
A comparison of the levels of earthquake awareness and preparedness in a high risk and low risk barangay

Janine Alyanna O. See, MD; Lorraine C. Rivera, MD; Iñigo Teodoro G. Santos, MD; Kristin Janina C. Santos, MD; Maebellene Grace R. Santos, MD; Niña Angelieksa V. Sarmiento, Randolph Erald G. Sese, MD; Shannon Petrina Sie, MD; Bernadine N. Urbano, MD; Jennifer M. Naites, MD, MSPH; and Jose D. Quebral, MD

Abstract

Introduction Metro Manila is at risk from “the big one”, a magnitude 7.2 earthquake caused by the movement of the West Valley Fault, thus awareness and preparedness of the people are very important. The study compared the levels of earthquake awareness and preparedness of households in a high-risk area and a low risk area.

Methods This was a cross-sectional study among 376 households each from a high- and a low-risk barangay in Metro Manila using a self-administered household-based survey questionnaire consisting of questions on awareness and preparedness. The prevalence of households classified as aware and well-prepared was computed; the significance of differences between the high- and low risk barangays was determined through Fisher’s exact test.

Results There were fewer households classified as aware in the high-risk barangay compared with the low risk barangay, but the difference was not significant (PR = 0.98, 95% CI 0.84, 1.01, $p = 0.078$, Fisher’s exact test). Less than half of households were classified as well-prepared in both high- and low risk barangays (49.7 vs 46.5%) and the difference was not significant (PR = 1.07, 95% CI 0.92, 1.24, $p = 0.422$, Fisher’s exact test). Television was the most common source of information in both barangays. Households in the high-risk barangay were more likely to be well-prepared when a member was at least a high school graduate (PR = 2.54, 95% CI 1.24, 5.22, $p = 0.001$, Fisher’s exact test).

Conclusion There was no difference in the levels of awareness and preparedness between high and low risk barangays. Television was the most common source of information in both high and low risk barangays. The presence of at least one high school graduate in the household from a high-risk barangay was associated with preparedness but not awareness.

Keywords: Earthquake awareness, earthquake preparedness, Valley Fault System, West Valley Fault

Metro Manila is bound on the east by the West Valley Fault and on the west by the Manila

Trench in Manila Bay, making the area highly vulnerable to “the big one”, a magnitude 7.2 earthquake that could strike anytime, affecting a large area of Luzon including Metro Manila. Based on the Metro Manila Earthquake Impact Reduction Study (MMEIRS), approximately 40% of the residential buildings in Metro Manila will collapse, causing 34,000 deaths and 114,000 injuries.¹ The Philippine Institute of Volcanology and Seismology (PHIVOLCS) has released an earthquake preparedness guide that

Correspondence:

Jennifer M. Naites, MD, MSPH, Department of Preventive and Community Medicine, College of Medicine, University of the East Ramon Magsaysay Memorial Medical Center, Inc., 64 Aurora Boulevard, Barangay Doña Imelda, Quezon City, PH 1113; Email: jmnaites@uerm.edu.ph

highlights the necessary steps to be undertaken before, during, and after an earthquake.² These, along with the efforts of local government units in information dissemination, aim to raise awareness and encourage proactivity in local communities. The problem is imparting knowledge to the people who think that they are safe until an emergency or disaster strikes. Thus, the researchers proposed to investigate the levels of awareness and preparedness of the local community.

The results of the study may add to the existing body of knowledge on the topic which would benefit the academe, the local community, as well as the government agencies tasked to implement programs for raising awareness and increasing responsiveness to such disasters. Results of this study may be used to map out areas that need more aggressive implementation of government programs, such as communities with a higher risk due to their location near a fault line. Furthermore, the findings may be used by government agencies to improve on the existing programs and methods of information dissemination, in order to more effectively reach and create an impact on the target audience.

The study compared the levels of earthquake awareness and preparedness of households in a high-risk area and a low risk area. Specifically, the study aimed to determine sources of information about earthquake awareness and preparedness, and factors associated with household earthquake awareness and preparedness among high and low risk barangays.

