it could offer Bangladesh the opportunity to catch up in earthquake preparedness and in reducing earthquake risk in Dhaka City.

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List of Publications

1. **Risk perception and awareness of earthquake: the case of Dhaka.**
   地震に関するリスク認知と意識：ダッカの事例研究
   Date published: 22 February, 2019
   International Journal of Disaster Resilience in the Built Environment, Vol. 10, Issue: 1, pp. 65- 82
   https://doi.org/10.1108/IJDRBE-04-2018-0020

2. **High school students' seismic risk perception and preparedness in Savar, Dhaka.**
   ダッカのシャヴアール地区における高校生の地震リスク認識と備え
   Date published: 10 March, 2019
   Educational Research and Reviews, Vol. 14, no. 5 (2019), pp. 168-177
   https://doi.org/10.5897/ERR2018.3674

Appendix 1

Survey of Knowledge about the earthquake in Bangladesh
Residents of Dhaka (English)
Please, Place ✓ mark on your choose

Category type Question
Gender: □ Male □ female

Ordinal Question
Age: □ 15-19 □ 20-29 □ 30-39 □ 40-49 □ 50-59 □ 60-69 □ 70+
Education: □ None □ Primary □ High school □ College □ Graduate □ Master's □ Ph.D.

Living area: ……

General Public *Questions (Primary data) for earthquake*

1. Do you know what earthquake is?
   □ Yes □ No □ Partially
2. Have you ever experienced any earthquake?
   □ Yes □ No □ Partially
3. Do you know how to be prepared for the earthquake?
   □ Yes □ No □ Partially
4. Are you prepared for a major earth-quake?
   □ Yes □ No □ Partially
5. Do you know how to turn off the gas?
   □ Yes □ No □ Partially
6. Do you know how to turn off the electric power?
   □ Yes □ No □ Partially
7. Do you know how to turn off the water?
   □ Yes □ No □ Partially
8. Do you have a first-aid kit available at your home?
   □ Yes □ No □ Partially
9. Do you know what to do to protect yourself during an earthquake?
   □ Yes □ No □ Partially
10. Are you considering your current home to be at risk of earthquake damage?
    □ Yes □ No □ Partially
11. Do you know where the exit doors are at your home?
    □ Yes □ No/Don't have exit door □ Partially
12. Where do you think you will hide at home when an earthquake occurs (tick one only)?
    □ Under a table or chair or bed close to the window (near the pillar)
    □ In a corner in the narrow space (storage, kitchen or toilet)
    □ Behind the door on the balcony
    □ Over the bed

□ Run to outside/ run to the elevator
□ Jump from the building

13. Do you talk with all of your family members about what kind of damage an earthquake can cause to your immediate surroundings?
□ Yes □ No □ Partially
14. How do you think about the level of risk for an earthquake in your city?
□ High □ Medium □ Low
15. Do you believe that, you live in seismic-resistant buildings, which can easily sustain in great earthquakes?
□ Yes □ No □ Partially
16. Do you think that you would be prepared if you participate in earthquake training sessions or workshops?
□ Yes □ No □ Partially

General Public *Questions (Primary data) for other hazards (cyclones, landslide, floods etc.)*

17. Do you know/ do your area have evacuation route or rescue map?
□ Yes □ No □ Partially
18. Do the government or NGO conduct evacuation plans practicing program?
□ Yes □ No □ Partially
19. Do you ever join in any evacuation plans practicing program?
□ Often □ Sometime □ Never
20. Do you know where the urban emergency shelters are?
□ Yes □ No □ Partially

Behavior analysis (Secondary data)

21. My attitude is: "Oh well, if the earthquake comes there is nothing I can do - whatever happens, happens."
□ Yes □ No □ Partially
22. My attitude is: "I want peace of mind and want to do the best I can. So, I am willing to prepare in advance."
□ Yes □ No □ Partially
23. My attitude is: “I know that preparing for a major earthquake is the single most important thing I can do for the safety of my family and friends”
□ Yes □ No □ Partially
24. My attitude is: “I am aware of that I can survive during an earthquake with more ease if I prepare rather than do nothing at all”.
□ Yes □ No □ Partially

Appendix 2

Survey of Knowledge about the earthquake in Bangladesh

Residents of Dhaka (Bangla)

বাংলাদেশে ভূমিকম্প সংক্রান্ত জরিপ

ঢাকার অধিবাসী

দয়া করে আপনার পছন্দ অনুযায়ী ✓ চিহ্ন দিন।

লিঙ্গ: □ পুরুষ □ মহিলা

বয়স: □ ১৫-১৯ □ ২০-২৯ □ ৩০-৩৯ □ ৪০-৪৯ □ ৫০-৫৯ □ ৬০-৬৯ □ ৭০+

শিক্ষাগত যোগ্যতা: □ প্রাইমারি স্কুল □ হাই স্কুল □ কলেজ □ গ্রাজুয়েট □ মাস্টার্স □ পিএইচডি □ কোনটিই নয়

ঢাকায় বসবাসরত এলাকার নাম: .....

