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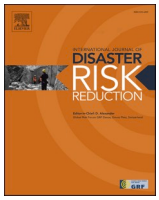

Children's earthquake preparedness and risk perception: A comparative study of two cities in Turkey, using a modified PRISM approach

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ABSTRACT

Understanding children's risk perception and investigating the underlying factors are important aspects of examining how children interpret and respond to earthquake events. This research examines children's perceptions of earthquake risk and preparedness level in the Van and Kocaeli provinces of Turkey. A mixed-method approach is used, with questionnaires and interviews, as well as the Pictorial Representation of Illness and Self Measure (PRISM) technique. The results show that the majority of the school children did not attend disaster education programs, even if they were living in an area of high seismic risk. The sampled children were generally aware of the earthquake risk in their home area. However, their levels of preparedness were low. A consistent relationship was found between: (1) earthquake risk perception, (2) earthquake awareness, (3) factual knowledge of preparedness, (4) importance of preparedness, and (5) earthquake education programs. The results indicate that children who participated in earthquake education programs had higher earthquake awareness, foresee future earthquake occurrence and the potential causes of injury. Also highlighted was the importance of information sharing within families, as a factor influencing children's earthquake risk perception and preparedness. The results are considered of value for actors in the disaster risk reduction sector. They provide perception insights to improve the communication and dissemination of information about earthquake risk.

1. Introduction

Earthquakes are one of the most deadly natural disasters, often causing devastating damage and loss of life. Globally, earthquakes have caused huge economic losses and thousands of deaths. Between 1998 and 2018, earthquake disasters killed 752,498 people and injured around 1,574,000 according to EM-DAT [1] statistics. The 2015 Nepal Earthquake (7.8 M_w) killed about 9000 people, injured 23,000 people and destroyed more than 250,000 buildings [2]; the 2011 Tōhoku earthquake (also known as the Great East Japan Earthquake) (9.1 M_w) killed more than 20,000 people, and displaced 465,000 [3]; the 2010 Haiti earthquake (7 M_w), killed around 316,000 people, injured 300,000 and displaced 1.3 million; and the 2008 Wenchuan Earthquake killed at least 69,195 people and injured 374,177 [4].

Turkey is a country prone to a range of natural hazards due to its geological setting and its climate: these include earthquakes, landslides, floods, and wildfires. Of all the natural disasters to affect Turkey since 1900, earthquakes have caused the greatest impact on population and infrastructure, with a large-scale earthquake occurring approximately every seven years [1,5]. Earthquake events account for 55% of all losses of life and property attributed to natural hazards in Turkey [6], close to double the amount of those incurred from landslides (30%) and 7x more than those resulting from flood events (8%). In total, since 1950, more than 33,000 people have lost their lives due to earthquakes [1]. The most recent devastating earthquakes in Turkey's history have been the 2011 Van earthquake (7.6 Mw), which killed more than 600, injured more than 2000 people, and damaged more than 49,000 buildings [7], and the 1999 Marmara earthquake (also known as the Kocaeli earthquake) (7.4 Mw), which caused more than 17,000 deaths, 43,953 injuries and cost more than 12 billion USD [8]. Specifically, Turkey is situated at the upper levels of child mortality due to earthquakes [6]. This is important because 34.5% of the population in Turkey is between 0 and 14 years old based on 2018 data from the Turkish Statistical Institute in 2019. For example, the 1999 Marmara earthquake caused 'heavy damage' to 43 schools and 'slight to moderate damage' to 381 schools leading to schools in the affected areas being closed for four

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months [6,9]. Furthermore, in the Bingol Earthquake, ten schools were heavily damaged, and four schools completely collapsed [6,10].

The 1999 Marmara earthquake was a pivotal point for Turkey's disaster management system: the extensive damage and many fatalities highlighted the need to overhaul disaster management in Turkey [11]. Consequently, many measures aimed at disaster risk reduction were taken in Turkey's educational and socioeconomic sectors to minimize the negative effect of future earthquakes [11]. As Merchant [12] argued, this should be not only responsibility for the Turkish government and its agencies but also a responsibility for families and individuals. Consequently, public initiatives should be encouraged and engaged in the decision making process.

Despite the need for better disaster management in Turkey to minimize the risk of earthquakes, without an understanding of how the general public perceives the risk of earthquakes, even the most well-designed policies and procedures may not lead to the desired results. Because public risk perception is an essential part of the disaster risk reduction process [13–15], policy makers the world over have started to include the public's views on risk perception in their policy making. Knowing how the public perceives risk is important as it provides an insight into how and why people respond to hazards in the way that they do [16–19]. To ensure that the impact of earthquakes is limited, there is a need to understand what factors affect an individual's subjective judgement on what actions will help them cope better with a major earthquake event. Understanding such influences will then enable both policy and practice to focus on ensuring appropriate strategies are put in place in the future. However, risk perception is a highly interpretive and dynamic process [20–22], with disaster management experts and general public often having different understanding of hazards and risk [23,24]. While public risk perception is generally driven by economic interest, intuitive biases and cultural values [14,23], experts' risk perception tends to be more a product of analytic, objective and rational risk assessments [14,23,25].

In recent years, there has been increased research into earthquake disaster risk reduction, aiming to raise awareness and reduce the possible effects of future earthquakes [15,26–33]. At the policy level, both the Hyogo Framework for Action [34] and Sendai Framework for Disaster Risk Reduction [35] have emphasized the importance of public awareness and preparedness, encouraging individuals and communities to undertake preparedness activities. Some of the research findings suggest that the relationship between risk and preparedness perception is null or weak [36]. Some researchers have found a relationship between risk perception and preparedness [37], while others found that there is not a direct link between the two [38,39]. Rustemli and Karanci [40]; in a study from Turkey, found that correlation between anticipation of earthquake-related damage and earthquake preparedness was not statistically significant. Furthermore, while the correlation between earthquake expectation and preparedness is statistically significant, it is very low with a correlation coefficient $r = 0.09$. Relatively few studies have specifically examined perceptions of earthquake risk and preparedness, and many have focused solely on adult perceptions. Although adult perceptions may have a beneficial influence on children's perceptions of earthquake risk and preparedness, this does not give a robust insight into children's own experience [41]: *the perceptions of children have been found to be considerably different to those of adults.*

1.1. Children and disasters

The United Nations International Strategy for Disaster Reduction [42] declared that children are the group most affected by disasters, with approximately 175 million children affected by natural disasters annually [43]. Children are more vulnerable to an emergency event than any other social group, a factor of their behavioural and psychological development level, physical size and partial or complete dependence on adults [44]. In addition, it is argued that children's physical, social and mental capacities experience rapid development, which can result in the effects of disasters being even greater for children, relative to adults [45]. Despite their vulnerability, children can play an important role in earthquake preparedness and response, by communicating risks, participating in decision-making processes, and undertaking disaster risk reduction actions for their families and communities [46,47]. Children can help their communities before and after a disaster, they can be agents of change within their communities, and they can be actively participant in preparedness activities in their schools, homes, and communities [19,48].

The study of children and disaster contexts is particularly important because it sheds light on the development of disaster management, as well as aspects of complicated adaptive systems involved in education, protecting and empowering children [49]. Children need to understand and be ready for natural hazards as much as adults [41,50] in order to build a resilient future [49]. The information gained in this area can help families, communities, and nations to better mitigate, respond to, and cope with future hazardous events. Disaster risk perception studies with children can also inform decision-makers and leaders with regard to better engagement with children and how best to allocate disaster management resources [51,52]. Children's disaster awareness and their education for preparedness is, therefore, an integral part of disaster risk reduction studies. Some studies focused on the different attitudes and perception of earthquakes related to education [53,54]. They indicate that disaster education is important in enhancing perception of earthquake and knowledge [55–59]. In a study carried out at high schools in the New Zealand towns of Inglewood, Stratford, and Opunak, it was found that participation in hazard awareness education increased children's knowledge of safety behaviour [60]. Also some studies have focused on children's disaster experience. For example; Yasuda et al. [61] indicated that children who experienced a disaster in the past have a higher awareness of threats and prevention; however, this effect was short-lived. Some other researchers indicated that the role of family is an important indicator on children's reactions to natural disasters [62,63]. Also Najafi et al. [64] indicates that feelings, emotions, and social norms are likely to influence children's beliefs in disaster contexts.

