POPULATION PERSPECTIVE ON THE SOCIAL IMPACT OF A STRONG EARTHQUAKE AFFECTING BUCHAREST

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Abstract: The paper presents a series of the results obtained from an extensive questionnaire survey conducted in Bucharest in 2016. The investigated topics are related to earthquake awareness and preparedness of the population currently living in the capital city of Romania, safety concerns and post-earthquake behaviour. Results are interpreted based on several criteria which characterize the target population such as age, education, income, children, as well as the type and year of construction of the building they inhabit. The questionnaire was completed by 1000 respondents and the main findings show that people are generally neither well informed nor prepared for a future major seismic event affecting Bucharest. However, the level of involvement in post-earthquake situations is positive, the majority of respondents agreeing to offer humanitarian help in various forms as well as temporary shelter to people, especially relatives or friends.

Keywords: Earthquake risk perception, Bucharest, questionnaire, awareness, Vrancea seismic source

1. Introduction

Romania is located in a seismically active region, the main source of hazard for the southern and eastern part of the country being the Vrancea intermediate-depth source. This paper investigates the potential social impact of a major seismic event affecting the capital city of Romania. Bucharest is one of the cities having the highest seismic risk in Europe, with direct losses in case of Vrancea earthquakes with $M_W \geq 7.5$ mounting up to several billion euros and the number of heavily damaged or collapsed buildings being of the order of several thousand [1-3]. Earthquakes of this magnitude occur, on average, once or twice per century. The Vrancea intermediate-depth seismic source has generated two destructive earthquakes in the past century in November 1940 (M_W =7.7 and focal depth h ≈ 150 km) and March 1977 (M_W =7.4, h = 94 km).

A survey conducted by Armas [4], in which 220 people were interviewed in order to assess the behaviour of the population of Bucharest during an earthquake, shows that respondents associate earthquakes with death or building collapse. Although all the respondents had experienced an earthquake, only 10% of them live in the constant fear of experiencing another one. This shows that people do not think about the risk associated with earthquakes and, consequently, fail in preparing for such an event. Another study aiming at investigating the human reactions towards the occurrence of an earthquake in Bucharest [5] shows that 82% of the total number of respondents think that an earthquake is likely to occur in the next three years in Romania with 64% of the respondents being worried about it. Results are based on a questionnaire surveyed over 1300 persons by phone interviews. The study also shows that only 60% of the respondents

are informed on how to behave in case of an earthquake and 56% declared that they are not prepared for such an event. Similar results may be found, for example in [6] were a public survey was conducted on the population of Portugal focusing on awareness, perception and communication of earthquake risk. Results show that people do not have a clear understanding and perception of seismic vulnerability. Also, the study concludes that the public awareness on seismic risk is poor, recommending national campaigns of information and education on seismic risk.
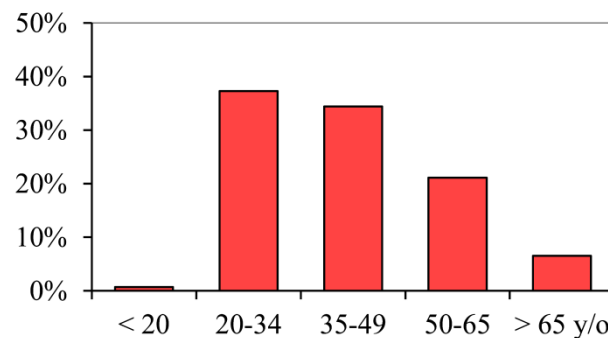
Ozkazac et. al [7] conducted a survey among students of Faculty of Architecture from Gazi University in Ankara, Turkey. The results showed that out of the total number of 187 surveyed students, only 15.5% received training in basic disaster awareness. Only 40% of the respondents know what to do in case of an earthquake and only 4.8% have an emergency situation bag. Another survey conducted in Zeytinburnu district of Istanbul [8] showed that only homeowners with higher house maintenance expenditure and expensive houses are more likely to adopt risk mitigation measures. The survey also showed that homeowners believe that the government has to take care of this problem. Santos - Reyes et. al [9] conducted a survey on seismic risk perception and other hazards in Mexico City area. The participants, wore selected by age, gender and education, divided into two categories: those who experienced the September 19th, 1985 Mexico City Earthquake and those who didn't. Respondents considered seismic risk as the most worrying daily threat (33%), followed by gas explosion (19%), fires (13%), volcanic eruption (11%) and floods (6%). The respondents showed insufficient knowledge about the right action to take during an earthquake, for instance they don't know that is not recommended (by Civil Protection) to immediately leave the building during the earthquake.