Methods

The study employed a quantitative cross-sectional design to determine the level of earthquake awareness and preparedness in a high risk and low risk barangay in Metro Manila through a self-administered household-based survey. High-risk areas were identified as those within 10 km from a fault zone.³ By tracing the fault line and different mapping methods, 81 barangays were identified to be traversed by the fault system in Metro Manila and its nearby provinces. Barangay Batasan Hills in Quezon City was identified to be a high-risk area being 436 m away from the fault line, with the largest population that can possibly be affected by an earthquake. Barangay Gen. T. De Leon in Valenzuela City is 10.8 km away from the West Valley Fault as mapped out in 2013.⁴ Thus, it is considered as a low risk area for earthquakes.

All households in the two barangays were eligible for inclusion. A literate adult was required to be present at the time of the survey. Informal settlers who had no legal claim or were not registered in the barangay were excluded. A sample size of 376 per barangay was computed based on the Z-value for alpha error of 1.96, a desired precision of 0.05 at 95% confidence interval. Since this study called for the participation of two barangays, the total sample size was 752 households. Convenience sampling was employed in selecting the households that participated in the study. Demographic data on the households were collected, including information about the members of the household, their corresponding ages, sex and highest educational attainment, household income and previous exposure to earthquake emergencies. The study was approved by the Ethics Review Committee. Permission was obtained from both barangays, and informed consent was obtained from all the respondents.

Data on awareness and preparedness were collected through a 28-item questionnaire adapted from the Department of Education's (DepEd) and Ardan's survey tools and was reviewed by an expert.^{5,6} Ardan's questionnaire had a Cronbach's alpha of 0.7 and CVIs ranging from 0.80 to 0.100.⁶ Four questions in the study questionnaire were taken from Ardan, and the remaining 24 questions came from the DepEd tool.^{5,6} Nineteen of the questions were answerable by 'yes' or 'no', eight required a short descriptive response, and the remaining one was a checklist of items that should be included in an emergency kit. The questionnaire consisted of five parts: household characteristics, sources of information, before earthquake, during earthquake, and after earthquake and first shake. The items included under the earthquake categories were classified as either awareness-related or preparedness-related questions. Ten questions measured earthquake awareness while 18 measured earthquake preparedness. The items reflect the knowledge of households on what to do in case of an earthquake, as well as specific preparations for such an event. A respondent was considered to be aware if he/she correctly answered at least 8 out of 10 questions on awareness and well-prepared if he/she correctly answered at least 14 out of 18 questions on preparedness. Those who got less than 75% correct answers were classified as not aware and poorly prepared, respectively. The questionnaire was self-administered and answered by an adult member of the household.

Data were encoded using Microsoft Excel and analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 23 (IBM Corporation, NY, USA). Difference in population proportions of those who are aware and not aware, and those who are well-prepared and poorly prepared was determined using the Fisher's exact test. Effect size was then determined using ratio, which allowed the researchers to determine the level of association between the variables. Both statistical analyses were employed for finding the difference in population proportions and magnitude of association between the dependent variables and other factors such as households with children and/or senior citizens, having at least a high school graduate in the household, and previous experience of an emergency due to earthquakes.

Results

A total of 752 responses were recorded - 376 each from Barangays Batasan Hills (high risk) and Gen. T. De Leon (low risk). The ratio of males to females was 1:1 in both barangays, 60% of the respondents were in the 18 to 59-year-old bracket and one-third were less than 18 years in both areas. Three of four households in both barangays had occupants below 18 years. A third of respondents in both barangays were high school graduates. The annual household income was not more than PHP 59,000 in 44 and 38% in the high and low risk barangays, respectively. Television was the source of information in more than 90% of households in both barangays. Two-thirds of households in Barangay Gen. T. De Leon had the internet as the second most common source of information on earthquake awareness and preparedness. Half of the households from both areas relied on radio as a source of information. Around 30% of households had a previous experience of an earthquake in both barangays. As shown in Table 1, the demographic characteristics of the two barangays are similar.

