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Earthquake Risk Perception and Preparedness of a Sample of Residents Following a Major Earthquake in Türkiye in 2023

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Abstract

The aim of this study was to investigate these residents' levels of earthquake risk perception and preparedness following the disastrous earthquake event on 6 February 2023 near Kahramanmaraş in Türkiye. The study involved a cross-sectional descriptive design. A sample of convenience comprising 411 residents of areas not impacted directly by the 6 February 2023 earthquakes completed an online survey over a three-month period March to May 2023. There was no indication of notably elevated levels of earthquake risk perception among those residents surveyed overall. Levels of physical, or material, preparedness for earthquakes were lower than desirable. Earthquake risk perception was negatively, though weakly, related to both physical and psychological preparedness. Physical preparedness was strongly and positively correlated with psychological preparedness. Having (a)past earthquake experience (b)read or viewed earthquake safety material, (c)attended earthquake safety meetings and (d)work experience related to emergencies were all associated with significantly higher levels of residents' preparedness. Although the information was collected a short time after a disastrous earthquake event when overall levels of community awareness of the danger posed by earthquakes were likely to be high, the findings about the levels of a possible earthquake preparedness were not satisfactory. Possible implications for improving community earthquake preparedness are discussed.

Keywords: Earthquake safety, Risk perception, Physical preparedness, Psychological preparedness, Natural disasters.

1. INTRODUCTION

Türkiye is one of several countries particularly vulnerable to earthquakes. It is located in a geologically active region of the world covering the Eurasian, Anatolian, African and Arabian tectonic plates. Approximately 93% of its geography is located in active seismic risk zones and approximately 98% of its population faces earthquake threats of various degrees of risk (UCTEA, 2012). In terms of the total number of large earthquakes since 1900, Türkiye is ranked fourth globally. In the 30 years prior to 2023, there had been three major earthquakes (magnitude 7Mw [1] and above) in Türkiye (AFAD, 2018.):

- 1999 Gölcük-Kocaeli earthquake, Mw 7.6
- 1999 Düzce-Bolu earthquake, Mw 7.1
- 2011 Van earthquake, Mw 7.1

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On 6 February 2023 two major earthquakes occurred near the Turkish city of Kahramanmaraş: first in Pazarcık (Mw 7.7) and then in Elbistan (Mw 7.6). These earthquakes together constituted the deadliest earthquake event in Türkiye since 1939, with more than 45,000 fatalities (Statista, 2023).

The organisation responsible for all disaster management activities in Türkiye, including earthquake safety, is the Disaster and Emergency Management Presidency (n.d.). Community awareness programs and campaigns are a key component of preparedness (Kuterdem et al., 2013). Major activities include provision of web-based and printed information about earthquake safety and preparedness for the public, and provision of training to key figures in the community including schoolteachers, hospital administrators, heads of neighbourhoods (mukhtars), and religious officials.

1.1. Literature Review

1.1.1. Earthquake Risk Perception

Since publication of the seminal paper on risk perception by Slovic (1987) the research literature on environmental hazard risk perception has become voluminous. Reviews have described environmental hazard risk perception variously as encompassing up to three components: the perceived probability or chance or likelihood of a hazard event occurring, likely severity of the impact of the hazard, and the level of aversive experience (concern, anxiety, dread) associated with contemplating the possibility of a future hazard impact (e.g., Hall et al., 2021; Lechowska, 2018; Trumbo et al., 2016; Wachinger et al., 2013).

Searches using ScienceDirect, Scopus, Web of Science, PSYCHINFO and Google Scholar identified seven studies in English language sources reporting Turkish residents' levels of earthquake risk perception. Two studies employed a measure asking residents about their anticipated likelihood, severity and concern about a future earthquake (Karanci et al., 2005; Ozdemir and Yilmaz, 2011); two used a measure asking about anticipated severity only (Okazaki et al., 2008; Tekeli-Yesil et al., 2011); one asked about probability and severity (Kasapoglu and Ecevit, 2004); one asked about severity and concern (Mizrak et al., 2021); and one asked about level of concern only (Joffe et al., 2013). While the format and content of the measures differed making comparisons across studies difficult, most of the studies described appreciable percentages of their participants reporting reasonably elevated levels of perceived earthquake risk.

