

# Geography Internal Assessment

How well prepared are the communities of Bahcesehir and Karaagac in the event of a major earthquake?  
To what extent do demographic factors determine this?

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## **A – Fieldwork Question and Geographic Context**

### *Fieldwork Question:*

How well prepared are the communities of Bahcesehir and Karaagac in the event of a major earthquake? To what extent do demographic factors determine this?

### *Hypothesis:*

I believe demographic factors highly determine earthquake preparedness. Thus, I would expect the residents of Bahcesehir to be better prepared for an earthquake seeing as though it is a region of higher education, income, and development. Overall, I suspect that those who have experienced earthquakes in the past are more knowledgeable and more likely to be prepared for future earthquakes.

### *Geographic Context:*

Turkey is located on the North Anatolian Fault, squeezed westwards as the Arabian and the Eurasian plates move together. This is one of the most energetic earthquake zones in the world.<sup>1</sup>

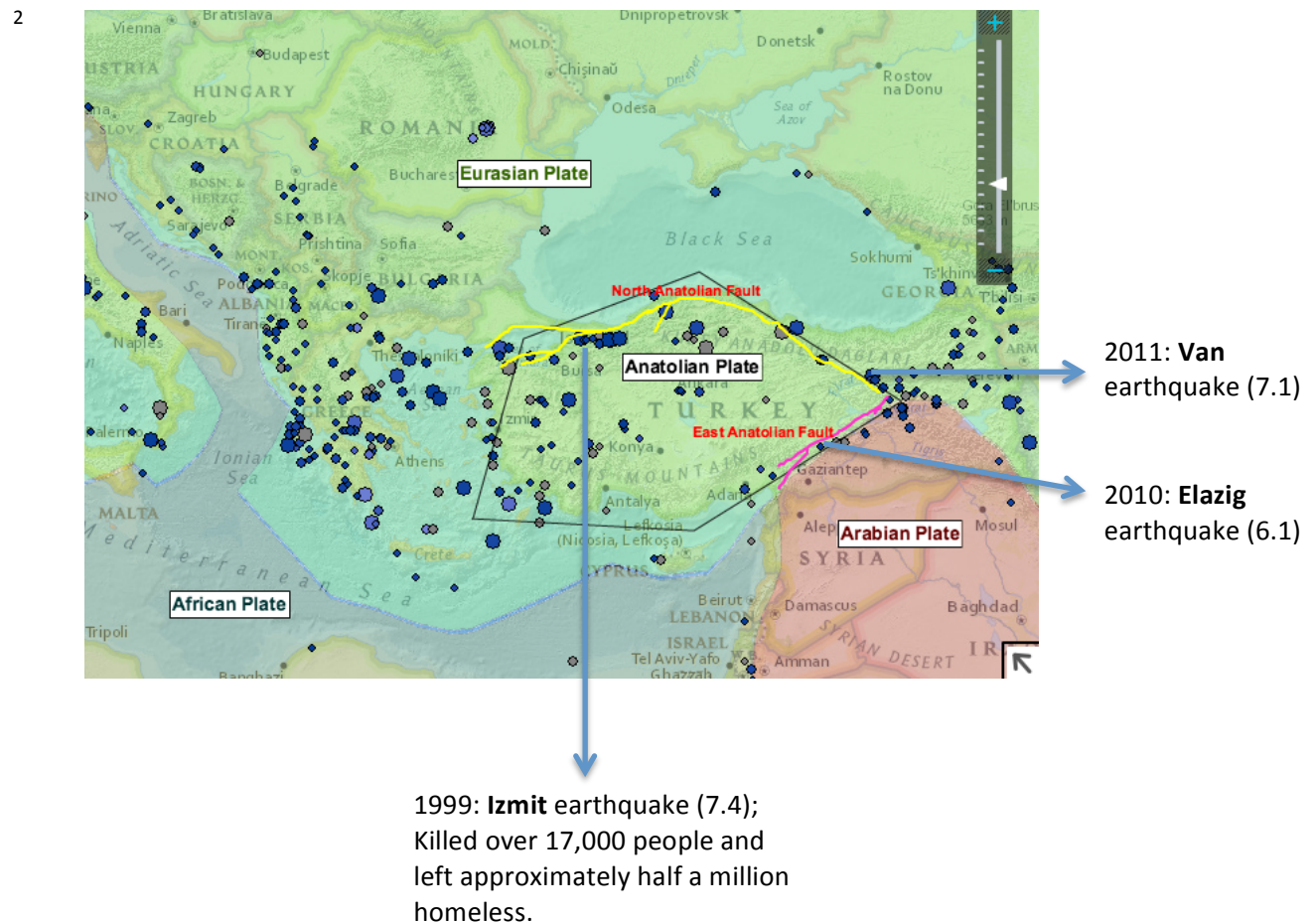
Specifically, we chose to conduct the fieldwork investigation in Bahcesehir and Karaagac (Figure 2): two socio-economically different urban regions in Istanbul, as they would allow for quantitative data collection and an analysis based on socio-economic disparity. Additionally, these are local communities in respect to Istanbul International Community School; Bahcesehir serves as a residence for many students and teachers, and Karagaac often hosts bus faculty and provides goods and services to school. While Bahcesehir occupies the transition and/or suburbs urban zone, Karagaac is found in the rural- urban Fringe. According to the scale of urban settlements, Karagaac is a village, whereas Bahcesehir is a small town.

