

Developing Public Health Resilience through Community Service Programs in Disaster-Prone Communities

Didi Taswidi^{1*}, & Arif Prima²

¹Sekolah Tinggi Ilmu Kesehatan Cirebon, Indonesia, ²STIKES Dharma Landbouw, Indonesia

*Co e-mail: diditaswidi.20@gmail.com¹

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ABSTRACT

Disasters pose major public health challenges by affecting mortality, physical health, and communities' capacity to prepare for, respond to, adapt to, and recover from health emergencies. Purpose: This study developed and evaluated a community service program to strengthen health resilience in disaster-prone communities. Method: A Research and Development (R&D) approach with a mixed-methods sequential exploratory design was applied. Program development included needs analysis, design, expert validation, limited trials, implementation, and evaluation. Effectiveness was assessed using a quasi-experimental one-group pretest-posttest design involving 120 participants. Data were analyzed thematically, descriptively, paired tests, and multiple linear regression. Results: Four key challenges were identified: low disaster health literacy, limited emergency response skills, weak community coordination, and the absence of community-based health action plans. The program demonstrated excellent validity (Aiken's $V = 0.94$). Significant improvements were found in disaster health knowledge, preparedness attitudes, preparedness behaviors, and community health resilience ($p < 0.001$). Preparedness behavior was the strongest predictor of resilience ($\beta = 0.391$). Implications: The program strengthened health knowledge, preparedness behaviors, local coordination, and community participation, supporting disaster risk reduction and sustainable recovery. Conclusion: The developed community empowerment-based program effectively improves community health resilience and is suitable for replication in disaster-prone regions across Indonesia.

Keywords: Community Health Resilience, Community Empowerment, Disaster Preparedness, Community-Based Intervention, Disaster Risk Reduction



INTRODUCTION

Disasters are an increasingly complex global challenge in public health. Climate change, environmental degradation, uncontrolled urbanization, and population growth have increased the frequency and intensity of various types of disasters, particularly hydrometeorological disasters such as floods, droughts, storms, and landslides. International studies have shown that the impact of disasters is no longer limited to physical damage and loss of life, but also impacts various aspects of social development and sustainable public health (Huda et al., 2026).

From a public health perspective, disasters have far-reaching consequences, both direct and indirect. Direct impacts include death, physical injury, acute trauma, and an increased risk of infectious diseases due to environmental damage and disruption of sanitation systems. Meanwhile, indirect impacts often last longer, including mental health disorders, increased chronic diseases, malnutrition, and reduced access to basic health services. Various studies have shown that post-disaster health problems can persist for years after the event, necessitating a comprehensive and sustainable public health approach (Ngaruiya et al., 2022).

Mental health disorders are one of the most frequently overlooked impacts of disasters, despite their significant long-term consequences. Individuals affected by disasters are at higher risk of post-traumatic stress, anxiety, depression, and other psychosocial disorders. A systematic review conducted by Newnham et al. (2022) shows that the psychological impact of disasters can be long-term and is influenced by social and economic factors, as well as community recovery capacity. These findings confirm that the success of disaster management is measured not only by infrastructure recovery but also by the community's ability to recover its physical and mental health (Newnham et al., 2022).

Beyond mental health, disasters also impact the management of non-communicable diseases. Damage to health facilities, disruptions to the pharmaceutical supply chain, and limited access to healthcare services increase the risk of complications for people with chronic diseases such as hypertension, diabetes mellitus, cardiovascular disease, and respiratory diseases. A systematic review by Ngaruiya et al. (2022) showed that the continuity of healthcare services for people with chronic diseases is a major challenge in disaster situations and is often overlooked during the emergency response phase (Ngaruiya et al., 2022).

Indonesia is one of the countries with the highest disaster risk levels in the world. Its geographical location at the confluence of three major tectonic plates, coupled with its tropical climate and environmental vulnerabilities, leads to the recurrent occurrence of various disasters, such as earthquakes, tsunamis, volcanic eruptions, floods, landslides, and forest fires. Despite the relatively high disaster risk, community mitigation capacity and preparedness across various regions still show significant disparities. A recent analysis based on Village Potential Data (PODES) from 2024 shows a gap between the level of disaster risk and the availability of mitigation facilities in many regions in Indonesia (Ar Rifqiy, 2024).

Community vulnerability to disasters is determined not only by physical threats, but also by social, economic, and health factors. Low levels of education, limited access to health services, poverty, and limited local resources often exacerbate the impacts of disasters. Research on community vulnerability in landslide-prone areas in Indonesia shows that social factors and community capacity significantly contribute to the level of risk faced by communities (Giofandi et al., 2024).

