

Integrating Public Health and Community-Based Disaster Risk Reduction: Effectiveness of Disaster Alert Group Formation in Enhancing Preparedness in Disaster-Prone Communities

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ABSTRACT

Indonesia is among the world's most disaster-prone countries, where disasters frequently disrupt public health systems and increase community health risks. Although Community-Based Disaster Risk Reduction (CBDRR) has been widely implemented, evidence regarding the integration of disaster preparedness with public health remains limited. This study aimed to evaluate the effectiveness of establishing community-based disaster alert groups in improving public health preparedness among disaster-prone communities in Agam Regency, West Sumatra. A mixed-methods study employing a quasi-experimental one-group pretest-posttest design combined with a Community-Based Participatory Research approach was conducted among 60 purposively selected residents. Preparedness knowledge, attitudes, and practices were assessed using a validated questionnaire (Cronbach's $\alpha = 0.82-0.88$). Quantitative data were analyzed using paired-sample *t*-tests and Cohen's *d* effect sizes, while qualitative data were examined through Braun and Clarke's thematic analysis. Significant improvements were observed in preparedness knowledge (mean increase = 22.15; $d = 1.66$; $p < 0.001$), attitudes (19.15; $d = 1.46$; $p < 0.001$), and practices (21.65; $d = 1.68$; $p < 0.001$). Qualitative analysis identified six themes, including enhanced disaster-health literacy, greater community ownership, strengthened preparedness practices, improved risk communication, reinforced social capital, and sustainability challenges. Overall, integrating public health education, disaster simulations, and community-based disaster alert groups effectively strengthened disaster preparedness and community resilience. These findings support the integration of public health components into CBDRR programs as a sustainable strategy for enhancing preparedness in disaster-prone communities.

Keywords: *Disaster Preparedness, Public Health, Community-Based Disaster Risk Reduction, Disaster Mitigation, Social Capital*

INTRODUCTION

Despite increasing global investment in community-based disaster risk reduction (CBDRR), recent international evidence indicates that disaster preparedness interventions remain predominantly focused on evacuation planning and emergency response, with limited integration of public health preparedness components such as disease prevention, sanitation management, risk communication, and continuity of essential health services. Recent systematic reviews further suggest that although community participation improves disaster resilience, evidence regarding comprehensive health-oriented preparedness outcomes remains inconsistent across low- and middle-income countries. Consequently, substantial knowledge gaps persist regarding how community-based disaster structures can simultaneously strengthen disaster preparedness and public health resilience through integrated interventions.

Indonesia is a country with a high level of disaster vulnerability due to its geographic location at the confluence of three tectonic plates and the Pacific Ring of Fire. This makes Indonesia vulnerable to various types of disasters, both geological and hydrometeorological. In addition to geological factors, global climate change is increasing the frequency and intensity of disasters, thereby increasing the risks faced by the community (Dwirahmadi et al., 2023).

The impacts of disasters are multidimensional, not only damaging infrastructure and the economy but also significantly impacting public health. Disasters can increase the incidence of infectious diseases due to disruptions to sanitation and clean water access, and worsen public health conditions through disruptions to suboptimal health services. These conditions demonstrate that disasters pose a serious threat to public health systems (Hajar, 2026).

Furthermore, disasters also disrupt the healthcare system, such as damage to healthcare facilities, limited medical personnel, and disruptions to the distribution of healthcare logistics. This results in increased morbidity and mortality rates, particularly among vulnerable groups such as the elderly, children, and pregnant women (Hajar, 2026).

Disaster management efforts in Indonesia still tend to be reactive, focusing on post-disaster response rather than mitigation and preparedness efforts. This approach is considered ineffective in reducing health impacts because it does not optimize community-based prevention efforts (Soalihin et al., 2025).

One of the main challenges in the disaster management system is the limited early warning system, which has not yet fully reached the wider community. Early warning information is often not effectively communicated to the grassroots level, hampering evacuation processes and initial disaster response (Supartono et al., 2022).

Furthermore, low levels of disaster literacy and community preparedness are also factors that increase the risk of disaster impacts. Lack of public understanding regarding evacuation procedures, disease prevention, and emergency response leads to high vulnerability to health risks (Widayati et al., 2025).

In this context, a community-based approach is a crucial strategy for disaster risk reduction. The community-based disaster risk reduction (CBDRR) approach emphasizes active community



participation in all stages of disaster management, thereby increasing community capacity and resilience independently (Rusmana et al., 2024).