In Pakistan, a country with a high seismic risk, after a recent earthquake that occurred in 2013, 90% of the buildings from Baluchistan were demolished due to poor compliance of building codes. A survey on public awareness about earthquake risk and building codes enforcement conducted in Quetta [10] showed that respondents are aware of the seismic risk but have no knowledge about building codes. In Japan, after the 2011 great Tohoku earthquakes, the issue of the vulnerable aging population was emphasized. Annear et. al [11] showed that older adults are disproportionately represented among victims of disaster in Japan. Younger respondents were concerned about the vulnerability of Japan aging population to disaster, specially about risk associated with poor functional capacity and social isolation. The results suggest that social integration of elder people can decrease the vulnerability.

This study aims at evaluating the general opinion of the population currently living in Bucharest with respect to several earthquake-related issues such as population awareness and preparedness, safety concerns and post-earthquake behaviour in the event of a major earthquake hitting Bucharest. For this purpose, an extensive survey has been elaborated and conducted in Bucharest in 2016 on a period of eight months (February-September) as part of a research project entitled Community Based Performance Engineering (COBPEE). The survey contained, in total, 34 questions and was divided into five parts dealing with aspects such as the level of public information and education regarding the occurrence of a potential major earthquake in Romania, the importance of the level of structural safety for the population and the its expectations regarding the safety of newly constructed buildings, the level of damage expected by the population and post-earthquake behaviour. The target population was contacted mainly online, the questionnaire being disseminated on social media and by email. The questionnaire contains both closed as well as open questions, with a preamble with additional explanation when necessary. The target population selected for study is the population of Bucharest. To validate the sample, the results were compared with statistical data from the Population and Housing Census conducted in 2011, the margin of error obtained being ± 3.1%. Preliminary results may be found in [12].
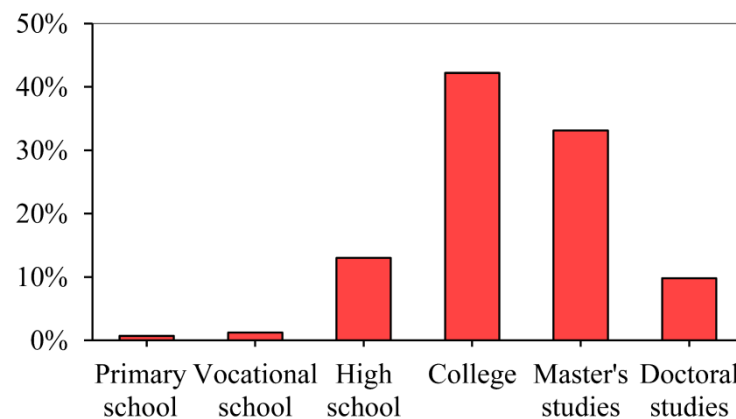
2. The target population

The COBEE survey targeted the population of Bucharest which, at the time of the most recent Population and Housing Census conducted in 2011, was inhabited by 1883425 residents out of which approximately 54% were women and 46% were men. A total number of 1000 people responded to the survey, 56% being female and 44% male. The responses analysed in this paper are interpreted based on five chosen criteria which describe the target population: age, education, income, children, year of construction of the building they inhabit and building type. The age distribution of the respondents is given in Figure 1 where it may be noticed that the majority of the respondents are young adults to middle aged persons. Also, 49% of the respondents have children whereas 51% don't.

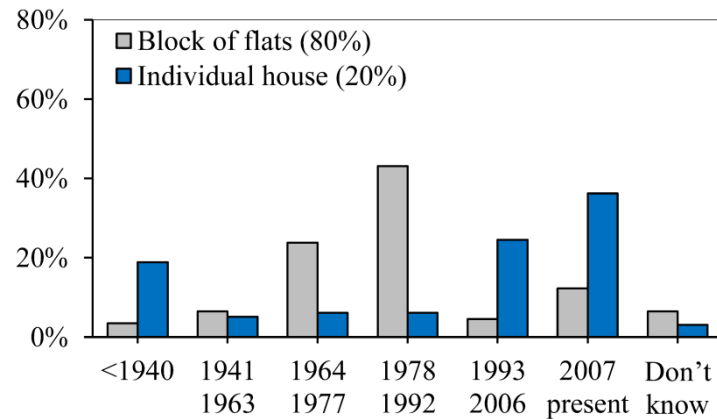**Fig. 1** – Age distribution of COBPEE survey respondents

