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Effectiveness of Community-Based Education in Improving Community Knowledge of Disasters and Public Health

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ABSTRACT
Indonesia remains one of the world's most disaster-prone countries, recording more than 2,900 disaster events in 2025. Despite this high risk, community literacy regarding disaster preparedness and public health remains inadequate, particularly concerning emergency sanitation, disease prevention, and clean and healthy living behaviors. Purpose: This study evaluated the effectiveness of community-based education in improving community knowledge of disasters and public health. Method: A one-group pretest–posttest design was conducted in January 2026 involving 45 participants selected using purposive sampling. Participants consisted of community leaders, health cadres, and community members. Knowledge was measured using a structured questionnaire that had demonstrated acceptable content validity through expert review and good internal consistency (Cronbach's a = 0.87). Data were analyzed using descriptive statistics and a paired-sample t-test at a significance level of p<0.05. Results: Mean knowledge scores increased significantly from 61.42±11.35 before the intervention to 84.71±8.26 after education (mean difference=23.29 points; t=17.15; p<0.001). Implications: Community-based education can strengthen community disaster preparedness by improving disaster and public health literacy. Conclusion: Community-based education is an effective strategy for increasing disaster and public health knowledge and should be integrated into sustainable community preparedness programs.

Keywords: *Community-Based Education, Disaster Management, Public Health, Preparedness, Disaster Risk Reduction*

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INTRODUCTION

Indonesia is recognized as one of the countries most vulnerable to disasters because it is located at the convergence of the Indo-Australian, Eurasian, and Pacific tectonic plates and is strongly influenced by hydrometeorological hazards associated with climate change. According to the Indonesian National Disaster Management Agency (BNPB), more than 2,900 disaster events occurred throughout 2025, predominantly floods, landslides, extreme weather, and forest and land fires, affecting millions of people and causing substantial social, environmental, and economic losses. These increasing disaster trends highlight that disaster risk reduction should become an integral component of sustainable public health and community development rather than merely an emergency response strategy.

Disasters not only damage infrastructure but also disrupt essential health services and environmental sanitation systems. Damage to clean water facilities, sanitation infrastructure, and waste management systems frequently increases the incidence of communicable diseases, including acute respiratory infections, diarrheal diseases, skin infections, and other environmentally related illnesses. Furthermore, overcrowding in evacuation shelters and inadequate hygiene practices further increase disease transmission risks among disaster-affected populations (Fatoni et al., 2023; Mauleky & Lasaiba, 2025; Putri et al., 2023).

Besides physical health impacts, disasters generate considerable psychosocial consequences. Psychological stress, anxiety, depression, and trauma may persist long after disasters occur, particularly among vulnerable populations such as children, older adults, pregnant women, and people with disabilities. These groups often experience limited access to health information and emergency services, making inclusive preparedness strategies essential for minimizing disaster-related health inequalities (Mutianingsi & Mustikasari, 2019; Sanjaya et al., 2024).

Community preparedness has consistently been identified as one of the strongest determinants of disaster resilience. Previous studies demonstrated that individuals with higher disaster awareness tend to exhibit better preparedness behaviors and greater adaptive capacity during emergencies (Hargono et al., 2023). Nevertheless, disaster education programs implemented in Indonesia have largely concentrated on evacuation procedures, emergency response, and physical mitigation measures, while public health components—including emergency sanitation, clean water management, communicable disease prevention, clean and healthy living behaviors (PHBS), and family health preparedness—remain insufficiently integrated into educational interventions.

Several recent studies have reported positive effects of community education and psychoeducation on disaster preparedness. Renidayati et al. (2025) demonstrated that community-based psychoeducation significantly improved disaster preparedness among residents in West Sumatra. Similarly, Sofyana et al. (2024) reported that integrating disaster preparedness training into Public Health Nursing effectively strengthened community preparedness capacities. Furthermore, Vandrevala et al. (2024), through a systematic review, emphasized that effective health emergency communication substantially enhances community resilience during disasters.

