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Earthquake in Peninsular Malaysia: What Should We Learn from Affected Countries?

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Abstract

Peninsular Malaysia is lucky enough in the sense that it isn't located on the Ring of Fire, the hotspot for earthquakes and volcanic eruptions. Nevertheless, since 2007, Malaysia has experienced about 40 cases of mild tremor (reported at 1.1 to 2.8 on the Richter scale) recorded at Bentong, Manjung, Jerantut, and Negeri Sembilan, respectively. Such events prove that there is an earthquake risk in Peninsular Malaysia, and this scenario leads to a crucial question, if a more significant tremor (caused by an earthquake) happens in Peninsular Malaysia, the local communities are ready and prepared for it? The main attempt of this study is to discover the preparedness of communities across the globe against earthquakes, and since the experience with disaster damage increases preparedness, several recommendations based on these global experiences have been suggested to strengthen local preparation against earthquake catastrophes. Based on the review, it can be concluded that structure, survival, behavioral factors, positive community-institution relationships, and individual differences (e.g., experience, marital status, educational background, etc.) play influential roles in strengthening the community's preparation against the earthquake catastrophe.

Keywords: Earthquake Preparedness, Natural Disasters, Community Preparedness, Peninsular Malaysia

Introduction

One of the most hazardous events on earth is the occurrence of natural disasters, such as earthquakes, which are difficult for humans to prevent. However, by being well-prepared, they may greatly lessen the harm caused by these catastrophes. People's losses are significantly decreased when they are sufficiently prepared for this tragedy (Onuma et al.,

2017). Despite the benefits of planning ahead, many individuals neglect to do so when it comes to preparing for disasters in general and earthquakes in particular (Sattler et al., 2000). People frequently neglect to make structural adjustments to their homes, get insurance, or even store an emergency first aid kit (Kelman, 2020).

Any sudden shaking of the ground caused by seismic waves resonating through the earth's rocks is referred to as an earthquake. Seismic waves are produced when a certain type of energy that has been stored inside the earth's crust is rapidly released, such as when two rock masses that are pushing against one another suddenly split and slide. Earthquakes most typically occur on geologic faults, which are small regions where rock masses move to one another. The bulk of the world's fault lines are found within the massive tectonic plates that make up the Earth's crust.

There were thousands of reported cases of earthquakes and tremors every day; however, the timing and the magnitude of each tremor are still erratic. Since an earthquake is an unpredictable disaster, individual readiness to face this disaster is less encouraging (Oral et al., 2015). Sutton and Tierney (2006) explained that preparedness for natural disasters such as earthquakes, floods, tsunamis, cyclones, volcanic eruptions, droughts, or hurricanes is crucial and critical for households, businesses, and communities, but many still need to be prepared. However, one of the options to mitigate damages and losses from the earthquake impact is adequate preparation before the disaster (Ao et al., 2021).

The higher the preparation of an individual to face the disaster, the lower the number of damages and losses incurred (Oral et al., 2015). According to Ishiwatari et al. (2020), preventing, preparing for, responding to, and recovering from disasters and emergencies has become a priority for everyone. Every community should have a preparedness plan to reduce the disruptive impacts of a natural disaster on communities.

There are four phases of disaster management, according to the Federal Emergency Management Agency (FEMA, 2015), prevention or mitigation, readiness, response, and recovery. The phases of prevention/mitigation and readiness, also known as hazard adjustment phases in the context of social psychology literature, are a part of pre-disaster management. Governments and people can prepare for disasters and the resulting damage in two ways: by purchasing insurance and by gathering and storing emergency supplies, such as supplies of food and water, a radio, energy sources, and medicine (Spittal et al., 2006). Following the National Research Council (2006), preparedness intersects with both two areas, acting as a temporal connector between the pre-impact and post-impact phases of a disaster event. Hazards research focuses on pre-disaster hazard vulnerability analysis and mitigation, while disaster research emphasises post-disaster emergency response and recovery.

UNISDR (2015) defined readiness as the ability of governments, organisations, community groups, and people "to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions". To support citizens, communities, states, local and tribal governments, and professional emergency workers as they prepare for disasters, mitigate the effects of disasters, respond to post-disaster community needs, and begin practical recovery efforts, preparedness is defined by FEMA (2015) as leadership, training, readiness and exercise support, as well as technical and financial assistance. The act of being ready for a situation or occurrence entails gathering the necessary supplies, such as food, water, cooking utensils, portable emergency lights, and documentation. It is crucial to use them to organise all of these materials. The discipline of emergency management considers preparation as actions made before a crisis that allow for efficient response and quicker recovery. Establishing roles and duties for emergency activities as well as securing the funding to support them are all part of preparation (FEMA, 2015).