1.1.2. Physical Preparedness for Earthquakes

Searches using ScienceDirect, Scopus, Web of Science, PSYCHINFO and Google Scholar identified 12 studies reporting data on Turkish residents' levels of physical (or material) preparedness for an earthquake in English language sources. Three studies (Evram et al., 2019; Kasapoglu and Ecevit, 2004; Ozdemir et al., 2021) used the Earthquake Readiness Scale developed in California by Mulilis et al. (1990). Three studies (Joffe et al., 2013; Oral et al., 2015; Ozdemir and Yilmaz, 2011) used the Earthquake Readiness Scale developed in New Zealand by Spittal et al. (2006). The study by Gün Çınğı and Yazgan (2022) used the Disaster Preparedness Scale developed by Şentuna and Çakı (2020). The remaining five studies (Güngörmüş et al., 2005; Kundak et al., 2014; Tekeli-Yesil et al., 2010; Yayla and Sahinoz, 2020) used measures constructed specifically for their studies based on various sources.

All the studies concluded that levels of preparedness for an earthquake were considerably lower overall than is desirable. The study by Yayla and Sahinoz (2020) presented participants with a list of 11 mitigation and survival preparatory actions and asked them if they (a) knew about the action, and (b) if they had carried out the action. There were generally high levels of awareness of

the listed actions, but much lower overall levels of implementation. Similar findings were reported by Güngörmüş et al. (2012), suggesting that factors other than simply lack of knowledge are associated with low levels of preparatory actions by residents.

Several possible reasons for the reported low levels of preparedness were suggested by the researchers. Kasapoğlu and Ecevit (2004) concluded that social reasons, notably religious values and lack of money were major factors in residents' low overall levels of preparedness. Karanci et al. (2005) noted that their interviewees reported that other concerns of more immediate relevance to everyday living associated with the high cost of living were prioritised over earthquake preparedness actions. Ozdemir and Yilmaz (2011) speculated that the main reason for their residents' low level of preparedness actions was that these were viewed as not likely to be very effective, as well as being time consuming and costly.

Several factors have been found to be related to residents reporting higher levels of preparedness: (a) known seismic risk, (b) higher level of education, (c) higher socioeconomic status, (d) previous experience of an earthquake event, (e) knowledge of earthquake preparedness actions, (f) home ownership, and (g) male gender (Karanci et al., 2005; Kundak et al., 2014; Oral et al., 2015; Tekeli-Yeşil et al., 2010; Yayla and Sahinoz, 2020). Three studies found that participants who had taken part in earthquake awareness training programs reported higher levels of preparedness (Gün Çınğı and Yazgan, 2022; Karanci et al., 2005; Yayla and Sahinoz, 2020).

1.1.3. Psychological Preparedness for Earthquakes

Historically, most early disaster preparedness research focused on physical, or material, preparations to reduce the likelihood of death, injury, and financial loss. However, more recent research has highlighted the importance of psychological preparedness (Boylan and Lawrence, 2020). There is general agreement among researchers that psychological preparedness for a disaster event comprises two broad mental dimensions, one mostly cognitive and the other mostly emotional. The cognitive dimension incorporates knowledge of threats, adaptive responses and resources; while the emotional dimension incorporates self-awareness in the face of threat and ability to down-regulate aversive emotions so as to cope adaptively (Every et al., 2019; McLennan et al., 2022). Being psychologically prepared can help individuals under disaster threat to cope with stress, feel safer, make better decisions, implement adaptive actions, and reduce the likelihood of subsequent adverse mental effects such as PTSD (Malkina-Pykh and Pykh, 2015; Roudini et al., 2017, Zakour, 2023).

ScienceDirect, Scopus, Web of Science, PSYCHINFO and Google Scholar databases were searched to find English language sources reporting Turkish residents' levels of psychological preparedness for earthquakes. No studies reporting research on psychological preparedness for earthquakes were found. However, three studies were identified which reported findings about psychological preparedness for disasters in general. Inal et al. (2018) described the development of a general disaster preparedness belief scale based on the Health Belief Model theoretical framework proposed by Glanz et al. (2002). The 31 item scale measures residents' self-reported anticipated levels of disaster Susceptibility, Severity, Benefits, Barriers, Cue to action and Self-efficacy. The scale was used subsequently to survey teachers' beliefs about disaster preparedness (Dascı Sonmez and Gokmenoglu, 2023) and the disaster beliefs of academic and administrative staff at a university (Inal et al., 2019).