However, important research gaps remain. Previous studies have primarily evaluated disaster preparedness from the perspective of evacuation readiness, early warning systems, or general disaster awareness. Few studies have simultaneously integrated disaster education with comprehensive public health topics, including environmental sanitation, disease prevention, healthy behaviors, and household preparedness within a single community-based educational

intervention. Moreover, evidence regarding the effectiveness of integrated disaster–public health education among heterogeneous community populations with varying educational backgrounds remains limited, particularly in disaster-prone urban communities in Indonesia.

The novelty of this study lies in the implementation and evaluation of an integrated community-based educational model that combines disaster risk reduction and public health promotion into a single participatory intervention. Unlike previous studies that focused primarily on disaster preparedness alone, this educational model simultaneously addresses disaster mitigation, emergency sanitation, communicable disease prevention, clean and healthy living behaviors (PHBS), family preparedness, and first aid using interactive learning, group discussion, and simulation approaches. This integrated model is expected to strengthen community health literacy while enhancing disaster preparedness more comprehensively.

The conceptual foundation of this study is supported by the Community-Based Disaster Risk Reduction (CBDRR) framework, which emphasizes active community participation in identifying risks, developing local capacities, and implementing sustainable preparedness strategies (Sulistiadi et al., 2024; Renidayati et al., 2025). This framework is complemented by health promotion theory, which suggests that improvements in knowledge constitute the first step toward behavioral change and long-term community resilience.

Therefore, this study aimed to evaluate the effectiveness of community-based education in improving community knowledge regarding disasters and public health among residents of Kuranji Village, Padang City. The findings are expected to provide empirical evidence supporting the integration of disaster risk reduction and public health education into sustainable community preparedness programs, particularly in disaster-prone settings.

METHODS

This study employed a pre-experimental one-group pretest–posttest design to evaluate the effectiveness of community-based education in improving community knowledge regarding disasters and public health. The educational intervention was conducted in January 2026 in Kuranji Village, Padang City, West Sumatra, Indonesia, an area characterized by relatively high disaster risk due to its vulnerability to flooding, earthquakes, and landslides. The intervention adopted a participatory learning approach that actively involved community members throughout the educational process, with activities facilitated collaboratively by academics, health professionals, and local community leaders.

Participants were recruited using a purposive sampling technique to ensure the inclusion of individuals expected to play an active role in disseminating disaster preparedness information within the community. Eligible participants included community leaders, health cadres, household representatives, and adult residents who had lived permanently in Kuranji Village for at least one year. The inclusion criteria comprised individuals aged 18 years or older, able to communicate in Indonesian, willing to participate throughout the educational activities, and providing written informed consent. Participants who did not complete both the pretest and posttest questionnaires, withdrew before completion of the intervention, or submitted incomplete questionnaires were excluded from the analysis. Based on the formula for paired mean comparison in a one-group pretest–posttest design, assuming a significance level of 5%, statistical power of 80%, and a moderate expected effect size (Cohen's $d = 0.50$), the minimum required sample size was 34 participants. After

allowing for a potential non-response rate of approximately 25%, the target sample increased to 43 participants. A total of 45 participants completed all study procedures and were included in the final analysis.

The educational intervention was developed according to the principles of Community-Based Disaster Risk Reduction (CBDRR). Educational materials covered disaster risk identification, disaster mitigation, household preparedness, emergency sanitation, clean and healthy living behaviours (PHBS), communicable disease prevention following disasters, safe drinking water management, solid waste management, and basic first aid. Learning activities consisted of interactive lectures, facilitated group discussions, question-and-answer sessions, case-based problem solving, and disaster preparedness simulations. This participatory approach encouraged participants to identify disaster risks within their own environment and formulate practical preparedness strategies that could be implemented at the household and community levels.