Community-based approaches have the advantage of leveraging local wisdom and strengthening social solidarity. Local values such as mutual cooperation have been shown to increase the effectiveness of disaster mitigation and accelerate post-disaster recovery (Nabila & Sodiq Maksum, 2025).

One way to implement this approach is through the formation of community-based disaster warning groups. These groups act as a liaison between the formal early warning system and the community and are tasked with disseminating disaster information quickly and accurately (Supartono et al., 2022).

Disaster warning groups also play a crucial role in health aspects, such as providing education on disease prevention, raising sanitation awareness, and assisting in coordinating emergency health services. The existence of these groups has been shown to improve community preparedness in the face of disasters (Renidayati et al., 2025).

However, the implementation of community-based programs still faces various obstacles, such as limited resources, lack of coordination between sectors, and the absence of a standardized operational model. This results in the program's effectiveness in reducing health risks being less than optimal (Budiman & Amalinda, 2025).

Furthermore, there are still gaps in the integration of early warning systems with public health aspects at the community level. Most programs operate sectorally and do not yet embrace a holistic approach that combines disaster mitigation and public health (Soalihin et al., 2025).

Although previous studies have demonstrated the effectiveness of community-based disaster risk reduction (CBDRR) programs in enhancing disaster preparedness, most interventions have primarily focused on evacuation readiness, disaster awareness, and emergency response capacity. Limited attention has been given to the integration of public health preparedness indicators, including disease prevention, sanitation management, health-risk communication, and continuity of essential health services during disasters. Furthermore, existing studies generally evaluate community preparedness programs using either quantitative or qualitative approaches separately, resulting in limited understanding of both measurable outcomes and implementation processes.

Another important gap concerns the operational role of community-based disaster alert groups as local health-risk communication mechanisms. While such groups are frequently established within disaster-prone communities, empirical evidence regarding their effectiveness in simultaneously improving disaster knowledge, preparedness attitudes, preparedness practices, and community health resilience remains limited, particularly in volcanic disaster-prone settings in Indonesia.

Therefore, this study contributes to the literature by evaluating a community-based disaster alert group model that explicitly integrates public health preparedness into the CBDRR framework. Using a mixed methods approach, this study not only measures changes in knowledge, attitudes, and practices but also explores the mechanisms through which community participation, social capital, and local institutional support contribute to preparedness improvements. This integrated perspective represents a novel contribution compared with previous community-based disaster

preparedness programs that have largely emphasized disaster response capacity without explicitly incorporating public health dimensions.

METHODS

This study employed a mixed methods approach using a quasi-experimental one-group pretest-posttest design combined with a Community-Based Participatory Research (CBPR) approach. The quantitative component was conducted to evaluate changes in disaster preparedness knowledge, attitudes, and practices before and after the intervention, whereas the qualitative component was intended to explore the formation process of community-based disaster alert groups, community participation dynamics, and factors influencing program implementation.

The study was conducted in disaster-prone communities in Agam Regency, West Sumatra Province, Indonesia, particularly in areas surrounding Mount Merapi and downstream regions vulnerable to volcanic eruptions, lahars, and flash floods. The research was carried out over a four-month period covering preparation, intervention implementation, monitoring, and evaluation phases. Study sites were selected purposively based on disaster risk levels, population density, previous disaster exposure, and community willingness to participate in empowerment activities.

The study population consisted of residents living in disaster-prone areas of Agam Regency. Participants were recruited using purposive sampling based on the following inclusion criteria: aged 18 years or older, residing in the study area for at least one year, and willing to participate in all stages of the research. Sample size was determined using an a priori power analysis conducted with G*Power version 3.1 for paired-sample comparisons. Assuming a medium effect size ($d = 0.50$), $\alpha = 0.05$, statistical power of 80%, and two-tailed testing, the minimum required sample was 34 participants. To improve statistical precision, accommodate potential attrition, and strengthen subgroup representation, 60 participants were ultimately recruited.

The independent variable was the formation of community-based disaster alert groups, while the dependent variables included disaster preparedness knowledge, preparedness attitudes, and preparedness practices related to public health emergencies. These variables were measured using a structured questionnaire developed based on the World Health Organization Health Emergency and Disaster Risk Management Framework, Community-Based Disaster Risk Reduction (CBDRR) guidelines, and previous disaster preparedness studies. The instrument assessed respondents' understanding of local disaster risks, emergency health management, sanitation practices, evacuation procedures, and community participation in preparedness activities.