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<sup>1</sup> "North Anatolian Fault." ScienceDaily. ScienceDaily, n.d. Web. 20 Nov. 2013.

This investigation stems from our studies of Hazards and Disasters (Option D) in IB Geography, where we have examined cases of risk assessment and response in relation to earthquakes, predominantly the Haiti earthquake of 2010 and the Tohoku earthquake of 2011. Vulnerable to earthquakes, we were eager to discover the level of preparedness of the populations of Karaagac and Bahcesehir.

**Figure 1: Tectonic Plates and Fault Lines in which Turkey Lies**

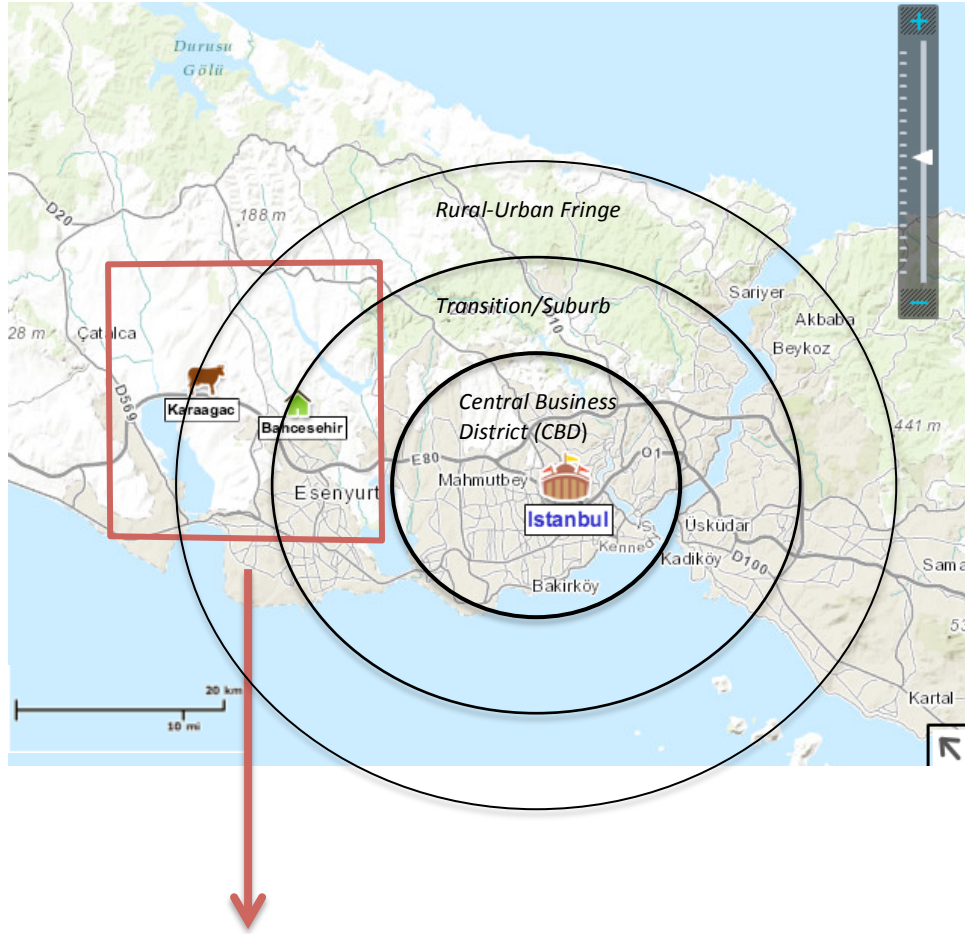


**KEY:** North Anatolian Fault drawn in yellow; East Anatolian Fault in pink. Past regional earthquakes indicated by the blue dots (size corresponds to magnitude). Recent earthquakes further explained through arrows.

<sup>2</sup> Figure 1: Map created through National Geographic MapMaker Interactive. "List of Earthquakes in Turkey." *Wikipedia*. Wikimedia Foundation, 16 Jan. 2014. Web. 10 Dec. 2013.



