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ARTICLE

Development and Validation of a Scale Based on Protection Motivation Theory to Investigate Factors Affecting Earthquake Preparedness Behaviors

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Abstract
Given Türkiye's high seismic risk, earthquake preparedness is vital. This study explored factors affecting earthquake preparedness behaviors among residents in high-risk areas. The factors affecting earthquake preparedness behaviors Scale based on protection motivation theory was developed, and its validity was tested. Scale development consists of a pilot and main application process. The pilot application was carried out with 50 participants, and the main application was carried out with 804 participants. The sample consisted of 804 participants who were divided into two groups for exploratory and confirmatory factor analysis. The sample was selected from 11 neighborhoods using the cluster sampling method. IBM SPSS 25 was used for exploratory factor analysis, while AMOS 24.0 was employed for confirmatory factor analysis. The final version of the scale consists of 24 items across four dimensions, with a Cronbach's alpha of 0.883, exceeding the acceptable threshold of 0.7 for each dimension. The Kaiser–Meyer–Olkin value is 0.898, and Bartlett's test of sphericity is significant, with the total variance explained being 51%. Confirmatory factor analysis results indicate a good fit for both the measurement and structural models ($\chi 2/df = 1.779$; RMSEA = 0.44; CFI = 0.96; NFI = 0.91; TLI = 0.95; $p<0.001$). Structural equation modeling showed that, among the constructs of protection motivation theory, perceived efficacy ($\beta = 0.690$) is the most important factor affecting earthquake preparedness behaviors. The results show that the scale is a valid and reliable tool to determine the factors affecting earthquake preparedness behaviors in Turkish society.

Keywords Disaster · Earthquake preparedness · Perceived efficacy · Protection motivation theory · Scale development · Türkiye

1 Introduction

An earthquake is a quick and intense seismic event resulting from the rupture and displacement of tectonic plates beneath the Earth's crust (Haddow et al. 2020). Earthquake is an unpredictable hazard that often causes great loss of life and major economic losses (Shaw et al. 2004; Ao et al. 2021). Beyond deaths and injuries, earthquakes may impair water, food, sanitation, and transportation for long durations (Becker et al. 2012). Türkiye, located on active fault lines, is frequently subject to devastating earthquakes. According to the emergency events database (EM-DAT) (CRED 2024), over 9.2 million people in Türkiye were affected by the Mw 7.8 and Mw 7.5 earthquakes on 6 February 2023, which resulted in 50,783 deaths. These earthquakes have cost Türkiye at least USD 34 billion in damage. The devastating consequences of these recent earthquakes have underscored the need for improved earthquake preparedness in the society of Türkiye.

Earthquake preparedness refers to a comprehensive set of proactive measures designed to mitigate the adverse impacts of seismic events. These measures encompass physical strategies such as retrofitting buildings, securing household items, and maintaining emergency supplies as well as cognitive and social actions, including acquiring first aid skills, participating in drills, and improving risk perception (Russell et al. 1995; Paton 2003; Becker et al. 2012). According

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to Shapira et al. (2018), individuals with strong earthquake preparedness and awareness are more likely to follow emergency response recommendations during an earthquake. Prati et al. (2013) noted that individuals who feel unsafe during an earthquake and are unprepared may act inappropriately. Identifying the factors that motivate individuals to engage in earthquake preparedness is essential for enhancing community resilience against seismic events (Moon et al. 2020). In the literature, various theoretical frameworks have been employed to explain these factors, including the theory of planned behavior (TPB) (Zaremohzzabieh et al. 2021; Fatehpanah et al. 2025), social-cognitive theory (SCT) (Davarani et al. 2023), person relative to event theory (PrE) (Duval and Mulilis 1999), and protection motivation theory (PMT) (Mulilis and Lippa 1990). This study focused on the factors that motivate individuals to participate in earthquake preparedness behaviors. Among these frameworks, PMT was adopted in this study due to its comprehensive approach to understanding how individuals assess threat and coping appraisals, which are critical in motivating protective behaviors in the context of earthquake.

Protection motivation theory, a type of health promotion model (Tang and Feng 2018), has also been used in the literature on disaster preparedness and has become popular (Bubeck et al. 2018). Westcott et al. (2017) used PMT in an expanded manner to understand the behaviors of animal owners and emergency response teams in emergencies such as natural hazard-induced disasters. In a study examining the disaster preparedness levels and factors affecting the behaviors of residents after the 2016 Meinong earthquake in Taiwan, China using PMT, it was determined that factors such as risk perception and self-efficacy were important in understanding preparedness intentions and post-disaster behaviors (Tang and Feng 2018). Faryabi et al. (2023) used PMT to predict behaviors related to the harmful effects of natural hazard-related disasters in households in southern Iran. Aghdasi et al. (2023) investigated the effects of pro-environment behaviors and institutional governance mechanisms on sustainable livelihoods in combating drought in the Borkhar-Isfahan region of Iran using PMT. Ma et al. (2024) investigated the progression of behavioral changes towards disaster preparedness through three developmental stages by integrating the transtheoretical model (TTM) with SCT and PMT. Ghoreishi et al. (2025) investigated the socioeconomic and psychological factors affecting residents' ice jam flood mitigation decisions in Canada by integrating PMT and TTM. However, despite its growing application, few studies have focused on systematically operationalizing PMT components within the specific sociocultural context of Türkiye (Usluer et al. 2023).