In this context, the concept of community health resilience is becoming increasingly important. Community health resilience refers to the ability of individuals, families, and communities to anticipate, respond to, adapt to, and recover from the health impacts of disasters. This concept positions communities as key actors in disaster risk reduction efforts, not simply as recipients of aid. The health resilience approach also aligns with the Health Emergency and Disaster Risk Management (Health EDRM) paradigm, which places health at the heart of disaster risk management (Wright et al., 2020).

Community-based approaches are considered an effective strategy for building public health resilience because they enable active citizen participation in risk identification, planning, implementation, and program evaluation. Direct community involvement has been shown to increase a sense of program ownership, strengthen social networks, and enhance collective capacity to cope with crises. Research in Indonesia shows that local leadership and community participation are key factors in the success of community-based disaster risk reduction programs (Ruslanjari et al., 2024).

One form of implementing a community-based approach is through community service programs. These programs can serve as a medium for health education, community empowerment, capacity building for health workers, first aid training, evacuation simulations, and strengthening community-based preparedness systems. Through this participatory approach, communities gain not only knowledge but also practical skills needed to deal with disaster situations (Sofyana et al., 2024).

The role of universities in developing community service programs is highly strategic due to their integrated functions of education, research, and community service. Through community service activities, universities can transform research findings into concrete interventions that can improve community capacity. Collaboration between academics, local governments, healthcare facilities, community organizations, and local communities is a crucial factor in creating a sustainable health resilience system (Sulistiadi et al., 2024).

Community resilience is reflected not only in disaster preparedness behaviour but also in the ability of communities to maintain social functioning during and after disasters. Previous studies indicate that resilient communities demonstrate stronger social cohesion, effective local leadership, better access to health information, continuity of health services, and collective capacity to support vulnerable groups. In addition, resilience includes psychosocial adaptation, where community support networks reduce psychological distress following disasters, while socioeconomic resilience enables households to recover livelihoods and maintain access to essential resources. These dimensions collectively strengthen disaster risk reduction by integrating preparedness, mitigation, response, and recovery into community development initiatives.

Although many community service programs have improved disaster preparedness, only a limited number have incorporated mitigation planning and sustainability evaluation as integral components of community resilience development. Consequently, further research is needed to evaluate how empowerment-based interventions contribute not only to preparedness but also to long-term disaster risk reduction.

Based on this description, the development of community empowerment-based public service programs is an urgent need to improve public health resilience in disaster-prone areas. Programs designed in a participatory, local-specific, and sustainable manner have the potential to



improve community knowledge, attitudes, preparedness, and capacity to face various disaster threats. Therefore, this research is crucial to analyze the state of public health resilience, develop community service interventions tailored to community needs, evaluate the effectiveness of implemented programs, and develop a model of community service that can be replicated as a public health-based disaster risk reduction strategy in various disaster-prone areas in Indonesia.

METHODS

This study used a Research and Development (R&D) approach with a mixed methods sequential exploratory design to develop and evaluate a community service program to improve the health resilience of disaster-prone communities. This approach was chosen because it allows for identification of community needs and the development of intervention models tailored to the characteristics of the target community.

The research was conducted through six stages adapted from the Borg and Gall model, namely: (1) needs analysis, (2) program design, (3) expert validation, (4) limited trials, (5) program implementation, and (6) evaluation of effectiveness and model refinement. The research location was determined purposively in disaster-prone areas based on BNPB and BPBD data by considering the level of risk, vulnerability, and community readiness.

The needs analysis phase employed a qualitative approach through in-depth interviews, focus group discussions (FGDs), observation, and document review. Informants included community leaders, health cadres, community health center staff, disaster volunteers, village officials, and local residents, selected purposively. Data were analyzed using thematic analysis through coding, categorization, and theme identification. Data credibility was maintained through source and method triangulation, member checking, and peer debriefing.

Based on the results of the needs analysis and literature review, a community service program was developed that included disaster health education, first aid training, preparedness and evacuation simulations, the formation of disaster health resilience cadres, strengthening community networks, and the development of a community-based health action plan. The program was then validated by experts in public health, disaster management, health promotion, and community service practitioners. Content validity was analyzed using the Aiken's V index, with a value of ≥ 0.80 as the eligibility criterion.

The program's effectiveness was evaluated using a quasi-experimental one-group pretest-posttest design. Respondents were adults living in the study area and selected based on the study's inclusion criteria. The variables measured included disaster health knowledge, preparedness attitudes, health preparedness behaviors, and community health resilience.

