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Earthquake preparedness in female students: differential contributions of multidimensional seismic risk perception and psychological resilience

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Introduction: Earthquake preparedness is a multidimensional construct associated with seismic risk perceptions and individual psychological resources. This study examined the independent associations and incremental explanatory contributions of multidimensional seismic risk perception and psychological resilience to self-reported disaster preparedness.

Methods: A cross-sectional study was conducted among 406 female psychology students aged 19–24 years ($M = 20.86$, SD $= 1.75$). Psychological resilience was assessed using the Brief Resilience Scale, seismic risk perception using the Seismic Risk Perception Questionnaire, and disaster preparedness using a researcher-developed 20-item Disaster Preparedness Questionnaire (DPQ). Exploratory factor analysis examined the DPQ structure, while hierarchical regression and exploratory multivariate analyses assessed associations between the study variables.

Results: Exploratory factor analysis provided only partial support for the proposed five-domain DPQ structure. Hierarchical regression analyses showed that seismic risk perception dimensions explained an additional 23.8 percentage points of variance in overall preparedness after controlling for psychological resilience, whereas resilience explained an additional 3.3 percentage points after controlling for risk perception. The final model explained 27.9% of the variance. Earthquake phenomenon ($\beta = 0.329$), Hazard ($\beta = 0.221$), Vulnerability ($\beta = 0.107$), and psychological resilience ($\beta = 0.183$) showed statistically significant independent associations with preparedness. Exploratory multivariate analyses suggested differentiated associations across conceptually defined preparedness domains.

Discussion: Seismic risk perception and psychological resilience showed distinct statistical associations with self-reported disaster preparedness, highlighting the relevance of considering both risk-related appraisals and individual psychological resources. However, the cross-sectional design precludes causal inference, and the DPQ requires further psychometric validation.

KEYWORDS
disaster preparedness, earthquake preparedness, protective behavior, psychological resilience, risk perception, seismic risk perception, university students

1 Introduction

Disaster preparedness is not a unitary behavior, but a multidimensional process that can include the accumulation of material resources, planning and evacuation, knowledge of safety measures, perceived response capacity, and psychological readiness for action. In the earthquake literature, Becker et al. (2024) distinguish between survival-oriented forms of preparedness, structural measures, emergency planning, and community preparedness, showing that the factors involved may vary depending on the behavior analyzed. The distinction between perceived and actual preparedness is also relevant, because the subjective feeling of being prepared does not always coincide with the existence of concrete preparedness resources and behaviors (Brown et al., 2024). Research that has examined disaster preparedness through multidimensional models or at the level of distinct components indicates, convergently, that the determinants of preparedness do not operate uniformly and may depend on economic resources, housing conditions, cognitive, behavioral and social barriers, or the initial level of preparedness (Nkouaga, 2025; Rahman et al., 2024; Rezabeigi Davarani et al., 2022).

Risk perception is the subjective assessment of threats and their consequences and should not be equated with protective behavior *per se* (Slovic, 2000). Data obtained in university populations support the existence of a relationship between risk perception and preparedness: among students, disaster risk perception was positively associated with both the general level of preparedness and some specific components, such as physical protection, planning and warning preparedness, and participants who had received disaster training showed higher levels of both constructs (Kalin and Yeşilyurt, 2025). Similarly, among nursing students, participation in training was associated with higher levels of earthquake awareness and preparedness, and previous disaster experience was associated with higher scores on the exposure dimension of risk perception (Kolaç et al., 2025).

However, heightened risk perception does not automatically translate into preparedness behavior. More generally, the Theory of Planned Behavior distinguishes between appraisals and intentions that precede action and actual behavior, the latter being explained by processes that include both intention and perceived behavioral control (Ajzen, 1991). In a European sample, the relationships between risk perception and attitudes toward preparedness were reduced (Cuesta et al., 2022), and Savadori et al. (2022) experimentally demonstrated that improving participants' sensitivity to differences in seismic probabilities did not systematically increase the number of intended protective behaviors. A similar gap was recently identified in Türkiye: although 93.1% of respondents perceived the existence of local seismic risk, only 19.3% considered themselves sufficiently prepared (Sahin et al., 2026). Also, Pereira et al. (2024) showed that actual household adjustments to earthquakes are associated with multiple appraisals of the event, personal resources, and responsibility, supporting a more complex process than a direct relationship between risk perception and preparedness behavior.

This discrepancy can be understood by differentiating between threat appraisal and coping capacity. Social-cognitive models applied to risk reduction include, in addition to hazard and vulnerability appraisal, mechanisms such as self-efficacy, response efficacy, resources, and perceived barriers (Ahmadi and Costa, 2025). Among foreign residents of the Tokyo metropolitan area, Adu-Gyamfi and Shaw (2022) identified a pattern of high threat perception but considerably lower perceived efficacy, indicating that awareness and perceived response capacity are distinct processes. In another hazard context, Mahittikul et al. (2024) found that both threat appraisal and coping appraisal predicted tsunami evacuation intention, and intention was associated with evacuation action selection. Converging evidence on the importance of efficacy assessment also comes from other risk contexts, where response efficacy was associated with adopting protective actions (Maghelal et al., 2025). In addition, Zhang et al. (2022), who studied individuals from areas affected by the Wenchuan and Lushan earthquakes, found that government and emotional trust are associated with perceived efficacy and self-efficacy. However, their study assessed perceived efficacy, not actual preparedness behavior, an important distinction for interpreting the relationships between psychological resources and disaster preparedness.

Preparedness is also influenced by how people acquire, interpret, and communicate risk information. In areas affected by the Wenchuan earthquake, cumulative experience of secondary hazards, access to information, risk communication, and participation in prevention exercises were associated with differences in risk perception (Huang et al., 2022). Research on early warning systems also shows that protective response depends not only on technical information but also on risk knowledge, perceived efficacy, confidence, and the ability to execute recommended actions (Bostrom et al., 2022; McBride et al., 2022). In educational contexts, institutional sources of information have been associated with knowledge about risk reduction (Ghale et al., 2025), and participation in an interactive exhibition about earthquakes has been followed by increased knowledge, vulnerability awareness, and self-perceived preparedness of students (Subedi et al., 2026). However, the effects of information and experience are not uniform: previous experience of a hazard can selectively contribute to certain forms of preparedness (Duan et al., 2025), and the characteristics of the communication source can differentiate protective responses depending on the specific type of behavior requested (Hyman et al., 2022).

Further evidence from university populations highlights the relevance of earthquake-related knowledge to psychological responses following seismic events. Atilgan and Öztürk (2025), in a study of 434 sports sciences students from earthquake-affected provinces in Türkiye, examined the relationship between earthquake knowledge and post-earthquake trauma. Their findings indicated statistically significant associations between dimensions of earthquake knowledge and specific post-earthquake trauma responses, including emotional, cognitive, behavioral, and sleep-related difficulties. Although their study focused on post-disaster trauma rather than preparedness behaviors, it illustrates the relevance of examining earthquake-related knowledge alongside psychological responses. This distinction is important for the present study, which considers disaster knowledge and psychological preparedness as conceptually separate components of overall preparedness.

At the contextual level, disaster preparedness is also associated with the social, community, and socioeconomic environment in which a person must translate risk assessment into action. Community participation and communication were consistent predictors of household preparedness in seismic areas, although the magnitude of the effects varied by level of preparedness (Nkouaga, 2025), and community education and cooperation between the population, institutions, and organizations were associated with greater disaster adaptation and management capacity (Lin and Lee, 2023). Residential environment characteristics have also been associated with preparedness behaviors (Lee, 2026). Beyond the seismic context, studies on floods show that certain components of preparedness vary with socioeconomic and housing conditions (Rahman et al., 2024), and research on occupational risk highlights a possible gap between hazard awareness and the adoption of protective behaviors (Mastrantonio et al., 2025). These findings from other risk domains are relevant as converging evidence that perceived danger is only one condition in the protective response, not a guarantee of action.

In this context, psychological resilience may represent a relevant individual resource for preparation. The psychological literature has operationalized resilience from different perspectives. Connor and Davidson (2003) approached resilience as a capacity associated with adaptation and stress management, developing the Connor–Davidson Resilience Scale to assess a broader construct. In the present study, resilience is defined more specifically, following the conceptualization of the Brief Resilience Scale, as a person's ability to return after stress or adversity (bounce back), distinct from broader conceptualizations that also include coping strategies and other adaptive resources (Smith et al., 2008). Recent, directly relevant evidence comes from Geylani and Göral (2026), who used the BRS in a sample of psychiatric nurses and found a positive predictive association between psychological resilience and disaster preparedness ($\beta = 0.272$, $p = 0.001$), with resilience explaining 6.7% of the variance. These results indicate a significant but modest contribution, supporting examination of post-stress recovery capacity alongside, not as a substitute for, specific risk assessments (Geylani and Göral, 2026).

Additional evidence concerning psychological resilience in earthquake-related contexts was reported by Uzun and Atilgan (2026), who examined associations between post-earthquake trauma and resilience among 479 teachers in Kahramanmaraş, Türkiye. Using the Brief Resilience Scale, the authors identified significant negative correlations between psychological resilience and the assessed dimensions of post-earthquake trauma. Their structural regression analysis further indicated that emotional restriction was the only trauma dimension showing a statistically significant association with resilience after the other trauma dimensions were considered. Although this study addressed psychological responses following earthquake exposure rather than anticipatory preparedness, it reinforces the relevance of investigating resilience as a distinct psychological construct in seismic contexts. The present research extends this line of inquiry by examining the statistical association between bounce-back resilience and self-reported disaster preparedness among female university students.

