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RESEARCH ARTICLE

THE IMPACT OF NURSES' DISASTER PREPAREDNESS COMPETENCIES ON PUBLIC HEALTH CENTER RESILIENCE IN DISASTER-PRONE AREAS: A CROSS-SECTIONAL STUDY

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ABSTRACT

BACKGROUND:

Disaster-prone areas need resilient health centers to ensure effective health management services and emergency response during earthquakes and tsunamis. Nurses play a critical role in disaster risk reduction which is essential to improving health center resilience. Resilience includes the ability of health centers to withstand, adapt to, and recover from the effects of disasters while continuing to provide essential health services. This study examined the influence of nurses' disaster preparedness skills on health center resilience in disaster scenarios.

METHODS:

Using a quantitative approach with a cross-sectional study design, this study sampled 125 nurses through proportional stratified random sampling. The questionnaire was administered to assess nurses' disaster preparedness skills, including disaster understanding and policy development and planning. Data were analyzed using Chi-squared and logistic regression.

RESULTS:

There was an association between understanding disaster risk (p=0.013) and policy development and planning competencies (p=0.005) with community health center resilience. Multivariate analysis showed that policy development and planning had a greater impact on community health center resilience (Exp(B)=2.992, 95%CI=1.276-7.014, p=0.012).

CONCLUSION:

This study highlights the importance of strengthening these competencies and fostering collaboration with local governments, health institutions, communities, and non-governmental organizations (NGOs) to support comprehensive disaster preparedness efforts.

KEYWORDS

community resilience, health management services, health policy, disaster preparedness, nurses ' competencies

INTRODUCTION

With the increasing frequency of natural disasters such as earthquakes and tsunamis, health system resilience is essential to ensure the continuity of essential health services and effective emergency response. Community health centers, often the first point of contact for affected populations, play a critical role in providing emergency health services and mitigating the impact of disasters [1]. The ability of these centers to withstand, adapt to, and recover from disaster-related disruptions is critical to maintaining public health and safety.

Nurses are an integral part of disaster preparedness and management, working on the front lines of health care delivery. Their expertise in disaster preparedness is critical to the overall resilience of health centers. According to the International Council of Nurses (ICN) [2], nurses must possess key competencies to effectively contribute to disaster preparedness and response, including understanding disaster risks, promoting health during disasters, and developing strategies and plans to manage such events [3].

Given the central role of community health centers in disasters, efforts should be made to strengthen their resilience to save lives and provide essential services during emergencies. These efforts can be categorized into three main areas: (a) protecting the lives of patients and health workers by ensuring the structural resilience of health centers; (b) maintaining the functionality of health services and facilities during disasters and emergencies; and (c) enhancing the emergency management capabilities of health workers and related agencies. Understanding the concept of disaster resilience and its supporting elements is essential to building the resilience of community health centers [4]. Resilience is the ability to cope with or adapt to situations, disasters, or stresses that are perceived as life-altering shocks [5]. While resilience has traditionally been studied in psychology to assess individual responses to life's challenges, the concept has now been applied to organizations, health care institutions, and broader contexts such as disasters and the economy. Resilience involves preparing for, coping with, and learning from shocks that occur, and is closely related to the concept of "shock," which is defined as a rapid and drastic change that has a significant impact on the health system. For example, epidemics can dramatically increase the demand for health services [6].

In the context of community health centers resilience, it is critical to focus on the competency of nurses in disaster management. The severe impact of disasters requires their competency such as adequate knowledge and skills [7]. Disaster management has prioritized emergency response over effective mitigation in the pre-disaster phase. There is a need for proactive mitigation that can effectively reduce disaster risk [3]. Mitigation is essential to ensure that key facilities, such as community health centers, can provide services and protect communities during disaster emergencies.

Nurses have an important role to play in prevention and mitigation. According to the ICN Framework of Disaster Nursing Competencies, essential competencies for nurses in disaster scenarios include risk reduction, disease prevention, health promotion, and policy development and planning [2]. The lack of disaster competencies has resulted in limited preparedness. The Director-General of UNESCO has emphasized that anticipation, education and information are key to reducing the deadly impact of natural disasters. Enhancing nurses' competence through training, technical guidance and experience is crucial to improving disaster preparedness and response [8].