There are only a few studies on children's earthquake risk perception and preparedness, especially in the context of disaster risk reduction in Turkey. In recent years the Turkish government has accelerated initiatives to create an earthquake-resilient society. That is particularly with the recent widespread growth of disaster awareness programs to prepare children better for hazardous events, by the Turkish Ministry of National Education and the Disaster & Emergency Management Presidency. However the question still remains about how Turkish children interpret earthquake risk in their home district. This study aims to fill that knowledge gap: we examine the earthquake awareness, risk perception, and level of preparedness of Turkish children. This will enable us to learn more about underlying processes at the heart of family and community resilience, enabling better preparedness and response with future earthquake events. It is intended that the research findings will contribute to the development of child-centred disaster risk reduction, with regard to the ways that children prepare for and respond to earthquakes. This research also explores the many diverse factors that have an influence on children's earthquake risk perception and preparedness. In this research paper, the sections are presented in the following order: study areas, methods, results, discussions, and conclusions.

2. Study areas

The study areas for this research are the Turkish cities of Golcuk (Kocaeli province) and Ipekyolu (Van province) (see Fig. 1). The research design is based on a comparative analysis, as in Bryman [65]. Many researchers have suggested that comparative studies are useful in order to be an important aspect of understanding the failure or success of a given intervention [66].

The two cities selected for this study were chosen first because of their location on seismically active fault lines and secondly due to their varied levels of socioeconomic development. Due to their geological position, both cities have in the last 20 years experienced devastating earthquakes: 1999 in Marmara (Kocaeli) and 2011 in Van [11]. According to the SEGE [67] socio-economic development ranking for the 81 provinces in Turkey, Kocaeli is ranked 4th, while Van is ranked 75th.

Despite much debate over whether or not socioeconomic factors have an influence on disaster preparedness [68], Turner et al. [69]; Bradford et al. [70] and Hal et al. [71] all report finding that higher income levels have a positive impact on levels of preparedness due to a rise in public risk perception. However in contrast, White [72], and Peacock et al., [73]; both found no influence. Also, Lamson [74] indicated that people of lower socioeconomic status are more likely to have hazardous or risky occupations, and they thus might employ coping mechanisms to deal with it. Furthermore, some studies found that people from low income have greater risk perception [75,76] and people from lower socioeconomic status tend to minimize or deny the risks [77].

3. Methods

3.1. Overview of the design

The current research was designed to provide information about Turkish school children's levels of earthquake awareness, risk perception, and preparation. In total, 809 participants were assessed in the cities of Kocaeli and Van. Each participant completed the same questionnaire (comprised of both the PRISM techniques and validation questions). In addition to the questionnaires undertaken, separate interviews were carried out with 100 of the same children surveyed, to explore participants' reasons for their questionnaire responses. Children were selected to be the focus of this study because children as a target population have received limited attention in studies of earthquake risk perception, yet children remain one of the most vulnerable groups in disasters. In this research, the attempt was made to contribute to child centred disaster management studies.

In this research a mixed methods approach was used. The collection

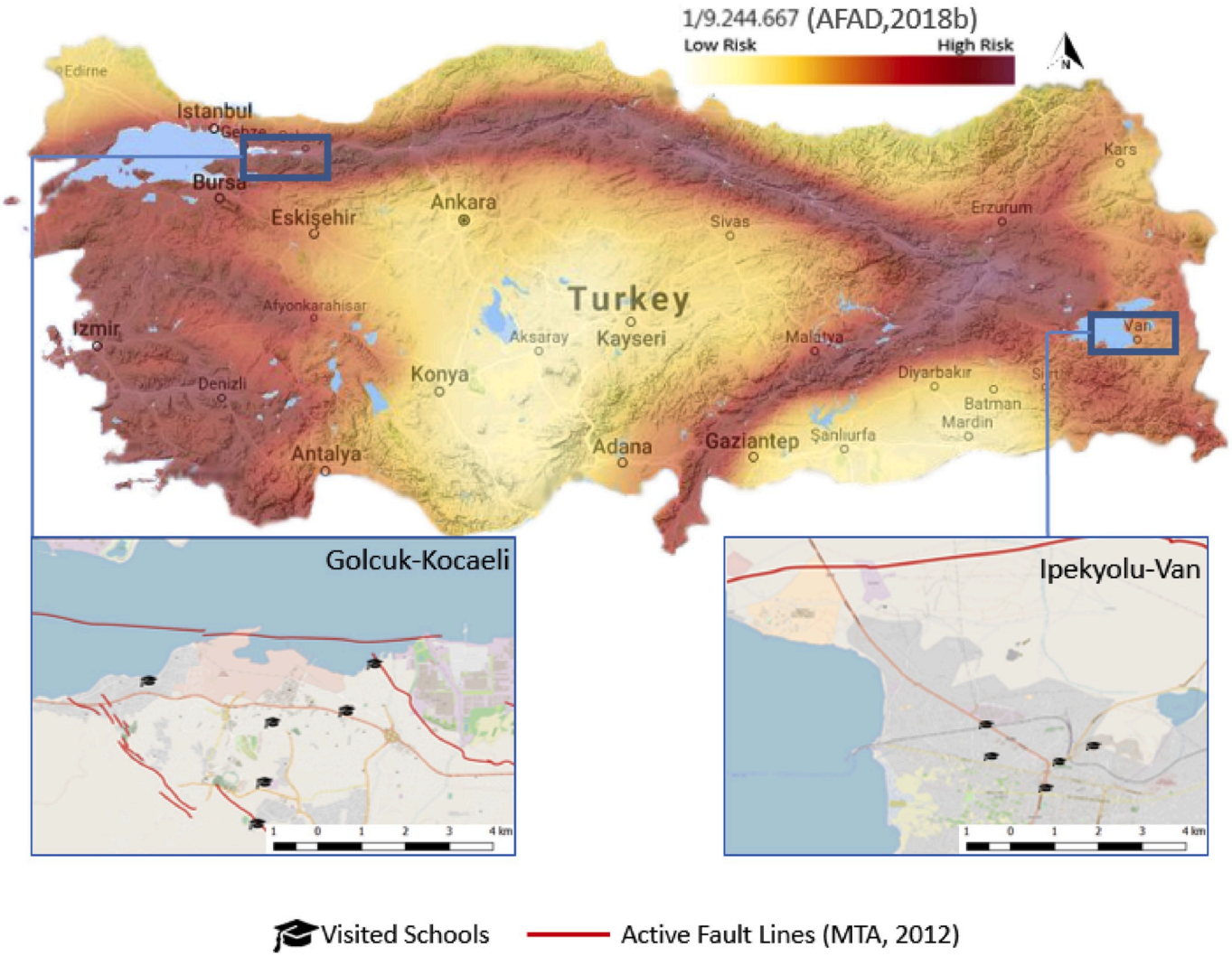

Fig. 1. Turkey earthquake hazard map and visited schools (map sources: Open Street Map) [78,79].

and analysis of both quantitative and qualitative data was selected in order to increase the rigor of the research by combining multiple measures, theories, perspectives and validation checks to ensure results were consistent [80,81]. A mixed approach combines both numerical measurements and more in-depth evaluation of participant knowledge and opinion to maximise the strengths of each technique, in turn increasing the validity of the results, and adding multi-level perspectives, offering a more complementary and complete understanding of the research questions [82]. This was important in this research because we wanted to better understand children's different points of view, give them voice and ensure findings based on their experiences. The triangulated approach was taken, combining the use of questionnaires, PRISM and a series of separate interviews, allowing for the cross-comparison of data sets [65].