**Figure 2: Karagaac and Bahcesehir in respect to Istanbul**



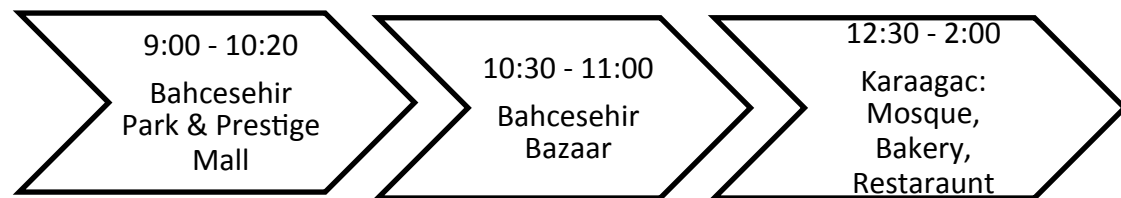
**Karagaac and Bahcesehir in respect to Istanbul International Community School**



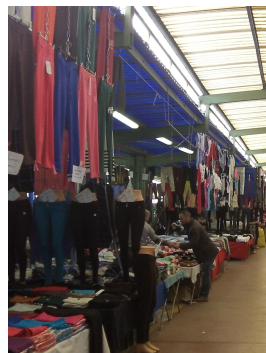
<sup>3</sup> Figure 2: Maps created through National Geographic MapMaker Interactive.

## B – Method(s) of Investigation

In order to effectively evaluate the level of preparedness of residents of Karagaac and Bahcesehir, we compiled a series of questions in the form of a survey regarding equipment and preparation. These questions were modeled after Mulilis-Lippa, a multiact behavioral scale developed in 1985 for “use in assessing earthquake preparedness”, consisting of items like “Are your cabinets securely fastened with latches?”<sup>4</sup>. We felt as though this was the best way to assess preparedness in both locations, as these types of questions are generally understood and can be answered through “Yes”, “No”, or “Maybe”. The survey can be found below (Figure 3), which was later translated into Turkish for data collection. These were distributed in strategic areas within Karaagac and Bahcesehir. The plan of action is outlined below.



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These locations were chosen primarily because of their abundance of pedestrians, which would provide not only a large sample of surveys, but also diversity (range of ages and income, for instance).

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<sup>4</sup> Tubbesing, Susan K. "The Loma Prieta, California, Earthquake of October 17th, 1989- Loss Estimation and Procedures." *US Geological Survey Professional Paper 1553-A* (1994): B63-64. *Google Books*. United States Government Printing Office, Washington, 27 Apr. 1994. Web. 20 Dec. 2013.

<sup>5</sup> Images of Bahcesehir Park, Bahcesehir Bazaar (Market), and the Mosque in Karaagac.

Earthquake Preparedness Questionnaire - English	
▪ Gender: Male <input type="radio"/> Female <input type="radio"/>	
▪ Do you live in: Bahcesehir <input type="radio"/> Karaagac <input type="radio"/> Neither <input type="radio"/>	
▪ How old are you? Under 18 <input type="radio"/> 18 – 24 <input type="radio"/> 25-44 <input type="radio"/> 45-64 <input type="radio"/> 65+ <input type="radio"/>	
▪ What is your monthly income? 0-2,000 TL <input type="radio"/> 2,001 – 4,000 <input type="radio"/> 4,000 + <input type="radio"/>	
▪ Do you have children aged under 12 living in your home? YES <input type="radio"/> NO <input type="radio"/>	
▪ What is your highest level of formal education? Primary <input type="radio"/> Secondary <input type="radio"/> Graduate <input type="radio"/> Post-Graduate + <input type="radio"/>	
▪ Which storey of your building do you live in ? ____	
▪ Have you experienced a major earthquake before? Major indicates destruction to property or loss of life. ▪ If yes where (City) and when (Year) write below.	
<b>Planning</b>	
▪ Does your household have a meeting place to come together after a possible earthquake? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ Do you read material on earthquake preparedness? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ Does your household have earthquake insurance? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ Have you attended a first aid training course? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ The occurrence and associated damage of an earthquake are God's will? Strongly Disagree <input type="radio"/> Disagree <input type="radio"/> Uncertain <input type="radio"/> Agree <input type="radio"/> Strongly Agree <input type="radio"/>	
▪ Being prepared for an earthquake could help save the lives of you and your family? Strongly Disagree <input type="radio"/> Disagree <input type="radio"/> Uncertain <input type="radio"/> Agree <input type="radio"/> Strongly Agree <input type="radio"/>	
<b>Supply Items</b>	
▪ An operating flashlight ? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ An operating transistor radio ? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ A complete first-aid kit ? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ At least 15 litres of water in plastic bottles? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ At least 4 days supply of dried or canned food ? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ An operating fire extinguisher ? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
<b>Utilities</b>	
▪ Location of the water shut ? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ Location of the gas shut ? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
▪ Location of the electric power shut ? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	
<b>Stabilization of Items</b>	
▪ Have you stabilized/fixed heavy objects/ furniture in your home? YES <input type="radio"/> NO <input type="radio"/> MAYBE <input type="radio"/>	

THANK YOU FOR TAKING THE TIME TO HELP US

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Displayed above, aside from questions regarding preparation, we also included demographics to enable the evaluation of a possible relation between demographic factors, such as residence, education, and income, and level of earthquake preparedness.