Moreover, disaster risk management to build the good resilience should be based on understanding disaster risk [9] and good policy and planning [10].The resilience of public health centers is not only about the structural integrity of the buildings, but also about the ability of health care workers (i.e., nurses) and a management system (e.g., policy and planning) that is adaptive and responsive to disaster threats [11]. Therefore, the aim of this study was to examine the impact of nurses' disaster preparedness competencies on the resilience of health centers in disaster scenarios.

METHODS

STUDY DESIGN

This quantitative study used a descriptive-analytical design with a cross-sectional methodology [12]. The cross-sectional design was used to collect data at a single point in time, allowing for analysis of the relationships between nurses' disaster preparedness competencies and health center resilience.

RESEARCH LOCATION

This study was conducted from January to June 2024 in a community health center (Puskesmas) in Palu City, Indonesia. This location was selected because of its vulnerability to disasters and the strategic role of PHCs in disaster response and resilience. Figure 1 shows a description of the damage to all facilities, including health facilities, that occurred during the disaster.

FIGURE 1. NATURAL DISASTER EVENT OF EARTHQUAKE, TSUNAMI, AND LIQUEFACTION IN PALU CITY, SEPTEMBER 28, 2018, INDONESIA

Source: https://www.bbc.com/indonesia/indonesia-45832237.

POPULATION AND SAMPLING

The population comprised 158 nurses working in the 14 Community Health Centers. The sample size was calculated using the Slovin formula [12].

$$n = \frac{N}{1 + N\,(e^2)}$$

Formula Description:

n = Sample size

N = Population size

e = Margin of error (with a 95% confidence level or 5% error tolerance)

$$n = \frac{158}{1 + 158\,(0{,}05^2)}$$

$$n = \frac{158}{1 + 158\,(0{,}0025)}$$

$$n = \frac{158}{1 + 0{,}395}$$

$$n = \frac{158}{1{,}395}$$

$n =$ 113 samples.

Thus, the calculated sample size was 113 samples. In this research, the authors added an additional 10% to the total sample to account for potential *dropouts*, as recommended by Lwangga and Lemeshow [13].

The sample size was increased by 10% using the following formula:

$$n = \frac{n}{1 - f}$$

Formula Description:

n = calculated sample size
f = estimated dropout proportion

$$n = \frac{113}{1 - 0{,}10}$$

$$n = \frac{113}{0{,}9}$$

$n =$ 125 samples.

Therefore, the respondent in this research was 125 respondents. The sample was selected using stratified random sampling technique [12] as shown on Table 1. The formula was below:

$$ni = \frac{Ni.n}{N}$$

Formula description:

ni = number of each sample stratum
Ni = number of each population stratum
n = total sample size (125 nurses)
N = total population (158 nurses)

TABLE 1. STRATIFIED RANDOM SAMPLING TECHNIQUE FOR THE SAMPLE

No	Community Health Centers (*Puskesmas*)	Stratified Population	Stratified Sample
1.	Puskesmas Birobuli	8	6
2.	Puskesmas Talise	7	5
3.	Puskesmas Singgani	12	10
4.	Puskesmas Bulili	20	16
5.	Puskesmas Pantoloan	14	11
6.	Puskesmas Taweli	11	9
7.	Puskesmas Kawatuna	12	10
8.	Puskesmas Sangurara	11	9
9.	Puskesmas Mabelopura	6	4
10.	Puskesmas Mamboro	11	9
11.	Puskesmas Kamonji	15	12
12.	Puskesmas Tipo	8	6

13.	Puskesmas Nosarara	10	8
14.	Puskesmas Lere	13	10
Total		**158**	**125**

INSTRUMENTS AND PROCEDURES

This study used a structured questionnaires about mitigation competencies according to International Council of Nurses (ICN-WHO), including nurses' disaster risk preparedness (a=765, 17 items, e.g., *Do you have an estimate of losses as a result of the disaster?*) and policy development and planning competencies (a=794, 6 items, e.g., *Does Puskesmas have a SOP for the management of disaster victims?*) [2], and Resilient health centers questionnaire using indicators from the Health Centre Resilience Framework for Disasters (a=0.769, 18 items, e.g., *All health center services are still accessible to the community during disasters*) [14].

