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Has Regional Hospital Autonomy Achieved Its Goals? Lessons Learned from Indonesia: A Systematic Review

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Abstract

This study examined the impact of hospital autonomy implementation on the performance of regional public hospitals in Indonesia, particularly in terms of efficiency, effectiveness, and governance. A systematic review of 32 peer-reviewed studies published between June 12 and September 6, 2023, was conducted using *Garba Rujukan Digital* and Google Scholar, following PRISMA guidelines. Studies addressing financial performance, service outcomes, and challenges related to implementing autonomy were included. The findings indicated that while autonomy led to improvements in infrastructure, service types, visit volumes, and hospital revenues, it had only a marginal impact on improving key health performance outcomes, such as service efficiency, effectiveness, and overall quality, suggesting the core goals of autonomy had not yet been fully achieved. Key barriers included weak policy capacity, inadequate governance structures, and limited human resources. Unlike centrally managed hospitals, the success of regional hospital autonomy is significantly shaped by local institutional arrangements and the broader decentralization framework, which together influence hospitals' capacity to manage their operations effectively.

Keywords: decentralized health system, healthcare reform, hospital reform, regional hospital, regional government

Introduction

As early as the 1980s, high health expenditure in government hospitals was attributed to inefficient resource use and managerial challenges within complex systems.[1] In later decades, longer life expectancy, chronic diseases, cancer, and technological advances further intensified demands on health systems.[2] Inefficiency, low productivity, poor service quality, and slow community response drove the need for health system reform.[3,4] While developed countries such as the United Kingdom (with its single-payer system), Austria, Norway, and Poland have successfully restructured primary and outpatient care, developing countries often struggle due to limited resources and capacity, failing to meet basic needs such as health.[4,5] Despite adopting decentralized systems, Ghana, Kenya, and the Philippines still face issues in resource distribution and governance.[3,4] Aligning roles with capabilities, which is central to the New Public Management paradigm and based on theories such as principal-agent and transaction cost economics, can enhance the success of reforms.[3]

Reforms should address efficiency in financing, service provision, resource generation, and governance.[5] A core component is organizational reform, such as granting autonomy to government hospitals to improve performance, quality, and efficiency.[3] In Indonesia, Law No. 22 of 1999 initiated decentralization, and since 2007, regional hospitals have been required to implement Regional Public Service Agencies (RPSA),[6] providing them greater operational flexibility. However, from 2007 to 2023, no comprehensive government evaluation has assessed the success of RPSA.

De Geyndt's study in developing countries shows limited success in hospital autonomy due to restricted authority over human resources and finance, weak governance, and inadequate performance data.[7] While De Geyndt's study examined central government hospitals, especially in Iran, reviews focusing on regional public hospitals are lacking. This study addresses this gap by evaluating the impact of autonomy on regional hospital performance in Indonesia, particularly in terms of efficiency, effectiveness, and governance within a decentralized health system.

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Method

This study used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to support systematic observation.[8] Literature published within 2007–2023 was explored using two databases, *Garba Rujukan Digital* (Garuda) and Google Scholar, from June to September 2023. Garuda was selected because it is the primary Indonesian journal database managed by the Ministry of Higher Education, Science, and Technology, providing access to academic journals, conference papers, theses, and dissertations. Garuda serves as a standardized and integrated gateway to various Indonesian library applications and platforms.[9] Additional relevant articles not indexed in Garuda were accessed using Google Scholar. The search employed different keywords for each database due to limitations in Boolean operator usage. The following keywords (*"badan layanan umum daerah"* OR "*BLUD*" OR "autonomy" AND *"rumah sakit daerah"* OR *"rumah sakit umum daerah"* OR "*RSUD*;" "Regional General Hospital" AND "Local Public Service Agency" OR "Financial Independence Regional Public Service Agency" OR "Regional Public Service Board" OR "public sector agency" OR "autonomy" for Google Scholar database and *Regional General Hospital Regional Public Service Agency* for Garuda database) were used in this study.

The search employed different keywords for each database due to limitations in Boolean operator usage. Articles from both databases were screened using Mendeley software to remove duplicates. The Science and Technology Index (SINTA), a web-based system that evaluates journals based on national accreditation standards and citation metrics, was used to assess the quality of Indonesian journals. Screening involved title and abstract review, followed by full-text reading to assess the inclusion criteria: published within 2007–2023 and related to hospital reform in Indonesia, written in Indonesian language and/or English, addressing the financial performance and services of regional public hospitals operating under the RPSA, and discussing the challenges in implementing autonomy in regional hospitals. Studies were excluded if they did not focus on financial or service outcomes, implementation challenges, or were not peer-reviewed. However, relevant gray literature was included to enrich the discussion.[10] A comprehensive multiple-review approach was used for study selection, ensuring rigorous screening, cross-checking, and consistency.[11] The first and second authors independently reviewed the articles to prevent unintentional exclusion.

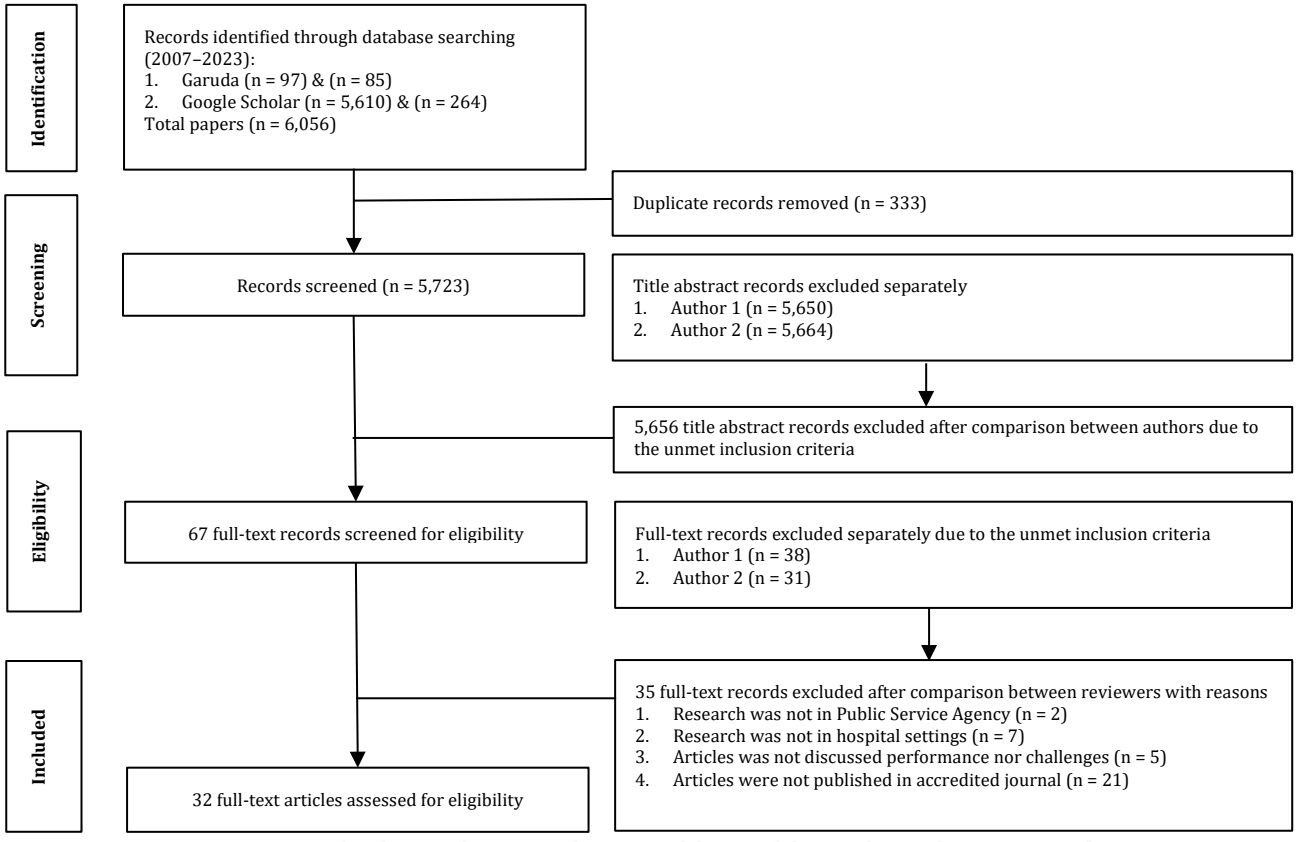

Figure 1. Study Selection Scheme Using the 2020 Guidelines[8] and the Complete Dual Review Approach[11]

A total of 6,056 articles were identified using Garuda and Google Scholar (2007–2023). After removing 333 duplicates, 5,723 records were screened. The first and second authors independently excluded 5,656 records at the title and abstract level due to unmet inclusion criteria. Of the 67 full-text articles assessed, 35 were excluded for not being published in public service agencies (n=2), not being published in hospital settings (n=7), lacking discussion of performance or challenges (n=5), or not being published in accredited journals (n=21). Ultimately, 32 articles met all the criteria and were included in the final review.

Only peer-reviewed articles, especially those indexed in SINTA for Indonesian publications, were included to maintain quality.[12] SINTA ranks journals based on accreditation and citation scores, highlighting quality through its National Journal Accreditation-based evaluation system.[9] Articles were further evaluated using the 2018 Mixed Methods Appraisal Tool (MMAT), assessing the methodological quality of empirical studies, including research question clarity, sampling relevance, and research design.[13] While several articles did not fully meet the MMAT standards, none were excluded because deviations were not deemed critical. Ultimately, 32 studies were included in the final synthesis and analysis.

Results

The article search process resulted in 32 articles that met the inclusion and exclusion criteria, and they were grouped based on the characteristics of their results.

Table 1. Profile Articles Included

Study	Index Type	Research Locus Based on INA-CBGs[14]	Hospital Class[15]	Research Method	Research Goals
Andi & Trisnantoro, 2014[16]	Sinta 3	Region II (South Sumatera)	B	Qualitative	To assess the effectiveness of the supervisory board's supervision on the hospital RSPA's performance.
Andri *et al.*, 2018[17]	Sinta 4	Region III (Aceh)	B	Qualitative	To get an overview of the implementation of RSPA at General Hospitals in Banda Aceh and the obstacles encountered during its implementation.
Tama, 2018[18]	Sinta 5	Region I (Central Java)	B	Quantitative	To evaluate the service and financial performance of RSPA, and to determine the correlation between service and finance using correlated component regression and independence.
Candrasari *et al.*, 2018[19]	Sinta 4	Region I (East Java)	C	Quantitative	To analyze the financial performance and services of a hospital which has implemented the RSPA since 2009.
Tama, 2020[20]	Sinta 5	Region I (Central Java)	C	Quantitative	To conduct an analysis and assessment of factors that influence financial independence after being designated as an RSPA.
Syahril, 2013[21]	Sinta 4	Region I (East Java)	C	Qualitative	To determine the financial management pattern of public service agencies at a Regional General Hospital, based on the regulation of the Minister of Home Affairs Regulation No. 61 of 2007
Wijayanti & Sriyanto, 2015[22]	Sinta 5	Region I (Central Java)	More than one hospital	Quantitative	To evaluate the service and financial performance of regional hospitals in Surakarta, Boyolali, Sukoharjo, Karanganyar, Wonogiri, Sragen, and Klaten from 2012.
Sutrini, 2017[23]	Sinta 5	Region III (Central Sulawesi)	B	Qualitative	To study, analyze, and describe in depth the implementation of the RSPA budget at a Regional Hospital, Palu City.
Putri *et al.*, 2017[24]	Sinta 4	Region I (Central Java)	C	Qualitative	To describe the performance measurement of a Regional General Hospital, Semarang City, Central Java.
Heriasman *et al.*, 2022[25]	Sinta 5	Region II (Riau)	C	Quantitative	To analyze and test the influence of financial performance (Liquidity Ratio - Current Ratio, Solvency Ratio, Profitability Ratio) on the level of financial independence of RSPA in the regional hospital
Chrishartoyo *et al.*, 2017[26]	Sinta 5	Region I (Central Java)	A	Quantitative	To see the differences in the financial and non-financial performance of a Regional Hospital before and after RSPA status.
Susandi *et al.*, 2017[27]	Sinta 3	Region II (Bali)	B	Quantitative	To examine the differences in performance of Klungkung District Hospital before and after becoming an RSPA.
Asfiah, 2017[28]	Sinta 5	Region III (Central Sulawesi)	B	Qualitative	1) To identify and analyze the accounting system of the RSPA at a General Hospital in Parigi Moutong District. 2) To identify and analyze the financial reports of the public service agency at a Regional General Hospital in Parigi Moutong District. 3) To identify the inhibiting and supporting factors of the accounting system of the public service agency at a Regional General Hospital in Parigi Moutong District.
Farwitawati, 2020[29]	Sinta 6	Region II (Riau)	B	Quantitative	To measure and analyze financial performance at Bengkalis Regional General Hospital before and after the implementation of the RSPA Financial Management Pattern in 2013-2018.
Korneles *et al.*, 2019[30]	Sinta 5	Region III (North Sulawesi)	C	Qualitative	To analyze the performance of Liun Kendage Tahuna Regional General Hospital after the implementation of the RSPA financial management pattern, analyze what obstacles hinder hospital management after the implementation of RSPA, and analyze efforts to resolve obstacles in hospital management after the implementation of RSPA.
Nuryanawati,	Sinta 5	Region I (East Java)	B	Qualitative	To analyze the performance evaluation of Dr. Soegiri Lamongan Regional

Study	Index Type	Research Locus Based on INA-CBGs[14]	Hospital Class[15]	Research Method	Research Goals
2019[31]					General Hospital, which implements RSPA.
Iskandar & Mutiarin, 2014[32]	Sinta 2	Region V (North Kalimantan)	C	Qualitative	To describe the implementation of the RSPA policy at Tanjung Selor Regional Hospital.
Larashati, 2016[33]	Sinta 4	Region I (East Java)	B	Qualitative	To analyze the financial performance and services of a hospital which has implemented the RSPA system since 2009.
Wahyuni & Artini, 2018[34]	Sinta 3	Region II (Bali)	B	Qualitative	To comprehensively assess the performance of a Regional General Hospital in Denpasar City using the Balanced Scorecard method over a three-year period, from 2014 to 2016.
Fahlevi, 2016[35]	International	Region I (Jakarta)	More than one hospital	Qualitative	To understand why the expected increase in the role of accounting in public hospitals in Indonesia has not occurred, despite a series of organizational changes and reforms to the hospital payment system.
Maharani *et al.*, 2015[36]	International	Region I (East Java)	Unidentified	Qualitative	To investigate the consequences of decentralization on the cost recovery rates of public hospitals at the district level.
Jumiati *et al.*, 2017[37]	Sinta 5	Region III (Southeast Sulawesi)	B	Qualitative	To obtain more in-depth information about the 2016 RSPA financial management study at a General Hospital, reviewed from the aspects of planning and budgeting, budget implementation, regional income and expenditure, and goods management.
Andiyanto *et al.*, 2016[38]	Sinta 3	Region III (Jambi)	C	Qualitative	To analyze the subsidy policy at a Regional Hospital after becoming an RSPA in 2015.
Hasna, 2016[39]	Sinta 5	Region III (Central Sulawesi)	B	Qualitative	To understand the implementation of the RSPA policy at a Regional Hospital in Central Sulawesi Province.
Rosnidah *et al.*, 2016[40]	Sinta 3	Region I (West Java)	C	Qualitative	To identify the accounting system, especially the preparation of accrual-based financial reports, in connection with the establishment of the Cirebon District Hospital, which has implemented RSPA.
Tama, 2019[41]	Sinta 5	Region I (West Java)	B	Quantitative	To conduct a study on financial independence after being designated as an RSPA and to examine its impact on service quality.
Slamet & Supeno, 2022[42]	Sinta 4	Region II (Riau)	C	Qualitative	To analyze the financial management compliance of RSPA against the Independence Level of a Regional General Hospital, which has been designated as an RSPA since 2012.
Silalahi *et al.*, 2021[43]	Sinta 5	Region III (North Sumatera)	B	Qualitative	To find out and analyze how the RSPA policy is implemented at a Regional Hospital in terms of improving the quality and standard of public services, especially health services to the people of Binjai City.
Trisnantoro, 2013[44]	Sinta 3	Region III (Central Sulawesi)	B	Qualitative	To evaluate the implementation of RSPA at a Regional Hospital.
Farwitawati *et al.*, 2021[45]	Sinta 6	Region II (Riau)	B	Quantitative	To see the difference in the service performance of Bengkalis Regional Hospital before and after the RSPA status.
Lesmana *et al.*, 2020[46]	Sinta 3	Region I (West Java)	C	Qualitative	To analyze the factors influencing the performance of accounting information systems focused on information technology, with management support and human resource competencies at a General Hospital.
Widodo *et al.*, 2022[47]	Sinta 4	Region I (East Java)	C	Quantitative	To analyze the financial performance of a Regional General Hospital before and after implementing the RSPA.

Notes: INA-CBG = Indonesian-Case Based Group, RSPA = Regional Public Service Agency

Table 2. Performance Indicators of Regional Hospital Service Quality

Study	Implementation Year	BOR 60%–%–85% (Standard)		LOS 6–9 Days (Standard)		GDR ≤45‰ (Standard)		NDR ≤25‰ (Standard)	
		Before	After	Before	After	Before	After	Before	After
Chrishartoyo *et al.*, 2017[26]	2009	68.68–77.71		6.65	4.71	88.19	76.95	50.64	43.56
		No Difference		Lower standard (better quality)		Above standard		Above standard	
Susandi *et al.*, 2017[27]	2012	58.19		61.64	3.79	4.19		-	
Tama, 2018[18]	2009	-	75.26 (increase)	-	3.97 (decrease)	-	31.5 (increase)	-	20.25 (increase)
Wahyuni, 2018[34]	2009	-	83.39 (increase)	-	4.28 (increase)	-	41.14 (decrease)	-	25.36 (decrease)
Farwitawati, 2021[45]	2016	56.80	57.10	3.53	3.52	19.00	26.82	5.38	13.97
		No difference		Lower than the standard (better)		Better		Better quality	
Wijayanti, 2018[22]	2009	-	77.93	-	3.84	-	2.76	-	1.43
		Correlations between CCR and independence were not significant		The correlation with CCR was not significant; however, significant independence		Correlations between CCR and independence were not significant		Correlations between CCR and independence were not significant	
Candrasari, 2018[19]	2012	-	76.50	-	3.95	-	52.16	-	22.16
		Correlations between CCR and independence were not significant		Correlations between CCR and independence were not significant		Correlations between CCR and independence were not significant		Correlations between CCR and independence were not significant	

Notes: BOR: bed occupancy rate; LOS: length of stay; GDR: gross death rate; NDR: net death rate; CCR: correlated component regression.

