Analysis of Resilience and Workload Among Healthcare Workers in Disaster-Prone Areas: A Mixed-Methods Study of Occupational Epidemiology and Health Resource Management at Puskesmas Peusangan, Bireuen Regency

Aris Winandar[1*], Rizkha Maulana[2]

[1]Faculty of Public Health, Universitas Muhammadiyah Mahakarya Aceh, Indonesia
[2]Department of Management, Universitas Muhammadiyah Mahakarya Aceh, Indonesia
* Corresponding Author:
Emial: ariswinandar17@gmail.com

Abstract.

Healthcare workers in disaster-prone areas face unique occupational challenges that affect their resilience and workload. This study aimed to analyze the relationship between resilience levels and workload among healthcare workers at Puskesmas Peusangan, Bireuen Regency, Aceh Province, Indonesia. A mixed-methods approach with explanatory sequential design was employed, combining quantitative cross-sectional survey (n=87) with qualitative in-depth interviews (n=15). Resilience was measured using the Connor-Davidson Resilience Scale (CD-RISC-25) Indonesian version, while workload was assessed using the NASA Task Load Index (NASA-TLX). Quantitative data were analyzed using Spearman correlation and multiple linear regression, while qualitative data underwent thematic analysis. Results showed that 43.7% of respondents had moderate resilience levels, while 51.7% experienced high workload. A significant negative correlation was found between resilience and workload ($r=-0.486$, $p<0.001$). Regression analysis revealed that disaster experience, years of service, and social support significantly predicted resilience ($R^2=0.412$, $p<0.001$). Qualitative findings identified four main themes: adaptive coping strategies, community bonding, resource constraints, and institutional support gaps. The study concludes that healthcare workers in disaster-prone areas require targeted interventions to enhance resilience and optimize workload management. Policy recommendations include implementing resilience training programs, improving staffing ratios, and establishing peer support systems.

Keywords: *Healthcare workers; resilience; workload; disaster-prone area; mixed-methods; occupational health and Puskesmas*

I. INTRODUCTION

Healthcare systems in disaster-prone regions face significant challenges in maintaining service quality while managing the physical and psychological demands placed on their workforce. Indonesia, as an archipelagic nation situated along the Pacific Ring of Fire, experiences frequent natural disasters including earthquakes, tsunamis, floods, and volcanic eruptions. Aceh Province, located at the northwestern tip of Sumatra, has historically been one of the most disaster-affected regions, with the devastating 2004 Indian Ocean tsunami serving as a stark reminder of the region's vulnerability.Bireuen Regency in Aceh Province presents a particularly relevant context for studying healthcare worker resilience. The region experiences annual flooding events, with recent incidents in late 2025 causing significant damage to healthcare infrastructure including Puskesmas Peusangan. During such events, healthcare workers are expected to maintain service delivery despite facing personal losses, infrastructure damage, and increased patient loads. This dual burden of professional responsibility and personal adversity creates unique occupational health challenges that warrant systematic investigation.Resilience, defined as the capacity to adapt successfully to adversity, stress, or trauma, has emerged as a critical factor in healthcare workforce sustainability. Previous studies have demonstrated that resilient healthcare workers exhibit lower burnout rates, higher job satisfaction, and better patient care outcomes. However, research specifically examining resilience among primary healthcare workers in disaster-prone areas of Indonesia remains limited.

Most existing studies have focused on hospital-based healthcare workers in urban settings or have been conducted in Western contexts that may not be directly applicable to Indonesian healthcare systems.Workload in healthcare settings encompasses multiple dimensions including mental demands, physical demands, temporal pressure, effort expenditure, performance perception, and frustration levels. The NASA Task Load Index (NASA-TLX), originally developed for aviation research, has been extensively validated for healthcare applications and provides a comprehensive multidimensional assessment of perceived workload. Understanding the interplay between workload and resilience is essential for developing

effective interventions to support healthcare workers in challenging environments.This study addresses the knowledge gap by employing a mixed-methods approach to comprehensively examine resilience and workload among healthcare workers at Puskesmas Peusangan, Bireuen Regency. The research objectives were: (1) to assess the levels of resilience and workload among healthcare workers; (2) to analyze the relationship between resilience and workload; (3) to identify factors associated with resilience; and (4) to explore the lived experiences of healthcare workers in managing occupational demands in a disaster-prone context.