ভূমিকম্প বিষয়ক (সাধারণ জ্ঞান) প্রশ্নাবলী:

১. আপনি কি জানেন ভূমিকম্প কি?

□ হ্যাঁ □ না □ আংশিকভাবে

২. আপনার কি কখনও ভূমিকম্পের অভিজ্ঞতা হয়েছে?

□ হ্যাঁ □ না □ আংশিকভাবে

৩. আপনি কি জানেন, ভূমিকম্পের জন্য কিভাবে প্রস্তুতি নিতে হয়?

□ হ্যাঁ □ না □ আংশিকভাবে

৪. আপনি কি বড় ধরনের ভূমিকম্প মোকাবেলার জন্য প্রস্তুত আছেন?

□ হ্যাঁ □ না □ আংশিকভাবে

৫. আপনি কি জানেন, আপনার ভবনের গ্যাসের প্রধান সরবরাহ/সংযোগ কিভাবে বন্ধ করতে হয়?

□ হ্যাঁ □ না □ আংশিকভাবে

৬. আপনি কি জানেন, আপনার ভবনের বিদ্যুতের প্রধান সরবরাহ/সংযোগ কিভাবে বন্ধ করতে হয়?

□ হ্যাঁ □ না □ আংশিকভাবে

৭. আপনি কি জানেন, আপনার ভবনের পানির প্রধান সরবরাহ/সংযোগ কিভাবে বন্ধ করতে হয়?

□ হ্যাঁ □ না □ আংশিকভাবে

৮. আপনার বাসায় কি প্রাথমিক চিকিৎসার সরঞ্জাম (First-Aid Kit) আছে?

□ হ্যাঁ □ না □ আংশিকভাবে

৯. আপনি কি জানেন, ভূমিকম্পের সময় কিভাবে নিজেকে রক্ষা করতে হয়?

□ হ্যাঁ □ না □ আংশিকভাবে

১০. আপনার বর্তমান বাসস্থানকে কি আপনি ভূমিকম্পের জন্যে ঝুঁকিপূর্ণ মনে করেন?

□ হ্যাঁ □ না □ আংশিকভাবে

১১. আপনি কি জানেন, জরুরী অবস্থায় আপনার বাড়ি থেকে বের হওয়ার পথটি (Emergency Exit Doors) কোথায় আছে?

□ হ্যাঁ □ না / এ ধরনের ব্যবস্থা নেই □ আংশিকভাবে

১২. ভূমিকম্পের সময় বাসা বাড়ির কোথায় লুকিয়ে থাকা নিরাপদ বলে আপনি মনে করেন (শুধুমাত্র একটিতে ✓ চিহ্ন দিন)?

□ পিলারের নিকটস্থ জানালার পাশে অবস্থিত কোন টেবিল, চেয়ার অথবা বিছানার নিচে

□ ছোট কোন ঘরের কোণায় (স্টোর রুম, রান্নাঘর বা টয়লেট/বাথরুম)

□ বারান্দার দরজার পিছনে

□ বিছানার উপরে

□ দৌঁড়ে ঘরের বাইরে যাওয়ার চেষ্টা করা / দৌঁড়ে লিফটের দিকে যাওয়ার চেষ্টা করা

□ ভবন থেকে নিচে লাফ দেওয়া

১৩. আপনি কি আপনার পরিবারের সদস্যদের সাথে ভূমিকম্পে কি ধরনের ক্ষয়ক্ষতি হতে পারে সে সম্পর্কে আলোচনা করেন?

□ হ্যাঁ □ না □ আংশিকভাবে

১৪. আপনি আপনার শহরকে ভূমিকম্পের জন্যে কি রকম ঝুঁকিপূর্ণ বলে মনে করেন?

□ উচ্চ □ মাঝারি □ নিম্ন

১৫. আপনি কি বিশ্বাস করেন যে, আপনি যে ভবনে বাস্ করেন তা বড় ধরনের ভূমিকম্প সহনশীল এবং ভূমিকম্প চলাকালীন সময়ে ভেঙ্গে পড়বে না?