The implementation of RPSA in hospitals has led to infrastructure improvements[26] and increased patient numbers.[15-

[17] It also positively influenced efforts to meet service standards,[45] but did not impact patient satisfaction or retention.[34] Indonesia uses key performance indicators to measure hospital service performance, utilization, quality, and efficiency. These indicators are regulated by the Ministry of Health and form the basis for assessing regional hospitals' service achievements (Table 2).[48]

Several studies have shown the impact of the RPSA implementation on financial performance, as measured by income, financial ratios, and financial independence regulated by the Indonesian Ministry of Home Affairs.[49] Most studies report an increase in income.[18,26,27,38,47] Despite this trend, the t-test found different results.[47] Widodo demonstrated a significant increase in income after the implementation of RPSA,[47] while Susandi *et al.* reported the opposite.[27] The findings of this review were consistent with previous studies, which stated that autonomy can increase hospital income.[3,50]

Table 3. Financial Performance Indicators of Regional Hospitals

Study	Implementation Year	Profitability ROE >8%; ROA >6% (Standard)		Liquidity Current Ratio >600%; Cash Ratio 240%<x<300% (Standard)		Activity Fixed Asset Turnover >20%; Inventory Turnover 30<x<35 Days; Collection Period <30 Days (Standard)		Solvency Proportion of Debt to Capital and Total Assets <200% (Standard)	
		Before	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
Chrishartoyo *et al.*, 2017[26]	2009	ROI 0.49	ROI 1.41	34.01	2.69	8.96	10.60	0.99	0.88
		Post-autonomy, equity became more effective in generating profits		Improvement occurred when the previous ratios exceeded the standard limits		No significant difference between before and after		Regional hospitals financed all assets independently, showing improvement	
Susandi *et al.*, 2017[27]	-	-	-	-	Current ratio: 709.27% (increase) Cash ratio of 433.03% (increase)	-	-	-	-
Wahyuni *et al.*, 2018[34]	2009	-	Achieved 100% profit	-	Achieved 40% liquidity	-	-	-	-
		-	ROE 19% (decrease) ROA 18% (decrease)	-	Current ratio of 315% (decrease) Cash ratio: 125%	-	-	-	-
Wijayanti, 2015[22]	2012	-	26.03	-	5.13	-	-	-	4.13
Candrasari, 2018[19]	2009	-	0.94	-	4.93	-	-	-	0.04
Widodo, 2022[47]	2021	ROE 13.37% ROA 13.32%	ROE 17.11% ROA 17.03%	Current ratio = 1,085.00%	Current ratio = 1,507.00%	-	-	0.34%	0.42%
		Increased trend with positive changes		Increased trend with positive changes		-	-	-	-
Farwitawati, 2020[29]	2016	ROE −36.33% ROA −43.00%	ROE −52.67% ROA −62.00%	Current ratio = 117,949.33%	Current ratio = 317.33%	Fixed asset turnover of 19.00%	Fixed asset turnover of 34.67%	-	-
		Downward trend with negative changes		Downward trend with negative changes		Increased trend with positive changes		-	-
		-	-	Cash ratio of 37.67%	Cash ratio 56.67%	Inventory turnover of 41 days	Inventory turnover 38 days	-	-
		-	-	Increased trend with positive changes		Downward trend with positive changes		-	-
Nuryanawati, 2019[31]	2009	-	Achieved 80.00% of ROE, 100.00% of ROA	-	Achieved 20.00% of current ratio, 12.50% cash ratio	-	Fixed asset achievements turnover of 100.00% Inventory turnover of 25.00% Collection period 25.00%	-	-

Notes: ROI = return on investment, ROE = return on equity, ROA = return on assets, CRR = cost recovery rate.

Governance challenges in regional hospital autonomy arose from the absence of essential regulations,[31,51] such as regional-level minimum service standards, despite their role as prerequisites for autonomy. The regional government, as the hospital owner, played a key role,[38] yet poor communication and coordination with hospitals resulted in differing perceptions of autonomy due to unclear roles and varying understanding of the public service agency model.[30,32,52–54] Supervision was also problematic,[44] as some hospitals lacked a functioning supervisory board, and in some cases, the hospital director served as a supervisor, undermining internal oversight.[27,29,31,51] Human resources were another critical issue, categorized into shortages in quantity[27,30,32,52] and gaps in quality.[27,28,32,35,36,43,52,55] Several hospitals lacked sufficient medical and non-medical personnel, including specialists and accounting staff.[27,30] However, the main challenge lay in limited technical and managerial competencies and a poor grasp of the public service agency concept.[27–29,35,36,55] Fear of error,[16] rigid mindsets,[32] weak leadership,[36] and low commitment further hinder performance.[28,52] These limitations reduced operational efficiency and the ability to generate revenue.[17,27,29,56] Efforts to enhance staff capacity, motivation, and discipline remain suboptimal in translating into improved performance outcomes.[51,57]

Discussion

The implementation of autonomy succeeded in increasing bed occupancy rate (BOR) and meeting standards,[18,26,27,34,45] although changes before and after autonomy were not significant.[26,45] The average length ot stay (LOS) decreased[18,26,45] and remained below the standard[18,26,27,34,45] set by the Indonesian Ministry of Health.[58] Although the reduction in LOS might reflect greater efficiency, it could also signal rushed discharges or efforts to adapt to the Indonesian-Case Based Groups (INA-CBGs) payment system introduced in 2014,[59] incentivizing shorter stays. A previous study also showed that unnecessary hospital days increase healthcare costs.[60] These findings suggested that the flexibility afforded by autonomy policies enabled hospitals to increase access to care. While autonomy improved infrastructure, service variety, and patient visits, it has not conclusively improved service quality. Autonomy has enabled facility enhancement and service diversification, which has increased the number of patient visits and BOR.

Service quality is also reflected in mortality indicators. Several studies have indicated an increase in mortality rates following autonomy,[18,34,45] whereas others have shown the opposite.[26] T-tests revealed no significant differences in gross death rate (GDR) and net death rate (NDR) before and after autonomy.[26,45] Hospital status changes did not always make services more responsive, especially in handling complaints.[32] This may be explained by Indonesia's tiered referral system, where tertiary hospitals (Class A and B) receive critically ill patients.[61] Previous studies confirmed that high referral volume and delays in receiving initial treatment result in higher mortality rates, as many patients die en route or upon hospital arrival before receiving care.[62,63] These findings highlighted that autonomy may improve inputs and outputs, but not necessarily outcomes, particularly in patient survival and safety.

Similar patterns are observed internationally. Autonomy improves infrastructure, equipment, and patient volumes, but not necessarily outcomes such as mortality.[3] This mirrors global trends in which decentralization enhances efficiency without consistently improving outcomes.[64] Service performance indicators did not significantly influence the cost recovery rate (CRR).[19,22] While LOS was found to significantly affect financial independence,[22] others found no such relationship. Thus, the evidence on the impact of autonomy remains mixed and context-dependent.[19] These inconsistencies suggested that broader system factors, including regulation, financing, and referral mechanisms, played a crucial role in determining autonomy's effectiveness.

Financial performance was also evaluated using the following ratios: profitability, liquidity, activity, and solvency. Profitability measures the ability of hospital assets to generate income. Several studies reported improved profitability ratios after autonomy;[26,47] however, other studies reported the opposite.[29,34] Similar discrepancies appear in liquidity ratios; four studies found improved hospital capacity to meet short-term obligations,[18,26,27,47] while two found deterioration.[29,34] Several hospitals' liquidity remained poor even after eight years, reflecting financial strain.[31] Activity ratios generally improved post-autonomy, and regional hospitals became better at meeting long-term obligations using internal and external resources.[26,47] These mixed results suggested that the financial benefits of autonomy were not guaranteed and heavily depend on hospital-specific management practices and local government support. This highlights the need for stronger capacity building and regulatory compliance to ensure the realization of the intended financial improvements from autonomy.

The ratio of independence measures a hospital's ability to finance its operations and investments through functional income. A good performance is indicated by an independence ratio of over 70%.[65] This review found that several studies reported an increase in independence levels after autonomy.[18,42] The independence had already reached 65-66% just one

year after implementation.[19,22] For CRR, the findings varied. While several studies reported values above one, another study found that hospitals in Java still had CRRs below one.[36] A study in Semarang City revealed declining income, rising expenditures, and reduced financial ratios.[24] Two studies' t-tests revealed no significant difference in financial performance before and after autonomy.[27,29] These mixed results suggest that while autonomy can offer greater financial flexibility, its success largely depends on local management capacity and contextual conditions, highlighting that autonomy alone does not guarantee improved financial performance.

A weakness in financial management practices and system implementation is one of the main barriers to achieving the expected financial outcomes of hospital autonomy. These variations in financial performance across hospitals are largely attributed to inadequate attention and weak financial management capacities. Studies point to poor compliance with established regulations,[27,29] including financial reports not being accrual-based,[29,40] non-adherence to financial accounting standards,[16] and financial records that do not follow standard accounting cycles.[28] Additionally, unused funds have been returned to regional treasuries, despite regulations allowing them to be carried forward into the next fiscal year.[23] Another major issue is the continued reliance on manual financial reporting through Microsoft Excel instead of digital financial management systems.[30] Furthermore, issues such as tariff setting not based on unit costs, outdated tariff models, and underutilized sources of revenue were found to limit financial performance.[27,29]

A major barrier to the success of hospital autonomy is weak institutional capacity, particularly the lack of integrated service and financial information systems, undermining governance and decision-making. Most selected articles identified service and financial information systems that have not been integrated as challenges in implementing autonomy.[27–29,32,57] The obstacle experienced by the hospital's RPSA in developing the hospital is limited facilities.[27,30] This challenge was also found in other developing countries where resources are limited and governance structures may be weak.[3] This reflects global experiences, emphasizing a shared vision between regional hospitals and local governments positively influencing service implementation,[66] where successful healthcare reforms often rely on strong governance, well-defined roles, and transparent accountability structures.[67]

Regional hospital autonomy was intended to improve service quality for communities more effectively, efficiently, economically, transparently, and rationally, while upholding the principles of justice, propriety, and public benefit in alignment with sound business practices.[49] However, this systematic review showed that autonomy had yet to achieve these goals. The failure of autonomy to fulfill its goals was caused by incomplete policies, weak accountability mechanisms, and minimal supervision.[3] Although hospitals were granted flexibility under autonomy, this could not be fully leveraged because governance remains hierarchical, and human resource capacity is limited.[3] Autonomy often struggles to thrive, as regional governments continue to assert power over personnel and finances.[68] This was supported by the policies of the Indonesian Ministry of Home Affairs, which provided regional heads full authority over human resources and finance within RPSA.[49] This review emphasized that hospital autonomy will remain limited in its impact on service delivery unless these structural constraints are addressed, particularly the imbalance of power and weak institutional support.

These findings were consistent with a previous study identifying human resources and financial constraints as the two main barriers to successful delegation of autonomy.[7] Hospitals also face difficulty balancing the need to meet performance indicators with compliance with hierarchical controls, especially in budgeting and management.[69] Consequently, they tend to prioritize rule-following over outcomes. True autonomy must be balanced with public accountability,[3] yet hospitals often face trade-offs between autonomy and control, creating tension among competing goals such as equity, efficiency, quality, and financial viability. For example, increasing political oversight and managerial freedom may support equity but reduce efficiency.[3]

The international literature outlines several success factors for hospital autonomy. These included a comprehensive policy framework that situates autonomy within broader national and regional health agendas with consistent, long-term goals;[66] internal and external accountability systems;[67] and adequate funding to support the transition from traditional to autonomous operations.[70] Autonomy cannot succeed in isolation; it requires structural alignment, adequate capacity, and clarity in governance roles. Hospital autonomy may result in partial reforms that improve financial indicators but fail to enhance service quality or responsiveness without these systemic enablers.

Hospital autonomy introduces competition that can drive performance improvements.[70] Hospitals must not only deliver efficient and patient-centered services but also ensure that they are politically and socially acceptable.[69] Regulatory frameworks are essential for balancing hospital autonomy and public accountability to avoid serving the interests of specific stakeholders.[70] Hospital social functions, including reducing mortality and serving vulnerable populations, should be explicitly stated in autonomy policies.[3] Misaligned interpretations of autonomy policies among

different stakeholders have created inconsistencies in implementation, undermining the effectiveness of autonomy. Therefore, aligning institutional, political, and governance capacities is essential to realize the autonomy benefits.

Meanwhile, decentralization contributes to variability in hospital service procedures due to differing interpretations of autonomy policies.[64] A systematic review found inconsistencies in the understanding of the RPSA concept between regional governments and hospitals.[54] This inconsistency also appears among regional heads, who interpret national regulations differently.[53] These discrepancies impact governance, managerial effectiveness, and resource use, ultimately affecting hospital performance.[64] Furthermore, the relationship between regional hospitals and regional governments also impacts autonomy. Regulations and funding from regional governments affect the extent to which regional hospitals can utilize their flexibility.[3,67] Variability in service procedures, driven by inconsistent interpretations of autonomy policies among key stakeholders, is a key challenge in implementing hospital autonomy under decentralization. The lack of shared understanding and commitment to reform undermines decentralization's potential benefits. Additionally, discrepancies in the application of regulations across regions weaken governance and the uniformity of managerial practices.

A limitation of this study were the potential publication bias, the exclusion of gray literature, and the review protocol that had not been registered in the PROSPERO database yet. However, not all reviewed studies compared hospital performance before and after autonomy. Future study should investigate how institutional arrangements, regional government capacity, hospital classification, and autonomy duration affect performance, particularly in decentralized developing countries. The environmental dynamics should also be considered.

Conclusion

After 15 years of regional hospital autonomy, improvements are mostly seen in infrastructure and patient visits, but not in service quality or financial performance. High mortality rates and inconsistent financial ratios indicate limited gains in effectiveness and efficiency. This condition suggests that while autonomy has enhanced access to healthcare services, it has not yet translated into better service quality or financial performance. Achieving autonomy goals requires aligning performance targets, strengthening governance and managerial capacity, and ensuring financial flexibility within supportive decentralization frameworks.

Abbreviations

RPSA: Regional Public Service Agency; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses; Garuda: *Garba Rujukan Digital;* SINTA: Science and Technology Index; MMAT: Mixed Methods Appraisal Tool; BOR: Bed Occupancy Rate; LOS: Length of Stay; GDR: Gross Death Rate; NDR: Net Death Rate.

Ethics Approval and Consent to Participate

This review article does not require ethics approval or consent from participants because the data were collected from previously published studies and do not involve direct human or animal subjects.

Competing Interest

There are no conflicts of interest in this review article.

Availability of Data and Materials

All data sources were publicly available and appropriately cited by academic standards.

Authors' Contribution

MB conceptualized the study, created the methodology, and supervised the project; MB and IW conducted the formal analysis, investigation, and data curation, and wrote the original draft, reviewed, and edited the manuscript.

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Barriers to Implementing Comprehensive Sexuality Education as a Strategy to Prevent Adolescent Pregnancy in Indramayu District, Indonesia

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Barriers to Implementing Comprehensive Sexuality Education as a Strategy to Prevent Adolescent Pregnancy in Indramayu District, Indonesia

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Abstract

The implementation of comprehensive sexuality education (CSE) is not optimal. This qualitative study aimed to identify and contextualize barriers to CSE implementation, specifically in Indramayu District, Indonesia. Conventional content analysis procedures were used. Seven participants, consisting of relevant authorities, were interviewed. A purposive sampling technique was employed to select participants. Data were collected through in-depth, semi-structured interviews. All interviews were recorded and transcribed verbatim. Data were analyzed using conventional qualitative content analysis. The barriers to CSE implementation in Indramayu District were identified across five themes: advocacy, technical considerations, coordination and collaboration, integration with other sexual and reproductive health projects, and access beyond school, highlighting the need for improved coordination, targeted outreach, and curriculum development to address these challenges and enhance program effectiveness.

Keywords: adolescence, barriers, implementation, pregnancy, sexuality education

Introduction

The United Nations Population Fund (UNFPA) and the United Nations International Children's Emergency Fund (UNICEF) define adolescent pregnancy as any legal marriage or union involving minors, whether with an adult or another child.[1] Adolescent pregnancy specifically refers to pregnancies occurring in female adolescents aged 10–19, with the majority being unintended. This can result from sexual relations with boyfriends, husbands, or as a result of rape, among other contributing factors.[2] Adolescent pregnancy is an international dilemma affecting not only the adolescent and her infant but also entire societies, with almost 300 million female adolescents worldwide experiencing 16 million yearly births, accounting for 11% of all global births.[3]

In Southeast Asia, where Cambodia, Indonesia, Lao People's Democratic Republic, the Philippines, Thailand, Timor-Leste, and Vietnam are represented, data show that among women aged 20–24 giving birth before age 18, up to one-third conceived outside of union.[1] In Indonesia, most adolescent pregnancies occur within the context of union (marriage or cohabitation), but about one in four women conceived outside of union, and of these women, 92% were married or in a union by the time they gave birth.[1]

Indonesia's adolescent birth rate of 47 per 1,000 female adolescents in 2018 exceeds the global average of 42 per 1,000, indicating a higher prevalence of adolescent pregnancies in the country.[4] The 2018 Indonesian Basic Health Research data showed that 56.92% of women experienced either pregnancy or had previously been pregnant at the age of 10–19 years in West Java Province.[5] In 2022, 1,200 adolescent pregnancies were recorded, representing 15% of the total pregnancies in Indramayu District. This data indicates an increase compared to previous years, where 950 and 850 cases were reported in 2020 and 2019, respectively.[6] These figures highlight the urgent need for targeted interventions to address adolescent pregnancy, particularly in regions with high rates such as Indramayu District.

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Studies show that Indonesia's sex education focuses primarily on biological aspects while neglecting psychosocial and practical knowledge, leaving adolescents without critical information to prevent unintended pregnancy and sexual violence.[7] Responding to this concern, at the 1994 International Conference on Population and Development in Cairo, Indonesia and 178 other countries pledged to invest in sexual and reproductive health and rights for women and girls,[8] placing comprehensive sexuality education (CSE) at the center of those rights.[9] The United Nations Educational, Scientific and Cultural Organization (UNESCO) defines CSE as a curriculum-based process addressing the cognitive, emotional, physical, and social dimensions of sexuality.[10] The World Health Organization (WHO) recommends the implementation of CSE to provide accurate and age-appropriate information about sexuality and reproductive health to adolescents.

