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Adaptation of hurricane risk perception scale to earthquake risk perception and determining the factors affecting women's earthquake risk perception

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Abstract

Worldwide studies show that gender is an important variable affecting disaster risk perception and that women have high levels of disaster risk perception. The objective of this study is to investigate women's earthquake risk perception as well as the factors that may help predict it. The data of the study were collected from 463 women living in Kocaeli (Turkey) by survey method. The study, which employed ordinary logistic regression analysis, analysed whether the same dependent variable was predicted by different independent variables in five models. Many of the women who participated in the research reported that they were more sensitive to earthquakes. The items with the highest mean among women's affective and cognitive risk perception factors are the items that measure fear and financial perception, respectively. Education and age significantly help predict women's earthquake risk perception. Living in dread of earthquakes and being depressed and worried for future generations make women feel more sensitive. This study has showed that all the underlying factors affecting women's disaster risk perception should be understood more deeply. It is thought that the results of the study will contribute to studies related to disaster management, risk perception, and women.

Keywords Earthquake · Women · Risk perception · Disaster

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1 Introduction

Gender is one of the significant factors that should be considered while developing disaster management policies because women suffer from disasters more than men (Işık et al. 2015; Drolet et al. 2015; Gaillard et al. 2017). Social factors, such as income inequality, sexual violence, and migration, make women more vulnerable to disasters (Cutter 2017). Even if women survive from disasters, they are exposed to sexual violence during recovery (True 2013). Furthermore, in forced migration situations, the risk of post-traumatic stress disorder is higher among women refugees (Alpak et al. 2015). Unfortunately, due to cultural and religious obstacles, the flood risk perception study in Pakistan was conducted only with male participants (Qasim et al. 2015). Women do not have sufficient means to access information on disaster preparedness and disaster risk (Juran and Trivedi 2015). After the earthquake that occurred in 2011 in Turkey's Van province, it was impossible to provide social services to earthquake victims since women were not supposed to speak with foreign men (Yaman and Akyurt 2013).

Women, like every individual, have responsibilities towards their communities and families related to disaster management. Clissold et al (2020) indicated that women had four critical strategies and roles, such as social mobilisers, collectivizing and leading forces, innovators, and entrepreneurs, in the recovery phase after disasters. Disaster-affected women ignore their own problems as they are concerned about their families and material losses (Sohrabizadeh et al. 2016). Similarly, Alam and Rahman (2014) stated that women took better care of the elderly, the sick, and children in the family than men in case of a disaster and facilitated rehabilitation in the family after a disaster. In disaster situations, while women's responsibilities towards their families increase, it also becomes more difficult for women to meet their own needs (Drolet et al. 2015). In particular, the responsibilities of pregnant women and women with babies increase considerably in the event of disasters, and these women need to prepare their babies for a potential disaster. Policy makers and scientists have endeavoured to help women take a more active role in disaster management and to solve women's problems related to disasters.

Efforts are underway to improve women's physical, psychological, social and economic well-being against difficult situations around the world. The United Nations' sustainable development goals include empowering women and girls (United Nations 2015). Global goals, strategies and policies are planned to be implemented between 2015 and 2030 in order to reduce the vulnerability of women to disasters and to enable them to play a greater role in disaster management (United Nations Office for Disaster Risk Reduction 2015). However, unless gender inequalities are eliminated in disaster management studies, the role of women who may actively contribute to disaster response will not change (Bradshaw 2015). *"Women's knowledge, agency, and collective action must be fully recognised and supported to build resilience, reduce disaster risks, and contribute to sustainable development"* (Drolet et al. 2015, p. 446). Therefore, when it comes to disasters, in order to understand the vulnerability of women, scientific studies that reveal how women feel about disasters are necessary. Investigating which factors affect women's perceptions about disasters, how and to what extent, may make women more resilient to disasters.

The situation of women in various issues related to disasters has been investigated through different scientific research methods. For example, Kwan (2020) explored the factors affecting the pre-disaster resilience of women who were poor, elderly, and widowed by means of qualitative research. Mamun et al (2019) investigated the presence of depression in women, who survived cyclone, and explored the predictors of depression. In a literature

survey, the needs and poor living conditions of women, who were considered as a risk group and seen as an important resource in disaster management, were analysed in the example of Turkey (Işık et al. 2015). In a study conducted on women after a devastating earthquake, the relationship among sexual assault, earthquake exposure, psychological symptoms, and social support was examined (Cénat et al. 2019). In addition to these studies, there is a need to understand women's disaster risk perception.