Governments often see individual preparedness duties as including tasks like learning about pertinent threats, creating an emergency communications plan, and keeping emergency supplies on hand (FEMA, 2015).

Five units comprise the units of preparedness analysis: people, homes, organisations, communities, and societies. Additionally, preparation measures seek to make sure that the tools are available and that individuals who will need to utilise them are knowledgeable on how to do so in the case of a disaster. Developing and planning processes to ensure readiness, creating disaster plans, gathering the supplies needed for an effective response, and developing skills and competencies to guarantee the successful completion of disaster-related tasks are some of the common activities associated with disaster preparedness.

Earthquake in Malaysia

Malaysia is inclined to earthquake disaster due to a pressure impacted by a shift of two earth's crust blocks. Malaysia is not part of the Ring of Fire (a significant area in the basin of the Pacific Ocean). Thus, the occurrence of earthquakes is not decisive and may not cause loss of life or property. The earthquake phenomenon in Malaysia is the shift of the earth's plate, which causes cracks in the earth's crust area. This crack produces tectonic friction of the earth's shaft crust and a tremor from the seismic point. According to the Meteorological Department of Malaysia, since 2007, Malaysia has experienced about 40 weak earthquakes. There were 37 tremors reported in Bentong, Pahang, and three tremors were described in Manjung, Perak, and Jerantut, Pahang. There were 29 tremors testified in Bentong, Pahang, between 2007 and 2009. However, the reading for these tremors was between 1.1 and 2.8 Richter scale. Thus, the record showed that Peninsular Malaysia may be at risk of moderate earthquakes, leading to loss of lives and property damage. The recent earthquake in Sabah with a reading of 5.9 Richter scale, while Peninsular Malaysia is still free of severe earthquakes. However, after the 2006 Acheh 9.0 Richter Scale earthquake, there is no more assurance that Malaysia will be free from tremors. Malaysia is closely located in a country actively prone to earthquakes and volcanoes, like the Philippines and Indonesia, which makes Malaysia experience low to moderate tremors whenever a strong-scale earthquake strikes these neighboring countries. In his research, Prof. Dr. Felix Tongkul, Director of the Research and Innovation Center, Universiti Malaysia Sabah (UMS) concluded that Malaysia may shortly experience a moderate earthquake (Sinar Daily, 2023).

Earthquake Preparedness

There has been an increase in earthquake preparedness literature recently, according to Bhandari et al (2023) there are various lists of who needs to be prepared, what needs to be prepared, and how it should be done. For people throughout the world, disaster preparedness can mean different things. A series of actions performed by a civilization, a community, or a person to lessen the impacts of an earthquake is referred to as earthquake preparation. The steps taken to be prepared might include locking up large things, altering the building, stockpiling supplies, and having insurance, emergency supplies, and evacuation plans. People should be prepared for catastrophes by what/who is anticipated to be pretentious in various areas of cities and nations, as noted by Ward (2020). Numerous studies measuring earthquake readiness have indicated that many individuals are not prepared for the effects of natural disasters (Spittal, 2003; Karanci et al. 2012; Momani and Salmi, 2012; Hemond and Robert, 2012; Norman et al., 2012; Oral et al., 2015; Bhandari et al., 2023).

A Study from Bhandari et al (2023) about increasing earthquake preparedness knowledge perception and practice among Nepalese immigrants residing in Japan through an

educational intervention. In total, 165 participants responded to the questionnaire. The generalized equation model showed that the knowledge score of earthquake preparedness was 4.01 points higher immediately after the intervention [95% CI (2.78–5.24), p-value < 0.001] compared to baseline with a further increase by 7.02 points [95% CI (5.96–8.09), p-value < 0.001] at two weeks follow up. However, the practice score increased only by 2.83 points [95% CI (2.51–3.14), p-value < 0.001] immediately after the intervention with a similar increase at two weeks and 12 weeks follow-up period [OR: 2.62, 95% CI (2.29–2.96), p-value < 0.001]. The educational intervention, when conducted in the native language, can increase both the knowledge and practice score of earthquake preparedness.