Evidence shows that CSE can delay sexual debut, reduce unprotected intercourse, limit the number of sexual partners, and increase condom use and access to reproductive health services without raising levels of sexual activity, risk-taking, or infection.[11] In Indonesia, Government Regulation Number 61 of 2014 on Reproductive Health mandates adolescent services, including communication, information, and education through comprehensive sexual education, to prevent risky sexual behavior and prepare young people for healthy and responsible reproductive lives.[12] Nevertheless, UNESCO observes that the coverage and details of comprehensive sexuality education within school curricula in Southeast Asia remain uneven, reflecting the taboos that still surround sexual topics in Indonesian society.[10]

Indramayu District is widely recognized for its significant number of cases of child marriage. In 2021, a total of 236 minors were married.[13] This high incidence of child marriages in Indramayu District is further confirmed by a study finding that 54.5% of respondents (48 individuals) experienced early marriage.[14] In 2023, the district reported 5,113 marriages.[15] This figure surpasses that of other districts in West Java Province, such as Ciamis with 3,229 marriages and Kuningan with 2,914 marriages.[15] This makes Indramayu's marriage rate notably high compared to its neighboring districts, reinforcing the need for targeted interventions such as CSE to address the risks associated with early marriages in the region. Indramayu has implemented CSE since 2022 as a key strategy in preventing adolescent pregnancy. The program adopts a comprehensive approach as guided by UNESCO and the Indonesian Ministry of Health, which not only focuses on the biological aspects of reproduction but also covers sexual rights, gender equality, and life skills development.

In Indramayu District, CSE is implemented through various methods to ensure that the target group receives the message. The CSE materials are integrated into lessons, including Natural Sciences or Counseling Guidance in the school environment, with participatory learning methods such as group discussions and simulations. At the community level, the program engages parents and community leaders through workshops and socialization to reduce stigma around sexual education. Creative approaches, such as the use of poster media, digital content, or radio dramas, are also used to reach adolescents in areas where access to information is difficult. Despite careful planning, the CSE in Indramayu District has not been implemented optimally. This study explored the structural, cultural, and operational challenges faced by stakeholders in effectively implementing CSE programs. By exploring the barriers, this study is expected to provide practical recommendations to strengthen the CSE program in Indramayu District.

Method

This study used a qualitative approach with a case study design, conducted in 2024, to explore the barriers to the CSE implementation in the Indramayu District. The study population included key stakeholders involved in the CSE program, including health workers, the adolescent reproductive health sector, and non-governmental organizations (NGOs). Purposive sampling technique was used to select key informants who understood the context of CSE, and snowball sampling was used to identify additional informants based on the initial participant recommendations. The inclusion criteria were established to ensure the relevance of the informants. These included having direct experience in planning and implementing CSE programs, serving in the Indramayu area for at least one year, and being willing to participate through informed consent. Table 1 shows the detailed characteristics of the informants. Each informant was assigned a code (ranging from I-1 to I-7) to ensure confidentiality and anonymity, and their identities were further protected using initials.

Table 1. Characteristics of the Respondents

Code	Informant Description	Position	Age (Years)	Sex
I-1	Mr. WWR	Head of Indramayu District Health Office	56	Male
I-2	Mrs. TING	Health Worker	50	Female
I-3	Mrs. AY	NGO Officer	33	Female
I-4	Mrs. YY	NGO Officer	37	Female
I-5	Mrs. DW	NGO Officer	42	Female
I-6	Miss. AM	NGO Officer	23	Female
I-7	Mrs. SH	NGO Officer	30	Female

The sample size was determined based on the principle of saturation sampling, where the addition of informants ceased once the data began to show repetition and no longer provided new themes. In total, this study involved seven informants, consisting of one health worker, one adolescent reproductive health sector representative, and five NGO representatives, as this sample size was deemed sufficient based on the principle of purposive saturation sampling. To obtain more comprehensive, valid, reliable, and objective data, an in-depth interview study was conducted involving the head of the Indramayu District Health Office as the key informant, a midwife responsible for implementing the reproductive health program in Indramayu District, and a local community figure.

In-depth interviews were conducted individually and privately in alternative settings of the participants' choice. The primary data collection instruments in this study included semi-structured interviews, designed to explore stakeholders' perspectives on the barriers to CSE implementation in Indramayu District. The interview guides were developed based on a review of existing literature and frameworks related to CSE and adolescent reproductive health. This process involved identifying key themes and constructs pertinent to the study objectives. All interviews were conducted in the Indonesian language, then translated into English, audio-recorded with consent, and later transcribed for thematic analysis using NVivo 12 (license: LU001-ED030-25004-90XIL) to ensure systematic coding and interpretation of qualitative data. Thematic analysis was a widely used qualitative analytic method that involved identifying, analyzing, and reporting patterns or themes within data. The process begins with familiarization with the data, followed by generating initial codes that capture the data's key features. These codes were then organized into potential themes, which were refined through constant comparison and validation against the dataset.[16]

Results

Table 2 presents the thematic framework used to explore the barriers in CSE implementation. This framework was structured around several critical areas, including advocacy challenges, technical considerations, coordination among stakeholders, integration with other sexual and reproductive health (SRH) projects, and adolescent access to education.

Table 2. Themes, Subthemes, and Operational Definitions

Theme	Subtheme	Operational Definition
Advocacy	Access to health services	Access to health services refers to the ease with which individuals or communities can obtain the necessary medical care, including the availability of healthcare facilities (clinics, hospitals, and community health centers), the distance and travel time required to reach them, affordability (including free or subsidized services), and the absence of long waiting times.
	Limited information	Limited information describes a situation in which individuals or communities do not have sufficient access to accurate and relevant knowledge on important topics: health, education, or social rights.
Technical Considerations	Modules and curriculum	A module refers to a structured set of learning materials designed to teach specific skills or knowledge, whereas a curriculum is a comprehensive educational plan outlining what students should learn.
	Information providers	Information providers are individuals or organizations disseminating knowledge to the public.
Coordination and Collaboration	Lack of coordination Lack of collaboration	Occurs when different stakeholders (e.g., government agencies, non-governmental organizations, or community groups) fail to work together efficiently, resulting in overlapping programs or gaps in services.
Integration with Other Sexual and Reproductive Health Projects	Lack of socialization	Insufficient efforts to raise public awareness of important issues through campaigns, workshops, or media.
Out of School	Adolescent school dropouts	Those who are not enrolled in formal or non-formal education.

Advocacy

Access to Health Services

The interview results stated that the provision of CSE is a part of health services for people of reproductive age to provide accurate information about sexual and reproductive health, teach life skills, and instill positive values in children and adolescents.

"Comprehensive sexual education is a program that aims to provide accurate and holistic information about sexual and reproductive health to children and adolescents. It covers various aspects, including biology, interpersonal relationships, values, sexual rights, and life skills. CSE programs are usually integrated into the school curriculum with the aim of providing accurate information. CSE provides correct and scientific information on anatomy, puberty, contraception, and sexually transmitted diseases. Students are taught life skills such as effective communication, decision-making, and resisting social pressures associated with sexual activity. CSE also helps students understand the importance of self-esteem, mutual respect, and responsibility in sexual and reproductive relationships." (Head of Indramayu District Health Office, I-1)

Additionally, the preparation process for the CSE program involves collaboration among the school, the primary health care (PHC), the village head, and health cadres. This cooperation aims to enhance the quality of reproductive health services, including CSE, especially for adolescents.

"To improve the quality of services, I collaborate with the PHC in accordance with its working area and work together with the community to overcome reproductive health problems, especially in preventing adolescent pregnancy. The main thing is how to strengthen the family or family and school. Because after all, these children spend more time at school, if in the morning until noon, or in the afternoon, they are at home." (Head of Indramayu District Health Office, I-1)

However, collecting accurate data on risky sexual behavior among adolescents in the Indramayu District remains challenging because not all adolescents disclose such behaviors to health services. This issue underscored the difficulty in evaluating the effectiveness of health services and programs due to the lack of comprehensive data.

"It is difficult for us, maybe from other fields, meaning the education sector or from others, to help search for it (the data), *but unfortunately, we cannot." (Health Worker, I-2)*

Limited Information

In addition to the reported data on adolescent pregnancy, the interview results highlighted the urgent need for CSE in Indramayu District, including indications of risky sexual behavior. Many adolescents engage in risky sexual practices without considering the potential consequences, which frequently leads to unintended pregnancy.

"…when we check in certain places, for example, places that are usually used for hanging out or that are a bit dark and a bit separate. We found there are condom marks, for example, that have been used. I think they do it without knowing whether or not this will have fatal consequences, resulting in pregnancy or the potential of transmission of sexually transmitted diseases like that…" (Health Worker, I-2)

Technical Considerations

Modules and Curriculum

The interview results indicated that schools have been equipped with reproductive health modules specifically designed to address the needs and developmental stages of adolescents. However, the implementation process of these modules within the school curriculum remained uncertain. The informant indicated that the health worker predominantly provides information programs related to reproductive health.

"…we have equipped the health service program for primary school age and adolescents with reproductive health module materials because the reproductive health modules for elementary, junior high, and senior high school students are different according to their respective needs and even different from children outside school. So, we have socialized I, but whether they (schools) *implement it or not, we cannot monitor it as well." (Health Worker, I-2)*

"…for us, it might be coordination at the district level if the direct implementer is indeed the health worker." (Health worker, I-2)

The informants pointed out that while reproductive health modules have been introduced, concerns remain regarding the curriculum's ability to effectively deliver this education across schools.

"I do not know whether the curriculum at school discusses that or not, whether there is a subject that specifically discusses adolescent reproductive health, but I think it is still low." (Head of Indramayu District Health Office, I-1)

Information Providers

Information providers' role is crucial in ensuring that adolescents and school staff have access to accurate and relevant health information. The respondents noted a continued lack of reproductive health information provided to teachers in both primary and boarding schools. They obtain health information only from the school's medical center teacher.

"(I think) *the health information has not been delivered yet* (to teachers)*, but there are the school health unit's teachers. So it may have been delivered." (Health Worker, I-2)*

The respondents highlighted that while teachers may receive health information through school medical centers, no dedicated or formal training is available for teachers to enhance their knowledge on reproductive health.

"We have not conducted special training, but the PHC team has provided materials, within the limits of the existing *budget." (Head of Indramayu District Health Office, I-1)*

Furthermore, the interview results indicated that the peer-educator approach in schools, which involved students, was limited to peer-to-peer narratives, and students did not receive specific health education.

"Yes, actually, at school, (I think) *the homeroom teacher is enough, because they can be an adolescent counselor. However, I think the peer educator is probably more focused on anticipating problems because students might be more comfortable with their friends. If, for example, there are problems like that, well, it might be a bit difficult to find students who have the ability to become counsellors, if it is just knowledge and skills, maybe it can be conveyed by their homeroom teacher." (Health Worker, I-2)*

Coordination and Collaboration

Lack of Coordination

During the implementation process, CSE was manifested in counseling and demonstrations by the health workers of PHC.

"The PHC staff foster schools in their working area and conduct health checks, health literacy, counseling, health demonstration, anemia check, giving iron supplementation…" (Health Worker, I-2)

Extracurricular activities at school, such as *Dokter Kecil* (junior doctor) for elementary school-age children, also help adolescents obtain health information. At the same time, peer counselors train junior and senior high school students.

"…For us, it is more about educating the peer counselor, then for elementary school (it is called) Dokter Kecil, *and for junior high school and high school,* (it is called) *the peer counselor who educates them. So, that is where we convey it." (Health Worker, I-2)*

Lack of Collaboration

In addition to the lack of coordination, there was insufficient collaboration among the different agencies involved in CSE. For example, the Women and Children Empowerment Office of Indramayu District played an important role in preventing sexual harassment, an issue that was closely related to adolescent health and pregnancy. However, their efforts in educating women about sexual harassment prevention were not consistently integrated with other reproductive health education programs, limiting the overall impact.

"All of these have their own roles, such as the office of women and children empowerment. They delivered (about) *sexual harassment prevention and handling of violent harassment." (Health Worker, I-2)*

Integration with Other Sexual and Reproductive Health Projects

Lack of Socialization

The PHC staff, along with their partners, have been implementing CSE in schools and community settings. Additionally, the PHC also offered adolescent care health services specifically for adolescents. However, these services were currently underutilized by adolescents due to insufficient outreach and awareness.

"…in general, our friends—midwives and nurses—have a very effective position as confidants. So, we do have health services for adolescents at the PHC, although perhaps the socialization is still limited so that there are still few (of adolescent) *who use it…" (Health Worker, I-2)*

Out of School

Adolescent School Dropouts

The interview results indicated that adolescents who could not access extracurricular activities or healthcare training outside school could still obtain health information from several sources. These include friends, health posts, the internet, and community in a mosque.

"… Our target is not only those in school; there are adolescents who go to school, but there are adolescents who do not go to school because of economic factors, so we target adolescents who do not go to school with the establishment of a youth health post." (Health worker, I-2)

"…for adolescents who are out of school, (I think) *they* (possibly can) *get it from friends or maybe they access the internet. If they go to places of worship, they can also get it from there…" (Health worker, I-2)*

The establishment of the PHC, which has been in operation for two years, also provided a platform for adolescents to obtain information, such as how to be a healthy person. The positive impact they felt was like expanding their network of friends and gaining access to information about reproductive health.

"…The positive impact is that they (the adolescents) *can make friends with others. The second point is that the information on reproductive anatomy was delivered clearly. The positive impact has been seen from the start, they can manage their emotions themselves, then they understand which ones are good relationships and which ones are bad because we invite them to share* (the story) to *each other…" (NGO Officer, I-3)*

However, these interviews revealed persistent challenges in the implementation of CSE for adolescents. Many adolescents and their parents, particularly in low-income families, lacked interest and awareness regarding sexual and reproductive health. This ignorance certainly affected adolescents' behavior, including risky sexual behaviors, which were closely linked to the likelihood of adolescent pregnancies. Insufficient parental guidance regarding the importance of sexual and reproductive health information influenced adolescent behavior.

"If the target is like I said earlier, yes, if it is for students who are enthusiastic, maybe they will accept and apply it easily. But if it is in the suburbs, it might be a bit difficult (to accept), so they cannot provide certainty." (Health worker, I-2)

"Society, family upbringing, economic factors, then, being in what kind of society (you are in) *are very influential. Sorry, unintended adolescent pregnancy is quite high* (I think), *it is because of those factors. Perhaps one reason is that they are not cared for by their parents, many of whom are migrant workers. Suppose adolescents understand* (about sex)*, even though they are sexually active, they may be able to prevent* (the risk of pregnancy)*, so that they do not get pregnant, but if they do not understand and are sexually active, it could lead to pregnancy." (Health worker, I-2)*

Moreover, the persistent perceptions of society that discussing adolescent sexuality and reproductive health was taboo and inappropriate resulted in a considerable challenge in the effective implementation of CSE.

"In the beginning, yes, it was taboo. (We think that) *It is a porn, dirty, like it is not easily accepted, but our goal is to approach the village and the district government, then the parents and adolescents, so we have a three-pronged approach. We explain the benefits and involve the adolescent in the village development planning meeting, and finally, they accept this program and want to be involved in the youth health posts." (NGO Officer, I-3)*

The findings from the in-depth interviews underscored several critical challenges and opportunities in the implementation of CSE programs in Indramayu District. Advocacy for CSE and access to health services emerged as key themes, highlighting the importance of providing accurate sexual and reproductive health information to adolescents. Barriers to accessibility persist, particularly in rural and economically disadvantaged areas, as many adolescents lack access to these services. Technical considerations, including inconsistent implementation of CSE modules and underutilization of peer-educator models, indicated the need for more structured monitoring and better training for educators to ensure effective delivery. The theme of coordination and collaboration was also emphasized, with stakeholders reporting fragmented coordination between schools, health workers, and local governments, which led to inefficiencies and missed collaboration opportunities. Additionally, although CSE programs were integrated with other sexual and reproductive health services, their integration with other SRH projects remains limited due to low awareness and stigma, further hindering their impact. The challenge of reaching out-of-school adolescents was highlighted, with these adolescents often relying on informal sources for health information, indicating a gap in effective outreach efforts.

Discussion

This study highlighted the importance of CSE in preventing adolescent pregnancy in Indramayu District, which can empower them to make informed and cautious decisions regarding risky sexual behaviors. This intervention aims to

minimize the incidence of sexually transmitted diseases and promote the adoption of healthier lifestyle practices among adolescents.[17] CSE aims to equip adolescents with the necessary knowledge and skills to prevent early pregnancies, contributing to broader public health goals through this framework.

Effective advocacy reduces the obstacles and challenges to implementing and scaling up CSE, ensuring that leaders, policymakers, and educators share a common understanding of CSE.[18] Yet, interviews revealed that adolescents were not engaged as agents of change during CSE drafting and advocacy, indicating that their participation is still absent. Therefore, adolescents need to be deliberately included in decision-making and policy-making processes related to CSE.[19] Consistent with the principle of meaningful youth participation, they should be consulted, engaged, and invited to collaborate in the design, implementation, and evaluation of programs that affect them.[20] Working together with adolescents and fostering youth leadership and participation are also key to young people's ownership of CSE while ensuring broader awareness of sexual and reproductive issues, including adolescent pregnancy.[21] Moreover, this study found a lack of data on risky sexual behaviors among adolescents in Indramayu District, which underscored the importance of leveraging existing government datasets to inform more effective, evidence-based CSE strategies.[22]

Building on these advocacy concerns, the integration of reproductive health content into the Indramayu school curriculum remains incomplete, despite WHO guidance that CSE should be a compulsory subject developed with adolescent input.[23] The implementation has been inconsistent, with gaps in integrating CSE fully into the school curriculum. Inconsistent rollout and limited use of age-appropriate modules indicated systemic barriers to effective delivery. Equipping teachers and selected students as peer educators is crucial to establishing a CSE-based curriculum that can delay sexual initiation and reduce the risk of adolescent pregnancy.[24] The National Population and Family Planning Board's Generation Planning Program, launched in Indramayu District in 2019 to prepare adolescents for marriage through education, economic readiness, health, mental well-being, and demographic awareness, shows both the promise and the challenges of peer-led approaches.[25] Although the program seeks to improve reproductive health literacy and curb risky sexual behavior, its impact has been hindered by uneven village-level implementation and inconsistent monitoring, highlighting the need to strengthen local capacity and standardize delivery to meet the program's objectives.[25]

These implementation challenges were further compounded by stakeholders' weak coordination. The implementation of CSE relies on multiple initiatives—youth-friendly health posts, reproductive health extracurriculars, and PHCs—designed to reach both primary school age and adolescents. These programs aim to build knowledge, skills, and values that help young people understand their sexuality, form safe relationships, and safeguard their own and others' sexual well-being.[26] The CSE equips adolescents with comprehensive information and encourages self-respect, respect for others, and the formation of healthy relationships.[27] Despite these efforts, coordination remained weak. Many activities operate in silos, with little systematic cooperation among schools, health services, and local organizations. Interviews revealed fragmented delivery and patchy integration into the formal curriculum, which produced service overlaps and gaps. The parent-school-health service collaboration was also limited. Permissive parental attitudes toward reproductive health and reluctance to discuss the topic with children hinder both classroom and clinical interventions.[28] In contrast, Sragen District demonstrates how tight partnerships among schools, health centers, external organizations, and NGOs expand the reach and improve outcomes.[29] Other studies also revealed that collaboration with NGOs plays a critical role in addressing barriers faced by governmental programs.[30]

The fragmented approach to CSE implementation also affects its integration with other SRH projects, which remains crucial for addressing the broader context of adolescent health. This study indicated that while CSE was being implemented through various platforms, such as schools, PHCs, and community groups, it was often not coordinated effectively with other SRH initiatives. A more integrated approach is needed to create synergies between CSE and other SRH programs, ensuring a holistic approach to adolescent health. Collaboration between the health, education, and community sectors is key to providing comprehensive support to adolescents, enabling them to make informed decisions about their sexual and reproductive health.[31,32] The implications suggest that to operationalize integration, policymakers must prioritize unified funding mechanisms and interdepartmental training frameworks.