Conducting risk perception studies, which are of great importance in terms of determining disaster management policies, on the female population will be of great benefit for women and management because many studies conducted on different types of disasters around the world have shown that women's risk perception is higher than men (Armaş 2006; Lovekamp and Mcmahon 2011; Soffer et al. 2011; Kellens et al. 2011; Tekeli-Yeşil et al. 2011; Kung and Chen 2012; Tian et al. 2014; Bronfman et al. 2016; Shrestha et al. 2018; Uhm and Oh 2018). For example, compared to men, women have a higher perception of exposure to disasters (Bronfman et al. 2016), a higher perceived worry, concern and fatal consequences against a storm (Kellens et al. 2011), and a higher perceived fearfulness against earthquakes (Kung and Chen 2012). These results show that, in order to make women more resilient, the risk perception should be better understood and risk perception studies should be conducted in detail. Because, on the one hand, women are a sensitive group that is more affected by disasters; on the other hand, they are a critical actor with an important role in disaster management. In particular, it is important to investigate the disaster risk perception of women against earthquake, which is the deadliest type of natural disaster that occurred between 2000 and 2019 (United Nations Office for Disaster Risk Reduction 2020). In this way, the community will be more resilient against disasters at local and national level, as women who are highly vulnerable to the most serious natural disasters are empowered. The studies investigating the thoughts, attitudes, perceptions and experiences of women, who live in an area with high earthquake risk and have an earthquake experience, provide information for the development of more effective disaster management strategies for women (Cénat et al. 2019; Hou and Wu 2020; Zhou et al. 2020; Yoosefi Lebni et al. 2020; Samouei et al. 2021). For instance, Cao and Kamel (2011) found that more women than men were hospitalized as victims after the 2008 Wenchuan earthquake. Zhou et al. (2020) stated that older women, injured women and women whose houses were damaged had higher psychological problems after the earthquake. After the earthquake in Iran, women faced many problems in terms of health needs, family relations, gender equality, security, cultural and social issues (Yoosefi Lebni et al. 2020). More scientific studies should be conducted on women in order to understand the risk perception of women so that women can be more prepared for disasters, respond more effectively and recover from the effects of potential disasters.

The objective of this study is to investigate the earthquake risk perception of the women living in Kocaeli (Turkey). The earthquake risk perception of the women will be determined by a question indicating the perceived sensitivity and by an eight-dimensional scale. Then, the factors that are thought to affect earthquake risk perception of women will be estimated by ordinal logistic regression analysis. It is hoped that this study will contribute to earthquake risk perception studies and women studies conducted worldwide. The results will also provide important ideas to managers and decision-makers for disaster risk reduction and disaster education. Furthermore, this study intends to answer the following questions:

Are women more sensitive to earthquakes because they are women?

What are the characteristics of women's affective risk perception and cognitive risk perception of earthquake?

What are the factors that predict women's earthquake risk perception?

2 Earthquake and risk perception

Earthquakes, which devastate people, the environment, economy and social life, affected 1.4 million people and caused a huge economic damage (7.1 billion US$) and 5264 deaths worldwide in 2018 (Centre for Research on the Epidemiology of Disasters 2019). In addition, earthquakes trigger other disasters and, therefore, create greater losses and crises. For example, the earthquake that happened on the Indonesian island of Sumatra in 2004 generated a tsunami, causing more than 300 000 deaths and leaving 1.5 million people homeless in 12 countries (Ghobarah et al. 2006). Likewise, the earthquake that occurred in Japan on 11 March 2011 and a huge tsunami triggered by this earthquake damaged the Fukushima Daiichi Nuclear Power Plant and caused a serious nuclear crisis on a national and international level. This situation affected many people in Japan and caused a great damage to the country's economy and environment (Norio et al. 2011). Moreover, as earthquakes damage school buildings, students' education is interrupted or they are forced to continue education in unsafe schools (Ersoy and Koçak 2016).

Earthquakes negatively affect people's feelings, thoughts, behaviours and attitudes, as earthquakes cause a great physical and material damage to people. For example, Cui and Han (2019) found that earthquake experience had a negative effect on happiness, general health status and life satisfaction. Most of the respondents (%72.19) in the study conducted in the region with high earthquake risk wanted to settle elsewhere to avoid disasters (Xu et al. 2019). In a study conducted among the survivors of the 1999 Marmara earthquake in Turkey, 76% of the participants stated that they thought that their relatives and loved ones might die during the earthquake (Sumer et al. 2005). Scientific studies showed that post-traumatic stress disorder and depression appeared among survivors after earthquakes (Başoğlu et al. 2004; Kun et al. 2009; Adhikari Baral and Bhagawati 2019; Inoue et al. 2019; Qi et al. 2020). Considering the negative effects of earthquakes, it is understood that earthquakes pose a great risk for people. Therefore, how people interpret and perceive earthquake risk is important in order to reduce the effects of an earthquake.

As a result of extensive studies to determine the earthquake risk perception, important information was found that could be used by managers and decision-makers in disaster management. For example, it was found that information reliability had a significant effect on earthquake risk perception (Zhu et al. 2011). A negative significant correlation was found between earthquake risk perception and earthquake preparedness (Shapira et al. 2018). The results of the study conducted on earthquake in Myanmar, fire and cyclone risk perception revealed that training arrangements should be made to increase disaster preparedness (Fernandez et al. 2018). The study conducted in Baluchistan, a province vulnerable to earthquakes, showed that awareness, resilience, coping and prevention mechanism affected risk perception (Ainuddin and Routray 2012). After the earthquake and the subsequent nuclear power plant accident in Japan, the level of public concern about the earthquake and the nuclear power plant accident increased (Nakayachi et al. 2015). Perceived outcome and perceived probability of earthquake are the positive significant predictors of earthquake preparedness (Baytiyeh and Naja 2015).