<sup>6</sup> Figure 3: 12<sup>th</sup> Grade IB Geography 2013 I.A. Survey

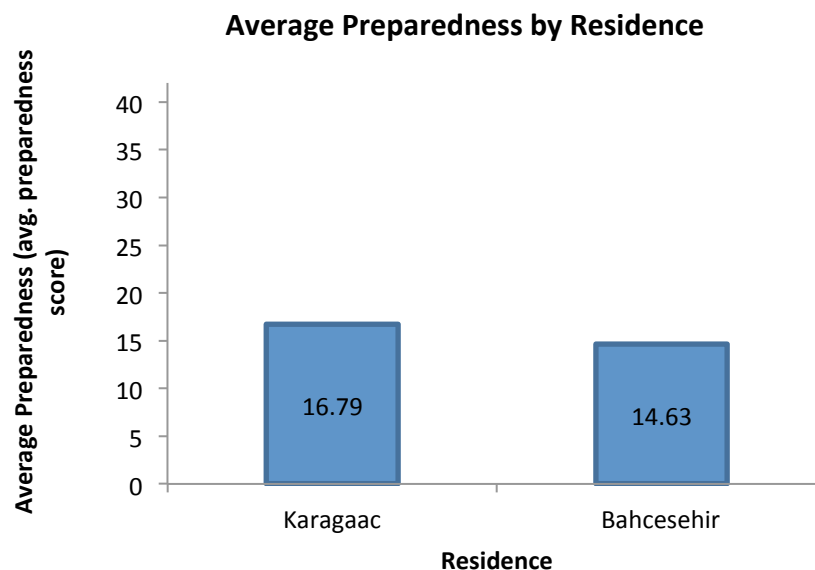
Collecting a total of 83 surveys, we analyzed the results using the Mulilis-Lippa point system: If the surveyed answered “Yes”, they were given 3 points, 1 point for the answer “Maybe”, and 0 points for “No”. Thus, the greater amount of points received indicated greater preparation for an earthquake. This transformed our data into numerical values, which could then be processed, allowing for a comprehensive analysis using tables and graphs.

The answers marked on the surveys were transferred manually to an Excel spreadsheet, where the data could be manipulated through sorting, averaging, among other tools. This made it possible to separate questions in order to analyze relationships.

## C/D – Quality and treatment of information collected and Written Analysis

*How well prepared are the communities of Bahcesehir and Karagaac in the event of an earthquake?*

In order to investigate this part of the research question, I selected two aspects to focus upon: residence and the average preparedness total. I used Excel to calculate preparedness scores by adding the points of each individual survey. I then sorted the data by residence and found the average preparedness for Bahcesehir and Karagaac. The graph below portrays the data accordingly:



42 being the highest possible preparedness score (three marks for all 14 questions), Karaagac averaged 16.79 of nineteen surveyed, while Bahcesehir averaged 14.63 of forty surveyed. Opposing the hypothesis, Bahcesehir's preparedness score is smaller than that of Karagaac, which exceeds by solely 2.16 points. If 42 theoretically indicates 100% preparedness, we could conclude Karagaac is only about 40% prepared, and Bahcesehir, roughly 35% prepared; both low values that suggest neither community is significantly prepared for an earthquake.

Having established that there is no significant difference between these two communities in relation to earthquake preparedness, I decided to evaluate different aspects of preparedness instead. The survey was divided into planning, supply,

utilities, and fixtures. The amount of preparedness regarding these different aspects differs; hence, I decided to determine where exactly there is a lack of preparation. Observe the following table.

Preparedness Questions	Yes %
Location of the electric power shut?	89.2
An operating flashlight?	83.1
Location of the water shut?	79.5
Location of the gas shut?	74.7
At least 4 days supply of dried or canned food?	59.0
At least 15 liters of water in plastic bottles?	57.8
A complete first-aid kit?	50.6
Have you attended a first aid training course?	47.0
An operating fire extinguisher?	38.6
Do you read material on earthquake preparedness?	37.3
Does your household have earthquake insurance?	37.3
An operating transistor radio?	33.7
Does your household have a meeting place to come together after a possible earthquake?	31.3
Have you stabilized/fixed heavy objects/furniture in your home?	28.9

Key:

Blue: Utilities

Yellow: Supply

Green: Planning

Pink: Fixing

It appears as though most people are well aware of their electric, gas, and water shut, and therefore, more prepared in the aspect of utilities in the event of an earthquake. Following utilities, the table ranking shows approximately 50% of these communities possess the necessary supplies to help survive an earthquake: predominantly the appropriate supply of food and water and a first-aid kit. It can be noted that little planning has taken place (less than 50% have attended training, read, and devised a household plan in case of a disaster). Lastly, just over one-fourth of people have taken the time to fix perilous objects and furniture.