Paton et al (2015) conducted on the level of community preparedness toward earthquakes revealing that most respondents have adequate preparedness for structure and survival. This study was led by quantitative research of 293 Canterbury, New Zealand respondents. The findings showed that they have a place, or a room built to keep themselves safe from the earthquake. They ration an adequate supply of food, drinking water, and medical. The results also specified that the community scored an excellent mark on planning and community-agency cooperation. Most respondents clarified that the psychological preparedness aspect is not significant as they believed they have the strength to face the earthquake disaster. Nevertheless, the analysis showed a weakness in the community concerning the obligation for psychological preparedness, for example, in handling post-disaster trauma.

According to research on household readiness for natural disasters in Japan (Onuma et al., 2017), experience with disaster damage makes people more prepared, although the influence differs depending on the category of items. Additionally, the preparation of items from the Basic Preparedness (BP) and Evacuation Preparedness (EP) categories is positively influenced by prior evacuation experience. Additionally, those affected by the Great East Japan Earthquake (GEJE) in 2011 were comparatively well prepared. However, GEJE evacuation experience only has a big influence on readiness. Additionally, Onuma et al (2017) discovered that some places with a higher potential for future large-scale earthquakes are less prepared than other regions. Spittal et al (2006) conducted quantitative research on 652 Wellington, New Zealand respondents. In this research, Spittal et al (2006) asked their respondents about the 23 important items needed to face an earthquake disaster. The analysis indicated that most respondents prepared themselves with an object like a flashlight and a first aid kit. Moreover, they also prepared themselves with food and drinking water ration, and cooking gas as is prepared to face an earthquake. However, most respondents did not specified the meeting point before the disaster or provided perishable objects at a specific place.

Another research by Oral et al (2015) examined how well people in Turkey's Eastern Anatolia region were prepared for earthquakes, and the results revealed a strong correlation between the location of residence, previous earthquake experience, and preparation. 174 respondents participated in this quantitative survey, which employed this methodology. According to Oral et al (2015), people who had previously experienced earthquakes were more prepared than those who hadn't. Additionally, those who owned a house had taken more precautions than those who did not, and married people had done more to prepare than single or widowed people. Residents of Erciş and Aşkale felt substantially better prepared for an earthquake than those in Erzurum, according to a comparison of respondents with major earthquake experience and those who had no significant earthquake experience.

A quantitative study was carried out by Ainuddin and Routray (2015) to explore the level of preparedness and community awareness toward earthquake disaster risk. This

research was conducted in Baluchistan, Pakistan, with 200 respondents. This research focuses on investigating these aspects: potential impact, vulnerability to disaster, perception towards risk, and resilience. All these four aspects are interrelated to one another. Furthermore, Ainuddin and Routray (2015) clarified that the weakness in social, economic, physical, and community institutions makes the community vulnerable to disaster risk. The weak level is dependent on resilience and community perception of disaster risk.

Ikizer et al (2016) discovered factors associated with preparedness and psychological resilience in a sample of 360 survivors of the two earthquakes in Van, Turkey in 2011. Using a survey with measures on various pre-, within-, and post-disaster variables, it has been shown that preparedness and psychological resilience were influenced by multiple factors, providing empirical evidence for a multifactorial understanding of preparedness and resilience. Furthermore, the study extended the traditional ways of resilience assessment by including stress-coping ability and severity of trauma-related symptoms as indicators of psychological resilience simultaneously. Findings were discussed considering the implications for research and interventions in the aftermath of natural disasters.

According to an Istanbul-based study (Sakiroglu, 2019) that looked at the factors that influence earthquake preparedness behaviour found that only 19% of the participants had done anything to prepare for one. The findings showed a substantial relationship between earthquake readiness and the degree of exposure to previous seismic experiences, avoidance, self-efficacy, and outcome efficacy. When taking into account important predictors, the degree of earthquake preparedness behaviour is increased by the severity of exposure to prior earthquake experiences and the perception that being prepared is effective; it is decreased by the perception that being prepared is difficult and by avoiding the impact of the event's scale (Sakiroglu, 2019).Another research, by Hoffmann and Muttarak (2017), looked at how well earthquake and tsunami preparedness is among people living along Thailand's Andaman coast in the province of Phang Nga. This study found that formal education may help people be more prepared for disasters since it improves people's cognitive and learning abilities as well as their access to information. The researchers also discovered a link between formal education and adopting precautions, which is assessed at the individual, family, and community levels. The study group without prior catastrophe experience shows a favourable relationship between disaster preparedness and household member education. The results also demonstrate that those with high educational attainment benefit most from disaster-related training. They also reside in a neighbourhood where more women have at least a secondary education, which increases the possibility of disaster preparedness. According to Hoffmann and Muttarak (2017), formal education can improve preparedness for disasters and lessen susceptibility to them.

