

Risk perception in Istanbul: An earthquake-prone city

Seda KUNDAK*, **Handan TÜRKOĞLU***, **Alper İLKİ****

* *Istanbul Technical University, Faculty of Architecture, Department of Urban and Regional Planning, Istanbul, TURKEY*

** *Istanbul Technical University, Faculty of Civil Engineering, Department of Civil Engineering, Istanbul, TURKEY*

Received: July 2013

Final Acceptance: January 2014

Abstract:

Risk perception on natural hazards in Turkey has been an emerging topic after of 1999 Kocaeli and Duzce earthquakes. The motivation lies behind the fact that it was the first time in the Turkish history, disaster mitigation had been considered as the responsibility of not only the government, but also all stake holders. Therefore, awareness campaigns, public participation, volunteering and increasing individual capacity against earthquakes have become hot topics to have a fresh start in building resilient communities. This paper aims to reveal earthquake risk perception and preparedness level of Istanbul residents. The results of two recent surveys on risk perception which were conducted in 2008 and 2013 are evaluated according to measures taken, willingness to pay for a safer house and trust to authorities. The findings of both surveys underline that there is an improvement in risk perception and measures taken to reduce risks related with earthquakes.

Keywords: *Istanbul, risk perception, risk reduction.*

1. Introduction

Istanbul is one of the most populated cities of the world which is located close to the North Anatolian Fault that can produce major earthquakes with high frequency of occurrence. Ambraseys and Finkel (1991) noted that “... during the 20th century no truly large shocks have occurred near Istanbul”. Eight years later, the expected shock hit the eastern part of the Marmara Region. When the Kocaeli earthquake occurred; in Istanbul, 1-2% of the buildings were damaged, 454 people were killed and 3600 people were injured (Erdik et al, 2000). Afterwards, Parsons (2004) underlined in his research that in the next 30 years, Istanbul would be affected by a magnitude 7.0 or higher earthquake with the probability of 41±14%. After the Kocaeli and Düzce earthquakes, seismicity and safety issues reached to highest rating in media, scientific and administrative platforms. While, this consequence was crucial for people to get more information, it also caused confusion in community in terms of risk perception.

Risk perception is defined as a subjective assessment of people about the consequences of hazards and severity of risks (Paton et al., 2001). Risk

perception studies basically aim to examine the key factors affecting the risk perception of governors, policy-makers and lay people. Furthermore, risk perception studies are considered critical as they give information about the level of preparedness of communities at-risk (Carlino et al., 2008; Perry and Lindell, 2008). The expected output of successful research on risk perception is to improve risk dialogue among all stakeholders, to provide participatory decision-making and to enhance educational efforts (Slovic et al., 1982; Arvai, 2003). There are several factors which may affect individual subjective assessment such as inherent factors (age, education, gender etc.) (Slovic et al., 1982, Turner et al. 1986; Dooley et al., 1992; Barnett and Breakwell, 2001), external factors (information, trust etc) (Slovic et al., 1991, Slovic, 1993; Liu et al., 1998; Siegrist and Cvetkovich, 2000; Sjöberg, 2001; Viklund, 2003; Horst et al., 2007) and cultural factors (societal structure, believes, habits etc.) (Bontempo et al, 1997; Weber and Hsee, 1998; Sjöberg, 2000; Renn and Rohrmann 2000; Rippl 2002).

This paper aims to reveal earthquake risk perception and preparedness level of Istanbul residents. The results of two recent surveys on risk perception which were conducted in 2008 and 2013 are evaluated according to precaution measures taken, willingness to pay for a safer house and trust to authorities. In the next section, risk perception studies on Istanbul are referred with their basic findings. The following sections present the methodology and analyses of the two surveys, including the comparison and cross-tabulation. In the last section, the findings are discussed in the frame of their possible contributions to risk reduction activities in a city-at-risk.

2. Background

Risk perception on natural hazards in Turkey has been an emerging topic after of 1999 Kocaeli and Duzce earthquakes. The motivation lies behind the fact that it was the first time in the Turkish history, disaster mitigation had been considered as the responsibility of not only the government, but also all stake holders. Therefore, awareness campaigns, public participation, volunteering and increasing individual capacity against earthquakes have become hot topics to have a fresh start in building resilient communities. The most obvious constraint in dissemination of risk reduction activities among people had arisen in the scope of their willingness which is supported by their trust to others, liability on information's given and their risk perception. Few but comprehensive case studies have been accomplished in this period focusing to investigate risk perception of Istanbul's inhabitants (Figure 1) (Kundak, 2013).

Fişek et al. (2002) investigated the role of socio-economic level of individuals on risk perception. The research was conducted on five districts of Istanbul with 254 face-to-face interviews. Two basic findings were underlined as: high risk perception level does not reflect on risk reduction activities, and socio economic level of respondents has an impact on risk perception, however the perception "*does not translate into mitigation behavior*". Inelmen et al. (2004) studied the level of community involvement in disaster mitigation activities. They worked with a focus group of a community-based organization specialized on disaster management. The results of this study showed that lack of trust disables community involvement and consequently, there is an emerging need that local and central governmental institutions should bring CBO's and NGO's in disaster related activities, in order to increase the recognition of these organizations in public. Green (2008)

focused on squatter and unauthorized areas in Istanbul to investigate the perception of inhabitants on seismic hazard and their opinion on engineers. She denoted that interviewees believe that the dwellings that they built, are not only cheaper but also safer. Consequently, some residents think that “engineers would use their technical knowledge to increase construction costs and garner excessive design fees”.

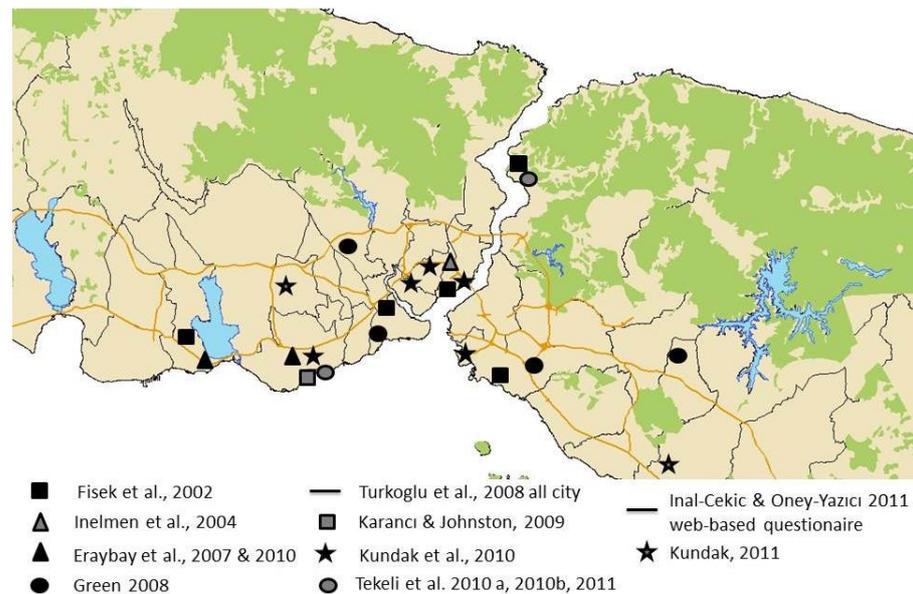


Figure 1. Risk perception studies in Istanbul (Kundak, 2013).

In 2006, Turkoglu and her colleagues conducted “The Quality of Urban Life Study” which was undertaken as part of the Istanbul Strategic Plan prepared by the Istanbul Metropolitan Municipality. The purpose was to explore the impact of environmental, economic, social, physical and health related indicators on quality of life satisfaction among Istanbul residents. 1,635 face-to-face household interviews, the interviewers tapped residents’ assessments of various dimensions of urban life. Using the database produced in this survey, Turkoglu and her colleagues evaluated subjective assessment of respondents on environmental problems and risks. The results showed that respondents having younger children are more concerned with environmental problems, women take security issues more serious than men do, income level and academic qualification are powerful indicators to be willing to pay more to reduce environmental risks (Türkoğlu et al, 2008). Karancı and Johnston (2009) conducted a research on social and economic barriers to seismic retrofitting of residential buildings and they compared the examples from Turkey and New Zealand. In Istanbul they administered questionnaires with 2429 people living in the high risk buildings. They basically asked the opinion of respondents on risk reduction activities in their households. The majority of the respondents declared that something could be done for mitigation, however, only half of them believed they could take this action. The barrier that they mostly mentioned in risk reduction was identified as the cost of this intervention. On the 9th anniversary of Kocaeli Earthquake in 2008, Kundak et al (2010) conducted a short survey in the exhibition stands at the five major nodes of the city which were installed to give information and to disseminate documents on current mitigation activities. During this activity, the visitors were asked to fill a short questionnaire on earthquake risk perception and their willingness to

participate trainings which would be organized by Istanbul Governorship. In two days, 1316 face-to-face interviews were accomplished. Regarding to the results, governmental authorities have difficulties to reach people to give information what they had done and what people have to do. Furthermore, the result of the survey underlines how gender, age and education affect risk perception and mitigation activities.