Understanding disaster preparedness reflects nurses' knowledge and awareness of disaster situations. Policy development and planning competency refers to the involvement of nurses in disaster-related policy development and implementation. Each variable was scored using a Guttman scale where responses were dichotomous, scored as 0 (no) or 1 (yes). The variable was categorized using mean score. The variable was categorized using the mean score. The lower score from the mean would be categorized as less or poor, while the counterpart would be categorized in the opposite direction.

Regarding the procedures, the sample was randomly selected at each puskesmas using a RNG (Random Number Generate) tool. The questionnaires were distributed directly to the nurses in their respective community health centers. Before the survey, participants were informed about the purpose of the study, the voluntary participation, and the confidentiality. An informed consent form was signed upon agreeing to participate. The questionnaire was then given to the participants to complete independently without any intervention from the researcher. If a question was unclear, the researcher would help explain its meaning.

DATA ANALYSIS

The questionnaires were assessed using Cronbach's alpha coefficient test. This test was used to measure the reliability or consistency of a set of survey items. The data distribution was tested using Kolmogorov-Smirnov to ensure the normality of the data. Therefore, the data were normally distributed. Moreover, univariate analysis was performed on the research characteristics using frequencies (n) and percentages (%). The Chi-square test was used to examine the bivariate association. Finally, multivariate analysis using logistic regression to examine the independent factors that had a greater impact on the dependent variable. All analyses were performed using IBM SPSS version 22 with 95% confidence of interval (a=0.05).

ETHICS CLEARANCE STATEMENT

This research was conducted after obtaining ethical approvement from the Research Ethics Commission of the Faculty of Public Health, Hasanuddin University, Makassar with number 1316/UN4.14.1/TP.01.02/2024.

RESULTS

TABLE 1. RESPONDENT CHARACTERISTICS

Characteristics	N	Percentage (%)
Gender		
Male	19	15.2
Female	106	84.8

Age		
17 – 25 years	4	3.2
26 – 35 years	52	41.6
36 – 45 years	58	46.4
46 – 55 years	8	6.4
56 – 55 years	3	2.4
Understanding Disaster Risk		
Less Understanding	55	44.0
Understanding	70	56.0
Policy and Planning		
Less Effective	44	35.2
Effective	81	64.8
Resilience of Community Health Centers		
Poor	40	32.0
Good	85	68.0

Table 1 shows that most respondents were female (84.8%) and between the ages of 36 and 45 (46.4%). Respondents with good understanding of risk were 70 people (56.0%), while respondents with poor understanding of risk were 55 people (44.0%).Respondents with effective policies and planning were 81 people (64.8%), while respondents with less effective policies and planning were 44 people (35.2%). Respondents with good health center resilience were 85 people (68.0%), while respondents with poor health center resilience were 40 people (32.0%).

TABLE 2. BIVARIATE ANALYSIS BETWEEN NURSES' DISASTER PREPAREDNESS COMPETENCIES AND HEALTH CENTER RESILIENCE

Variables	HC resilience				N		P Value
	Poor		Good				
	n	%	n	%	n	%	
Understanding Disaster Risk							
Less Understanding	24	17,6	31	37,4	55	100	0,013
Understanding	16	22,4	54	47,6	70	100	
Policy and Planning							
Less Effective	21	14,1	23	29,9	44	100	0,005
Effective	19	25,9	62	55,1	81	100	

Table 2 shows that there were significant associations between understanding disaster risk (p=0.013) and policy and planning competencies (p=0.005) with community health center resilience. As shown in the table that 47.6% and 55.1% respondents who understood disaster risk and had effective policy planning, had good HC resilience.