3 Rationale for research

Disaster and Emergency Management Authority (DEMA) reported that 92% of the total land area of Turkey is located in the earthquake region and that 95% of the population lived in areas with high earthquake risk (DEMA 2014). Besides, the earthquakes between 1923 and 2016 constitute 47.5% of the natural disasters which occurred in Turkey (Bahadır and Uçku 2018). Two earthquakes with epicentre in Kocaeli occurred on 17 August 1999 and 12 November 1999, causing enormous damage and economic destruction. Detection of the dead, injured and material damage caused by these earthquakes has not been fully realized. However, it is estimated that there is an economic loss of US $16 billion, 18,373 dead, and 48,901 injured; and 40% of these injured people were disabled due to the earthquake (Erdik 2001). After this earthquake, it was understood that major changes must be made in disaster management in Turkey. Therefore, changes and innovations were carried out in laws, practices and corporate governance.

The scope of studies on earthquakes is wider than other types of disasters because earthquakes left a significant trace in Turkey's history. For example, there is a special unit called Presidential of Earthquake Department within the scope of the Turkey's national disaster management, specific to the earthquake. National Earthquake Strategy and Action Plan (UDSEP-2023) covering several projects is in effect (DEMA 2013). Many ministries, institutions and private sector are the partners of it, and it determines the plan, programs and policies for earthquake disaster management at a national level in Turkey. In addition, projects are being carried out within the scope of the National Earthquake Research Program (UDAP), which has a duration of 12 years (2012–2023), to produce scientific and technological resources related to earthquakes (DEMA 2019a). Kocaeli Municipality organizes disaster education in different fields, especially in earthquake education. Kocaeli Municipality provided disaster education to 8,518 people in 2018 and distributed the educational game "Disaster Ready" to the students (Kocaeli Metropolitan Municipality 2019). While mitigation and preparedness policies are developed against earthquakes, more resources should be allocated to women in terms of disaster management in order to build a community disaster resilience. Furthermore, the vision of disaster management in Turkey's 2019–2023 strategic plan was expressed as "to build a community disaster resilience." (DEMP 2019b). In order to reach this vision, it is important to empower women to cope with disasters. Since it is planned to promote women leadership to reduce disaster risks on a global and national scale (United Nations Office for Disaster Risk Reduction 2015), understanding women's disaster risk perception is important. Given the devastation caused by the earthquake and the high vulnerability of women, it is clear that scientific studies should be conducted to protect women from damages caused by earthquakes. These scientific studies can show whether the activities related to earthquakes are effective and efficient. Policy practices at the global level have set goals and targets to save women from their disadvantages and empower them in the face of adversity. Eliminating gender inequality and empowering women and girls is one of the sustainable development goals of the United Nations (United Nations 2015). Stronger and more effective participation of women in disaster management efforts is emphasized in order to build better after disasters (United Nations Office for Disaster Risk Reduction 2015). Under these circumstances, it is expected that the results and methodological approach of this study will shed light on the work of scientists and disaster managers examining about earthquake, women and risk perception.

4 Method

4.1 Study area

The study was conducted in 12 central districts of Kocaeli (Fig. 1). The data were collected between January 2019 and July 2019 from women aged 18 and over by survey method. A total of 1,906,391 people (963,326 males and 943,065 females) live in the central districts of Kocaeli (Turkish Statistical Institute 2019). In this study, a total of 518 questionnaires were applied by means of the convenience sampling. The researchers collected the data from women in the streets, cafes, workplaces and at home who voluntarily participated after the purpose of the research was revealed. Since there were deficiencies in the demographic data, 55 questionnaires were not included. 55 questionnaires were 10.6 percent of the total questionnaire and no change or transformation was made in this data to avoid any manipulation in the results, and the study was conducted with the data collected from 463 women. When the universe and the sample size of the study are calculated, according to the criteria of Krejcie and Morgan, the total sample of 463 women is sufficient for this research (Krejcie and Morgan 1970).

4.2 Instrument

The questionnaire prepared to collect data consists of two parts. In the first part, information about age (continuous variable), marital status (single/married), monthly income (low/middle/high), educational level (literate/primary school/secondary school/high school/associate degree/undergraduate degree or higher), number of children (no child/1/2/more than 2), disaster experience (no/yes), and chronic disease (no/yes) were collected. Life threat, health deterioration and material damage are among the factors used in order to measure the risk perception of people with regard to future disasters (Tian et al. 2014; De Dominicis et al. 2015; Baytiyeh and Öcal 2016; Zhang et al. 2017; Armaş et al. 2017; Fernandez et al. 2018; Sun and Xue 2020). In this section, based on these approaches, there is also a question (Do you feel more sensitive to earthquake because you are a woman?) to determine whether women feel more sensitive to earthquakes. Women answered this question using one of the following options: no, sometimes and yes.