1.1.4. Study Aims and Overview

Previous earthquakes in the history of Türkiye have demonstrated the vulnerability of communities to the impact of medium-to-large earthquake events. Studies reported over the period 2004 to 2022 found levels of preparedness for earthquakes by residents to be generally lower than desirable. We reasoned that awareness of the hazardous nature of earthquakes may be high across all of Türkiye in the aftermath of the 6 February 2023 Kahramanmaraş earthquakes and decided to investigate levels of earthquake risk perception and preparedness by an online survey of communities not impacted directly by the events of 6 February 2023. We chose **not** to seek responses from residents in locations impacted directly for two reason, ethical and practical. The ethics of conducting seeking to obtain data from survivors of disasters in the immediate aftermath has been questioned (Newman et al., 2006). Further, we anticipated that disruption of communications and relocations of residents would reduce residents' ability to respond.

The aim of this study was to investigate levels of earthquake risk perceptions and both physical and psychological preparedness for possible future earthquakes in a sample of residents of Türkiye at a time of likely high awareness of the dangers posed by earthquakes. We describe findings from an online survey of a sample of residents from locations not impacted directly by the 6 February 2023 Kahramanmaraş earthquakes conducted over the three-month period March to May 2023. Findings are presented about these residents' reported levels of current earthquake risk perceptions and preparedness—both physical and psychological. Possible correlates of earthquake risk perception and preparedness are investigated. We note limitations of the study. Finally, we discuss possible implications of the findings for future mitigation of earthquake-related hazards by residents.

2. METHOD

2.1. Participants and Recruitment Procedure

A total of 411 adult residents from a range of provinces in Türkiye from areas not impacted by the Kahramanmaraş earthquakes took part in the study, details are presented in the Results section. Participants completed the online survey advertised via the social media tools *WhatsApp*, *Facebook*, I*nstagram*, and *LinkedIn*. Invitations were posted by the first author on popular sites, together with requests that information about the study to be forwarded to others.

Google Forms was used as the online questionnaire platform. Data was collected over the period March to May 2023. Participation was specified as being voluntary and anonymous. The study was approved by the Giresun University Ethics Committee (No: E-50288587-050.01.04-145465). For ethical reasons, the study was not advertised in the provinces affected directly by the earthquakes. The invitation to complete the survey included the following instructions *"If you have been affected personally in any way by the recent earthquakes you should consider not taking part. Also, if you experience any discomfort while completing the survey, please feel completely free to stop taking part and close the browser".* Subsequent sections of this paper report English language translations of the online survey questionnaire items. The Turkish questionnaire is available as Supplementary material with the online version of the paper.

2.2. Materials

2.2.1. Participant Characteristics Questionnaire

Participants were asked:
(a) Gender.
(b) Age.
(c) Type of residence: Detached house (One- or two-level house); Low-rise apartment (1-4 levels); Mid-rise apartment (5-9 levels); High-rise apartment (10 or more levels); Other.
(d) Have you ever experienced a damaging earthquake? Yes; No
(e) Have you read or viewed earthquake safety or preparedness material during the previous two years? Yes; No.
(f) Have you attended an information meeting or taken part in training about earthquake safety or preparedness during the previous two years? Yes; No.
(g) Have you ever taken part as a volunteer / staff member in emergencies or disasters? Yes; No.
(h) Location of your residence.

2.2.2. Earthquake Risk Perception

It was noted in *Section 1.5.1* that (a) previous researchers had employed a variety of earthquake risk perception measures; and (b) the measures focussed variously on the perceived probability or likelihood of an earthquake event, the expected severity or adverse consequences on an earthquake event; and/or the aversive psychological experiences associated with contemplating the possibility of a future earthquake event—concern, worry, dread, fear. We were informed by the analysis of the risk perception concept offered by Hall *et al*. (2021) and chose to adapt their brief four-item measure of wildfire risk perception to construct the Resident Earthquake Risk Perception Scale-4 (RERPS-4) with responses on 7-point Likert scales. Their scale demonstrated high internal consistency reliability ($\alpha = .93$) and test-retest reliability ($r = .95$), and evidenced both construct validity and concurrent convergent and discriminant criterion validity. The adapted scale items are:

What do you think your home's earthquake risk level will be over the next five years? (no risk=1, extremely high=7).
How likely is it that your home will ever be threatened by an earthquake? (not at all=1, extremely likely=7).
How dangerous could an earthquake in your region be for you and other residents? (not at all=1, extremely dangerous=7).
How concerned are you about a possible earthquake threat to your home? (not at all=1, extremely concerned=7).
Total RERPS-4 scores could range from 4 to 28.