Tekeli et al. tested a risk perception survey on a focus group with 93 people in 2006. They pointed out that *“lower socioeconomic and education level, ..., are the main factors that hinder participants in taking earthquake precautions”* (Tekeli et al. 2010a). Tekeli et al., then conducted a comprehensive and improved field survey in 2007 to investigate the factors affecting risk perception of individuals. 1123 people were interviewed in two districts of Istanbul. They revealed that personal characteristics and home ownership are crucial indicators to affect the involvement of people into risk reduction activities (Tekeli et al, 2010b). Besides, they underlined that risk knowledge is *“not enough to make people take action”*. This finding perfectly overlays with the statement of Palm and Hodgson (1993) where they noted that *“a person may be aware of a hazard, and know about mitigation measures, but still be constrained from appropriate action”* because of numerous factors. In the further step, risk perception and risk knowledge level of interviewees were crossed with their socio-economic level (income, education, home ownership). The results underlined that activities to increase earthquake awareness should target lower socio-economic using the media and internet in more effective way (Tekeli et al, 2011).

In 2007, Eraybar and his colleagues conducted a survey on risk perception in two districts of Istanbul. The first case study area was Avcılar where the most devastating impact occurred in Istanbul due to Kocaeli earthquake in 1999. The main finding of the survey was that earthquake experience reveals as an important factor to make people worry about the future, but, it has no impact in taking precautions (Eraybar et al., 2007). In the following study of the same group, they evaluated the results that they got in Avcılar with another district, Bakirköy where the inhabitants have higher socio-economic level. Thus, they found a strong relationship between the awareness and academic qualification of respondents; however they found some minor effects on behavior of respondents (Eraybar et al., 2010).

Kundak (2011) conducted a survey on participants of earthquake risk reduction training programs. The questionnaire was administered in 21 training activities with 492 community representatives. Among the participants, housewives revealed as the most active and volunteer group to practice more and to contribute dissemination activities. İnal-Çekiç and Öney Yazıcı (2011) studied the attitudes and perceptions of housing investors regarding to earthquake threat. They interviewed 117 people who invested on housing in Istanbul since 1999, after the Kocaeli earthquake. They found out that *“the individuals with high perception of risk have a tendency towards the new residential buildings”* and a great housing demand has been emerging in the northern part of the city (because the Northern Anatolian Fault travels in the south of Istanbul).

The findings of the researches given above mostly overlay with the critical correlations cited in the risk perception literature. Furthermore, they enlighten hidden relationships among personal characteristics, socio-economic status and preferences of Istanbul inhabitants. The suggestions

indicated in these papers are useful to design an efficient path to increase both earthquake awareness and coping capacity of people.

3. Methodology and prefatory results

This paper evaluates the results of two surveys on earthquake risk perception of Istanbul residents which were conducted in 2008 and 2013. The samples for both surveys were randomly selected. The first survey was conducted in the summer of 2008, in the 33 neighborhoods of Istanbul, where 496 face-to-face household interviews were accomplished to assess risk perception of Istanbul inhabitants. The second survey was conducted in the spring of 2013, in 48 neighborhoods, where 491 face-to-face household interviews were carried out. In Figure 2, the case study neighborhoods of 2008 and 2013 are given.

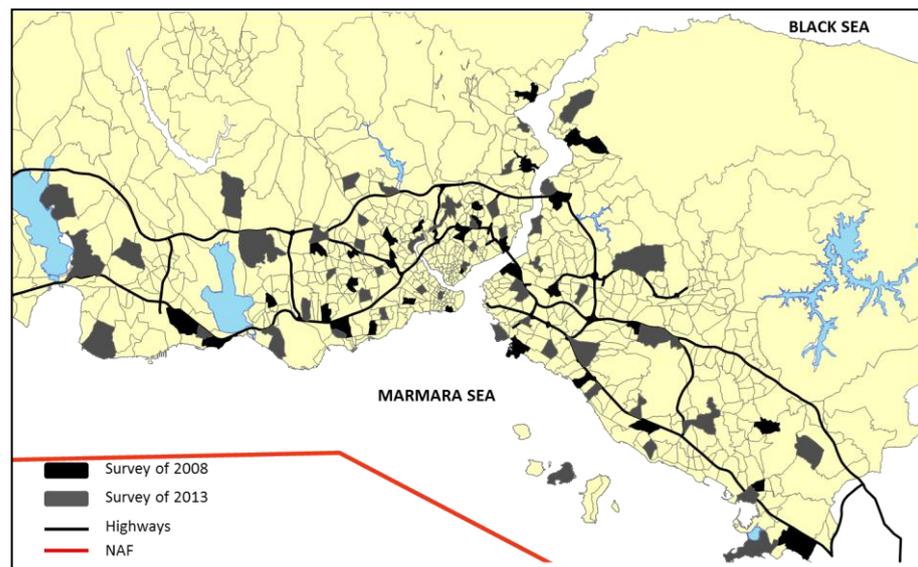


Figure 2. Risk perception case study areas in 2008 and 2013.

The questionnaire form of both surveys consists of seven chapters including information on: (1) personal data; (2) household data; (3) residence data; (4) disaster's experience and perception of respondents; (5) disaster preparedness; (6) participation, awareness and perception; and (7) volunteering. In the chapters from (4) to (7), some questions are designed with multiple-choice answers and others with Likert Scale. In this paper, precaution measures taken for earthquake risk reduction, willingness to pay for safer house and trust of respondents are evaluated.

3.1 Personal characteristics of respondents

As the consequence of random selection of the samples in the surveys, personal characteristics of respondents differ from each other and also from the distribution in Istanbul according to two censuses in 2008 and 2013 respectively. Female and male gender ratio in Istanbul is 1.01, whereas, in the survey of 2008 the gender ratio is 6.6 and in 2013 it is around 0.7. Once the ratios are associated with the age distribution and the occupation of respondents, it is clear that the share of retired male respondents of the first survey in 2008 was high, while the share of housewives in the survey of 2013 was higher. In both surveys, the age distribution of respondents presents a similar concentration where the highest ratios are indicated in the

groups of 30-39 and 40-49. The education level of respondents in the surveys is considerably high comparing to Istanbul's average (Table 1).

Table 1. Personal characteristics of respondents.

| | 2008 | | Istanbul (2008) ¹ | 2013 | | Istanbul (2013) ² |
|------------------|------|------|---------------------------------|------|------|---------------------------------|
| | # | % | % | # | % | |
| Gender | | | | | | |
| Female | 65 | 13,1 | 49,7 | 292 | 59,5 | 49,8 |
| Male | 431 | 86,9 | 50,3 | 199 | 40,5 | 50,2 |
| Age | | | | | | |
| <20 | 8 | 1,6 | 32,4 | 10 | 2,0 | 30,7 |
| 20-29 | 90 | 18,1 | 19,4 | 101 | 20,6 | 17,4 |
| 30-39 | 98 | 19,8 | 18,1 | 119 | 24,2 | 19,1 |
| 40-49 | 145 | 29,2 | 13,3 | 122 | 24,8 | 14,2 |
| 50-59 | 88 | 17,7 | 8,9 | 74 | 15,1 | 9,7 |
| 60-69 | 60 | 12,1 | 4,6 | 48 | 9,8 | 5,2 |
| >70 | 7 | 1,4 | 3,3 | 17 | 3,5 | 3,7 |
| Education | | | | | | |
| Literate | 12 | 2,4 | 21,7 | 19 | 3,9 | 18,5 |
| Primary School | 171 | 34,5 | 31,7 | 146 | 29,7 | 20,9 |
| Secondary school | 70 | 14,1 | 17,2 | 59 | 12,0 | 25,0 |
| High school | 154 | 31,0 | 20,3 | 178 | 36,3 | 21,0 |
| University | 79 | 15,9 | 8,0 | 75 | 15,3 | 12,8 |
| Master / PhD | 10 | 2,0 | 1,1 | 11 | 2,2 | 1,8 |

¹ Turkish Statistical Institute, 2008

² Turkish Statistical Institute, 2013

Table 2. Spatial features of surveyed neighborhoods.

| | 2008 | | 2013 | |
|--|------|------|------|------|
| | # | % | # | % |
| Population Density (p/ha) | | | | |
| Low (< 100) | 84 | 16,9 | 231 | 47,0 |
| Medium (100-200) | 201 | 40,5 | 120 | 24,4 |
| High (200 <) | 211 | 42,5 | 140 | 28,5 |
| Land Value (TL/m²) | | | | |
| Low (< 100) | 286 | 57,7 | 281 | 57,2 |
| Medium (100-250) | 188 | 37,9 | 100 | 20,4 |
| High (250 <) | 22 | 4,4 | 110 | 22,4 |
| Acceleration Response Spectrum (gal.) | | | | |
| Low (< 400) | 104 | 21,0 | 130 | 26,5 |
| Medium (400-600) | 190 | 38,3 | 170 | 34,6 |
| High (600 <) | 202 | 40,7 | 191 | 38,9 |

3.2 Spatial features of case study neighborhoods

Istanbul is the largest city of Turkey and Europe with its population of 14.1 million. The urban pattern of the city shows a polycentric structure which can be noticed by the change in the two most relevant indicators which are population density and land value in the neighborhoods of the city. Consequently, while the traditional city center has a saturated level in population, sub-centers and the surrounding areas show an increase in population, once the difference between 2008 and 2013 is evaluated. In 2002, Japan International Cooperation Agency (JICA) and Istanbul Metropolitan Municipality conducted a comprehensive study on earthquake modelling for the fault segment of the North Anatolian Fault near to Istanbul. In this study, four earthquake scenarios were produced and ground accelerations for each model were calculated. In our study, acceleration response spectrum (ARS) for an earthquake with the magnitude of 7.7

(according to the worst case earthquake scenario) is used to represent the earthquake threat in the neighborhoods (Table 2).