TABLE 3. MULTIVARIATE ANALYSIS OF NURSES' DISASTER PREPAREDNESS COMPETENCIES AND HEALTH CENTER RESILIENCE

	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI Lower	Upper
Understanding Disaster Risk	1.017	0.426	5.703	1	0.017	2.766	1.200	6.375
Policy and Planning	1.096	0.435	6.358	1	0.012	2.992	1.276	7.014
Constant	-4.878	1.496	10.631	1	0.001	0.008		

Logistic regression; Method: Enter.

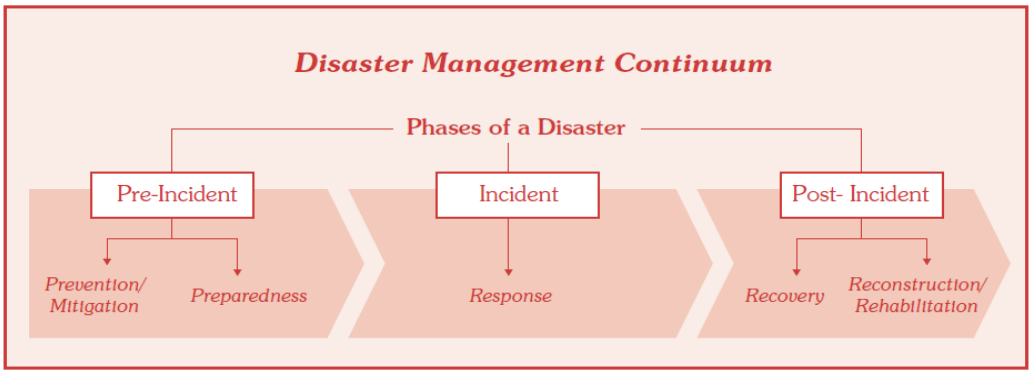
Table 3 shows that policy and planning competency had the strongest impact on community health center resilience (Exp(B)= 2.992, 95%CI=1.276-7.014, p=0.012). Meanwhile, understanding disaster risk competency also had significant impact (Exp(B)= 2.766, 95%CI=1.200-6.375,p=0.017).

DISCUSSION

Community or public health centers can develop specific and effective preparedness plans, including evacuation procedures, storage of emergency medicines, and training for health staff to be adaptable and resilient in difficult situations [15]. By identifying risks, public health centers can take mitigating actions, such as strengthening building structures [1], placing medical equipment in safe locations, and increasing staff capacity to handle emergency situations. Community health centers that understand disaster risks can respond more quickly and effectively, reducing the negative impact on health services and ensuring faster recovery after a disaster [17].

The resilience of facing disaster can be applied in disaster risk management by knowing and implementing the framework to address the element of disaster risk including exposure to hazards, vulnerability and capacity of exposed elements, and characteristics of hazards to prevent the creation of new risks and reduce existing risks as recommended by the Sendai Framework for Disaster Risk Reduction 2015-2030 adopted at the Third UN World Conference on Disaster Risk Reduction in Sendai, Japan, on 18 March 2015 [18,19]. Moreover, disaster risk management to build the good resilience should be based on understanding disaster risk in all its dimensions. This knowledge can be used for risk assessment, prevention, mitigation, preparedness and response [20].

FIGURE. 2. DISASTER MANAGEMENT CONTINUUM FROM THE INTERNATIONAL COUNCIL OF NURSES (ICN-WHO).



Source: This figure is extracted from the original ICN-WHO reference [2].

The resilience of public health centers is1ot only about the structural integrity of the buildings, but also about the ability of health care workers (i.e., nurses) to maintain primary health care services during and after a disaster. Nurses are often on the front lines, providing critical care, coordinating emergency response, and assisting in the recovery process. Their preparedness and competencies directly affect the ability of health centers to withstand, adapt to, and recover from disasters [11]. This study examines nurses' disaster preparedness competencies as key determinants of health center resilience.