One of the critical gaps identified in this study was the lack of adequate CSE for out-of-school adolescents. The absence of structured programs for these adolescents left a significant portion of the population without access to essential sexual health information. In many cases, out-of-school adolescents are more vulnerable to risky sexual behaviors and unintended pregnancies because of a lack of formal education on these topics.[33,34] Therefore, developing outreach strategies and programs that target out-of-school youth is vital to ensure that they also benefit from CSE

initiatives. This can include peer-led initiatives, community-based education, and digital platforms that reach adolescents who are not engaged in the formal education system.[35,36]

While this study provided valuable insights into the barriers to implementing CSE in Indramayu District, its methodological limitations should be acknowledged. The limitation of this study was that the cross-sectional design did not allow exploration of causation beyond associations. Purposive sampling might limit the generalizability of the findings, although it was appropriate for targeting key informants with direct experience in CSE implementation. Since participants were selected based on specific criteria (e.g., educators (NGOs staff), policymakers, and health workers), the results might not fully represent the perspectives of stakeholders in other regions or contexts with differing sociocultural and policy environments.

Additionally, the qualitative nature of this study, though rich in depth, means that the findings are context-specific and might not be directly applicable to broader populations. Future research can employ mixed methods or larger-scale quantitative surveys to validate and extend these findings across diverse settings. Despite these limitations, this study offered critical preliminary evidence that can inform localized policy and program adjustments to strengthen CSE implementation as a strategy for preventing adolescent pregnancy. The strengths of this study lie in its in-depth qualitative approach, which allowed for a nuanced exploration of the barriers to CSE implementation from the perspectives of the program's key stakeholders directly involved in the program. By employing interviews with health workers, NGO representatives, and the adolescent reproductive health sector, the study was able to capture rich, detailed data on the challenges faced during the implementation process.

Conclusion

This study highlights critical barriers to the implementation of CSE in Indramayu District, including inadequate data on risky sexual behaviors, lack of a tailored curriculum, and limited youth engagement. A holistic approach that emphasizes systemic collaboration, youth involvement, and community ownership is necessary to overcome these challenges. Strengthening partnerships between local stakeholders and fostering youth-led initiatives will improve program outcomes, while cultural resistance can be alleviated through targeted awareness campaigns. With effective monitoring mechanisms, this strategy will facilitate the institutionalization of CSE, enabling youth to make informed sexual health decisions.

Abbreviations

CSE: Comprehensive Sexuality Education; WHO: World Health Organization; UNFPA: United Nations Population Fund; UNICEF: United Nations Children's Fund.

Ethics Approval and Consent to Participate

Health Research Ethics Committee of Faculty of Public Health, Universitas Muhammadiyah Jakarta (Approval No. 10.121.B/KEPK-FKMUMJ/V/2024).

Competing Interest

The author declares that there are no competing interests.

Availability of the Data and Materials

Data and information used as study materials can be obtained from the corresponding author upon reasonable request.

Authors' Contribution

EK, CKH, and NF analyzed and interpreted the data. EK conducted the final revision of the manuscript, which was reviewed and approved by CKH and NF.

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Understanding User Needs in Health Crisis Risk Monitoring Information System Development: A Lesson from Tasikmalaya District, Indonesia

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Understanding User Needs in Health Crisis Risk Monitoring Information System Development: A Lesson from Tasikmalaya District, Indonesia

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Abstract

A health crisis risk monitoring information system needs to be developed, especially during the pre-disaster phase; therefore, understanding the needs of prospective users is crucial. This study aimed to investigate the needs of potential users regarding the development of this system. This study employed a qualitative, exploratory approach to gather user needs from stakeholders through interviews (n = 7) and one focus group discussion (n = 12). The data were audio-recorded, transcribed verbatim, and then thematically analyzed using qualitative content analysis. The need for information was related to disaster preparedness and its preferred format. The system should be targeted, multiplatform, support multiple users, and easy to access. Features should include fully integration, advanced capabilities, online access, and the ability to generate fast and actionable information. It is essential to have this system for all users. A system must facilitate decision-making at various levels. The system should contain related information in a standardized format, easily accessible through various platforms and by multiple users, and serve as a tool for providing information for risk mitigation, monitoring, and reporting purposes.

Keywords: disaster preparedness, health crisis risk, health information system, pre-disaster, user need

Introduction

A disaster is defined by its impact on the health and health services of the affected community from a public health perspective. Public health is a fundamental aspect of emergency management, disaster risk reduction, and disaster risk management.[1] Information technology and data management tools are indispensable in the health care and public health communities for preventing, preparing for, responding to, and recovering from natural and manufactured public health emergencies. The effectiveness of preparedness functions during the pre-disaster phase can be enhanced by leveraging technology and data systems.[2,3]

Based on the Sendai Framework for Disaster Risk Reduction 2015–2030, as outlined by the United Nations World Conference on Disaster Risk Reduction, countries play a crucial role in addressing disaster risks that can lead to health crises. The framework highlights four priority action areas: understanding disaster risks, strengthening government disaster management, investing in disaster risk reduction by building resilience, and enhancing disaster preparedness for effective response and recovery processes.[4,5] Communities can reduce the impact of disasters on health systems and promote sustainable development by implementing effective disaster risk management strategies.[6]

The health information system plays a critical role in implementing disaster preparedness measures. However, due to the unique features and attributes of each area, no universal template can be applied consistently across all disaster zones globally. Therefore, innovative and sustainable initiatives must be undertaken to establish a system that aligns with disaster management requirements in a specific region.[7] Information technology has proven to be significantly applicable during every phase of disaster management. Local governments can reduce the risk of catastrophe by utilizing infrastructure monitoring technologies and managing public health emergencies caused by natural disasters or human activities.[2,3]

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The use of information systems is essential and increasingly plays a significant role in disaster management, spanning from the pre-disaster phase to the post-disaster phase and encompassing the disaster itself. A multi-layered decision-making theoretical framework integrates information systems and various stakeholders into a structured model, enhancing, facilitating, and supporting management processes during disaster events.[8] The Internet of Things (IoT) is one of the emerging technologies. It is one of the most promising application domains in environmental surveillance for public protection, disaster relief monitoring, and detection.[9] A system design also develops and builds a model of the Geospatial-Based Adolescent Reproductive Health Disaster Alert System.[10] Another important system is the Community Disaster Information System. With the global rise of information technology, communities are increasingly active in gathering, analyzing, and sharing information, making them key players in information management.[11] Information Communication Technology (ICT)-based methods, including robust databases, many-to-many communications, and Geographic Information System (GIS), can make this response faster, more transparent, and more easily accessible.[12]

Indonesia is a large country with varied geographical features. It is situated in the Ring of Fire, making it a country with the highest global disaster risk.[13] According to the Centre for Research on the Epidemiology of Disasters, Indonesia was the second most disaster-prone country after the United States.[14] One of the areas in Indonesia with a high disaster risk is the Tasikmalaya District in West Java Province, which has diverse geographical characteristics, from coastlines to active volcanoes. As of 2019, there were 149 disaster events in the Tasikmalaya District.[15] These disasters resulted in casualties, as well as physical and economic losses, with landslides being the most frequent. However, the disasters with the highest number of casualties were earthquakes and tsunamis, with 63 people killed and missing in one incident. Two destructive earthquakes were recorded in 2017.[15] Between 2020 and 2025, 31 natural disasters occurred, including 11 floods, four landslides, three earthquakes, and three tornadoes, in addition to incidents combining three floods and landslides.[16]

Based on these considerations, a project called the development of a health crisis risk monitoring information system (HCR-MIS) has been carried out by the authors together with the Tasikmalaya District Health Office since 2023, with the primary goal of measuring health crisis risk in improving regional preparedness in primary health care (PHC) and the District Health Office. HCR-MIS needs to be developed to meet the need for fast and accurate information for decision-making, as well as gathering and integrating data from various sources. Therefore, a thorough understanding of the needs of prospective users is crucial. This study aimed to explore potential users' needs regarding the desired content and function of the HCR-MIS.

Method

The HCR-MIS project was carried out from March 2023 to July 2024. The Tasikmalaya District, which encompasses diverse regions from mountainous areas to coastal zones, was selected as the research site due to its increased vulnerability to health crises. In the first phase of the research, a qualitative exploratory study was carried out through interviews and focus group discussions (FGDs) to enable an in-depth exploration of the prospective users' needs. The informants were stakeholders intentionally selected by the authors as potential users of this system, totaling 19 informants. They were responsible for providing daily reports and managing disaster and health crisis data. Informants were divided into two groups: interviews (n = 7), which consisted of the Health Crisis Center (HCC) of the Indonesian Ministry of Health at the national-level (n = 2), Provincial Health Office (n = 1), District Health Office (n = 3), and Regional Disaster Management Agency (RDMA) (n = 1). The second category was FGDs with PHC staff (n = 12), which were considered to represent the entire area, including PHC heads (n = 4), surveillants (n = 4), and medical team members (n = 4).

Data collection began on March 13, 2023. On average, the interviews with each informant lasted about 50 minutes, while the FGD session lasted around 90 minutes. The interviews and FGDs were conducted in the auditorium of the Tasikmalaya District Health Office. All interviews were digitally recorded and transcribed verbatim. In-depth interviews were conducted using an interview guide prepared by the research team. During the FGD process, a preview of the HCR-MIS to be developed was presented, with the research assistants serving as moderators, recording and noting important points. The FGD concluded after all issues were discussed using the FGD guide that was previously designed.

The content analysis method was used to analyze the interviews and FGD data. The informant double-checked and approved these data before the analysis process. Therefore, the analysis involved the inductive development of categories and their deductive application. Initially, using the preliminary category system, all transcripts were independently reviewed by each author. Additional key issues were identified during this review. After summarizing and labeling these key issues as codes, the authors sorted them into main and subcategories. The codes were clearly defined and linked with representative examples from the original texts. The categories were then discussed and further modified within the interprofessional research team until a consensus was reached on the category system. The data analysis was conducted using OpenCode, an open-source software. Informant characteristics will be analyzed descriptively in terms of age, sex, education, and professional experience. The data will be presented in the form of tables, figures, and interview quotes.

Results

Table 1 provides a detailed description of the characteristics of the interview and FGD participants. It shows that most of the respondents were male, both in the interview group and the FGD. The age group in the interview group was mostly over 50 years, while in the FGD, the age group was evenly distributed, with participants under 44.5 years and those 44.5 years or older. The interview group had more than 7 years of experience. In contrast, most FGD informants had less than 12 years of experience. Regarding education level, the interview group had a higher level of education than the FGD group.

Table 1. Informants' Characteristics

Code	Age (years)	Sex	Job Position	Experience (years)	Education	Data Collection Process
A01	54	Male	Coordinator of Health Services and Financing of the District Health Office	10	Master	Interview
A02	51	Female	Health Crisis Response Analysis at the District Health Office	1	Bachelor	Interview
A03	51	Male	Surveillance Data Manager at the District Health Office	7	Bachelor	Interview
A04	40	Male	Prevention and Preparedness Analyst at the Regional Disaster Management Agency	5	Bachelor	Interview
A05	54	Male	Epidemiologist, Team Leader of Hajj Health and the Health Crisis Center	16	Master	Interview
B01	27	Male	Administrator of the Data and Information Management and Monitoring of the Health Crisis Center	1	Diploma	Interview
B02	52	Female	Team Leader of the Data and Information Management and Monitoring of the Health Crisis Center	11	Master	Interview
C01	47	Male	Head of the Primary Health Care	1.5	Master	Focus Group Discussion
C02	42	Male	Nurse	3.5	Diploma	Focus Group Discussion
C03	39	Male	Medical Doctor	3.5	Bachelor	Focus Group Discussion
C04	53	Male	Head of Administration	27	Bachelor	Focus Group Discussion
C05	42	Male	Nurse	22	Diploma	Focus Group Discussion
C06	37	Female	Surveilans	1	Bachelor	Focus Group Discussion
C07	47	Female	Head of the Primary Health Care	1.5	Master	Focus Group Discussion
C08	37	Female	Epidemiologist	2	Bachelor	Focus Group Discussion
C09	47	Male	Nurse	21	Bachelor	Focus Group Discussion
C10	53	Male	Head of the Primary Health Care	7	Bachelor	Focus Group Discussion
C11	58	Male	Head of the Primary Health Care	17	Bachelor	Focus Group Discussion
C12	37	Male	Epidemiologist	3	Bachelor	Focus Group Discussion

Overall, an information system for monitoring health crises was highly needed and would be greatly beneficial if it functioned effectively. The data analysis process began with the compilation of interview transcripts, followed by coding and categorization until themes and subthemes/categories were identified (Figure 1).

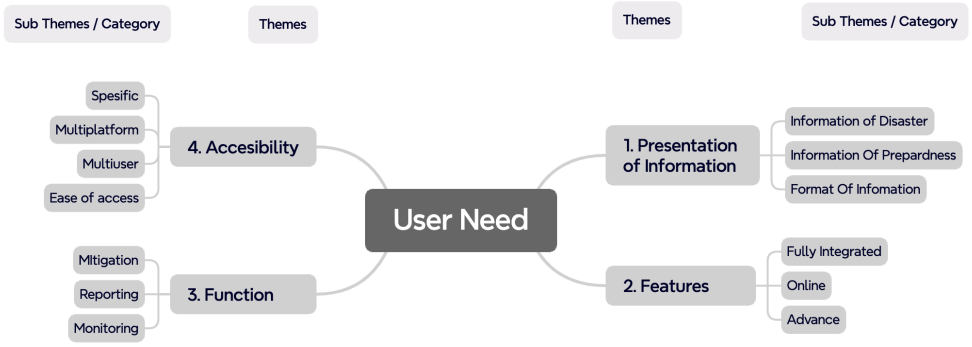

Figure 1. Overview of Identified Key Results Regarding User Needs

Based on Figure 1, the key findings from interviews and FGD regarding user needs were divided into four major themes: mitigation, reporting and monitoring, with features that facilitate full integration, online information generation, and rapid access. Accessibility required a specialized, multiplatform, multiuser, and easily accessible system. Meanwhile, the information itself encompassed disaster-related information, preparedness information, and standardized information formats. More detailed explanations of each theme, category, and code will be provided individually in Table 2.

Table 2. Themes, Categories, and Codes

Themes	Categories	Codes
Presentation of Information	Information on the disaster	Information on the disaster situation
		Information on the location of the disaster
	Information on preparedness	Early warning system
		Mapping area
	Format of information	National standardization
		Local specific needs
Features	Fully Integrated	Integrated with the Regional Disaster Management Agency
		Integrated with the Indonesian Ministry of Health system
		Integrated with Health Office Networks
	Online	Online system
	Advanced	Advance
Function	This system is needed for the mitigation	This system is needed for the mitigation
	Performance monitoring	Performance monitoring
	Activities monitoring	Activities monitoring
	Pre-disaster monitoring	Pre-disaster monitoring
	Reports are based on PHC's data	Reports are based on PHC's data.
	Graphical visualizations are available	Graphical visualizations are available.
	The need for a reporting system.	The need for a reporting system
Accessibility	Specific application	Need a specific application
		Application as a specific instrument
	Multiplatform	Web-based
		Mobile
	Multiuser	RDMA as a user
		RDMA as its functions
		User from base to top
	Ease of access	Easy to access
		The public can access it
		Easy to share

Notes: RDMA = Regional Disaster Management Agency, PHC = primary health care

Presentation of Information

The theme of information presentation was divided into three categories: information on disaster, information on preparedness, and format of information. In detail, the description of each category will be explained below.

Information on the Disaster

The informants agreed that the information should provide disaster situation information. Statements from each part complemented one another regarding the types of information that should be included in the HCR-MIS. One informant firmly stated that the information system should provide the following disaster situation information:

> *"To keep the community informed, disaster-related information, such as procedures to follow in the event of an earthquake or instructions on what to do in case of a flood, can be included in the information system." (C01)*

An informant added that the system should include data on disaster-prone areas. Two informants from PHC and the District Health Office emphasized that this information should be useful not only for department officials or the PHC but also accessible to the public.

Information on Preparedness

In addition to disaster-related information, the informants expressed the need for preparedness information. PHC informant stressed the need for an early warning system:

> *"It also serves as a warning. Being aware, for example, of an event of potential disaster. Information should be obtained from the Meteorology, Climatology, and Geophysics Agency. For instance, if there is a potential for heavy rainfall and landslides." (C01)*

According to them, this information was crucial for the community to be prepared and alert. One informant added that important information, such as the mapping of disaster-prone areas, should be available in the information system. Mapping disaster-prone areas is of utmost importance in this system, as it enables the identification of vulnerable areas and serves as a guide for determining the priority of response and vigilance toward potential disasters.

Format of Information

After discussing the information content, the participants also expressed their preferences regarding the generated information format. They desired standardized and nationally applicable information that was tailored to the specific needs of the Tasikmalaya Region.

> *"The desire is for the system/information to be standardized nationally." (A01)*

With a standardized format for information and reporting, the reports between regions would have a unified national format, eliminating differences between regions. However, one informant stated that the information generated by the information system should consider the conditions and needs of the local region.