□ হ্যাঁ □ না □ আংশিকভাবে

১৬. আপনি কি মনে করেন, ভূমিকম্প বিষয়ক প্রশিক্ষণ অথবা কর্মশালা আপনাকে ভূমিকম্প ও এর ক্ষয়ক্ষতি মোকাবেলা প্রস্তুতিতে সাহায্য করবে?

□ হ্যাঁ □ না □ আংশিকভাবে

অন্যান্য প্রাকৃতিক দুর্যোগ (সাইক্লোন, ভূমিধস, বন্যা ইত্যাদি) বিষয়ক (সাধারণ জ্ঞান) প্রশ্নাবলী:

১৭. আপনি কি জানেন, জরুরী অবস্থায় আপনার এলাকা থেকে নিরাপদ স্থানে যাওয়ার কোন বিশেষ রাস্তা অথবা উদ্ধার কাজের জন্যে কোন বিশেষ দিক নির্দেশনা আছে কিনা?

□ হ্যাঁ □ না □ আংশিকভাবে

১৮. সরকার বা এনজিও গুলো কি প্রাকৃতিক দুর্যোগ বিষয়ক প্রাথমিক সতর্কতামূলক ব্যবস্থা অথবা পরবর্তী উদ্ধার কাজের ব্যাপারে কোন ধরনের প্রশিক্ষণ অথবা মহড়ার ব্যবস্থা করে থাকে?

□ হ্যাঁ □ না □ আংশিকভাবে

১৯. আপনি কি কখনও প্রাকৃতিক দুর্যোগ বিষয়ক প্রাথমিক সতর্কতামূলক ব্যবস্থা অথবা পরবর্তী উদ্ধার কাজের ব্যাপারে কোন ধরনের প্রশিক্ষণ অথবা মহড়ায় অংশগ্রহণ করেছেন?

□ বেশিরভাগ সময় □ মাঝেমাঝে □ কখনো না

২০. আপনি কি জানেন, শহরে জরুরী আশ্রয়কেন্দ্রগুলো কোথায় অবস্থিত?

□ হ্যাঁ □ না □ আংশিকভাবে

মানবিক চারিত্রিক বিশ্লেষণ (আনুষঙ্গিক তথ্য):

২১. আমার দৃষ্টিভঙ্গি হলো, "ভূমিকম্প হলে আমার কিছুই করার নেই, মানুষ হিসেবে আমার ক্ষমতা সীমিত, যা হবার তা এমনিই হবে"।

□ হ্যাঁ □ না □ আংশিকভাবে

২২. আমার দৃষ্টিভঙ্গি হলো, " যেহেতু আমার মানসিক শান্তি আমার জন্য একটি গুরুত্বপূর্ণ বিষয় এবং এর জন্য আমি সব কিছু করতে প্রস্তুত, সেহেতু কোন ধরনের বিপর্যয় আসার পূর্বেই আমি সতর্কতামূলক ব্যবস্থা নিতে চাই।"

□ হ্যাঁ □ না □ আংশিকভাবে

২৩. আমার দৃষ্টিভঙ্গি হলো, " ভূমিকম্পের ক্ষেত্রে আমার পরিবার পরিজনদের জন্যে সবচেয়ে গুরুত্বপূর্ণ বিষয় হল তাদের জন্য প্রাথমিক সতর্কতামূলক সব ধরনের প্রস্তুতি গ্রহণ করা।"

□ হ্যাঁ □ না □ আংশিকভাবে

২৪. আমার দৃষ্টিভঙ্গি হলো, “হাত পা গুটিয়ে বসে না থেকে সতর্কতামূলক ব্যবস্থা গ্রহণের মাধ্যমে ভূমিকম্পের বিপর্যয় থেকে অনেকাংশে রক্ষা পাওয়া সম্ভব"।

□ হ্যাঁ □ না □ আংশিকভাবে

Appendix 3

Photography of first survey

April to May, 2017

Appendix 4

Survey of Knowledge about the earthquake in Bangladesh
Residents of Dhaka (English)
Please, Place ✓ mark on your choose

Category type Question
Gender: □ Male □ female

Ordinal Question
Age: □ 15 □ 16 □ 17 □ 18 □ 19□ 20 □ 21+
Education: □ None □ Primary □ High school □ College.