The results showed that most respondents who have a good understanding of various aspects of disaster risk tend to work in health centers with better resilience, suggesting the importance of continuous education and training on disaster risk management to improve the preparedness and response capacity of Puskesmas. This is consistent with recent research on disaster preparedness, which suggests that nurses who understand potential disasters and how to prevent them can respond better when a disaster occurs [20]. Teaching nurses more about disasters can help them make better decisions, which can make health facilities more resilient [21].

Nurse educators and trainers are helping community health centers prepare for and respond to disasters [22]. This shows that education and training on disaster risk management is important. Efforts to educate and train people on disaster risk must continue [23]. Ibrahim et al. [16] said that nurses can help communities prepare for disasters and reduce their impact. They are health workers close to the community. The International Council of Nurses (ICN) suggests that nurses should be involved in disaster preparedness. Nurses in Indonesia can work with other health workers, the government, and the community to manage disasters. They can support rural communities by working with village heads, village government officials, hamlets, and community health center representatives [24]. Therefore, this study emphasizes the importance of education and training in disaster risk management as a key component in improving the strength of health centers. Ongoing training and disaster simulations can increase the awareness and preparedness of *Puskesmas* staff.

Most respondents said that health centers had effective policies and plans which suggest that they are actively involved in collaboration with external parties, including local governments, other health institutions, and local communities (Table 1). Such collaboration helps get the resources and knowledge needed to create effective strategies. Proactive management of policies, plans, and monitoring will increase success in disasters. Effective policies and planning lead to more efficient disaster mitigation and response.

Policy and planning were the most important factors in how well health centers could cope with challenges. This is evidenced by the multivariate analysis that shows the most significant of these variables for public health resilience. This shows that good policies and planning make health centers three times more likely to be resilient in a disaster. Therefore, strong policies are important for responding to disasters and making good use of resources.

Developing policies and planning for disaster management is a critical aspect of building the resilience of community health centers. The resilience of community health centers includes not only physical capacity and resources, but also a management system that is adaptive and responsive to disaster threats [25]. Effective policy development in the context of community health centers includes the establishment of clear and structured standard operating procedures (SOPs) for disaster management. These SOPs include steps to be taken at various stages of disaster management, such as preparedness, mitigation, response, recovery, and rehabilitation [10].

The involvement and collaboration of community health centers with external parties has a positive impact on disaster preparedness and response [10]. This effective collaboration not only expands available resources, but also increases access to knowledge, technology, and best practices in disaster management [26,27]. This involvement allows community health centers to integrate multidimensional perspectives into disaster planning, thereby strengthening the adaptive capacity to deal with different disaster scenarios that may occur [28].

The significant influence of both policy and planning and understanding of disaster risk highlights the multifaceted nature of resilience in health centers. While strategic policies and comprehensive planning provide the structural backbone for disaster response, a thorough understanding of disaster risk empowers health professionals to implement these plans effectively. It is therefore recommended that, in addition to focusing on the development of robust policies, investment be made in the ongoing education and training of health workers. In addition, policy frameworks should include elements that increase nurses' risk awareness and preparedness [29]. Collaborative efforts involving local governments, health care institutions, communities, and non-governmental organizations (NGOs) are essential to creating an integrated disaster preparedness ecosystem. Such collaboration can facilitate the sharing of best practices, resources, and support systems that are critical during disaster events [30]

CONCLUSIONS

This research underlines the critical role of nurses in increasing the resilience of Community Health Centers through disaster mitigation competencies. The development of sustainable training programs and the preparation of comprehensive policies are needed to strengthen *Puskesmas* preparedness and response to disasters. In addition, effective collaboration

with local governments, other health institutions, and local communities is essential to increase resources and access to knowledge and technology in disaster management. This research contributes to the literature on disaster risk management and shows that increasing mitigation competencies among nurses is a long-term investment in building community resilience to disasters. These findings are relevant for application not only in Indonesia but also in various disaster-prone regions around the world, providing the basis for better mitigation strategies and stronger public health resilience.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest

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