Participants' knowledge was assessed using a structured self-administered questionnaire developed based on the disaster preparedness guidelines of the Indonesian National Disaster Management Agency (BNPB), the Indonesian Ministry of Health guidelines on disaster health management, and relevant scientific literature. The questionnaire consisted of 25 multiple-choice items distributed across six domains, namely disaster risk recognition, disaster mitigation, household preparedness, emergency sanitation, clean and healthy living behaviours (PHBS), and prevention of disaster-related communicable diseases. Each correct answer was scored as one point, whereas incorrect responses received zero points, with total scores converted into percentages ranging from 0 to 100, where higher scores reflected better knowledge.

Content validity of the questionnaire was evaluated by three experts in disaster management, environmental health, and public health education, with all items demonstrating satisfactory relevance and clarity, indicated by an Item Content Validity Index (I-CVI) of at least 0.80. Prior to implementation, the questionnaire was pilot-tested among 30 community members outside the study area to evaluate its reliability. Internal consistency testing demonstrated good reliability, with a Cronbach's alpha coefficient of 0.87, indicating that the instrument was appropriate for measuring community knowledge regarding disasters and public health.

Data collection was conducted in two stages. Baseline knowledge was measured immediately before the educational intervention using the pretest questionnaire, while post-intervention knowledge was assessed using the same questionnaire immediately after all educational sessions and simulation activities had been completed. Sociodemographic information, including participants' age, sex, educational level, and occupation, was also collected using a standardized participant information form.

Data were analyzed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize participant characteristics and knowledge scores, including frequencies, percentages, means, and standard deviations. The normality of knowledge score distributions was examined using the Shapiro–Wilk test. Since both pretest and posttest scores satisfied the assumption of normality ($p>0.05$), differences between measurements were analyzed using the paired-sample *t*-test. All statistical analyses were two-tailed, and statistical significance was established at a p-value of less than 0.05.

Ethical approval for this study was obtained from the Health Research Ethics Committee of Akademi Kebidanan Menara Primadani Soppeng under approval number No. 367/KEPK/2026

prior to participant recruitment. Before data collection, all participants received written and verbal explanations regarding the study objectives, procedures, potential benefits, and their rights as research participants. Written informed consent was obtained from every participant, and confidentiality was maintained throughout the study by anonymizing all participant information and reporting findings only in aggregate form.

RESULTS

1. Characteristics of Activity Participants

The community-based educational activity was attended by 45 participants from the Kuranji Subdistrict community in Padang City. Participant characteristics are presented in Table 1.

Table 1. Characteristics of Activity Participants (n = 45)

Characteristics	Frequency (f)	Percentage (%)
Age		
18–35 years	12	26.7
36–50 years	18	40.0
>50 years	15	33.3
Gender		
Man	17	37.8
Woman	28	62.2
Education		
Elementary/Middle School	10	22.2
High School/Vocational School	24	53.3
College	11	24.5
Work		
Housewife	16	35.6
Self-employed	11	24.4
Farmers/Laborers	8	17.8
Employee	6	13.3
Other	4	8.9
Total	**45**	**100**

Participant characteristics indicate that community-based education activities successfully reached a diverse group of people across various ages, educational levels, and occupational backgrounds. The diversity of participant characteristics indicates that the educational program was not only accepted by a specific group but also attracted broader community participation. The involvement of the productive age group demonstrates significant potential in the process of disseminating disaster and health information to family members and the surrounding community. Furthermore, the high level of female participation provides a good opportunity to strengthen family preparedness, given that women generally play a crucial role in managing household health and protecting family members during emergencies. The varying educational levels of participants also indicate that the material provided was acceptable to people with varying literacy skills, thus the community-based education approach used was deemed sufficiently inclusive and appropriate to the conditions of the target community.

2. Knowledge Level Before and After Education

The results of measuring participants' knowledge before and after implementing community-based education are presented in Table 2.