The literature indicates that risk perception, perceived efficacy, experience, information, contextual characteristics, and psychological resources can contribute to disaster preparedness, but their importance varies depending on the population and behavior analyzed. Recent research has begun to simultaneously examine psychological factors and risk perception in explaining earthquake preparedness. In a sample of 447 university students in Nepal, Atalyan et al. (2026) found that psychological preparedness positively predicted preparedness behaviors and explained an additional proportion of the variance after including risk perception, while risk perception did not make a statistically significant contribution in the final model. In their study, psychological preparedness included processes such as emotional regulation, coping capacity, and confidence in response ability, and risk perception was assessed as a distinct construct, relating to the perceived probability and consequences of the earthquake (Atalyan et al., 2026). Consequently, it remains relevant to examine the contribution of a more specifically defined psychological resource—bounce-back resilience—alongside a multidimensional conceptualization of seismic risk perception and preparedness, both globally and through its specific components.

Gender represents a relevant contextual consideration in disaster risk perception and preparedness, as previous research has identified differences in perceived vulnerability, risk-related concerns, and protective responses. Dooley et al. (1992) examined gender-related differences in earthquake preparedness and risk concerns, while Pérez-Gañán et al. (2023), in a systematic review, highlighted the relevance of gender-related social roles, access to resources, and participation in decision-making for women's responses to disasters. Nevertheless, these findings do not establish uniform gender differences across populations or preparedness domains. Against this background, the present study deliberately focused on female university students, taking into account the demographic composition of the Faculty of Psychology and Educational Sciences, where women represent more than 90% of the student population. Within this predefined target population, participants were recruited through non-probabilistic convenience sampling. This approach enabled the examination of associations between multidimensional seismic risk perception, psychological resilience, and disaster preparedness within a specific educational context. However, the study was not designed to investigate gender differences, and its findings should be interpreted in relation to the characteristics of the investigated population, without assuming generalizability to male students or other demographic groups.

The research hypotheses were formulated to examine the associations between seismic risk perception, psychological resilience, and disaster preparedness within this predefined female student population. The focus on female students therefore defined the population to which the proposed statistical relationships were applied, rather than representing a hypothesis that gender itself would influence these associations. Consequently, the study was not designed to establish gender-specific effects or differences between female and male students.

The objective of this study is to examine the independent and incremental contributions of multidimensional seismic risk perception and psychological resilience to disaster preparedness in a sample of female university students. In addition to general

preparedness, the study aims to examine whether the dimensions of seismic risk perception show distinct patterns of association with material and logistical preparedness, evacuation planning and strategies, disaster knowledge and information, perceived response capacity, and psychological and attitudinal preparedness. Given the cross-sectional and observational design of the research, the term predictive used hereafter refers to statistical prediction and does not imply causal relationships.

H1: After controlling for psychological resilience, the dimensions of seismic risk perception will explain a significant additional proportion of the variance in general disaster preparedness.

H2: Psychological resilience will have a positive and incremental predictive contribution to explaining general disaster preparedness, after controlling for the dimensions of seismic risk perception.

RQ1: Which dimensions of seismic risk perception present statistically independent contributions to general disaster preparedness, after controlling for psychological resilience and the other dimensions of seismic risk perception?

RQ2: What patterns of association do the dimensions of seismic risk perception show in relation to specific components of disaster preparedness, after controlling for psychological resilience?

2 Materials and methods

2.1 Research design

The study employed a quantitative, observational, and cross-sectional design to examine the statistical associations between multidimensional seismic risk perception, psychological resilience, and disaster preparedness. Hierarchical regression analyses were used to estimate the incremental explanatory value of seismic risk perception and psychological resilience in relation to overall disaster preparedness, while multivariate analyses examined patterns of association across specific preparedness components. Because all variables were measured at the same time, the analyses support statistical prediction and the estimation of explained variance, but do not establish temporal precedence, causal relationships, or the effectiveness of interventions.

2.2 Samples

The final sample included 406 female psychology students aged 19–24 years ($M = 20.86$, SD = 1.75), recruited through non-probabilistic convenience sampling at the Faculty of Psychology and Educational Sciences, Ovidius University of Constanta, Romania. The study deliberately focused on female students, reflecting the predominantly female composition of the faculty's student population, in which women account for more than 90% of enrolled students. Within this predefined target population, participants were recruited based on accessibility and voluntary participation. This sampling strategy allowed the examination of the proposed associations within the population of interest, although it limits the generalizability of the findings beyond the investigated sample.

Gender was not included as a covariate in the statistical analyses because the study was intentionally restricted to female students, resulting in no gender variability within the sample. Accordingly, the research hypotheses focused on associations between seismic risk perception, psychological resilience, and disaster preparedness within this predefined population, rather than on gender-related differences. The findings therefore cannot establish whether the observed associations would be similar among male students or in gender-diverse university populations.

The inclusion criteria were: (a) female student status within the Faculty of Psychology and Educational Sciences, (b) age between 19 and 24 years, (c) ability to understand and independently complete the research instruments, and (d) provision of informed consent for participation.

2.3 Instruments

The instruments used in this study were selected to assess the three central constructs of the analytical model: psychological resilience, disaster preparedness, and multidimensional perception of seismic risk. The analyses tracked both the overall level of disaster preparedness and its specific components, as well as the differential contributions of the dimensions of seismic risk perception.

2.3.1 Psychological resilience

Psychological resilience was assessed using the Brief Resilience Scale (BRS; Smith et al., 2008), a six-item unidimensional instrument designed to assess the ability to bounce back from stressful or adverse experiences. The BRS specifically assesses the functional capacity to recover from stress, distinct from broader conceptualizations of resilience that include personal resources, coping strategies, or adaptive characteristics.

Items are rated on a 5-point Likert scale. Items 2, 4, and 6 are negatively worded and were reverse-coded before calculating the composite score, so higher values indicate greater post-stress recovery capacity. In the present study, after reverse-recoding items 2, 4, and 6, the BRS score was calculated by summing the six items, resulting in a theoretical range between six and 30. The summative score is equivalent, by linear transformation, to the mean score of the scale (summative score = mean score × 6); therefore, using the sum instead of the mean does not change the standardized relationships between variables or the conclusions of the statistical analyses. The descriptive statistics and internal consistency of the Brief Resilience Scale are presented in Table 1.

2.3.2 Disaster preparedness

Disaster preparedness was assessed using a 20-item questionnaire developed for this study, based on the literature on individual disaster preparedness and protective action (Paton, 2003; Lindell and Perry, 2012). Hereinafter, the instrument is referred to as the Disaster Preparedness Questionnaire (DPQ).

TABLE 1 Descriptive statistics and internal consistency for the brief resilience scale.

Scale	*N*	Min	Max	*M*	SD	Cronbach's α
Brief resilience scale	406	6	30	20.09	3.85	0.74

Higher scores indicate a greater capacity for post-stress recovery.

The items were formulated to cover several domains of disaster preparedness, including concrete preparedness behaviors and resources, planning, knowledge and information, perceived response capacity, and psychological and attitudinal orientations associated with preparedness.

Based on the conceptual structure established *a priori*, the 20 items were grouped into five areas: material and logistical preparation (five items; items 1–5), evacuation planning and strategies (4 items; items 6–9), disaster knowledge and information (four items; items 10–13), perceived response capacity (4 items; items 14–17), and psychological and attitudinal preparation (3 items; items 18–20).

Items are rated on a 5-point Likert scale, from 1 = strongly disagree to 5 = strongly agree. The instrument does not contain reverse-rated items, and higher scores indicate a higher level of disaster preparedness. Scores for the five domains were calculated by summing the corresponding items. A global disaster preparedness composite score (DPQTot) was also calculated by summing all 20 items, with a theoretical range between 20 and 100. In the present study, DPQTot serves as a descriptive composite index of overall disaster preparedness, obtained by aggregating the 20 items, and not as a score derived from a unidimensional latent model or as evidence of the instrument's unidimensionality.

In the analyses corresponding to H1, H2 and RQ1, DPQTot was used, and for RQ2, the five conceptual domains were analyzed separately. The internal consistency of the total score was good (Cronbach's $\alpha = 0.87$). At the domain level, the internal consistency coefficients were $\alpha = 0.80$ for material and logistical preparedness, $\alpha = 0.77$ for planning and evacuation strategies, $\alpha = 0.67$ for disaster knowledge and information, $\alpha = 0.83$ for perceived response capacity and $\alpha = 0.65$ for psychological and attitudinal preparedness. The internal consistency coefficients for Disaster Knowledge and Information ($\alpha = 0.67$) and Psychological and Attitudinal Preparedness ($\alpha = 0.65$) were below the conventional threshold of 0.70, indicating limitations in the reliability of these domain scores. Although internal consistency alone does not establish construct validity, these findings, considered alongside the incomplete factorial separation observed in the exploratory factor analysis, warrant particular caution when interpreting domain-specific associations. Accordingly, the five conceptually defined DPQ domains were retained for descriptive and exploratory purposes, and the multivariate and univariate analyses addressing RQ2 are interpreted as preliminary findings rather than definitive evidence of associations involving independently validated preparedness subscales.

2.3.3 Seismic risk perception

Seismic risk perception was assessed using the Seismic Risk Perception Questionnaire (SRP-Q; Crescimbene et al., 2015), a multidimensional instrument developed to assess subjective perception of seismic risk using the semantic differential method. The instrument includes five main dimensions: hazard (10 items), vulnerability (12 items), exposure (seven items), institutions and community (seven items), and earthquake phenomenon (15 items).

The items are formulated as pairs of opposite terms or adjectives and are rated on 7-point scales. The Hazard dimension assesses the perceived characteristics of a possible earthquake in the area of residence, with higher scores indicating a more pronounced perception of seismic hazard. Vulnerability captures the perceived vulnerability of the home or workplace, with higher scores indicating greater perceived vulnerability. Exposure reflects the perceived exposure of the area of residence to the effects of an earthquake, with higher scores indicating greater perceived exposure. Institutions and community assesses the perception of the capacity of institutions and the community to cope with a seismic event; in this dimension, higher scores indicate a lower perceived capacity of institutions and the community. The earthquake phenomenon captures cognitive and affective representations related to the seismic phenomenon, with higher scores indicating a more intense and threatening perception of the earthquake. For the analyses in the present study, the items were coded and, where necessary, recoded so that the scores of each dimension maintained a unitary direction of interpretation.