Data collection was conducted using a structured questionnaire that had undergone validity and reliability testing. Data analysis included univariate analysis to describe respondent characteristics and the distribution of study variables, and bivariate analysis using the paired sample t-test or Wilcoxon signed-rank test according to data distribution. Multivariate analysis with multiple linear regression was used to identify factors influencing the improvement of community health resilience after the intervention.

The study has received ethical approval from the Health Research Ethics Committee. All respondents provided written informed consent before participating, and data confidentiality was maintained in accordance with research ethics principles.

RESULTS

1. Respondent Characteristics

Table 1. Characteristics of Respondents to the Community Health Resilience Program (n=120)

Characteristics	n	%
Gender		
Man	46	38.3
Woman	74	61.7
Age		
18–35 years	35	29.2
36–55 years	57	47.5
>55 years	28	23.3
Education		
Elementary/Middle School	39	32.5
Senior High School	58	48.3
College	23	19.2
Have experienced a disaster		
Yes	102	85.0
No	18	15.0

The majority of participants were of productive age and had previous disaster experience. This indicates that most respondents have lived experience with disaster risks, making them more receptive to disaster health capacity building programs. The predominance of female participants indicates the high level of involvement of family groups and community cadres in community service activities.

2. Results of Community Needs Analysis

Table 2. Findings of Needs Analysis through FGD and In-Depth Interviews

Main Theme	Subtheme
Low disaster health literacy	Lack of knowledge of post-disaster diseases, emergency sanitation
Limited emergency response skills	First aid and evacuation are not optimal
Weak community coordination	There are no special disaster health cadres yet
Limitations of preparedness plans	No community-based health procedures available

The needs analysis revealed that community vulnerability stems not only from the threat of disasters but also from low community health capacity. The community identified key needs as improving practical skills, developing disaster health cadres, and strengthening local coordination systems as the foundation for community health resilience.

3. Program Validation Results by Experts

Table 3. Validation Results of the Community Service Program Model

Program Components	Aiken's V value
Disaster health education module	0.92



First aid training	0.95
Evacuation simulation	0.94
Formation of disaster health cadres	0.96
Community action plan	0.91
Average	0.94

All program components achieved a very high level of validity. These findings indicate that the program developed is aligned with community needs and is deemed relevant by experts for implementation in disaster-prone communities. The health cadre development component received the highest rating, as it is considered capable of ensuring the program's sustainability at the community level.

4. Effectiveness of Community Service Programs

Table 4. Changes in Knowledge, Attitudes, Behavior, and Public Health Resilience Before and After Intervention (n=120)

Variables		Pre-test Mean $\pm$ Standard Deviation	Post-test Mean $\pm$ Standard Deviation	Δ Mean	p-value
Disaster health knowledge		61.42 $\pm$ 10.38	82.75 $\pm$ 8.26	21.33	<0.001
Attitude of preparedness		65.18 $\pm$ 9.74	83.64 $\pm$ 7.89	18.46	<0.001
Health preparedness behavior		58.93 $\pm$ 11.12	80.51 $\pm$ 8.47	21.58	<0.001
Public health resilience		60.24 $\pm$ 9.95	84.17 $\pm$ 7.43	23.93	<0.001

The program's implementation resulted in significant improvements across all measured indicators. The greatest improvement was found in the community health resilience aspect, indicating that the intervention not only increased knowledge but also strengthened the community's ability to cope with and recover from the health impacts of disasters. These results indicate that a community-based empowerment approach can produce more comprehensive changes than conventional health education.

5. Analysis of Factors Influencing Community Health Resilience

Table 5. Results of Multiple Linear Regression of Factors Influencing the Improvement of Community Health Resilience

Independent Variables	β	t	p-value
Disaster health knowledge	0.298	3,912	<0.001
Attitude of preparedness	0.246	3,187	0.002
Health preparedness behavior	0.391	5,126	<0.001
Active participation in the program	0.275	3,844	<0.001

$$R^2 = 0.682$$

The model explained approximately 68.2% of the variation in community health resilience improvement. Health preparedness behavior emerged as the most dominant factor, indicating that the ability to implement concrete actions is more crucial than simply increasing knowledge. Furthermore, active participation during the program was a crucial factor in strengthening the

intervention's success, confirming that community engagement is a key component in building community-based health resilience.