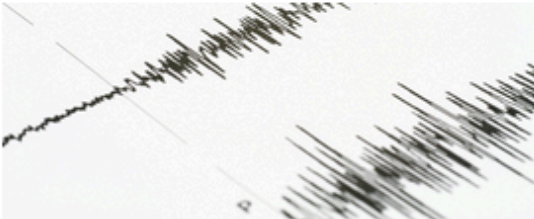


The Federal Emergency Management Agency of the United States Department of Homeland and Security stresses the importance of 1) being informed, 2) making a plan, and 3) building a kit<sup>7</sup>. Primarily, it is crucial to learn about the protective measures needed before, during, and after an emergency. It is therefore concerning to find a low ranking for planning in Karagaac and Bahcesehir. Interestingly, FEMA puts less emphasis on utilities and supplies, which is the aspect in which these communities are most prepared. The following image presents FEMA's advised preparation for an earthquake:

### Before an Earthquake

The following are things you can do to protect yourself, your family and your property in the event of an earthquake.

- To begin preparing, you should build an emergency kit and make a family communications plan.
- Fasten shelves securely to walls.
- Place large or heavy objects on lower shelves.
- Store breakable items such as bottled foods, glass, and china in low, closed cabinets with latches.
- Fasten heavy items such as pictures and mirrors securely to walls and away from beds, couches and anywhere people sit.
- Brace overhead light fixtures and top heavy objects.
- Repair defective electrical wiring and leaky gas connections. These are potential fire risks. Get appropriate professional help. Do not work with gas or electrical lines yourself.
- Install flexible pipe fittings to avoid gas or water leaks. Flexible fittings are more resistant to breakage.
- Secure your water heater, refrigerator, furnace and gas appliances by strapping them to the wall studs and bolting to the floor. If recommended by your gas company, have an automatic gas shut-off valve installed that is triggered by strong vibrations.
- Repair any deep cracks in ceilings or foundations. Get expert advice if there are signs of structural defects.
- Be sure the residence is firmly anchored to its foundation.
- Store weed killers, pesticides, and flammable products securely in closed cabinets with latches and on bottom shelves.
- Locate safe spots in each room under a sturdy table or against an inside wall. Reinforce this information by moving to these places during each drill.
- Hold earthquake drills with your family members: Drop, cover and hold on.



<sup>7</sup> "Earthquakes." *Home*. N.p., n.d. Web. 1 Jan. 2014.

Figure 4: List of how to prepare for an earthquake released by FEMA.

Based on this form of preparation, the communities of Bahcesehir and Karagaac are not well prepared for an earthquake. Utilities and supplies are only two aspects of preparedness, and arguably not the most important. The lack of planning by individuals and families, and fixing of harmful belongings is hindering the level of preparedness demonstrated by these communities. Nonetheless, although FEMA is a highly reputable organization devoted to boosting preparedness, aid emergency situations, and provide relief, advice from country to country can vary dependent upon local conditions.



### *To what extent do demographic factors determine this?*

“Socioeconomic and demographic characteristics are commonly found to be associated with preparedness behaviors although the direction of association is not always consistent.”<sup>8</sup> I have therefore chosen education, income, and previous experience as demographic factors for my investigation, as I believe these possess a linear correlation to earthquake preparedness.