For clarity, higher scores on the Hazard, Vulnerability, Exposure, and Earthquake phenomenon dimensions indicate greater perceived seismic hazard, vulnerability, exposure, and intensity of earthquake-related cognitive and affective representations, respectively. In contrast, higher scores on the Institutions and community dimension indicate lower perceived institutional and community capacity to respond to a seismic event. Accordingly, positive associations involving this dimension reflect associations with lower perceived institutional and community response capacity, rather than with greater institutional effectiveness. This distinction was consistently considered when interpreting the correlation, hierarchical regression, and multivariate GLM results.

The scoring direction and interpretation of the five SRP-Q dimensions are summarized in Table 2.

The five dimensions were analyzed separately and no overall SRP-Q score was calculated. Using summative scores, the theoretical ranges were 10–70 for Hazard, 12–84 for Vulnerability, 7–49 for Exposure, 7–49 for Institutions and community, and 15–105 for Earthquake phenomenon.

Internal consistency of the SRP-Q dimensions was high for Hazard (Cronbach's $\alpha = 0.90$), Vulnerability ($\alpha = 0.95$), Exposure ($\alpha = 0.91$), and Institutions and community ($\alpha = 0.91$) and acceptable for Earthquake phenomenon ($\alpha = 0.72$).

TABLE 2 Scoring direction and interpretation of the SRP-Q dimensions.

SRP-Q dimension	Higher scores indicate
Hazard	Greater perceived seismic hazard
Vulnerability	Greater perceived vulnerability
Exposure	Greater perceived seismic exposure
Institutions and community	Lower perceived institutional and community response capacity
Earthquake phenomenon	More intense and threatening earthquake-related representations

Higher scores on the Institutions and community dimension indicate lower perceived institutional and community response capacity, whereas higher scores on the remaining dimensions indicate stronger perceptions of the corresponding seismic risk-related constructs.

2.4 Procedure and ethical considerations

Data were collected in 2026 from psychology majors. Participants were recruited from the student population accessible to the research and received information regarding the general objectives of the study, the voluntary nature of participation, data confidentiality, and the right to discontinue participation at any time, without consequences. Before completing the instruments, all participants expressed their informed consent.

The instruments were administered online, via Google Forms. Completing the instrument set took approximately 20–30 min. No personal identification data were collected that would allow the direct association of the responses with the identity of the participants.

The study was conducted in accordance with the ethical principles applicable to research with human participants and was approved by the Ethics Committee by decision/opinion no. 2994 of 19.03.2026.

2.5 Data analysis

Statistical analyses were performed using IBM SPSS Statistics, version 31 (IBM Corp., Armonk, NY, USA). All analyses were performed on the final sample of $N = 406$ participants. Descriptive statistics were calculated for the variables included in the study, Pearson correlation coefficients to examine bivariate associations, and Cronbach's α coefficients to assess the internal consistency of the scales and domains analyzed. The level of statistical significance was set at $p < 0.05$.

Because the DPQ was developed for the present study, we explored its internal structure using principal axis factoring (PAF) with Direct Oblimin oblique rotation, appropriate when the dimensions of a construct may be correlated. The adequacy of the data for factor analysis was assessed by the Kaiser–Meyer–Olkin (KMO) index and the Bartlett test of sphericity. In the first stage, the factor structure was examined without imposing a predetermined number of factors, using eigenvalues and the scree plot. In a second stage, we explored a five-factor solution corresponding to the five conceptual domains defined *a priori*: material and logistical preparedness, evacuation planning and strategies, disaster knowledge and information, perceived response capacity, and psychological and attitudinal preparedness. Factor loadings were examined based on the Pattern Matrix. Factor analysis was used for exploratory examination of the internal structure of the DPQ and not as a confirmatory test of the five-domain structure.

Before the regression analyses, multicollinearity between predictors was examined, based on tolerance and variance inflation factor (VIF) values.

H1 was tested by hierarchical linear regression. In the first block, psychological resilience was introduced; in the second block, the five dimensions of seismic risk perception were introduced simultaneously: hazard, vulnerability, exposure, institutions and community, and earthquake phenomenon. The incremental contribution of seismic risk perception was assessed by the change in the coefficient of determination (ΔR^2) and the associated test of the change in F (ΔF).

H2 was tested by a second hierarchical linear regression, using the reverse order of the blocks. The five dimensions of seismic risk perception were introduced in the first block, and psychological resilience in the second block, to assess its incremental contribution after controlling for the dimensions of seismic risk perception.

RQ1 was examined using the full multiple regression model, assessing the independent statistical contributions of the five dimensions of seismic risk perception after controlling for psychological resilience and the other dimensions of risk perception. Unstandardized and standardized regression coefficients (B and β), t and p values, and 95% confidence intervals were examined.

RQ2 was examined using a General Linear Multivariate Model (GLM). The five components of disaster preparedness—material and logistical preparedness, evacuation planning and strategies, disaster knowledge and information, perceived response capacity, and psychological and attitudinal preparedness—were entered simultaneously as dependent variables. The five dimensions of seismic risk perception and psychological resilience were entered simultaneously into the model as continuous variables, with psychological resilience included for statistical control. Multivariate effects were assessed using Pillai's Trace, and effects on each component were examined by associated univariate tests. Partial eta squared (ηp^2) was reported to estimate the magnitude of effects. Given the number of follow-up univariate tests, their interpretation was made in the context of the corresponding multivariate effect. Multivariate effects assessed by Pillai's Trace constituted the main level of inference for RQ2, and univariate results were used to characterize the patterns of association with specific components of disaster preparedness.

Isolated univariate results, especially those close to the conventional significance threshold, were interpreted with caution.

Given that the exploratory factor analysis did not fully support the proposed five-domain structure of the DPQ, the multivariate GLM and subsequent univariate analyses addressing RQ2 were treated as exploratory and preliminary. The five dependent variables represented *a priori* defined composite domains rather than independently validated latent dimensions. Accordingly, the results were used to describe potential patterns of association requiring replication and further psychometric validation, rather than to support definitive construct-specific inferences.

The regression and multivariate models included the variables specified in the study objectives and hypotheses. Additional potentially relevant contextual variables, including previous earthquake exposure, disaster-related losses or injuries, post-disaster housing circumstances, residential seismic exposure, prior disaster education, and participation in emergency preparedness drills, were not assessed and therefore could not be included as covariates. Consequently, the reported associations represent statistical relationships adjusted for the predictors included in each model, rather than associations adjusted for all potentially relevant contextual factors.

3 Results

3.1 Exploratory examination of the internal structure of the disaster preparedness questionnaire

The adequacy of the data for factor analysis of the DPQ was supported by the Kaiser–Meyer–Olkin index, KMO = 0.802, and the Bartlett test of sphericity, χ^2 (190) = 3,330.99, $p < 0.001$. In the initial unconstrained solution, eigenvalues > 1 indicated six factors, which together explained 54.23% of the variance after extraction. Given the five-domain conceptual structure defined *a priori*, a PAF solution with five imposed factors and Direct Oblimin oblique rotation was additionally examined. This solution explained 50.26% of the variance after extraction. The pattern matrix for the exploratory five-factor solution is presented in Table 3.

In the Pattern Matrix, two of the conceptual domains were clearly reproduced. The items corresponding to perceived response capacity (DPQ4.14–DPQ4.17) loaded on Factor 2, with loadings ranging from 0.613 to 0.819, and the items of psychological and attitudinal readiness (DPQ5.18–DPQ5.20) loaded on Factor 3, with values ranging from.495 to.822. Four of the five items of material and logistical readiness (DPQ1.1–DPQ1.4) loaded on Factor 4, with values ranging from 0.576 to 0.716, while DPQ1.5 showed loadings ≥0.30 on both Factor 1 (0.362) and Factor 4 (0.313).

For the domains of planning and evacuation strategies and disaster knowledge and information, the factorial separation was less distinct. DPQ2.6, DPQ2.7, and DPQ2.9 loaded on Factor 1, whereas DPQ2.8 loaded on Factor 5. Among the disaster knowledge and information items, DPQ3.10 loaded on Factor 1, DPQ3.11 and DPQ3.12 loaded on Factor 5, and DPQ3.13 did not reach an absolute factor loading of 0.30 on any of the five factors. In addition, DPQ1.5 exhibited cross-loadings on Factors 1 and 4. Together with the initial extraction of six factors in the unconstrained solution, these findings indicate that the proposed five-domain conceptual structure was not fully reproduced by the exploratory factor analysis. Although some domains demonstrated relatively coherent item groupings, the lack of clear factorial separation between planning and evacuation strategies and disaster knowledge and information limits the interpretation of the five domains as psychometrically distinct subscales. Consequently, the original domains were retained exclusively as *a priori* defined conceptual groupings, and the corresponding domain-level analyses were considered exploratory and preliminary rather than confirmatory. Further psychometric investigation and independent validation are required before the proposed five-domain structure can be regarded as empirically established.

TABLE 3 Pattern matrix for the five-factor exploratory solution of the disaster preparedness questionnaire.