Instrument development followed several stages. First, an initial pool of 38 items was developed from relevant literature and disaster preparedness indicators. Second, content validation was conducted by three experts in disaster management, public health, and community empowerment to assess item relevance, clarity, and contextual suitability. Revisions were made according to expert recommendations. Third, a pilot study involving 30 residents from a neighboring disaster-prone community was conducted to evaluate psychometric properties.

A control group was not included because the intervention was implemented as a community empowerment program targeting all eligible residents in high-risk villages. Withholding disaster preparedness training from a comparable group was considered ethically inappropriate because preparedness education constitutes an essential public health intervention. Furthermore, implementation followed local government disaster preparedness policies requiring



community-wide participation. Therefore, a one-group pretest–posttest design was considered the most feasible design for evaluating program effectiveness under real-world community conditions.

Item validity testing using Pearson Product Moment correlation demonstrated acceptable correlation coefficients ranging from 0.42 to 0.86 ($p < 0.05$). Reliability testing showed satisfactory internal consistency, with Cronbach’s alpha coefficients of 0.82 for the knowledge scale, 0.85 for the attitude scale, and 0.88 for the practice scale. These findings indicated that the instrument possessed adequate validity and reliability for measuring disaster preparedness outcomes. The questionnaire consisted of 38 items divided into three domains: knowledge (12 items), attitudes (13 items), and preparedness practices (13 items). Knowledge items were scored as correct (1) or incorrect (0), whereas attitude and practice items employed a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Raw scores were transformed into percentages (0–100), with preparedness categorized as low (<60), moderate (60–79), and high (≥ 80). Higher scores indicated better preparedness.

The intervention consisted of disaster and public health education sessions, establishment of community-based disaster alert groups, training on risk communication, early warning systems, emergency evacuation procedures, sanitation management during disasters, and simulation exercises. All activities were conducted collaboratively with local government representatives, health personnel, community leaders, and residents to ensure active participation and contextual relevance.

Data collection was conducted in three phases. Baseline measurements (pretest) were administered prior to the intervention. Following completion of the four-month intervention program, posttest measurements were conducted using the same questionnaire. Qualitative data were collected through in-depth interviews, focus group discussions (FGDs), and participant observation to obtain a comprehensive understanding of participants’ experiences and perceptions regarding the intervention.

Quantitative data analysis was performed using descriptive and inferential statistics. Descriptive statistics were used to summarize respondent characteristics and preparedness indicators. Data normality was assessed using the Shapiro–Wilk test. Since all variables met normality assumptions ($p > 0.05$), differences between pretest and posttest scores were analyzed using paired sample t-tests. In addition, effect sizes were calculated using Cohen’s d to evaluate the practical significance of intervention outcomes. Statistical significance was established at $p < 0.05$.

Qualitative data were analyzed using Braun and Clarke’s thematic analysis framework. Audio recordings from interviews and FGDs were transcribed verbatim and independently reviewed by two researchers experienced in qualitative research. Open coding was initially conducted to identify meaningful units of information. Similar codes were subsequently grouped into categories and refined into broader themes through iterative discussions among the research team. Six final themes were generated to explain participants’ experiences and perceptions regarding disaster preparedness improvements.

Several strategies were employed to ensure trustworthiness of qualitative findings. Credibility was enhanced through triangulation of interviews, FGDs, and participant observations, as well as member checking with selected participants. Dependability was ensured through maintenance of an audit trail documenting coding decisions and analytical procedures.

Confirmability was strengthened through peer debriefing among researchers, while transferability was supported by detailed descriptions of study settings and participant characteristics.

Ethical approval for this study was obtained from the Health Research Ethics Committee of Universitas Baiturrahmah (Ethical Clearance No. 112/KEPK-FKM/UBM/2025). Written informed consent was obtained from all participants prior to data collection. Participant confidentiality, anonymity, and voluntary participation were maintained throughout the study.

Several methodological limitations should be acknowledged. The one-group pretest–posttest design without a control group may be susceptible to internal validity threats, including history effects, maturation, testing effects, and external influences occurring during the intervention period. Therefore, causal interpretations should be made cautiously. Nevertheless, the integration of quantitative and qualitative approaches provided complementary evidence regarding both intervention outcomes and implementation processes.