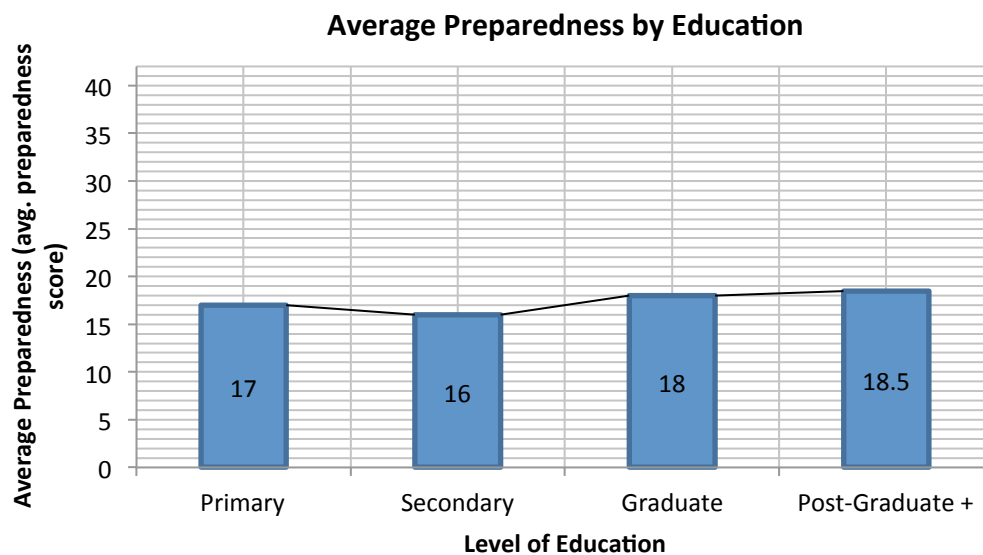
### Education

According to a case study done by Princeton attendees, education is commonly regarded an indicator of socioeconomic status and therefore is included as a vulnerability indicator in disaster preparedness, “...it is assumed that disaster preparedness increases with education because highly educated individuals have better economic resources to undertake preparedness actions.”<sup>9</sup> In respect to the data collected at Karagaac and Bahcesehir, I would suspect those who received a Post-Graduate or higher education to be better prepared (achieve a higher preparedness score) than those who received primary education. The average preparedness total of each achievement level is displayed in the graph below.  
(Overleaf)

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<sup>8</sup> Muttarak, Raya, and Wiraporn Pothisiri. *The Role of Education on Disaster Preparedness: Case Study of 2012 Indian Ocean Earthquakes and Tsunami Warnings on Thailand's Andaman Coast*. Princeton University. N.p., n.d. Web. 01 Jan. 2014.

<sup>9</sup> Muttarak, Raya, and Wiraporn Pothisiri. *The Role of Education on Disaster Preparedness: Case Study of 2012 Indian Ocean Earthquakes and Tsunami Warnings on Thailand's Andaman Coast*. Princeton University. N.p., n.d. Web. 01 Jan. 2014.



The graph shows, overall, a slight increase in preparedness from primary to post-graduate and above. Arguably the drop is an anomaly, but since there are only four values, it is difficult to tell. Nonetheless, the data collected appears to reflect previous studies and research regarding education and disaster preparedness. Logically speaking, the more educated a person is, the more content he/she possesses which would enable decision-making before and at the time of the emergency. Aside specific instruction of how to prepare for an earthquake, concepts like vulnerability, spatial extent, and earthquake prediction would significantly aid preparedness. In Karagaac and Bahcesehir, education does not seem to be a significant determining factor in earthquake preparedness.

I therefore decided to undertake the Spearman's Rank Correlation Coefficient to identify whether these two variables, education and preparedness, relate in a monotonic function<sup>10</sup>. The general formula is displayed below (Figure 5).

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<sup>10</sup> "How to Calculate Spearman's Rank Correlation Coefficient." *WikiHow*. N.p., n.d. Web. 3 Jan. 2014.

### Spearman's Rank Correlation Coefficient

$$r = 1 - \left( \frac{6\sum d^2}{n(n^2 - 1)} \right)$$

*d = difference between the two numbers in each pair of ranks*

*n = number of pairs of data*

**Interpretation of result** (it can vary between -1 and 1)

- Close to -1 - Negative correlation.
- Close to 0 - No linear correlation.
- Close to 1 - Positive correlation.

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I input the corresponding values into the equation after the necessary calculations:

$$r = 1 - \left( \frac{6(17226)}{80(80^2 - 1)} \right)$$

**Spearman's Rank Result** = 0.7981012658;

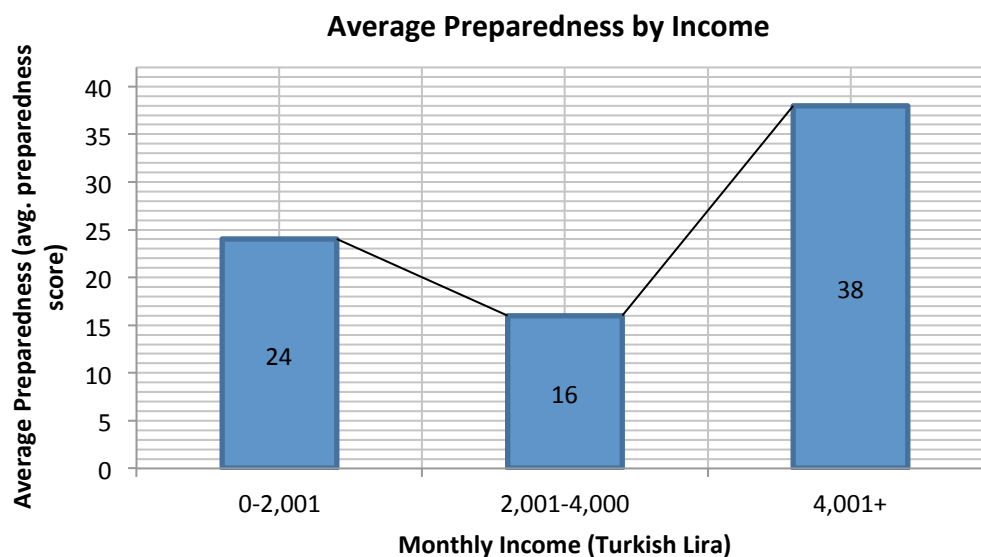
This value is closer to 1, which indicates a positive correlation between education and preparedness, supporting the data displayed on the graph and the original hypothesis.