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
DPQ2.6	0.793	—	—	—	—
DPQ2.7	0.712	—	—	—	—
DPQ2.9	0.659	—	—	—	—
DPQ3.10	0.430	—	—	—	—
DPQ1.5	0.362	—	—	0.313	—
DPQ3.13	—	—	—	—	—
DPQ4.14	—	0.819	—	—	—
DPQ4.15	—	0.795	—	—	—
DPQ4.16	—	0.719	—	—	—
DPQ4.17	—	0.613	—	—	—
DPQ5.19	—	—	0.822	—	—
DPQ5.18	—	—	0.554	—	—
DPQ5.20	—	—	0.495	—	—
DPQ1.1	—	—	—	0.716	—
DPQ1.2	—	—	—	0.708	—
DPQ1.3	—	—	—	0.684	—
DPQ1.4	—	—	—	0.576	—
DPQ3.12	—	—	—	—	0.639
DPQ2.8	—	—	—	—	0.521
DPQ3.11	—	—	—	—	0.516

Extraction method = principal axis factoring; rotation method = Direct Oblimin with Kaiser normalization. Factor loadings with absolute values <0.30 are suppressed. The five-factor solution accounted for 50.26% of the variance after extraction. DPQ1.5 showed loadings ≥0.30 on Factors 1 and 4. DPQ3.13 did not show a loading ≥0.30 on any of the five factors. The factor solution is presented as an exploratory examination of the questionnaire's internal structure and is not interpreted as confirmatory evidence for the five conceptually defined domains.

The DPQTot score was used as a composite index of general disaster preparedness, without being interpreted as an indicator of a strictly unidimensional latent construct.

3.2 Descriptive statistics and correlations

Descriptive and correlational analyses were performed for a sample of 406 participants. Descriptive statistics for the analyzed variables are presented in Table 4.

General disaster preparedness had a mean score of $M = 68.84$ (SD = 10.00), with observed values ranging from 33 to 96. For psychological resilience, operationalized by post-stress recovery capacity, a mean of $M = 20.09$ (SD = 3.85) was obtained. In the case of seismic risk perception dimensions, the means were $M = 55.49$ (SD = 14.86) for Hazard, $M = 48.41$ (SD = 17.76) for Vulnerability, $M = 36.14$ (SD = 7.77) for Exposure, $M = 36.68$ (SD = 7.60) for Institutions and community and $M =$

TABLE 4 Descriptive statistics for the main study variables.

Variable	*N*	Minimum	Maximum	*M*	SD
Psychological resilience – post-stress recovery	406	6.00	30.00	20.09	3.85
Institutions and community	406	13.00	49.00	36.68	7.60
Exposure	406	13.00	49.00	36.14	7.77
Earthquake phenomenon	406	15.00	88.00	48.42	13.34
Vulnerability	406	12.00	74.00	48.41	17.76
Hazard	406	15.00	70.00	55.49	14.86
Total disaster preparedness	406	33.00	96.00	68.84	10.00

M, mean; SD, standard deviation.

TABLE 5 Pearson correlations among the study variables.

Variable	1	2	3	4	5	6	7
1. Psychological resilience – post-stress recovery	—						
2. Institutions and community	0.006	—					
3. Exposure	0.040	0.180**	—				
4. Earthquake phenomenon	0.024	0.161**	0.081	—			
5. Vulnerability	0.106*	0.112*	0.137**	0.246**	—		
6. Hazard	−0.013	0.143**	0.117*	0.171**	0.181**	—	
7. Total disaster preparedness	0.202**	0.136**	0.143**	0.407**	0.259**	0.306**	—

$N = 406$. Values are Pearson correlation coefficients. $^{*}p < 0.05$. $^{**}p < 0.01$.

48.42 (SD = 13.34) for Earthquake phenomenon. Because these variables are constructed from a different number of items and have distinct theoretical ranges, the raw means of the dimensions are not directly comparable.

To examine the bivariate associations between the variables, Pearson correlation coefficients were calculated. The results are presented in Table 5.

General disaster preparedness was significantly associated with all five dimensions of seismic risk perception, although the magnitude of the associations varied. The largest correlation observed was with Earthquake phenomenon, $r = 0.407$, $p < 0.001$. Disaster preparedness was also positively associated with Hazard, $r = 0.306$, $p < 0.001$, and Vulnerability, $r = 0.259$, $p < 0.001$. A smaller positive association was observed for Exposure, $r = 0.143$, $p = 0.004$. For Institutions and community, the correlation was also positive and of smaller amplitude, $r = 0.136$, $p = 0.006$; Given the direction of scoring on this dimension, this association indicates that lower perceived capacity of institutions and community was associated with higher levels of individual disaster preparedness, but the association was of small magnitude. General disaster preparedness was also positively associated with psychological resilience, $r = 0.202$, $p < 0.001$, indicating that higher levels of post-stress recovery capacity were associated with higher levels of disaster preparedness.

Regarding the relationships between the dimensions of seismic risk perception, Institutions and community was positively associated with Exposure, $r = 0.180$, $p < 0.001$, Earthquake phenomenon, $r = 0.161$, $p = 0.001$, Vulnerability, $r = 0.112$, $p = 0.024$, and Hazard, $r = 0.143$, $p = 0.004$. Exposure was positively associated with Vulnerability, $r = 0.137$, $p = 0.006$, and Hazard, $r = 0.117$, $p = 0.018$, while the association with Earthquake phenomenon was not statistically significant, $r = 0.081$, $p = 0.104$.

Earthquake phenomenon was positively associated with Vulnerability, $r = 0.246$, $p < 0.001$, and Hazard, $r = 0.171$, $p < 0.001$. Vulnerability was also positively associated with Hazard, $r = 0.181$, $p < 0.001$. Psychological resilience showed a small-amplitude positive association with Vulnerability, $r = 0.106$, $p = 0.033$, while its associations with Institutions and community, Exposure, Earthquake phenomenon, and Hazard were not statistically significant.

The correlational pattern indicated stronger associations of disaster preparedness with Earthquake phenomenon, Hazard and Vulnerability and weaker associations with Exposure and Institutions and community. These bivariate associations were subsequently examined in multivariate models corresponding to H1, H2 and RQ1, to estimate the independent and incremental contributions of the dimensions of seismic risk perception and psychological resilience to overall disaster preparedness.

3.3 Testing hypothesis H1. After controlling for psychological resilience, the dimensions of seismic risk perception will explain a significant additional proportion of the variance in overall disaster preparedness

To test hypothesis H1, a hierarchical linear regression was performed, with total disaster preparedness as the dependent variable. In the first block, psychological resilience was introduced,

TABLE 6 Hierarchical regression model summary for predicting total disaster preparedness.

Model	Predictors	R	R^2	Adjusted R^2	ΔR^2	ΔF	df	p for ΔF
1	Psychological resilience – post-stress recovery	0.202	0.041	0.039	0.041	17.232	1, 404	<0.001
2	Psychological resilience + seismic risk perception dimensions	0.528	0.279	0.268	0.238	26.393	5, 399	<0.001

Dependent variable = total disaster preparedness. $N = 406$. ΔR^2 = change in explained variance; $\Delta F = F$ test for the change in R^2.

TABLE 7 Hierarchical regression coefficients for predicting total disaster preparedness.

Predictor	B	SE B	β	t	p	95% CI for B	VIF
Model 1							
Psychological resilience – post-stress recovery	0.525	0.126	0.202	4.151	<0.001	[0.276, 0.773]	1.000
Model 2							
Psychological resilience – post-stress recovery	0.475	0.111	0.183	4.284	<0.001	[0.257,00.694]	1.013
Institutions and community	0.036	0.058	0.028	0.626	0.532	[−0.077,0.150]	1.070
Exposure	0.081	0.056	0.063	1.446	0.149	[−0.029,0.192]	1.056
Earthquake phenomenon	0.247	0.033	0.329	7.382	<0.001	[0.181, 0.312]	1.101
Vulnerability	0.060	0.025	0.107	2.385	0.018	[0.011, 0.110]	1.114
Hazard	0.149	0.030	0.221	5.029	<0.001	[0.091, 0.207]	1.072

Dependent variable = total disaster preparedness. B, unstandardized regression coefficient; SE B, standard error of B; β, standardized regression coefficient; CI, confidence interval; VIF, variance inflation factor. $N = 406$.

operationalized through post-stress recovery capacity. In the second block, the five dimensions of seismic risk perception were simultaneously introduced: hazard, vulnerability, exposure, institutions and community, and earthquake phenomenon. The results of the hierarchical regression analysis, including model fit and changes in explained variance, are presented in Table 6.

In the first model, psychological resilience explained 4.1% of the variance in disaster preparedness, $R^2 = 0.041$, adjusted $R^2 = 0.039$. The model was statistically significant, $F(1, 404) = 17.23$, $p < 0.001$. In this model, psychological resilience was positively and statistically significantly associated with disaster preparedness, $\beta = 0.202$, $B = 0.525$, $p < 0.001$.

The introduction of the seismic risk perception dimensions in the second block resulted in a 23.8 percentage point increase in explained variance, $\Delta R^2 = 0.238$. This increase was statistically significant, $\Delta F(5, 399) = 26.39$, $p < 0.001$. The final model explained 27.9% of the variance in disaster preparedness, $R^2 = 0.279$, adjusted $R^2 = 0.268$, and the regression model was statistically significant, $F(6, 399) = 25.77$, $p < 0.001$.

This increase in explained variance indicates a significant incremental contribution of the dimensions of seismic risk perception, after controlling for psychological resilience. The regression coefficients for both hierarchical models, including the independent contributions of the predictors, are presented in Table 7.

In the final model, Earthquake phenomenon had the largest observed standardized coefficient, $\beta = 0.329$, $B = 0.247$, 95% CI [0.181, 0.312], $p < 0.001$. Hazard also had a positive independent association with general disaster preparedness, $\beta = 0.221$, $B = 0.149$, 95% CI [0.091, 0.207], $p < 0.001$, and Vulnerability had a smaller positive independent association, $\beta = 0.107$, $B = 0.060$, 95% CI [0.011, 0.110], $p = 0.018$.

Psychological resilience remained positively and statistically significantly associated with general disaster preparedness after the inclusion of seismic risk perception dimensions, $\beta = 0.183$, $B = 0.475$, 95% CI [0.257, 0.694], $p < 0.001$. In contrast, Exposure ($\beta = 0.063$, $p = 0.149$) and Institutions and community ($\beta = 0.028$, $p = 0.532$) did not show significant independent contributions in the final model.

No indications of problematic multicollinearity were identified, with VIF values ranging from 1.013 to 1.114 and tolerance values between 0.897 and 0.987.

