

EARTHQUAKE KNOWLEDGE AND PREPAREDNESS AMONG NURSING STUDENTS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Objective: This study investigated the association between earthquake-related knowledge and preparedness among nursing students.

Methods: An analytical cross-sectional study was conducted in January 2026 at Sekolah Tinggi Ilmu Keperawatan PPNI Jawa Barat, Bandung, Indonesia. The participants were 122 fourth-year nursing students recruited through total sampling. Data were collected using a demographic questionnaire, a 26-item earthquake knowledge questionnaire, and a 30-item earthquake preparedness questionnaire. Participant characteristics and study variables were summarized descriptively, and Spearman's rank correlation was used to examine the association between knowledge and preparedness.

Results: Most participants demonstrated good earthquake-related knowledge, while all participants were categorized as having good preparedness. Analysis based on complete paired observations identified a statistically significant moderate inverse association between knowledge and preparedness (Spearman's $\rho = -0.433$, $p < 0.001$). The negative direction of the coefficient requires cautious interpretation because preparedness scores showed limited variation and were concentrated within the highest category.

Conclusion: Earthquake knowledge was significantly associated with preparedness among the nursing students included in this study. However, the inverse relationship and restricted variability in preparedness indicate that knowledge should not be considered an adequate representation of practical disaster readiness by itself. Disaster nursing education should therefore combine theoretical learning with simulation, competency-based assessment, self-efficacy development, and institutional emergency-preparedness activities.

Keywords: disaster nursing; earthquake; knowledge; nursing students; preparedness

1. INTRODUCTION

Indonesia experiences substantial seismic activity because of its location

within a complex tectonic environment associated with several major lithospheric plates and the Pacific Ring of

Fire. Earthquakes can result in mortality, injury, displacement, infrastructure destruction, interruptions to health services, economic consequences, and prolonged psychological effects. During 2025, national monitoring recorded tens of thousands of seismic events, including earthquakes felt by communities and events associated with physical damage (Badan Meteorologi, Klimatologi, dan Geofisika [BMKG], 2026). Consequently, preparedness for earthquakes remains an important public-health concern in Indonesia.

Preparedness encompasses the capabilities and knowledge developed by individuals, organizations, communities, and governments to anticipate and respond to disasters and facilitate recovery (United Nations Office for Disaster Risk Reduction [UNDRR], 2017). This capacity is particularly important within health systems because emergencies can simultaneously increase healthcare needs and disrupt personnel, infrastructure, supplies, communication, and referral mechanisms. Nurses have essential responsibilities in disaster situations, including triage, first aid, evacuation, surveillance, psychosocial care, risk communication, and maintenance of essential health services. Nursing students approaching graduation may also become part of the future disaster-response workforce. Their education should therefore provide

sufficient preparation before they enter professional nursing practice.

Knowledge of earthquakes involves understanding hazards and their consequences, appropriate mitigation strategies, evacuation procedures, and protective behaviors required before, during, and after an earthquake. Such knowledge facilitates hazard recognition and informed decision-making. Nevertheless, possessing information does not necessarily ensure appropriate action during an emergency. Longo (2021) identified gaps in nursing students' understanding of recommended self-protective behaviors during earthquakes. Similarly, Mohamed et al. (2023) reported that nursing students could demonstrate adequate knowledge and favorable attitudes despite inadequate preparedness practices. These observations illustrate a potential gap between knowing what should be done and being able to translate that knowledge into effective action. Practical training, self-efficacy, simulation experience, and institutional support may therefore complement theoretical understanding.

Evidence from Indonesia also demonstrates variation in nursing students' disaster preparedness. Widyastuti et al. (2023) identified a significant association between earthquake knowledge and preparedness among students in Surabaya and Bangkalan. Conversely,

Rahayu and Khoiriyati (2019) reported that favorable knowledge and attitudes did not necessarily correspond with adequate emergency planning or resource mobilization. Other studies suggest that preparedness may differ according to training opportunities, educational exposure, institutional circumstances, and previous experience (Darmareja et al., 2022; Fitriyani et al., 2021; Nurdawati et al., 2024). Findings from one educational setting may therefore not fully represent students studying within different curricular or institutional environments.