DISCUSSION

1. Needs Analysis and Program Validation

The findings of the needs analysis indicate that community vulnerability stems not only from the threat of disasters, but also from low community health capacity. The low level of disaster health literacy identified through focus group discussions (FGDs) and in-depth interviews aligns with research by Sofyan et al. (2025), which asserts that knowledge about threat sources and emergency preparedness remains a major barrier to community preparedness, despite increasing awareness of disaster risks (Sofyan et al., 2025; Tiwi et al., 2025). Communities in the study area identified key needs as improving practical skills, establishing disaster health cadres, and strengthening local coordination systems as the foundation for community health resilience.

Program validation by experts resulted in an average Aiken's V value of 0.94, with the disaster health cadre formation component receiving the highest rating (0.96). This indicates that the developed program is in accordance with community needs and is relevant for implementation. This finding is supported by research by Sofyana et al. (2024) which showed that an integrated training model based on public health nursing is effective in increasing community capacity in four preparedness parameters, namely knowledge and attitudes about disasters (KA), disaster preparedness plans (PE), disaster warnings (WS), and community resource mobilization (RMC).

Based on the findings, the present study indicates that strengthening local institutions through disaster health cadres provides an important mechanism for sustaining community preparedness beyond the intervention period. The establishment of community cadres, together with community action plans and strengthened coordination, represents practical mitigation measures that enable communities to maintain preparedness capacity and support continuous disaster risk reduction. Therefore, the implications of these findings extend beyond immediate improvements in knowledge and behaviour toward strengthening institutional resilience through community participation and local governance.

2. Program Effectiveness on Knowledge, Attitudes, and Behavior

The program implementation resulted in significant improvements in all measured indicators ($p < 0.001$). Disaster health knowledge increased by 21.33 points (from 61.42 to 82.75), confirming Vandrevalla et al.'s (2024) findings that training and communication initiatives are effective strategies for building resilience through increased individual and community capacity (Vandrevalla et al., 2024). This increased knowledge provides an important foundation for behavioral change, as explained in the Protective Action Decision Model (PADM), which states that perceptions of threat and risk play a critical role in decision-making during disasters (Lindell & Perry, 2011).

The 21.58-point increase in health preparedness behavior (from 58.93 to 80.51) demonstrates that a community-based empowerment approach can produce more comprehensive changes than conventional health education. This aligns with WHO research (2024) on the earthquake response in Turkey, which emphasized that communities are not passive recipients of aid, but rather first responders leveraging their local knowledge, assets, social networks, and coping strategies (World Health Organization, 2026). Active participation during the program was a crucial factor in



strengthening the intervention's success, confirming that community engagement is a key component in building community-based health resilience.

The improvement in preparedness behaviour observed in this study suggests that repeated training and simulation strengthened participants' confidence to respond appropriately during emergencies. Although mental health outcomes were not directly measured, previous resilience theories indicate that higher preparedness and stronger social participation may reduce psychosocial vulnerability by increasing perceived control, collective efficacy, and social support during disasters. Furthermore, preparedness training serves as an important mitigation strategy because it enhances community capacity before disaster events occur. Therefore, future community service programs should integrate preparedness training with psychosocial support activities and community-based mitigation planning to strengthen overall disaster resilience.

3. Analysis of Factors Influencing Community Health Resilience

The results of multiple linear regression analysis showed that health preparedness behavior was the most dominant factor ($\beta=0.391$; $p<0.001$) in improving community health resilience, followed by disaster health knowledge ($\beta=0.298$), active participation in programs ($\beta=0.275$), and preparedness attitude ($\beta=0.246$). The model explained 68.2% of the variation in improving community health resilience.

These findings reinforce the research findings of Tiwi et al. (2025) which showed that active community participation in evacuation simulations and drills is crucial because direct involvement improves their understanding of evacuation routes and emergency responses (Tiwi et al., 2025). Furthermore, research on the implementation of the ILATGANA-PHN model by Sofyana et al. (2024) also demonstrated that integrated training interventions have a significant impact on improving community self-preparedness, particularly in terms of knowledge and attitudes about disasters, preparedness plans, warning systems, and community resource mobilization.

This is also in line with the WHO South-East Asia Region (2025-2029) framework that places community participation and engagement as a key component in strengthening resilience to health emergencies, with six priority areas including inclusive governance mechanisms, strengthening the community workforce, and using social, cultural, and behavioral evidence (World Health Organization, 2024). In the context of behavior change theory, the Theory of Planned Behavior (TPB) explains that actual behavior (in this case preparedness) is the strongest predictor of health outcomes, because behavior is a direct manifestation of intentions and perceived behavioral control.