After controlling for psychological resilience, the introduction of seismic risk perception dimensions increased the explained variance of overall disaster preparedness by 23.8 percentage points, $\Delta R^2 = 0.238$, $\Delta F(5, 399) = 26.39$, $p < 0.001$. Therefore, H1 was supported.

3.4 Testing hypothesis H2. Incremental explanatory value of psychological resilience after controlling for seismic risk perception dimensions

To test hypothesis H2, a hierarchical linear regression was performed, with total disaster preparedness as the dependent variable. In the first block, the five dimensions of seismic risk perception were simultaneously entered: hazard, vulnerability, exposure, institutions and community, and

TABLE 8 Hierarchical regression analysis examining the incremental contribution of psychological resilience to total disaster preparedness.

Model/Predictor	*B*	SE	*β*	*t*	*p*	95% CI for *B*
Model 1						
Hazard	0.144	0.030	0.215	4.780	<0.001	[0.085,0.204]
Exposure	0.088	0.057	0.069	1.543	0.124	[−0.024,0.201]
Institutions and community	0.035	0.059	0.026	0.586	0.558	[−0.081,0.151]
Earthquake phenomenon	0.247	0.034	0.330	7.236	<0.001	[0.180,0.314]
Vulnerability	0.071	0.026	0.127	2.783	0.006	[0.021, 0.122]
Model 2						
Hazard	0.149	0.030	0.221	5.029	<0.001	[0.091, 0.207]
Exposure	0.081	0.056	0.063	1.446	0.149	[−0.029,0.192]
Institutions and community	0.036	0.058	0.028	0.626	0.532	[−0.077,0.150]
Earthquake phenomenon	0.247	0.033	0.329	7.382	<0.001	[0.181, 0.312]
Vulnerability	0.060	0.025	0.107	2.385	0.018	[0.011, 0.110]
Psychological resilience	0.475	0.111	0.183	4.284	<0.001	[0.257, 0.694]

Dependent variable = total disaster preparedness. Model 1: $R = 0.496$, $R^2 = 0.246$, adjusted $R^2 = 0.237$, F(5, 400) = 26.12, $p < 0.001$. Model 2: $R = 0.528$, $R^2 = 0.279$, adjusted $R^2 = 0.268$, F(6, 399) = 25.77, $p < 0.001$. Addition of psychological resilience: $\Delta R^2 = 0.033$, $\Delta F(1, 399) = 18.35$, $p < 0.001$. B = unstandardized regression coefficient; SE, standard error; β = standardized regression coefficient; CI, confidence interval. $N = 406$.

earthquake phenomenon. In the second block, psychological resilience was entered to assess its incremental contribution after controlling for the dimensions of seismic risk perception. The results of the hierarchical regression analysis examining the incremental contribution of psychological resilience to total disaster preparedness are presented in Table 8.

In the final model, psychological resilience was positively and statistically significantly associated with disaster preparedness, $B = 0.475$, SE = 0.111, $\beta = 0.183$, $t = 4.284$, $p < 0.001$, 95% CI [0.257, 0.694]. Thus, after controlling for the five dimensions of seismic risk perception, higher psychological resilience scores were associated with higher levels of disaster preparedness.

Entering psychological resilience in the second block increased the explained variance of disaster preparedness by 3.3 percentage points, $\Delta R^2 = 0.033$, and this increase was statistically significant, $\Delta F(1, 399) = 18.35$, $p < 0.001$.

Therefore, H2 was supported. Psychological resilience explained an additional 3.3 percentage points of the variance in overall disaster preparedness after controlling for the five dimensions of seismic risk perception ($\Delta R^2 = 0.033$, $p < 0.001$). This finding indicates a statistically significant incremental explanatory contribution within the regression model, without implying a causal or temporal relationship between resilience and preparedness.

3.5 Analysis of RQ1. Independent contributions of seismic risk perception dimensions to overall disaster preparedness

RQ1 examined which of the dimensions of seismic risk perception make independent statistical contributions to overall disaster preparedness, after controlling for psychological resilience and the other dimensions of seismic risk perception. The analysis was based on the full regression model presented in Table 7, which explained 27.9% of the variance in overall disaster preparedness, $R^2 = 0.279$, adjusted $R^2 = 0.268$, F(6, 399) = 25.77, $p < 0.001$.

Of the five dimensions of seismic risk perception, Earthquake phenomenon had the largest observed standardized coefficient, $\beta = 0.329$, $B = 0.247$, $t = 7.382$, $p < 0.001$, 95% CI [0.181, 0.312]. Hazard also showed a positive independent statistical contribution, $\beta = 0.221$, $B = 0.149$, $t = 5.029$, $p < 0.001$, 95% CI [0.091, 0.207], and Vulnerability also showed a positive independent statistical contribution, $\beta = 0.107$, $B = 0.060$, $t = 2.385$, $p = 0.018$, 95% CI [0.011, 0.110].

Exposure, $\beta = 0.063$, $p = 0.149$, and Institutions and community, $\beta = 0.028$, $p = 0.532$, did not show significant independent statistical contributions in the full model. For Institutions and community, the positive coefficient should be interpreted in relation to the direction of the dimension score, where higher values indicate lower perceived capacity of institutions and community; however, the adjusted association was not statistically significant.

The results related to RQ1 indicate that, after controlling for psychological resilience and the other dimensions of seismic risk perception, Earthquake phenomenon, Hazard, and Vulnerability presented statistically significant independent contributions to overall disaster preparedness, while Exposure and Institutions and community did not present significant independent contributions.

3.6 Analysis of RQ2. Association patterns between dimensions of seismic risk perception and components of disaster preparedness

A General Linear Multivariate Model (GLM) was used to examine RQ2, in which the five components of disaster

TABLE 9 Multivariate effects of seismic risk perception dimensions and psychological resilience on disaster preparedness components.

Predictor	Pillai's Trace	F(5, 395)	p	ηp^2
Psychological resilience	0.109	9.653	<0.001	0.109
Exposure	0.035	2.860	0.015	0.035
Institutions and community	0.027	2.153	0.059	0.027
Earthquake phenomenon	0.103	9.026	<0.001	0.103
Vulnerability	0.057	4.740	<0.001	0.057
Hazard	0.078	6.645	<0.001	0.078

The five dependent variables were material and logistical preparedness, planning and evacuation strategies, disaster knowledge and information, perceived response capacity, and psychological and attitudinal preparedness. ηp^2 = partial eta squared. $N = 406$.

TABLE 10 Univariate follow-up effects on disaster preparedness components.

Predictor	Disaster preparedness component	B	p	ηp^2
Earthquake phenomenon	Material and logistical preparedness	0.093	<0.001	0.061
Earthquake phenomenon	Planning and evacuation strategies	0.066	<0.001	0.067
Earthquake phenomenon	Disaster knowledge and information	0.040	<0.001	0.038
Earthquake phenomenon	Perceived response capacity	0.022	0.036	0.011
Hazard	Material and logistical preparedness	0.077	<0.001	0.054
Hazard	Planning and evacuation strategies	0.038	<0.001	0.030
Hazard	Disaster knowledge and information	0.030	0.001	0.027
Hazard	Perceived response capacity	0.026	0.005	0.019
Vulnerability	Material and logistical preparedness	0.028	0.045	0.010
Vulnerability	Disaster knowledge and information	0.019	0.014	0.015
Vulnerability	Perceived response capacity	0.035	<0.001	0.046
Exposure	Disaster knowledge and information	0.057	0.001	0.027
Institutions and community	Planning and evacuation strategies	0.046	0.032	0.011
Psychological resilience	Planning and evacuation strategies	0.192	<0.001	0.053
Psychological resilience	Disaster knowledge and information	0.070	0.037	0.011
Psychological resilience	Perceived response capacity	0.184	<0.001	0.064

Univariate follow-up effects with $p < 0.05$ are displayed for descriptive characterization of the multivariate association patterns. These effects should be interpreted in the context of the corresponding multivariate tests. The association between Earthquake phenomenon and psychological and attitudinal preparedness was at the conventional significance threshold ($p = 0.050$) and is therefore not included among the effects with $p < 0.05$. The association between Vulnerability and psychological and attitudinal preparedness did not reach statistical significance ($p = 0.051$). Because the multivariate effect of Institutions and community was not statistically significant ($p = 0.059$), its isolated univariate association with planning and evacuation strategies ($p = 0.032$) should be interpreted cautiously. ηp^2 = partial eta squared.

preparedness were entered simultaneously as dependent variables: material and logistical preparedness, evacuation planning and strategies, disaster knowledge and information, perceived response capacity, and psychological and attitudinal preparedness. The five dimensions of seismic risk perception and psychological resilience were entered simultaneously in the model as continuous variables, with psychological resilience being included for statistical control.

At the multivariate level, significant effects were observed for Exposure, Pillai's Trace = 0.035, $F(5, 395) = 2.860$, $p = 0.015$, $\eta p^2 = 0.035$; Earthquake phenomenon, Pillai's Trace = 0.103, F (5, 395) = 9.026, $p < 0.001$, $\eta p^2 = 0.103$; Vulnerability, Pillai's Trace = 0.057, F (5, 395) = 4.740, $p < 0.001$, $\eta p^2 = 0.057$; and Hazard, Pillai's Trace = 0.078, F (5, 395) = 6.645, $p < 0.001$, $\eta p^2 = 0.078$. The multivariate effect for Institutions and community did not reach the conventional threshold of significance, $p = 0.059$. Psychological resilience also showed a significant multivariate effect, Pillai's Trace = 0.109, F (5, 395) = 9.653, $p < 0.001$, $\eta p^2 = 0.109$. The multivariate effects of seismic risk perception dimensions and psychological resilience on disaster preparedness components are summarized in Table 9.

At the univariate level, we observed different patterns between the dimensions of seismic risk perception and the components of disaster preparedness. The results of the univariate follow-up analyses examining the associations between seismic risk perception dimensions and specific disaster preparedness components are presented in Table 10.