> *"The information should be tailored to the Tasikmalaya District, so it should be adapted to the region." (A03)*

According to this informant, specific information may be relevant to a particular area but not applicable to other regions.

Features

The features required by users were categorized into three types: fully integrated, online, and advanced. A detailed description will be provided below.

Fully Integrated

One central issue discussed in both the interview groups and the FGD was the information system's complete integration. One member of the group stated that the information system should be integrated with the RDMA.

> *"When we have an application, we display information, but if RDMA or the relevant area/region is not connected, there is a concern about miscommunication." (C03)*

Additionally, the informant expressed that the RDMA can share data and information related to area mapping. Through its community-based network, the RDMA can contribute by providing and sharing disaster-related data and preparedness information with the public. The information network of the RDMA extends to the Subdistrict level,

which helps coordinate and assess existing resources. Furthermore, the RDMA can contribute by sharing information regarding the availability of community-based resources at the sub-district level, which can be integrated with other information systems from the Indonesian Ministry of Health, such as the online integrated referral information system called SISRUTE, which provides data on the readiness of crisis victims and available capacities.

The current crisis management system at the ministry level is integrated with the information system for the Health Reserve Workforce, serving as a list of available health personnel during health crises. Another informant suggested integrating the system with the government's full-scale application called SatuSehat. All integrations with the current Indonesian Ministry of Health are coordinated through the information center called Pusdatin. The HCC's information system is open to collaborating with the HCR-MIS development in the regions.

Another critical integration that should be implemented in this information system is the integration of the Health Office network, including PHCs, District Health Office, and Provincial Health Office. The informant expressed the hope that this system can be integrated with the existing PHC systems. Integration is also desired for higher-level health facilities such as hospitals. Data can be easily and quickly retrieved with the integration of existing systems in PHCs. Integration within the health office network will also facilitate the processing of data, where the district health department will aggregate the input data from PHCs.

Online Systems and Advances

The next expectation from the informants regarding the HCR-MIS is that it should be an advanced system that keeps up with the latest technology trends and is accessible online. The informant stated that the information system should be capable of generating fast information.

> *"The system can provide fast information to relevant leaders based on their needs." (B01)*

Function

The function themes were divided into three categories: disaster mitigation, risk monitoring, and risk reporting. In detail, the description of each category will be explained below.

Mitigation

The functions of the HCR-MIS were an important topic discussed. The informant stated that the PHC needs this information system to provide data or information for mitigation.

> *"So, actually, the PHC also needs it, including for mitigation." (C04)*

Monitoring

Furthermore, one informant expected the HCR-MIS to monitor the performance of personnel in handling health crises.

> *"About monitoring, or what else? Monitoring is about assessing the extent of our success or the extent of our work in handling the crisis" (A01).*

It is also essential to monitor the activities carried out by the personnel.

> *"Requesting reports and information on the activities carried out in the field and assessing the outcomes." (A01)*

Another function of the information system was to perform pre-disaster or health crisis risk monitoring.

> *"Regarding disasters, for example, the pre-disaster phase. Therefore, while monitoring the safety situation in the area, we repeatedly ask whether it is related to seasonal or situational factors." (A01)*

The system was designed to function in this manner. The specific application for which the informant expressed a need for an information system that generates graphical reports.

> *"For example, in the application, the types of reporting might be something like an early warning graph. We can automatically see the fluctuations and trends." (A01)*

Reporting

The HCR-MIS is also expected to function as a reporting system.

> *"It helps us coordinate, and we do need some kind of reporting application." (C03)*

The reporting feature in this information system can also facilitate the Health Office in generating reports because the PHC personnel already enter the data directly.

> *"Therefore, the ones who should fill it out should be from PHC, where PHC is the lowest level. If it is here, the personnel are from the PHC (there are more of them), so it would be better if they fill it out from the PHCs and then submit it to the District Health Office." (B02)*

Accessibility

The accessibility theme was divided into four categories: specific application, multiplatform, multiuser, and ease of access.

Specific Application

The informants expected a specific application or information system for health crisis risk monitoring; therefore, developing an HCR-MIS that the public could also access was essential. Likewise, the other informant stated that they required an application to provide support data for advocacy or decision-making purposes and to create an automated report.

> *"....we need to create a program (system), whatever its name, especially for reports, there could even be a specific one that suits our needs to create disaster reports." (A03)*

Multiplatform

One crucial aspect discussed by the informant is the information system's accessibility. One informant suggested developing a specific information system for disaster management. Furthermore, another informant stated that a specific application for disaster management could be developed.

Based on information from the HCC, the information system was centered on a web-based platform. Additionally, a mobile-based application was being developed to complement the web-based application. Furthermore, one informant requested that the information system be accessible through social media platforms for faster dissemination.

Multiuser

In addition to multiplatform access, the informants emphasized the importance of various users for the effectiveness of the system. One informant suggested that the RDMA should be a user in the system.

> *"...it would be great if the RDMA could be a user as well." During the COVID-19 response, the coordination between the Health Office and RDMA was always in sync." (A04)*

The involvement of the RDMA should align with its role and function. One informant added that the users of this system should range from the lower level (PHCs) to the higher level (Health Office).

Ease of Access

The informants also highlighted the importance of easy access to the information system. The PHC informant requested that the system be easily accessible anytime, anywhere.

> *"The challenge for us is to make it easily accessible anytime, anywhere." (C05)*

Furthermore, one informant expressed the hope that the system could be accessed by the public in terms of accessibility. Another informant suggested that the system should be made more accessible to the public, for example, through their mobile phones.

Discussion

Disaster management is a multifaceted field in public health that encompasses preparedness, response, recovery, and mitigation.[17] These efforts aim to safeguard and enhance the well-being of communities affected by disasters. A comprehensive health systems approach, including risk assessments and disaster risk management fact sheets, is crucial for enhancing disaster management and mitigating associated risks.[17] Therefore, the implementation of information systems as tools for monitoring health crisis risk is essential to address health crises effectively. The results of the data analysis indicated that the informants desired an easily accessible, advanced, online, and fully integrated HCR-MIS with the need to present information on disasters, preparedness, and the preferred format for

such information.

The first theme was user-required information. This information included details related to disaster events or hazards, such as location, time, and type of disaster. In addition, information was required for preparedness. This information was formatted following national standards that also addressed regional needs. Therefore, during system development, it was necessary to consider variables related to disaster and hazard information, as well as preparedness data, presented in a standardized format and aligned with field conditions.

Disaster and preparedness information must adhere to the variable data required in the Health Crisis Management Regulation of the Minister of Health No. 75 of 2019.[18] By referring to these regulations, data and information can be standardized nationally, and information related to specific local regions can be adjusted to existing standards. Standardization is crucial in providing a universal framework for data exchange across healthcare systems.[19] Although national and even global standardization is crucial, the need for data specific to local contexts must still be addressed. These findings align with research emphasizing the need to carefully examine the local context and dynamics, as well as to identify needs a priori. Ideally, any product should be codeveloped with local stakeholders through a user-centered design approach.[20]

In addition to content, the identification of user-desired features and system capabilities was also conducted. The informants strongly expected integration and advanced online system information. Data integration is a crucial issue in an information system. Integrating data and platforms facilitates centralization and enables each stakeholder to participate more effectively. It is designed to be extensible, making it convenient to add new features according to user needs and feedback.[21]

It is important to develop a clear and context-specific understanding of what effective integration entails, how it should be implemented (i.e., what needs to be integrated and how different system activities can be coordinated), and what benefits will be obtained, including identifying best practice examples.[22] The integration of modern technologies, such as Artificial Intelligence, IoT, and GIS, can enable faster and more efficient crisis responses, helping organizations, including crisis management agencies, make better resource allocation decisions during emergencies and improve overall performance.[23-24]

Integration also facilitates coordination, aligning with a previous study that emphasizes the importance of data integration, particularly in risk management and disaster response, where data are integrated from each relevant government agency.[25] Various models of integration can be identified, including information-oriented integration through information exchange, such as databases and Application Programming Interfaces (APIs); process-oriented integration through centrally managed processes to support information flow; service-oriented integration to share common business logic or methods;[26] user-oriented integration to enable users to have a consistent view of various systems.[27] The proposed integration model should align with user expectations, and the most appropriate approach should be selected based on contextual suitability.

The system functions theme was divided into three categories: disaster mitigation, risk monitoring, and risk reporting. The information system serves as a tool for mitigation, and real-time spatial data is essential in disaster management and disaster response.[28] Therefore, in the pre-crisis phase, hazard management and disaster mitigation become crucial.[29] The functions expected by the informants must be realized as a form of effort to reduce the risk of health crises. In line with the health Emergency Disaster Risk Management (EDRM) framework, the comprehensive approach refers to closely interrelated prevention and mitigation, emergency preparedness (including operational readiness), response, and recovery measures. It is based on the premise that prevention and mitigation measures can reduce the likelihood and severity of emergencies and that sound preparedness will lead to a more timely and effective response.[30] In practice, one of the risk mitigation efforts is risk monitoring, which includes resource management, infrastructure improvement, contingency planning, education, and family planning. These efforts are documented and reported within a reporting system, making it a unified package for recording and reporting.[31]

The final theme is accessibility, which consists of four categories: specific application, multiplatform, multiuser, and ease of access. The accessibility needs of users align with the current advances in information technology, making it essential to recognize. Accessibility aligns with the principles of multiplatform or cross-platform systems, as the development of information and communication technology, particularly web-based applications, evolves rapidly.[32] A cross-platform application is an example of this type of development. This approach reflects the importance of usability and accessibility as key quality characteristics in software development.[33] Technology must be accessible to

all, and accessibility should be integrated into the development process of information systems.[34] It is crucial to ensure that everyone can use the final version of a given technology. In this context, the HCR-MIS will play its role as a system that assists a variety of users, particularly leaders at the PHC and District Health Office levels, in decision-making.

The rapid development of ICT, particularly web-based internet applications, underscores the importance of involving potential users in the design of a system to ensure that it is centered around their interests and needs. This study included informants from various levels, ranging from the PHCs frontliners to national-level HCC personnel at the Indonesian Ministry of Health. This approach provided diverse insights across roles, professions, and expertise levels. However, this study had some limitations, such as a male-dominated group of informants and a significant gap in the informants' experience in the field of health crisis management. Not all elements of the Penta-helix approach were involved, as the system was dedicated to the main users in the health cluster. Additionally, the findings might not be fully generalizable to other regions or the entire country.

Conclusion

The system should meet the needs of both implementers and leaders by providing standardized disaster-related information, including preparedness, mitigation, and early warning. It must be accessible across platforms and usable by multiple stakeholders, including the public. The system should support health crisis risk mitigation, monitoring, and reporting, while integrating with other related online systems. To ensure sustainability, collaboration with community groups, media, and the business sector through the Penta-helix approach is essential.

Abbreviations

IoT: Internet of Things; ICT: Information Communication Technology; GIS: Geographic Information System; HCR-MIS: Health Crisis Risk Monitoring Information System; PHC: primary health care; FGD: focus group discussion; HCC: Health Crisis Center; RDMA: Regional Disaster Management Agency.

Ethics Approval and Consent to Participate

Ethical approval for the research was obtained from the Ethical Committee of the Faculty of Medicine, Public Health, and Nursing at Gadjah Mada University (Ref. No: KE/FK/0181/EC2023).

Competing Interest

The authors declare no conflicts of interest.

Availability of the Data and Materials

All data sources and information used in this research are available upon request. If further details are needed, including access to the datasets or supplementary files referenced in this study, the author may contact interested parties directly via email. The corresponding author's email address is provided for inquiries and requests related to the research materials.

Authors' Contribution

HK conceptualized the study and methodology, and ATI designed and prepared the initial draft. AAPP and ATI interpreted, validated, reviewed, and edited the data. All authors have reviewed and approved the manuscript.

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Experiences of Elderly Living with Noncommunicable Diseases in Utilizing Health Services in Myanmar During the COVID-19 Pandemic

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Abstract

The COVID-19 pandemic and armed conflicts in Myanmar have intensified the challenges in accessing and utilizing health services, particularly for noncommunicable diseases (NCDs) among older adults. This qualitative study explored the experiences of the elderly with NCDs regarding health service accessibility and utilization in secure areas with fully operational health facilities by conducting in-depth interviews with 20 eligible older adults in Myanmar; data were analyzed using content analysis. Four key themes emerged: NCD service utilization patterns; unmet needs; preferences and hesitancy toward NCD services; and disparities, barriers, and opportunities. The findings revealed widespread underutilization of NCD services due to several factors, including geographic inaccessibility, lack of telemedicine, absence of nearby primary health care, inaccessibility of preferred specialists, quality of care issues, high costs, inadequate communication by providers, and insufficient support for healthcare appointments. In conclusion, strengthening elderly-friendly NCD services in Myanmar requires improving accessibility, affordability, care quality, and communication to reduce unmet needs and support healthy aging.

Keywords: elderly, health services utilization, Myanmar, noncommunicable diseases

Introduction

Since 1990, noncommunicable diseases (NCDs) have become the leading cause of death worldwide, accounting for 75% of all deaths in 2021.[1] In Myanmar, NCDs caused 290,000 deaths in 2020, with mortality disproportionately affecting older adults—75.52% of total deaths among those aged ≥70 years.[2] With a growing aging population, Myanmar urgently requires older people-centered NCD strategies.[3]

The World Health Organization's Package of Essential NCDs Interventions (PEN) aims to expand the NCDs service coverage in primary health care (PHC) settings in low-income countries, including Myanmar, yet progress remains slow.[4] According to 2014 data, life expectancy at 60 years in Myanmar was 16.9 years; however, healthy life expectancy is only 12 years, leaving nearly 5 years in poor health.[5] Despite nationwide PEN implementation since 2017, Myanmar has missed key NCDs targets,[4] with hypertension (50%) and diabetes mellitus (18%) prevalence remaining high until 2023.[6,7] Healthcare access for older adults is inequitable, exacerbated by systemic barriers.[7-9] In 2023, HelpAge Myanmar reported that NCD service access was as low as 7% in Southern Shan State, compared to 60% in Yangon.[7] During political instability, 60% of older women and 52% of older men faced healthcare disruptions in 2023.[10,11]

The COVID-19 pandemic further strained NCD care, delaying screening and treatment.[12] Myanmar's health system has adapted to telemedicine and awareness campaigns;[13] however, political instability has disrupted routine care. In 2023, 52% of older adults required screenings, while 32% required NCD services.[10] Despite global research on NCDs and COVID-19, the lived experiences of older adults in Myanmar remain scarce, particularly regarding unmet needs during the dual pandemic–political crisis. This study aimed to explore the experiences of the elderly in utilizing NCDs-related health

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services in Myanmar during the COVID-19 pandemic, focusing on demand-side barriers to access. Its key contribution lied in capturing the lived experiences of elderly individuals during a dual crisis, pandemic, and political instability, an area not sufficiently addressed in existing research. Although the pandemic has officially ended, its long-term effects on health systems, especially in fragile contexts such as Myanmar, persist and continue to impact older populations disproportionately. This study provided timely, context-specific insights to inform equitable and resilient health service strategies for current recovery efforts and future crises; its relevance extends beyond Myanmar, offering lessons for health system planning in other low-resource and politically unstable settings.

Method

This qualitative study explored the experiences of the elderly with NCDs health services utilization in Myanmar during the COVID-19 pandemic, focusing on accessibility, utilization patterns, and support/barriers. Following the protocol and the lists of patients with NCDs provided by the PHC staff and local authorities, face-to-face in-depth interviews were conducted with 20 participants aged ≥60 with NCDs (cardiovascular disease, diabetes mellitus, cancer, or chronic respiratory conditions), who were identified as key informants (Table 1), from urban (Yangon) and rural (Zigon Township) areas, between February and December 2023. Purposive sampling ensured diversity in age, sex, and independence levels based on the proportion of the aging population, urbanization, rural population density, health facilities operationalization, and local security context.

Table 1. Demographics of Elderly with Noncommunicable Diseases (n = 20)

Code	Location	Age	Sex	Education level	Marital status	Occupation	Living situation
E-01	Urban	62	Female	Senor High School	Married	Factory worker	With family
E-02	Rural	78	Male	Junior High School	Married	Farmer	With family
E-03	Rural	90	Female	Elementary School	Married	Dependent	With son
E-04	Rural	62	Male	Higher Education	Married	Retired school teacher	With family
E-05	Rural	62	Male	Higher Education	Married	Farmer	With family
E-06	Rural	73	Female	Elementary School	Married	Dependent/Farmer	With family
E-07	Rural	71	Female	Elementary School	Married	Dependent	With family
E-08	Rural	68	Male	Elementary School	Married	Farmer	With family
E-09	Rural	82	Male	Elementary School	Married	Farmer	With family
E-10	Urban	65	Male	Higher Education	Married	Company staff	With family
E-11	Urban	73	Male	Higher Education	Married	Retired lecturer	With family
E-12	Rural	62	Female	Senior High School	Married	Farmer	With family
E-13	Urban	82	Female	Higher Education	Married	Retired teacher	With family
E-14	Urban	63	Male	Higher Education	Married	Business owner	With family
E-15	Rural	75	Male	Junior High School	Married	Farmer	With family
E-16	Urban	64	Male	Higher Education	Married	Company staff	With family
E-17	Urban	65	Female	Higher Education	Single	Retired teacher	Alone
E-18	Urban	85	Female	Higher Education	Married	Dependent	With family
E-19	Urban	75	Female	Uneducated	Married	Factory worker	With spouse
E-20	Urban	72	Female	Higher Education	Married	Business owner	With family

Inclusion criteria were diagnosed with NCDs for ≥1 year, residing in the study areas since March 2020, and able to communicate in Myanmar. The exclusion criteria included severe illness, cognitive impairment, or language barriers. Interviews (45–60 minutes) were conducted face-to-face at the participants' homes, covering experiences from 2022 to 2023. Participants were asked about their unmet healthcare needs, "What was the main reason for not receiving treatment/services at that time?" and reasons for non-utilization, "Could not afford the treatment cost" / "Could not afford the travel cost" / "Long waiting time" / "Difficulty traveling or living far away from facilities"/ "No time to get treatment"/ "Do not trust or feel confident with facilities or providers"/ "Did not know where to go to receive treatment"/ "No one to accompany to health facilities"/ "Other reasons for outpatient or inpatient services" / "Provider cannot provide proper service." Unmet healthcare need, defined as people who require health services but do not use them for whatever reasons, is a key indicator for monitoring access to health services as it reflects the gaps in access to care, such as availability, geographical accessibility, financial accessibility, and poor quality of care that people do not trust. After interviewing 20 key informants, data were collected. Transcripts (translated from Myanmar to English) were manually coded and thematically analyzed. Key themes were derived from the participants' narratives and presented verbatim and in *italics*. Ethical approval and informed consent were obtained from the participants.