The regression analysis confirms that preparedness behaviour, disaster health knowledge, and active participation are key determinants of community health resilience. These findings are consistent with disaster resilience theories emphasizing that resilience develops through the interaction of behavioural capacity, social participation, and local institutional support. Although mitigation outcomes were not directly evaluated in this study, the establishment of disaster health cadres, community coordination mechanisms, evacuation simulations, and community health action plans constitute important community-based mitigation efforts. Consequently, future research should include broader indicators of resilience, such as psychosocial wellbeing, community social capital, and long-term mitigation capacity, to provide a more comprehensive evaluation of community resilience.

4. Research Implications

Overall, the findings of this study have strategic implications for the development of community service programs in disaster-prone areas. First, a community-based approach with an emphasis on empowering local cadres has been shown to be more effective than a top-down model that relies solely on external assistance. A study by Sulistiadi et al. (2024) corroborates this by showing that building health system resilience requires a deep understanding of the social, economic, and cultural impacts of climate change and disasters from the perspective of local stakeholders (Sulistiadi et al., 2024). Second, the community service model developed can be replicated in various disaster-prone areas in Indonesia, taking into account the local context and involving various stakeholders, as is done in the UMY Rescue 2025 program, which integrates general health services, dental and oral health, maternal and child health, environmental health, and psychosocial support.

Third, the finding that health preparedness behaviors dominate as the most influential factor suggests that community service programs should place greater emphasis on practical training and simulations rather than simply knowledge transfer. A scoping review conducted by researchers in Latin America and the Caribbean (2025) also identified that effective community-based strategies involve the participation of community health workers, the mobilization of civil society organizations, and strategies tailored to the local sociocultural context (Houghton et al., 2025).

Fourth, the formation of disaster health cadres, the component with the highest validity, demonstrates that the program's sustainability is highly dependent on strengthening local capacity. This aligns with research findings on evacuation preparedness in Banda Aceh, which emphasized that preserving local wisdom and strengthening community capacity through regular, periodic, and systematic training is crucial for enhancing community resilience (Sofyan et al., 2025).

Third, the finding that preparedness behaviour was the strongest predictor of community health resilience indicates that community service interventions should prioritize practical capacity building through repeated simulations, first-aid practice, and community coordination exercises. These activities represent essential elements of disaster mitigation because they improve community readiness before disasters occur and strengthen local response capacity. Based on the present findings, mitigation should be viewed not only as physical risk reduction but also as strengthening community participation, institutional preparedness, and sustainable health action planning. Consequently, future community service programs should integrate behavioural training, community-based mitigation planning, and continuous monitoring to enhance long-term disaster resilience.

CONCLUSIONS

This study concludes that community empowerment-based community service programs are effective in improving public health resilience in disaster-prone areas. Based on a needs analysis, four main community problems were identified: low disaster health literacy, limited emergency response skills, weak community coordination, and the absence of a community-based health action plan, which then became the basis for developing an intervention program. The developed program includes six main components: disaster health education, first aid training, evacuation simulations, disaster health cadre formation, community network strengthening, and community action plan development, with a very high level of validity (Aiken's V average of 0.94), where the disaster health



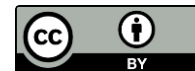
cadre formation component obtained the highest validity (0.96) as an indicator that the program's sustainability is highly dependent on strengthening local capacity.

Program implementation showed significant improvements in all health resilience indicators ($p < 0.001$), with the highest increase in community health resilience ($\Delta = 23.93$), followed by health preparedness behavior ($\Delta = 21.58$), disaster health knowledge ($\Delta = 21.33$), and preparedness attitude ($\Delta = 18.46$), confirming that the community-based empowerment approach resulted in more comprehensive changes than conventional health education. Determinant factor analysis identified health preparedness behavior as the most dominant predictor ($\beta = 0.391$; $p < 0.001$), followed by disaster health knowledge ($\beta = 0.298$), active participation in the program ($\beta = 0.275$), and preparedness attitude ($\beta = 0.246$), with the research model able to explain 68.2% of the variation in community health resilience improvements, confirming that the ability to implement concrete actions and active community participation are key to the success of the intervention.

The findings suggest that the developed community service model contributes to strengthening disaster resilience through several key elements of disaster management, including preparedness, community-based mitigation, response capacity, and institutional strengthening. The establishment of disaster health cadres, development of community health action plans, repeated preparedness training, and strengthened local coordination constitute practical mitigation measures that can support sustainable disaster risk reduction. Although this study primarily evaluated preparedness-related outcomes, the intervention provides an evidence-based framework for integrating community empowerment into disaster management at the local level. Future studies should incorporate broader resilience indicators, including psychosocial resilience, social capital, and long-term recovery capacity, to provide a more comprehensive evaluation of disaster resilience.

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