4. Evaluation of earthquake risk reduction activities, willingness to pay and trust

Risk reduction activities and taking mitigation measures at households are considered as the most tangible reflection of risk perception. Some people are aware of risk and take precautions, whereas others may have tendency to ignore it (Asgary and Willis, 1997). On the other hand, as Palm and Hodgson (1993) underlined, even though some people know about the risks and the way to protect their residents and families, there may be some obstacle to prevent them to take necessary action. Likewise, Fişek et al (2002) commented on the results of their survey as “*The level of perceived risk is not necessarily followed by commensurate efforts at mitigation.*”

As noted in the previous section, some differentiations can be observed in the results of 2008 and 2013 surveys. These changes may rely on the random sampling where none of the interviewees attended to both surveys. On the other hand, considering the confidence level of 95% and confidence interval of 4.4, it can be noted that both groups are representative to evaluate risk perception in Istanbul. Therefore, some additional parameters may come up to explain the changes in frequency distribution in the surveys. In this section, the differentiation in the responses is evaluated and the effect size of these changes is explained by using Cohen’s d (Table 3).

Table 3. Differentiation rates between 2008 and 2013.

| | M 2008 | M 2013 | t | p | Cohen’s d* |
|---|--------|--------|--------|-----------|------------|
| Precautions | | | | | |
| Living in/moved to/bought an earthquake resistant house | 0,13 | 0,35 | 8,111 | < 0.001 | 0,519 |
| Retrofitting the house | 0,05 | 0,18 | 6,865 | < 0.001 | 0,451 |
| TCIP Insurance | 0,31 | 0,28 | 0,802 | <i>ns</i> | 0,050 |
| Private Insurance | 0,04 | 0,10 | 4,122 | < 0.001 | 0,267 |
| Secured the safety of non-structural components | 0,11 | 0,24 | 5,294 | < 0.001 | 0,338 |
| Keeping emergency materials | 0,10 | 0,28 | 7,585 | < 0.001 | 0,489 |
| Awareness rising with family members | 0,18 | 0,43 | 9,066 | < 0.001 | 0,577 |
| Awareness rising with neighbors | 0,01 | 0,24 | 11,492 | < 0.001 | 0,842 |
| Willingness to Pay | | | | | |
| Budget allocated for a safer house (owners) | 2,65 | 2,50 | 1,791 | <i>ns</i> | 0,113 |
| Budget allocated for a safer house (tenants) | 2,20 | 1,65 | 7,381 | < 0.001 | 0,475 |
| Trust | | | | | |
| Trust to the municipality in EQ risk reduction | 2,09 | 2,71 | 7,515 | < 0.001 | 0,475 |
| Trust to the governorship in EQ risk reduction | 2,16 | 2,86 | 8,373 | < 0.001 | 0,529 |
| Truth / exaggeration in EQ issues | 3,78 | 3,26 | 6,013 | < 0.001 | 0,380 |
| Everything is told / not told | 3,21 | 2,97 | 2,648 | < 0.01* | 0,167 |
| Relevant information is given / hidden | 3,12 | 2,92 | 2,282 | < 0.01* | 0,144 |

* Cohen’s 0.2 > d small effect size; 0.2 < d < 0.50 medium effect size; d > 0.50 large effect size.

4.1 Precautions taken by the respondents to reduce earthquake risk (earthquake mitigation at households)

While risk perception represents the subjective assessment of risks, it also enfold risk mitigation activities implemented by individuals. In the questionnaire, respondents were asked to define the mitigation/precaution measures that they had already taken in their households. The results of 2008 and 2013 surveys show that there is a dramatic difference in households' risk reduction in the five-year period. In the 2008 survey, half of the respondents declared that they had done nothing to reduce earthquake risks in their households. In the 2013 survey, this ratio decreased to 37.5%. Furthermore, the number of precautions taken increased in 2013, comparing to the results in 2008 (Table 4) (Figure 3). Even though, the questionnaire does not imply the root causes of motivation to take action in risk reduction at the households, some triggers should be noted to understand this shift.

Table 4. Number of precautions taken by respondents.

| | 2008 | | 2013 | |
|--------------|------------|------------|------------|------------|
| | # | % | # | % |
| None | 248 | 50,0 | 184 | 37,5 |
| 1 | 114 | 23,0 | 92 | 18,7 |
| 2 | 77 | 15,5 | 47 | 9,6 |
| 3 | 38 | 7,7 | 45 | 9,1 |
| 4 | 17 | 3,4 | 28 | 5,7 |
| 5 | 1 | 0,2 | 34 | 6,9 |
| 6 | 1 | 0,2 | 19 | 3,9 |
| 7 | 0 | 0 | 23 | 4,7 |
| 8 | 0 | 0 | 19 | 3,9 |
| Total | 496 | 100 | 491 | 100 |

In the group of *precautions taken for risk reduction in the households*, it can be noted that there are medium to large size changes in moving to an earthquake resistant house and retrofitting the house, even though these precautions require considerable investment from the household budget. In the recent years, the number of new housing projects has raised at the fringe of Istanbul as well as at the urban regeneration subjected areas. Moreover, current mortgage system offers alternatives extending up to 10 years. Consequently, purchase of new houses which have been built according to the new building codes seems favorable to people who plan to move to an earthquake resistant building.

Purchasing TCIP insurance does not show any difference when it is compared to the value in 2008, however, there is a slight difference in the case of purchasing private household insurance. TCIP covers earthquake related damages on buildings up to defined limits according to earthquake zones and building types. On the other hand, private household insurance covers all losses in domestic items and dwelling due to natural hazards (including earthquake, fire, inundation etc.), terrorist attacks and robbery. Consequently, the number of respondents who bought both insurance for their household safety has increased in 2013, once it is compared to the ratio in 2008.

Minor and low budget adjustments in households, such as *securing the safety of non-structural components and keeping emergency materials*, show medium size effects. This change can be explained with the dissemination of knowledge on earthquake risk reduction through the media.

The largest effect size is observed in awareness rising in the respondents in both their households and neighborhood. This shift can be related with the increasing number of NGO's in neighborhoods which are specified on earthquake preparedness and risk reduction. For instance, Neighborhood Disaster Volunteer Program (NDV) (MAG - Mahalle Afet Gönüllüleri in Turkish) is a widespread initiative which presently covers 62 neighborhoods with more than 5000 volunteers in Istanbul (MAG, 2013).

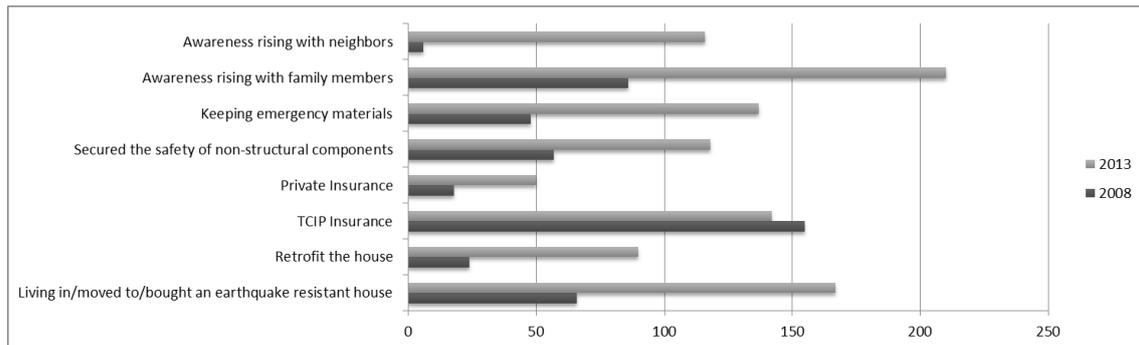


Figure 3. Precautions taken by respondents.