3.2. Sampling and data

Data collected for this research formed part of a three year longitudinal study carried out to assess preparedness and risk perception of children aged 11–14. The age bracket of 11–14 years was selected in line with the ethics policy of Turkish Ministry of National Education and the University of Portsmouth. The ethical guidelines restricted participating children under the age of 11. Therefore to enable the three year longitudinal study, the first surveyed children were selected from Grade 5 and Grade 6 (11–14 years old).

The sampling strategy was driven firstly by researchers and secondly by the Turkish Ministry of National Educations in the two cities, along with the school authorities. On request, the Turkish Ministry of National Education gave permission for the survey to be run in 6 out of 24 of their government-run schools (for grades 5, 6, 7, 8) in Golcuk (Kocaeli), and 5 out of 56 in Ipekyolu (Van). Each individual school was selected for participation based on class availability. Individual teaching classes in which the survey would be carried out were selected by school managers. Only classes not undertaking core revision subjects on the days of the survey were available to participate in this survey. Core subjects are maths and science, Turkish language, social studies, foreign language, religion and moral lessons, art, sports and elective courses. When permission for a school survey was gained, the families of the sampled children were sent an information letter in their child's school bag, explaining the survey and requesting their signed permission for their child to participate in this study. Before starting this survey, the school children were told about the purpose of the study, and then their right to participate, or not participate, in the research was explained. Individuals were encouraged to answer the questions, and to ask for clarity if there was anything they found difficult about the research.

In this study, questionnaire data were collected from 809 children in the cities of Van (n = 384) and Kocaeli (n = 425), from October to November 2018. This sample size follows the guidance of Krejcie & Morgan [83]; who indicate that a sample size of 384 is sufficient for a population size of more than 1,000,000. According to the Turkish Statistical Institute [84]; the population of Golcuk (Kocaeli) is 162,584, and for Ipekyolu (Van) it is 312,244. In 2018, the total population of 11–14 years old children (grades 5 and 6) in the 11 schools selected were: 1740 in Golcuk (Kocaeli), and 2398 in Ipekyolu (Van).

Following the questionnaires, three or four children from each participating class at each school were interviewed. The interview questions aimed to further investigate how children perceive earthquake risk and the importance of preparedness. The selection of children for the interview was dependent on each child's availability and time. The total 58 children from Golcuk (Kocaeli) and 42 from Ipekyolu (Van) were interviewed from the same participating classes that engaged in the questionnaires. The sample size was determined by the possible maximum number of students from each class to make valid inferences about the total population and generalize the findings. Britten [85] indicates that large qualitative studies generally involve around 50 or 60 interviews.

3.3. Measures

Various methods can be used to measure risk perception and there is no agreed standard. The most common method is based on questionnaires about the likelihood or the probability of an event happening in the near future [38,39] within an unspecified time period [86]. Some of the scenarios assume a future event causing harm and injury to oneself, one's household, a friend, or a neighbour [87]. Other scenarios examine the likelihood of damage to a respondent's property [88]. The mixed methods used in this research were: the Pictorial Representation of Illness and Self Measure (PRISM), close-ended yes-no questionnaires, Linkert scale questionnaires, and interviews.

3.3.1. The questionnaire and Pictorial Representation of Illness and Self Measure (PRISM)

For the quantitative data collection, the PRISM technique, along with Linkert scale and close ended yes-no questions were applied. The close-ended questionnaire used in this research was adopted from that used in Ronan and Johnston [89]; Finnis et al. [60]; and in the Turkey Disaster and Emergency Management Presidency disaster awareness survey [90]. To find the most appropriate method, similar studies were reviewed from the EBSCO [91] database. From this review it was decided that questionnaires were well suited for the purpose of this study because questionnaires provide a relatively efficient and quick way to gather information from large samples.

This research is innovative in its use of the PRISM technique to understand school children's earthquake risk perception and their preparedness. The initial aim of the PRISM technique developers, Tom Sensky and Stefan Buchi, was to develop a simple visual method to assess patient's perceptions of their health and coping capacity [92,93]. PRISM is a simple visual instrument of aggregating and eliciting personally salient information, and depends heavily on defining subject, object(s) and context [92]. According to Sensky & Büchi [94]; applying PRISM techniques gives participants a wider ability to explain themselves. The reliability of the PRISM technique is high with test-retest reliability $r = 0.95$, $p < 0.001$ and interrater reliability $r = 0.79$, $p < 0.001$ [93,95]. In 2013 Parham et al. [96] used a modified PRISM technique with school children in Dominica to assess their multi-hazard risk perceptions relative to changes in their geography teaching curriculum. Their results indicated that school children have understood and engaged well with PRISM, and support the validity of data obtained using PRISM.

The reason for using PRISM in this Turkish study is that it provides a simple visual way to measure the perceived effect of hazard in the respondent's current life as well as evaluating the importance of hazard preparedness, by asking the participant to identify where to place their preferred choices on the PRISM template (Fig. 2). A paper and pencil

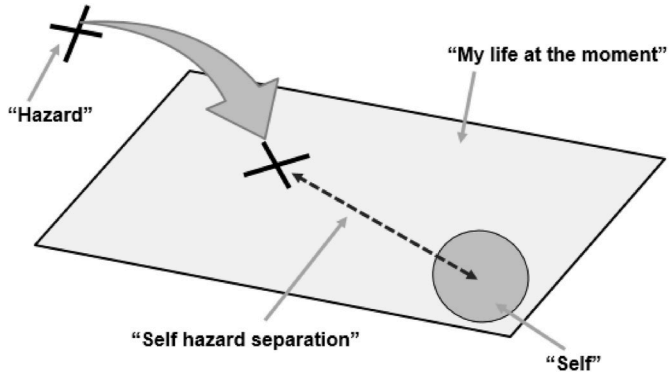

Fig. 2. An example of a completed PRISM sample. The line represents a measurement of the self hazard separation (SHS) distance. Terms translated to English for publication [97].

version of PRISM was used in this research. Children were told to imagine that A4 sheet of paper represents their life, and the circle on the bottom right hand corner represents themselves (Fig. 2). Then they were asked where to locate threats of (mentioned) hazards in their life and the importance of preparedness on the PRISM template related to "self" circle. The distance between the centers of the "self" circle and the crosses indicating the threat and preparedness for earthquakes ranged from 0 to 27 cm, and this measured distance was used for statistical analysis, with higher distances indicating lesser threats in their life (Fig. 2).

3.3.1.1. PRISM instructions. The participating school children were given the following instructions to respond to using the PRISM template illustrated in Fig. 2.

i. I would like to understand better how natural hazards (earthquake, flood, landslide, storm, and wildfire) in your local area affect your life at the moment.
ii. I would like you to imagine that this white template represents your life as it is now.
iii. The circle in the bottom right-hand corner represents your 'self', and the cross (X) represents (mentioned) hazard.
iv. Where would you put the (mentioned) hazard to reflect its threats to your life at the moment?
v. Where would you like to put (mentioned) hazard to reflect its importance of preparedness in your life at the moment?

3.3.1.2. Questionnaire for earthquake awareness and risk perceptions. Participating school children were asked about the future likelihood of earthquake occurrence in their local area, and likelihood of causing injury. Responses were gathered using a three-point Likert scale, as in the study of Finnis et al. [60]; which focused on children's natural hazard perception in New Zealand. Using yes/no questions, children were asked if they knew any active earthquake faults in their district, if they were aware of any earthquake risk maps, and if they were able to interpret those maps to understand their earthquake awareness. These questions were adopted from Refs. [90]. Using PRISM, children were asked "*Where would you put earthquake hazard to reflect its threats to your life at the moment?*" to measure their earthquake risk perception.