In the second part, in order to determine earthquake risk perception, the Turkish adaptation of a scale, which is originally in English, was used. Trumbo et al. (2016) developed a scale to determine hurricane risk perception from an affective and cognitive perspective. Trumbo et al. (2016) stated that the scale they developed had a good promise about generalization for other natural hazards and risk domains. When the scale is intended to be used

Fig. 1 Turkey earthquake hazard map (DEMA 2019c)

Kocaeli Province
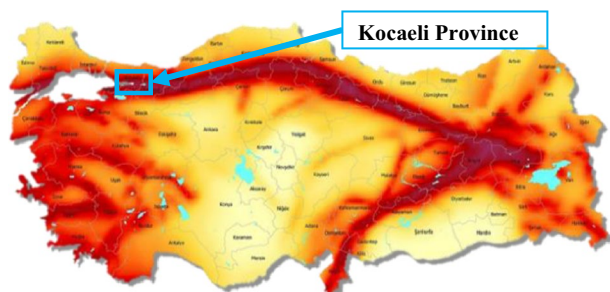
in another type of disaster, only changing the name of the disaster increases the generalizable power of the scale. In order to use it in this study, the scale was modified according to earthquake disaster. For example, "Hurricane makes me feel worried" was changed to "Earthquake makes me feel worried". The scale consists of 8 items structured between 1 and 5 in a 5-point Likert scale. The researchers conducting this study translated the scale into Turkish and three experts in the field of English checked the translation of the scale in terms of language. Five experts in the field of disaster management checked the scale for compliance with disaster management and language. The questionnaire was applied to 15 women for pilot testing. With the feedback received from these women, writing and form changes were made in the scale, and the scale was, then, used.

4.3 The background of the models used in this study

Scientists have widely investigated socio-demographic characteristics among many factors that affect individuals' perception of earthquake risk. Age, marital status, income, presence of children, chronic illness and education variables are frequently included as independent variables in studies investigating the perception of earthquake risk (Table 1). In addition, the disaster experience variable, which indicates whether people are affected by disasters or how they are affected by disasters, is considered as an independent variable (Table 1).

The relationships between people's cognitive and affective perceptions related to disasters, such as anxiety, fear, depression, probability, consequences, awareness, exposure, severity, controllability, and uncertainty, should be explored to explain risk perception more comprehensively. For example, Zhu et al. (2011) investigated the relationship among controllability, visibility, fearfulness, possibility, and severity as factors affecting earthquake risk perception. Another study examined whether there was a relationship among the variables regarding earthquake risk perception including probability, severity, dread, controllability, responsibility, and knowledge (Ozdemir and Yilmaz 2011). Similarly, Tian et al. (2014) explored the relationship among the variables related to earthquake risk perception.

Some scientists employed control variables to reveal changes in risk perception when those variables were included in the model. For instance, Xu et al. (2019) applied the

Table 1 Factors affecting earthquake risk perception

Factors	References
Age	(Armaş 2006; Soffer et al. 2011; Zhu et al. 2011; Tekeli-Yeşil et al. 2011; Kung and Chen 2012; Ainuddin et al. 2014; Tian et al. 2014; Bronfman et al. 2016; Baytiyeh and Öcal 2016; Shapira et al. 2018; Fernandez et al. 2018)
Marital status	(Soffer et al. 2011; Tekeli-Yeşil et al. 2011; Kung and Chen 2012)
Income	(Armaş 2006; Tekeli-Yeşil et al. 2011; Ainuddin et al. 2014; Tian et al. 2014; Bronfman et al. 2016; Shapira et al. 2018; Fernandez et al. 2018)
Presence of children	(Ozdemir and Yilmaz 2011; Tekeli-Yeşil et al. 2011; Fernandez et al. 2018)
Disaster experience	(Tekeli-Yeşil et al. 2011; Tian et al. 2014; Xu et al. 2016, 2019; Castro et al. 2017; Shapira et al. 2018; Fernandez et al. 2018; Sun and Xue 2020)
Chronic illness	(Castro et al. 2017; Shapira et al. 2018)
Education	(Armaş 2006; Soffer et al. 2011; Zhu et al. 2011; Tekeli-Yeşil et al. 2011; Kung and Chen 2012; Ainuddin et al. 2014; Tian et al. 2014; Bronfman et al. 2016; Baytiyeh and Öcal 2016; Shapira et al. 2018; Fernandez et al. 2018)

control variable (age, education, residence time, etc.) to investigate factors predicting severity and probability perceived against earthquake. In addition, while determining the factors affecting perceived probability and consequences for earthquake; age, education, and income were used as control variables (Sun and Xue 2020). In a study investigating the predictors of flood risk perception, disaster experience was addressed as a control variable (O'Neill et al. 2016). With reference to these studies, socio-demographic variables and disaster experience were used as the control variable in this study. In the present study, five different models were performed to better understand the effects of independent variables on women's earthquake risk perception. In order to comprehensively reveal the effects of socio-demographic variables, disaster experience, affective and cognitive risk perception items and factors, non-significant variables were not excluded in subsequent analyses.