On the other hand, public awareness campaigns can be evaluated as useful triggers for people to learn about risk reduction methods and to implement these methods in their residence. Indeed, these activities have been set since the 1999's earthquakes; however, they might become visible and demanded by public after L'Aquila Earthquake in 2009, Haiti Earthquake in 2010, Tohoku Earthquake in 2011 and Van Earthquake (Turkey) in 2011. In fact, Van Earthquake should be considered as a litmus paper to check the performance of all institutional and legal adjustments which had been improved after 1999. The long recovery process after the Van Earthquake may urge Istanbul citizens to take their own risk mitigation measures in advance, rather than to expect governmental recovery after a major earthquake which is likely to hit Istanbul in the near future. Therefore, as indicated in the Figure 3, the number of respondents who gave positive answers for different choices listed in mitigation/precaution activities has increased in 2013.

4.2. Willingness to pay to reduce earthquake risk

It is certain that people can afford earthquake risk reduction activities according to their household budget. Therefore, instead of asking our respondents how much they could pay for a safer house, we asked how much they can allocate for this purpose as number of months/years of their family income. In the survey of 2008, 47% of homeowners denoted that they can allocate 3-6 months family income to retrofit their houses while 27% are willing to spend less than their monthly income. Regarding to tenants, 47% declared they would not accept any raise in their rent; even their house would be safer after retrofitting. Regarding to the survey of 2013, 20.8% of homeowners responded that they can allocate 3-6 months family income to retrofit their houses where it represents about a half of the ratio received in 2008. The majority of homeowners (36.5%) checked the choice 1-3 month household income to allocate for a safer house. As for tenants, in 2013, any raise in their rent is not acceptable as it was noted in 2008, but with a larger share of 60% (Figure 4 and Figure 5). The major change in tenant's case might have several reasons. For instance, tenants might think that instead of having rent increase in an old building, it would be logical to pay more for an

apartment in a new building which was constructed according to the new building codes. Another reason might be that tenants prefer living in their current resident because of the affordable rent. Consequently, they would not accept any raise in their rents which would put pressure on their budget.

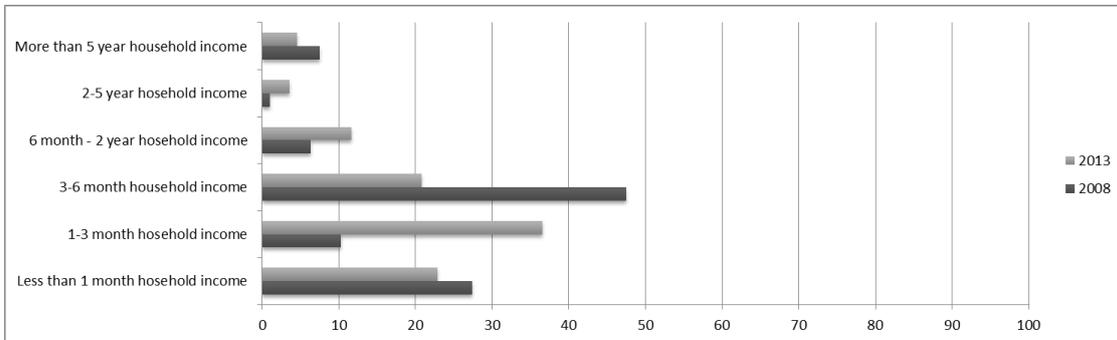


Figure 4. Willingness to pay for a safer house (home owners).

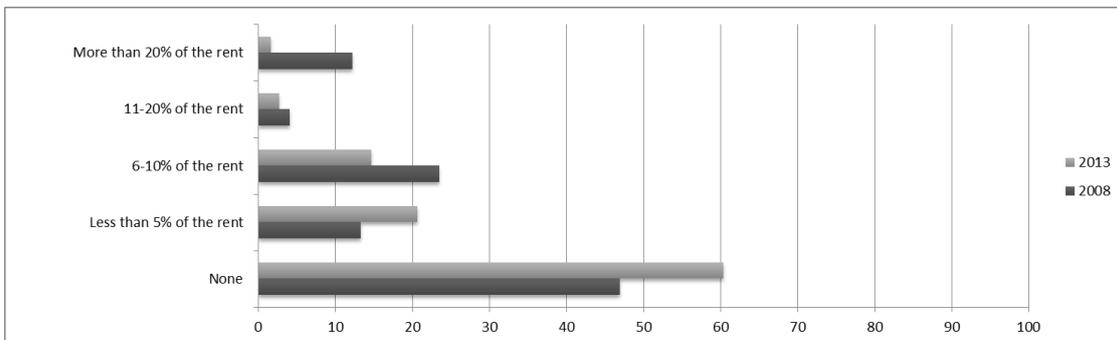


Figure 5. Willingness to pay for a safer house (tenants).

4.3. Trust to authorities and information

In both of the surveys, trust is used as an indicator to explain how people see earthquake risk and how they evaluate mitigation activities conducted by central and local administrations. The Likert Scale from 1 to 5 is employed in the questions related to trust. The first two questions are designed to reveal the thoughts of respondents on risk reduction activities handled by the Istanbul Metropolitan Municipality and the Istanbul Governorship respectively (Figure 6 and Figure 7). It can be easily noticed that there is a great change in satisfaction of respondents in the favor of both municipality and governorship. This shift may rely on tangible results of mitigation

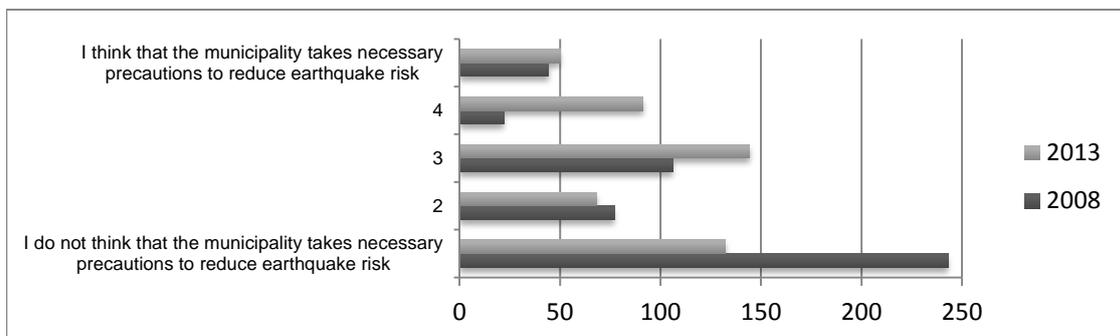


Figure 6. Perception of respondents on risk reduction activities by Istanbul Metropolitan Municipality.

activities such as; retrofitting public buildings (schools, hospitals, etc.), organizing widespread earthquake trainings in public and private entities, dissemination of online risk reduction tools and so on.

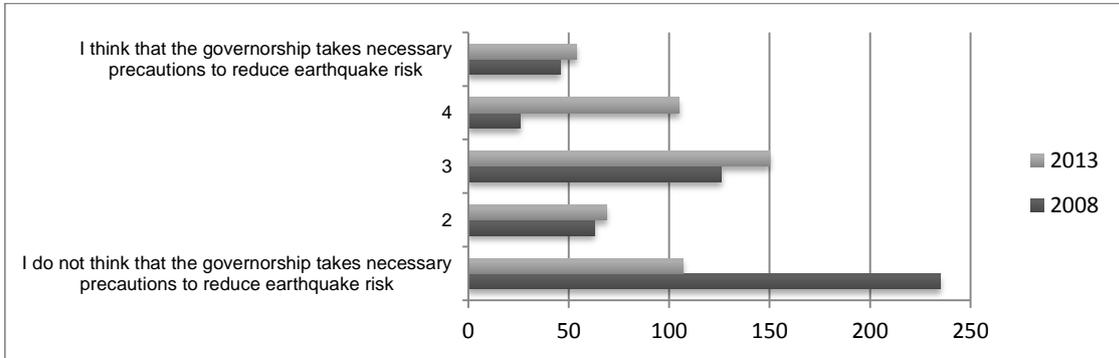


Figure 7. Perception of respondents on risk reduction activities by Istanbul Governorship.

The following three questions examine the level of skepticism of respondents on the information related to earthquake that they receive from different channels. Few respondents think that earthquake risk is exaggerated. On the other hand, according to the results of 2008, there is a great emphasis that earthquake risk has factual basis. Regarding to the results in 2013 survey, the distribution has relatively homogenous pattern comparing to those in 2008 (Figure 8). In the next two questions, respondents tell their opinion on accessibility to the information given on earthquake risk and earthquake hazard. Both surveys show that the number of respondents who think that information related to earthquake risk and earthquake hazard is given, is almost equal to the share of respondents who think in the opposite way (Figure 9 and Figure 10).