3.3.1.3. Questionnaire for preparedness. To examine factual knowledge for preparedness; the school children were asked to identify the actions they felt were the most appropriate responses for earthquakes. They were instructed that they could select more than one action to represent the appropriate response for earthquake hazard. For earthquake preparedness knowledge, correct actions are a) Stay inside, taking cover under beds, etc. b) Curl into a turtle shape and protect your head (duck, cover, hold); incorrect responses are, c) Run outside, d) If you are outside, find a tree or something sturdy to grab on to e) Stay right where you are and wait for it to be over. The correct answers are promoted by the Disaster and Emergency Management Presidency of Turkey [98].

To examine physical preparedness; children were asked questions regarding plans and practices, and preparedness measures, and hazard adjustment adoptions on close-ended yes-no questions. Regarding information on response plans and practices, children were asked if they or a member of their close family had previously done any of the following: compiled a household emergency plan, practiced an emergency plan at home, practiced an emergency plan at school, identified potential emergency exits, identified assembly areas, switched utilities, and planned where to meet or leave a message in an emergency. For preparedness measures and hazard adjustment, the following responses were examined via questions with yes/no answers regarding having the following items: a torch, a first aid kit, an emergency kit, a transistor radio with spare batteries, a fire extinguisher, a stockpile food and water for three days; or carrying out the following tasks: selecting an emergency contact person living outside the local district, safe storage of hazardous materials and adding lips to shelves to keep things from sliding off. The questions in this section were adopted from Bursa AFAD [90]; Finnis et al. [60] and Ronan and Johnston [89].

To examine the importance of earthquake preparedness in children's lives; using the PRISM template, children were asked: "Where would you like to put earthquake hazard to reflect its importance of preparedness?"

3.3.1.4. Questionnaire for previous exposure to disaster education. Education is one of the most important aspects in disaster risk reduction studies. In order to understand the effects of education on children's earthquake risk perception and preparedness, their previous exposure to disaster education was investigated. Children were asked to identify prior exposure to disaster education; in school, outside school, education by the teacher, civil defence, and the year of participation in disaster education on close-ended yes/no questions. The questions in this section were adopted from Finnis et al. [60] and Ronan and Johnston [89].

3.3.1.5. Questionnaire for sources of information dissemination. The role of the source of information can be important before, during and after disasters; it can help to develop awareness, prevent future emergencies and reduce their effects, by preparedness, response and recovery [99–101]. A better understanding of children's sources of information is needed for the development of a more effective plan for disseminating risk reduction information, which plays an important role in human safety and reducing losses from hazard events [102]. Therefore in this section, we wanted to investigate the importance of the information of sources from children's perceptions, to learn more about children's views and so design better disaster awareness programs for them. In order to understand how important different sources of information were for informing individuals about different hazard types, the children were asked, using the PRISM template, how important for them the following information sources were: their family, school teacher, television and radio, books and the internet.

3.3.2. The interview

The reason for carrying out the interview was to better understand the reasons behind children's responses, and to maximise the strengths of quantitative approach. In this research children were given an opportunity to speak, express their feelings and experiences. As Taylor and Peace [45] mention: "children are the best authorities on their own lives and more than capable of expressing their views". Speaking directly to children can give us more ideas about how earthquakes affect children's life, we can learn their ideas, thoughts and perceptions. That information can help us to reduce the effects of earthquakes, design better disaster education programs to increase children's earthquake awareness and encourage them to take appropriate actions. To do so, following the questionnaires, separate interviews were carried out with the surveyed children. During their face to face interview, children were asked to explain the reasons for their choices when they had used the PRISM template. The interviews of children were conducted by the Turkish-speaking lead researcher, and ethical guidelines were considered carefully.

3.4. Pilot study

In April 2018 a pilot study was conducted in two randomly selected classes of school children, in both Golcuk (Kocaeli) and Ipekyolu (Van), with samples of 38 children, and 28 children questioned respectively. The pilot study aimed to understand whether the survey questions were appropriate, comprehensive, clearly understood, and well defined, as in Hassan et al. [103]. Participants completed all the questions, with all the respondents stating that they did not face any difficulties in understanding the questions. The children completed the questionnaire on a second occasion, and the paired *t*-test compared the scores between the

first and second questionnaires. Paired students' test-retest means for each value were not significantly different. General feedback from the participating children during the pilot study was positive, supporting the selection of the PRISM tool. The participating children commented that using PRISM was easy and that they enjoyed giving their answers using the PRISM template (Fig. 2). For example some of them said "it is like playing a game" and "very easy to use".

3.5. Data analysis

Using SPSS Statistics 25 software, the Shapiro-Wilk test was applied for verifying the normality of data. The Cronbach's alpha coefficient was reported for measurement scales. Descriptive statistics were used to provide mean values and 95% confidence intervals of the results. The Pearson correlation was used to measure the relationship between earthquake risk perception, preparedness, and other factors. A chi-square test of independence was performed to examine the relation between cities and the experience of disaster. In every case, a two-tailed p-value < 0.05 was considered as statistically significant.

Thematic qualitative analysis was preferred to analyse the interview data [104]. The reason for selecting thematic analysis was that "rigorous thematic approach can produce an insightful analysis that answers particular research questions' [105]. All interviews were recorded and subsequently translated into English for the analysis. The transcripts were read and reread and colour coded manually to identify the key themes. During the analysis Braun & Clarke [105], guidelines were followed because they offer a clear and useable framework. The aim of this was to find the kinds of beliefs and explanations that are prevalent among participating schoolchildren as in Knafl et al. [106] and Taylor & Peace [45].

3.6. Ethical considerations

Before conducting the research, the requisite Turkish government approval was obtained. The University of Portsmouth research ethics guidelines were followed as an ongoing and reflexive part of the research process. It should be noted that the researcher carrying out the school surveys (also the first author) has a teaching certificate and experience of working with school children in Turkey.

Children younger than 11 years of age were excluded because of the Turkish Ministry of Education and the University of Portsmouth ethical considerations on the sensitivity of the topic. This study includes children who had earthquake experience thus ethical concerns were our priority as much as the research questions. The children's age group and the sensitivity of the subject matter needed to be considered carefully. The lead researcher's conduct of research was also checked by the school authorities, with the research being well received by the school authorities and with positive comments from the parents of participating children.

4. Results

A total of 809 children were surveyed about their perceptions of earthquake risk and their preparedness in Van (n = 384) and Kocaeli (n = 425). The return rate of the questionnaires was 100%, with 48% of the school children from Van and 52% from Kocaeli each agreeing to participate. Of these, 421 were female, and 388 were male. Almost half of all the respondents, 46% (n = 372), reported that they had experienced an earthquake disaster. A chi-square test of independence was performed to examine the relation between cities and the experience of disaster. The relationship between the variables was found to be significant, X^2 (1, N = 809) = 664.16, p <.01. Participations from Van (44.6%) were found more likely than Kocaeli (1.6%) to have earthquake disaster experience. In addition, the responses from Van and Kocaeli may have reflected socioeconomic differences: in the development ranking statistics of provinces in Turkey, Kocaeli is ranked 4th while Van is 75th [67].

4.1. Hazard awareness and risk perceptions

Children were asked about the likelihood of occurrence of earthquake hazard in the future, and likelihood of causing injury on a three-point Likert scale. A Shapiro-Wilk test showed a significant departure from normality W (809) = 0.74, p < .001. However, Pallant [107] indicates that this is quite common in large samples. The likelihood of occurrence of earthquake hazard in the future, and likelihood of cause injury responses on a three-point Likert scale has acceptable internal consistency, with a Cronbach alpha coefficient reported of .71, p < .001 [107,108].