RESULTS

1. Respondent Characteristics

Table 1. Distribution of Respondent Characteristics (n = 60)

Characteristics	Category	n	%
Gender	Man	28	46.7
	Woman	32	53.3
Age	18–35 years	22	36.7
	36–55 years	27	45.0
	>55 years	11	18.3
Education	Elementary–Middle School	18	30.0
	Senior High School	29	48.3
	College	13	21.7
Length of Stay	≥5 years	44	73.3
	<5 years	16	26.7

The majority of respondents were female (53.3%) and in the productive age group (36–55 years). The majority were high school graduates (48.3%), and most had lived in disaster-prone areas for more than five years. This indicates that respondents have sufficient contextual experience with disaster risk, making it relevant in assessing the effectiveness of community-based interventions.

2. Results of Descriptive Analysis of Pretest and Posttest

Table 2. Mean Scores of Knowledge, Attitudes, and Practices Before and After Intervention

Variables	Pretest Mean ± SD	Posttest Mean ± SD	Δ Mean
Knowledge	56.20 ± 10.45	78.35 ± 8.90	+22.15
Attitude	62.10 ± 9.80	81.25 ± 7.75	+19.15
Practice	54.75 ± 11.20	76.40 ± 9.10	+21.65

There was a significant increase descriptively in all variables after the intervention. The highest increase occurred in knowledge (+22.15), followed by practice (+21.65), and attitude (+19.15). This indicates that the formation of community-based disaster warning groups is effective in increasing the cognitive, affective, and behavioral capacity of community preparedness.



3. Data Normality Test

Table 3. Results of the Shapiro-Wilk Normality Test

Variables	Pretest (p-value)	Posttest (p-value)
Knowledge	0.072	0.085
Attitude	0.064	0.077
Practice	0.058	0.069

All variables had a p-value > 0.05, indicating a normal distribution of the data. Therefore, inferential analysis using the Paired Sample t-test was deemed appropriate.

4. Paired Sample t-test Results

Table 4. Pretest and Posttest Difference Test

Variables	Mean Difference	t-value	p-value
Knowledge	22.15	12.84	< 0.001
Attitude	19.15	11.27	< 0.001
Practice	21.65	13.02	< 0.001

The results of the paired sample t-test showed that all variables had a p-value <0.001, indicating a significant difference between before and after the intervention. A high t-value indicates a strong intervention effect on improving public health preparedness.

4. Qualitative Analysis Results

a. Main Themes of Analysis Results

Qualitative data were analyzed using Braun and Clarke's thematic analysis framework. Interview and FGD recordings were transcribed verbatim and independently reviewed by two researchers with experience in qualitative health research. Open coding was first conducted to identify meaningful statements related to preparedness experiences, group formation processes, and perceived program impacts. Similar codes were subsequently grouped into categories and refined into broader themes through iterative discussion among the research team.

To enhance trustworthiness, several strategies were employed. Credibility was strengthened through data triangulation across interviews, FGDs, and participant observations, as well as member checking with selected participants. Dependability was ensured through audit trail documentation of coding decisions and theme development. Confirmability was improved through peer debriefing between researchers, while transferability was supported by providing detailed contextual descriptions of the study setting and participants. Consensus on the final coding structure was achieved through discussion until agreement was reached among the analysts.

Theme 1: Increasing Knowledge and Awareness of Health Risks

Findings:

Most informants stated that there was an increase in understanding regarding:

- Types of local disasters (eruptions, lava floods, flash floods)
- Post-disaster health risks
- The importance of sanitation and clean water in emergencies

Informant quote:

"Previously, we only knew that disasters were dangerous, but now we understand the impact on health, such as illness after flooding." (Informant 3)

Educational and training interventions within disaster warning groups contributed to improved health-based disaster literacy, consistent with improved knowledge scores in the quantitative analysis.

Theme 2: Changing Attitudes towards Disaster Preparedness

Findings:

There has been a change in attitude from:

- Passive → Proactive
- Government dependent → Community based independent

Informant quote:

"Before we had to wait for help, now we feel we have to prepare ourselves before help comes." (Informant 7)

This change in attitude demonstrates the internalization of preparedness values. This indicates the success of the participatory approach in building a sense of community ownership of disaster mitigation.