Although PMT has been widely used in disaster preparedness research, the literature lacks a culturally adapted, psychometrically validated instrument specifically designed to assess earthquake preparedness within the context of Türkiye. Our study aimed to fill a gap in the literature by systematically operationalizing PMT constructs and adapting them to the seismic and cultural context of Türkiye. In this study, we developed and tested a PMT scale specifically for earthquake preparedness behaviors in Türkiye. In this article, we report our research findings as follows: (1) development of a culturally appropriate PMT scale for earthquake preparedness behaviors with a scale representative of the PMT constructs; and (2) psychometric evaluation of the developed scale. This study is expected to significantly enhance our understanding of earthquake preparedness among communities living in high seismic risk regions.

2 Theoretical Research Framework

In 1975, Rogers created the PMT and in its initial version, the model contained three cognitive processes: assessment of threat severity, anticipation of exposure, and belief in coping response effectiveness (Prentice-Dunn and Rogers 1986). The 1983 revision and expansion of the PMT stressed cognitive processes regardless of origin. The revised theory elaborates on information sources initiating coping, incorporates additional cognitive mediators, and provides a fuller account of coping modes (Rogers 1983). Recent studies have shown that PMT not only explains health behaviors but also provides a valid theoretical framework for broader behavioral areas such as disaster preparedness (Bubeck et al. 2018; Tang and Feng 2018; Hu et al. 2021; Faryabi et al. 2023; Ghoreishi et al. 2025). The PMT aims to assess perceived hazards and promote effective protective behaviors in response to these threats. Several studies showed that individuals who perceive disasters as highly severe are more likely to engage in disaster preparedness behaviors (Ong et al. 2021; Gumasing and Sobrevilla 2023; Kurata et al. 2023). Studies also emphasized that fear of possible disaster outcomes is an important psychological element that encourages preparedness behaviors in individuals (Lindell and Perry 2011; Faryabi et al. 2023). Previous studies have consistently shown that both self-efficacy (the belief in one's own ability to perform protective actions) and response efficacy (the belief that these actions are effective in mitigating risk) are significant predictors of disaster preparedness behaviors (Tang and Feng 2018; Botzen et al. 2019; Hu et al. 2021; Liu et al. 2024). Individuals who perceive disasters as more severe are more likely to find protective actions effective and believe that they can carry them out (Bubeck et al. 2012). The hypotheses in this study were created by making use of the literature and they are as follows:

H1: Perceived severity (perception of the seriousness of the threat) positively influences earthquake preparedness

behaviors (survival, planning, and both structural and non-structural risk reduction measures).
H2: Perceived fear positively influences earthquake preparedness behaviors.
H3: Perceived efficacy positively influences earthquake preparedness behaviors.
H4: Perceived severity positively impacts perceived efficacy.

The conceptual framework of PMT used in earthquake preparedness behaviors (Fig. 1) consists of three parts: threat appraisal, coping appraisal, and earthquake preparedness behaviors, and the unique contribution of the model lies in the operationalization of these three core components of PMT within the specific context of earthquake preparedness in Türkiye. Unlike the original PMT model, the model proposed in this study includes perceived self-efficacy and response efficacy as a single dimension of perceived efficacy (MacDonell et al. 2013), thereby offering a differentiated approach from prior studies that typically examine these components independently.

3 Materials and Methods

This section describes the materials and methods used to investigate the factors affecting earthquake preparedness behaviors based on the PMT theoretical framework.

3.1 Research Design

This cross-sectional study used a quantitative methodology to examine the factors that affect individuals' decisions regarding the adoption of earthquake preparedness activities. A methodological research design was used to develop a measurement scale based on the 1983 model of the PMT. Methodological research designs are important in scale development studies as they focus on determining the psychometric properties of new instruments.

3.2 Participants and Sampling

The study universe consists of individuals aged 18 and over living in Antakya, the central city of Hatay, which has a high earthquake risk, according to the Earthquake Hazard Map of Türkiye (AFAD 2018). Antakya is located in the seismically active Eastern Mediterranean region, where the African, Arabian, and Eurasian tectonic plates converge, leading