Evidence specifically addressing the relationship between earthquake knowledge and preparedness among senior nursing students in West Java remains limited. This population is particularly relevant because West Java is exposed to seismic hazards, while senior students have generally received greater academic and clinical exposure than students at earlier stages of their education. Examining this group may provide insight into whether knowledge acquired through nursing education corresponds with students' perceived readiness to respond to earthquakes.

Accordingly, this study examined the association between earthquake-related knowledge and preparedness among fourth-year nursing students at Sekolah Tinggi Ilmu Keperawatan PPNI Jawa Barat. The study also described participants' demographic characteristics

and levels of knowledge and preparedness and evaluated the direction, magnitude, and statistical significance of the relationship between the two variables. The findings may contribute to understanding disaster preparedness as a multidimensional construct and provide evidence for strengthening disaster-nursing education, simulation activities, competency assessment, and institutional emergency planning.

2. METHODS

2.1 Study Design

This study employed a quantitative analytical cross-sectional design. Earthquake-related knowledge was defined as the independent variable, whereas earthquake preparedness was considered the dependent variable. Both variables were assessed during a single data-collection period, with no educational intervention or clinical treatment introduced. This design was selected to examine the association between knowledge and preparedness within a defined population of nursing students.

2.2 Study Setting and Period

The study was undertaken at Sekolah Tinggi Ilmu Keperawatan PPNI Jawa Barat, Bandung, West Java, Indonesia, in January 2026. The institution provides undergraduate nursing education that incorporates disaster-related material

and learning activities within its curriculum.

2.3 Population, Sample, and Sampling Technique

The study population included all active fourth-year, or seventh-semester, nursing students registered during the 2025/2026 academic year. A total of 122 students constituted the accessible population. Given the manageable population size and accessibility of all eligible students, total sampling was employed and the entire eligible cohort was invited to participate.

Eligibility criteria included active enrollment in the designated cohort, willingness to participate, and completion of the research questionnaire. Students who declined participation or submitted substantially incomplete questionnaires were excluded from the relevant analyses. Descriptive analyses were conducted for 122 respondents, whereas the bivariate analysis was based on complete paired observations available in the dataset.

2.4 Variables and Operational Definitions

Earthquake knowledge was the independent variable and represented participants' cognitive understanding of earthquake hazards, consequences, mitigation strategies, and recommended protective behaviors. Knowledge was assessed using the designated

knowledge questionnaire, with higher total scores representing greater knowledge.

Earthquake preparedness was the dependent variable and referred to participants' reported readiness to respond appropriately before, during, and after an earthquake across different environmental situations, including circumstances involving tsunami risk. Preparedness was assessed using the designated preparedness questionnaire.

2.5 Data Collection Instruments

Three instruments were used for data collection. The first questionnaire obtained demographic information, including participants' age and sex.

Earthquake-related knowledge was measured using a questionnaire adapted from the instrument used by Robby and colleagues. The version administered in this study consisted of 26 items addressing previous exposure to disaster education, fundamental earthquake concepts, earthquake-related risks, and self-rescue measures. Correct answers received four points, whereas incorrect responses received zero points. Total scores were grouped into good, moderate, and poor categories according to the criteria specified for the original instrument. The source instrument reported a Cronbach's alpha coefficient above 0.60.

Preparedness was assessed using a questionnaire adapted from Aulia's

instrument. The questionnaire consisted of 30 closed-response items organized into six areas: fundamental earthquake concepts, actions before an earthquake, responses during an earthquake while indoors, responses in public settings, outdoor actions, and preparedness for earthquakes associated with tsunami risk. Responses of “Yes” received one point and “No” received zero points. Overall scores were classified into good, moderate, or poor preparedness according to the original instrument. The reported reliability coefficient for this questionnaire was 0.915.

2.6 Data Collection Procedure

Data collection commenced after institutional authorization and ethical approval had been obtained. Eligible participants received information regarding the purpose and procedures of the study, voluntary participation, confidentiality, and their right to withdraw. Students who agreed to participate provided informed consent before completing the questionnaires. Completed questionnaires were reviewed for completeness. Responses were subsequently coded and entered into a statistical database. Data cleaning was performed before statistical analysis. As the study was cross-sectional, there was no intervention, comparison group, pretest, or posttest.