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<sup>11</sup> Figure 5: Spearman's Rank Formula ["How to Calculate Spearman's Rank Correlation Coefficient." *WikiHow*. N.p., n.d. Web. 3 Jan. 2014.]

## Income

Alongside education, socioeconomic factors tend to be linked to preparedness behavior. Incidentally, those more “well-off” are capable of obtaining better education, which in turn can increase preparedness. The survey given to the communities of Karagaac and Bahcesehir provided three income options: 0-2000 Turkish Lira (roughly US\$920), 2,001-4,000 TL (roughly US\$1840), and 4,001 TL or above. The data obtained is presented below.



Comparable to education, there is an overall increase in average preparedness from the lowest income value to the largest. Nonetheless, the data is inconsistent as there is an unexpected decrease. In my opinion, however, this can be considered an anomaly due to the unequal number of respondents: 42 for the lowest range of income, 15 for the middle range, and 23 for the highest range. Arguably, the middle value is less accurate due to less data collection. According to FEMA’s Preparedness Profiles<sup>12</sup>, those belonging to the “Part of Life” profile received higher incomes (\$75,000 or more) and were deemed most prepared. The majority have discussed preparation, been encouraged by family and/or school to have a disaster plan, are confident in responding to a natural disaster, and believe

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<sup>12</sup> FEMA. *Preparedness in America - Research Insights to Increase Individual, Organizational, and Community Action*. Rep. N.p., n.d. Web. 1 Jan. 2014.

preparation helps. This is an example of a region (United States) in which income appears to have a positive correlation to disaster preparedness. Although the beginning and end result of the communities of Karagaac ad Bahcesehir indicate the same correlation, the whole of data is inconsistent. Aiming to further evaluate this relationship, I calculated the Spearman's Rank once more:

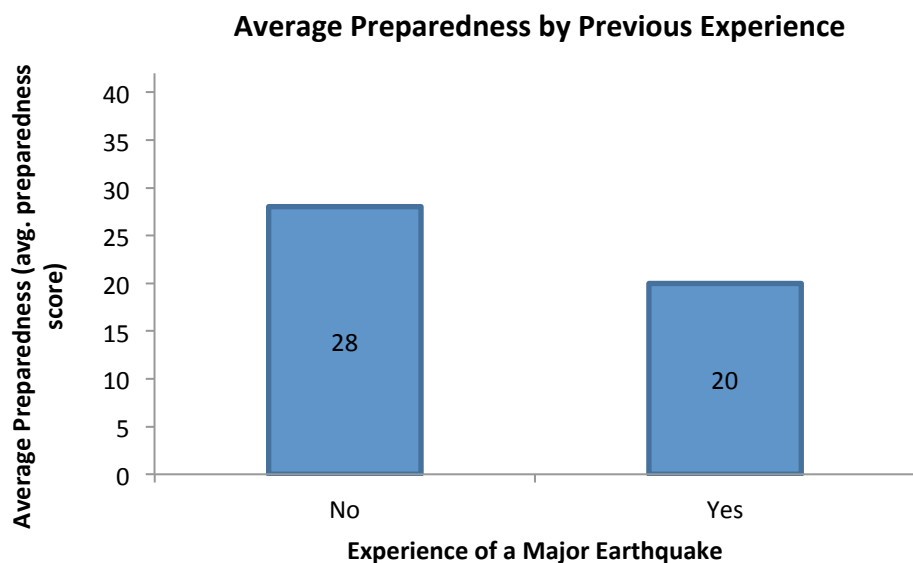
$$r = 1 - \left( \frac{6(18069)}{80(80^2 - 1)} \right)$$

**Spearman's Rank Result:** 0.7882208158;

This value suggests income and preparedness do relate monotonically: those with higher incomes are prepared to a greater extent in the event of an earthquake.

## Previous Experience

The mental and physical deterioration major earthquakes can cause would likely trigger cautious risk assessment, ultimately improving preparation and response to future disasters. Thus, it can be assumed that those who have experienced earthquakes first-hand have solidified their knowledge and preparation. Turkey has suffered from major earthquakes in the past, notably 1668, 1939, and 1999, with magnitudes of 8, 7.8, and 7.6 respectively<sup>13</sup>. 51 people that were surveyed had previously experienced a major earthquake, predominantly in 1999, although some occurred in different places, such as Japan, Iran, and Peru.