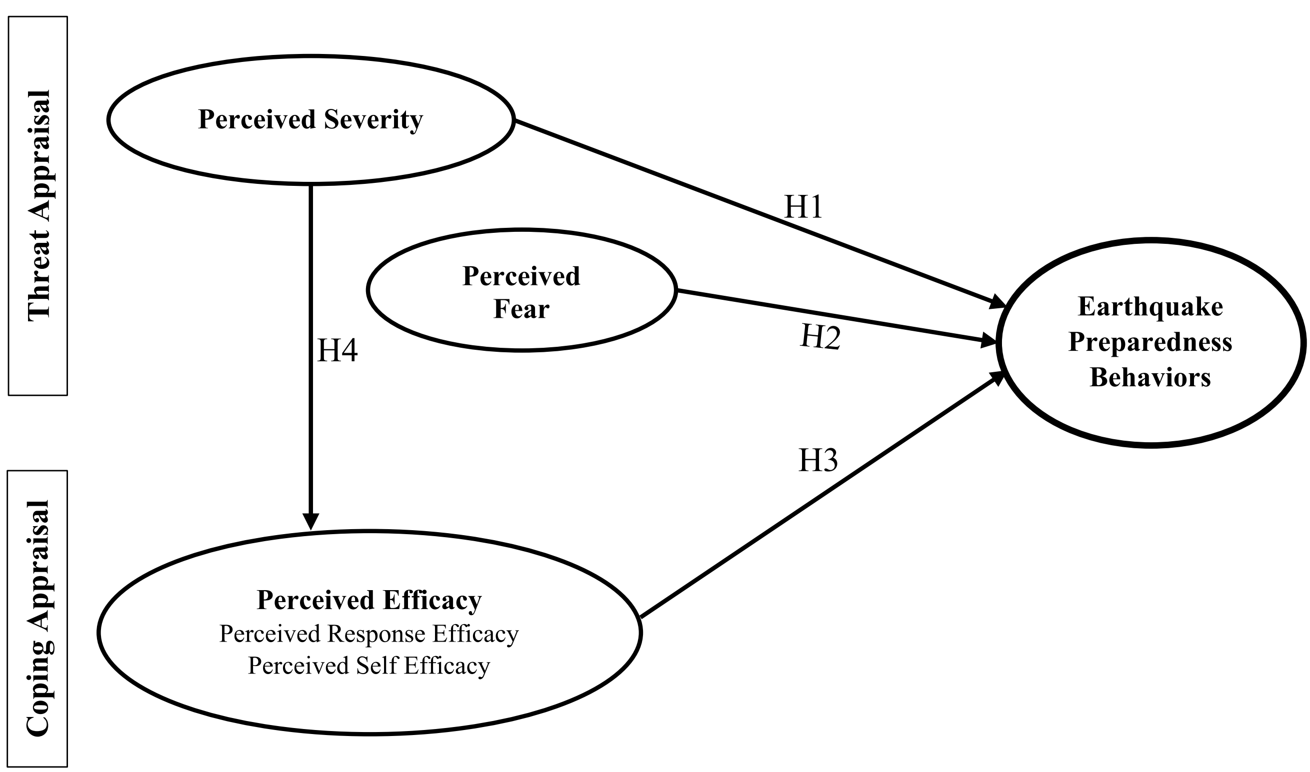

Fig. 1 Framework of this research

to medium- and large-scale earthquakes. This city, once a center of ancient civilization, has experienced destruction from earthquakes multiple times throughout its history (Över et al. 2010). This study selected samples using cluster sampling. In emergencies, public health field evaluations employ cluster random sampling. Researchers randomly cluster sample residential blocks or zip codes with the research population. Potential study subjects are clustered randomly. Study participants might be randomly selected from clusters or all cluster members (Stratton 2019).

We determined that at least 300 participants should be examined after a pilot application during scale development (Clark and Watson 1995). For factor analyses, 50–1,000 participants with a 1:3–1:20 item-response ratio are suitable. A parameter-sample ratio of 1:5–1:20 is also recommended. Pilot studies should include 15–30 participants (Gunawan, Marzilli and Aungsuroch 2021). Comrey and Lee (1992) recommended the following participant numbers for scale development studies: 50 is inferior, 100 is bad, 200 is reasonable, 300 is fair, 500 is very good, and 1,000 or more is outstanding. Clark and Watson (2016) advised 300 participants, whereas Mundfrom et al. (2005) advised 100–1000. Scale development pilot studies should evaluate at least 30 people, according to Johanson and Brooks (2010).

In this study, 50 participants were involved in the pilot application. Following the pilot phase, data were collected and analyzed from 804 participants residing in 11 neighborhoods selected through the cluster selection method during the main application. Data were collected between 12 December 2022 and 2 May 2023, via both face-to-face and online (Google Forms) surveys. Participation was voluntary and anonymous in both formats, and Google Forms was configured to prevent access to other participants' responses. The use of online surveys (186 out of 804) was due to the 6 February 2023 earthquakes—when discussing the study's findings, consider that some data were acquired online. Ethics committee permission was obtained from Hatay Mustafa Kemal University Social and Human Sciences Scientific Research and Publication Ethics Committee. Permission was also obtained from the Hatay Governorship to conduct the survey.

3.3 Data Collection Tools

This study's questionnaire has two sections: "Socio-demographic characteristics" and "Factors affecting earthquake preparedness behaviors Scale (FAEPBS)." Both were developed by the authors. Socio-demographic characteristics pertain to the attributes of the study participants, including gender, age, educational attainment, marital status, income level, employment status, neighborhood, duration of residence, housing situation (rent or lodging), prior earthquake experience, and earthquake-related damage.

The final FAEPBS, developed by the authors, consists of 24 items in four dimensions—perceived severity, perceived fear, perceived efficacy, and earthquake preparedness behaviors. The FAEPBS is a Likert-type 5-point scale (1 = Strongly Disagree, 5 = Strongly Agree). The scale development process was based on the scale development principles stated by DeVellis (2012). A literature research on PMT and earthquake preparedness behaviors informed the scale's items (Russell et al. 1995; Heller et al. 2005; Spittal et al. 2008; Becker et al. 2012; Ma et al. 2021). The draft scale initially included an item pool of 75 items. Content validity index (CVI) was evaluated with the Davis technique (Davis 1992), which allocates four points to experts—A: Inappropriate, B: Moderately acceptable, C: Acceptable with modest modifications, D: Highly suitable. This methodology endorses CVI over 0.80 (Davis 1992). The experts who evaluated the draft scale consist of public health, earthquake, marine geology and geophysics, trauma/disaster psychology, Earth physics, seismology, earthquake, disaster medicine, geophysical engineering, disaster management, and measurement/evaluation and linguistic experts. The CVI was developed based on the evaluations of 13 experts to ascertain whether any components of the draft scale should be eliminated owing to insufficient content validity. We calculated the draft scale item's CVI by dividing the sum of the expert judgments for "Very appropriate but minor changes should be made" and "Very appropriate" (corresponding to C and D in Davis (1992)) by 13. Content validity is sufficient when CVI surpasses 0.80. From the initial 75 items, recommendations for expert draft scale items were modified or eliminated if deemed unsuitable. These modifications were not based on author intent but on expert recommendations. The resulting draft scale has 59 items. After creating scale descriptions and instructions, a pilot application was run. The main application followed pilot data analysis, which resulted in the final scale. This final version has 24 items in four dimensions as described above.