As far as education level is concerned, Figure 2 shows that 85% of the respondents have higher education level as opposed to 15% who have either only graduated high school or vocational school. This might be due to the fact that the survey was conducted mainly online and higher-education level people might be more active in this area. The monthly income of the respondents is structured as follows: 18% earn less then 1500RON (approximately 330€), 44% earn between 1501…3000 RON (330€…660€) and 38% have a monthly income higher than 3000 RON (660€).

Fig. 2 – Distribution of COBPEE survey respondents with respect to education level

Roughly 80% of the respondents live in blocks of flats whereas 20% live in individual houses Figure 3 shows the distribution of the type of inhabited building with year of construction. It can be seen that most respondents live in blocks of flats built in the year interval 1978-1992 which is the end part of communist era in Romania. Results of the COBPEE survey also show that these buildings are considered the safest to live in by the respondents (39%) as opposed to, for example, the buildings built in the past ten years (26%). This is evidence that people think of those times in a positive way, at least in what concerns the construction industry. However,

results also show that, based on the type of expected damage, the safest buildings, as considered by the respondents, are those built between 1993-2006 [13].
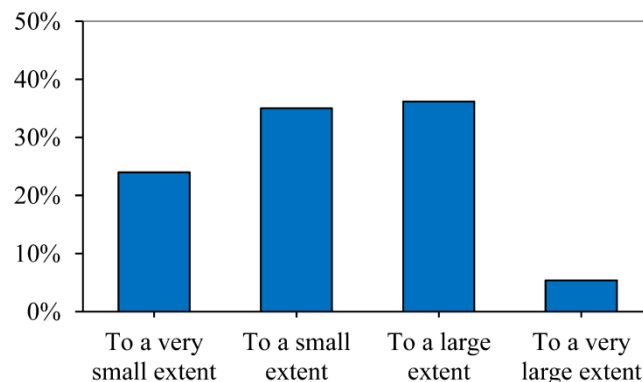

Fig. 3 – Distribution of individual houses and blocks of flats with year of construction

3. Awareness, preparedness and safety concerns

The population of Bucharest lives in an extremely vulnerable city, this high vulnerability being associated to the old building stock of the capital. The residential building stock of Bucharest comprises of more than 130000 buildings of which around 60 % was built prior to the seismic event of 1977. In addition, roughly 20% of the existing buildings (mostly masonry and reinforced concrete buildings) are approximately 70 years old or even older. These buildings are still inhabited today by people who are mostly unaware of the risk. In this context, the COBPEE survey had as objective to identify the level of awareness, preparedness and knowledge of the target population with respect to significant issues related to earthquake safety.

Results show that people are generally unaware about prevention measures and what to do in case of an earthquake as seen in Figure 5, with 59% of the respondents being aware to a small or very small extent. Also, only 5% of the respondents have an "emergency bag" prepared and ready for use in case of an earthquake as opposed to 95% who don't have such a kit of which 24% have never even considered preparing in this way for an earthquake. Out of the total number of respondents, 41% don't know how to perform first aid, 49% have some knowledge on the issue and only 10% have took a specialized course. Only 10% of the respondents have an agreed meeting point with their family in the event of major earthquake affecting Bucharest, whereas 90% don't.