Table 2. Distribution of Participants' Knowledge Scores Before and After Educational Intervention (n = 45)

Variables	Mean ± SD	Median	Minimum	Maximum
Pretest	61.42 ± 11.35	62.00	38	82
Posttest	84.71 ± 8.26	86.00	65	98
Score Difference	23.29 ± 9.11	24.00	5	42

The knowledge assessment results showed an increase in participants' understanding of various aspects of disaster management and public health after participating in the education program. These changes indicate that the material provided enhanced participants' understanding of disaster risks, mitigation measures, family preparedness, environmental sanitation, and the prevention of diseases that could potentially arise in disaster situations. These findings demonstrate that the participatory learning process provided participants with the opportunity to gain a deeper understanding of the material through interactions, discussions, and simulations relevant to everyday life. The increased knowledge also reflects the community's need for practical disaster and health information that is easily applicable in the local context. Therefore, community-based education can be an effective strategy for increasing community capacity to respond to disaster threats.

3. Normality Test Results

Before analyzing the differences in knowledge scores, a normality test was carried out using Shapiro-Wilk as shown in Table 3.

Table 3. Results of the Knowledge Data Normality Test

Variables	Shapiro-Wilk Statistics	p-value
Pretest	0.972	0.218
Posttest	0.964	0.132

The results of the normality test indicate that the distribution of participants' knowledge data meets the assumption of normality, allowing for analysis using parametric statistical tests. This condition indicates that the distribution of participants' knowledge scores before and after the intervention is relatively even and shows no significant deviations. Fulfilling the assumption of normality provides a strong basis for further testing the effectiveness of the educational program using mean comparison analysis. Furthermore, these results indicate that changes in participants' knowledge scores can be analyzed more accurately, thus providing a higher level of validity in conclusions regarding the effect of the educational intervention on increasing knowledge.

4. Effectiveness of Community-Based Education on Participants' Knowledge

The results of the Paired Sample t-Test are shown in Table 4.

Table 4. Results of the Paired Sample t-Test of Participants' Knowledge Before and After Education (n = 45)

Variables	Mean ± SD	Mean Difference	t	p-value
Pretest	61.42 ± 11.35	23.29	17.15	<0.001

Posttest	84.71 ± 8.26

The analysis results show that community-based education significantly increased participants' knowledge about disasters and public health. This finding indicates that the educational intervention achieved the program's objectives, namely increasing community capacity to understand disaster risks and the health protection measures that need to be taken before, during, and after a disaster. The program's effectiveness was supported by the use of interactive and participatory learning methods, enabling participants not only to obtain information but also to engage in reflection and problem-solving processes related to their environmental conditions. These results demonstrate that community-based education is a relevant approach to strengthening community preparedness and building resilience to various disaster threats. The increased knowledge gained by participants is expected to form the basis for developing more adaptive attitudes and behaviors in dealing with emergency situations and in maintaining environmental health in a sustainable manner.

DISCUSSION

1. Improvement in Participants' Knowledge

The present study demonstrated a significant improvement in participants' knowledge following the community-based educational intervention. Mean knowledge scores increased by 23.29 points (37.9%), indicating that the intervention effectively enhanced participants' understanding of disaster preparedness and public health. These findings suggest that integrating disaster risk reduction with health promotion within a participatory educational model can improve community disaster literacy more effectively than conventional information delivery.

One possible explanation for this improvement is the participatory learning process implemented throughout the intervention. Rather than relying solely on lectures, participants actively engaged in discussions, simulations, and problem-solving activities based on local disaster experiences. Active participation enables learners to connect newly acquired information with previous experiences, thereby facilitating deeper understanding and better knowledge retention. This mechanism is consistent with Community-Based Disaster Risk Reduction (CBDRR), which emphasizes community participation as the foundation for strengthening local preparedness and resilience (Renidayati et al., 2025).