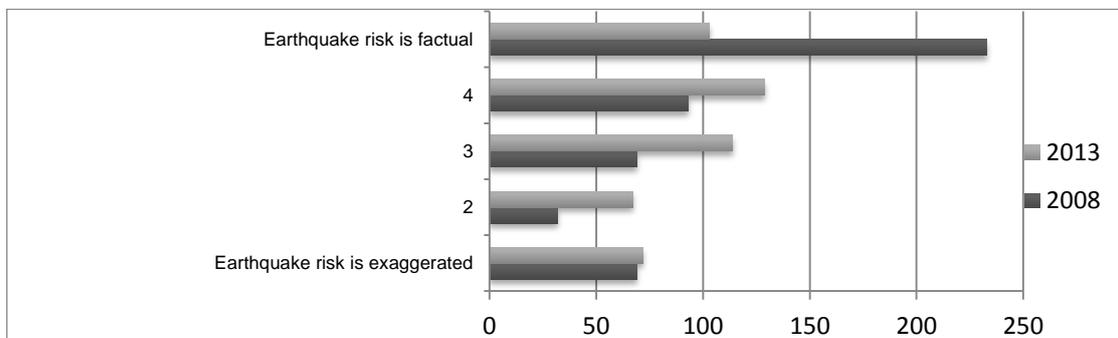


Figure 8. Perception of respondents on earthquake information.

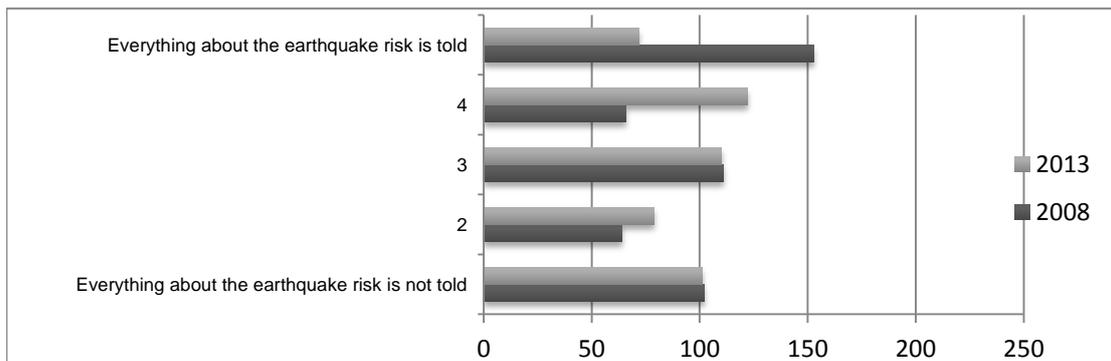


Figure 9. Perception of respondents on earthquake risk information.

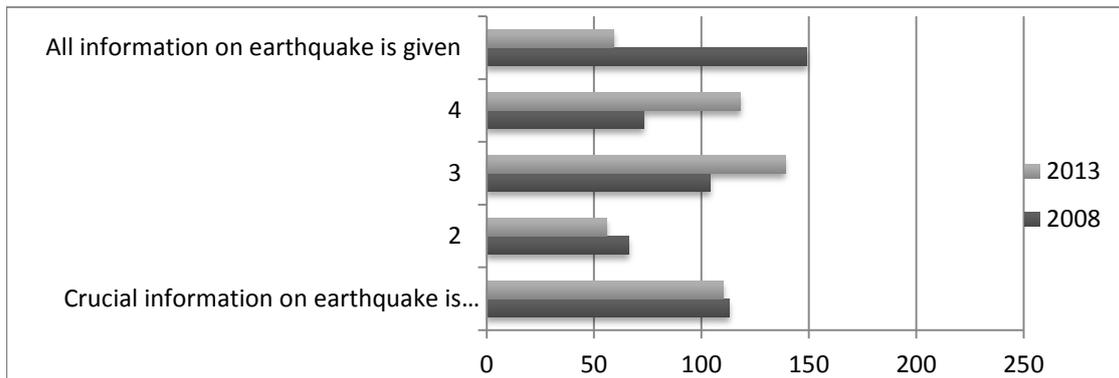


Figure 10. Perception of respondents on earthquake hazard information.

5. Evaluation of cross tabulation results

Referring to the risk perception literature, personal characteristics are revealed as strong components which affect individual perception of risks. In this section, cross tabulations are used to better understand, if they are in case, how responses differ according to gender, age and education of respondents. Furthermore, spatial attributes of case study areas (density, land value and hazardous zone) are examined to understand if they affect respondents to take precautions, to be willing to pay for a safer house and to trust more or less on the information and actions by administrative bodies in risk reduction.

5.1 Precautions vs. personal characteristics and spatial features

According to the results of cross tabulation, gender reveals as an indicator in taking some specific precautions to reduce earthquake risk in households. As indicated in the Table 5, female respondents in 2008 are more active than men in keeping emergency materials at home and rising awareness with both family members and neighbors. In the survey of 2013, a unique differentiation is set in purchasing TCIP insurance where more male respondents replied positively than women. Regarding to age as an indicator, it is observed that younger generation (between the ages 20-40) represents a larger share in living in an earthquake resistant house and purchasing TCIP insurance in 2008. On the other hand, according to the results of 2013, most of the respondents older than 50 declared that they secured the safety of non-structural components and kept emergency materials in their households, as well as they had attempts in rising awareness with family members. Education level of respondents appears as the most powerful indicator in personal characteristics in both surveys. University graduates and master/PhD holders are more active than the others in taking precautions. In the 2008 survey, 50% of the master/PhD holders denoted that they were living/moved to/bought an earthquake resistant house. The ratio of university graduates who were living/moved to/bought an earthquake resistant house reaches to 51% in the survey of 2013. Furthermore, the share of the university graduates and master/PhD holders who strengthened the house is quite distinctive among the others. Another difference related to education is visible in purchasing TCIP and private insurance in both surveys. The share of respondents who are university graduates and further is greater than the others. Moreover, a similar difference is noted in rising awareness with family members in the survey of 2008, but this distinction is not observed in 2013.

Besides the personal characteristics of the respondents, spatial features of their living environment are considered as indicators to have an impact on

their risk perception and consequently risk reduction activities. According to the results of the 2008 survey, population density does not have a noticeable effect on precautions taken by the respondents. However, in 2013, some slight differences are noted as indicated in the Table 5. These differences are mostly indicated due to the answers of respondents who live in the high population density neighborhoods (more than 200 persons/hectare). Considering the properties of the high density neighborhoods, two basic development processes are observed. The first group represents the central neighborhoods of the city which have old building stock. The second group consists of newly developed areas in the last 30-40 years, but in an unplanned way. Concisely, the common point of these two groups is related to structural weaknesses of buildings either due to their age or their low quality. Therefore, in the first two precautions (living/moved to/bought an earthquake resistant house and strengthened the house), the share of positive answers by the respondents living in high density neighborhoods is less than half of those which were given in the case of low and medium population density areas. Even though the number of respondents who bought TCIP insurance shows no difference according to the population density of neighborhoods, the ratio of purchasing private insurance is considerably lower in high density areas. A crucial finding reveals according to the answers given for the last precaution which associates to rising awareness with neighbors. The lowest ratio is observed in high density neighborhoods where it might be challenging to provide a collective action with greater population. However, once examining the answers given in the low density neighborhoods, we notice that the ratio is not the highest because of the dispersed urban pattern which hampers social integration. Regarding to medium density areas, there seems to retain an advantageous situation in both population size and urban pattern which enable inhabitants to be close to their neighbors and to take action for risk reduction by awareness rising in the community.

The average land price of neighborhoods is used as a spatial indicator because it reflects (1) economic status of inhabitants, (2) land use diversity of the area, (3) accessibility to urban facilities and (4) other attractive features. Neighborhoods, which have higher land value, are near to city center or sub-centers, have diversity of transportation modes that increase accessibility, and provide livable environment for inhabitants. Certainly, the positive aspects of these neighborhoods lead the land values to become higher and to be affordable for the people with higher socio-economic status. The precautions taken to reduce earthquake risks in the households substantially differ regarding to land values. Respondents, who live in neighborhoods with high land value, have larger share in purchasing TCIP insurance in both 2008 and 2013 surveys. In the case of owning private insurance, the difference is observed only in 2008. A slight difference in securing the safety of non-structural components is set in the results of 2013 survey in favor of neighborhoods with high land value. In the next two precautions (keeping emergency materials and awareness rising with family members), the positive responses of participants who live in neighborhoods with high land value are greater than those of the low and medium land value groups and show an increase as percentage from 2008 to 2013. The largest differentiation is indicated in the last precaution according to the results of 2008 survey. The share of respondents, who were involved in activities on rising awareness with neighbors, has a strong and positive correlation with the increase of land values.

Since the main focus of this paper is defined as the earthquake risk perception, an indicator should be presented to imply earthquake threat. Therefore, acceleration response spectrum (ARS) of the earthquake model which was produced by JICA and IMM has been used. As a broad evaluation, the threat level has an emphasis on individual risk perception and on mitigation activities in households. Especially, this differentiation becomes more significant in the 2013 survey. About half of the respondents who live in risky zones declared that they moved to an earthquake resistant house, whereas around 20-30% of the respondents from the other zones did so. Likewise, strengthened the house is a selected option in the risky areas rather than it is in the other groups. Furthermore, the percentage of respondents who bought TCIP insurance is considerably high in earthquake threatened neighborhoods. On the other hand, according to both surveys, the private insurance ownership is lower in neighborhoods with higher ARS. It is worthy to note that low ARS neighborhoods are mostly located in the northern part of the city. These neighborhoods are considered as urban fringes, consequently, the population density is lower and single houses are very common. As the private insurance covers all types of losses including robbery, the residents who live in these neighborhoods have more tendency to purchase private insurance than the others. The similar attitude is observed in keeping emergency materials in the results of 2008 survey. The percentage of interviewees, who secured the safety of non-structural components and who increased earthquake awareness with family members, is greater in high ARS neighborhoods.