Theme 3: Improving Emergency Preparedness and Response Practices

Findings:

People are starting to implement:

- Establishing local evacuation routes
- Provision of emergency kits
- Self-evacuation simulation

Informant quote:

"Now we have our own evacuation route and know where to go when a disaster occurs." (Informant 1)

Changes in practice indicate that the intervention not only impacts cognitive and affective aspects, but also actual behavior (behavioral change), which is an indicator of program success.

Theme 4: The Strategic Role of Disaster Warning Groups

Findings:

The groups formed function as:

- Early warning information disseminator
- Evacuation coordinator
- Liaison with health workers and government

Informant quote:

"This group is very helpful because information reaches residents quickly." (Informant 5)



Disaster warning groups act as local risk communication systems that bridge formal systems and the community, thereby increasing the effectiveness of initial response.

Theme 5: Supporting Factors for Program Implementation

Findings:

Factors that support the success of the program include:

- Active community participation
- Support from community leaders and village government
- The values of mutual cooperation and social solidarity
- Practical training methods (live simulation)

The success of the program is greatly influenced by social capital and a contextual participatory approach.

Theme 6: Inhibiting Factors and Challenges

Findings:

Some of the identified constraints:

- Limited facilities and infrastructure
- Variations in community education levels
- Difficulty maintaining consistent participation
- Limited ongoing support

Informant quote:

"Sometimes it's difficult to gather residents for training because everyone is busy." (Informant 9)

These barriers indicate the need for program sustainability strategies, including institutional strengthening and policy support.

DISCUSSION

The findings of this study demonstrate that the formation of community-based disaster alert groups significantly improved disaster preparedness knowledge, attitudes, and practices among residents living in disaster-prone areas of Agam Regency, West Sumatra. Quantitative analysis revealed significant improvements across all outcome variables ($p < 0.001$), while qualitative findings provided insights into the mechanisms underlying these changes. The integration of both findings confirms that community-based disaster alert groups can function not only as disaster mitigation structures but also as important mechanisms for strengthening public health preparedness.

1. Improving Disaster Preparedness Knowledge

The largest increase was observed in disaster preparedness knowledge, with a mean increase of 22.15 points following the intervention. According to the Knowledge-Attitude-Practice (KAP) framework proposed by Notoatmodjo (2018), knowledge constitutes the primary foundation for behavioral change because individuals must first understand risks and appropriate responses before adopting preparedness behaviors. The significant improvement observed in this study indicates that educational activities, disaster simulations, and group-based discussions successfully enhanced participants' understanding of disaster risks and associated public health consequences.

Qualitative findings supported the quantitative results. Participants reported increased awareness of local disaster hazards, post-disaster disease risks, sanitation management, and the importance of maintaining access to clean water during emergencies. Informants described a shift from viewing disasters solely as physical events to understanding their broader implications for community health. This finding suggests that the intervention promoted comprehensive disaster-health literacy rather than merely increasing factual knowledge.

The present findings are consistent with Renidayati et al. (2025), who reported that community-based psychoeducational interventions significantly improved disaster preparedness literacy. Similarly, Rusmana et al. (2024) emphasized that active community participation in disaster risk reduction programs contributes substantially to improved understanding of local hazards and preparedness strategies. The current study extends these findings by demonstrating that integrating public health preparedness components into community-based disaster risk reduction initiatives can further strengthen disaster-related health knowledge.

Although substantial improvements were observed, the findings should be interpreted cautiously because repeated exposure to the same questionnaire may have introduced testing effects, potentially inflating post-intervention knowledge scores. Nevertheless, the large effect size suggests that the observed improvements were unlikely to be explained solely by measurement repetition. Similar improvements have been reported in studies conducted in Japan, the Philippines, Bangladesh, and Nepal, where community-based preparedness education consistently enhanced disaster-health literacy.

2. Changes in Preparedness Attitudes

Preparedness attitudes also improved significantly after the intervention, with a mean increase of 19.15 points. The observed changes can be interpreted through the Health Belief Model (HBM) developed by Rosenstock (1974) and further elaborated by Champion and Skinner (2008). The intervention exposed participants to information regarding disaster vulnerability, health consequences, and preparedness benefits, thereby strengthening perceived susceptibility, perceived severity, and perceived benefits of preparedness actions.

Qualitative findings revealed an important transformation from passive dependence on external assistance toward proactive community self-reliance. Participants reported feeling more responsible for preparing themselves and their families before disasters occur. This shift reflects the successful internalization of preparedness values and aligns with the core principles of Community-Based Disaster Risk Reduction (CBDRR), which emphasize local ownership, empowerment, and active participation.