As can be seen in Table 1, almost half of the participants rated earthquakes "likely" to occur in the future in their living environment and "likely" to cause injury. However, 21.1% of the surveyed children in Van, and 21.9% surveyed children in Kocaeli rated future earthquake occurrences as "unlikely." A total of 48 children from Van and 80 from Kocaeli rated future earthquakes as "unlikely" to cause injury (Table 1).

Table 2 shows the results of children's earthquake awareness. Based on the results, in both surveyed cities, almost half of the participating school children were aware of the earthquake faults, and earthquake risk maps of their home district. Importantly, around 48% of them reported that they understood those maps.

It is also crucial to understand children's perceptions of natural hazards and whether or not they are related to hazards in their living environments. To explore this, using the PRISM technique, children were asked: *"Where would you put the earthquake hazard to reflect its threats to your life at the moment?"* The closer the distance to the self-circle that participants placed their response cross on the PRISM template, the higher their perceived risk. Table 3 shows the overall mean and standard deviation of the perceived risk that the participating children have in their current life, for five natural hazards (earthquake, flood, landslide, storm, and wildfire). Earthquake hazard (mean distance 6.10 cm) was selected by the children as the most threatening event in the two surveyed cities, followed by flood hazard (mean 8.79). Previous risk perception studies have focused on earthquakes [15,31], others on floods [41,48], landslides [109] and wildfires [110]. In our research, we focus on earthquake hazard because the study areas are located on the high seismic risk area [79]. Our research findings indicated that children are able to identify the earthquake risk in their local environment.

4.2. Disaster preparedness

4.2.1. Importance of preparedness

Table 3 shows the PRISM survey results (overall mean and standard deviation) on the importance of disaster preparedness for five hazards (earthquake, flood, landslide, storm, and wildfire). The closer was the distance to the "self" circle that participants placed their response on the PRISM template, the more important it became for them being prepared for a given hazard. Earthquake hazard (mean distance: 8.34 cm) and flood hazard (mean distance: 8.40 cm) were selected by the children as the ones for which they thought it was most important to be prepared.

Table 1
Earthquake hazard perceived as likely to occur and likely to cause injury in two Turkish cities of Turkey (% within cities).

	% likelihood of occurrence		% likely to cause injury	
	Ipekyolu (Van)	Golcuk (Kocaeli)	Ipekyolu (Van)	Golcuk (Kocaeli)
Likely	56.0	48.2	66.9	60.5
Chance	22.9	29.9	20.6	20.7
Unlikely	21.1	21.9	12.5	18.8

Table 2
Earthquake awareness of children in the two cities examined.

	Ipekyolu (Van)		Golcuk (Kocaeli)	
(% within cities)	*"Yes"*	*"No"*	*"Yes"*	*"No"*
Do you know of any active earthquake faults in your home area?	57.6	23.2	49.9	30.8
Are you aware of any earthquake risk maps for your home area?	56.0	27.1	48.0	34.8
Do you understand those earthquake risk maps?	52.9	29.9	43.1	37.9

4.2.2. Factual knowledge for preparedness

In terms of factual knowledge of earthquake preparedness, children were asked to identify the correct actions for earthquake response, as in Table 4. 63.3% (512/809) of the surveyed children in the two cities were aware of the need to stay inside and take cover in a doorway, under beds or tables. 81.3% of the school children (658/809) were aware of the need to curl into a turtle shape and protect your head (duck, cover, hold). Unfortunately, 59.5% (481/809) were not aware of the danger from running outside, as the ground is moving, and they could easily be injured or falling by debris. 36.5% (295/809) were not aware of the danger of "if they are outside, to find a tree, or something sturdy to grab on to" while only 26.5% (214/809) of the school children considered it best to "stay right where you are and wait for it to be over".

4.2.3. Physical preparedness

Table 5 shows that almost half of the children (171/384) in Van reported that they had a family emergency plan. However, in Kocaeli, only 29.2% (124/425) of the children reported that they had a family emergency plan. While more than half of the children (51.8%) in Kocaeli practiced what to do in case of an emergency at school, only 22.4% of children practiced what to do in case of an emergency at the sampled school in Van province. Only 7.6% (62/809) of the children practiced what to do in case of an emergency at home in the two provinces. In both cities, under 41% of school children reported knowledge of knowing exits, assembly areas, utility switches, and where to meet or leave a message in an emergency.

In order to understand children preparedness measures and hazard adjustment adoptions, several questions were asked (as shown in Table 6). It can be seen in the table that less than half of the participated school children reported having key items, such as first aid kit, radio with spare battery, a torch, an emergency kit, pick an emergency contact person outside of their area, fire extinguisher, and stockpile of water and food for three days. Earthquake hazard adjustments, such as storing hazardous materials safely are adopted by 36.3% (294/809) of the children, and adding lips to shelves to keep things sliding off are adopted by 41% (332/809) in total.

Table 5
Information on preparedness plans and practices.

	Ipekyolu (Van)	Golcuk (Kocaeli)
(% within city)	*N=384*	*N=425*
I have family emergency plan	44.5	29.2
I have practiced what to do in case of emergency at school	22.4	51.8
I have practiced what to do in case of emergency at home	6.3	8.9
I know exits, assembly areas, utility switches	37	37.4
I know where to meet or leave a message in an emergency	32	40.2

Table 6
Preparedness measures and hazard adjustment.

	Ipekyolu (Van)	Golcuk (Kocaeli)
(% within city)	*N=384*	*N=425*
I have a first aid kit	32.3	42.6
I have a radio with a spare battery	29.4	40.2
I have a torch	41.4	39.1
I have a stockpile of water and food for three days	32	44.9
I picked an emergency contact person outside my area	10.4	4.9
I have an emergency kit	36.5	29.4
I store hazardous materials safely	32	40.2
I add lips to shelves to keep things sliding off	44.8	37.6
I have a fire extinguisher	37	37.4

Table 3
Mean and standard deviation in cm. of the children's perceptions for risk and importance of preparedness, for earthquake, flood, landslide, wildfire, and storm hazard.

		Range of scores (cm)	Earthquake	Flood	Landslide	Wildfire	Storm
Risk Perception	*N*		809	809	809	809	809
	Mean	0–27	6.10	8.79	10.23	10.47	9.92
	Std. Deviation	0–27	4.81	5.90	6.03	6.27	6.17
Importance of Preparedness	Mean	0–27	8.34	8.40	9.27	10.14	9.91
	Std. Deviation	0–27	6.49	5.80	6.23	5.50	6.32

Table 4
Children's awareness of correct actions in response to earthquakes (correct responses are in light grey).

	Ipekyolu (Van)	Golcuk (Kocaeli)
(% within city)	*N=384*	*N=425*
Stay inside and take cover in a doorway, under beds or tables	57.3	68.7
Curl into a turtle shape and protect your head (duck, cover, hold)	78.6	83.8
If you are outside, find a tree or something sturdy to grab on to	39.6	33.6
Stay right where you are and wait for it to be over	36.7	17.2
Run outside	65.6	53.7

Table 7
The school children's participation in earthquake education programmes.

(% within city)	Ipekyolu (Van)	Golcuk (Kocaeli)
	N = 384	N = 425
In School	43	51.3
Outside School	2.3	5.2
By teacher	37.2	32
By civil defence	8.6	22.4
Participated in 2018	5.2	6.8
Participated in 2017	32.6	44.0
Participated in 2016	5.5	10.8
Participated in before 2016	1.8	6.8

4.3. Previous exposure to disaster education

Results of previous exposure to disaster education shown in Table 7 indicate that nearly half of the participants (383/809) from both cities participated in disaster education at school, and a minority of them participated outside of the school (5.2% or less). Between 32% and 44% of the surveyed children participated in disaster education in 2017, significantly more than in 2016 (between 5% and 11% for Van and Kocaeli respectively). In Van province disaster education was mostly via school teachers; however in Kocaeli province the civil defence seems to be more active.