3.4 Data Analysis

We used IBM SPSS Statistics 25 (SPSS Inc., Chicago, IL) and AMOS 24.0 to evaluate the data. After eliminating outliers, demographic factors and scale items of the 804 participants were analyzed. The item-total correlation method was used to analyze internal consistency. Initially, Kaiser-Meyer-Olkin (KMO) statistics was used to assess data appropriateness for factor analysis. In order to determine whether the items were eligible for structure analysis, we applied the Bartlett's sphericity test. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to verify the scale's construct validity. The CFA employed principal component analysis and Varimax rotation. The measurement model's fit was assessed using model fit indices. A separate sample was used for the CFA. To evaluate the convergent validity of the FAEPBS concept, we calculated the composite reliability (CR) and average variance extracted (AVE) values. Cronbach's alpha coefficient and Hotelling's T-square test were used to examine the scale's reliability and response bias.

4 Results

This section presents the outcomes from the FAEPBS analysis, based on established methodologies in the literature and evaluated for its psychometric qualities.

4.1 Demographic Profile

The pilot application revealed that 58.0% of the participants were female, 64.0% were married, and 58.0% earned 9000 TL[1] or more. Furthermore, 26.0% were aged 18–30, 68.0% were aged 31–50, and 12.0% were aged 51–64; 36.0% of the participants were homeowners; 86.0% of individuals reported having experienced an earthquake, while 94.0% stated that neither they nor their family had been harmed by the earthquake.

In the main application, 68.7% of the participants were male, with a significant overrepresentation of men in the sample compared to TÜİK (2025a) data, which indicates a 50.02% male and 49.98% female population in Türkiye as of 2024. Of the total sample, 92.4% was between the ages of 18 and 50, indicating a younger and more active population compared to the 68.3% share of the 15–64 age group in Türkiye (TÜİK 2025b). Regarding education, the sample had a high school education or higher education rate of 73.8%, while the higher education graduation rate in Türkiye was 7.1% for women and lower for men (TÜİK 2025a) The proportion of those with earthquake experience in the sample is quite high, at 71.5%; this is due to the high seismic risk in the region where the study was conducted (Över et al. 2010) (Table 1).

4.2 Construct Validity: Exploratory Factor Analysis (EFA)

The intial draft scale included 75 items, but expert comments and the content validity index reduced it to 59. The scale's factor structure was examined using EFA. Under the premise that factors are independent, varimax orthogonal rotation was used for principal component analysis. The EFA was repeated on the 59 items, removing those that loaded on multiple factors or had factor loadings below 0.40. Tabachnick and Fidell (2014) recommended ignoring factor loadings below 0.32. A factor loading criterion of 0.40 or above was used in this investigation. Valid factors have at least three significant pattern coefficients and theoretical relevance. The final factor analysis yielded 40 items in five components. However, the fifth component included only three items, and one had an item-total correlation <0.20. Therefore, this item was eliminated since CFA needs three items in a factor to assess model fit indices. This removed just two items from the fifth component, making goodness of fit difficult to judge; hence, the factor was removed from the scale (Fabrigar et al. 1999; Brown 2015; Kline 2016). The explained variance was calculated using a new EFA after elimination (Table 2). The final factor analysis yielded 34 items. The first component accounted for 27.685% of the variation, the second 11.267%, the third 6.654%, and the fourth 5.948%. Together they explained 51.554% of the entire variation, exceeding the 50% minimum recommended by Shrestha (2021).

Data fit for factor analysis was assessed using the Bartlett test of sphericity and the KMO test. The KMO test results of 0.905 show that the sample is suitable for this analysis. Kaiser (1974) defined KMO values below 0.5 as insufficient, between 0.5 and 0.7 moderate, between 0.7 and 0.8 fair, between 0.8 and 0.9 excellent, and beyond 0.9 exceptional. We recommend factor analysis with our KMO value of 0.905. Also, Bartlett's test of sphericity (Bartlett 1954) confirmed that the correlation matrix was not random. A statistically substantial chi-square value is needed to validate EFA (Watkins 2018). A Bartlett's test showed strong correlations between variables ($\chi 2 = 6{,}999.391$, df = 561, $p = 0.001$; $p < 0.05$). Thus, the correlation matrix is acceptable for factor analysis, suggesting that this data set is suitable.

4.3 Construct Validity: Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis was used to verify the EFA structure. The CFA included 34 FAEPBS components. This research used confirmatory factor analysis dimensions to do a first-level multifactor analysis. Model fit indices showed a satisfactory fit after first-level multifactor CFA. However, three items with factor loadings <0.60 were eliminated and the analyses revised. Below this level, factor loadings may be poor markers of the latent concept and impair construct validity (Hair et al. 2010; Tabachnick and Fidell 2013).

Standardized residual covariances, like modification indices, show mismatch between observed and model-implied covariances. Thus, removing items with high standardized residuals improves model fit (Kline 2016; Collier 2020). After model respecification, standardized residual covariances were assessed, and seven items were deleted. After these revisions, model fit indices were

[1] USD 1 = 41,45 TL.