The ratio of households classified as aware to not aware was 2:1 in the high-risk barangay and 3:1 in the low risk barangay. There were fewer households classified as aware in the high-risk barangay compared with the low risk barangay, but the difference was not significant (PR = 0.98, 95% CI 0.84, 1.01, $p = 0.078$, Fisher's exact test). The mean awareness score in the high-risk barangay was lower (8.1 vs 8.4) as shown in Table 2. The ratio of households classified as well-

prepared to poorly prepared was 1:1 in the high-risk barangay. Less than half of households were classified as well-prepared in both barangays; there were more well-prepared households in the high-risk barangay compared with the low risk barangay (49.7 vs 46.5%) but the difference was not significant (PR = 1.07, 95% CI 0.92, 1.24, $p = 0.422$, Fisher's exact test). The mean preparedness scores in the two barangays were similar (12.9 vs 13.0) as shown in Table 2.

Table 1. Demographic characteristics of individual members in 376 households each in the high risk and low risk barangays.

Demographic Characteristic n (%)	High risk (n = 1860)	Low risk (n = 1877)
Sex		
Male	946 (50.9)	913 (48.6)
Female	914 (49.1)	964 (51.4)
Age (year)		
< 18	638 (34.3)	660 (35.2)
18 - 59	1083 (58.2)	1071 (57.1)
> 59	113 (6.1)	133 (7.1)
Not reported	26 (1.4)	13 (0.7)
Households with occupants below 18 years	284 (75.5)	294 (78.2)
Highest educational attainment		
Elementary & below	428 (23.0)	459 (24.4)
Elementary	262 (14.1)	187 (9.9)
High School	583 (31.3)	540 (28.8)
College, postgraduate	359 (19.3)	490 (26.1)
No formal education	35 (1.9)	17 (0.9)
Not reported	193 (10.4)	184 (9.8)
Annual income (PHP)		
≤ 39,000	123 (32.7)	98 (26.1)
40,000 - 59,000	43 (11.4)	46 (12.2)
60,000 - 99,000	50 (13.3)	48 (12.8)
100,000 - 249,000	106 (28.2)	93 (24.7)
≥ 250,000	36 (9.6)	62 (16.5)
Not reported	18 (4.8)	29 (7.7)
Source of information		
Print media	134 (35.7)	136 (36.2)
Internet	21 (5.6)	239 (63.6)
Radio	194 (51.6)	196 (52.1)
Television	355 (94.4)	347 (92.3)
Government campaigns	167 (44.4)	175 (46.5)
School/Office	157 (41.8)	166 (44.1)
Friends	125 (33.2)	127 (33.8)
Previous experience of earthquake emergency	119 (31.7)	127 (33.8)

Levels of earthquake awareness and preparedness in a high risk and low risk barangay

Table 2. Percentage of aware and well-prepared households in the high- and low risk barangays.

Risk level	Awareness, n (%)			Preparedness, n (%)		
	Aware	Not aware	Mean score	Well-prepared	Poorly prepared	Mean score
High	254 (67.6)	122 (32.4)	8.1	187 (49.7)	189 (50.3)	12.9
Low	277 (73.7)	99 (26.3)	8.4	175 (46.5)	201 (53.4)	13.0
PR	0.98 (95% CI 0.84, 1.01), p = 0.078*			1.07 (95% CI 0.92, 1.24), p = 0.422*		

* Fisher's exact test

PR – Prevalence (risk) ratio

Households with at least a high school graduate in the high-risk barangay had a higher mean awareness score compared with households without at least a high school graduate (8.2 vs 7.3) as seen in Table 3. There were no differences in the mean awareness scores when the presence of senior members or children, and previous experience were considered. The mean preparedness scores were higher in households with at least a high school graduate both high and low risk barangays (13.1 vs 11.1 and 13.1 vs 11.9, respectively) as seen in Table 3. There were no differences in the mean preparedness scores when the presence of senior members or children, and previous experience were considered.

Table 3. Comparison of mean awareness and preparedness scores in different variables.

Factor	Awareness score	Preparedness score
Presence of children/ senior citizens		
High risk		
With	8.1	13.0
Without	8.0	12.7
Low risk		
With	8.4	13.0
Without	8.2	12.8
Level of education		
High risk		
At least HS graduate	8.2	13.1
No HS graduate	7.3	11.1
Low risk		
At least HS graduate	8.4	13.1
No HS graduate	8.4	11.9
Previous experience		
High risk		
With	8.1	12.9
Without	8.1	12.9
Low risk		
With	8.3	13.0
Without	8.4	12.9