4.4. Sources of information dissemination

Using the PRISM technique, the children were asked about the importance of the information provided by the sources for learning about local natural hazards. The closer the distance was to the "self" circle that participants placed their response cross on the PRISM template, the more they thought a given information source was important in their life. Table 8 shows the mean and standard deviation of the PRISM (0–27 cm) responses: the information sources being family, school teacher, television and radio, book, or the internet. The results show that children in the Kocaeli and Van cities examined had "family" as their first source (means 4.87 and 4.68, respectively) of information about hazards. "Internet" (mean 8.53) was selected as a second source of information in Kocaeli, while "school teacher" (mean 7.78) was selected as a second source of information in Van.

4.5. Relationship between earthquake risk perception, preparedness, and other factors

In this section we examine the correlation between earthquake risk perception and other factors (e.g. perceived importance of preparedness, likelihood of earthquake occurrence and cause injury, earthquake education. See Table 9). This is done by observing the correlation coefficient, r, and its respective level of marginal significance, p, for the number of cases, n. Table 9 shows the relationship of the variables.

4.5.1. Risk perception and factual knowledge

The results indicate that earthquake risk perception is related to the knowledge of correct actions of earthquake preparedness. There was a significant correlation between earthquake risk perception related to "stay inside and take cover in a doorway, under beds or tables" ($r = 0.08$; $n = 809$; $p < .05$), and "curl into a turtle shape and protect your head (duck, cover, hold)" ($r = 0.09$, $n = 809$, $p < .01$). That indicates that children with higher levels of earthquake risk perception also had awareness of the correct earthquake preparedness actions. There is a significant negative correlation between children's earthquake risk perception and "stay right where you are and wait for it to be over" ($r = -0.08$, $n = 809$, $p < .05$); i.e., children who have low perception of earthquake risk are more likely to prefer to stay where they are and wait for it to be over. Although the correlations are significant between these variables, they remain rather weak. Therefore, they do not represent large differences. The relation between earthquake risk perception and; "run outside" ($r = 0.00$), and "if you are outside, find a tree or something sturdy to grab on to" ($r = 0.01$), was weak and did not reach statistical significance. There is no significant relationship between earthquake risk perception and "run outside," and "if you are outside, find a tree or something sturdy to grab on to."

4.5.2. Factual knowledge and importance of preparedness

The results indicate that responses of perceived importance of earthquake preparedness were strongly related to correct responses of earthquake preparedness knowledge, "stay inside and take cover in a doorway, under beds or tables" ($r = 0.09$, $n = 809$, $p < .05$), "curl into a turtle shape and protect your head (duck, cover, hold)" ($r = 0.08$, $n = 809$, $p < .05$). These mean that children who placed higher levels of importance on preparedness also made correct responses regarding earthquake preparedness actions. There was also a significant negative correlation between the importance of preparedness and "stay right where you are and wait for it to be over" ($r = -0.11$, $n = 809$, $p < .01$), and "if you are outside, find a tree or something sturdy to grab on to" ($r = -0.09$, $n = 809$, $p < .01$). That indicates that the higher the importance of preparedness, the higher were the correct responses on knowledge of earthquake preparedness knowledge. Findings in this section show that correlations between the variables mentioned were significant; however, the relationships are quite weak. In addition, the one exception that did not relate to the psychological issue of the importance of preparedness was: "run outside" ($r = -0.01$). This relationship was weak and did not reach statistical significance.

4.5.3. Location, risk perception, awareness, education and other variables

The results show that location was strongly related to many variables: disaster experience ($r = 0.90$), earthquake risk perception of children ($r = -0.20$), and importance of preparedness ($r = -0.47$), likelihood of cause injury ($r = -0.08$), earthquake awareness ($r = -0.10$), earthquake education ($r = -0.10$), and the knowledge of correct actions of earthquake preparedness actions (as shown Table 9).

Previous exposure to earthquake education was strongly related to the earthquake awareness of children ($r = 0.07$, $n = 809$, $p < .05$). It is reassuring to find that children who have previous earthquake education have higher earthquake awareness. Disaster education is also strongly related to the psychological issue of the importance of preparedness ($r = 0.09$, $n = 809$, $p < .01$). That indicates that children have higher levels of perceived importance of preparedness when they have received earthquake education. Furthermore, the earthquake awareness of children was strongly related to the likelihood of future earthquake occurrence (r

Table 8
The importance of the information of sources from children's perceptions.

Location	Variable	Range	Family	School Teacher	Tv & radio	Book	Internet
Kocaeli	*N*		425	425	425	425	425
	Mean	0–27	4.87	9.53	10.18	11.16	8.53
	Std. Deviation	0–27	4.10	7.56	7.45	7.40	6.85
Van	*N*		384	384	384	384	384
	Mean	0–27	4.68	7.78	9.77	9.27	8.08
	Std. Deviation	0–27	3.71	6.35	6.72	6.80	6.21

Table 9
Correlation coefficient (Pearson r) matrix for variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Location		-.06	.90**	-.20**	-.47**	-.05	-.08*	-.10**	-.10**	-.13**	-.08*	.14**	.12**	.22**
2. Gender			-.06	.03	.06	.02	-.03	.00	.10**	.01	.00	.05	-.00	-.01
3. Disaster Experience				-.19**	-.42**	-.04	-.07*	-.08*	-.09**	-.13**	-.07*	.15**	.10**	.19**
4. Earthquake Risk perception					.18**	.05	.08*	-.01	.05	.08*	.09**	.00	.01	-.08*
5. Importance of Preparedness						-.00	.03	.05	.09**	.09*	.08*	-.01	-.09**	-.11**
6. Likelihood of Occurrence							.54**	.43**	.00	-.01	.05	-.00	.02	.04
7. Likelihood of Cause Injury								.48**	.01	-.08*	.07*	.00	-.01	-.02
8. Earthquake Awareness									.07*	-.01	.03	.01	-.03	.03
9. Earthquake Education										.02	.01	-.01	.01	-.02
10. Stay Inside, taking cover under beds											.01	-.02	.02	-.05
11. Duck, cover, hold												.06	-.02	-.06*
12. Run Outside													.11**	.00
13. If you are outside find a tree to grab														.05
14. Stay right where you are and wait it to be over														

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 10
Results of the qualitative research.

Theme	Categories	Sample of quotation
Education	Lack of plan and practice	We live in a high seismic earthquake zone, and I think I do not know enough how to protect myself.
	Lack of earthquake information	We do not practice enough emergencies to cope with a real earthquake event.
	Lack of awareness	I do not believe so; my teacher mentioned much about earthquake preparedness.
		I cannot find much information about earthquakes in school books.
		I do not think that earthquakes are a serious event.
Family	Understanding the importance of the family role	My family does not see earthquakes as a significant hazard.
		My family does not secure furniture and dangerous things that can harm or injure us during or after an earthquake.
		I do not want to lose my family because of earthquakes.
		We do not talk much about earthquakes and earthquakes preparedness at home.
Earthquake safe buildings	Insufficient trust in buildings	I do not trust buildings because I do not think they design for earthquakes.
		I lost one of my family members due to the bad design of the buildings.
		I do not believe that my building is strong enough to resist earthquake shakes; it makes me anxious.
Beliefs	Religious beliefs	God knows when we live or when we die, preparation is not needed.
	Risk belief	We cannot predict an earthquake, so preparation is not essential for me to
		I do not think earthquakes will impact my family or me because our preparation is good enough to protect us.
		Earthquakes are not serious situations.

= 0.43, n = 809, p < .01), and cause of injury (r = 0.48, n = 809, p < .01). These indicate that children who have previous disaster education are more likely to foresee future earthquake occurrence and the potential causes of injury.