4.4 Data analysis

The data analysis was performed using SPSS (Statistical Package for Social Sciences) and AMOS (Statistical Package for Social Sciences). The data from the first part of the questionnaire were presented with frequency distribution and percentages. The status of women feeling sensitive to earthquakes was presented with a bar of chart. The construct validity of the scale was tested using exploratory factor analysis (EFA) with SPSS program, and confirmatory factor analysis (CFA) with AMOS program. In the presentation of the data, the mean (M) and standard deviation (Sd) of the scale items, factor mean and standard deviation, factor load, eigenvalue, explained variance, and explained total variance are given as well as the values of Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO), Bartlett's Test of Sphericity (Bartlett's test) and Cronbach Alpha (CA).

The situation of women feeling sensitive to earthquake was used as the dependent variable (no = 0, sometimes = 1, yes = 2), and the independent variables predicting the dependent variable were determined with the help of five ordinal logistic regression models. Before the regression analysis, the existence of multicollinearity among the independent variables was checked with variance inflation factors (VIF) and tolerance values. The educational variable was re-coded as low (literate / primary / secondary), middle (high school / associate degree) and high (undergraduate or higher). In the first model, the socio-demographic variables (age, marital status, monthly income, education level, number of children, and chronic disease) and disaster experience were used as the independent variables. In the second model, eight items of the scale, which are continuous variable, were used as the independent variables. All the aforementioned independent variables were included in the model with the same dependent variable in the third model. In the fourth model, the affective and cognitive factors were used as the independent variables. The affective factor, the cognitive factor, the socio-demographic variables and disaster experience were used as the independent variables in the fifth model.

4.5 Ethical consideration

The women voluntarily participated in this research. The Scientific Research and Publication Ethics Committee of Gümüşhane University approved this research in scientific and ethical terms. The governorship of Kocaeli gave permission for the implementation of the survey in the city.

5 Results

Table 2 presents the characteristics of the sample. 352 (76%) of the women were married, and 111 were single. According to the perceived monthly income, 49 (10.6%) of the women were in the low-income group, 382 (82.5%) were in the middle-income group, and 32 (6.9%) were in the high-income group. There were 119 (25.7%) women without children, 78 (16.8%) women with 1 child, 186 (40.2%) women with 2 children and 80 (17.3%) women with more than 2 children. While 135 (29.2%) women did not experience any disasters, 328 (70.8%) women experienced a disaster. The number of women without chronic disease was 379 (81.9%), and the number of women with chronic disease was 84 (18.1%). 141 (30.5%) women had a low level of educational status, 210 (45.4%) women had a medium level of education, and 112 (24.1%) women had a high level of education. In addition, the mean age of the women was 37.77 (SD=9.47, minimum=18, maximum=72).

Figure 2 shows the status of the women feeling sensitive to earthquakes because they are women. 171 (36.9%) of the women do not feel sensitive to earthquakes because they

Table 2 Characteristics of the sample

Variable	Groups	Frequency	Percent (%)
Marital status	Single	111	24
	Married	352	76
Monthly income	Low	49	10.6
	Middle	382	82.5
	High	32	6.9
Number of children	No Child	119	25.7
	1	78	16.8
	2	186	40.2
	More than 2	80	17.3
Disaster experience	No	135	29.2
	Yes	328	70.8
Chronic disease	No	379	81.9
	Yes	84	18.1
Education level	Low	141	30.5
	Middle	210	45.4
	High	112	24.1

Fig. 2 Perceived sensitivity of women to earthquake
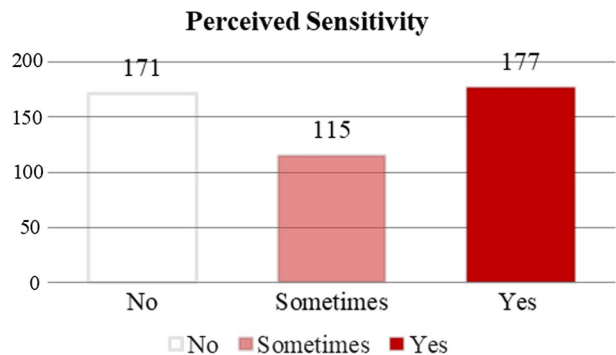
are women. While 115 (24.8%) women sometimes feel sensitive to earthquakes, 177 (38.3%) always think that they are sensitive to earthquakes. On the whole, more than half of the women in the study consider themselves sensitive to earthquakes because they are women.