Follow-up univariate analyses revealed distinct patterns by disaster preparedness component. These results are interpreted descriptively, in the context of the corresponding multivariate effects.

For Earthquake phenomenon, for which the multivariate effect was significant, univariate effects were observed for material and logistical preparedness, $B = 0.093$, $p < 0.001$, $\eta p^2 = 0.061$, evacuation planning and strategies, $B = 0.066$, $p < 0.001$, $\eta p^2 =$

0.067, disaster knowledge and information, $B = 0.040$, $p < 0.001$, $\eta p^2 = 0.038$, and perceived response capacity, $B = 0.022$, $p = 0.036$, $\eta p^2 = 0.011$. For psychological and attitudinal preparation, $p = 0.050$, so the result was not included among the effects with $p < 0.05$.

Hazard also showed a significant multivariate effect. At the univariate level, effects were observed for material and logistical preparedness, $B = 0.077$, $p < 0.001$, $\eta p^2 = 0.054$, evacuation planning and strategies, $B = 0.038$, $p < 0.001$, $\eta p^2 = 0.030$, disaster knowledge and information, $B = 0.030$, $p = 0.001$, $\eta p^2 = 0.027$, and perceived response capacity, $B = 0.026$, $p = 0.005$, $\eta p^2 = 0.019$. No significant univariate effect was observed for psychological and attitudinal preparedness, $p = 0.256$.

For Vulnerability, the multivariate effect was significant, and follow-up analyses indicated univariate effects for material and logistical preparedness, $B = 0.028$, $p = 0.045$, $\eta p^2 = 0.010$, disaster knowledge and information, $B = 0.019$, $p = 0.014$, $\eta p^2 = 0.015$, and perceived response capacity, $B = 0.035$, $p < 0.001$, $\eta p^2 = 0.046$. No significant effect was observed for planning and evacuation, and the result for psychological and attitudinal preparedness did not reach the conventional threshold of significance, $p = 0.051$.

Exposure showed a significant multivariate effect, but the univariate pattern was more specific: of the five components of preparedness, an effect with $p < 0.05$ was observed only for disaster knowledge and information, $B = 0.057$, $p = 0.001$, $\eta p^2 = 0.027$.

For Institutions and community, the multivariate effect did not reach the conventional threshold of significance, Pillai's Trace = 0.027, F(5, 395) = 2.153, $p = 0.059$, $\eta p^2 = 0.027$. Although an association with evacuation planning and strategies was observed at the univariate level, $B = 0.046$, $p = 0.032$, $\eta p^2 = 0.011$, this isolated result is interpreted with caution, as the corresponding multivariate effect did not reach the conventional threshold of statistical significance. In addition, interpret the positive coefficient in relation to the scoring direction of the Institutions and community dimension, where higher values indicate lower perceived capacity of institutions and community.

Psychological resilience showed a significant multivariate effect. Follow-up univariate analyses indicated effects for evacuation planning and strategies, $B = 0.192$, $p < 0.001$, $\eta p^2 = 0.053$, disaster knowledge and information, $B = 0.070$, $p = 0.037$, $\eta p^2 = 0.011$, and perceived response capacity, $B = 0.184$, $p < 0.001$, $\eta p^2 = 0.064$. No significant univariate effects were observed for material and logistical preparedness or psychological and attitudinal preparedness.

The full univariate models, including the five dimensions of seismic risk perception and psychological resilience, explained 15.6% of the variance in material and logistical preparedness, 19.9% of the variance in evacuation planning and strategies, 15.9% of the variance in disaster knowledge and information, 17.8% of the variance in perceived response capacity, and 4.4% of the variance in psychological and attitudinal preparedness. The psychological and attitudinal component was thus less explained by the set of predictors included in the model than the other components.

The results for RQ2 indicate that associations with disaster preparedness differ by seismic risk perception dimension and preparedness component. Earthquake phenomenon and Hazard presented multivariate effects and univariate patterns distributed over several components; Vulnerability presented a more selective pattern; and for Exposure, the univariate effect with $p < 0.05$ was concentrated on the knowledge and information component. The results highlight differentiated patterns of association between the seismic risk perception dimensions and the disaster preparedness components, without all risk perception dimensions presenting uniform associations with all forms of preparedness.

Given the incomplete empirical support for the proposed DPQ domain structure, these component-level findings should be regarded as exploratory and preliminary associations involving conceptually defined composite scores, rather than definitive evidence of relationships between independently validated preparedness dimensions.

4 Discussion

The present study examined the independent and incremental contributions of multidimensional seismic risk perception and psychological resilience to disaster preparedness, as well as the patterns of association of these variables with specific components of preparedness. The results supported both hypotheses: the dimensions of seismic risk perception added 23.8 percentage points to the explained variance of overall preparedness after controlling for psychological resilience, and resilience had a positive and incremental contribution after controlling for the dimensions of risk perception. The full model explained 27.9% of the variance of overall preparedness. These results indicate that earthquake preparedness is associated with both differential seismic risk appraisal and individual psychological resources.

The results regarding H1 support the relevance of the multidimensional conceptualization of risk perception. The positive association between risk perception and preparedness is consistent with the results reported by Kalin and Yeşilyurt (2025) in a sample of university students. However, the results of the present study show that this association is not uniform across all risk dimensions. Earthquake phenomenon presented the strongest independent contribution in the full model, followed by Hazard and Vulnerability, while Exposure and Institutions and community did not present significant independent contributions. This differentiation is compatible with approaches that treat risk perception and the decision to adopt protective actions as complex processes, influenced by distinct threat and response assessments (Crescimbene et al., 2015; Lindell and Perry, 2012). Research on seismic risk communication also shows that the way information is presented can modify individuals' sensitivity to different levels of risk (Savadori et al., 2022).

The relatively strong association between Earthquake phenomenon and overall disaster preparedness warrants consideration of potential conceptual overlap between the constructs assessed. The Earthquake phenomenon dimension of the SRP-Q captures cognitive and affective representations of seismic events, whereas the psychological and attitudinal preparedness domain of the DPQ concerns self-reported psychological readiness and preparedness-related attitudes. Although these constructs are theoretically distinguishable, their affective and cognitive content may partially overlap.

Consequently, the comparatively large standardized regression coefficient for Earthquake phenomenon ($\beta = 0.329$) should not be interpreted as evidence of a distinct psychological mechanism or causal influence on preparedness. Furthermore, the incomplete factorial validation of the DPQ prevents firm conclusions about the empirical separation of these constructs. Future studies should examine their discriminant validity using independently validated measures and assess whether the observed associations remain stable after accounting for potential construct overlap.

The absence of significant independent contributions for Exposure and Institutions and community does not imply the lack of relevance of these dimensions, but indicates that they did not provide additional statistical information in the presence of the other predictors. For Exposure, the bivariate association with preparedness did not hold in the adjusted model. Literature shows that prior hazard experience may have differential relationships with preparedness, depending on the characteristics of the experience and the type of behavior analyzed (Duan et al., 2025). In the case of Institutions and community, the scale score requires careful interpretation: the positive bivariate association indicated that the perception of lower institutional and community capacity was associated with slightly higher individual preparedness, but this relationship did not hold in the full model. Previous research confirms the complexity of the relationships between community dimensions, trust, perceived efficacy, and disaster preparedness (Lin and Lee, 2023; Zhang et al., 2022).

H2 was also supported. Psychological resilience explained an additional 3.3 percentage points of the variance in overall preparedness after controlling for risk perception dimensions. The BRS operationalizes resilience in the specific sense of the ability to bounce back from stress and adversity (Smith et al., 2008), and the association identified is consistent with Geylani and Göral (2026), who reported that resilience assessed by the BRS was a positive predictor of disaster preparedness in psychiatric nurses, explaining 6.7% of the variance. The results are also relevant in relation to Atalyan et al. (2026), who found, in a sample of university students in Nepal, that psychological preparedness explained additional variance in preparedness behavior beyond risk perception. However, their construct is broader than bounce-back resilience, including emotional regulation, coping, and perceived response capacity. The convergence of these results supports the relevance of psychological resources for understanding preparedness, without considering them as substitutes for risk perception.

Analyses for RQ2 revealed that the relationships also differed by preparedness component. Earthquake phenomenon and Hazard showed broader patterns, associated with material and logistical preparedness, evacuation planning and strategies, knowledge and information, and perceived response capacity. Vulnerability showed a more selective pattern, and for Exposure, the univariate effect with $p < 0.05$ was limited to knowledge and information. Resilience was associated with evacuation planning and strategies, knowledge and information, and perceived response capacity. These results show that relying solely on global scores may hide relevant patterns at the level of risk perception and preparedness components.

Interpretation of the results at the level of DPQ domains, however, requires caution. Exploratory factor analysis provided partial, but not full, support for the five-domain conceptual structure, and internal consistency was more modest for some components. Consequently, these domains are treated in the present study as *a priori* defined conceptual dimensions, not as empirically confirmed factors. This caution does not preclude the use of the DPQTot as a descriptive composite index of general preparedness, for which internal consistency was good, but it indicates the need for further validation of the multidimensional structure.

The distinction between perceived seismic risk and preparedness is also relevant to recent skill-based approaches to disaster literacy. Although the dimensions of seismic risk perception explained an additional 23.8 percentage points of explained variance in overall disaster preparedness after controlling for psychological resilience, a substantial proportion of the variance remained unexplained. This finding suggests that risk-related appraisals, despite their significant contribution, should not be regarded as sufficient explanations of preparedness. Karacaoglu (2025) proposed a skill-based framework of disaster literacy that emphasizes the practical application of knowledge across the preparedness, response, and recovery phases of disasters. Extending this perspective, Karacaoglu et al. (2026) organized disaster literacy competencies into practical, cognitive, social, and adaptive domains, highlighting the importance of actionable skills alongside risk awareness. These perspectives provide a complementary conceptual framework for interpreting the multidimensional nature of preparedness examined in the present study. Specifically, material and logistical preparedness, evacuation planning, and perceived response capacity may be understood as conceptually related to the application of disaster-related knowledge in practical situations. However, the present study did not directly assess disaster literacy competencies or objectively verified preparedness behaviors. Therefore, the relevance of skill-based disaster literacy is proposed as a theoretical interpretation and a direction for future research, rather than as a mechanism empirically tested by the current findings.