These findings support previous studies demonstrating that community empowerment initiatives contribute to stronger preparedness attitudes and community resilience. Nabila and Sodik Maksum (2025) found that community-based disaster management programs strengthened local resilience by encouraging active involvement in preparedness planning and risk reduction activities. Likewise, Soalihin et al. (2025) highlighted the importance of local community engagement in developing sustainable disaster preparedness capacities. The present study adds evidence that integrating public health dimensions within preparedness interventions can further reinforce positive preparedness attitudes among disaster-prone populations.



Social desirability bias may have influenced participants' responses because post-intervention assessments were conducted shortly after completion of community activities. Participants may have tended to report more favorable attitudes toward preparedness. Nevertheless, similar attitudinal improvements have been documented across multiple community-based disaster preparedness interventions internationally, supporting the robustness of the present findings.

3. Transformation of Preparedness Practices

One of the most important findings of this study was the substantial improvement in preparedness practices, with a mean increase of 21.65 points. In disaster preparedness literature, behavioral change is often considered the most challenging outcome because knowledge acquisition does not automatically translate into action. This phenomenon is frequently described as the knowledge-practice gap or intention-behavior gap (Webb & Sheeran, 2006).

The findings indicate that the intervention successfully facilitated the translation of knowledge into practical preparedness behaviors. Participants reported establishing evacuation routes, preparing emergency kits, participating in disaster simulations, and becoming actively involved in local preparedness activities. These behavioral changes demonstrate that preparedness concepts were not only understood cognitively but also implemented within daily community practices.

The results are consistent with findings reported by Elkady et al. (2024), who observed substantial improvements in preparedness practices following community-based disaster preparedness training programs. Their study highlighted the effectiveness of experiential learning approaches, particularly simulation-based training, in promoting sustainable behavioral change. Similarly, the simulation exercises conducted in the present study appeared to play a crucial role in strengthening participants' confidence and preparedness behaviors.

Qualitative findings further reinforced these results. Informants explained that they now possessed clear evacuation plans and practical knowledge regarding appropriate actions during emergencies. Such evidence suggests that the intervention effectively reduced the gap between preparedness awareness and actual preparedness behavior.

Behavioral outcomes remain vulnerable to short-term intervention effects because posttest measurements were conducted immediately after completion of the program. Longer follow-up assessments are required to determine whether preparedness behaviors are sustained over time. Comparable studies from China, Iran, and Turkey similarly reported that simulation-based disaster training significantly improved preparedness behaviors, although several studies observed gradual declines without refresher interventions.

4. Strategic Role of Disaster Alert Groups

An important contribution of this study is the identification of disaster alert groups as effective community-level risk communication systems. Qualitative findings revealed that these groups served multiple functions, including dissemination of early warning information, coordination of evacuation activities, facilitation of communication between residents and government agencies, and support for emergency health preparedness activities.

These findings align with the WHO Health Emergency and Disaster Risk Management Framework (WHO, 2019), which emphasizes the importance of strengthening local capacities and community-based structures in disaster preparedness efforts. The effectiveness of the disaster alert groups suggests that community organizations can bridge the gap between formal disaster management systems and vulnerable populations.

Furthermore, the findings support the observations of Supartono et al. (2022), who reported that community-centered mitigation initiatives improve information dissemination and facilitate more effective disaster response processes. The current study expands this perspective by demonstrating that disaster alert groups can simultaneously strengthen public health preparedness through risk communication, health education, and community mobilization activities.

Another potential limitation concerns implementation fidelity, as the effectiveness of disaster alert groups may vary depending on facilitator competency, local leadership, and community participation. Therefore, replication in different socio-cultural settings is needed before generalizing the findings.

5. The Role of Social Capital and Community Participation

The success of the intervention was strongly influenced by social and contextual factors identified through qualitative analysis. Active community participation, support from local leaders, village government involvement, and strong traditions of mutual cooperation emerged as important facilitators of program implementation.

These findings are consistent with the CBDRR literature, which recognizes social capital as a critical determinant of community resilience. Community participation enhances ownership of preparedness initiatives and increases the likelihood that preparedness activities will be maintained beyond the intervention period. Rusmana et al. (2024) similarly highlighted the importance of local participation and community engagement in sustaining disaster risk reduction programs.