Table 1 Demographic and socioeconomic characteristics of the survey participants for the main application

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	552	68.7
	Female	252	31.3
Age	18–30	418	52.0
	31–50	325	40.4
	51–64	46	5.7
	65 and above	15	1.9
Education level	Primary Education	189	23.5
	High School	257	32.0
	Associate Degree	175	21.8
	Bachelor's Degree	161	20.0
	Postgraduate	22	2.7
Marital status	Married	476	59.2
	Single	328	40.8
Income level (TL)	0–5,999	485	60.3
	6,000–10,999	155	19.3
	11,000–15,999	89	11.1
	16,000–20,999	62	7.7
	21,000 and above	13	1.6
Occupation	Public Officer	86	10.7
	Worker	109	13.6
	Self-Employed	45	5.6
	Retired	25	3.1
	Housewife	228	28.4
	Unemployed	131	16.3
	Student	149	18.5
	Private Sector	31	3.9
Neighborhood of residence	Akevler	128	15.9
	Akhisar	59	7.3
	Alahan	36	4.5
	Cebrail	54	6.7
	Derince	52	6.5
	Emek	90	11.2
	Haraparası	56	7.0
	Kanatlı	43	5.3
	Meydan	88	10.9
	Serinyol	122	15.2
	Ürgenpaşa	76	9.5
Duration of residence in the city	Less than 1 year	34	4.2
	1–5 years	91	11.3
	6–10 years	71	8.8
	11 years or More	608	75.6
Type of housing	Rental	281	35.0
	Owned	425	52.9
	Government Housing	12	1.5
	Belonging to a Relative	86	10.7
Have you experienced an earthquake before?	Yes	575	71.5
	No	229	28.5
Have you or any of your family members been affected by an earthquake before?	Yes	177	22.0
	No	627	78.0

Table 2 Exploratory factor analysis results

Item (I)	Factors 1 Earthquake preparedness behaviors	2 Perceived fear	3 Perceived efficacy	4 Perceived severity	Eigenvalue	Explained variance (%)
I30	0.792				9.413	27.685
I36	0.788					
I28	0.769					
I31	0.763					
I29	0.760					
I38	0.718					
I25	0.714					
I32	0.710					
I40	0.708					
I39	0.704					
I37	0.662					
I33	0.657					
I35	0.602					
I27	0.591					
I34	0.568					
I27	0.444					
I22		0.793			3.381	11.267
I20		0.762				
I23		0.762				
I19		0.682				
I21		0.649				
I9			0.746		2.262	6.654
I10			0.740			
I11			0.672			
I14			0.602			
I8			0.578			
I15			0.456			
I12			0.434			
I13			0.424			
I2				0.766	2.022	5.948
I3				0.746		
I5				0.682		
I4				0.649		
I1				0.641		
Cumulative Variance (%):						51.554
KMO value:						0.898
Bartlett's test of Sphericity Chi-Square value:						6999.391
Degrees of freedom (df):						561

satisfactory. This research used latent variable path analysis. In these models, structural equation modeling (SEM) analysis includes latent variables and observable variables (measurement model) (Gürbüz 2019). To determine causal links between variables, the structural model was evaluated after confirming the measurement model. The structural model fit index results were typically satisfactory.

The assessment of data distribution normality involved the examination of skewness and kurtosis (Kline 2005). A variable exhibiting an absolute skew-index value exceeding 3.0 is classified as extremely skewed, whereas a kurtosis index surpassing 8.0 indicates extreme kurtosis (Kline 2005). Hair et al. (2010) and Byrne (2010) contended that data are considered of normal distribution if skewness ranges from − 2 to +2 and kurtosis ranges from − 7 to + 7. Skewness scores for all items range from − 2 to 0, indicating that all variables fit the normal distribution assumption. All objects have kurtosis values between − 7 and + 7. Item 1 has the greatest kurtosis (6.10), which is within Hair et al. (2010) and Byrne (2010) bounds. Kurtosis-wise, all objects fit normal distribution.

The results in Fig. 2 show the four sub-dimensions' model of the 24-item instrument. The model shows good fit (χ^2 = 474.110, df = 241, RMSEA = 0.049, CFI = 0.950, TLI = 0.943, NFI = 0.905) (Hu and Bentler 1999). Perceived efficacy had a significant positive effect on earthquake preparedness behaviors (β = 0.694, $p < 0.001$, 95% confidence intervals [0.611, 0.771]), explaining 46.2% of the variance in earthquake preparedness behaviors. In contrast, perceived severity and perceived fear did not have significant direct effects on preparedness ($p > 0.05$). Each item was highly correlated with its sub-construct, and the model coefficients ranged from 0.60 to 0.86.

Composite reliability (CR) and average variance extracted (AVE) values were calculated for model latent variable reliability and validity. The AVE score for perceived severity was 0.385, below 0.50, while the CR value was 0.714, which is acceptable. The relevant structure may have limited explanatory power. In perceived efficacy (PE), the CR was good at 0.791 while the AVE was poor at 0.432. Both structures have AVE values below 0.50, whereas CR values above 0.70 indicate internal consistency (Fornell and Larcker 1981). Perceived Fear (PF) and Earthquake Preparedness Behaviors (EPB) variables fulfill composite reliability and AVE standards. The PF had 0.861 CR and 0.554 AVE; EPB had 0.927 CR and 0.561 AVE. These results suggest substantial internal consistency of key structures and latent variable capacity to explain observed variable variance (Fornell and Larcker 1981).