2.2.3. Physical Earthquake Preparedness

In *Section 1.5.2* it was noted that while researchers had employed a range of measures of physical preparedness for an earthquake event two measures had been influential in previous research: the Mulilis-Lippa (California) Earthquake Preparedness Scale (Mulilis et al*.*, 1990) and the (New Zealand) Earthquake Readiness Scale developed by Spittal et al. (2006). We chose to use the latter measure as a basis because of its reported good psychometric properties: internal consistency reliability $\alpha = .85$, with evidence of both construct and criterion-related validity. We anticipated that many of our respondents would be (a) renters and/or (b) residents of apartment blocks and omitted items about detailed retrofitting or strengthening or insuring the home. We also consulted the website of Türkiye's Disaster and Emergency Management Authority (AFAD) and added items about gas valve and electrical fuse safety, household plans, and post-earthquake

communication arrangements. The resulting 24 items of the Resident Earthquake Readiness Checklist (RERC-24) are shown in Table 3. Responses are simply "no" or "yes", and total scores can thus range from 0 to 24.

We also incorporated a single-item measure of self-perceived earthquake preparedness, with a seven-point Likert response scale: Do you think that you are prepared for a major earthquake? (1=not at all prepared, 4=somewhat prepared, 7=very well prepared).

2.2.4. Psychological Readiness

The 21-item Turkish Psychological Preparedness for Disaster Threat Scale (PPDTS-T21). It was adapted by Türkdoğan Görgün et al., (2023). The PPDTS-T21 comprises three subscales:

1. Management of one's emotional and psychological response to threat; 9 items, example: *I feel reasonably confident in my own ability to deal with stressful situations that I might find myself in.*
2. Knowledge and management of the external threat situational environment; 9 items, example: *I know which household preparedness measures are needed to stay safe in a very severe natural disaster such as earthquake, flood, forest fire or epidemic/pandemic.*
3. Management of one's social environment; 3 items, example: *I know which strategies I could use to calm others in a severe natural disaster such as earthquake, flood, forest fire or epidemic/pandemic warning situation.*

Responses were made on 4-point Likert type scales: 1=Not at all true of me; 2= Hardly true of me; 3=Moderately true of me; and 4=Exactly true of me. Türkdoğan Görgün et al. (2023) reported evidence of both construct validity and internal consistency reliability with Cronbach's alphas of 0.91, 0.93 and 0.83 for the three subscales, respectively and 0.95 for the scale total.

2.3. Design and Analysis

The study employed a cross-sectional descriptive design with a sample of convenience. Apart from nine people declining to specify their gender there were no missing data. *IBM SPSS Amos 22* software was used to undertake a preliminary confirmatory factor analysis (CFA) of the PPDTS-21 to check for cross-sample factor stability. *IBM SPSS 26.0* software was used to check the internal consistency of the multi-item measures and undertake analyses of the data.

3. RESULTS

3.1. Participants

A total of 411 residents responded to invitations to participate in the online survey, 264 (64%) were women, 138 (34%) were men and 9 (2%) preferred not to state their gender. The mean age of the sample was 37.4 years (SD = 13.7). Further details are shown in Table 1.

3.2. Residents' Earthquake Risk Perceptions

Table 2 reports descriptive data on the four items of the RERPS-4 and their intercorrelations. For all four items, the median value was the mid-point of their seven-point response scale: 4—"moderate". Cronbach's α = .83, indicating a high level of internal consistency for the four-item measure. The distribution of scores gave no indication that participants' earthquake risk perception scores were skewed appreciably towards higher levels: S = -.04.

Table 1. Participant characteristics (*N* = 411)

Characteristic	*f*	%
Gender		
Female	264	64
Male	138	34
Preferred not to report	9	2
Type of residence		
One- or two-level detached house)	53	13
Low-rise apartment (1-4 levels)	119	29
Mid-rise apartment (5-9 levels)	179	43
High-rise apartment (10 or more levels)	60	15
Have you ever experienced a damaging earthquake?		
Yes	90	22
No	321	78
Have you read or viewed earthquake safety or preparedness material during the previous two years?		
Yes	248	60
No	163	40
Have you attended an information meeting or taken part in training about earthquake safety or preparedness during the previous two years?		
Yes	112	27
No	299	73
Have you ever taken part as a volunteer / staff member in emergencies or disasters?		
Yes	66	16
No	345	84
Residence location		
Istanbul	97	24
Elsewhere	314	76

Table 2. Intercorrelations among the residents' earthquake risk perception scale (RERPS-4) items and total score, means and standard deviations (*N* = 411)

	Total	1.	2.	3.	4.	*Median*	*Mean*	*SD*
RERPS-4 Total score[a]	α = .83	.76	.84	.85	.80	16	16.56	5.50
1. RERPS1 (Omnibus risk)[b]		-	.57	.50	.43	4	3.75	1.60
2. RERPS2 (Likelihood)[b]			-	.65	.53	4	3.80	1.67
3. RERPS3 (Dangerousness)[b]				-	.60	4	4.51	1.67
4.RERPS4 (Concern)[b]					-	4	4.50	1.83