Baytiyeh and Naja (2016) made an effort to investigate how Lebanon's institutions were preparing students for potential seismic catastrophes. A study of 860 students from a range of fields at Lebanese colleges was conducted to gauge how well-prepared they were for earthquakes and how their college experiences influenced that degree of preparedness. The investigation suggested that higher educational institutions had little impact on students' required degree of readiness, whereas the data indicated a low level of seismic preparedness.

Güngörmüş et al (2012) conducted a study in the city of Erzurum to determine people's knowledge and behaviours regarding earthquake preparedness at home. The study's findings revealed that although people have enough knowledge about earthquake preparation to prevent earthquake damage, they are not taking enough precautions. Although the population has a high degree of information regarding earthquake readiness, they are not prepared for an earthquake since they are unable to put this knowledge into practise. Long-

term training programmes should be used to alter the behaviours. To achieve this, it is necessary to make sure that public organisations that will support behaviour change are established as well as extensive, long-lasting, and resourceful public training programmes.

Recommendations

Based on the findings of literature review across the globe, a recommendation for local communities in Peninsular Malaysia to take precautions against natural disasters, particularly earthquakes. Small-scale evidence that has occurred in several areas such as Pahang, Perak, and Negeri Sembilan has qualified that Peninsular Malaysia is at an unsafe level and the people need to be cautious and prepared to face this disaster. Although Peninsular Malaysia has not experienced severe tremors, it is a good initiative for the communities in every state involved to be prepared for devastating disasters. Earthquake lessons learned and experiences from the countries mentioned above, such as Japan, Thailand, Turkey, Pakistan, New Zealand, and Lebanon, may provide much guidance for the community's preparedness to face the earthquake.

Some crucial elements of earthquake preparedness need to be addressed by the communities in Peninsular Malaysia. The elements comprising structure, survival activities, planning, behavioral factors, positive community-institution relationship, and individual differences (e.g., Experience, marital status, educational background, etc.) play an influential role in strengthening a community's preparation against the earthquake disaster. These initial availability before the earthquake can indirectly help the local community be more alert and prepared whenever the disaster strikes. Although Peninsular Malaysia has not experienced any large-scale earthquake catastrophe as is happening in other countries, one day Peninsular Malaysia may experience a tremor. In addition, it is also recommended that future studies be conducted on the local community in Peninsular Malaysia, especially those who have experienced minor tremors as recorded by the National Meteorological Department, to investigate the level of earthquake preparedness in the state involved. The following is further explained in detail about these essential elements for earthquake preparation.

Structure

Different elements go into earthquake preparation, and each element's level of readiness might vary. Most earthquake readiness strategies concentrate on acts that may improve survival both before and after an earthquake. The structural aspect of readiness is the first part, which consists of actions that might lessen harm. The structure involves anchoring bookcases and other large things, securing and strengthening a home and its contents, or fortifying structures to stop them from collapsing (Tournier et al., 2023). Since most earthquake deaths and injuries are caused by buildings or other structures collapsing on people, this damage-reducing aspect of preparation is crucial for people's outcomes during earthquakes (Tournier et al., 2023). Therefore, this hazard mitigation is essential for the residents to protect themselves from overhanging home appliances. Positioning the home appliances correctly, such as rearranged cupboards, latched cupboards, secure furniture, and reinforced structures at home in a specific position, can help people to reduce the danger of an earthquake. Residents who experience tremors like Pahang, Perak, and Negeri Sembilan can implement the well-structure in their home's preparation by carefully arranging the home appliances.

Survival Activities

Making house preparations for earthquakes as part of your daily survival routine is another strategy to lower your chance of experiencing an earthquake. Collecting and keeping supplies and learning strategies like having emergency supplies like a first-aid kit for simple survival, water, a battery radio, and a torch are examples of survival activities (Yayla and Şahinöz, 2020). People's perceptions of readiness revealed their conviction that being ready mostly involved possessing the "basics" needed for safety or survival. Earthquake-prone nations like Japan, New Zealand, and Turkey have advocated the concept that each home should make preparations that make it easier for people to deal with, adapt to, and recover from the effects of earthquakes. Individuals can take precautions by learning how to survive, as well as through participating in social activities that promote earthquake readiness (Kirschenbaum 2002, 2004; Lindell et al., 2009; Yayla and Şahinöz, 2020; Tournier et al., 2023; Spittal et al., 2008). Because they can prepare all the materials in their house, such as having a torch, radio, first-aid kit, saved food, and stored water, as well as how to switch off the gas, provide first aid, and secure the water heater, being prepared for survival activities is crucial. Residents of Peninsular Malaysia can obtain all the knowledge and expertise from other nations to prepare everything in their homes to aid in their readiness before or after the tremor occurs.