General Public *Questions (Primary data) for earthquake*

1. Do you know what earthquake is?					
2. Have you ever experienced any earthquake?					
3. Do you know how to be prepared for the earthquake?					
4. Are you prepared for a major earth-quake?					
5. Do you know how to turn off the gas?					
6. Do you know how to turn off the electric power?					
7. Do you know how to turn off the water?					
8. Do you have a first-aid kit available at your home?					
9. Do you know what to do to protect yourself during an earthquake?					
10. Are you considering your current home to be at risk of earthquake damage?					
11. Do you know where the exit doors are at your home?					
12. Do you talk with all of your family members about what kind of damage an earthquake can cause to your immediate surroundings?					
13. How do you think about the level of risk for an earthquake in your city?					
14. Do you believe that, you live in seismic-resistant buildings, which can easily sustain in great earthquakes?					
15. Do you think that you would be prepared if you participate in earthquake training sessions or workshops?					

16. Where do you think you will hide at home when an earthquake occurs (tick one only)?
    - □ Under a table or chair or bed close to the window (near the pillar)
    - □ In a corner in the narrow space (storage, kitchen or toilet)
    - □ Behind the door on the balcony
    - □ Over the bed
    - □ Run to outside/ run to the elevator
    - □ Jump from the building

General Public *Questions (Primary data) for other hazards (cyclones, landslide, floods etc.)*

17. Do you know/ do your area have evacuation route or rescue map?					
18. Do the government or NGO conduct evacuation plans practicing program?					
19. Do you ever join in any evacuation plans practicing program?					
20. Do you know where the urban emergency shelters are?					

Behavior analysis (Secondary data)

21. My attitude is: "Oh well, if the earthquake comes there is nothing I can do - whatever happens, happens."					
22. My attitude is: "I want peace of mind and want to do the best I can. So, I am willing to prepare in advance."					
23. My attitude is: “I know that preparing for a major earthquake is the single most important thing I can do for the safety of my family and friends”					
24. My attitude is: “I am aware of that I can survive during an earthquake with more ease if I prepare rather than do nothing at all”.					

Appendix 5

Survey of Knowledge about the earthquake in Bangladesh
Residents of Dhaka (Bangla)

বাংলাদেশে ভূমিকম্প সংক্রান্ত জরিপ

ঢাকার অধিবাসী

লিঙ্গ: ☐ পুরুষ ☐ মহিলা

বয়স: ☐ ১৫ ☐ ১৬ ☐ ১৭ ☐ ১৮ ☐ ১৯ ☐ ২০ ☐ ২১

শিক্ষাগত যোগ্যতা: ☐ হাই স্কুল ☐ কলেজ

ভূমিকম্প বিষয়ক (সাধারণ জ্ঞান) প্রশ্নাবলী:

দয়া করে আপনার পছন্দ অনুযায়ী ✓ চিহ্ন দিন।	হ্যাঁ	আংশিকভাবে	না
১. আপনি কি জানেন ভূমিকম্প কি?			
২. আপনার কি কখনও ভূমিকম্পের অভিজ্ঞতা হয়েছে?			
৩. আপনি কি জানেন, ভূমিকম্পের জন্য কিভাবে প্রস্তুতি নিতে হয়?			
৪. আপনি কি বড় ধরনের ভূমিকম্প মোকাবেলার জন্য প্রস্তুত আছেন?			
৫. আপনি কি জানেন, আপনার ভবনের গ্যাসের প্রধান সরবরাহ/সংযোগ কিভাবে বন্ধ করতে হয়?			
৬. আপনি কি জানেন, আপনার ভবনের বিদ্যুতের প্রধান সরবরাহ/সংযোগ কিভাবে বন্ধ করতে হয়?			
৭. আপনি কি জানেন, আপনার ভবনের পানির প্রধান সরবরাহ/সংযোগ কিভাবে বন্ধ করতে হয়?			
৮. আপনার বাসায় কি প্রাথমিক চিকিৎসার সরঞ্জাম (First-Aid Kit) আছে?			
৯. আপনি কি জানেন, ভূমিকম্পের সময় কিভাবে নিজেকে রক্ষা করতে হয়?			
১০. আপনার বর্তমান বাসস্থানকে কি আপনি ভূমিকম্পের জন্যে ঝুঁকিপূর্ণ মনে করেন?			
১১. আপনি কি জানেন, জরুরী অবস্থায় আপনার বাড়ি থেকে বের হওয়ার পথটি (Emergency Exit Doors) কোথায় আছে?			
১২. আপনি কি আপনার পরিবারের সদস্যদের সাথে ভূমিকম্পে কি ধরনের ক্ষয়ক্ষতি হতে পারে সে সম্পর্কে আলোচনা করেন?			
১৩. আপনি আপনার শহরকে ভূমিকম্পের জন্যে কি রকম ঝুঁকিপূর্ণ বলে মনে করেন?			
১৪. আপনি কি বিশ্বাস করেন যে, আপনি যে ভবনে বাস করেন তা বড় ধরনের ভূমিকম্প সহনশীল এবং ভূমিকম্পের সময় ভেঙ্গে পড়বে না?			
১৫. আপনি কি মনে করেন, ভূমিকম্প বিষয়ক প্রশিক্ষণ অথবা কর্মশালা আপনাকে ভূমিকম্প ও এর ক্ষয়ক্ষতি মোকাবেলা প্রস্তুতিতে সাহায্য করবে?			