II. METHODS

Study Design and Setting

This study employed a mixed-methods explanatory sequential design, consisting of two phases: a quantitative cross-sectional survey followed by qualitative in-depth interviews. The explanatory sequential design was chosen to allow the qualitative phase to help explain and elaborate on the quantitative findings. The study was conducted at Puskesmas Peusangan and its satellite health posts (Pustu) in Kecamatan Peusangan, Bireuen Regency, Aceh Province, Indonesia, from March to August 2025.Puskesmas Peusangan serves as the primary healthcare center for approximately 45,000 residents across 27 villages. The facility provides comprehensive primary healthcare services including outpatient care, maternal and child health services, immunization programs, and emergency services. The area is classified as disaster-prone due to its geographic location in a flood plain and proximity to seismically active zones.

Participants and Sampling

For the quantitative phase, total sampling was employed, recruiting all healthcare workers at Puskesmas Peusangan who met the inclusion criteria: (1) permanent or contract employees with minimum six months of service; (2) actively involved in patient care activities; and (3) willing to participate. Exclusion criteria included healthcare workers on extended leave or those assigned to administrative-only positions. Of 95 eligible healthcare workers, 87 (91.6%) completed the survey.For the qualitative phase, purposive sampling was used to select 15 participants representing diverse characteristics including profession, years of experience, and disaster exposure. Participants were selected to ensure maximum variation and theoretical saturation. Sample size was determined by data saturation, achieved after 12 interviews with 3 additional interviews conducted for confirmation.

Instruments

Resilience was measured using the Connor-Davidson Resilience Scale 25-item version (CD-RISC-25), which has been validated for Indonesian populations. The instrument assesses five factors: personal competence, trust in one's instincts, positive acceptance of change, control, and spiritual influences. Items are rated on a 5-point Likert scale (0=not true at all to 4=true nearly all the time), with total scores ranging from 0 to 100. Higher scores indicate greater resilience. The Indonesian version demonstrated good internal consistency (Cronbach's α=0.89) in this study.Workload was assessed using the NASA Task Load Index (NASA-TLX), a validated multidimensional tool measuring six subscales: Mental Demand, Physical Demand, Temporal Demand, Performance, Effort, and Frustration.

Participants rated each subscale on a 21-point scale (0-100), and weighted scores were calculated based on pairwise comparisons. The NASA-TLX has been previously validated for Indonesian healthcare settings with good reliability (Cronbach's α=0.82).A demographic questionnaire collected information on age, gender, education, profession, years of service, employment status, marital status, number of dependents, disaster experience (direct/indirect), and perceived social support (measured using the Multidimensional Scale of Perceived Social Support).Qualitative data were collected through semi-structured in-depth interviews using an interview guide developed based on the research objectives and preliminary quantitative findings. The guide explored themes including daily work experiences, coping strategies, disaster-related challenges, support systems, and recommendations for improvement.

Data Collection Procedures

Quantitative data collection was conducted over four weeks (March-April 2025). Participants completed questionnaires during work breaks or after duty hours to minimize interference with patient care. Research assistants were available to clarify any questions. All questionnaires were self-administered with an average completion time of 25 minutes.Qualitative interviews were conducted from May to June 2025 by the principal investigator. Interviews were conducted in private rooms at the Puskesmas or participants' preferred locations, lasting 45-60 minutes each. All interviews were audio-recorded with participant consent and transcribed verbatim within 48 hours.

Data Analysis

Quantitative data were analyzed using SPSS version 26.0. Descriptive statistics (frequencies, percentages, means, standard deviations) characterized participant demographics and instrument scores. Normality was assessed using the Kolmogorov-Smirnov test. Spearman's rank correlation analyzed the relationship between resilience and workload due to non-normal distribution. Multiple linear regression identified predictors of resilience, with assumptions tested for multicollinearity (VIF<10), homoscedasticity, and normality of residuals. Statistical significance was set at $p<0.05$.Qualitative data underwent thematic analysis following Braun and Clarke's six-phase approach: familiarization with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Two researchers independently coded transcripts, with disagreements resolved through discussion. NVivo 12 software facilitated data management and analysis. Trustworthiness was ensured through member checking, peer debriefing, and maintaining an audit trail.