Fig. 4 – Responses to: *Are you aware of the prevention measures and how to behave in case of earthquake according to the emergency situation guidelines issued by the General Inspectorate for Emergency Situations?*
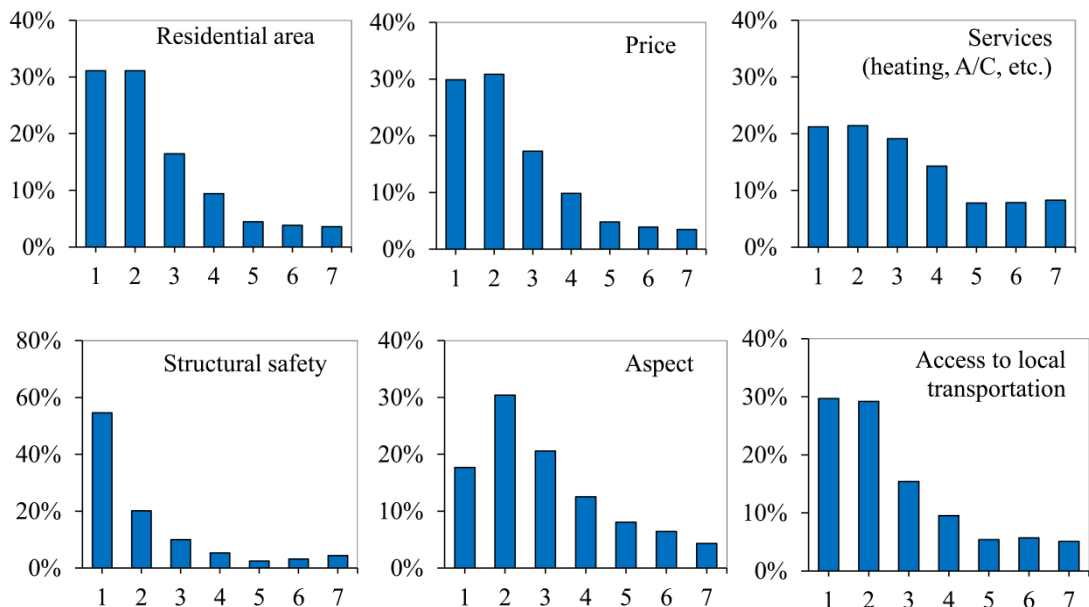
A further analysis of the results shows a strong association of group categories with awareness level represented by responses in Figure 4. The association was determined based on a chi-square test as seen in Table 1 where df represents the number of degrees of freedom and the p-value represents the probability used in the hypothesis testing. A p-value smaller than the chosen significance level (0.05) indicates a dependence between the selected variables. On the contrary, p-values larger than the significance level (0.05) shows weak or no correlation between the selected variables. χ^2 represents the value of the chi-square statistic for the given number of degrees of freedom. Age group 50-65 years old tends to be slightly more informed when compared to other categories whereas people aged 35-49 years old are the least informed when it comes to how to behave in case of an earthquake. Education and having children have no obvious association with earthquake awareness. Similar results are obtained from cross-tabulation of responses shown in Figure 4 with the year of construction of the building. However, an association was determined between the type of building and the level of earthquake awareness, respondents living in blocks of flats being better informed than those who live in individual houses. A similar association was determined between the level of income of respondents and the level of awareness, people earning more money being slightly more informed than those earning less as seen in Table 1.
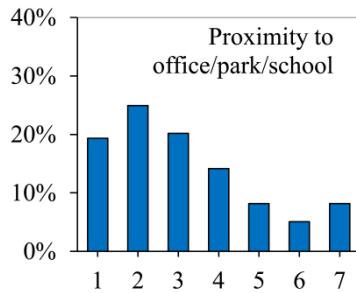
Table 1

Association with awareness level of criteria characterizing the target population

Variable	χ^2 or Likelihood ratio	df	p	Observation
age	31.655	12	0.002	strong association
children	3.991	3	0.262	no association
education	20.730	15	0.146	no association
income	18.502	6	0.005	strong association
type of building	7.867	3	0.049	association
year of construction	24.400	18	0.142	no association

Concerning preparedness of the surveyed population with respect to a major seismic event, results showed that only 5% have an emergency bag prepared and 10% have an agreed meeting point with the family. The majority of the 5%, corresponding to each selected criterion, are people aged 35-49 years old, living in blocks of flats built in the year interval 1978-1992, who have a Master's degree, earn between 1501…3000RON and have children. The same results are obtained for the 10% who have a meeting point established with their family.

Fig. 5 – Responses to question: *When buying an apartment in a new building (build within the last 10 years), please specify the importance level for each criterion in your opinion*
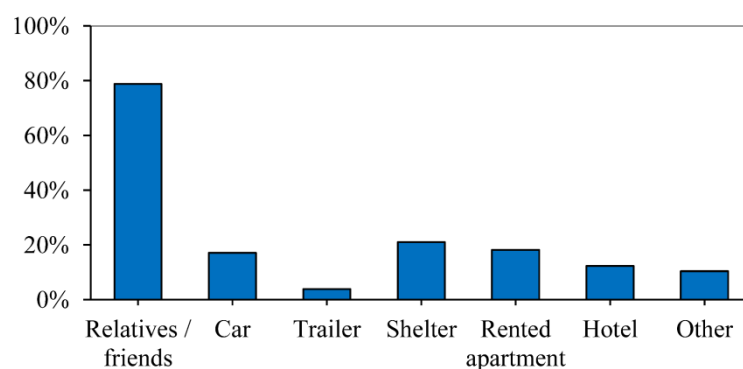
Related to safety concerns, respondents were asked whether they feel safe in the building they inhabit. Only 10% don't feel safe in their buildings whereas 45% feel partially safe. The rest of 45% specified that they feel completely safe. The majority of those who do not feel safe are aged 20-34 years old and live in blocks of flats built before 1992.