১৬. ভূমিকম্পের সময় বাসা বাড়ির কোথায় লুকিয়ে থাকা নিরাপদ বলে আপনি মনে করেন (শুধুমাত্র একটিতে ✓ চিহ্ন দিন)?

☐ পিলারের নিকটস্থ জানালার পাশে অবস্থিত কোন টেবিল, চেয়ার অথবা বিছানার নিচে

☐ ছোট কোন ঘরের কোণায় (স্টোর রুম, রান্নাঘর বা টয়লেট/বাথরুম)

☐ বারান্দার দরজার পিছনে

☐ বিছানার উপরে

☐ দৌঁড়ে ঘরের বাইরে যাওয়ার চেষ্টা করা / দৌঁড়ে লিফটের দিকে যাওয়ার চেষ্টা করা

☐ ভবন থেকে নিচে লাফ দেওয়া

অন্যান্য প্রাকৃতিক দুর্যোগ (সাইক্লোন, ভূমিধস, বন্যা ইত্যাদি) বিষয়ক (সাধারণ জ্ঞান) প্রশ্নাবলী:

দয়া করে আপনার পছন্দ অনুযায়ী ✓ চিহ্ন দিন।	হ্যাঁ	আংশিকভাবে	না
১৭. আপনি কি জানেন, জরুরী অবস্থায় আপনার এলাকা থেকে নিরাপদ স্থানে যাওয়ার কোন বিশেষ রাস্তা অথবা উদ্ধার কাজের জন্যে কোন বিশেষ দিক নির্দেশনা আছে কিনা?			
১৮. সরকার বা এনজিও গুলো কি প্রাকৃতিক দুর্যোগ বিষয়ক প্রাথমিক সতর্কতামূলক ব্যবস্থা অথবা পরবর্তী উদ্ধার কাজের ব্যাপারে কোন ধরনের প্রশিক্ষণ অথবা মহড়ার ব্যবস্থা করে থাকে?			
১৯. আপনি কি কখনও প্রাকৃতিক দুর্যোগ বিষয়ক প্রাথমিক সতর্কতামূলক ব্যবস্থা অথবা পরবর্তী উদ্ধার কাজের ব্যাপারে কোন ধরনের প্রশিক্ষণ অথবা মহড়ায় অংশগ্রহণ করেছেন?			
২০. আপনি কি জানেন, শহরে জরুরী আশ্রয়কেন্দ্রগুলো কোথায় অবস্থিত?			

মানবিক চারিত্রিক বিশ্লেষণ (আনুষঙ্গিক তথ্য):

দয়া করে আপনার পছন্দ অনুযায়ী ✓ চিহ্ন দিন।	হ্যাঁ	আংশিকভাবে	না
২১. আমার দৃষ্টিভঙ্গি হলো, "ভূমিকম্প হলে আমার কিছুই করার নেই, মানুষ হিসেবে আমার ক্ষমতা সীমিত, যা হবার তা এমনিই হবে"।			
২২. আমার দৃষ্টিভঙ্গি হলো, " যেহেতু আমার মানসিক শান্তি আমার জন্য একটি গুরুত্বপূর্ণ বিষয় এবং এর জন্য আমি সব কিছু করতে প্রস্তুত, সেহেতু কোন ধরনের বিপর্যয় আসার পূর্বেই আমি সতর্কতামূলক ব্যবস্থা নিতে চাই।"			
২৩. আমার দৃষ্টিভঙ্গি হলো, " ভূমিকম্পের ক্ষেত্রে আমার পরিবার পরিজনদের জন্যে সবচেয়ে গুরুত্বপূর্ণ বিষয় হল তাদের জন্য প্রাথমিক সতর্কতামূলক সব ধরনের প্রস্তুতি গ্রহণ করা।"			
২৪. আমার দৃষ্টিভঙ্গি হলো, "হাত পা গুটিয়ে বসে না থেকে সতর্কতামূলক ব্যবস্থা গ্রহণের মাধ্যমে ভূমিকম্পের বিপর্যয় থেকে অনেকাংশে রক্ষা পাওয়া সম্ভব"।			

Appendix 6

Photography of second survey

March, 2018