4.4 Constructing the Final Scale

The final FAEPBS and descriptive statistics for each item are presented in Table 3.

4.5 Hypothesis Testing

Hypothesis testing was conducted using structural equation modeling. The results of the hypothesis testing are presented in Table 4.

4.5.1 H1: Perceived Severity Positively Influences Earthquake Preparedness Behaviors (Rejected)

The rejection of this hypothesis shows that people' comprehension or recognition of the possible severity of an earthquake does not inherently lead to enhanced preparing actions. This result implies that just awareness of risk severity may be inadequate as a catalyst for action; other elements, including knowledge, resources, and support networks, might have more influence.

4.5.2 H2: Perceived Fear Positively Influences Earthquake Preparedness Behaviors (Rejected)

The rejection of the second hypothesis suggests that intensified sensations of fear, while representing an emotional reaction to the perceived threat, are not associated with heightened preparedness activities.

4.5.3 H3: Perceived efficacy positively influences earthquake preparedness behaviors (Accepted)

The acceptance of this hypothesis emphasizes the essential function of perceived efficacy as a motivational trigger for preparedness activities. Individuals confident in their capacity to execute preparedness measures are more inclined to undertake proactive planning and reaction activities. This finding corresponds with existing research on self-efficacy and its impact on behavioral modification, indicating that bolstering people' confidence in their earthquake preparedness capabilities may result in heightened participation in preparedness initiatives.

4.5.4 H4: Perceived Severity Positively Impacts Perceived Efficacy (Accepted)

The acceptance of this hypothesis suggests that an individual's awareness of the severity of earthquake risks is positively correlated with their belief in their capacity to take effective action. This relationship indicates that when individuals recognize a substantial threat, it can drive them to pursue knowledge and resources that improve their coping skills and preparedness abilities.

4.6 Internal Validity

Distinctability and homogeneity were assessed for item analysis. Each item was compared between the top 27% and bottom 27% using two independent sample t-tests (Mao et al. 2021). The independent sample t-test was used to assess the mean of the overall scale scores for the lower 27% and higher 27% groups to support the scale's validity. The lower 27% and higher 27% groups had significantly different mean scores. Thus, the scale shows item distinguishability.

4.7 Reliability

The factor for earthquake preparedness behaviors has a 0.920 Cronbach alpha, suggesting high dependability. The