Items were scored on 7-point response scales

[a] Possible score range 4—28

[b] Possible score range 1—7: (1, None)— (4, Moderate)— (7, Extreme)

3.3. Earthquake Preparedness

3.3.1. Physical Preparedness

Before completing the earthquake readiness actions checklist, participants made a self-rating of their overall level of preparedness for a major earthquake (Do you think that you are prepared for a major earthquake?) on a seven-point response scale. The descriptive statistics for participants' responses were: range = 1—7; Median = 3; Mean = 3.18, SD = 1.64.

The 24 items making up the Residents' Earthquake Readiness Checklist (RERC-24) are listed in Table 3 with the percentage of participants who reported undertaking each preparatory action. The checklist exhibited a high level of internal consistency reliability: Cronbach's α = .91 and corrected item-total correlations ranged from .37 (#1. I considered the risk of a major earthquake when deciding to live in this residence) to .63 (#17. I have put aside spare plastic bags and toilet paper for use as an emergency toilet). Descriptive statistics for the responses from our 411

participants were: range = 0—24; Median = 9; Mean = 9.83; SD = 6.55. Total RERC-24 scores were correlated significantly with self-ratings of preparedness: r = .53, p = <.001.

Table 3 includes findings from eight previous studies reporting residents' earthquake preparedness actions. While there are some indications that the overall level of earthquake preparedness in our sample may, perhaps, be somewhat greater than that reported in some previous studies, the median RERC-24 total score of 9 shows that 50 percent of the residents in our sample had taken only 9 or less of the 24 earthquake preparation actions making up the checklist.

Table 3. Percentages of participants reporting completion of each earthquake preparedness checklist item for the present study and eight previous studies.

The present study		*Percentages for corresponding items in eight other studies*[a]								
Resident Earthquake Readiness Checklist (RERC-24) items		A	B	C	D	E	F	G	H	*M*[b]
	%	%	%	%	%	%	%	%	%	
1. I considered the risk of a major earthquake when deciding to live in this residence (.37)	**56**	-	-	-	35		-	-	47	*41*
2. I have a plan that is written or has been discussed with all members of the household about what we will do if there is a destructive earthquake (.50)	**37**	-	25	4	28	18	23	32	-	*22*
3. My residence has been strengthened (or will be strengthened in the near future) to improve its earthquake resistance (.40)	**33**	-	-	17	18	-	-	-	40	*27*
4. I know that my gas valve and/or electrical fuses are automated against gas leakage and fire (.39)	**49**	-	-	-	-		-	-	-	-
5. I have fastened tall furniture to the wall securely (.51)	**35**	30	-	-	24	10	25	39	33	27
6.I have arranged the things in my cupboards so that heavy objects are stored at floor level (.57)	**49**	-	-	-	-	-	-	-	38	*38*
7. I have securely fastened cupboard and closet doors with latches to keep them from opening and spilling the contents (.52)	**19**	-	-	15	-	-	29	-	20	*21*
8. I have ensured that objects which may contain water are not on top of electrical equipment (e.g., a pot plant or fishbowl on top of the television) (.41)	**69**	-	-	-	-	-	-	-	56	*56*
9.I have ensured that heavy objects are stored on the floor (.49)	**68**	-	-	-	-	24	-	-	-	*24*
10. Any potentially movable heavy objects in my home have been secured (e.g. television) (.60)	**43**	-	-	-	-	9	-	-	48	*29*
11. I have obtained a working fire extinguisher (.50)	**21**	21	-	-	-	-	18	21	19	*20*
12. I have obtained a working torch (.55)	**60**	53	-	-	-	-	46	49	58	*52*
13. I have spare batteries for the torch (.58)	**53**	25	-	-	-	-	23	-	-	*24*
14. I have purchased a first aid kit (.60)	**42**	45	-	-	-	9	29	-	33	*29*
15. I have a supply of essential medicines for illness and allergies (.49)	**56**	-	-	-	-	19	-	-	29	*24*