5.2 Willingness to pay vs. personal characteristics and spatial features

The level of willingness to pay of the respondents is evaluated on personal characteristics of respondents and spatial features of the neighborhoods where they currently live. Gender shows a slight difference on the budget allocated for a safer house among house owners, in the 2008 survey. About half of the male respondents declared that they would spend 3-6 monthly income of their households for a safer house, whereas the majority of female respondents checked the options "less than a month" and "1-3 month household income". Furthermore, 8% of men affirmed that they would spend "more than 5 year household income" for a safer house, whereas none of women selected this option. According to the age groups, the willingness to pay of respondents concentrated on two categories; more than half of younger respondents declared that they would allocate "3-6 month household income" and majority of elderly group selected "less than a month". In the 2008 survey, education level of respondents enabled remarkable difference in budget which would be allocated for a safer house in responses of both house owners and tenants. The level of willingness to pay correlates to the academic qualifications of interviewees. In the survey of 2013, no difference has been detected between personal features and willingness to pay of respondents.

According to 2008 survey, population density of the neighborhoods, where the interviewees reside, reflects on the budget allocation for a safer house. The higher the population density, the amount of household budget increases. Land value is more distinctive in spatial features to define the level of willingness to pay of respondents. In the survey of 2008, interviewees who live in highest land value areas are willing to pay more in "3-6 month household income" and "6 month 2 year household income" with a percentage of 61% and 33% respectively. In 2013, even though the willingness to pay is still higher in the high land value areas, the

concentration has moved over the “1-3 month household income” and “3-6 month household income”. A remarkable difference in this group of questions is set in the relation between the earthquake threatened neighborhoods and allocated budget which would be spent for a safer house by both house owners and tenants, in 2013. Respondents who live in the high ARS neighborhoods are willing to pay more. In the case of tenants, 83% of the inhabitants of low ARS neighborhoods declared that they would not accept any raise in their rent even the house would be safer, whereas this ratio decreases steadily in medium and high ARS neighborhoods.

5.3 Trust vs. personal characteristics and spatial features

Personal characteristics of interviewees have more emphasis on trust related issues in the 2008 surveys rather than it has in the 2013 survey. Male respondents believe that all information is given on earthquake threat and risk, whereas the tendency of women has an opposite direction. Female respondents have skeptical attitude and around 40% think that most crucial information is hidden by purpose. Considering the age indicator, it can be noted about a sharp difference between the answers of respondents of up to 50 years old and older than 50. Around 45-50% of the first group declared that neither the IMM nor Istanbul Governorship take necessary actions in risk reduction in Istanbul. The answers of the latter group concentrate on the interval from un-decided to successful in defining the works of IMM and Istanbul Governorship. The skepticism of respondents on the given information highly correlates with the age indicator, but in a negative way. Younger respondents think that not all information is shared with the public, whereas elderly group believe that everything related to earthquake threat and risk is told and no information is hidden by purpose. It may be observed in Table 5 that academic qualifications of respondents affect their evaluation on earthquake risk reduction activities of IMM and Istanbul Governorship, and also their level of trust on information. Respondents who have higher academic qualifications think that the risk reduction activities conducted by IMM and Istanbul Governorship are not enough to reduce earthquake risk in the entire city. The majority of interviewees declared that earthquake related issues are given in a realistic way. However, in detailed, it is observed that university graduates and master/PhD holders think that there might be some exaggerations. A similar attitude of high academic level respondents is indicated in the following questions. Respondents from the group up to high school graduates noted that they receive all information related to earthquake issues. However, university graduates and master/PhD holders have tendency to think in opposite way. Regarding to the results of 2013 survey, among all personal characteristics, only education level had an influence on just an item. Literate and primary school graduates think that everything about the earthquake risk is not told. Secondary and high school graduates reply perfectly on the opposite way. Lastly, university graduates and master/PhD holders selected the option of “un-decided” on whether everything was told.

Population density of the neighborhoods is distinctive only in the opinion of respondents about the hidden/given information. Interviewees living in high density neighborhoods believe that relevant information is given. This declaration of respondents might be related to the access to the information as well. Among the spatial features, land value is the most dominant indicator which affects the opinion of respondents. In both 2008 and 2013 surveys, some remarkable differences may be noted. For instance, in the survey of 2008, respondents living in the high land value neighborhoods were

Table 5. Cross-tabulation results of risk perception surveys.

| | PERSONAL CHARACTERISTICS | | | | | | SPATIAL FEATURES | | | | | |
|---|----------------------------------|---------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| | GENDER | | AGE | | EDUCATION | | DENSITY | | LAND VALUE | | SPEC. ACC. (M=7,7) | |
| | 2008 | 2013 | 2008 | 2013 | 2008 | 2013 | 2008 | 2013 | 2008 | 2013 | 2008 | 2013 |
| PRECAUTIONS | | | | | | | | | | | | |
| Living in/moved to/bought an earthquake resistant house | ns | ns | $\chi^2=19,24$ $\alpha=0,004$ | ns | $\chi^2=23,57$ $\alpha=0,001$ | $\chi^2=17,26$ $\alpha=0,008$ | ns | $\chi^2=6,96$ $\alpha=0,031$ | ns | ns | ns | $\chi^2=25,89$ $\alpha=0,000$ |
| Strengthened the house | ns | ns | ns | ns | $\chi^2=23,37$ $\alpha=0,001$ | $\chi^2=30,82$ $\alpha=0,000$ | ns | $\chi^2=6,41$ $\alpha=0,04$ | ns | ns | ns | $\chi^2=12,32$ $\alpha=0,002$ |
| TCIP Insurance | ns | $\chi^2=4,57$ $\alpha=0,032$ | $\chi^2=18,09$ $\alpha=0,006$ | ns | $\chi^2=57,31$ $\alpha=0,000$ | $\chi^2=30,82$ $\alpha=0,000$ | ns | ns | $\chi^2=27,77$ $\alpha=0,000$ | $\chi^2=13,76$ $\alpha=0,001$ | ns | $\chi^2=8,48$ $\alpha=0,014$ |
| Private Insurance | ns | ns | ns | ns | $\chi^2=75,07$ $\alpha=0,000$ | $\chi^2=13,53$ $\alpha=0,035$ | ns | $\chi^2=9,41$ $\alpha=0,009$ | $\chi^2=7,02$ $\alpha=0,03$ | ns | $\chi^2=11,24$ $\alpha=0,004$ | $\chi^2=9,38$ $\alpha=0,009$ |
| Secured the safety of non-structural components | ns | ns | ns | $\chi^2=12,84$ $\alpha=0,046$ | ns | ns | ns | ns | ns | $\chi^2=6,69$ $\alpha=0,035$ | ns | $\chi^2=19,41$ $\alpha=0,000$ |
| Keeping emergency materials | $\chi^2=15,36$ $\alpha=0,000$ | ns | ns | $\chi^2=15,33$ $\alpha=0,018$ | ns | ns | ns | ns | $\chi^2=9,35$ $\alpha=0,009$ | $\chi^2=9,10$ $\alpha=0,011$ | $\chi^2=7,72$ $\alpha=0,021$ | ns |
| Awareness rising with family members | $\chi^2=13,75$ $\alpha=0,000$ | ns | ns | $\chi^2=19,74$ $\alpha=0,003$ | $\chi^2=54,9$ $\alpha=0,000$ | ns | ns | ns | $\chi^2=9,91$ $\alpha=0,007$ | $\chi^2=7,14$ $\alpha=0,028$ | ns | $\chi^2=9,28$ $\alpha=0,01$ |
| Awareness rising with neighbors | $\chi^2=7,26$ $\alpha=0,007$ | ns | ns | ns | ns | ns | ns | $\chi^2=6,18$ $\alpha=0,045$ | $\chi^2=30,23$ $\alpha=0,000$ | ns | ns | ns |
| WILLINGNESS TO PAY | | | | | | | | | | | | |
| Budget allocated for a safer house (owners) | $\chi^2=12,8$ $\alpha=0,025$ | ns | $\chi^2=86,26$ $\alpha=0,000$ | ns | $\chi^2=144,7$ $\alpha=0,000$ | ns | ns | $\chi^2=29,05$ $\alpha=0,001$ | $\chi^2=43,79$ $\alpha=0,000$ | $\chi^2=22,06$ $\alpha=0,015$ | ns | $\chi^2=29,33$ $\alpha=0,001$ |
| Budget allocated for a safer house (tenants) | ns | ns | ns | ns | $\chi^2=28,35$ $\alpha=0,029$ | ns | ns | ns | ns | ns | ns | $\chi^2=19,25$ $\alpha=0,014$ |
| TRUST | | | | | | | | | | | | |
| Trust to the municipality in EQ risk reduction | ns | ns | $\chi^2=48$ $\alpha=0,003$ | ns | $\chi^2=69,06$ $\alpha=0,000$ | ns | ns | ns | $\chi^2=22,04$ $\alpha=0,004$ | $\chi^2=25,47$ $\alpha=0,001$ | ns | ns |
| Trust to the governorship in EQ risk reduction | ns | ns | $\chi^2=44,12$ $\alpha=0,007$ | ns | $\chi^2=80,3$ $\alpha=0,000$ | ns | ns | ns | $\chi^2=21,43$ $\alpha=0,006$ | $\chi^2=37,69$ $\alpha=0,000$ | ns | ns |
| Truth / exaggeration in EQ issues | ns | ns | ns | ns | $\chi^2=60,83$ $\alpha=0,000$ | ns | ns | ns | $\chi^2=15,68$ $\alpha=0,047$ | $\chi^2=17,42$ $\alpha=0,026$ | ns | $\chi^2=26,22$ $\alpha=0,001$ |
| Everything is told / not told | $\chi^2=20,13$ $\alpha=0,000$ | ns | $\chi^2=50,74$ $\alpha=0,001$ | ns | $\chi^2=59,43$ $\alpha=0,000$ | $\chi^2=37,78$ $\alpha=0,037$ | ns | ns | $\chi^2=19,89$ $\alpha=0,011$ | ns | $\chi^2=21,06$ $\alpha=0,007$ | $\chi^2=23,75$ $\alpha=0,003$ |
| Relevant information is given / hidden | $\chi^2=17,96$ $\alpha=0,001$ | ns | $\chi^2=70,51$ $\alpha=0,000$ | ns | $\chi^2=52,04$ $\alpha=0,004$ | ns | ns | $\chi^2=15,8$ $\alpha=0,045$ | $\chi^2=32,25$ $\alpha=0,000$ | $\chi^2=17,31$ $\alpha=0,027$ | $\chi^2=22,04$ $\alpha=0,005$ | $\chi^2=27,45$ $\alpha=0,001$ |