Planning

The next element of earthquake preparedness is family earthquake planning. Planning reflects cognitive preparation and resource allocation, such as family instruction, saving money, neighborhood planning, contact officials, work preparedness, and earthquake insurance purchasing. Family earthquake planning is essential to ensure people know and understand how to handle the situation if the earthquake happens in their place. More time, money, and emotions are engaged in helping their town survive an earthquake by those who are more closely connected to it. Encourage those who are more prepared to create strategies for communal readiness. These strategies would aid the underprepared and encourage the hesitant to prepare so they may participate in the process. The residents in Peninsular Malaysia can take the initiative by purchasing earthquake insurance for all their family members, knowing a neighborhood earthquake plan, instructing the families on the earthquake, and learning the right contact person, such as contacting disaster officials in every state involved.

Behavioral Factors

Behavioral or psychological factors are also one of the most essential elements of earthquake preparedness. Behavioral characteristics affect or arise in the mind; related to a person's mental and emotional state. The perceived effectiveness of preparation is the factor predicting catastrophe preparedness. People think that because earthquakes are strong natural occurrences, actions made by humans to lessen loss will be ineffective. Some individuals believe it is difficult to prevent earthquake damage because they only consider the severity of the earthquake and ignore the impact of building design (McClure et al., 2017). The behavioral factor may affect the actions and thoughts of individuals, especially the community in Peninsular Malaysia that they need to be reminded about earthquakes, worry if a disaster happens in their state, and concerned that relatives or family members are living or studying in the countries experiencing an earthquake, and avoid themselves to go to the countries that are active in the earthquake.

Positive Community-Institution Relationship

Positive community-institution relationship reflects people's active involvement in their community. One of the programs that can educate people about earthquake preparedness is the Public Hazard Education Program, which may reduce a person's perceived risk and level of readiness. The importance of community-institutional collaboration in the planning and execution of earthquake preparation initiatives cannot be overstated. The implementation of community-based projects in Peninsular Malaysia must take several factors into account. They include how to convince people that they are in danger, how to open a line of communication with service providers, and how to engage communities in earthquake preparations without relying on the government. Communities may need to have all the tools or information (physical, financial, and informational, for example) needed to deal with sporadic, difficult, and dangerous incidents. The ability and willingness of civil defence and emergency management agencies to interact with communities in a way that empowers them rather than imposing solutions upon them can help people improve their disaster preparedness planning and be a part of society (Becker et al., 2017). Communities that have received enough cultural, social, and psychological training are better equipped to deal with disasters and their aftermath. The National Catastrophe Management Agency (NADMA) was created for Malaysians to act as a focal point and coordinating body to make it easier to implement catastrophe plans. The top policy- and decision-making body for disaster risk management in the nation is this organisation. It has a vital role in ensuring the safety of people and the country's well-being by fostering cooperation among various parties as a team to build and enhance the community's capacity and preparedness in disaster management.

Individual Differences

According to Turner et al (2022), individual differences and demographic variables such as income, experience, marital status, educational background, age, gender, and homeownership are also elements that have anything to do with earthquake readiness, either directly or indirectly. According to Turner et al (2022), the factors given may constitute a predictive construct that represents community ties or engagement. A sense of investment in a way of life and a location as well as access to a social support network with like-minded others who are interested in disaster preparedness are examples of community ties. These factors might indicate a person's sense of responsibility for themselves and others.

Conclusion

In other words, the community's preparation before the crisis will have a significant impact on its capacity to cope, adapt, and recover quickly and efficiently. Communities that make more preparations before an earthquake are likely to take fewer different actions after the earthquake in a particular earthquake preparedness scenario (Zaremohzzabieh et al., 2021). Furthermore, government, community, and individual levels may all have a role in preparing for earthquakes (Shaffril et al., 2021). The neighbourhood should prioritise earthquake preparedness efforts and mobilise its residents and resources. The community and organisations involved in catastrophes must enhance their capacity. Risk reduction must be made feasible at all levels, from the individual to the society to the provincial and federal. With full-swing preparedness given by the government, community, and individuals, it is hoped that communities will be readier and prepared for all aspects to face if an earthquake happens in any country, including Malaysia.

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