The findings also indicate that gender did not relate to either children's perceptions of risk or the importance of preparedness. However, it is important to point out that even if findings showed significant correlations, the r values suggested a small size effect.

4.6. Interview results

The interview results show that the children mainly discussed four themes; education, family, earthquake-safe buildings, and beliefs (as shown in Table 10). Firstly, the most highlighted theme from the interview analysis was "education". In total 68 of the children out of 100, directly or indirectly mentioned the "education" theme. It appears that activities offered by schools can affect children's views, attitudes, and knowledge of disasters. The following are some examples. "I do not scare much about earthquake hazards because we practice it in our school every year; therefore, I feel ready" (Umut, male, Golcuk). "It is really important for me to be prepared for an earthquake because our teacher told us in the class, we are living in a high earthquake risk area." (Rabia, female, Ipekyolu).

The "family" theme was the second key finding from the interview data analysis. The importance of family preparation at home was highlighted. The children's responses show that their initiatives were not enough to take precautionary actions without their families' help. Also, a desire to protect their families from the consequences of earthquake disaster appears to drive children to be better prepared for earthquakes. For example, "earthquakes bother me a lot because it can give harm to my family" (Eyyub, male, from Golcuk); or, "I feel afraid to lose my family because of the earthquakes, so preparation is really important for me" (Sukran, female, Golcuk); and, "I know that it is very important to be prepared for earthquakes, but how can I stabilize the furniture at the home by myself. I think my family's preparation is more important than my preparation" (Reyhan, female, Ipekyolu).

The interview results show that the construction of children's homes influences their earthquake risk perception and their preparedness. They highlight the importance of earthquake-safe buildings and structures; for instance: "earthquakes really bother me because I do not believe that my home is strong enough to resist earthquake shake" (Yakup, male, Golcuk), "no matter how much individual preparation I make, if my home or school structures are not strong enough to protect me, I might lose my life" (Asaf, male, Ipekyolu).

Another key theme found in the interview analysis is the religious belief of the children. The religious belief of children seems to shape their earthquake risk perception and preparedness. Several individual responses (15 interviews in total) referred to God to explain the reason

for their earthquake risk perception and preparedness. For example, “earthquakes depend on God, we cannot do much about it” (Ahmet, male, Golcuk), “the only thing I can do to protect myself from earthquakes is praying God” (Elif, female, Ipekyolu). Children’s beliefs about earthquake risk also shape their risk perception and preparedness. For example, “Earthquakes cannot be predictable, we do not know when it will happen, so how can I be ready all the time” (Fatih, male, Golcuk). “I do not believe earthquakes are a serious situation, because I have made my preparation for it” (Sevgi, female, Ipekyolu).

4.6.1. Linking interview results to quantitative results

Mixed methods research is a creative and expansive form of research, using multiple approaches to answer research questions, rather than restricting the researcher’s choice [111]. Our findings from the qualitative data show a consistent relationship with the findings from quantitative data and help to explain some of the underlying factors (such as the ones in Table 10). For example, the children pointed to a lack of plans and practice, earthquake information and awareness, when they were asked to explain the reason for their choices on the PRISM template for earthquake risk perception and preparedness, relative to the results found in the quantitative data. Furthermore, the qualitative data findings explain other important points that affect children’s earthquake risk perception, as well as importance of earthquake preparedness which could not be obtained in the qualitative data, such as: importance of school education for earthquakes, importance of family earthquake awareness and preparation, fears and beliefs, importance of earthquake safe building.

5. Discussion

5.1. Risk perceptions

The findings of this research show that children perceive earthquake hazards as being more threatening than floods, landslides, wildfires, and storm events (Table 3). In both of the sampled cities, children rated the earthquake hazard as likely to occur and likely to cause injury in the future (Table 1). Also, they reported that the majority of them are aware of earthquake fault lines in their district (Table 2). The children’s responses seem to reflect their local environment being in areas with high earthquake risk. AFAD [79] notes that earthquakes are frequently occurring in both cities. Our research findings indicate that children were able to identify the earthquake risk in their environment (Tables 1–3).

Our research findings also indicate that home location is related to children’s earthquake risk perception ($r = -0.20$, $n = 809$, $p < .001$) and children’s earthquake awareness ($r = -0.10$, $n = 809$, $p < .004$). Children who lived in an area with lower socioeconomic status had a lower perception of earthquake risk. However, this might be due to other factors beyond the socioeconomic status of children in Kocaeli and Van children; therefore, further research is needed into the relationship between the socioeconomic status of children and their perception of earthquake risk.

Previous exposure to education appears to play a role in children’s earthquake risk perception and their level of reported earthquake awareness. Almost half of the children reported that they were aware of the earthquake faults in their living environment; however, it is a cause for concern that 30% or less of the children were not aware of their local earthquake risk (Table 2). The results indicate that children who had previous earthquake education were more aware of their earthquake risk than those who have not had an earthquake education. This clearly indicates that earthquake education programs should be increased, especially in areas prone to earthquakes. The interview data collected in this study also points to the importance of education for improving earthquake risk awareness, with the results showing that most of the children linked their earthquake risk perception to a lack of earthquake information.

In terms of previous exposure to earthquake disaster, the results seem to be related to the children’s risk perception ($r = -0.19$, $n = 809$, $p < .001$), and their level of awareness ($r = -0.08$, $n = 809$, $p < .013$). Having experience of earthquakes in the past has an effect on children’s earthquake risk perception and their awareness.

Previous research shows some similar findings to the results of this study. For example, working with 10–11 years old children in Japan, Yasuda et al. [61] showed that children who experienced a disaster in the past have a higher awareness of threats and prevention; however, this effect was short-lived. A study carried out with children in Christchurch, New Zealand, indicated that they were able to identify the flood risk in their living environment [50].

Some researchers have indicated that higher income levels have a positive impact on levels of preparedness, due to a rise in public risk perception [69–71]. Lamson [74] suggested that people of lower socioeconomic status are more likely to have hazardous or risky occupations, and they thus might employ coping mechanisms to deal with it. It is important to point out that our research is based on child participation rather than adult. Thus this makes the findings difficult to compare to adult-based research. However the findings of this research, in line with adult based findings, the children who live in an area with lower socioeconomic status have a lower perception of earthquake risk. Also, research carried out in Mexico with children shows that urban children are more aware of the preparedness activities toward earthquakes than children living in semi-rural areas [15].

In our research, we have found that previous exposure to education has an important role in children’s earthquake awareness. Research with high school students in Japan also indicates that education can help participants to be more aware of earthquakes [55]. Similar results can be found in Santos- Reyes et al. [15]; Finnis et al. [60]; and Yasuda et al. [61].

5.2. Preparedness

In terms of psychological issue of the importance of preparedness, the surveyed children selected earthquakes (mean 8.34) and floods (mean 8.40) as the most important hazard to be prepared for relative to landslides, storms and wildfire hazard (Table 3). The children’s sense of importance of preparedness is related to their previous earthquake experience ($r = -0.42$, $n = 809$, $p < .001$), disaster education ($r = 0.09$, $n = 809$, $p < .001$), earthquake risk perception ($r = 0.18$, $n = 809$, $p < .001$), and location ($r = -0.47$, $n = 809$, $p < .001$) (Table 9).