Unexpectedly, the data acquired shows the opposite behavior from that which we would expect: those who have never experienced a major earthquake, on average, are more prepared than those who have. Reasons for this may include the belief that if you survive once, you can do so again.

The University of Texas found the same results in a study about Houston's vulnerability to hurricanes. After investigated whether or not people become better prepared in the aftermath of a natural disaster they found "no significant changes in

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<sup>13</sup> "List of Earthquakes in Turkey." *Wikipedia*. Wikimedia Foundation, 16 Jan. 2014. Web. 18 Jan. 2014.

preparedness or evacuation plan in residents of Houston prior to and a year after Hurricane Ike.”<sup>14</sup>.

Contrarily, FEMA conducted a survey in 2011 concerning personal and social experiences that were analyzed in terms of preparedness behaviors and found that “The personal disaster experience had a positive relationship with preparedness behaviors...over half the respondents indicated experience with some type of disaster and referencing past experiences should be reinforced.”<sup>15</sup>

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<sup>14</sup> V, Chen, Banerjee D, and Liu L. "Do People Become Better Prepared in the Aftermath of a Natural Disaster? The Hurricane Ike Experience in Houston, Texas." *National Center for Biotechnology Information*. US National Library of Medicine, May 2012. Web. 1 Jan. 2014.

<sup>15</sup> FEMA. *Preparedness in America - Research Insights to Increase Individual, Organizational, and Community Action*. Rep. N.p., n.d. Web. 1 Jan. 2014.

## **E – Conclusion**

Firstly, there is clearly no significant difference between the communities of Karaagac and Bahcesehir in terms of preparedness. If they were to be classified under a category, they would most likely fall under the same one, as the overall average preparedness of both areas lie fewer than 50% of the highest possible preparedness score. This leads me to believe that both communities lack preparation for potential earthquakes.

The data compiled also suggests these communities are more prepared in terms of utilities and supplies, but have undergone little planning and fixing, vital aspects of preparation.

Although not always consistent, demographic factors do relate to preparedness behavior. High levels of education and income are thought to increase preparedness, as shown in previous studies. In respect to Karagaac and Bahcesehir, these factors show a general increase, but the correlation is not linear. Past experience, however, does not seem to determine preparedness in this particular area in which the research was conducted.



## **F – Evaluation**

In general terms, the data collection was very efficient. We had a large group, two Turkish speakers to facilitate communication and translate the survey, and a targeted a variety of areas in which different people were accessible (i.e. park, mall, market, streets). These areas provided a large amount of samples, allowing for quantitative and qualitative data for processing.

Nonetheless, there are evident limitations with surveys, such as the reliance on the credibility of the data; there is no possible way of confirming the answers were honest. In addition, many people were hesitant to respond, especially in the village. This hindered our sampling and affected the amount of surveys we were able to obtain. If there had been more data, the conclusions made could have been even more accurate. Lastly, if I were to repeat this investigation, I would attempt to collect the same amount of data for each community, as I believe difference in samples (scarce in the village) affected the results.

## Works Cited:

"Earthquakes." *Home*. N.p., n.d. Web. 1 Jan. 2014.

FEMA. *Preparedness in America - Research Insights to Increase Individual, Organizational, and Community Action*. Rep. N.p., n.d. Web. 1 Jan. 2014.

"How to Calculate Spearman's Rank Correlation Coefficient." *WikiHow*. N.p., n.d. Web. 3 Jan. 2014.

"List of Earthquakes in Turkey." *Wikipedia*. Wikimedia Foundation, 16 Jan. 2014. Web. 10 Dec. 2013.

Muttarak, Raya, and Wiraporn Pothisiri. *The Role of Education on Disaster Preparedness: Case Study of 2012 Indian Ocean Earthquakes and Tsunami Warnings on Thailand's Andaman Coast*. Princeton University. N.p., n.d. Web. 01 Jan. 2014.

North Anatolian Fault." *ScienceDaily*. ScienceDaily, n.d. Web. 20 Nov. 2013.

Tubbesing, Susan K. "The Loma Prieta, California, Earthquake of October 17th, 1989- Loss Estimation and Procedures." *US Geological Survey Professional Paper 1553-A* (1994): B63-64. *Google Books*. United States Government Printing Office, Washington, 27 Apr. 1994. Web. 20 Dec. 2013.

V, Chen, Banerjee D, and Liu L. "Do People Become Better Prepared in the Aftermath of a Natural Disaster? The Hurricane Ike Experience in Houston, Texas." *National Center for Biotechnology Information*. US National Library of Medicine, May 2012. Web. 1 Jan. 2014.