not satisfied at all about the precautions taken by IMM and Istanbul Governorship. Regarding to the results of 2013, it is observed that dissatisfaction of lower land value neighborhoods increased dramatically. This shift can be evaluated as the consequence of lack of dissemination and risk reduction activities in outskirts of Istanbul which have relatively lower land prices comparing to the inner city. A similar change in responses is observed in the evaluation of earthquake related information. In the survey of 2008, %52 of the respondents living in the lower land value neighborhoods declared that they found earthquake related information realistic, whereas, in the survey this ratio dropped to 19%. The skeptical attitude of all respondents has changed from 2008 to 2013. In the 2008 survey, approximately 40% of the respondents living in the lower land value neighborhoods declared that they think all information given and everything is told. This ratio signifies a great distinction of lower land value neighborhoods to the others. However, the results of 2013 show that respondents of lower land value neighborhoods become more skeptic than the others, and respondents from other groups began to trust more on the information. In the five-year period, the change in the opinion of respondents is observed, once it is compared to the earthquake threat level of their neighborhood. In the 2008 survey, respondents living in the higher ARS neighborhoods believe that nothing was hidden and everything was told. Even though majority of this group still think that earthquake related issues are given in a realistic way, in the 2013 survey; skepticism arises remarkably about the given information, once the results are compared both with the previous research and the answers of other groups.

6. Conclusion

This paper has three main focuses to explore. The first focus is to reveal the shifts in a five year period on risk perception, earthquake preparedness and willingness to pay for a safer housing of Istanbul inhabitants. The second focus is to understand the impacts of personal characteristics of interviewees on their perceptions, precautions to reduce risks and trust to authorities and information. The third focus is to test the availability of spatial features in evaluation of risk perception of individuals.

In the first focus, it is remarkable that there is an improvement in both risk perception of individuals and variety of precautions taken in the households. If the results of 2013 survey were evaluated independently, the concluding remarks would be quite different. For instance, still 37,5% of the respondents declared that they did nothing to reduce the earthquake risk in their households. Even the ratio is high, once it is compared to the finding of 2008, there is a positive trend in taking precautions. Another crucial difference is the change in the share of the respondents who took action in rising awareness with the family members. This ratio increased from 17% in 2008 to 43% in 2013. The differentiation in each component can be evaluated as an important indicator to test current dissemination activities and also it can be used as an efficient tool to re-design community awareness campaigns.

The results related to the second focus overlay with the local and international findings. The emphasis of academic qualification on larger investments for a safer house is visible in both surveys. However, it is worthy to note that there is a slight difference between 2008 and 2013 survey results, according to the cross-tabulation. In the 2008 survey, personal

characteristics of respondents are predominant in the given answers. In the 2013 survey, we may notice that the dominance of personal characteristics diminishes. This change can be either by chance or be evaluated as a precursor of a new trend in risk perception where former indicators would be replaced with newer ones according to the new perspective of modern societies.

The third focus seeks different indicators which are likely to affect risk perception of individuals and their way to deal with and to respond to risks. In the surveys, three indicators are described to define spatial features. Population density has a slight effect on answers or choices of respondents. Differentiation in land values brings different attitudes to people since the land value is also considered as an indicator to present the economic level. The last indicator which implies the earthquake threat in the neighborhoods has an increasing emphasis on precautions, willingness to pay and trust. Today, more people are aware of the most risky zones in the city due to media and discussions of regeneration subjected areas. Therefore, this impact can be associated to dissemination of information on earthquake issues through different channels. Nevertheless, the cross-tabulation results show that some nuances in the severity of threat affects mitigation measures of individuals even they live in the same city.

It is worthy to note that cities at risk are products of a long term process that means cities cannot become vulnerable overnight. Consequently, risk awareness and enhancing risk reduction activities are long run processes when the different socio-economic levels of the society are considered. The dissemination of knowledge should be continuous to increase individual capacity. In case of Istanbul, the surveys show that perception and the level of knowledge are changing over time. Therefore, a monitoring system should be developed to reveal success conditions of activities, gaps in dissemination and new response tools that would meet needs of the community.

Acknowledgements

This study is based on two comprehensive research projects entitled "Environmental and Urban Risk Perception in Istanbul" conducted in 2008 and 2013. The field survey of 2008 research was supported by AHDER (Disaster Preparedness and Earthquake Training Association). The research of 2013 was fully supported by Istanbul Technical University, Scientific Research Project Unit.

References

- Ambraseys, N.N., Finkel, C.F. (1991), Long-term seismicity of Istanbul and of the Marmara Sea region. **Terra Nova**, 3, 527-539.
- Arvai, J.L., (2003), Using Risk Communication to Disclose the Outcome of a Participatory Decision-Making Process: Effects on the Perceived Acceptability of Risk-Policy Decisions. **Risk Analysis** 23:2, 281-289.
- Asgary, A., Willis, K.G. (1997), "Household Behaviour in Response to Earthquake Risk: An Assessment of Alternative Theories", **Disasters**, 21(4)354-365.
- Barnett, J., Breakwell, G.M. (2001), Risk Perception and Experience: Hazard Personality Profiles and Individual Differences. **Risk Analysis** 21:1, 171-177.