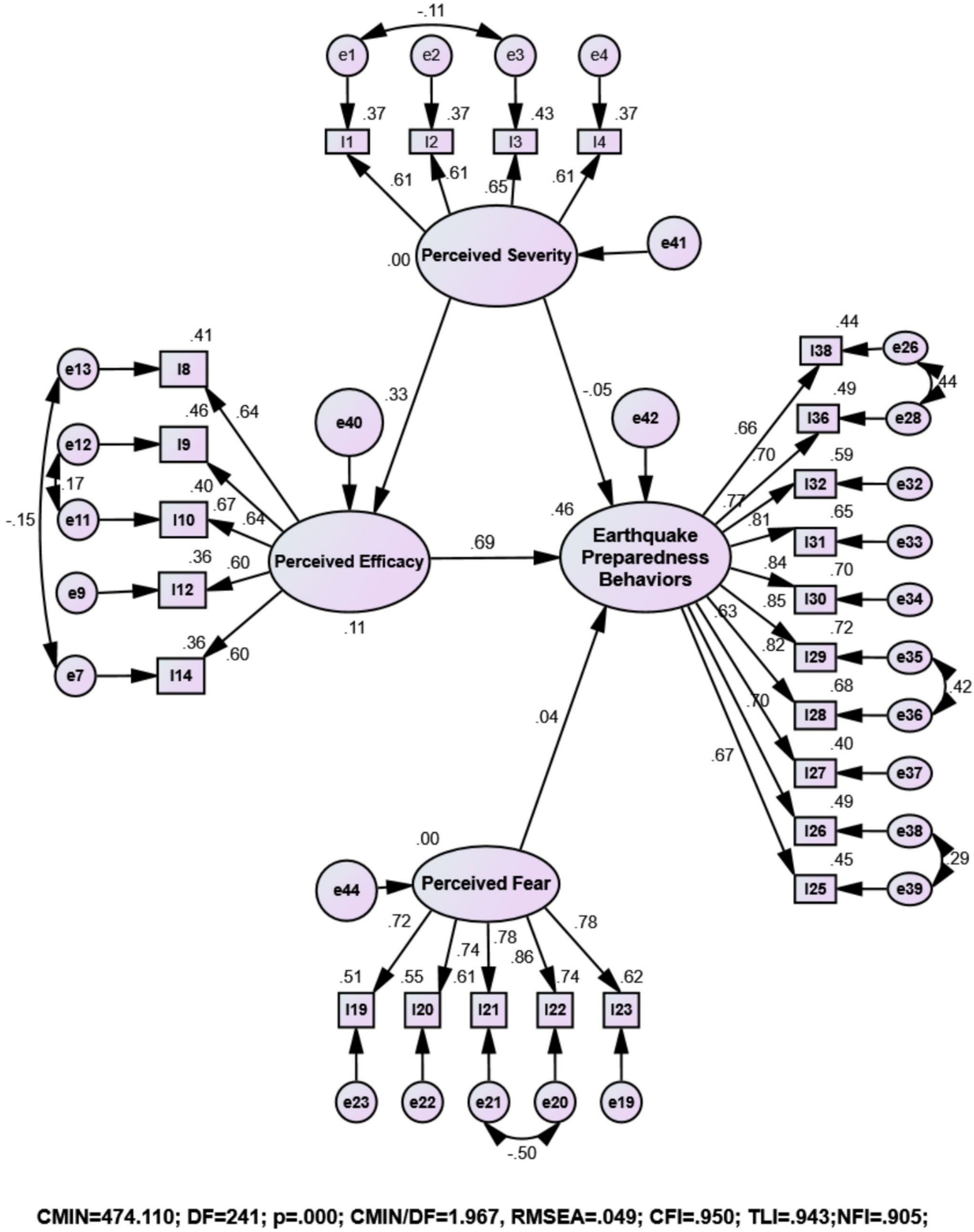

Fig. 2 Structural equation model. TLI: Tucker-Lewis index, NFI: Normed fit index, CFI: Comparative fit index, RMSEA: Root mean square error of approximation, CMIN/DF: Minimum discrepancy function by degrees of freedom divided, I: Item, e: Error terms.

Table 3 Items of the final factors affecting earthquake preparedness behaviors scale (FAEPBS) and descriptive statistics

Dimension	Item		Mean	Standard deviation	Min. value	Max. value
Perceived severity	I1	I think my daily life will be negatively affected by the earthquake.	4.36	0.92	1	5
	I2	The house I live in may be damaged due to an earthquake.	4.14	1.00	1	5
	I3	I think my body may be damaged due to the earthquake.	3.95	0.98	1	5
	I4	I may have difficulty breathing due to the dust spreading from the collapsed building during an earthquake.	4.24	0.85	1	5
Perceived efficacy	I8	I can do the drop-cover-hold protective behavior during an earthquake.	3.84	1.03	1	5
	I9	I can evacuate myself safely after the shaking stops.	4.05	0.88	1	5
	I10	I can support the elderly, children and disabled in case of need after an earthquake.	4.17	0.87	1	5
	I12	I can secure items that may risk falling in an earthquake in advance.	3.62	1.12	1	5
	I14	I believe that my disaster and emergency kit can meet my basic needs for the first 72 hours after an earthquake.	3.76	0.94	1	5
Perceived fear	I19	I am afraid of being caught unprepared by an earthquake.	4.48	0.75	1	5
	I20	I fear losing my life in a devastating earthquake.	4.40	0.85	1	5
	I21	I fear losing my family and loved ones in a devastating earthquake.	4.68	0.56	1	5
	I22	I fear getting injured due to an earthquake.	4.41	0.78	1	5
	I23	I fear being trapped under debris/rubble in an earthquake.	4.59	0.69	1	5
Earthquake preparedness behaviors	I25	I prepare a family disaster and emergency plan for the first 72 hours after an earthquake.	3.57	1.02	1	5
	I26	I determine how to communicate with family members during an earthquake.	3.84	0.91	1	5
	I27	I learn basic first aid information.	4.11	0.78	1	5
	I28	In an emergency, I store enough high-calorie, dehydration-preventing and durable foods for each family member.	3.70	1.04	1	5
	I29	I store enough water for each family member in an emergency.	3.73	1.03	1	5
	I30	I prepare or keep a disaster and emergency bag ready.	3.73	1.02	1	5
	I31	I take the necessary precautions to have the items I regularly use (medications, medical devices, prescription glasses, hearing aids) in case of an evacuation.	3.82	0.99	1	5
	I32	I take the necessary precautions regarding the structural elements damaged in the house/building I live in.	3.81	0.96	1	5
	I36	I secure my furniture that may fall and topple over in an earthquake using earthquake-resistant techniques.	3.83	1.00	1	5
	I38	I secure white goods like refrigerators that may tip over or slide during an earthquake.	3.75	0.03	1	5

Table 4 Results of hypothesis testing using structural equation modeling

Hypothesis	Hypothesis path	Coeffient	SE	CR	P	Result
H1	EPB <--- PS	− 0.052	0.076	− 0.925	0.355	Rejected
H2	EPB <--- PF	0.043	0.060	0.976	0.329	Rejected
H3	EPB <--- PE	0.694	0.086	8.628	***	Accepted
H4	PE <--- PS	0.333	0.094	4.425	***	Accepted

SE Standard error, *CR* Critical ratio, ****P* <0.01, *PS* Perceived severity, *PE* Perceived efficacy, *PF* Perceived fear, *EPB* Earthquake preparedness behaviors.

final FAEPBS and Cronbach alpha values for perceived severity, efficacy, and fear were 0.7 to 0.9. The value shows strong dependability, per George and Mallery (2003). For the final scale, the Spearman-Brown coefficient was 0.84 and the Guttmann Split coefficient was 0.93. These coefficients are satisfactory for each component and the scale, indicating excellent internal dependability.

5 Discussion

This study aimed to develop and evaluate the validity and reliability of a theory-based scale—the FAEPBS—that uses the constructs of the PMT as a framework to measure the factors that influence earthquake preparedness behaviors. The hypothesis that perceived severity boosts earthquake preparedness behaviors has been disputed in various contexts. The analysis indicated that perceived severity did not have a direct positive influence on earthquake preparedness behaviors. This finding aligns with studies suggesting that although perceived severity raises awareness of the potential consequences of earthquakes, it does not necessarily trigger preparedness actions on its own (Mulilis and Lippa 1990; Habibi and Feld 2020). Spittal (2003) highlighted that while understanding risk is critical, it is often the degree of personal efficacy perceived by individuals that ultimately steers their capacity to prepare. Numerous research indicated that persons who see disaster as very severe are more inclined to participate in disaster preparedness behaviors (Ong et al. 2021; Gumasing and Sobrevilla 2023; Kurata et al. 2023). A positive attitude about earthquake preparedness influences preparedness intentions and is associated to perceived severity (Vrselja et al. 2022). This inconsistency in the literature underscores the need for integrated models that consider cognitive, emotional, and efficacy-related variables together.