Results

A total of 20 elderly individuals living in urban and rural areas of the selected study sites shared their experiences with the utilization of NCD health services during 2023. Table 2 reveals the respondents' general characteristics. The age range was from 62 to 90 years, with the majority in their 60s and 70s, and an average age of approximately 70.7 years. The sex was balanced, with 50% male and 50% female participants. The educational level comprised 30% completed elementary school, 20% completed junior and senior high schools, and 50% completed higher education. This distribution highlighted a varied educational landscape, with several individuals having had access to at least some form of formal education. However, a notable number had relatively low levels of education, particularly among those in rural areas. Most respondents (95%) were married, and 90% lived with family or a spouse, reflecting typical family-oriented living arrangements for older adults. Overall, the sociodemographic data suggested a largely stable group in terms of marital status and living conditions, with varying levels of educational attainment.

Table 2. Characteristics of the Elderly with Noncommunicable Diseases (n = 20)

Characteristic	Category	Variable	
		n	%
Age (years)	60–69	9	45.0
	70–79	7	35.0
	≥80	4	20.0
Sex	Female	10	50.0
	Male	10	50.0
Marital status	Single	1	5.0
	Married	19	95.0
Type of Noncommunicable Diseases	Hypertension	6	30.0
	Diabetes Mellitus	3	15.0
	Hypertension + other comorbid diseases (BPH, gastritis, hyperlipidemia, IHD, stroke, RA, etc.)	10	50.0
	Diabetes Mellitus + Hyperlipidemia	1	5.0
Type of residency	Urban	10	50.0
	Rural	10	50.0
Education Level	≤Elementary School	6	30.0
	Junior and Senior High School	4	20.0
	Higher Education	10	50.0
Received social pension/health insurance/health benefit (FOC service for retired civil servants at public health facilities)	Yes	4	20.0
	No	16	80.0
Previous occupation	A dependent who did not work to earn money	3	15.0
	Agriculture	7	35.0
	Retired civil servant (teacher, lecturer, etc.)	4	20.0
	Business owner	2	10.0
	Company employee	4	20.0
Health facility	Primary health care (public/private)	7	35.0
	Secondary health center (public/private)	5	25.0
	Tertiary health center (public/private)	8	40.0

Notes: BPH = benign prostate hyperplasia, IHD = ischemic heart disease, RA = rheumatic arthritis, FOC = free of charge

The qualitative interview explored the pattern of NCDs health services utilization, the unmet need for NCDs health services utilization among the aging population, barriers to accessing NCDs health services, and opportunities to utilize NCD health services among the elderly.

Theme 1: Pattern of Health Services Utilization Among the Elderly with NCDs

The findings revealed a complex pattern of health services utilization among the elderly population with NCDs, characterized by the types and places of service utilization. Those who used the services when they needed them and those who experienced unmet needs for utilization. Six out of 20 key informants reported utilizing various NCD health services, including general practitioner (GP) clinics, philanthropic clinics, and PHCs. In addition, curative care, follow-up care, inpatient care, blood pressure (BP) measurement, blood glucose checks, medical check-ups, nurse aid services, and outpatient care at public and private health facilities, and specialist clinics or tertiary hospitals, were commonly accessed.

The various ways in which the elderly managed their NCDs outside formal healthcare settings were also examined. The informal healthcare system refers to services provided by unskilled or unqualified persons for the diagnosis and treatment of NCDs in the community. Some informants (25%) indicated engaging in self-medication practices, including the use of western medicine, traditional remedies, over-the-counter drugs from pharmacies, and medications prescribed by peers. The preference for western medicine was evident in the responses, with patients preferring medications prescribed by doctors because of their perceived effectiveness and clear instructions. Telemedicine emerged as an important service during the pandemic, with some participants opting for remote consultations when face-to-face visits were not possible.

Conversely, some reasons affecting the decision to utilize NCD health services were captured. The biggest constraint to the utilization of health services among the elderly was financial hardship, especially for those lacking insurance or savings. This was compounded by dissatisfaction with service quality, particularly negative staff behavior, and a widespread reliance on self-medication through over-the-counter drugs, traditional remedies, or advice from peers, which further discouraged formal healthcare use. These practices, while providing a sense of autonomy, often led to suboptimal NCD management. Although traditional medicine was present in the community, it was less commonly used, and most informants (75%) did not express a preference for it.

Additionally, some elderly informants (20%) reported hesitancy to use health services owing to a lack of perceived need or fear of burdening their families. Nearly one-third of the informants (30%) expressed that family members, particularly children or spouses, heavily influence their health service decisions. For instance, elderly individuals often rely on younger family members to help navigate healthcare systems, schedule appointments, or provide emotional support during visits. This reliance reflected the dependence of several elderly on family for assistance because of physical limitations or health conditions, highlighting the importance of social structures in managing health. Elderly individuals with NCDs reported opting out of health services owing to perceived good health, financial constraints, dissatisfaction with staff behavior, and reliance on self-medication. Furthermore, participants acknowledged that telemedicine lacked the comprehensive care offered in person and was limited by factors such as poor internet connectivity.

Both positive and negative experiences with NCDs health services utilization were discussed in the in-depth interview. The positive aspects included having adequate health literacy, good health, effective NCDs management, access to necessary equipment and medication, and the availability of public facilities. In contrast, negative experiences were characterized by issues such as the quality of services, financial barriers, and hesitancy to use the services, as illustrated by the following quotes that present the experiences of the elderly respondents.

> *"I did not use the health service after December 2022 because I feel healthy. I never use health services at a public hospital where there is a long waiting time, poor staff behavior, crowded places, etc. I do a blood glucose self-check at home, and the result is normal."* (E-20)

> *"I have not utilized the health service provided by medical doctor or trained basic health staff because of no money... I need money to get treated at the clinic with the doctor. We rarely use outpatient care treatment at a public hospital except for hospitalization... As I am running out of money, I miss the follow-up visit. But, I buy the medicine at the pharmacy by showing the used medicine to take it regularly."* (E-06).

Theme 2: Unmet Need for NCDs Health Service Utilization

Despite the availability of healthcare services, several barriers hindered the elderly from fully utilizing NCD care when they needed it, leading to unmet needs. Limited health literacy among certain respondents affected their ability to navigate the healthcare system and make informed treatment decisions. Some elderly informants (30%) relied heavily on family members, particularly children or spouses, to navigate healthcare systems, schedule appointments, and provide emotional support during visits. This reliance highlighted the elderly's dependence on social structures for managing their health, often because of physical limitations or health conditions.

Additionally, some informants (25%) reported opting out of formal health services owing to perceived good health, financial constraints, dissatisfaction with staff behavior, or reliance on self-medication. Although traditional medicine was available in the community, it was less commonly used, and most participants did not express a preference for it, indicating a gap in the culturally aligned healthcare options. The limitations of telemedicine further underscored unmet needs, as participants felt that it could not fully replace in-person care. Financial constraints were a major deterrent,

particularly for those who could not afford consultations, diagnostic tests, or medications. Dissatisfaction with healthcare providers, including negative experiences with staff attitudes, service quality, and a lack of trust in available medical services, discouraged some elderly individuals from seeking care. These findings can fill the gaps in care and hinder effective disease management.

Moreover, some key informants (20%) expressed hesitancy toward seeking medical care, particularly in the context of the COVID-19 pandemic. Some of them voiced concerns about visiting clinics or hospitals due to fears of contracting infections, which led them to seek alternative methods such as telemedicine or avoiding visits altogether. However, four key informants still sought care when necessary, especially when services were remotely accessible. There were concerns about the adequacy of medical explanations from healthcare providers, which sometimes led to uncertainty about treatment plans, mentioning instances where doctors failed to adequately explain procedures, resulting in confusion and reluctance to engage with health services.

Adherence to prescribed treatments varied widely among the participants. Some key informants (30%) diligently followed their treatment regimens, recognizing the importance of managing their NCDs. However, others expressed reluctance or fear of side effects, leading them to avoid medications. For instance, a few key informants feared that antihypertensive medications might worsen their condition or cause other health issues. The lack of proper health education, combined with informal advice from peers and family members, often resulted in suboptimal management of their conditions.

> *"I am hesitant to use health services because of no money, and I am afraid of being diagnosed with an incurable disease."* (E-07)

> *"I fear using NCD services because I am afraid of being scolded by the health provider."* (E-08)

> *"There is no explanation before the procedure in the GP clinic."* (E-17)

Theme 3: Opportunity for Utilization of NCD Health Services

Despite the existing challenges, several opportunities exist to facilitate the utilization of health services among the elderly population with NCDs in Myanmar. One key opportunity was the existence of health insurance schemes, health benefit packages for retired civil servants, and elderly social pensions that offer some degree of financial support, reducing the direct burden of healthcare expenses. Community and family support have emerged as a key factor in healthcare for the elderly. Several participants expressed that they relied on community-based health services, such as philanthropic clinics, where costs were lower or subsidized.

Furthermore, social support networks were crucial for elderly individuals who faced mobility challenges, as family members often accompanied them to clinics. However, home care services were identified as a gap in service provision, especially for those unable to visit clinics regularly because of physical limitations. Participants also highlighted that several elderly individuals in their communities, especially those without sufficient financial means, often relied on self-medication or traditional medicine before seeking professional care.

> *"My wife always accompanies me when I go to the clinic. If needed, I can request help from my neighbors."* (E-05)

> *"My husband accompanies me when I go to the clinic. My son sends money for us."* (E-07)

Health education and behavioral change interventions were another important opportunity. Half of the participants reported feeling healthy, indicating that these individuals may benefit from targeted interventions to maintain their health status and prevent the progression of NCDs. In contrast, most respondents (80%) were experiencing hypertension and other comorbid diseases. The elderly respondents' knowledge, attitude, and practice of NCDs risk factors, such as alcohol consumption, cigarette smoking, betel chewing, physical inactivity, and eating an unhealthy diet, were referred to as risk behavior of NCDs. In terms of NCDs risk behavior, a small subset of older adults with NCDs (three individuals) adhered to a healthy lifestyle, engaging in regular exercise, preparing meals at home, incorporating vegetables into every meal, and avoiding risk factors such as adding flavors such as monosodium glutamate (MSG) and chicken seasoning powder, betel chewing, alcohol consumption, and cigarette smoking. Conversely, the remaining 17 elderly individuals

exhibited at least one risk factor associated with NCDs; these risk factors included cigarette smoking, betel chewing, alcohol consumption, excessive intake of salty foods, and unrestricted use of MSG or chicken seasoning powder. Furthermore, the availability of private health facilities, which some participants preferred for their convenience and personalized care, presents an opportunity to explore public–private partnerships to improve access to quality NCD care.

> *"I eat chicken powder and MSG daily in every meal. Without them, the curry becomes tasteless. Here, almost everyone chews betel. We add licorice to betel. I do not drink alcohol. Although I do not do any specific physical activity, I walk when I go to the paddy fields."* (E-02)

> *"I do not smoke or drink alcohol. I chew betel, which is added with licorice. I do not have time for physical exercise. In the factory, I sit for a long time... As my main dish is rice, I eat a lot of rice with our Burmese cuisine vegetables eaten with* ngapi yay*, which is a paste made by fermented salted fish."* (E-19)

Theme 4: Barriers to NCD Health Services Utilization

Despite several opportunities, certain barriers impeded the effective utilization of health services among the elderly with NCDs. The financial burden associated with NCD treatment was one of the most significant barriers. Four respondents noted that health insurance, health benefit packages at public health facilities for retired civil servants, and elderly social pensions are available; however, the coverage is often insufficient to cover the full costs of consultations, medications, and specialized treatments. Consequently, many elderly individuals resort to significant out-of-pocket payments, making healthcare unaffordable and pushing them toward self-medication or over-the-counter drugs as alternative treatments.

Physical mobility limitations and transportation difficulties further restricted access to NCD services, especially for those living alone or relying on others for assistance in traveling to health facilities. Public transportation may be inadequate or inconvenient, particularly in rural areas, where health facilities are far from residential communities, and in urban areas, where elevators are lacking in high-level buildings. Another major barrier was the quality of healthcare services. Long waiting times at public hospitals, perceived inadequacies in patient-provider communication, and a sense of powerlessness in the face of medical uncertainty were other major frustrations, discouraging many from utilizing public health facilities despite their lower cost.

Participants often preferred private health facilities for their convenience and personalized care, even though this preference came at a higher financial cost. However, the high cost of routine tests and specialist consultations at private facilities remained a deterrent for some patients, leading them to forego the recommended procedures. Additionally, inadequate explanations from health providers about diagnoses, treatment options, and medication regimens contributed to feelings of confusion and reluctance to seek care. The availability of essential health services also poses a challenge. Local health facilities lacked the necessary diagnostic tools or medications as well as specialists, forcing elderly individuals to seek care elsewhere or decline treatment. Some patients resort to consulting unqualified practitioners or rely on self-medication due to the accessibility of formal healthcare constraints, further worsening their health risks.

> *"Although I have insurance, I cannot always afford the healthcare cost because the total reimbursed amount may cover only a couple of visits."* (E-16)

> *"There is no clinic/health facility in my village. It is located in another village (6 miles away). Money is required to go to the clinic. I cannot go to the clinic without money."* (E-04)

> *"As I live on the upper floor of an apartment, it is difficult for me to climb up/down when I go to utilize the health service. Nobody can carry me… For the home service it is too expensive. I cannot always afford it."* (E-13)

Additionally, cultural factors, such as the reliance on traditional medicine and fear of medical procedures, influenced healthcare choices. A total of 16 older people with NCDs shared their religious permission to receive NCD healthcare, their perception of spiritual healers, and their experiences of suffering from disease because of past karma.

> *"In my village, we mostly get treated by a quack and take traditional medicine. There is no religious*

restriction on using health services. Some get treated by traditional healers." (E-08)

"In my village, the monk provides treatment as a traditional healer, letting us drink the holy water that can cure all diseases. The majority of the villagers get treated by a quack. Unless we recover, we go to the clinic to receive treatment from a doctor. We regard hypertension and diabetes mellitus as old-age diseases because almost all the elders in my village have these diseases. There is no need for special care. Some suffer from cancer, which might be due to bad luck." (E-15)

Discussion

The findings of this study offer valuable insights into the patterns and barriers associated with health service utilization among the elderly with NCDs in urban and rural areas of Myanmar. This study revealed the complex interplay of the elderly's experiences in NCDs healthcare access and use, particularly in the context of geographic disparities, financial limitations, and the ongoing impact of the COVID-19 pandemic. The quantitative part of this study[14] demonstrated that 53.3% of the elderly with NCDs use health services, and 64.8% reported unmet needs, reflecting persistent gaps in Myanmar's PEN program implementation. Common reasons for not utilizing NCD health services included financial constraints, the belief that their health condition was not serious, reliance on self-treatment, and dissatisfaction with the behavior of the healthcare provider.

Participants also navigated a mixed healthcare system, primarily using outpatient services (43.4%) at GP clinics (14.4%) and private facilities (13.8%), mirroring low- and middle-income countries' trends where cost and accessibility dictate care-seeking.[14,15] The underutilization of PHC (13.8%) owing to perceived poor service quality aligns with studies from Vietnam,[14,16] suggesting structural deficiencies in Myanmar's first-level health facilities' system. Notably, telemedicine adoption remained low despite pandemic needs, constrained by digital divides, a finding consistent with global reports on elderly telehealth barriers.[17,18] Furthermore, unmet needs for NCD health services remain a critical issue. A significant proportion of respondents (64.8%) reported unmet needs for NCD health services, whereas 35.2% reported no unmet needs.[14,18] These results highlighted a substantial gap in NCDs service provision, with most elderly experienced unmet healthcare needs. Addressing these unmet needs and improving access to diverse NCD services, particularly in underserved locations, could enhance healthcare outcomes for the elderly.

Financial constraints emerged as the predominant obstacle, with consultations costing the uninsured elderly their monthly income. This condition intensified health inequities, as documented in other low- and middle-income countries.[19] Geographic barriers disproportionately affected rural residents, who faced 2–4-hour travel times versus urban dwellers' 30-minute access. Structural challenges such as medicine stockouts and long wait times compounded these issues, creating care-avoidant behaviors similar to those observed in Greece and South Korea.[20-22] Family support played dual roles: while the majority relied on relatives for care coordination, the absence of support created care gaps.[23] Moreover, dependency can lead to gaps in care when family support is unavailable or insufficient. This study's findings aligned with previous research emphasizing the importance of family involvement in healthcare decision-making, particularly in collectivist societies.[24] Traditional medicine use and spiritual health beliefs influenced treatment adherence, underscoring the requirement for culturally sensitive interventions as proposed by the Organisation for Economic Co-operation and Development.[25] The integration of traditional and modern healthcare approaches may be a key strategy to improve healthcare access and outcomes in rural areas.[26] Pandemic-related fears and provider distrust further reduced utilization, emphasizing the communication gaps identified in rural health studies.[27]

In terms of NCDs health behaviors for preventive measures, some participants engaged in activities to reduce the risk factors, such as walking and cutting down on sweet foods and MSG. Regular BP measurements at home were also noted. Conversely, most participants exhibited risk factors such as physical inactivity, poor dietary habits, and flavor use, highlighting a significant gap in health education regarding NCDs prevention and management. The lack of health education, combined with informal advice from peers and family members, may contribute to suboptimal health behaviors and poorly managed conditions.[28] It also emphasizes the requirement for community-based health promotion programs tailored to the elderly, which could improve awareness of NCD risks and encourage healthier lifestyles.[29]

This study offered important contributions by providing firsthand insights into the experiences of the elderly with NCDs in utilizing health services during the COVID-19 pandemic in Myanmar. This context remains underexplored in the existing literature. One of this study's key strengths lies in its focus on urban and rural settings, enabling a more nuanced understanding of geographic disparities in service utilization. Furthermore, this study adds value to global discussions

on health system resilience and equity in fragile contexts by capturing perspectives during an overlapping health and political crisis.

However, several limitations should be acknowledged. The use of purposive sampling may limit the generalizability of the findings, as participants were selected based on specific criteria rather than randomly. This study only included the elderly with NCDs who were independent in their activities of daily living, potentially excluding the most vulnerable and dependent elderly populations who may face even greater barriers to accessing care. Additionally, the reliance on self-reported data regarding health service utilization during 2022–2023 introduces the possibility of recall bias, which could affect the accuracy of reported experiences and behaviors.