The findings also support observations by Nabila and Sodik Maksum (2025), who reported that local cultural values and collective action mechanisms contribute significantly to community resilience. In the present study, the tradition of mutual cooperation appeared to facilitate participation in training activities, simulation exercises, and preparedness planning. These results suggest that preparedness interventions are more effective when they are aligned with existing social structures and community values.

Since this study was conducted in communities characterized by strong traditions of mutual cooperation (gotong royong), external validity may be limited in areas with lower levels of social cohesion. Future multicenter studies should examine whether similar intervention effects can be achieved across different socio-cultural contexts.

6. Challenges and Sustainability Considerations

Despite the positive outcomes, several challenges were identified during program implementation. Participants reported limited facilities and resources, differences in educational backgrounds, difficulties maintaining consistent participation, and limited long-term institutional support. These challenges indicate that sustaining preparedness improvements requires continuous support beyond the initial intervention period.



The findings are consistent with Budiman and Amalinda (2025), who identified resource constraints, coordination issues, and sustainability challenges as common barriers to community-based disaster preparedness programs. Similar concerns were highlighted by Soalihin et al. (2025), who emphasized the importance of institutional integration and policy support in maintaining preparedness capacities over time.

Qualitative findings further revealed that maintaining long-term community engagement may be difficult without structured follow-up activities. This observation is consistent with Bryngeirsdottir et al. (2022), who reported that community-based programs frequently experience declines in participation and effectiveness when sustainability mechanisms are absent. Consequently, future preparedness initiatives should incorporate regular refresher training, institutional strengthening strategies, and long-term monitoring systems to maintain preparedness gains.

Resource limitations and inconsistent community participation may have resulted in implementation bias, whereby intervention intensity differed among participants. Similar implementation challenges have been reported in community preparedness studies conducted in Southeast Asia and Sub-Saharan Africa, emphasizing the importance of institutional support and sustainable funding mechanisms.

7. Implications and Contribution of the Study

This study contributes to the growing literature on community-based disaster preparedness by addressing an important gap in previous research. While many CBDRR interventions primarily focus on evacuation readiness and emergency response capacity, the present study explicitly integrates public health preparedness into the intervention framework. The findings demonstrate that community-based disaster alert groups can simultaneously improve disaster knowledge, preparedness attitudes, preparedness practices, and awareness of disaster-related health risks.

The mixed methods approach further strengthens the contribution of this study by providing evidence not only regarding intervention effectiveness but also regarding the contextual and social mechanisms that facilitate successful implementation. These findings support the development of more integrated disaster preparedness programs that combine disaster risk reduction principles with public health preparedness strategies, particularly in disaster-prone communities facing complex environmental and health risks.

CONCLUSIONS

This study confirms that the formation of community-based disaster warning groups significantly improved public health preparedness capacity in disaster-prone areas of Agam Regency, West Sumatra. The four-month intervention demonstrated highly significant improvements in three key dimensions—knowledge, attitudes, and practices—with a significance value of $p < 0.001$ across all variables. The most significant improvement occurred in knowledge, followed by practices and attitudes, reflecting a pattern of behavioral change where cognitive transformation precedes affective change. The success in narrowing the gap between knowledge and practice demonstrates the program's effectiveness in encouraging concrete implementation at the community level. These quantitative findings were reinforced by qualitative analysis, which revealed six key themes: increased disaster health risk literacy, a shift in attitudes from dependence

to independence, and the implementation of concrete practices such as developing evacuation routes, providing emergency bags, and conducting independent simulations. The formed groups also functioned as a local risk communication system capable of creating a multiplier effect in the dissemination of preparedness capacity within the community.

The effectiveness of the intervention was significantly influenced by the socio-cultural context of the local community, which possesses strong social capital, such as the value of mutual cooperation (gotong royong), active community participation, and the strategic role of community leaders and village officials. The simulation-based training approach also strengthened the program's impact, demonstrating that the alignment of the intervention design with socio-cultural characteristics was a key success factor. However, several obstacles, such as limited facilities, varying levels of education, and inconsistent participation, indicate the potential for program decay if a systematic sustainability strategy is not followed. Practically, the results of this study recommend replication of the model in similar areas, integration of health aspects into disaster mitigation programs, and strengthening institutional and budgetary support by local governments. The limitations of the design without a control group and the absence of long-term measurements are also important considerations, so further research is recommended using a more robust experimental design, including follow-up measurements and effect size analysis to increase the validity and comparability of the findings.

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