In both high and low risk barangays, 80 to 90% of households in both aware and not aware, and well-prepared and poorly prepared groups had children and/or senior members. The presence of children and/or senior members was not a significant factor in the percentage of households in awareness and preparedness in both high and low risk barangays. In both high and low risk barangays, 80 to 95% of households in both aware and not aware, and well-prepared and poorly prepared groups had at least a high school graduate. As shown in Table 4, households in the high-risk barangay were 2 ½ times more likely to be well-prepared when a member was at least a high school graduate (PR = 2.54, 95% CI 1.24, 5.22, p = 0.001, Fisher's exact test). In the low risk barangay, households with at least a high school graduate were 1 ½ times more likely to be well-prepared (PR = 1.52, 95% CI 0.78, 2.97, p = 0.247, Fisher's exact test). The presence of at least a high school graduate was not a significant factor in the proportion of households in awareness in both high and low risk barangays. Previous experience of an earthquake emergency was not a significant factor in the proportion of households in awareness and preparedness in both high and low risk barangays.

A lower percentage of respondents from the high-risk barangay correctly answered 8 of 10 questions on awareness. The highest percentage of correct answers were the items on awareness of the danger of returning to the house due to the possible effects of aftershocks (94.1 vs 88.8%), credible sources of information (90.7 vs 92.6%) and duck-cover and hold (88.8 vs 90.4%) for the high and low risk barangays, respectively. Fewer respondents from the high-risk barangay were aware of emergency contact numbers of government agencies (68.1 vs 78.5%).

A higher percentage of respondents from the high-risk barangay correctly answered 8 of 18 questions on preparedness and a higher percentage of respondents

Table 4. Association between having one member who is at least a high school graduate and levels of awareness and preparedness.

	Awareness n (%)		Preparedness n (%)	
	Aware	Not aware	Well-prepared	Poorly prepared
High risk				
With high school graduate (n = 329)	227 (69.0)	102 (31.0)	173 (52.6)	156 (47.4)
No high school graduate (n = 29)	15 (51.7)	14 (48.3)	6 (20.7)	23 (79.3)
PR	1.33 (95% 0.93, 1.91), p = 0.095		2.54 (95% CI 1.24, 5.22), p = 0.001	
Low risk				
With high school graduate (n = 340)	250 (73.5)	90 (26.5)	163 (47.9)	177 (52.1)
No high school graduate (n = 19)	16 (84.2)	3 (15.8)	6 (31.6)	13 (68.4)
PR	0.87 (95% CI 0.71, 1.07), p = 0.455*		1.52 (95% CI 0.78, 2.97), p = 0.247*	

* Fisher's exact test

PR – Prevalence (risk) ratio

from the low risk barangay correctly answered nine other questions. The highest percentage of correctly answered items in the high-risk barangay were knowledge of contact numbers of other household members (91.2%), effects of aftershocks such as fire and further damage (81.9%), and overhead shelves/cabinets free of heavy objects (81.4%), while in the low risk barangay, these were: knowledge of contact numbers of other household members (88.3%), having stored food and drinking water (84.8%), initial response (84.0%), and overhead shelves/cabinets free of heavy objects (83.0%). The most frequently mentioned items in the emergency kit in both high and low risk barangays were the first aid kit (91.7 vs 96.1%) and flashlight (90.9 vs 90.5%). Water was the third most frequently mentioned item in the high-risk barangay (80.4 vs 73.8%) while it was canned food in the low risk barangay (77.0 vs 67.5%). The can opener was the item least mentioned as part of the emergency kit in both high and low risk barangays (49.1 vs 47.7%). Less than half of respondents in the high-risk barangay mentioned a battery-operated radio as part of the emergency kit (49.4 vs 55.1%).

Discussion

Despite one barangay having a higher risk than the other, the study found that there was no significant difference in the percentage of households classified

as aware and well-prepared in the two barangays. The mean awareness and preparedness scores were slightly higher in the low risk barangay. As no significant difference in the levels of awareness and preparedness was found between high- and low risk barangays, this may imply that the government's efforts in raising awareness and preparedness may not be concentrated only in the high risk areas but have been evenly distributed regardless of geographical risk. This means that communities in high-risk and low risk areas are almost equally equipped with the knowledge about earthquakes, and these campaigns can encourage households to take the necessary preparations in anticipation of disasters. The researchers note that government must intensify its efforts since less than 70% of households were aware and less than half were well-prepared in both high- and low risk barangays.