The second hypothesis regarding perceived fear's positive influence on preparedness behaviors has also been challenged. Similarly, perceived fear did not significantly predict preparedness behaviors in this study. For instance, the PMT asserts that while fear may heighten awareness of a threat, it can also overwhelm individuals, leading to avoidance or denial rather than preparedness (Mulilis and Lippa 1990; Welton-Mitchell et al. 2018). Individuals often perceive threats but do not feel adequately equipped or believe that their actions will make a difference, which can dampen any potentially motivating effects of fear (Lovekamp and Tate 2008). Individuals experiencing earthquakes often have elevated fear levels about their risk, prompting more proactive preparedness activities (Gün Çınğı and Yazgan 2022). Goltz et al. (2020) suggested that fear can drive individuals to take necessary actions both before and during an earthquake. In this perspective, several studies indicate that perceived fear improves preparedness for disasters. According to other research, perceived fear alone does not motivate disaster-reduction efforts (Wachinger et al. 2012). The result of this research that perceived fear did not affect earthquake preparedness activities suggests that emotional variables alone are not enough. This result contributes to ongoing debates about the role of emotional factors in disaster preparedness.

Hypothesis three, which asserts that perceived efficacy positively affects earthquake preparedness behaviors, has been accepted. This claim is well substantiated in the literature (Keshavarz and Karami 2016; McCaughey et al. 2017; Tang and Feng 2018; Botzen et al. 2019; Rostami-Moez et al. 2020; Kurata et al. 2022; Tasantab, Gajendran and Maund 2022). Effective training and instruction increase individuals' confidence in their self-efficacy, resulting in improved preparedness behaviors (Becker et al. 2013; Rostami-Moez et al. 2020). Individuals who perceive their ability to adequately prepare for disasters are more inclined to undertake proactive measures (Heller et al. 2005; Fatehpanah et al. 2025). Research indicates that augmented knowledge and abilities foster a heightened feeling of self-efficacy, hence increasing the probability of undertaking preparedness measures in crises (Welton-Mitchell et al. 2018; Habibi and Feld 2020). This result reinforces the PMT framework's assertion that efficacy beliefs are a central determinant of protective behaviors.

Hypothesis four asserts that perceived severity positively influences perceived efficacy, which has been confirmed. The idea that acknowledging the potential severity of a danger might foster confidence in the efficacy of one's activities is substantiated. When people recognize the gravity of an earthquake hazard, they are more inclined to see preparedness measures as essential and to have confidence in their capacity to execute these measures effectively (Spittal 2003; Soffer et al. 2011). Individuals residing in regions with significant historical seismic activity often exhibit increased awareness of earthquake hazards, leading to proactive improvements in their preparedness strategies (Lindell and Whitney 2000; Oral et al. 2015). This supports the idea that perceived severity can indirectly foster preparedness behaviors by strengthening efficacy beliefs.

For practitioners in disaster risk reduction, the findings suggest that communication strategies should go beyond emphasizing the severity of earthquakes or invoking fear. Instead, interventions should prioritize enhancing individuals' self-efficacy and response efficacy through skill-based training, accessible preparedness resources, and community-based drills.

6 Limitations and Future Research Areas

The data collection was hampered by the 6 February 2023 earthquakes in Türkiye, making it difficult to reach the target population. A Google Forms online survey was conducted alongside the face-to-face survey. Some individuals have no smartphone or Internet access to take part in the poll and following the earthquake, more individuals may have experienced similar circumstances. Our results are unique to the sample and cannot be generalized to the Turkish population. The existing findings may not be applicable to other areas or countries; hence, the suggested scale may need adaptation for usage in other contexts prior to further validation in those settings. This study also did not directly measure financial capability, so future research should examine it to provide a more comprehensive understanding of preparedness actions.

Notwithstanding these limitations, this work represents a significant first effort to discover and evaluate particular protective characteristics that enhance individual earthquake preparedness. In addition, our findings show that motivational factors shape preparedness behaviors. Therefore, future researchers can employ SCT in combination with PMT and TTM to build a more comprehensive framework. By integrating these theories, researchers may gain deeper insights into how social learning, observational modeling, environmental influences, and motivational processes shape disaster preparedness within community and family contexts.

7 Conclusion

This study developed the factors affecting earthquake preparedness behaviors scale (FAEPBS) based on the protection motivation theory (PMT) model, helping to identify which PMT components influence earthquake preparedness behaviors. In this sense, this study is the first to develop a tool based on PMT to predict individuals' participation in earthquake preparedness behaviors in Türkiye.

The results of this study show that the theory-based FAEPBS scale is a valid and reliable scale to evaluate the factors that affect people's earthquake preparedness behaviors. Regarding the coping assessment variables included in the structure of the PMT, it was determined that perceived efficacy was the most important factor for individuals in earthquake preparedness behaviors.

Beyond statistical validation, the study highlighted the role of perceived efficacy in disaster preparedness. Future research should investigate educational interventions that enhance self-efficacy and response efficacy to strengthen preparedness behaviors and community resilience to earthquakes.

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