16. I have water stored in strong containers for survival (.62)	**40**	46	-	15	28	13	34	-	23	*27*
17. I have put aside spare plastic bags and toilet paper for use as an emergency toilet (.63)	**26**	-	-	-	-	-	-	-	28	*28*
18. I have obtained a supply of tinned or dried food that could be used in an emergency (.59)	**30**	34	-	15	28	7	20	22	21	*20*
19. I have access to an alternative cooking source (e.g., gas barbecue) (.49)	**28**	-	-	-	-	-	-	-	42	*42*
20. I have tools to make minor repairs to the residence following an earthquake (.50)	**45**	-	-	-	-	-	-	-	43	*43*
21. My important documents (identity cards, insurance documents, passport, etc) are kept safe, e.g., in waterproof holders (.64)	**34**	-	-	-	-	-	-	30	-	*30*
22. Copies of my important documents (identity cards, insurance documents, passport, etc) are stored safely outside my region (.52)	**28**	-	-	-	-	-	-	-	-	-
23. I have arranged a place to meet family/friends after a damaging earthquake (.54)	**30**	11	20	-	-	5	9	-	20	*13*
24. In case of a disaster or emergency I have arranged a contact person outside the region (.40)	**34**	-	-	5	-	6	-	-	-	*6*

[a] Key: Study: A. Evram *et al.* (2006); B. Güngörmüş *et al*. (2010); C. Kasapoglu and Ecevit (2004); D. Kundak *et al.* (2014); E. Joffe *et al*. (2013); F. Ozdimir and Yilmaz (2011); G. Tekeli-Yesil *et al.* (2010); H. Yayla and Sahinoz (2020).
[b] *M* = Unweighted mean percentage for the preparedness action taken across studies 1—8.

3.3.2. Psychological Preparedness

A confirmatory factor analysis (CFA) was conducted on PPDTS-T21 scores to check the cross-sample stability of the three-factor structure. All items loaded significantly on their corresponding factors. The fit indices of the model indicated an acceptable fit to the data: $\chi 2(181)=527.797$ ($p<0.001$), RMSEA=0.068 ($p<0.05$), CFI=0.939, GFI=0.892, AGFI=0.862, NFI=0.911, TLI=0.929. Table 4 includes the median, mean and standard deviation of scores on the three subscales of the PPDTS-T21 and the total score, and their intercorrelations. Cronbach's α = .94, indicating a high level of internal consistency. Participants' total scores were skewed slightly towards higher levels: S = -.12.

Table 4. Intercorrelations among the psychological preparedness of disaster threat scale (PPDTS-T21) subscales and total score, means and standard deviations (*N* = 411)

	Total	1.	2.	3.	*Median*	*Mean*	*SD*
PPDTS-T21 Total score[a]	α = .94	.86	.89	.78	58	57.64	14.20
1. PPDTS-T21 EEM[b]		α = .89	.57	.59	24	24.52	6.76
2. PPDTS-T21 EM[b]			α = .93	.67	25	24.51	7.23
3. PPDTS-T21 SM[c]				α = .80	9	8.60	2.34

EEM = External Environment Management; EM = Emotional Management; SM = Social Management
Items were scored on 4-point response scales
[a] Possible score range 21—84
[b] Possible score range 9—36
[c] Possible score range 3—12

3.4. Correlates of Earthquake Risk Perception and Preparedness

Table 5 shows intercorrelations among scores on the RERPS-4, RERC-24 and PPDTS-T21 total scores. Earthquake risk perception was related negatively but weakly to both earthquake physical preparedness and psychological preparedness. We discuss this finding in *Section 4.3*. Earthquake physical preparedness was correlated positively and strongly with psychological preparedness.

In subsequent analyses r was used as a standardised effect size metric to indicate relative magnitudes of mean differences, where .10 = small, .30 = moderate, and .50 = large (Cohen, 1992). There was no meaningful mean difference between men and women on earthquake risk perception total score (RERPS-4 total): $M_{\text{Men}} = 16.5$, $SD = 6.05$, $M_{\text{Women}} = 16.7$, $SD = 5.21$; $F(137,263) = 0.82$, $r = .02$. The mean score for men was greater than that for women on physical preparedness total scores (RECR-24 total). However, the magnitude of the difference was small: $M_{\text{Men}} = 10.9$, $SD = 6.79$, $M_{\text{Women}} = 9.1$, $SD = 6.2$; $F(137,263) = 5.13$, $r = .13$. The mean score for men was greater than that for women on psychological preparedness total scores (PPDTS-T21 total). However, the magnitude of the difference was small: $M_{\text{Men}} = 60.1$, $SD = 13.50$, $M_{\text{Women}} = 56.3$, $SD = 14.4$; $F(137,263) = 3.53$, $r = .14$. Participants' age was not related meaningfully to physical preparedness ($r = -.01$) nor to psychological preparedness ($r = -.06$) but was related negatively, though weakly, to earthquake risk perception *(*$r = -.13$, $p = .006$).