The findings are consistent with previous studies reporting the effectiveness of participatory educational approaches in improving disaster preparedness. Renidayati et al. (2025) demonstrated significant improvements in community preparedness following community-based psychoeducation, while Sofyana et al. (2024) reported that integrating disaster preparedness into Public Health Nursing substantially enhanced community capacity in disaster-prone areas. Collectively, these studies indicate that educational interventions become more effective when participants are actively involved throughout the learning process.

Another important finding is that participants with relatively low educational backgrounds were able to achieve substantial improvements in knowledge after the intervention. These findings may indicate that participatory education reduces learning barriers by emphasizing experiential learning rather than formal educational attainment. Consequently, community-based education may represent an inclusive strategy applicable to populations with heterogeneous literacy levels.

2. Effectiveness of Community-Based Education

The paired-sample *t*-test demonstrated a statistically significant difference between pretest and posttest knowledge scores ($t = 17.15$; $p < 0.001$), confirming the effectiveness of the educational intervention. The magnitude of this improvement suggests that the observed changes were attributable to the intervention rather than random variation.

From the perspective of health promotion theory, the educational strategy successfully strengthened participants' cognitive capacity by providing understandable, relevant, and context-specific information. Interactive discussions and simulation activities also promoted observational learning and improved participants' confidence in applying disaster preparedness measures in daily life. This interpretation is consistent with social cognitive theory, which emphasizes that behavioural change begins with increased knowledge and self-efficacy.

The present findings also support recent evidence highlighting the importance of community engagement in disaster risk reduction. Vandrevala et al. (2024) concluded that effective community communication substantially contributes to resilience during health emergencies. Likewise, Ravazzoli et al. (2025) reported that participatory approaches are most successful when communities are actively involved throughout disaster risk reduction planning and implementation. The current study extends this evidence by demonstrating that integrating disaster preparedness with public health education provides measurable improvements in community knowledge.

3. Practical Implications

The findings have several practical implications for disaster risk reduction programs in Indonesia. First, community-based disaster education should be integrated into routine community activities, including village meetings, women's organizations (PKK), youth organizations, and community health posts, to ensure continuous knowledge reinforcement. Second, local health cadres and community leaders should receive regular training-of-trainers (ToT) so they can function as sustainable agents of change within their communities.

Third, collaboration among local governments, public health centres (Puskesmas), the Regional Disaster Management Agency (BPBD), universities, and community organizations should be strengthened to develop integrated disaster preparedness programs that combine disaster mitigation, environmental sanitation, communicable disease prevention, and healthy lifestyle promotion. Such multisectoral collaboration may improve community resilience while reducing disaster-related health risks.

4. Study Limitations

Several limitations should be considered when interpreting these findings. First, the one-group pretest–posttest design without a comparison group limits causal inference because external influences during the intervention period could not be fully controlled. Second, knowledge was assessed only immediately after the intervention, preventing evaluation of long-term knowledge retention. Third, the relatively small sample size and purposive sampling technique may limit the generalizability of the findings to broader populations.

Future studies should employ quasi-experimental or randomized controlled designs involving larger and more diverse populations. Longitudinal follow-up at three, six, and twelve

months is also recommended to evaluate knowledge retention, behavioural changes, and long-term community resilience outcomes.

CONCLUSIONS

Community-based education significantly improved community knowledge regarding disasters and public health, demonstrating its effectiveness as an educational strategy for strengthening disaster preparedness. The participatory learning approach enabled participants to better understand disaster mitigation, environmental sanitation, disease prevention, and household preparedness through contextual and interactive learning experiences.

These findings support the integration of community-based disaster and public health education into routine community empowerment programs, accompanied by strengthened collaboration among health services, disaster management agencies, local governments, and academic institutions. Future studies employing stronger experimental designs and long-term follow-up are recommended to evaluate the sustainability of behavioural changes and community resilience after educational interventions.

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