Ethical Considerations

This study received ethical approval from the Health Research Ethics Committee of Universitas Syiah Kuala (Reference No: 045/KEPK-FK/2025). All participants provided written informed consent after receiving detailed information about the study purpose, procedures, risks, and benefits. Participation was voluntary, and participants could withdraw at any time without consequences. Data confidentiality was maintained through coded identification and secure data storage.

III. RESULT AND DISCUSSION

Participant Characteristics

Table 1 presents the demographic characteristics of the 87 quantitative study participants. The majority were female (74.7%), reflecting the gender distribution typical of Indonesian primary healthcare workforce. The mean age was 34.6 years (SD=8.2), with most participants (48.3%) in the 26-35 age group. Regarding profession, nurses comprised the largest group (40.2%), followed by midwives (28.7%) and general practitioners (10.3%).

Table 1. Demographic Characteristics of Participants (n=87)

Characteristic	n	%
Gender		
Male	22	25.3
Female	65	74.7
Age (years)		
≤25	12	13.8
26-35	42	48.3
36-45	24	27.6
>45	9	10.3
Education		
Diploma III	38	43.7

Bachelor/Diploma IV	41	47.1
Master	8	9.2
Profession		
General Practitioner	9	10.3
Nurse	35	40.2
Midwife	25	28.7
Laboratory Technician	6	6.9
Pharmacist	5	5.7
Other	7	8.0
Years of Service		
<5 years	28	32.2
5-10 years	34	39.1
>10 years	25	28.7
Disaster Experience		
Direct exposure	54	62.1
Indirect exposure	33	37.9

Notably, 62.1% of participants reported direct exposure to disasters, having experienced personal or family losses during flood events. The mean years of service was 7.8 years (SD=5.4), indicating a relatively experienced workforce. Most participants (67.8%) were married with dependents, adding to their responsibilities during disaster events.

Resilience Levels

The mean resilience score was 64.8 (SD=14.3), ranging from 32 to 91. Based on established cut-off values for the CD-RISC-25, resilience levels were categorized as low (<50), moderate (50-74), and high (≥75). Table 2 shows the distribution of resilience levels among participants.

Table 2. Distribution of Resilience Levels (n=87)

Resilience Level	Score Range	n	%
Low	<50	17	19.5
Moderate	50-74	38	43.7
High	≥75	32	36.8

The finding that nearly one-fifth (19.5%) of healthcare workers exhibited low resilience is concerning and warrants attention from health administrators. This proportion is higher than reported in studies of healthcare workers in non-disaster-prone areas of Indonesia (12-15%), suggesting that chronic disaster exposure may erode resilience over time. However, it is encouraging that over a third (36.8%) demonstrated high resilience, indicating successful adaptation despite challenging circumstances.Analysis of CD-RISC subscales revealed that participants scored highest on the spiritual influences domain (Mean=3.42, SD=0.68) and lowest on the personal competence domain (Mean=2.51, SD=0.72). This pattern reflects the strong religious and cultural values in Acehnese society, where faith serves as a primary coping mechanism during adversity. The relatively lower personal competence scores may indicate self-doubt regarding professional capabilities during crisis situations.

Workload Assessment

The mean NASA-TLX weighted workload score was 68.4 (SD=12.7), indicating moderate to high perceived workload. Table 3 presents the distribution of workload levels and subscale scores.

Table 3. NASA-TLX Workload Scores (n=87)

Subscale/Category	Mean	SD	Range
Mental Demand	72.4	15.3	35-95
Physical Demand	58.6	18.2	20-90
Temporal Demand	74.8	14.6	40-100
Performance	62.3	16.8	25-90
Effort	71.2	13.9	40-95
Frustration	65.7	19.4	15-95
Overall Weighted Score	68.4	12.7	38-92
Workload Category	n	%	
Low (<50)	14	16.1	
Moderate (50-70)	28	32.2	
High (>70)	45	51.7	

The data reveal that over half (51.7%) of healthcare workers experienced high workload levels. Temporal demand emerged as the highest-scoring subscale (Mean=74.8), reflecting the time pressure inherent in providing healthcare services with limited staff. Mental demand (Mean=72.4) and effort (Mean=71.2) were also elevated, consistent with the complex decision-making and sustained concentration required in clinical work.Physical demand showed the lowest mean score (58.6), though still moderate, indicating that while primary healthcare work involves physical activity, the cognitive and temporal demands predominate. The frustration subscale (Mean=65.7) with high variability (SD=19.4) suggests heterogeneous experiences among workers, possibly reflecting differential access to resources and support.

