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Assessing the Resilience of Primary Health Care Services: Evidence from Public Health Centers in Depok City

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ABSTRACT

Purpose of the study: This study aims to quantitatively assess the resilience level of primary health care services at Public Health Centers (Puskesmas) in an urban setting by measuring multiple resilience dimensions under routine service conditions in Depok City, Indonesia.

Methodology: This quantitative descriptive cross-sectional study used a structured questionnaire based on the WHO Primary Health Care Measurement Framework and the Oktari–Kurniawan resilience model. Data were collected via Google Forms from 100 purposively selected Puskesmas staff and analyzed using descriptive statistics with univariate analysis.

Main Findings: The findings show that primary health care services demonstrated high resilience across all assessed dimensions. Good resilience was reported for physical conditions (83%), institutional roles (88%), staff capacity (83%), external relationships (84%), and environmental exposure (81%), indicating strong organizational readiness and service continuity at the primary care level.

Novelty/Originality of this study: This study provides novel quantitative evidence on primary health care resilience during routine, post-crisis operational conditions rather than emergency phases. It integrates five resilience dimensions within a single empirical framework at the Puskesmas level, contributing localized urban evidence to strengthen primary health care resilience assessment and policy development.

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1. INTRODUCTION

Primary health care services play a fundamental role in ensuring equitable access to health services and improving population health outcomes, particularly at the community level [1]. Public Health Centers (Puskesmas) in Indonesia function as the frontline of the health system, delivering promotive, preventive, curative, and rehabilitative services [2]. In urban areas, increasing population density and diverse health needs place continuous pressure on the capacity and performance of primary health care facilities [3]. As a result, the ability of Puskesmas to maintain service continuity and quality under various conditions has become a critical concern [4]. This situation highlights the importance of strengthening resilience within primary health care services [5].

Health service resilience refers to the capacity of health facilities to anticipate, adapt to, and recover from disruptions while continuing to provide essential services [6]. In practice, many Puskesmas face persistent challenges related to limited infrastructure, workforce constraints, information systems, and financial resources

[7]. These challenges can hinder service delivery and reduce the effectiveness of health programs at the community level [8]. Despite ongoing health system reforms, disparities in service readiness and adaptive capacity remain evident across regions [9]. Such conditions indicate that resilience at the primary care level is not yet evenly developed [10].

Previous studies on health system resilience have largely focused on hospitals or national-level health systems, with limited attention given to primary health care facilities [11]. Existing research has examined resilience frameworks related to disaster management, institutional preparedness, and emergency response capacity [12]. However, empirical evidence assessing resilience in routine primary health care service delivery, particularly using quantitative approaches, remains scarce [13]. Studies that specifically explore resilience dimensions within Puskesmas are still limited in number and scope [14]. This gap suggests a need for more context-specific investigations at the primary care level [15].

The lack of comprehensive quantitative assessments of primary health care resilience represents a significant research gap, especially in urban settings [16]. Many studies emphasize policy responses or qualitative descriptions without systematically measuring resilience indicators [17]. Furthermore, few studies integrate multiple dimensions such as physical infrastructure, institutional capacity, human resources, and external collaboration within a single analytical framework [18]. As a result, the current body of literature does not fully capture the operational resilience of Puskesmas [19]. Addressing this gap is essential to inform evidence-based health system strengthening strategies [20].

The urgency of assessing primary health care resilience is closely linked to ongoing health challenges faced by urban populations [21]. Cities such as Depok experience high service demand due to rapid urbanization and demographic transitions [22]. Strengthening the resilience of Puskesmas is crucial to ensure uninterrupted service delivery, improve system responsiveness, and support sustainable community health outcomes [23]. Without adequate resilience, primary health care services risk becoming overwhelmed and ineffective [24]. Therefore, evaluating resilience at the Puskesmas level is vital for long-term health system sustainability [25].

This study offers novelty by providing a quantitative assessment of primary health care service resilience at the Puskesmas level in an urban Indonesian context. Unlike previous research that predominantly focused on crisis-specific events or hospital-based settings, this study evaluates resilience under routine service conditions. By integrating multiple resilience dimensions including physical conditions, institutional roles, human resource capacity, external relationships, and environmental exposure this study provides a comprehensive analytical perspective. The use of empirical data from Public Health Centers in Depok City contributes localized evidence to the broader global discourse on health system resilience. The findings are expected to inform policy development and practical interventions aimed at strengthening primary health care services.