To address these limitations, future studies should consider incorporating a more diverse sample, including dependent and homebound elderly individuals, to better capture the full spectrum of experiences. Using mixed-methods approaches and triangulating self-reported data with medical records or caregiver interviews may help minimize recall bias and improve data reliability. Further research is recommended to explore the long-term effects of pandemic-related disruptions on chronic disease management and to assess the effectiveness of interventions aimed at improving equitable access to NCD services across Myanmar. Exploring the role of telemedicine and its potential in overcoming geographic and financial barriers, as well as integrating traditional medicine with formal healthcare systems, could provide new insights.

Conclusion

This study reveals that elderly individuals in Myanmar navigate a complex mix of formal and informal healthcare services to manage NCDs, with self-medication being common because of barriers such as financial hardship, poor service quality, and limited access. Key strategies to improve health service utilization for the elderly with NCDs include developing age-friendly programs, deploying mobile health teams, strengthening community health workers, and integrating digital tools for outreach and follow-up. Empowering women and engaging community leaders can also enhance health-seeking behavior. Tailored, community-based health promotion is essential for improving health literacy and supporting healthier aging.

Abbreviations

NCDs: Noncommunicable diseases; PEN: Package of Essential NCDs Interventions; PHC: primary health care; GP: general practitioner; BP: blood pressure; MSG: Monosodium glutamate.

Ethics Approval and Consent to Participate

This study was approved by Documentary Proof of Ethical Clearance from the Research Ethical Committee of the Faculty of Public Health, Mahidol University (COA. No. MUPH 2023-145). All respondents provided written informed consent prior to data collection, having been informed about the voluntary nature of their participation and the confidentiality of their information.

Competing Interest

The authors have no conflicts of interest to declare.

Availability of Data and Materials

This paper is a part of the Doctor of Public Health (Global Health Major) dissertation. Data and materials used in this research may be obtained from the corresponding author upon reasonable request.

Authors' Contribution

NEC, KA, NC, and AB contributed to the design and implementation of the research and analysis of the results. NEC and KA verified the study instruments, analytical methods, and data interpretation; they were also responsible for the preparation of the manuscript. All authors discussed the results and contributed to the final manuscript, which was approved by all authors.

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Exploring Stunting in South Kalimantan Province Using R Programming-Based Data Visualization

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Abstract

South Kalimantan Province continues to face the challenge of relatively high stunting prevalence despite being endowed with abundant coal resources that could serve as a source of funding for public health. Therefore, this study aimed to examine differences in stunting prevalence among cities, mining districts, and non-mining districts in South Kalimantan to raise stakeholder awareness of disparities across these regional types. This study was conducted between April and December 2024, using secondary data obtained from the Indonesian Ministry of Health and the South Kalimantan Provincial Government. R programming was used to process the data, generate visualizations, and perform analysis of variance (ANOVA) and Tukey's honestly significant difference (HSD) tests. Following the significant ANOVA result, Tukey's HSD test was conducted to identify specific regional pairs that differed significantly following the ANOVA result. The results showed that cities had significantly lower mean stunting prevalence than non-mining districts (p-value <0.01). However, the difference between cities and mining districts was not statistically significant (p-value >0.05). Additionally, no significant difference was observed between mining and non-mining districts (p-value >0.05). In conclusion, abundant coal resources in mining districts have not translated into more effective stunting reduction efforts.

Keywords: budget, data visualization, public sector accounting, R programming, stunting

Introduction

Stunting is a condition characterized by a child's length or height falling more than two standard deviations below the median of the World Health Organization Child Growth Standards.[1] Stunting is a complex issue that can not be addressed through public health disciplines alone.[2] Although it primarily falls within the health science domains, it intersects with other fields. Various disciplines, including public sector accounting,[3] public policy,[4] and budgetary systems,[5] play a crucial role in accelerating efforts to alleviate stunting in Indonesia. According to the Indonesian Ministry of Finance, in addressing stunting issues, the government has allocated funding amounting to IDR 48.85 trillion (approximately USD 2.97 billion) through various financial schemes, such as the General Allocation Fund, Specific Allocation Fund, Village Fund, and revenue sharing from both taxes and non-taxes, including mineral royalties.[6]

Indonesia is one of the world's leading coal producers, along with China, India, the United States, Australia, and Russia. In 2023, Indonesia's coal production was projected to exceed that of the United States, Australia, and Russia, while remaining below China and India, approximately 623 million metric tons.[7] The experience of Peru may offer valuable insights into addressing stunting. Peru is rich in natural resources, such as natural gas, oil, and coal, and has integrated revenue from these resources into its national budget to support targeted stunting reduction programs.[8,9]

South Kalimantan Province is the second-largest coal producer in Indonesia.[10] According to the Extractive Industry Transparency Initiative Indonesia, coal production in South Kalimantan Province reached 177.68 million tons in 2021, 202.52 million tons in 2022, and 224.44 million tons in 2023.[10] This advantage enables the South Kalimantan Provincial Government and its district governments under the province to gain more money from the revenue sharing of mineral royalty than their counterparts. However, this economic benefit has not effectively translated into reductions in stunting prevalence across the region. The Ministry of Health showed that the prevalence of stunting in the province was 24.7%, which exceeded the national average of 21.5%.[11] Table 1 presents the prevalence of stunting in each city and district, along with relevant information.

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Table 1. Stunting Prevalence in Cities/Districts in South Kalimantan, 2023

City/District/ Province/State	Population Size 2023[12]	Stunting Prevalence (%) Among Children Aged 0–59 Months		
		2021[13]	2022[14]	2023[11]
Banjarbaru	268,110	19.0	22.1	12.4
Banjarmasin	666,440	27.8	22.4	26.5
Kotabaru	339,060	21.8	31.6	20.1
Tanah Bumbu	337,330	18.7	16.1	25.1
Tanah Laut	360,930	31.0	26.6	41.7
Banjar	591,510	40.2	26.4	30.1
Tapin	196,470	33.5	14.5	14.4
Hulu Sungai Selatan	235,980	29.1	20.3	25.4
Balangan	136,120	32.3	29.8	33.4
Tabalong	263,400	28.2	19.7	18.1
Barito Kuala	326,280	32.4	33.6	25.1
Hulu Sungai Tengah	266,200	29.6	31.1	13.0
Hulu Sungai Utara	234,510	20.9	28.0	36.0
South Kalimantan Province	4,222,330	30.0	24.6	24.7
Indonesia	278,696,200	24.4	21.6	21.5

Data source: Statistics Indonesia of Kalimantan Selatan Province and the Indonesian Ministry of Health

The high prevalence of stunting in a province with abundant coal resources is particularly interesting to investigate because the reality turned out to contradict what was expected. According to Article 33, Paragraph 3 of the 1945 Constitution of the Republic of Indonesia, *"The land and waters and the natural wealth contained therein shall be controlled by the state and utilized for the greatest welfare of the people."*[15] However, the abundance of coal resources has not translated into improved welfare for people in South Kalimantan, as reflected by the high prevalence of stunting.

Several studies have investigated stunting in South Kalimantan Province.[16-19] A previous study showed that stunted children were commonly born to adolescent mothers who married early because of unfavorable socioeconomic conditions.[16] Another study examined socioeconomic status, maternal health service utilization, and toddler characteristics and showed that underweight nutritional status is the primary contributing factor to stunting in South Kalimantan Province.[17] Additionally, a study on nutritional intervention programs found no significant correlation between the implemented programs and policy budgeting.[18] Furthermore, a data-driven study highlighted the importance of using local-level data to strengthen public health infrastructure in South Kalimantan Province.[19] However, these studies did not address the role of the province's abundant natural resources in addressing stunting.

Accounting and its subfields, particularly management accounting and public sector accounting, focus on facilitating effective and efficient decision-making, including allocating state and local budgets in the public sector. Accounting researchers and practitioners are increasingly engaging with the Sustainable Development Goals (SDGs),[20] with stunting being identified as a target for elimination by 2030 under Goal 2: End Hunger.[21] However, limited research examined the intersection of stunting with accounting, budgetary data, and data visualization in Indonesia, particularly in South Kalimantan, a mineral-rich province.

This study aimed to analyze disparities in stunting prevalence across cities, mining districts, and non-mining districts in South Kalimantan Province. The findings are expected to provide policymakers with valuable insights into the stunting issue. This study introduced a novel perspective by highlighting the paradox of stunting in resource-rich regions, examining its intersection with budgeting and public sector accounting, and presenting findings through carefully designed data visualization.

Method

This study used a quantitative descriptive research design, utilizing secondary data analysis. Exploratory data visualization techniques in R were employed to analyze categorical disparities in stunting prevalence across various regions in South Kalimantan. This study was conducted between April and December 2024. South Kalimantan is not only the smallest province on Kalimantan Island,[22] but also one of the largest coal producers in Indonesia,[10] making it a region of particular interest due to its unique socioeconomic profile.

South Kalimantan Province comprises 13 regions, which were categorized into three groups based on regional characteristics: cities, mining districts, and non-mining districts. Banjarbaru and Banjarmasin were classified as cities. The mining districts included Kotabaru, Tanah Bumbu, Tanah Laut, Banjar, Tapin, Hulu Sungai Selatan, Balangan, and Tabalong. The remaining districts (Barito Kuala, Hulu Sungai Tengah, and Hulu Sungai Utara) were categorized as non-

mining districts. Therefore, the main research variable was the stunting prevalence, which was analyzed across the three regional categories, including cities, mining districts, and non-mining districts.

Data were obtained from open sources, specifically the official websites of the South Kalimantan Provincial Government (https://data.kalselprov.go.id/dataset/data/1334)[23] and the Indonesian Ministry of Health (https://layanandata.kemkes.go.id/katalog-data/).[24] Data on stunting prevalence from 2015–2018 were obtained from the South Kalimantan Provincial Government, whereas data from 2019–2023 were retrieved from the Indonesian Ministry of Health. The complete dataset was not available from a single source. Therefore, compiling information from both sources was necessary. Data for 2020 were unavailable because the survey could not be conducted due to the COVID-19 pandemic. The research methods are shown in Figure 1.

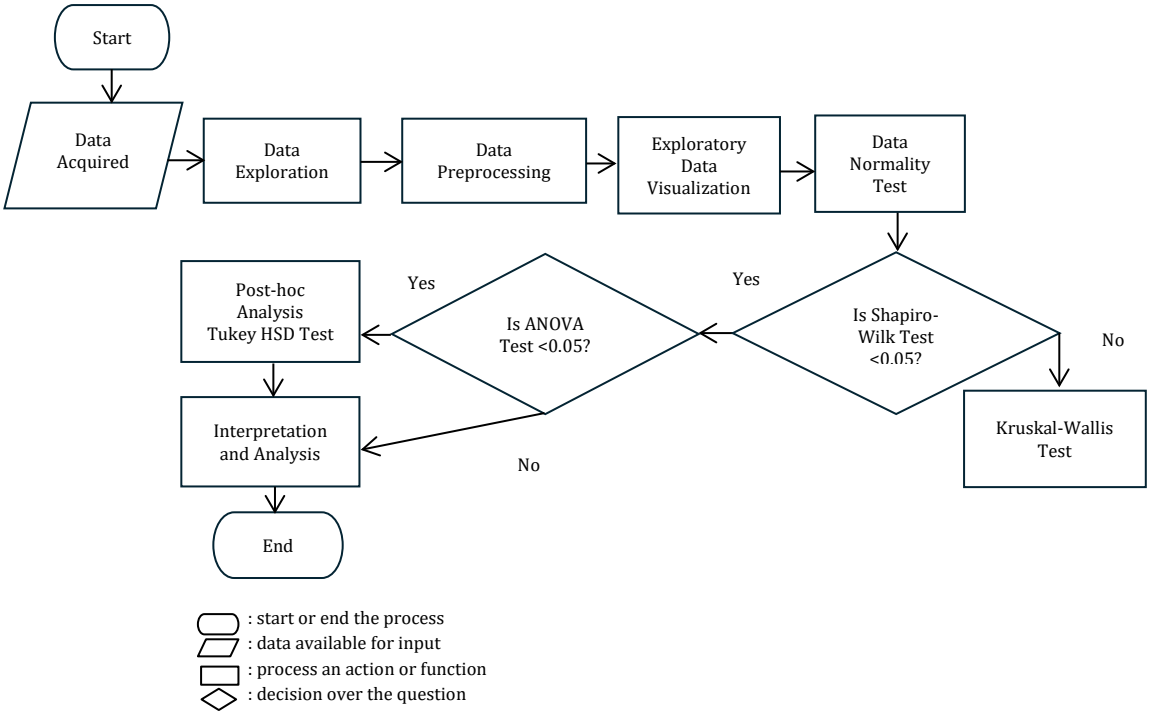

Figure 1. Research Method Diagram

A structured, data-driven approach was adopted, beginning with the collection of secondary data from the South Kalimantan Provincial Government and the Indonesian Ministry of Health. The dataset was explored to assess its completeness and consistency, followed by preprocessing to ensure its analytical readiness. Exploratory data visualization was conducted using R Programming, which helped identify patterns and disparities in stunting prevalence across the three regional categories. These preliminary visual insights informed the selection of appropriate statistical tests.

Several visualization techniques from the ggplot2 package in R were used.[25] The geom_line() function was used to illustrate the temporal trends in stunting prevalence for each district. The facet_wrap() function was used to generate individual panels for each regional category to facilitate subgroup comparisons. Additionally, the geom_boxplot() function was used to summarize the distribution of stunting prevalence, showing medians, variability, and outliers. These plots enhanced the understanding of group-level differences.

Data normality was assessed using the Shapiro–Wilk test to determine the correct statistical test.[26] For normally distributed (p-value ≥ 0.05), a one-way analysis of variance (ANOVA) was performed to test for significant differences among the three groups. When ANOVA results were significant (p-value <0.05), a Tukey's honestly significant difference (HSD) test was performed to identify specific pairwise differences. The Kruskal–Wallis test was used as a non-parametric alternative for non-normally distributed data.[26] The final interpretation was based on statistical outcomes and visual analyses.

R programming was selected due to its open-source nature and extensive functionality for statistical analysis and data visualization.[27] Particularly, the ggplot2 package offers a wide range of geometric objects (geoms) and plotting tools, such as geom_line(), facet_wrap(), and geom_boxplot(), which are well-suited for the visualization of complex datasets.[25]

Results

Geom_line() function was used to visualize the data, the resulting plot appeared visually cluttered, resembling tangled threads. This complexity made it difficult to extract a clear interpretation of the stunting trends across regions (Figure 2, upper panel). The data were then visualized using the facet_wrap() function. Before the 13 regions were grouped into three categories (cities, mining districts, and non-mining districts), each was assigned a distinct color to enhance visual differentiation. This method allowed for a clearer and more interpretable visualization than the previous line plot, thereby facilitating comparison of stunting prevalence both by individual district and across the three regional categories. The results effectively "untangled" the complex visual patterns seen earlier. As shown in Figure 2 (lower panel), cities (represented in purple) had the lowest stunting prevalence compared with mining districts (green) and non-mining districts (yellow).

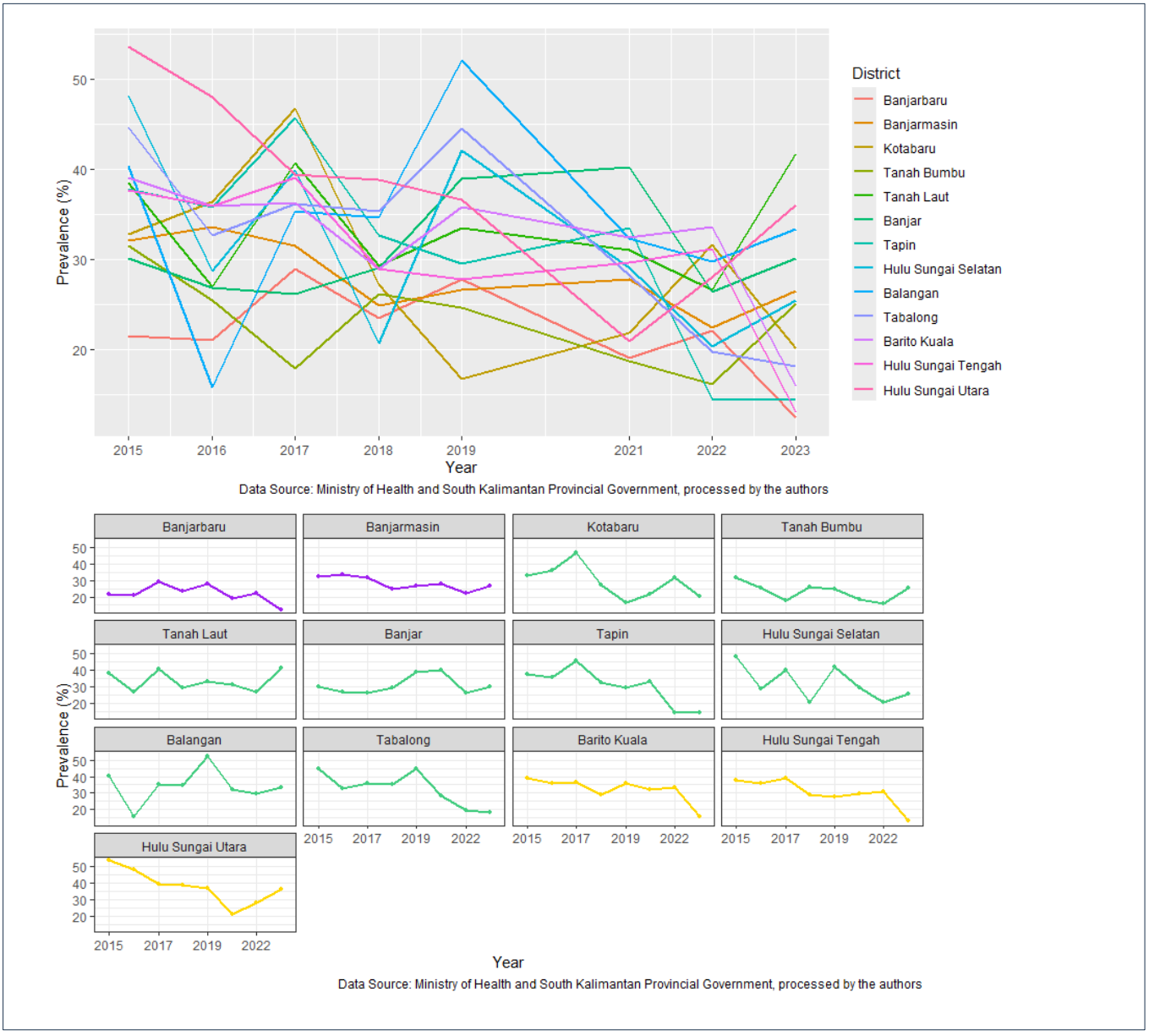

Figure 2. Exploring South Kalimantan Province Stunting Data Visualization Using geom_line() and facet_wrap() Functions

The next stage of data exploration was performed using the geom_boxplot() function to generate informative visualizations of stunting prevalence within each regional category. This method provided a clear summary of the data distribution, variability, and central tendency, highlighting the median values for each year across the three categories. The boxplots enabled a more structured comparison of stunting trends over time, providing valuable insight into disparities across the three categorical regions, as shown in Figure 3.