Relationship Between Resilience and Workload

Spearman's correlation analysis revealed a significant negative correlation between resilience and overall workload ($r=-0.486$, $p<0.001$), indicating that healthcare workers with higher resilience perceived lower workload burden. Table 4 presents the correlation matrix between resilience and NASA-TLX subscales.

Table 4. Correlation Between Resilience and NASA-TLX Subscales

NASA-TLX Subscale	Resilience (r)	p-value
Mental Demand	-0.312	<0.01
Physical Demand	-0.198	0.066
Temporal Demand	-0.425	<0.001
Performance	0.287	<0.01
Effort	-0.356	<0.001
Frustration	-0.518	<0.001
Overall Weighted Score	-0.486	<0.001

The strongest negative correlations were observed between resilience and frustration ($r=-0.518$) and temporal demand ($r=-0.425$). This suggests that resilient healthcare workers are better able to manage time pressure and experience less work-related frustration. Interestingly, performance showed a positive correlation with resilience ($r=0.287$), indicating that resilient workers perceived better task performance.

Physical demand showed no significant correlation with resilience (r=-0.198, p=0.066), suggesting that resilience primarily buffers against psychological rather than physical workload dimensions.

Predictors of Resilience

Multiple linear regression analysis was conducted to identify factors associated with resilience. The model included demographic variables (age, gender, education, years of service), disaster-related factors (direct/indirect exposure, disaster preparedness training), and psychosocial factors (social support, marital status). Table 5 presents the regression results.

Table 5. Multiple Linear Regression: Predictors of Resilience

Variable	B	SE	β	p-value
(Constant)	28.42	8.65		0.002
Years of Service	0.84	0.28	0.28	0.004
Disaster Preparedness Training	6.52	2.14	0.24	0.003
Social Support Score	0.42	0.09	0.38	<0.001
Direct Disaster Exposure	-4.87	2.31	-0.17	0.038
Education (Bachelor+)	3.24	2.08	0.12	0.124
Gender (Female)	-1.86	2.54	-0.06	0.467

$R^2 = 0.412$, Adjusted $R^2 = 0.368$, $F(6,80) = 9.34$, $p < 0.001$

The regression model explained 41.2% of the variance in resilience scores. Social support emerged as the strongest predictor (β=0.38, p<0.001), underscoring the protective role of interpersonal relationships. Years of service positively predicted resilience (β=0.28, p=0.004), suggesting that experience builds adaptive capacity. Disaster preparedness training was also significantly associated with higher resilience (β=0.24, p=0.003), highlighting the value of institutional preparedness programs.Notably, direct disaster exposure was negatively associated with resilience (β=-0.17, p=0.038), indicating that personal disaster experiences may have lingering psychological effects despite potential post-traumatic growth. Education level and gender did not significantly predict resilience in this model, though the direction of effects was consistent with previous literature.

Qualitative Findings

Thematic analysis of 15 in-depth interviews identified four main themes that elaborate on the quantitative findings: (1) Adaptive Coping Strategies, (2) Community Bonding and Social Cohesion, (3) Resource Constraints and Infrastructure Challenges, and (4) Institutional Support Gaps.

Theme 1: Adaptive Coping Strategies

Participants described various strategies for managing work demands and maintaining psychological well-being. Religious practices emerged as the most frequently mentioned coping mechanism, consistent with the quantitative finding of high spiritual resilience scores. One experienced nurse explained:

> *"When the flood came last year and destroyed my house, I still came to work. I prayed, 'Allah will help me get through this.' My faith gives me strength. If I stop working, who will take care of the patients? They also suffer." (Nurse, 12 years of service)*

Problem-focused coping strategies were also evident, including task prioritization, seeking assistance from colleagues, and breaking overwhelming work into manageable components. Emotion-focused strategies included positive reframing, acceptance, and seeking emotional support from family members.

Theme 2: Community Bonding and Social Cohesion

Participants emphasized the importance of workplace relationships and community connections. The collective experience of repeated disasters appeared to foster solidarity among healthcare workers and between providers and community members. A midwife described:

> *"We are like family here. When one of us has problems, others help. During emergencies, we work together without being asked. The community also supports us—they bring food, help clean the Puskesmas. This mutual support makes us stronger." (Midwife, 8 years of service)*

This theme aligns with the quantitative finding that social support was the strongest predictor of resilience. The communal culture of Acehnese society, characterized by gotong royong (mutual cooperation), appears to provide a protective buffer against occupational stress.