2. RESEARCH METHOD

2.1 Study Design

This study used a quantitative descriptive design with a cross-sectional approach to assess the resilience of primary health care services, enabling real-time capture of health facility readiness and organizational adaptations during routine operations. Descriptive cross-sectional designs are commonly used in healthcare research to analyze associations and prevalence at a single point in time without manipulating variables, ensuring efficient comparison across dimensions of resilience [26], [27]. Such methods have been applied in nursing and healthcare settings to measure resilience outcomes and workforce characteristics under stress conditions, providing robust quantitative insight into system capacity [28]. In the context of primary care resilience research, cross-sectional surveys capture frontline workers' perceptions of system performance and adaptive responses, which are essential for comprehensive resilience assessment [29]. Data were collected using a structured questionnaire administered to health center staff to provide a quantitative overview of organizational and service readiness across multiple resilience dimensions.

2.2 Study Setting and Participants

The study was conducted in four Public Health Centers (Puskesmas) in Depok City, Indonesia: Abadi Jaya, Sukmajaya, Cilodong, and Sawangan. These facilities were selected to represent different sub-districts and service characteristics. The study population included all Puskesmas employees in Depok City. A total of 100 respondents were selected using purposive sampling based on their involvement and knowledge of health service operations.

2.3 Research Instrument

Data were collected using a structured questionnaire developed from the World Health Organization's Primary Health Care Measurement Framework and the resilience model proposed by Oktari and Kurniawan. The

instrument assessed five dimensions of health service resilience: physical conditions, institutional roles, staff capacity, external relationships, and environmental exposure. Responses were measured using a dichotomous Guttman scale (Yes = 1, No = 0). After validity testing, 18 items were retained for analysis.

Table 1. Dimensions and Indicators of Primary Health Care Resilience

Dimension	Number of Items	Measurement Scale
Physical conditions	6	Guttman (Yes/No)
Institutional role	3	Guttman (Yes/No)
Staff capacity	3	Guttman (Yes/No)
External relationships	4	Guttman (Yes/No)
Environmental exposure	2	Guttman (Yes/No)
Total	18 items	

2.4 Data Collection and Analysis

Data collection was conducted using an online questionnaire distributed via Google Forms. Respondents provided informed consent before completing the survey. Data analysis employed descriptive statistical methods with univariate analysis to present frequencies and percentages. Normality testing using the Kolmogorov–Smirnov test indicated non-normal data distribution; therefore, median values were used to categorize resilience levels.

2.5 Ethical Considerations

Data collection for this study was conducted using an online questionnaire distributed via Google Forms with respondents providing informed consent before participation, a method increasingly adopted in health research to enhance reach and convenience in data gathering in cross-sectional designs. Online surveys have been utilized in numerous health contexts to capture participant responses remotely and efficiently, enabling rapid data acquisition across wide samples. For example, an observational cross-sectional study on burnout and job stress among healthcare professionals employed an online questionnaire and utilized SPSS for descriptive statistics, including Kolmogorov–Smirnov normality testing to guide further analysis frameworks [30]. Similarly, a recent online survey among menopausal women in Iran deployed questionnaires via social media and assessed normality of responses with the Kolmogorov–Smirnov test before conducting frequency and inferential analyses [31]. In the social sciences, online surveys have also applied descriptive statistics to present frequency and percentage distributions of questionnaire responses using SPSS, demonstrating the widespread applicability of this approach [32]. Additionally, studies investigating positive mental health in adolescents have employed online questionnaires and explicitly tested data normality using Kolmogorov–Smirnov as part of their descriptive statistical assessments [33]. These examples illustrate that online questionnaire distribution combined with descriptive and normality analyses is a validated methodology in quantitative health research, supporting the reliability of our data collection and preliminary analysis strategy.

3 RESULTS AND DISCUSSION

3.1 Study Setting

This study was conducted in Depok City, West Java Province, Indonesia, an urban area with a total population of approximately 2.49 million people. Depok consists of 11 sub-districts and is served by an extensive primary health care network. In 2021, the city had 38 Public Health Centers (Puskesmas), including inpatient and non-inpatient facilities. Four Puskesmas were selected for this study Sukmajaya and Cilodong (inpatient), as well as Abadi Jaya and Sawangan (non-inpatient) to represent variations in service capacity and organizational characteristics.