Figure 5 shows results corresponding to question *When buying an apartment in a new building (build within the last 10 years), please specify the importance level for each criterion in your opinion.* Respondents were asked to rank the given criteria from 1 to 7, 1 being of highest importance and 7 the least important. Results showed that structural safety ranked first, with 55% of the respondents selecting this as the most important criteria to consider when buying a new home. The second criteria resulted the price together with residential area whereas the third one was the aspect of the building.
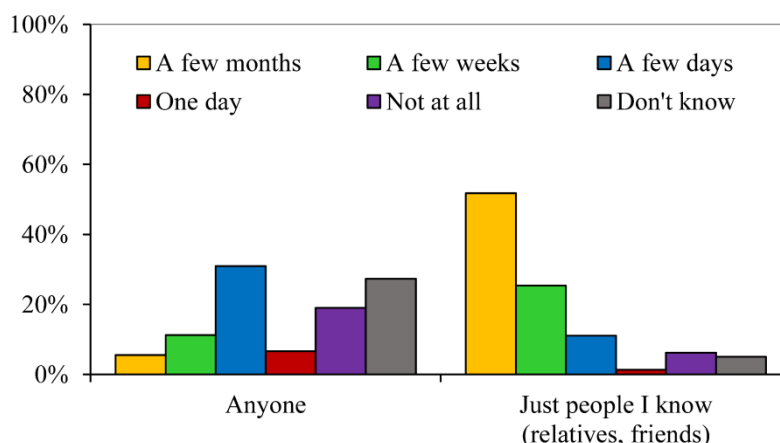
4. Post-earthquake behaviour

This paper investigates the social impact of a possible major earthquake affecting Bucharest by means of a survey conducted on the residents of the capital city. To this aim, several questions were asked in order to examine post-earthquake behaviour of the residents, with focus on their involvement in the aftermath of the seismic event.

Respondents were asked to express their opinion with respect to the choice of temporary shelter in case they were forced to leave their home due to earthquake damage (Fig. 6).

Fig. 6 – Responses to question: *After a major seismic event, you are forced to leave your home. What temporary shelter would you choose?*

The vast majority, 79%, would seek shelter from relatives or friends in such a situation, the next choice being a shelter offered by the authorities or NGO's (13%). As for the time they would spend in the chosen temporary shelter, 35% of the respondents would spend a few days, 25% a few weeks, 10% a few months, 4% only one day and the rest of 26% didn't know how to answer this question.

Fig. 7 – Responses to question: *After a major seismic event, would you agree to offer temporary shelter?*

Further on, we asked respondents whether they would agree to offer temporary shelter to people and for how long. As seen in Figure 7, respondents would rather help family or friends, with 52% agreeing to offer temporary shelter for a few months to someone they know as opposed to 5% who would offer their help to anyone for the same amount of time. However, 31% of the respondents would receive a stranger in their home for a few days.