- Bontempo, R.N., Bottom, W.P., Weber, E.U. (1997), Cross-Cultural Differences in Risk Perception: A Model-Based Approach. **Risk Analysis** 17:4, 479-488.
- Carlino, S., Somma, R., Mayberry, G.C. (2008), Volcanic risk perception of young people in the urban areas of Vesuvius: Comparisons with other volcanic areas and implications for emergency management, **Journal of Volcanology and Geothermal Research**, 172 (2008), 229-243.
- Dooley, D., R. Catalano, S. Mishra and S. Serxner (1992), Earthquake Preparedness: Predictions in a Community Survey. **Journal of Applied Social Psychology** 22(6): 451–470.
- Eraybar, K., İlki, A., Okazaki, K. (2007), Avcılar İlçesinde Sismik Risk Algılaması, **6. Ulusal Deprem Mühendisliği Konferansı**, 16-20 Ekim 2007, İstanbul (6th National Conference on Earthquake Engineering).
- Eraybar, K., Okazaki, K., İlki, A. (2010), An exploratory study on risk perceptions of seismic risk and mitigation in two districts of Istanbul, **Disasters**, 34(1) 71-92.
- Erdik, M., Durukal, E., Biro, Y. ve Birgören, G., (2000), İstanbul'da Binalar için Deprem Riski ve Risk Azaltımına Yönelik Somut bir Öneri, **İkinci İstanbul ve Deprem Sempozyumu**, TMMOB İnşaat Mühendisleri Odası İstanbul Şubesi, 27 Mayıs 2000, İstanbul Teknik Üniversitesi Maçka Kampüsü, 131-149.
- Fişek, G.O., Yeniceri, N., Muderrisoğlu, S. (2002), Risk Perception and Attitudes Towards Mitigation, **IIASA-DPRI Meeting**, July 29-31 2002 Laxenburg Austria.
- Green, A.R. (2008), Unauthorized development and seismic hazard vulnerability: a study of squatters and engineers in Istanbul, Turkey, **Disasters**, 32(3) 358-376.
- Horst, M., Kuttschreuter, M., Gutteling, J.M. (2007), Perceived usefulness, personal experiences, risk perception and trust as determinants of adoption of e-government services in The Netherlands. **Computers in Human Behavior**. Vol:23 Issue: 4, pp: 1838-1852
- Inal-Cekic, T., Oney Yazici, E. (2011), Spatial Distribution of Housing Investment and Perception of Earthquake Risk in Istanbul Metropolitan Area, **51st Congress of the European Regional Science Association**, August 30 – September 4 2011, Barcelona, Spain.
- Inelmen, K., A. İşeri-Say and H. Kabasakal (2004), Participation lethargy in disaster preparedness organizations within the framework of a Turkish CBO. **International Journal of Sociology and Social Policy**. 24(10/11). pp. 130–158.
- Japon Uluslar arası İşbirliği Ajansı (JICA) ve İstanbul Büyükşehir Belediyesi (İBB), (2002), **Türkiye Cumhuriyeti, İstanbul İli Sismik Mikro-Bölgeleme Dahil Afet Önleme/Azaltma Temel Planı Çalışması**, İstanbul.
- Karancı, N., Johnston, D. (2009), Overcoming Social and Economic Barriers to Seismic Retrofitting of Residential Buildings in Turkey and New Zealand. Ansal, A., İlki, A., Karancı, N., Kundak, S. (Eds.) **Book of Proceedings of Istanbul International Conference on Seismic Risk Mitigation**. 215-222.
- Kundak, S. (2011), Risk Perception as a Process of Mitigation, **20th SRA-Europe Conference**, 5-8 June 2011, Stuttgart, Germany.
- Kundak, S. (2013), Risk Perception Studies on Istanbul, **22nd SRA-Europe Conference**, 17-19 June, Tronsheim, Norway.

- Kundak, S., Türkoğlu, H., İlki, A., (2010), Earthquake Risk Perception of Istanbul Residents, **International Disaster Risk Reduction Conference** (IDRC), 30 May - 3 June 2010 Davos Switzerland
- Liu, S., Huang, J., Brown, G.L. (1998), Information and Risk Perception: A Dynamic Adjustment Process. **Risk Analysis** 18:6, 689-699.
- Mahalle Afet Gönüllüleri (MAG) www.mag.org.tr (accessed on November, 2013)
- Palm, R.I., Hodgson, M. (1993), Natural Hazards in Puerto Rico. **The Geographical Review** 83(3): 280–89
- Parsons, T. (2004), Recalculated probability of $M \geq 7$ earthquakes beneath the Sea of Marmara, Turkey. **Journal of Geophysical Research**. 109(B5). Art. No. B05304.
- Paton, D., Johnston, D.M., Bebbington, M.S., Lai, C.D., Houghton, B.F. (2001), Direct and vicarious experience of volcanic hazards: implications for risk perception and adjustment adoption. **Australian Journal of Emergency Management** 15 (4), 58–63.
- Perry, R.W., Lindell, M.K. (2008), Volcanic risk perception and adjustment in a multi-hazard environment, **Journal of Volcanology and Geothermal Research**, 172 (2008), 170-178.
- Renn, O and Rohrman, B. (2000), **Cross-Cultural Risk Perception: A survey of Empirical Studies**, Kluwer Academic Publishers, The Netherlands.
- Rippl, S. (2002), Cultural theory and risk perception: a proposal for a better measurement, **Journal of Risk Research**, 5:2, 147-165.
- Siegrist, M. And Cvetkovich, G. (2000), Perception of Hazards: The role of Social Trust and Knowledge. **Risk Analysis**, Vol:20 No:5 pp: 713-719.
- Sjöberg, L. (2000), Factors in Risk Perception. **Risk Analysis** Vol:20 No:1 pp:1-11.
- Sjöberg, L. (2001), Limits of Knowledge and the Limited Importance of Trust. **Risk Analysis** 21:1, 189-198.
- Slovic, P. (1993), Perceived Risk, Trust, and Democracy. **Risk Analysis** 13:6, 675-682.
- Slovic, P., Fischhoff, B., Lichtenstein, S. (1982), Why Study Risk Perception?. **Risk Analysis** 2:3, 83-93.
- Slovic, P., Layman, M., Flynn, J.H. (1991), Risk Perception, Trust, and Nuclear Waste: Lessons from Yucca Mountain. **Environment Science and Policy for Sustainable Development**. Vol:33, Issue: 3, pp: 6-30.
- Tekeli-Yesil, S., Dedeoglu, N., Braun-Fahrlaender, C., Tanner, M. (2010b), Factors Motivating Individuals to Take Precautionary Action for an Expected Earthquake in Istanbul, **Risk Analysis**, Vol:3, No:8, pp:1181-1195.
- Tekeli-Yeşil, S., Dedeoğlu, N., Braun-Fahrlaender, C., Tanner, M. (2011), Earthquake awareness and perception of risk among the residents of Istanbul, **Natural Hazards**, 59, pp:427-446.
- Tekeli-Yeşil, S., Dedeoğlu, N., Tanner, M., Braun-Fahrlaender, C., Obrist, B., (2010a), Individual preparedness and mitigation actions for a predicted earthquake in Istanbul, **Disasters**, 34(4), pp: 910-930.
- Turkish Statistical Institute (2008), Address Based Population Registration System Database.
- Turkish Statistical Institute (2013), Address Based Population Registration System Database.
- Türkoğlu, H., Kundak, S., Korça Baran, P., Bölen, F., Marans, R.W., (2008), A Perceptual Approach to Environmental Problems in Istanbul,

- International Disaster Reduction Conference**, 25-29 August 2008, Davos, Switzerland
- Turner, R.H., J.M. Nigg and D.H. Paz (1986), **Waiting for Disaster: Earthquake Watch in California**. University of California Press, London.
- Viklund, M.J. (2003), Trust and Risk Perception in Western Europe: A Cross-National Study. **Risk Analysis**, Vol:23 No:4 pp: 727-738.
- Weber, E.U., Hsee, C. (1998), Cross-Cultural Differences in Risk Perception, but Cross-Cultural Similarities in Attitudes Towards Perceived Risk. **Management Science** 44(9):1205-1217.

Deprem tehlikesi altındaki şehirde risk algısı: İstanbul örneği

İstanbul'da deprem risk algısına yönelik çalışmalar, 1999 depremlerinin ardından sayı ve kapsam yönünden gelişme göstermiştir. Son 15 yıllık dönemde yürütülmüş olan bu araştırmaların bulguları, uluslararası literatürde vurgulanan kritik bağlantılarla örtüşmekle beraber, farklı toplumsal özelliklerin bireylerin risk algısı üzerindeki etkilerini de ortaya koymaktadır. Risk algılama çalışmaları, bireylerin risklere bakış açılarını, gerekçelerini ve riskleri azaltma yönünde almış oldukları önlemlerin türünü ve etkinliğini ölçmektedir. Bu çalışmanın temel kurgusu, 1999 depremlerinin ardından geliştirilen yasal ve uygulamaya yönelik sistemlerin toplum genelinde yaygınlaşmasını ve toplumdaki tavır değişikliğini ölçmek üzerine oluşturulmuştur. 2008 ve 2013 yıllarında, İstanbul'da yapılan risk algılama anketlerinin sonuçları bu kapsamda karşılaştırılarak değerlendirilmiştir. Bu değerlendirme sonucunda 2008-2013 yılları arasında bireylerin evlerinde almış oldukları önlemlerde bir artış olduğu görülmektedir. Ayrıca, aile afet planlarının oluşturulması konusunda da kayda değer bir gelişme söz konusudur.

Bireysel özellikler ve alınan önlemler karşılaştırıldığında, bireyin cinsiyet, yaş ve eğitim gibi temel özelliklerinin aldıkları önlemlerde etkili olduğu görülmektedir. Ancak bu oran 2013 yılında yapılan çalışmada çok baskın bir fark olarak belirlenmemiştir. Risk algılama literatüründeki temel belirleyicilere ek olarak, bireylerin risk algısında yaşadıkları mekanın özelliklerinin etkinlik düzeyi de bu çalışmada ölçülmüştür. Depremden etkilenme düzeyinin yüksek olduğu bölgelerde yaşayanların, diğer bölgelerde yaşayanlara göre daha fazla önlem aldıkları görülmektedir.

Bu çalışmanın sonuçları, bireylerin risk algılarındaki değişimin izlenmesi ve bu değişikliklere uygun farkındalığı artırıcı yeni yöntemlerin geliştirilmesi gerekliliğini ortaya koymaktadır. Ayrıca, risk algılama çalışmaları, toplumun bilgiye ulaşmada sorun yaşayan katmanlarının belirlenmesinde de faydalı olacaktır.