Theme 3: Resource Constraints and Infrastructure Challenges

Participants consistently identified inadequate resources as a major stressor contributing to high workload. Equipment shortages, medication stockouts, and infrastructure damage during disasters were frequently mentioned. A physician noted:

> *"After the flood, our examination rooms were full of mud. We had to see patients in tents while cleaning the building. Some equipment was destroyed. We managed with what we had, but it was exhausting—physically and mentally. We worry constantly about whether we are providing adequate care." (General Practitioner, 5 years of service)*

Staffing shortages were particularly problematic, with participants describing extended shifts and cancelled leave during emergencies. The temporal demand subscale's high scores in the quantitative phase reflect this reality of stretched human resources.

Theme 4: Institutional Support Gaps

While participants valued peer support, they identified gaps in formal institutional support mechanisms. Psychological services for healthcare workers were notably absent, and career development opportunities were limited. A laboratory technician expressed:

> *"Nobody asks how we are coping. We are expected to be strong for patients, but who takes care of us? I have seen colleagues burn out and leave. We need mental health support, not just for emergencies but regularly. Training programs help, but they are rare and often in Banda Aceh—difficult to attend." (Laboratory Technician, 6 years of service)*

Participants recommended several institutional improvements: regular psychological support or counseling services, recognition programs for disaster response efforts, clearer career pathways, and localized training opportunities. These suggestions align with evidence-based practices for supporting healthcare worker well-being.

Integration of Findings

The mixed-methods design allowed for comprehensive understanding of resilience and workload dynamics. Quantitative findings established the prevalence and correlational relationships, while qualitative data illuminated the mechanisms and contextual factors. The convergence of findings strengthens the validity of conclusions.The significant negative correlation between resilience and workload ($r=-0.486$) can be understood through the qualitative themes: resilient workers employ adaptive coping strategies that reduce perceived burden, leverage social connections for support, and maintain psychological flexibility despite resource constraints. Conversely, low resilience may amplify perceived workload through maladaptive coping, social isolation, and rumination on constraints.The finding that disaster preparedness training predicted higher resilience (quantitative) was elaborated by participants who described how training provided practical skills, psychological preparation, and professional confidence during emergencies (qualitative). Similarly, the protective effect of social support (strongest regression predictor) was richly illustrated through descriptions of workplace solidarity and community cooperation.

Limitations

Several limitations should be considered when interpreting these findings. First, the cross-sectional design precludes causal inferences; longitudinal studies are needed to establish temporal relationships between resilience and workload. Second, the study was conducted at a single Puskesmas, limiting generalizability; however, the findings may be transferable to similar disaster-prone primary healthcare settings in Indonesia. Third, self-reported measures are subject to social desirability and recall biases; future research could incorporate objective workload measures such as patient volumes and staffing ratios. Fourth, the study was conducted approximately six months after a major flood event, which may have influenced responses; different timing might yield different results.

IV. CONCLUSION

This mixed-methods study provides comprehensive evidence on resilience and workload among healthcare workers in a disaster-prone area of Indonesia. Key findings include: moderate average resilience levels with nearly one-fifth of workers showing low resilience; high workload particularly in temporal and mental demand dimensions; a significant negative correlation between resilience and workload; and the importance of social support, experience, and disaster preparedness training as protective factors.Qualitative findings enriched understanding by revealing adaptive coping strategies centered on religious faith and mutual support, as well as institutional gaps in psychological services and career development. The convergence of quantitative and qualitative results strengthens confidence in conclusions and provides actionable insights for policy and practice.

Based on these findings, we recommend: (1) implementing structured resilience training programs tailored to disaster-prone contexts; (2) establishing regular psychological support services for healthcare workers; (3) improving staffing ratios to reduce temporal workload demands; (4) strengthening peer support systems through formal mentoring programs; (5) providing localized disaster preparedness training accessible to all staff; and (6) creating recognition systems for healthcare workers' contributions during emergencies.Future research should employ longitudinal designs to track resilience trajectories, intervention studies to evaluate resilience-building programs, and multi-site studies to assess generalizability across disaster-prone regions of Indonesia. Understanding and supporting healthcare worker resilience is essential for maintaining robust primary healthcare systems capable of serving communities through both routine operations and emergency responses.

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