4.1 Practical Implications

From an applied perspective, the findings suggest that university-level earthquake preparedness initiatives should integrate risk awareness with opportunities to develop practical response competencies. This recommendation is consistent with the skill-based disaster literacy frameworks proposed by Karacaoglu (2025) and Karacaoglu et al. (2026), which emphasize the application of disaster-related knowledge through practical, cognitive, social, and adaptive competencies. Educational activities could therefore combine seismic hazard and vulnerability information with structured evacuation planning, emergency resource management, identification of safer locations, and scenario-based response exercises. Particular attention could also be given to developing perceived response capacity through guided practice, simulations, and collaborative preparedness activities. Psychological resilience may be considered alongside these components as a potentially relevant individual resource,

while recognizing that the present findings do not establish its causal influence on preparedness. Such interventions should be evaluated through experimental or quasi-experimental designs incorporating objective indicators of preparedness, rather than relying exclusively on self-reported perceptions. Accordingly, these recommendations represent theoretically informed directions for intervention development and evaluation, not evidence of the effectiveness of specific training programs.

5 Limitations

The present study presents several limitations that should be considered in interpreting the results, without diminishing the relevance of the identified patterns. First, the cross-sectional, observational design does not allow causal conclusions or establish the temporal direction of relationships between variables. However, this design is appropriate for the study's objective, which is focused on examining the independent and incremental statistical contributions of seismic risk perception and psychological resilience to disaster preparedness. The results thus provide an empirical basis for further investigation of these relationships through longitudinal or prospective designs.

Second, the study was based on a non-probabilistic convenience sample comprising exclusively female psychology students aged 19–24 years from a single faculty at Ovidius University of Constanța. This sampling strategy limits the external validity of the findings, particularly their generalizability to male students, students from other academic disciplines, different age groups, and university populations with different demographic or educational characteristics. Moreover, the participants' academic background in psychology may be associated with particular levels of familiarity with psychological concepts, self-reflection, and risk-related information, although these characteristics were not directly assessed in the present study. Consequently, the observed statistical associations should be interpreted within the specific educational and demographic context investigated. Replication in multicenter samples encompassing different academic fields, genders, and geographic regions is necessary to evaluate their generalizability.

A further methodological limitation concerns the absence of information on potentially relevant earthquake-related experiences and contextual characteristics. Previous earthquake exposure, disaster-related bereavement or injuries, post-disaster housing conditions, residence in areas with different levels of seismic hazard, previous disaster preparedness training, and participation in emergency drills were not measured. The relevance of earthquake-related experiences to psychological outcomes is illustrated by Kurt et al. (2024), who found that family bereavement, earthquake-related injuries, hospitalization, and housing damage were associated with emotional stress and behavioral difficulties among children exposed to the 2023 Kahramanmaraş earthquake. Although these findings concern post-disaster psychological outcomes in children rather than preparedness among university students, they highlight the importance of assessing exposure-related experiences and contextual circumstances. In the present study, such characteristics may represent potential confounding factors because they could be associated with both seismic risk perception and preparedness. Their omission prevents the assessment of whether the observed associations would remain unchanged after accounting for these variables. Consequently, the independent statistical associations and incremental explained variance reported in this study should not be interpreted as evidence that the models fully account for the determinants of earthquake preparedness. Future research should incorporate these variables into more comprehensive analytical models.

For the DPQ, exploratory factorial examination provided partial support for the five-domain conceptual structure, with some components being reproduced more clearly than others. For this reason, the results at the component level were interpreted as reflecting *a priori* defined conceptual domains, rather than confirmed empirical factors. This finding also represents a starting point for further refinement and validation of the instrument. The good internal consistency of the total score ($\alpha = 0.87$) supports the use of the DPQTot as a composite index in analyses of general preparedness, while the results obtained for the domains with more modest internal consistency require more cautious interpretation.

Despite these limitations, using a multidimensional measure of seismic risk perception alongside a specific conceptualization of resilience as post-stress recovery ability allowed us to differentiate their contributions to disaster preparedness. Furthermore, the analysis of both general preparedness and its specific components revealed patterns that might have gone undetected by using global scores alone. These results provide a basis for testing and extending the model in different populations and contexts.

6 Future research

The results of the present study open several directions for further research on earthquake preparedness. A first direction concerns the replication of the model in a wider variety of populations. Extending the research to students from other academic fields, to participants of both genders, and to other age groups would allow examining the stability of the differential contributions observed for Earthquake phenomenon, Hazard, Vulnerability, and psychological resilience. In addition, including participants from regions with different levels of seismic exposure could clarify the extent to which the identified relationships depend on the geographical context and the experience of risk.

An important direction is using longitudinal designs, which would allow examination of the temporal relationships between risk perception, resilience, and disaster preparedness. The current results show independent and incremental statistical contributions of seismic risk perception and resilience, but the cross-sectional nature of the study does not allow establishing the temporal order between these variables. Repeated assessment of participants could clarify whether changes in risk perception and psychological resources are followed by changes in training or whether training experiences, in turn, contribute to changing these assessments.

Future research could further develop the multidimensional assessment of disaster preparedness. In the current study, factorial examination of the DPQ provided partial exploratory support

for the conceptual organization into five domains, without fully replicating the proposed structure. Application of the instrument in independent samples would allow for refinement of the items and more rigorous examination of its psychometric structure. Particular attention could be paid to the domains of disaster knowledge and information and psychological and attitudinal preparedness, for which internal consistency was more modest in the current sample.

The results on the components of preparedness also justify continuing a differentiated approach, instead of examining only one global score. Earthquake phenomenon and Hazard showed associations with several components of preparedness, while Vulnerability and Exposure showed more selective patterns. At the same time, the predictors explained different proportions of variance in the five components, with the current model explaining the least variance in psychological and attitudinal preparedness. Further studies could examine which other psychological, social, or contextual variables contribute to this component and whether the predictors of different forms of preparedness change by population and context. Another relevant direction is integrating self-reported preparedness indicators with behavioral or objective measures. Verifying the existence of emergency resources, evacuation plans, participation in exercises, or other concrete actions would allow examination of the concordance between perceived preparedness and the behaviors actually adopted. Such an approach would be particularly useful for clarifying the mechanisms by which risk assessments and psychological resources are associated with the transition from risk awareness to preparedness action.

Finally, the results provide a basis for developing and testing educational interventions in the university setting. Experimental or quasi-experimental studies could separately examine the effects of interventions focused on hazard and vulnerability information, emergency planning, and strengthening relevant psychological resources for managing stressful situations. This approach would allow us to determine whether modifying these factors produces subsequent changes in preparedness behaviors, which the cross-sectional design used in the current research cannot determine.

7 Conclusions

The present study highlights the multidimensional nature of earthquake preparedness and shows that seismic risk perception and psychological resilience contribute distinct statistical explanations. The dimensions of seismic risk perception added 23.8 percentage points to the explained variance of general preparedness after controlling for resilience, supporting H1, and psychological resilience made a positive, incremental contribution after controlling for risk perception, supporting H2. The full model explained 27.9% of the variance of general disaster preparedness.

The results also show that the dimensions of risk perception are not uniformly associated with preparedness. Earthquake phenomenon, Hazard, and Vulnerability presented significant independent contributions to general preparedness, while Exposure and Institutions and community did not provide significant independent contributions in the full model. Analyses at the level of preparedness components also highlighted differentiated patterns, with Earthquake phenomenon and Hazard being associated with multiple forms of preparedness, and Vulnerability and Exposure presenting more selective associations.

These findings support examining the components of seismic risk perception and disaster preparedness separately, rather than reducing them exclusively to global indicators. At the same time, the incremental explanatory contribution of resilience indicates that disaster preparedness is statistically associated not only with seismic threat appraisal but also with individual psychological resources relevant to coping with adversity. From this perspective, the findings provide a basis for the future development and evaluation of educational interventions integrating seismic risk information, practical preparedness competencies, and psychological resources. The effectiveness of such interventions remains to be established through experimental or quasi-experimental studies, as the cross-sectional design of the present research does not permit causal inferences.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Ethics Committee of Ovidius University of Constanța. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MS: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. MC: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. MP: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. FA: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. SM: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. MT: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that Generative AI was used in the creation of this manuscript. Grammarly was used to improve the English language, grammar, clarity, and readability of the manuscript. All suggested changes were reviewed and approved by the author(s), who take full responsibility for the final content.