The results showed that television plays a significant role in disseminating information on earthquakes. As television is an outlet for news networks and government agencies, most households were assumed to receive reliable information regarding earthquakes. In Barangay Batasan Hills, radio was the next most common information source. Households from Barangay Gen. T. De Leon had the internet as one of its top sources of information. These are important to note since information sources are significant factors in household earthquake preparedness.⁷ They may be classified into formal agency communications and informal social media.

Formal agency sources can highlight credibility. Meanwhile, informal social media sources provide quicker means of communication, but are prone to passing along incorrect information. A previous study found that both formal and informal information sources can create an impact on raising household preparedness.⁸

The presence of many dependents in the family, such as children and elderly, reflects greater obstacles encountered when responding to an emergency.⁹ This makes them more vulnerable to disaster-related consequences. This study found no association between households having children and/or senior citizens in the family with awareness and preparedness in both high and low risk barangays.

The researchers explored the possible role of having at least a high school graduate in the household in improving awareness and preparedness. A previous study found that disaster-related training is most effective for individuals with a high educational attainment.¹⁰ Present study shows a significant association with the level of preparedness based on educational level. However, no significant association is found with earthquake awareness. This is congruent with other research findings that showed significant association between the levels of disaster preparedness and respondents with at least a secondary education.¹⁰ As the ability to process abstract thinking and better learning skills are associated with a higher level of education, households may benefit from educational training on disaster.

A previous study found a strong association between previous experience and awareness and preparedness, which may be explained by individuals recalling prior serious economical and physical damage, and fear of similar disastrous events in the future.¹¹ Present findings did not show any significant association between having a previous earthquake experience and awareness or preparedness in both high- and low risk barangays. This is consistent with a Turkish study which showed the impact of the earthquake being forgotten over time.¹² It is essential to know the short, medium- and long-term effects of disasters on societies.

Recent efforts of the government in promoting disaster preparedness may be one of the factors affecting the results obtained in the study. According to the National Disaster Risk Reduction and Management Plan for 2011-2028, the goal of disaster preparedness is to establish and strengthen the capacity

of communities to anticipate, cope, and recover from the negative impacts of disasters. Hence, standard programs of instruction and training modules are to be implemented for communities to have an increased understanding of and application of risk-reduction measures.¹⁴ In addition, an earthquake preparedness guide was prepared by PHIVOLCS and was launched to the public. This guide includes information about what to do before, during, and after an earthquake.²

The present study concluded that there was no significant difference in the levels of awareness and preparedness for earthquakes between the high-risk and low risk barangays. Television was the most common source of information in both high- and low risk barangays. The presence of at least a high school graduate in the household was associated with being prepared but not with awareness. The presence of children and/or seniors, and previous experience of an earthquake were not associated with awareness and preparedness in both high- and low risk barangays.

The scope of the study included households geographically located within the high-risk and low risk barangays at the time of data collection. The duration of residency of the occupants of the household was not considered in this study. Perceived risk and the association of household income were not investigated. Another limitation encountered in the study was the accessibility of the respondents in terms of location within the barangay. Based on the results of the study, the researchers recommend that perceived risk be included in future studies. Demographic data such as number of occupants in a household, total yearly household income, and sex may also be considered as independent variables in future studies.¹⁵ Obtaining a larger sample size and using a probability sampling method may also increase the reliability of the study.

Acknowledgements

The group would like to extend their gratitude to the people who helped make this research paper possible: Dr. Ronald P. Law, MPH, Medical Officer V of the Health Emergency Management Bureau of the Department of Health, for his participation and input in the formulation of the study questionnaire; Mr. Sanaz Sohrabidazeh and the Department of Education, for allowing the group to adapt the questionnaires used in their research; Mr. Daniel Jose

Buhay, Science Research Specialist of PHIVOLCS, for helping the group identify the barangays; Barangay Captains John M. Abad of Batasan Hills and Alfren Caina of Gen. T. De Leon, and their respective barangay secretaries, for their assistance during data collection; and all the respondents, for their honesty and cooperation.