Items, mean and standard deviation of items, factor loads, mean and standard deviation of factors, eigenvalue, explained variance, CA, and explained total variance are presented in Table 3. KMO (0.825) and Bartlett's test (*Chi-Square* = 1880.97, df = 28, p = 0.000) show that the data are suitable for factor analysis (Field 2013). Women's dread (M = 3.598, Sd = 1.292) and depression (M = 2.792, Sd = 1.348) perception level is the lowest. Women's financial (M = 4.188, Sd = 0.825) and fear (M = 4.175, Sd = 0.856) perception level is the highest. The first factor called affective risk perception had a factor load value between 0.650 and 0.836, and the second factor called cognitive risk perception had a factor load value between 0.715 and 0.870. The average of the first factor (M = 3.681, Sd = 0.888) is lower than the second factor (M = 4.118, Sd = 0.752). The eigenvalue of the first factor was 2,828, the variance explained was 35,349%, and the CA internal consistency coefficient was 0.805. The eigenvalue of the second factor was 2,645, the variance explained was 33.067%, and the CA internal consistency coefficient was 0.859. These two factors explain 68.416% of the total variance, and the sum of eigenvalues is 5.473. The mean of the scale was 3.9 (Sd = 0.717), and the CA internal consistency coefficient was 0.857. CFA confirmed the two-factor structure obtained by EFA with appropriate goodness-of-fit values (Chi-square/Degree of Freedom = 3.174, Root-Mean-Square Error Approximation = 0.069, Goodness-of-fit Index = 0.973, Adjusted Goodness-of-fit Index = 0.943 and Comparative Fit Index = 0.980) (Schermelleh-Engel et al. 2003; Hooper et al. 2008; Hair et al. 2010; Schumacker and Lomax 2010). Both the EFA and CFA conducted to test the construct validity of the scale indicate that the Turkish and earthquake versions of the scale are valid and reliable.

Table 4 shows the ordinal logistic regression results of the five models. The VIF value of all the models is below 4 (O'brien 2007) and the tolerance value is above 0.2 (Hosmer et al. 2008), indicating that there is no multicollinearity problem for regression analysis. In addition, according to the model fit information, all the models are statistically significant (p = 0.000). Among the socio-demographic variables, while age predicted positively and significantly women's earthquake risk perception, education predicted negatively and significantly women's earthquake risk perception (Model 1, Model 3, Model 5). Other socio-demographic variables and disaster experiences did not have a significant effect on women's perception of earthquake risk (Model 1, Model 3, Model 5). As for the affective and cognitive risk perception variables; dread, depressed and generations positively and significantly predicted the earthquake risk perception of women (Model 2, Model 3). However, fear, worry, catastrophe, widespread and financial did not significantly predict women's perception of earthquake risk (Model 2, Model 3). When the affective and cognitive variables were included in the analysis as a factor, the affective risk perception predicted women's earthquake risk perception positively and significantly, while the cognitive risk perception negatively and significantly predicted women's earthquake risk perception (Model 4, Model 5). According to the R^2 values, the best model explaining the variation in the earthquake risk perception of the women was model 3, model 5, model 2, model 4 and model 1, respectively. Model 3, which included all independent variables, was the strongest model, while model 1 with socio-demographic variables and disaster experience was the weakest. The strongest independent variables that positively and significantly

Table 3 Structural properties of the scale

Items	Factor				CA	Eigenvalues	Explained variance (%)
	M	Sd	1	2			
Fear = Earthquake makes me feel fearful	4.175	0.856	**0.785**	0.196		2.828	35.349
Worry = Earthquake makes me feel worried	4.160	0.887	**0.836**	0.183			
Dread = Earthquake makes me feel dread	3.598	1.292	**0.832**	0.241			
Depressed = Earthquake makes me feel depressed	2.792	1.348	**0.650**	0.265			
1. Affective risk perception	3.681	0.888			0.805		
Catastrophe = I think that earthquake may cause catastrophic destruction	4.131	0.879	0.231	**0.845**		2.645	33.067
Widespread = I think that earthquake may cause widespread death	4.142	0.878	0.198	**0.870**			
Financial = I think earthquake pose great financial threat	4.188	0.825	0.212	**0.804**			
Generations = I think earthquake pose a threat to future generations	4.010	0.998	0.279	**0.715**			
2. Cognitive risk perception	40.118	0.752			0.859		
Scale	30.9	0.717			0.857	5.473	66.416

Extraction method = Principal component analysis, Rotation method = Varimax, KMO = .825 Bartlett's test of sphericity = Chi-square = 1880.97, df = 28, *p* = .000

Table 4 The ordinal logistic regression results for women's earthquake risk perception

Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5
Age	0.029 (0.012)*		0.036 (0.013)*		0.038 (0.012)*
Marital Status	−0.065 (0.292)		−0.132 (0.316)		−0.105 (0.306)
Income	−0.037 (0.216)		−0.136 (0.231)		−0.144 (0.227)
Child	0.068 (0.121)		0.008 (0.130)		−0.002 (0.128)
Chronic Illness	0.133 (0.242)		0.025 (0.257)		0.093 (0.253)
Education	−0.441 (0.132)*		−0.311 (0.139)*		−0.339 (0.138)*
Disaster Experience	0.020 (0.201)		−0.258 (0.218)		−0.229 (0.213)
Fear		0.171 (0.165)	0.165 (0.168)		
Worry		0.010 (0.164)	0.124 (0.169)		
Dread		0.318 (0.111)*	0.296 (0.114)*		
Depressed		0.447 (0.091)**	0.402 (0.093)**		
Catastrophe		−0.116 (0.179)	−0.155 (0.182)		
Widespread		−0.352 (0.184)	−0.366 (0.188)		
Financial		−0.189 (0.156)	−0.137 (0.158)		
Generations		0.299 (0.124)*	0.273 (0.125)*		
Affective risk perception				1.081 (0.133)**	1.078 (0.138)**
Cognitive risk perception				−0.346 (0.144)*	−0.375 (0.148)*
Pseudo-R-Square					
Cox and Snell	0.073	0.204	0.239	0.165	0.213
Nagelkerke	0.083	0.231	0.270	0.187	0.240
McFadden	0.035	0.105	0.126	0.083	0.111
Model fitting information					
-2 Log Likelihood	862.637	690.182	873.480	454.772	889.220
Chi-Square	35.203**	105.638**	126.529**	83.575**	110.789**

Robust standard errors in parentheses; **$p < 0.001$; *$p < 0.05$

predicted the earthquake risk perception of women were depressed, dread, generations and age, respectively.

6 Discussion

In this study, in order to determine the earthquake risk perception of the women living in Kocaeli, the scale, which was developed by Trumbo et al. (2016) for the determination of hurricane risk perception and proposed to be adapted to other disaster types, was used after having been adapted to earthquake. The results showed that the scale adapted

to earthquake and to Turkish was valid and reliable. In addition, a question regarding whether women feel themselves more sensitive to earthquakes due to their gender was included. Five ordinal logistic regression analyses were conducted to determine the factors affecting women's risk perception.

The results of this study consisted of only women participants showed that some of the women who participated in the study always felt sensitive to earthquakes, while others felt sensitive occasionally. The reason why women think so is related to the fact that they are women. There are also other reasons of why women feel more sensitive to disasters. Liu et al (2018) reported that women being physically, mentally and economically more sensitive caused a high risk perception. Işık et al. (2015) stated that women in Turkey were more disadvantaged than men in terms of genetic, psychological, physiological, legal, sociological and educational conditions against disasters. This situation shows that studies are needed in Turkey in order to make women more resilient to disasters and to strengthen the existing socio-economic situation. It shows that more time, money and energy should be spent on women in disaster education activities conducted for the society and the individual because women who are vulnerable to dangers in normal life become more vulnerable in disaster situations and their exposure to disasters increases tremendously. In particular, qualitative studies on women who feel more sensitive to earthquake can provide a more comprehensive and profound understanding of factors affecting women's risk perception. Moreover, these studies may precisely reveal in which disaster management phase women feel more sensitive.

The ordinal logistic regression analysis showed that the age and education variable had an effect on women's earthquake risk perception and revealed that higher age and lower education level were associated with high earthquake risk perception. Some studies found that age positively affected earthquake risk perception (Tian et al. 2014; Armaş et al. 2017) and some studies did not (Shapira et al. 2018; Xu et al. 2019). Increasing age may cause physical weakness in women, which may increase women's risk perception. This situation shows that further studies are necessary to understand women's earthquake risk perception by age groups. Studies examining the effect of education level on risk perception have produced different results. Ainuddin et al. (2014) found that education significantly affected earthquake risk perception. Tian et al. (2014) found a negative correlation between education level and risk perception. In the seismically active zone, while people with higher education levels think that the earthquake will happen very soon, people with lesser education levels tend to deny scientific approaches (Paradise 2006). In this study, it can be said that the educated women have a lower risk perception because they may have more knowledge and skills to deal with disasters. In the studies which attempted to determine the risk perception of different disasters, it was investigated whether marital status, income, number of children, disaster experience and chronic disease variables had an effect on risk perception. In this study, the results showed that these variables did not significantly predict earthquake risk perception.

The ordinal logistic regression analysis showed that the variables dread, depressed and generations significantly predicted the earthquake risk perception of the women, but the variables fear, worry, catastrophe, widespread and financial did not significantly predict the earthquake risk perception of the women. Increasing perception of dread, depressed and generations increases women's earthquake risk perception. The dread used by researchers in different meanings and dimensions affects people's thoughts about disasters. For example, perceived dread significantly predicts disaster preparedness behaviour (Terpstra 2011). In the study where the risk perception was determined with seven items for fire, earthquake, and cyclone, the participants determined dread as the highest risk rate among the seven items (Fernandez

et al. 2018). Disasters cause permanent and temporary negative emotions in humans. In the study conducted after the disaster, individuals were found to be more pessimistic about the future when they thought of the disaster that they experienced (Västfjäll et al. 2008). Since the risk of earthquake increases women's level of depression, women may see themselves more sensitive to earthquakes. Women may be worried about themselves, their families and other people they love, since they know that the next earthquake can cause environmental damage, death and injury. In a study conducted on students in Turkey, students stated that in a potential earthquake, most of the damage would be on people (Gerdan 2014).