2.7 Statistical Analysis

Data were processed using IBM SPSS Statistics version 26. Frequencies and percentages were calculated for categorical variables, while age was summarized using the mean, standard deviation, minimum, and maximum values. The distribution of the study variables was evaluated using the Kolmogorov–Smirnov test together with inspection of the data distribution. Because the assumptions required for parametric correlation were not satisfied, Spearman's rank correlation was selected to assess the relationship between earthquake knowledge and preparedness.

Statistical significance was established at $p < 0.05$. The absolute value of the correlation coefficient was used to characterize the magnitude of the relationship, whereas its positive or negative sign indicated the direction of the association.

2.8 Ethical Considerations

The research was conducted in accordance with ethical principles concerning respect for persons, beneficence, non-maleficence, justice, privacy, and confidentiality. Ethical approval was granted by the Research Ethics Committee of Sekolah Tinggi Ilmu Keperawatan PPNI Jawa Barat. Participation was voluntary, written informed consent was obtained from all participants, and identifying information

was not incorporated into the analytical dataset.

3. RESULTS

3.1 Participant Characteristics

A total of 122 nursing students participated. Almost all participants were between 20 and 24 years of age, with only one participant belonging to the 25–27-year age group. The mean age was 21.84 years (SD = 0.982; range = 20–

27 years). Female students constituted the majority of the sample.

3.2 Earthquake-Related Knowledge

Most participants demonstrated a good level of earthquake-related knowledge. A smaller proportion was categorized as having moderate knowledge, while only a small number were included in the poor-knowledge category.

Table 1. Demographic characteristics of participants (N = 122)

Characteristic	Frequency (n)	Percentage (%)
Age (years)		
20–24	121	99.2
25–27	1	0.8
Sex		
Male	23	18.9
Female	99	81.1

Note. Mean age = 21.84 years; SD = 0.982; range = 20–27 years.

Table 2. Distribution of earthquake-related knowledge

Knowledge category	Frequency (n)	Percentage (%)
Good	94	77.7
Moderate	25	20.7
Poor	2	1.7

Table 3. Distribution of earthquake preparedness

Preparedness category	Frequency (n)	Percentage (%)
Good	122	100.0
Moderate	0	0.0
Poor	0	0.0

Table 4. Spearman correlation between earthquake knowledge and preparedness

Variables	Complete cases (n)	Spearman's rho	p value	Interpretation
Knowledge and preparedness	121	-0.433	<0.001	Significant, moderate inverse association

3.3 Earthquake Preparedness

All 122 participants were categorized as having good earthquake preparedness. No participants were classified in either the moderate or poor category. Although these results indicate high self-reported preparedness, the absence of variation across preparedness categories should be considered when interpreting subsequent findings.

3.4 Association Between Earthquake Knowledge and Preparedness

Spearman's rank correlation demonstrated a statistically significant association between earthquake knowledge and preparedness. The coefficient indicated a moderate relationship in magnitude but an inverse direction ($\rho = -0.433$, $p < 0.001$). Thus, within the analyzed dataset, higher knowledge scores corresponded with lower preparedness scores.

Because the observed direction differs from the theoretically expected positive relationship, this result should be interpreted conservatively. In particular, confirmation of instrument scoring, data coding, missing-data procedures, and the distribution of continuous preparedness scores is required before a substantive

explanation of the inverse association can be established.

4. DISCUSSION

This study investigated earthquake-related knowledge and preparedness among senior nursing students and examined the relationship between these two variables. Three findings warrant particular attention. Most participants demonstrated good earthquake knowledge, all were categorized as having good preparedness, and the two variables were significantly associated. Unexpectedly, however, the observed association was moderately negative. The first two findings indicate substantial cognitive and perceived preparedness within the cohort, whereas the inverse association requires more cautious interpretation.

The predominance of good knowledge may be related to the participants' stage of nursing education and their exposure to disaster-related learning. As senior students, participants had opportunities to encounter disaster nursing through classroom teaching, clinical learning, seminars, information from various media, and institutional learning activities. Disaster-nursing coursework

and earthquake simulations available within the study setting may also have contributed to their understanding of earthquake hazards, evacuation, self-protection, and nursing responsibilities during emergencies.