References

1. Metro Manila Earthquake Impact Reduction Study [Internet]. Philippines: Philippine Institute of Volcanology and Seismology. Department of Science and Technology; 2010. [Cited 2017 Nov 10]. Available From: http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=419%3Ammers&catid=66
2. PHIVOLCS Earthquake Preparedness Guide [Internet]. Philippines: Philippine Institute of Volcanology and Seismology; 2009. [Cited 2018 Sep]. Available from: https://www.phivolcs.dost.gov.ph/images/IEC/what_to_do_pocketsize.pdf
3. Pacheco BM. Safety of PH structures during quakes [Internet]. Philippines: Metropolitan Manila Development Authority; 2011 Apr 9. [Cited 2017 Nov 11]; Available from <http://www.mmda.gov.ph/20-faq/297-safety-of-ph-structures-during-quakes>
4. Faultfinder [Internet]. Philippines: Philippine Institute of Volcanology and Seismology. Department of Science and Technology; 2010. [Cited 2017 Nov 11]. Available from: <http://faultfinder.phivolcs.dost.gov.ph/>
5. Earthquake Family Preparedness Questionnaire (K-2, SPED) [Internet]. Philippines: Department of Education; 2015. [cited 2017 Nov]. Available from: http://www.deped.gov.ph/sites/default/files/order/2015/DO_s2015_27.pdf
6. Ardalan A, Sohrabizadeh S. Assessing households preparedness for earthquakes: An exploratory study in the development of a valid and reliable Persian-version tool. *PLoS Curr* 2016 Feb 25. [Cited 2017 Nov 10]. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4778920/>
7. Kirschenbaum A, Rapaport C and Canetti D. The impact of information sources on earthquake preparedness. *Int J Disaster Risk Reduct* 2017. [Cited 2017 Nov]. 21: 99-109. Available from: <https://doi.org/10.1016/j.ijdr.2016.10.018>
8. Marti M, Stauffacher M, Matthes J, Wiemer S. Communicating earthquake preparedness: The influence of induced mood, perceived risk, and gain or loss frames on homeowners' attitudes toward general precautionary measures for earthquakes. *Risk Anal* 2018 Apr. [Cited 2017 Sep 21]. 38(4):710-23. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/28799655>
9. Morrow B. Identifying and mapping community vulnerability. *Disasters* 1999. [Cited 2018 Sep]. 23: 1-18. Available from: <https://onlinelibrary.wiley.com/doi/abs/10.1111/1467-7717.00102>
10. Muttarak R, Pothisiri W. The role of education on disaster preparedness: case study of 2012 Indian Ocean earthquakes on Thailand's Andaman Coast. *Ecol Soc* 2013. [Cited 2018 Sep]. 18(4): 51. Available from: <http://pure.iiasa.ac.at/id/eprint/10359/>
11. Ashenebe B, Wubshet M, Shimeka A. Household flood preparedness and associated factors in the flood-prone community of Dembia district, Amhara National Regional State, northwest Ethiopia. *Risk Manag Healthc Policy* 2017. [Cited 2018 Sep]. 10: 95-106. Available from: <https://pubmed.ncbi.nlm.nih.gov/28615980/>
12. Gerdan S. Determination of disaster awareness, attitude levels and individual priorities at Kocaeli University. *Eurasian J Educ Res* 2014. [Cited 2018 Sep]. 55: 159-76. Available from: <https://files.eric.ed.gov/fulltext/EJ1060452.pdf>
13. Becker JS, Paton D, Johnston DM, et al. A model of household preparedness for earthquakes: How individuals make meaning of earthquake information and how this influences preparedness. *Nat Hazards* 2012. [Cited 2017 Sep 21]. 64(1): 107-137. Available from: <https://doi.org/10.1007/s11069-012-0238-x>
14. National Disaster Risk Reduction and Management Plan (NDRRMP) 2011-2028 [Internet]. Philippines: National Disaster Risk Reduction and Management Council; 2010. [Cited 2017 Nov]. Available from: http://www.ndrrmc.gov.ph/attachments/article/41/NDRRM_Plan_2011-2028.pdf
15. Wise GI. Preparing for disaster: A way of developing community relationships. *Dis Manag Resp* 2007. [Cited 2018 Sep]. 5(1): 14-7. Available from: <https://www.sciencedirect.com/science/article/abs/pii/S1540248706000745>