When the socio-demographic variables, disaster experience and the affective and cognitive risk perception items were all included in the analysis, the best model that explained women's earthquake risk perception was obtained. Therefore, in order to understand the earthquake risk perception of women, both the socio-economic characteristics and the affective and cognitive thoughts of women should be considered together. The strongest predictors that positively and significantly affected women's earthquake risk perception were depressed, dread, generation and age, respectively. Destructive earthquakes have occurred in Turkey from the past to the present, and scientists state that there is a high probability of major earthquakes in the country in the future (Stein et al. 1997; Parsons et al. 2000; Nalbant et al. 2002; Kürçer et al. 2008; Emre et al. 2018). The high probability of earthquakes and the uncertainty of the consequences of earthquake may cause depression, which increases women's earthquake risk perception. The number of earthquakes of four or more magnitude which occurred in 2017, 2018 and 2019 in Turkey are 92, 32 and 68, respectively (Bogazici University 2020). Moreover, because of the frequent occurrence of earthquakes, women may feel high depression related to earthquake. As past earthquakes have damaged people, the environment and the economy, women may think that earthquakes can cause damage.

In this study, when the affective and cognitive scale items are analysed by factor analysis, the former increases the earthquake risk perception, while the latter decreases the earthquake risk perception. For this reason, there seems to be a need for a deeper investigation of affective and cognitive factors related to gendered risk perception. This study revealed that when the socio-demographic variables and the affective and cognitive risk perceptions were included in the model along with disaster experience, disaster experience did not predict women's earthquake risk perception. A number of studies have shown that earthquake experience is a significant variable that significantly affects risk perception (Tian et al. 2014; Xu et al. 2019; Sun and Xue 2020). Collecting limited information regarding women's disaster experience in this study may affect the results. Determining how and when women are affected by what kind of disasters may provide a better understanding of the impact of disaster experience on risk perception. However, it should be stated that in this study the earthquake risk perception utilized the dependent variable was measured with a holistic approach and one question. In other words, the risk perception of the women against earthquakes was not determined separately socially, economically, physically, environmentally, culturally and psychologically. At the same time, the earthquake risk perception was not determined separately according to pre-earthquake, during earthquake and post-earthquake. For this reason, in order to better understand women's risk perception, further research is required that takes into account the time of earthquake and women's individual and environmental characteristics.

7 Conclusion and recommendations

Many scientific studies have shown that women have a higher perception of disaster risk than men. For this reason, this study was carried out to reveal the risk perception of women living in the region with high earthquake risk and the factors affecting it. In particular, it should be noted that most of the women participating in the research have earthquake experiences. In order to better understand the risk perception of women, the effect of their cognitive and affective perceptions of earthquake risk was investigated by multiple analysis method, by both items and factors. Consequently, the vast majority of the women participating in this study feel more sensitive to earthquake and their cognitive risk perception level is higher than their affective risk perception. The education level of women decreases the earthquake risk perception; however, the age of women increases the earthquake risk perception. The possibility of an earthquake makes women feel dread and makes them feel depressed. Women, who are attached to the society and their family, naturally think that next generations will suffer from the negative effects of earthquakes.

It is understood that, in order to make women feel more powerful, knowledgeable and resourceful against earthquakes and to reduce their concerns, women need primarily more resources in social and economic terms. Stakeholders in disaster management should support more women with low education levels and older women to better cope with disasters. Solution suggestions to women's problems should be developed with different methods and scientific studies. Whether the risk perceptions of men and women differ against all types of disasters should be revealed through comparative studies by gender. Scientists should investigate the thoughts and experiences of men, women and also those involved in disaster management in order to uncover the problems and obstacles women face in a disaster situation. For a safer life and future, disaster education and risk reduction studies should be women-centred and conducted through the support of women.

8 Limitations

This study has some limitations. First, because only women participated in this study, the results could not be compared between men and women. In addition, women's perception of risk against all other disaster types was not measured in detail and multidimensionally. Furthermore, women's risk perception was not evaluated temporally and spatially. Second, the results do not reflect the general situation in Turkey, since the research was carried out only in Kocaeli province. Third, many women did not want to complete the questionnaire. Some women did not want to answer some questions. Although they were not specifically and numerically asked, they did not fill the monthly income option in the questionnaire. These surveys were, therefore, excluded from the study. Fourth, the lack of data on occupation and residence time in the province constitute the limitations of this study.

Declarations

Conflicts of interest The authors declare that they have no conflict of interest.

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