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References

Adu-Gyamfi, B., and Shaw, R. (2022). Risk awareness and impediments to disaster preparedness of foreign residents in the Tokyo Metropolitan Area, Japan. *Int. J. Environ. Res. Public Health* 19:11469. doi: 10.3390/ijerph191811469

Ahmadi, A., and Costa, R. (2025). Agent-based simulation of the effectiveness of policies for the adoption of seismic retrofits. *Earthquake Spectra* 41, 3447–3473. doi: 10.1177/87552930251377731

Ajzen, I. (1991). The theory of planned behavior. *Organ. Behav. Human Decision Proc.* 50, 179–211. doi: 10.1016/0749-5978(91)90020-T

Atalyan, T., Bhandary, N. P., and Joshi, B. R. (2026). Psychological preparedness and risk perception for predicting earthquake preparedness behavior among university students in Nepal. *Nat. Hazards Res.* 63:52. doi: 10.1016/j.nhres.2026.06.007

Atilgan, D., and Öztürk, O. (2025). Earthquake knowledge level and post-earthquake trauma: a study on sport sciences faculty students. *Nat. Hazards* 121, 1865–1884. doi: 10.1007/s11069-024-06889-3

Becker, J. S., Vinnell, L. J., Doyle, E. E. H., McBride, S. K., Paton, D., and Johnston, D. M. (2024). A decade of shaking in the Garden City: the dynamics of preparedness, perceptions, and beliefs in Canterbury, New Zealand, and implications for earthquake information. *Front. Commun.* 9:1410333. doi: 10.3389/fcomm.2024.1410333

Bostrom, A., McBride, S. K., Becker, J. S., Goltz, J. D., de Groot, R.-M., Peek, L., et al. (2022). Great expectations for earthquake early warnings on the United States West Coast. *Int. J. Disaster Risk Reduct.* 82:103296. doi: 10.1016/j.ijdrr.2022.103296

Brown, G. D., McMullan, C., Largey, A., and Leon, D. (2024). An assessment of nurses' perceived and actual household emergency preparedness. *PLoS ONE* 19, e0300536. doi: 10.1371/journal.pone.0300536

Connor, K. M., and Davidson, J. R. T. (2003). Development of a new resilience scale: the Connor–Davidson Resilience Scale (CD-RISC). *Depress. Anxiety* 18, 76–82. doi: 10.1002/da.10113

Crescimbene, M., La Longa, F., Camassi, R., and Pino, N. A. (2015). The seismic risk perception questionnaire. *Geol. Soc.* 419, 69–77. doi: 10.1144/SP419.4

Cuesta, A., Alvear, D., Carnevale, A., and Amon, F. (2022). Gender and public perception of disasters: a multiple hazards exploratory study of EU citizens. *Safety* 8:59. doi: 10.3390/safety8030059

Dooley, D., Catalano, R., Mishra, S., and Serxner, S. (1992). Earthquake preparedness: predictors in a community survey. *J. Appl. Soc. Psychol.* 22, 451–470. doi: 10.1111/j.1559-1816.1992.tb00984.x

Duan, T., Li, Q., Zhang, F., Xi, D., and Lin, N. (2025). Wind forecast and prior community experience are associated with high preparedness for sequential tropical cyclones in the United States. *Commun. Earth Environ.* 6:977. doi: 10.1038/s43247-025-02938-2

Geylani, M., and Göral, S. (2026). Predictive role of psychological resilience on disaster preparedness among psychiatric nurses: a cross-sectional study. *BMC Nurs.* 25:782. doi: 10.1186/s12912-026-04912-5

Ghale, A., Jnawali, K., and Paneru, D. P. (2025). Knowledge on disaster risk reduction among secondary level students of public schools of Pokhara metropolitan city of Nepal. *BMC Public Health* 25:2058. doi: 10.1186/s12889-025-23332-9

Huang, H., Wang, R., Xiao, Y., Li, Y., Zhang, Q.-F., and Xiang, X. (2022). Determinants of people's secondary hazards risk perception: a case study in Wenchuan earthquake disaster areas of China. *Front. Earth Sci.* 10:865143. doi: 10.3389/feart.2022.865143

Hyman, A., Arlikatti, S., Huang, S.-K., Lindell, M. K., Mumpower, J., Prater, C. S., et al. (2022). How do perceptions of risk communicator attributes affect emergency response? An examination of a water contamination emergency in Boston, USA. *Water Resources Res.* 58:e2021. doi: 10.1029/2021WR030669

Kalin, B., and Yeşilyurt, M. (2025). The effect of disaster risk perceptions on disaster preparedness levels of students at a university in Turkey. *BMC Emergency Med.* 25:114. doi: 10.1186/s12873-025-01263-3

Karacaoglu, Ö. C. (2025). Developing a skill-based framework for disaster literacy: insights from the 2023 Turkey earthquake and cross-cultural validation. *J. Hazard Literacy* 1:e15. doi: 10.63737/jhl.25.0023

Karacaoglu, Ö. C., Juran, L., and Trivedi, J. (2026). A skills-based disaster literacy framework to improve disaster preparedness, response, and recovery. *Int. J. Health Literacy Sci.* 4, 63–80. doi: 10.60074/ihelis.v4i1.105

Kolaç, N., Eroglu, N., and Nirgiz, C. (2025). Disaster risk perception and sustainable earthquake awareness among public and private university nursing students. *Public Health Nurs.* 42, 10–22. doi: 10.1111/phn.13430

Kurt, A., Topan, A., and Akkoç, B. (2024). Early childhood stress and behavioural problems in children following the 2023 Kahramanmaraş earthquake in Turkey. *Curr. Psychol.* 43, 32471–32481. doi: 10.1007/s12144-024-06788-7

Lee, R. J. (2026). Satisfied enough to take action? The role of neighborhood perceptions on disaster preparedness behaviors in the United States. *J. Plan. Educ. Res.* 46, 883–895. doi: 10.1177/0739456X251379291

Lin, B.-C., and Lee, C.-H. (2023). Conducting an adaptive evaluation framework of importance and performance for community-based earthquake disaster management. *Nat. Hazards* 115, 1255–1274. doi: 10.1007/s11069-022-05594-3

Lindell, M. K., and Perry, R. W. (2012). The protective action decision model: theoretical modifications and additional evidence. *Risk Analysis* 32, 616–632. doi: 10.1111/j.1539-6924.2011.01647.x

Maghelal, P. K., Lindell, M., Taibah, H., and Arlikatti, S. (2025). Stakeholder's response to COVID-19 using protective action decision model: perception of Saudi citizens. *Jàmbá: J. Disaster Risk Studies* 17:a1886. doi: 10.4102/jamba.v17i1.1886

Mahittikul, N., Wancham, N., Treeranurat, W., Saengtabtim, K., Laosunthara, A., Tang, J., et al. (2024). Examining the factors influencing tsunami evacuation action selection in Thailand: a comprehensive study involving local residents, non-local workers, and travelers. *Sustainability* 16:2024. doi: 10.3390/su16052024

Mastrantonio, R., Cofini, V., Tobia, L., Mastrangeli, G., Guerriero, P., Cipollone, C., et al. (2025). Assessing occupational chemical risk perception in construction workers: a cross-sectional study. *Sustainability* 17:3332. doi: 10.3390/su17083332

McBride, S. K., Smith, H., Morgoch, M., Sumy, D., Jenkins, M., Peek, L., et al. (2022). Evidence-based guidelines for protective actions and earthquake early warning systems. *Geophysics* 87, WA77–WA102. doi: 10.1190/geo2021-0222.1

Nkouaga, F. (2025). Beyond average preparedness: a quantile analysis of earthquake mitigation behaviors among homeowners. *Front. Environ. Economics* 4:1658608. doi: 10.3389/frevc.2025.1658608

Paton, D. (2003). Disaster preparedness: a social-cognitive perspective. *Disaster Prevent. Manag.* 12, 210–216. doi: 10.1108/09653560310480686

Pereira, S. M., Rego, I. E., and Mónico, L., dos S. M. (2024). Revisiting the Person-relative-to-Event (PrE) model of coping with threat: a study in the Azores (Portugal). *Geoenviron. Disasters* 11:29. doi: 10.1186/s40677-024-00294-5

Pérez-Gañán, R., Dema Moreno, S., González Arias, R., and Cocina Díaz, V. (2023). How do women face the emergency following a disaster? A PRISMA 2020 systematic review. *Nat. Hazards* 116, 51–77. doi: 10.1007/s11069-022-05663-7

Rahman, M. M., Shobuj, I. A., Islam, M. R., Islam, M. R., Hossain, M. T., Alam, E., et al. (2024). Flood preparedness in rural flood-prone area: a holistic assessment approach in Bangladesh. *Geomat. Nat. Hazards Risk* 15:2379599. doi: 10.1080/19475705.2024.2379599

Rezabeigi Davarani, E., Farahmandnia, H., Khanjani, N., and Nekoei-Moghadam, M. (2022). The viewpoints of residents of Kerman, Iran regarding the challenges and barriers of preparing households against earthquakes: a theory-guided qualitative content analysis. *Front. Public Health* 10:1036311. doi: 10.3389/fpubh.2022.1036311

Sahin, A. U., Yücel, H., and Kara, B. (2026). Earthquake preparedness in the context of Maslow's hierarchy of needs theory and the risk perception paradox: the role of socioeconomic inequalities in Türkiye. *BMC Public Health* 26:2569. doi: 10.1186/s12889-026-28211-5

Savadori, L., Ronzani, P., Sillari, G., Di Bucci, D., and Dolce, M. (2022). Communicating seismic risk information: the effect of risk comparisons on risk perception sensitivity. *Front. Commun.* 7:743172. doi: 10.3389/fcomm.2022.743172

Slovic, P. (2000). *The Perception of Risk*. Barcelona: Earthscan.

Smith, B. W., Dalen, J., Wiggins, K., Tooley, E., Christopher, P., and Bernard, J. (2008). The brief resilience scale: assessing the ability to bounce back. *Int. J. Behav. Med.* 15, 194–200. doi: 10.1080/10705500802222972

Subedi, S., Valenzuela, N., Dhami, P., Böse, M., Hetényi, G., Chardot, L., et al. (2026). Organizing an Earthquake Learning Exhibition for transferring geoscience knowledge to the public: the example from Nepal. *Geosci. Commun.* 9, 101–114. doi: 10.5194/gc-9-101-2026

Uzun, M., and Atilgan, D. (2026). The relationship between post-earthquake trauma and psychological resilience: a cross-sectional study among teachers. *J. Workplace Behav. Health* Advance online publication. doi: 10.1080/15555240.2026.2660878

Zhang, F., Bao, X., Deng, X., Wang, W., Song, J., and Xu, D. (2022). Does trust help to improve residents' perceptions of the efficacy of disaster preparedness? Evidence from Wenchuan and Lushan earthquakes in Sichuan Province, China. *Int. J. Environ. Res. Public Health* 19:4515. doi: 10.3390/ijerph19084515