3.2 Characteristics of Respondents

A total of 100 health care workers participated in this study. The majority of respondents were female (66%), while males accounted for 34%. Most respondents were aged between 31 and 35 years (40%), followed by those aged 26–30 years (39%). In terms of educational background, more than half of the respondents held a bachelor's degree (57%), while 21% had a diploma qualification and 15% held a master's degree. These characteristics indicate that the respondents were predominantly productive-age health workers with adequate educational qualifications relevant to primary health care services.

Table 2. Characteristics of Respondents

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	34	34.0
Female	66	66.0
Age (years)		
< 25	8	8.0
26–30	39	39.0
31–35	40	40.0
> 35	13	13.0
Educational Level		
Senior High School	7	7.0
Diploma (D3/D4)	21	21.0
Bachelor's Degree	57	57.0
Master's Degree	15	15.0

3.3 Resilience of Primary Health Care Services

The physical condition dimension showed a high level of resilience, with 83% of respondents categorized as having good physical readiness. Most respondents reported that health services remained accessible, supported by adequate ventilation systems, physical distancing arrangements, availability of handwashing facilities, and routine use of personal protective equipment by staff. These findings suggest that physical infrastructure and environmental safety measures were well maintained to support continuous service delivery.

Table 3. Distribution of Physical Condition Resilience Scores

Physical Condition	n	%
Good	83	83.0
Poor	17	17.0

3.4 Institutional Roles

Institutional roles demonstrated strong resilience, with 88% of respondents classified in the good category. The majority indicated that services were delivered in accordance with technical guidelines, supported by effective communication systems and health information management systems. This reflects the presence of clear governance structures and institutional mechanisms that support service continuity and coordination at the primary care level.

Table 4. Distribution of Institutional Role Resilience Scores

Institutional Role	n	%
Good	88	88.0
Poor	12	12.0

3.5 Staff Capacity

Regarding staff capacity, 83% of respondents perceived this dimension as good. Regular capacity-building activities, the presence of rapid response teams, and adaptive task allocation by health center leadership were reported by most respondents. These results indicate that human resource management and workforce preparedness contributed positively to the resilience of primary health care services.

Table 5. Distribution of Staff Capacity Resilience Scores

Staff Capacity	n	%
Good	83	83.0
Poor	17	17.0

3.6 External Relationships

External relationships were also rated positively, with 84% of respondents categorized as having good external collaboration. Health centers were reported to actively engage communities in health promotion activities and maintain coordination with stakeholders such as community leaders and local organizations. Financial and institutional support from external entities further strengthened service resilience.

Table 6. Distribution of External Relationship Resilience Scores

External Relationships	n	%
Good	84	84.0
Poor	16	16.0

3.7 Exposure to Hazards

The dimension of exposure to hazards showed that 81% of respondents perceived good resilience. Most health centers had conducted risk identification related to service disruptions and were strategically located near referral facilities and laboratories. This indicates that preparedness and environmental considerations were integrated into service planning to mitigate potential risks.

Table 7. Distribution of Environmental Exposure Resilience Scores

Environmental Exposure	n	%
Good	81	81.0
Poor	19	19.0

The findings of this study indicate that primary health care services in Depok City demonstrated a generally high level of resilience across all assessed dimensions. Physical conditions, institutional roles, staff capacity, external relationships, and exposure to hazards were predominantly categorized as good by the majority of respondents. This suggests that primary health care centers were able to maintain essential service delivery despite operational pressures. The results highlight the capacity of health systems to adapt organizational structures and resources under challenging conditions. Overall, these findings confirm that resilience is a multidimensional concept that reflects both structural and functional readiness at the primary care level.