This result is broadly consistent with Widyastuti et al. (2023), who reported good knowledge among many nursing students in Surabaya and Bangkalan and identified an association between knowledge and earthquake preparedness. Longo (2021) also highlighted the importance of earthquake education and drills for nursing students, although gaps in recommended protective behaviors remained evident. International findings further indicate that nursing students may possess disaster knowledge and favorable attitudes while continuing to report limited competence and unmet educational needs (Abou Hashish & Banoona, 2023; Wang et al., 2023). Therefore, classification within a good knowledge category primarily reflects cognitive understanding and should not automatically be interpreted as comprehensive disaster competence.

Another notable finding was that every participant was categorized as having good preparedness. Previous Indonesian studies have reported different patterns. Rahayu and Khoiriyati (2019), for example, found weaknesses in overall preparedness despite relatively strong knowledge and attitudes, particularly in

emergency planning and resource mobilization. Fitriyani et al. (2021) reported that most participants demonstrated moderate preparedness. By contrast, the present finding is more comparable with Darmareja et al. (2022), who found that most diploma nursing students were ready or highly ready to respond to earthquakes.

Differences among studies may reflect variation in participant characteristics, academic level, curricula, exposure to hazards, frequency of disaster training, institutional preparedness, and measurement approaches. Consequently, preparedness estimates obtained using different populations or instruments should not be interpreted as directly equivalent.

The finding that 100% of participants belonged to the highest preparedness category also warrants methodological consideration. It may indicate genuinely high perceived readiness within this cohort; however, it may also reflect limited discrimination of the categorization thresholds or a ceiling effect. Furthermore, questionnaire-based preparedness primarily represents reported readiness rather than observed performance. Knowing the appropriate response to a questionnaire item does not necessarily demonstrate that an individual can perform the same action accurately during an actual emergency characterized by uncertainty, time pressure, environmental disruption, and

emotional stress. Mohamed et al. (2023), for example, reported a distinction between disaster knowledge and attitudes and actual preparedness practices among nursing students.

The significant association observed in this study indicates that earthquake knowledge and preparedness were related within the study population. Nevertheless, preparedness should not be conceptualized solely as an accumulation of factual knowledge. The UNDRR (2017) conceptualization encompasses both knowledge and capacities and incorporates components such as planning, coordination, evacuation, public information, exercises, and training. From this perspective, knowledge represents one component of preparedness, while practical ability, confidence, available resources, and organizational arrangements influence whether knowledge can be translated into effective disaster response.

Recent educational evidence supports this broader understanding. Erkin and Kiyan (2025) reported improvements in disaster literacy and perceived preparedness following integration of disaster nursing into nursing education. Genç et al. (2025) similarly demonstrated improvements in disaster literacy and preparedness beliefs through a structured educational intervention using digital and active-learning approaches.

The inverse coefficient observed in the present study is nevertheless inconsistent with the expected direction of the relationship. It also differs from research demonstrating positive associations between preparedness-related constructs. İşleyen and Demirkaya (2024), for example, identified a moderate positive relationship between disaster-response self-efficacy and preparedness perceptions among nursing students after a major earthquake.

Several possible explanations should be considered without assuming that any single explanation accounts for the finding. Instrument scoring or data coding may influence the direction of the coefficient. Restricted variability at the upper end of preparedness scores may also affect the stability of the association. Another possibility is that students with greater knowledge evaluate their own readiness more critically because they have a better understanding of the complexity and demands of disaster response. Alternatively, theoretical knowledge may not correspond directly with practical readiness when opportunities for repeated drills and performance-based assessment are limited.

Importantly, the present result cannot be interpreted as evidence that increasing earthquake knowledge causes preparedness to decline. The cross-sectional design establishes an

association at one point in time and cannot determine causal direction. The negative coefficient should therefore be interpreted only after the original scoring procedures, coding decisions, raw scores, and missing observations have been confirmed. On the basis of the current findings, the appropriate conclusion is that knowledge and preparedness were significantly associated, while the nature of the inverse relationship requires further investigation.

From a theoretical perspective, these findings are compatible with an understanding of disaster preparedness as a multidimensional phenomenon. Readiness to respond to earthquakes may involve the interaction of cognitive knowledge, attitudes, risk perception, practical ability, confidence, previous experience, psychological preparedness, and institutional support. The transition from knowing an appropriate response to performing it effectively should therefore not be assumed to occur automatically.