Table 5. Intercorrelations among scores on the earthquake risk perception (RERPS-4), earthquake physical preparedness (RERC-24) and psychological preparedness for disaster (PPDTS-T21) measures ($N = 411$)

	RERPS-4 Total	RERC-24 Total	PPDTS-T21 Total
RERPS-4 Total	α = .83	-.17**	-.12*
RERC-24 Total		α = .91	.51***
PPDTS-T21 Total			α =.94

*$p < .05$; *$p < .01$; *$p < .001$

Table 6 compares participants grouped according to differing previous earthquake related experiences and type of residence on their mean scores for the earthquake risk perception, physical preparedness and psychological preparedness measures total scores. There was no significant mean difference in risk perception between those with and those without previous experience of a damaging earthquake. However, those with previous experience of a damaging earthquake reported a significantly higher mean level of both physical and psychological preparedness. The findings were similar for those who had read or viewed earthquake safety material compared with those who had not, and for those who had attended a meeting or training session about earthquake safety compared with those who had not. Those who had taken part in emergency response work reported a significantly lower mean level of risk perception and a higher mean level of both physical and psychological preparedness. Those who resided in a mid-level apartment reported a higher mean level of risk perception compared with those who resided in a detached house. Those who resided in a detached house reported a higher mean level of physical preparedness. There were no differences in mean level of psychological preparedness among the four groups of residents.

Table 6. Comparison of groups of participants on mean scores on the earthquake risk perception, physical preparedness and psychological preparedness totals measures

		Risk perception (RERPS-4 total)	Physical preparedness (REPC-24 total)	Psychological preparedness (PPDTS-T21 total)
Previous earthquake experience?	Yes No	M = 16.7; SD = 5.67 M = 16.5; SD =5.45 t(409) = 0.22, p = .82; r = .04	M = 11.1; SD = 6.21 M = 9.5; SD =6.60 t(409) = 2.10, p = .04; r = .12	M = 60.7; SD = 14.82 M = 56.8; SD =13.93 t(409) = 2.30, p = .02; r = .13
Read/viewed earthquake safety material?	Yes No	M = 16.2; SD = 5.69 M = 17.1; SD =5.16 t(409) = 1.67, p = .10; r = .08	M = 11.8; SD = 6.39 M = 6.8; SD =5.58 t(409) = 8.35, p < .001; r = .38	M = 61.2; SD = 13.07 M = 52.2; SD =14.17 t(409) = 6.62, p < .001; r = .31
Attended a meeting/training about earthquake safety?	Yes No	M = 16.4; SD = 5.71 M = 16.6; SD =5.42 t(409) = 0.36, p = .72; r = .02	M = 13.0; SD = 6.54 M = 8.7; SD =6.17 t(409) = 6.17, p < .001; r = .32	M = 63.4; SD = 13.37 M = 55.5; SD =13.91 t(409) = 5.22, p < .001; r = .28
Taken part in emergency/disaster response?	Yes No	M = 14.9; SD = 6.72 M = 9.0; SD =6.19 t(409) = 2.74, p = .01 r = .42	M = 14.0; SD = 6.54 M = 8.7; SD =6.17 t(409) = 6.05, p < .001; r = .38	M = 62.5; SD = 13.07 M = 56.7; SD =14.24 t(409) = 3.04.22, p = .002; r = .21
Type of residence: Detached house Low-rise apartment Mid-rise apartment High-rise apartment		M_H = 14.5; SD = 4.94 M_L = 16.2; SD = 5.24 M_M = 17.7; SD = 5.53 M_{HR} = 15.9; SD = 5.72 F(3,407) = 5.53, p = .001 Scheffe tests; $M_M > M_H$ r = .29	M_H = 12.2; SD = 6.09 M_L = 10.1; SD = 6.58 M_M = 9.1; SD = 6.25 M_{HR} = 9.5; SD = 6.69 F(3,407) = 3.13, p = .03 Scheffe tests: $M_H > M_M$ r = .24	M_H = 60.1; SD = 14.06 M_L = 58.3; SD = 13.95 M_M = 56.9; SD = 13.20 M_{HR} = 56.2; SD = 17.39 F(3,407) = 0.94, p = .42

4. DISCUSSION

4.1. Summary

Previous surveys have indicated that Turkish residents perceived earthquakes as posing a significant risk to life and property, and reported generally low levels of physical preparedness for an earthquake event. In our survey of 411 residents from areas not impacted directly by the Kahramanmaraş earthquakes of 6 February 2023 we found no indication of notably elevated levels of earthquake risk perception, but lower than desirable levels of physical preparedness for an earthquake. Risk perception was negatively, though weakly, related to preparedness. Physical preparedness was strongly correlated with psychological preparedness. Past experience of earthquakes, having read earthquake safety material, attending earthquake safety meetings and taking part in work-related activities involving emergencies were all associated with significantly higher levels of preparedness—both physical and psychological.