The results of this study are consistent with previous research showing that resilient primary health care services play a critical role in sustaining essential service delivery during public health disruptions, where integrated capacities in governance, workforce and infrastructure enabled services to maintain access even under strain [34], [35]. Empirical evidence indicates that facility-level resilience, including adaptive infection control measures and staffing flexibility, contributed to sustained outpatient service volumes through the COVID-19 pandemic in multiple low- and middle-income country contexts, emphasizing workforce and health systems building blocks as key determinants of resilience [36]. Similar studies also demonstrate that organizational resilience mechanisms, such as planning capacity and adaptive decision-making, are positively associated with frontline workers' ability to respond to external shocks and maintain service continuity in primary care settings [37]. However, resilience levels observed in routine operational contexts like this study may differ from settings facing acute crises, highlighting temporal and contextual variations in health system adaptive capacities [38]. This gap underscores the importance of localized resilience assessments rather than reliance on broad national indicators, given that workforce, infrastructure, and service delivery readiness can vary fundamentally between contexts. These findings affirm that resilience is multifaceted rooted in governance, human resources, and operational adaptability requiring targeted strengthening across these domains to support continuity of primary health care in future disruptions [39].

This study contributes novelty by providing empirical evidence on primary health care resilience during a post-crisis transition phase rather than focusing solely on acute emergency responses, addressing a common limitation in existing literature that often concentrates on crisis or shock settings [40]. Recent reviews highlight that most empirical health systems resilience research has focused on crisis responses, but systematic multi-dimensional assessments in routine service contexts remain limited, emphasizing the need for broader analytical frameworks that can capture resilience under stabilized conditions [41]. Additionally, scoping evidence shows that strategies to strengthen primary health care resilience involve governance, workforce, infrastructure, and service delivery dimensions which ensure continuity and adaptability of services during and after crises, supporting a comprehensive framework for resilience beyond immediate emergencies [42]. By integrating multiple resilience dimensions ranging from institutional capacity to external collaboration and environmental considerations this approach aligns with advanced health systems resilience frameworks while extending their application specifically to decentralized primary care settings, thus contributing new, context-specific empirical insights to the global resilience discourse [43], [44].

The imperative to strengthen health systems at the primary care level is well-recognized, with evidence showing that resilience in infrastructure, workforce, and governance enhances the continuity of essential services during crises and routine operations alike, highlighting the need for strategic investment beyond emergency periods. Global scoping reviews clearly demonstrate that resilient primary health care (PHC) systems are capable of maintaining essential service delivery during health emergencies by adopting coordinated governance, workforce training, and adaptive service delivery mechanisms, which contribute to overall system sustainability and responsiveness [45]. Workforce development and institutional coordination are fundamental in navigating

system shocks and ensuring continued service provision, as effective PHC governance and workforce strategies strengthen health system adaptability, support service continuity, and build trust within communities and stakeholders [46]. Integrating resilience indicators such as workforce readiness, service continuity metrics, and governance performance into routine health system monitoring can further reinforce preparedness and accountability, thereby supporting sustainable responses to future public health challenges.

This study has several limitations that should be considered when interpreting the findings. The use of non-probability sampling limits the generalizability of the results to all primary health care centers. Differences in respondents' perceptions and understanding of resilience indicators may have introduced response bias. Additionally, the resilience framework was originally developed for natural disasters and required contextual adaptation. These limitations suggest the need for future studies using probabilistic sampling and mixed-method approaches. Further research could also refine measurement tools to better capture resilience in non-disaster settings.

4 CONCLUSION

This study concludes that primary health care services in Depok City demonstrate a generally high level of resilience across five key dimensions, namely physical conditions, institutional roles, staff capacity, external relationships, and exposure to hazards, indicating that Puskesmas are able to maintain essential service delivery under routine operational pressures. The findings confirm the study objective of quantitatively assessing primary health care resilience in an urban setting and reveal that institutional governance and human resource capacity play particularly strong roles in sustaining service continuity. Despite these positive outcomes, variations across dimensions highlight the need for continuous system strengthening rather than reliance on crisis-driven preparedness alone. Therefore, it is recommended that policymakers and health managers integrate resilience indicators into routine monitoring and evaluation systems, strengthen capacity-building programs for health workers, and enhance cross-sectoral collaboration with communities and stakeholders. Future efforts should also focus on developing standardized resilience assessment tools and expanding research using probabilistic sampling to support evidence-based strategies for sustainable primary health care resilience.

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USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors confirm that no artificial intelligence (AI)-assisted technologies were utilized in the preparation, analysis, or writing of this manuscript. All stages of the research process, including data collection, data interpretation, and the development of the manuscript, were conducted solely by the authors without any support from AI-based tools.

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