Future research could examine whether factors such as self-efficacy, previous disaster experience, simulation exposure, and institutional readiness help explain the relationship between knowledge and preparedness. Including these variables may provide a more comprehensive account of why students with similar levels of theoretical knowledge can differ in their capacity or perceived readiness to respond.

The findings also have practical implications for nursing education. Disaster education should extend beyond lectures and knowledge-based examinations. Scenario-based learning, evacuation exercises, tabletop activities, triage simulations, first-aid practice, communication exercises, and interprofessional disaster training may provide opportunities for students to translate conceptual knowledge into observable skills. Assessment should likewise include performance-based measures of decision making, safety procedures, communication, teamwork, and reflective learning. Intervention studies have indicated that active, digital, and simulation-based educational approaches can strengthen disaster literacy, preparedness beliefs, and disaster-related competence (Erkin & Kiyani, 2025; Genç et al., 2025; Hill et al., 2025).

Preparedness also requires institutional support. Nursing schools should maintain clear emergency procedures, evacuation routes, assembly areas, communication mechanisms, and collaboration with relevant disaster-response organizations, emergency services, hospitals, and community partners. Students need to understand not only personal protective actions but also their roles within coordinated emergency-response systems. Regular exercises followed by structured debriefing may help transform

preparedness from theoretical knowledge into routine organizational practice.

Limitations

Several limitations should be considered when interpreting the findings. First, the cross-sectional design does not permit causal conclusions. Second, participants were recruited from a single nursing institution and represented a relatively homogeneous cohort, which restricts the generalizability of the findings. Third, preparedness was assessed through self-report rather than direct observation, making the results susceptible to response and social-desirability biases. Fourth, the concentration of participants in the highest preparedness category suggests restricted variability and a potential ceiling effect. Fifth, potentially relevant variables—including previous disaster experience, frequency of simulation participation, self-efficacy, risk perception, and family emergency planning—were not included in the analysis. Finally, the inverse correlation, discrepancy between the total sample and complete cases, and the total number reported across knowledge categories require confirmation against the original dataset and scoring procedures.

5. CONCLUSION

Most nursing students demonstrated good earthquake-related knowledge, and all participants were categorized as

having good preparedness. Earthquake knowledge and preparedness were significantly associated, although the relationship was moderate and inverse. Given the restricted variation in preparedness and the unexpected direction of the coefficient, this finding should be interpreted cautiously.

The results reinforce the view that disaster preparedness extends beyond cognitive knowledge. Nursing education should integrate theoretical instruction with repeated simulation, observable competency assessment, opportunities to strengthen self-efficacy, and institution-wide emergency preparedness. Future studies involving broader populations and direct measures of disaster-response performance are needed to clarify the relationship between knowledge and preparedness.

6. RECOMMENDATIONS

Nursing education programs should incorporate disaster-related competencies across the curriculum rather than limiting them to a single learning experience. Simulation and other performance-based assessments should complement questionnaire measures of preparedness to provide a more direct evaluation of students' ability to respond.

Educational institutions should also conduct regular disaster exercises addressing evacuation, triage, first aid, emergency communication, and decision

making in situations involving potential tsunami hazards. Future research should involve multiple institutions and more heterogeneous samples and consider variables such as previous disaster experience, exposure to training and simulation, self-efficacy, risk perception, and organizational preparedness.

DECLARATIONS

Ethics approval and consent to participate

Ethical approval was obtained from the Research Ethics Committee of Sekolah Tinggi Ilmu Keperawatan PPNI Jawa Barat. Written informed consent was obtained from all participants.

Consent for publication

Not applicable.

Availability of data and materials

The dataset may be obtained from the corresponding author upon reasonable request and subject to applicable ethical and institutional requirements.

Competing interests

The authors declare no competing interests.

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Author Contribution

NNPC, R, NN, and NE contributed to the development and completion of the

study and manuscript. NE contributed to the conception of the study, data collection, data analysis, and preparation of the initial manuscript. NNPC contributed to study supervision, methodological review, interpretation of the findings, and critical revision of the manuscript. R and NN contributed to the review and revision of the manuscript. All authors reviewed and approved the final version of the manuscript.

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