Table 2 shows the cross-tabulation between age-groups and answers in the category *Anyone*. The highest percentages in each category are obtained for age-group 20-34 years old showing that young adults are more willing to accept strangers into their homes. Table 2 also shows a somewhat decreasing pattern of willingness to accept strangers with increasing age, people over 65 years old being the most reluctant. When comparing these answers to income categories, results show that people earning less money are less willing to offer temporary shelter to strangers as well as to people they know. This is understandable given the fact that providing shelter generally implies attending to other needs such as, for example, providing food which implies considerable cost. Related to children, as expected, families with children are less willing to receive strangers in their homes, even for a single day, than people who don't have children. Finally, results show that education level is not associated with willingness to offer temporary shelter to strangers, although, people with higher education tend to be more prone to help unknown people than people with lower education levels.
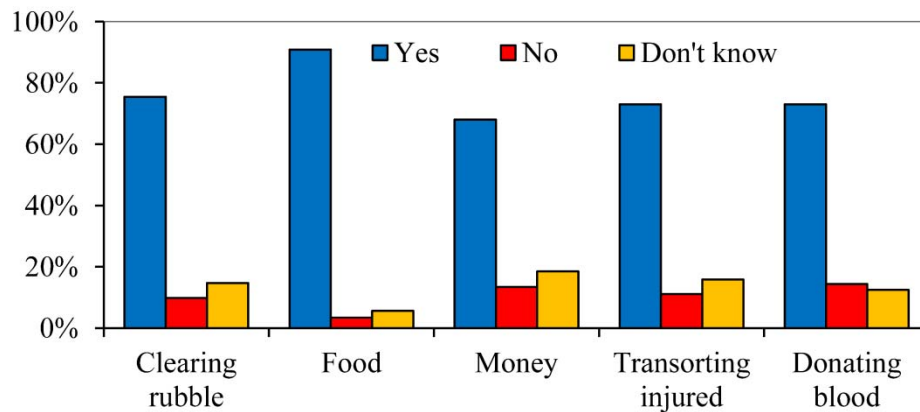
Table 2

Cross-tabulation age-groups vs. willingness to offer temporary shelter to strangers

		Age group					
		<20	20-34	35-49	50-65	>65	Total
After a major seismic event, would you agree to offer temporary shelter? Answers: To anyone	A few months		35.0%	25.0%	27.5%	12.5%	100%
	A few weeks		42.7%	34.8%	20.2%	2.2%	100%
	A few days	.4%	38.8%	40.0%	16.7%	4.1%	100%
	One day		55.1%	30.6%	10.2%	4.1%	100%
	Not at all	1.4%	38.6%	32.1%	19.3%	8.6%	100%
	Don't know	1.0%	41.3%	32.2%	21.2%	4.3%	100%
Total		.6%	40.7%	34.5%	18.9%	5.2%	100%

Another aspect considered in this study is represented by the willingness to provide humanitarian help after a major seismic event. At it may be noticed in Figure 8, the majority of people would offer help in various ways such as clearing rubble, donating blood, providing food and so on. Offering money has obtained the lowest percentage, as expected. A cross-tabulation of this category with respondents' income shows, as expected, that people earning less money are less willing to offer this

kind of help. Related to age-groups, a decreasing pattern is observed, with younger people more willing to offer money, the highest percentage being obtained for the 20-34 years old category.

Fig. 8 – Responses to question: *After a major seismic event, would you agree to offer humanitarian help?*

5. Conclusions

This paper presents results obtained from a survey questionnaire conducted in Bucharest in 2016 for which a total number of 1000 responses were obtained. The main goal was to identify the opinion of the population regarding the social impact of a strong earthquake affecting Bucharest. The results were further analysed with respect to several criteria characterizing the target population such as age, income, education, children, type and year of construction of the building they inhabit.

Romania is a country which has experienced major earthquakes that have produce both human loss as well as considerable damage. However, results show that people generally seem to be unprepared for a future event of such magnitude. Only 5% of the respondents have a bag prepared for emergency situations and only 10% have an agreed meeting point with the family in the event of a major earthquake. This might due to the fact that major earthquakes in Romania occur roughly every 50 years and so, when generations change, people tend to forget. Also, the last major earthquake occurred in a period when Romania was under a communist regime which tried to hide from the public the actual amount of damage and loss that the earthquake induced. The results show that no obvious relationship exists between education or having children with the level of earthquake awareness or preparedness. Respondents aged 50-65 years old are generally better informed on how to behave in case of an earthquake than the rest age groups whereas the 35-49 years olds are the less informed. Related to safety concerns, more than half of the respondents consider structural safety as the first criteria to take into account when buying an apartment in building erected in the past 10 years. Also, in general, respondents feel safe or partially safe in the buildings they inhabit, with only 10% not feeling safe in their homes. These are generally young adults (20-34 years old) living in blocks of flats built before 1992.

Finally, results related to post-earthquake implication show that people are very willing to offer their help in the aftermath of such an event in various forms such as clearing rubble, donating food, money or blood as well as offering temporary shelter to strangers. Results show a somewhat decreasing curve of willingness to offer temporary shelter to anyone for a period of time from one day to a few months with increasing age, the most willing to offer this type of help being younger people, aged 20-34 years old. Also, there is a strong correlation between income level and willingness to accept strangers or even know people into their home, with people having more money being more willing to help is such a way.

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