4.2. Limitations

The present study has two notable limitations. First, previous studies of Turkish residents used a range of different measures of earthquake risk perception and preparedness making, historical comparisons tentative. Second, the sample was one of convenience so generalisations of findings from the sample to the wider population of residents of Türkiye requires caution. More than half the sample (58%) resided in mid- to high-rise apartments (> 5 levels) suggesting that participants from rural areas and smaller population centres are under-represented.

The sample size of N = 411 may be criticised as being insufficiently large. We acknowledge that more participants would have been desirable. Of the 12 previous studies of earthquake preparedness cited, the mean sample size was 355 and the range was 48—941. Limited resources and time constraints did not permit us to undertake a more systematic or larger-scale study.

4.3. Conclusions

The finding that earthquake risk perception was related negatively to physical preparedness was unexpected. Previous studies by Karanci et al. (2005), Ozdemir and Yilmaz (2011), and Tekeli-Yesil et al. (201) reported positive, though small, correlations between earthquake risk perception and physical preparedness of .14, .15 and .17, respectively. However, negative correlations between risk perception and preparedness have been reported previously in wildfire research (Koksal et al., 2019). The review by Wachinger et al. (2012) noted that researchers had reported negative relationships between risk perception and preparedness across a range of hazards and proposed four reasons why residents' hazard risk perception levels may be related negatively to their levels of preparedness: (i) residents understand their risk but choose to simply accept it because the perceived benefits of living where they do outweighs potential negative impacts of the hazard, (ii) residents understand their risk but do not take responsibility for their own protection, transferring that responsibility to other parties such as relevant authorities, (iii) residents understand their risk but, for a range of reasons, believe they are unable to undertake effective preparatory actions, (iv) residents undertake preparations and as a result view their risk as being low as a consequence. The relationship between residents' earthquake risk perception and preparedness clearly warrants further investigation.

The finding that residents' physical earthquake preparedness was significantly and positively related to psychological preparedness for disasters is consistent with findings by other researchers across a range of hazards, including severe storms and floods (Every et al., 2019), bushfires (Boylan and Lawrence, 2020), and tropical cyclones (Morrissey and Reser, 2003). It seems likely that programs which promote residents' physical preparedness for a hazard will also result in increased levels of psychological preparedness, particularly on the external threat environment dimension.

Gun Cingi and Yazgan (2022), Karanci (2005), Tekeli-Yessel et al. (2010) and Yayla and Sahinoz (2020) all reported findings that women's mean level of physical earthquake preparedness was significantly lower than that for men. However, a study by Oral et al. (2015) found that gender was not a significant predictor of earthquake preparedness. We found that while the mean levels of physical and psychological preparedness were lower for women than those for men, the magnitude of the difference was small. It seems likely that the relationship of gender to earthquake preparedness is mediated by demographic factors such as education, home ownership, and residence location. Further research will be needed to clarify the issue.

The finding that higher levels of both physical earthquake preparedness and psychological preparedness for disasters were related to residents' earthquake education and training is consistent with previous research findings (Gun Cingi and Yazgan, 2020; Karanci, 2015; Yayla and

Sahinoz, 2020). It seems clear that programs to inform residents about earthquake preparedness measures can be effective. However, the challenge for authorities is to motivate residents to engage with these programs. An important first step would be to collect accurate knowledge of residents' levels earthquake risk perception and preparedness by monitoring these through regular surveys of communities at high seismic risk using standard questionnaire items. Developing earthquake safety preparedness programs specially aimed at women and taking into account their multifaceted roles in modern Türkiye—child and family member care, home management, employment—is likely to result in meaningful increases in overall levels of community preparedness.

Expanding the role of the existing network of health service organisation to include informing and educating community members about disaster preparedness could provide opportunities for outreach into sections of communities not currently engaged by existing disaster preparedness programs. As stated in the relevant legislation (Presidency of the Republic of Turkey Legislation Information System, 2013) the role of community health centres is to identify health-related risks and problems in order to protect and improve the health of their communities and carry out corrective and preventive activities related to these.

Note

[1] Mw, earthquake moment magnitude, is the most common measure of earthquake severity now used for medium to large earthquakes. It is a dimensionless index.

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