Regarding the physical preparedness of children, preparedness via an emergency plan and practice drills had a low rating (44.5% or less in Table 5). It is interesting that although the majority of the children reported that they were aware of their local earthquake risk, their actual preparedness on plan and practice was poor, with more than half of the participants reporting that they did not have an emergency plan, and they did not practise earthquake drills. From the children’s responses, family emergency plans appear to be more common in Van than in Kocaeli. This might be related to the disaster experience of people living in Van, the majority of them have experienced the 2011 Van earthquake. This bitter disaster experience might have encouraged the families to have “family emergency plan” to better prepare for future earthquakes. On the other hand, in Kocaeli, children practiced earthquake drills in their school more than the Van children. Although all the participating schools are government-run and have the same school curriculum, there is no government obligation to practice earthquake drills at schools. Also, in both participating provinces, only a minority of the children have practiced what to do at home in case of a major emergency (8.9% or less in Table 5). When we look at the results for the sources of information dissemination, the surveyed children preferred their families as the main source of information for learning about natural hazards. Thus children’s engagement with their families, and practising what to do at home in the case of a major emergency, them to better prepare to cope with earthquake disasters. Furthermore, earthquake education

programs should include showing children the locations of: exits, assembly areas, and utility switches, as well as where to meet or leave a message in an emergency - more than half of the participants reported that they were aware of those crucial emergency response features.

In terms of earthquake preparedness measures and hazard adjustments, participating children in both cities reported that 44.9% or less of them have preparedness measurements and hazard adjustments (Table 6). Even the study locations prone to high earthquake risk, it was surprising to see that children's hazard adjustments for earthquakes were low (below 45%, Table 6). Children's preparedness levels can be increased via effective earthquake education programs. To do so, school authorities should have more responsibility to encourage children and their families to take more preparedness measures – not including children's families in this process can severely limit earthquake emergency preparedness programs. Children's easily-applied risk reduction actions for earthquakes, such as fitting lips on shelves to keep things from sliding off, or storing hazardous materials safely, show that children are capable of taking some measures to protect themselves and their families. Some of the interview results (as shown in Table 10) indicate that children want to make hazard adjustments in their homes to reduce the potential risks, but without their families support they are not able to do so. Thus it is not just children's education, but also family education, that has an important role in earthquake preparedness.

In this research, we also have examined the effects of gender on the psychological issues of children's earthquake risk and preparedness levels. The results show that gender is not a major factor associated with children's perceptions of earthquake risk and preparedness. Based on analyses of previous adult-based research, women tend to perceive environmental and safety risks higher than men [112]. In adult-based research, Armas [113] found that females had a higher earthquake risk than males in Bucharest, Romania. Furthermore, in a child sample study in Indonesia, girls' risk perception of landslide hazard was found to be higher than that of boys, while the flood risk perception of boys was higher than that of girls [114].

Taken together, education is an essential issue to mitigate the impacts of earthquake disasters, consequently, the authors of this article are in agreement with the findings of Graham et al. [56]; Mutch [58] and Torani et al. [59]. Schools are clearly vitally important places for education, and they can play a key role in gaining disaster awareness and preparedness [58]. Furthermore, schools play an important part in community life, as places of daily mass gathering and have a key role in disaster management [56]. The results of this study support the findings of Proctor et al. [63] and Repetti et al. [62]; that the family has been linked to wide-ranging child outcomes in the social context of the child. Also our findings are in line with Najafi et al. [64] who argued that feelings, emotions, and social norms are likely to influence beliefs.

5.3. Limitations

This study has some limitations. The sample selected for this study is limited to school children living in Van and Kocaeli provinces of Turkey; therefore, the findings cannot be generalised to all children. Another limitation could be that selection bias exists in the data. Although the lead researcher and Ministry of National Education representatives in two cities were careful to select a representative sample of the socioeconomic background of the surveyed schools, there is a possibility that children from participating schools may not be generalizable to the population of the provinces of Van and Kocaeli, or indeed the entire population of Turkey. Nevertheless, the results provide useful insights into children's earthquake perception, awareness, and preparedness. Another concern is the reliability of the responses from the surveyed children. Although the children were asked about any aspects of the survey that they found difficult, it might be that the children answered the questions with minimal thinking, or they might have copied answers from a classmate. Finally, the PRISM technique was initially designed as a clinical psychology methodology for assessing the treatment of an illness, not for the perception of earthquake risk and the importance of earthquake preparedness. However, PRISM - being a non-verbal and easy to use, pictorial technique - was found to be appropriate and very useful in our study.

6. Conclusions

The paper has presented the results of earthquake awareness, risk perception, and levels of preparedness among children in two provinces of Turkey with major earthquake risks: Van and Kocaeli. The findings show that 21.1% of the participating children in Ipekyolu (Van) and 21.9% of the participating schoolchildren in Golcuk (Kocaeli) think that the likelihood of occurrence of a future earthquake in their living environment is "unlikely" (Table 1). 23.2% of the children participating in Ipekyolu (Van), and 30.8% in Golcuk (Kocaeli) reported that they were not aware of any earthquake faults in their living area (Table 2).

The results of this research indicate that the surveyed children have accurate earthquake risk perceptions since more than half of the participants are aware of the likelihood of the future earthquake occurrence and its consequences. More than half of the participants in two cities were aware of the correct actions knowledge for earthquakes (Table 4). However, regarding children's preparedness, more than half of the participants in the two cities do not have enough information on preparedness plans and practices, nor on preparedness measures and hazard adjustment (Tables 5 and 6).

The findings of this study highlight the importance of earthquake education programmes to increase children's levels of earthquake awareness and their coping mechanisms, as well as encouraging children to take measures to protect themselves and their families. The children who participated in the earthquake education programme had higher earthquake awareness, and predicted the future earthquake occurrence and the potential causes of injury. Our results show that children in the two examined cities have "family" as their first source to get information about hazards, with our results from qualitative surveys giving supporting arguments. The findings show a consistent relationship between earthquake risk perception, earthquake awareness, factual knowledge of preparedness, the importance of preparedness, and earthquake education programs. Children who lived in an area of lower socioeconomic status had a lower perception of earthquake risk. Also, our results show that gender was not a major factor associated with children's perceptions of earthquake risk and preparedness.

The study has some important implications, both theoretically and empirically, as well as for disaster risk reduction applications. While this paper was under the review process, the Elazig (Turkey) earthquake (6.8 M_w) occurred in January 2020: it killed 41 people, injuring and displacing a considerable number of people, who now face a long and hard fight to return to their normal life. The effects of this earthquake were devastating for the people who live in Elazig and Malatya cities, especially for the children. As the risks from earthquakes in Turkey continue to increase with expanding urban population, we need to better understand how children perceive earthquake risks, to more effectively assist them to prepare for, and to cope with, earthquakes. Within the disaster risk reduction sector, we have provided perception insights that can improve the communication and dissemination of information on earthquake hazards. Consequently, the findings of this study are important to understand children's earthquake risk perceptions and their preparedness, informing the development of disaster risk reduction strategies, not just in Turkey but also in other countries prone to earthquakes.

6.1. Recommendations

This study used the PRISM technique to measure children's perceptions of earthquake risk and preparedness. The PRISM technique is recommended for other risk perception studies: the surveyed children found it easy to use, with its visual simplicity and interactive features. A

further recommendation is to carry out longitudinal research into children's earthquake risk perceptions, to examine the effectiveness of educational interventions for disaster risk reduction, e.g., disaster preparedness publicity campaigns, inclusion of disaster topics in science and/or geography curriculum of schools, including school-hosted events for building local maps of hazardous terrain or vulnerable features. Further research is also needed into the relationship between the socioeconomic status of children and their perception of earthquake risks.

In terms of policy and practice, disaster education programs should be strengthened, with frequent school emergency practices: drills can improve children's coping levels during hazardous events, such as earthquakes. Hazard maps, highlighting high-risk areas, should be readily available and easy to understand for children to better prepare for a potential emergency event in their local area. Disaster education programs should include the training of teachers to work with children to understand, or even co-create, maps of their local hazards and high-risk areas, with a discussion about ways of reducing hazard impacts and improving community resilience. This study thus supports the recommendation of Anderson [47]: recognizing children's capabilities and vulnerabilities should be policy and research priorities for disaster risk reduction.

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Appendix A. Supplementary data

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