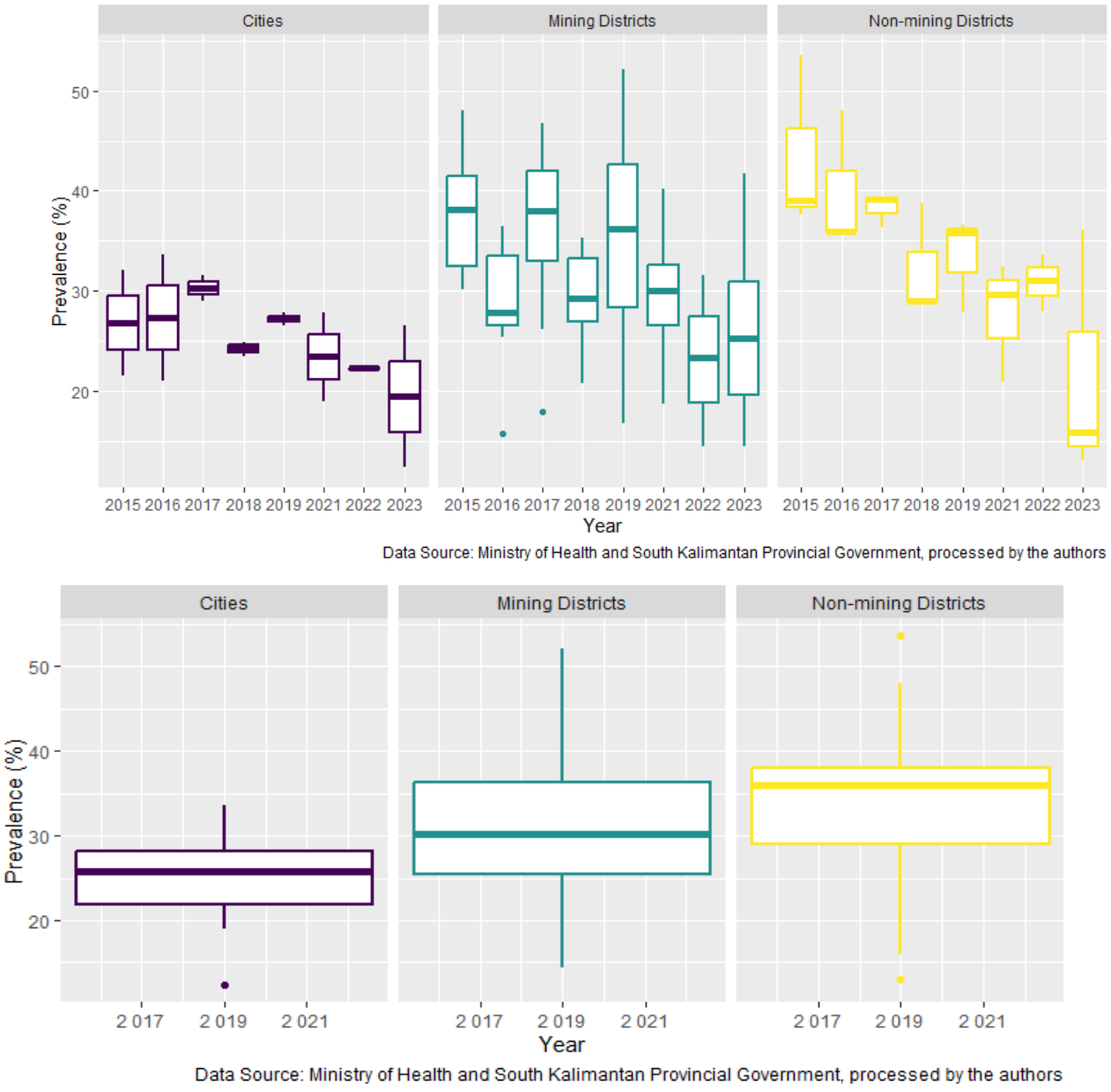

Figure 3. Comparison of Stunting Prevalence in South Kalimantan Province Among Cities, Mining Districts, and Non-Mining Districts

R programming enabled the integration of multiple box plots within each regional category into a single comparative visualization, effectively representing the three regional categories. This allowed easy observation and comparison of the median stunting prevalence across cities, mining districts, and non-mining districts, as illustrated in Figure 3 (lower panel). This study was initially intended to conclude at this stage, as the primary focus was on data visualization. Although the visual output revealed noticeable differences in the median stunting prevalence among the three categories, it was unclear whether these differences were statistically significant.

A one-way ANOVA test was performed to statistically examine whether the observed differences among the three groups were significant. The results of the Shapiro–Wilk test (p-value >0.05) confirmed that the data were normally distributed, validating the assumption required for ANOVA. The one-way ANOVA test revealed statistically significant differences in stunting prevalence among the three regional categories, with a p-value of <0.05.

Considering the ANOVA test results, which indicated statistically significant differences in stunting prevalence among the three regional categories, the data were analyzed with Tukey's HSD test to obtain more detailed pairwise comparisons. The results of the analysis showed that the difference in stunting prevalence between cities and mining districts was not statistically significant (p-value >0.05). However, the difference between cities and non-mining districts was statistically significant (p-value <0.05). Interestingly, the difference in stunting prevalence between non-mining and

mining districts was not statistically significant (p-value >0.05) as shown in Table 2. These findings indicated that, despite their differing resource profiles, mining and non-mining districts exhibited similar stunting prevalence.

Table 2. Tukey's Honestly Significant Difference Test Result

Term	Comparison	null. value	Mean Difference	Lower CI	Upper CI	p-value
Category	Mining Districts vs Cities	0	5.614375	-0.02763344	11.256383	>0.05
Category	Non-Mining Districts vs Cities	0	8.322292	1.80746149	14.837122	<0.05
Category	Non-Mining Districts vs Mining Districts	0	2.707917	-2.12361070	7.539444	>0.05

Notes: null.value = 0 (no difference in means between categories); CI = confidence interval

Furthermore, this study explored the data visualization of the ANOVA and Tukey's HSD tests by incorporating the mean stunting prevalence for each category, which was represented by red rhombus symbols (Figure 4). This enhanced visualization facilitated the observation and comparison of the distribution of values within each group, thereby clarifying the statistically insignificant difference in stunting prevalence between mining and non-mining districts.

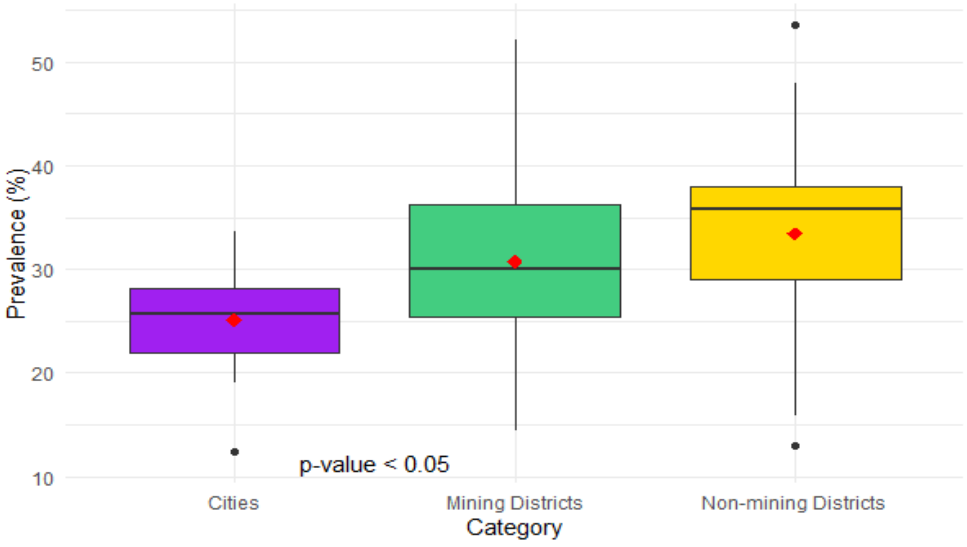

Figure 4. Further ANOVA Visualization Displaying Both the Median and Mean of Stunting Prevalence

Discussion

From a data visualization perspective, R programming proved to be highly effective in untangling complex patterns in stunting prevalence across districts. The use of the facet_wrap() and geom_boxplot() functions in the ggplot2 package allowed for a clearer interpretation of trends, particularly for non-technical stakeholders. Well-crafted visuals are effective tools for communicating scientific findings to a broader audience, including policymakers and the general public.[28] Additionally, by categorizing districts into cities, mining districts, and non-mining districts, and color-coding them accordingly, the visualization strategy helped reveal disparities that might otherwise remain obscured.

Given that non-mining districts generally had more limited financial and infrastructural resources to effectively address stunting, the statistically significant difference in stunting prevalence between cities and non-mining districts was not surprising. However, the absence of a significant difference between cities and mining districts was noteworthy. Cities typically offer greater access to healthcare, education, clean water, and social protection programs, which are well-established determinants of child nutrition and development.[2] Banjarmasin City, which is expected to be an exemplary model of stunting reduction due to its advanced health facilities and educational institutions, has not been able to leverage these advantages and its stunting prevalence effectively has consistently remained above the national average over the past 3 years.[11,13,14]

Surprisingly, the absence of a significant difference in stunting prevalence between mining and non-mining districts, despite the former's economic advantage, presented a paradox that warrants further investigation. This condition indicated that the mere presence of resource wealth did not automatically translate into better health outcomes, underscoring the need for further investigation into the allocation and use of resource-generated revenues in public health interventions. Peru's experience presents a successful example of stunting prevalence reduction.[27] The government implemented targeted

budget interventions through a conditional cash transfer program for families in rural areas, locally known as JUNTOS, with coverage reaching approximately 330 families per 10,000 rural population. This program provided financial assistance to families living below the poverty line, conditional on compliance with specific health and education requirements. The program contributed to a significant reduction in stunting rates by prioritizing vulnerable households, particularly those with children at risk of chronic malnutrition.[29]

The effectiveness of JUNTOS highlights the crucial role of well-designed social protection mechanisms in addressing childhood undernutrition in resource-limited settings.[9] The reduction in stunting prevalence in Peru from 31.3% in 2000 to 11.5 % in 2021,[30] due to its concerted public health and social protection policies.[31] In Indonesia, a similar policy called the Family Hope Program, a conditional cash transfer initiative, was launched in 2007. This program targets the poorest 20% of households nationwide, reaching approximately 10 million beneficiaries in 2020.[32] The cumulative impact of this program has been reported to contribute to a 23% reduction in stunting prevalence.[33] However, comparison of national data from the 2007 Indonesian Basic Health Research[34] and the 2021 Indonesian Nutritional Status Survey,[13] both conducted by the Ministry of Health, showed that the overall decline in national stunting prevalence was only 12.4%. This discrepancy indicates that reliance on the PKH program alone is insufficient. Therefore, complementary budget interventions through other financial schemes, such as regional mineral royalty transfers, village funds, and locally-generated revenue, are necessary for effectively addressing the persistent issue of stunting in Indonesia.

South Kalimantan Province, Indonesia's second-largest coal producer,[10] serves as a textbook example of the "resource curse," where wealth from natural resources fails to translate into improved public health outcomes, highlighting that effective governance and institutional capacity are necessary for better outcomes.[35,36] This argument is further supported by the insignificant difference in stunting prevalence between mining and non-mining districts in this study. Indonesia's fiscal transfer mechanisms, including the General Allocation Fund, Special Allocation Fund, Village Fund, and Revenue Sharing Fund, are intended to reduce disparities in development outcomes, including stunting.[6] However, these funds are not always effectively translated into actionable programs, particularly in regions with weak administrative capacity.[5,37] This study reinforced this viewpoint by demonstrating the disconnect between mining revenue and health outcomes in mining districts in South Kalimantan Province. Public sector accounting plays a vital role. The field increasingly intersects with efforts to meet the SDGs, particularly SDG 2: End Hunger.[20,21] Accounting mechanisms, such as performance-based budgeting and expenditure transparency, can improve the allocation of public resources.[3,38] However, in many Indonesian local governments, budget execution and accountability mechanisms remain weak, often serving elite interests rather than public welfare.[35,36,38]

This study's findings underscore the importance of applying data science in public health. R programming provides a robust and flexible platform for statistical analysis and visualization.[27] Despite its limited adoption in Indonesia, the increasing demand for data-driven decision-making makes R programming a valuable tool for researchers and government analysts. The integration of R programming into higher education, as implemented in other countries[39,40] can strengthen analytical capacity within the public sector and academia.

The strength of this study lies in its innovative use of R programming for data visualization and statistical analysis, which enabled a clearer understanding of the disparities in stunting prevalence across different regions in South Kalimantan Province. Combining visual analytics and inferential statistics provided policymakers with valuable, data-driven insights that are both accessible and actionable. However, this study had several limitations. This study relied solely on secondary data, which may vary in accuracy and consistency across sources and years. Additionally, the cross-sectional nature of this study may limit the ability to infer causality, and other important determinants of stunting, such as household income, maternal education, and sanitation access, which can influence the outcomes, were not considered in the analysis. Future studies should investigate the institutional and policy-level barriers that hinder the conversion of resource wealth into public health improvements. Additionally, comparative studies across other mineral-rich provinces may yield valuable insights into the development of more effective and context-sensitive strategies for stunting.

Conclusion

The economic benefits have not translated into meaningful reductions in stunting prevalence despite South Kalimantan's abundance of coal resources. Cities exhibit lower stunting prevalence compared to non-mining districts, with no significant difference observed between mining and non-mining districts. These findings indicate systemic challenges in converting resource wealth into effective public health investment. To address this, reforms in resource allocation and stronger budget accountability are needed to ensure revenues are directed toward targeted stunting reduction programs.

Abbreviations
SDGs: Sustainable Development Goals; ANOVA: analysis of variance; HSD: honestly significant difference.

Ethics Approval and Consent to Participate
Not applicable.

Competing Interest
The authors declare that they have no competing interests related to the research, authorship, and publication of this article.

Availability of Data and Materials
The authors state that the secondary data is available to anyone interested in this study.

Authors' Contribution
MH and MY initiated and conceptualized the study. MH, WN, and MN collected and curated the data. MH and MY performed data visualization and statistical analysis. WN, MH, MN, and MY interpreted the results. MH and MY finalized and edited the manuscript.

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Low Economic Level and the Risk of Overweight Among Indonesian Junior and Senior High School Students

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Abstract

Overweight and obesity among Indonesian adolescents have emerged as a pressing public health issue, reflecting global trends. This study examines the relationship between economic status and overweight prevalence among junior and senior high school students in Indonesia, using secondary data from the Global School-based Health Survey (GSHS). This study analyzed data from 9,977 students aged 11–18 years through a cross-sectional design and binary logistic regression, adjusting for dietary habits, physical activity, and sedentary behavior. Overall, 14.7% of students were overweight; the prevalence was notably higher among low-income students (27.4%) compared to high-income groups (14.2%). Students from lower economic backgrounds were 1.374 times more likely to be overweight (95% confidence Interval (CI): 1.011–1.867). Although many reported healthy behaviors, including regular fruit and vegetable consumption and participation in physical education, sedentary lifestyles and limited access to nutritious food remained significant challenges for low-income adolescents. These results highlight the complex interplay between economic status, health behaviors, and environmental factors, highlighting the need for targeted, equity-focused interventions to address disparities and curb obesity in Indonesia's youth.

Keywords: cross-sectional studies, health inequities, overweight, students

Introduction

The rising prevalence of overweight and obesity in Indonesia poses a major public health challenge, particularly in the context of the country's rapid nutritional transition. According to the Indonesian Basic Health Research, the proportion of overweight adults increased from 13.6% in 2007 to 21.8% in 2018.[1] A 2024 community-based assessment similarly revealed a high proportion of overweight or obese children, based on anthropometric indices, emphasizing the growing burden on the healthcare system.[1,2] Significant regional disparities have been reported, with provinces such as South Sumatra and Bengkulu exhibiting higher prevalence rates, suggesting the influence of localized socioeconomic and dietary factors. While these patterns are consistent with global trends, Indonesia faces unique challenges linked to rapid urbanization and shifting dietary habits.[3]

Urban areas, in particular, show elevated rates of overweight, driven by greater access to energy-dense foods and increasingly sedentary lifestyles compared with rural regions.[4,5] Dietary shifts, including increased consumption of fast foods and sugar-sweetened beverages, as well as other energy-dense, nutrient-poor items, combined with low physical activity levels, are among the primary contributors to this trend.[4] Adolescents, who experience heightened nutritional needs and lifestyle changes, face particular vulnerability. Urban adolescents, with greater exposure to unhealthy food choices outlets, are at heightened risk.[6] In rural areas, limited access to recreational facilities and the availability of inexpensive, calorie-rich foods also contribute to weight gain. Also, rural adolescents often spend long periods engaged in screen-based activities with minimal physical activity.[7–9] This pattern is exacerbated by the consumption of low-cost, nutrient-poor foods.[10]

The use of technology, including extended gaming and social media engagement, further reduces opportunities for physical activity, thereby compounding the risk of being overweight.[4,11–13] Socioeconomic status (SES) is a well-established determinant of adolescent obesity. Higher SES families may adopt dietary lifestyle patterns that increase

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body mass index,[12] while lower SES is associated with barriers to healthy eating and safe opportunities for exercise. A previous study indicated that economic status operates as a robust risk factor, with both extremes of the economic spectrum influencing overweight prevalence through distinct mechanisms.[2]

While several studies have explored the prevalence of overweight adolescents and risk factors in general,[4,5,12–15] few have examined the school-based adolescent population specifically. This study addresses that gap by focusing on junior and senior high school students in Indonesia using Global School-based Health Survey (GSHS) data to assess the relationship between economic status and overweight. Findings from this study provided further evidence that adolescents from lower socioeconomic backgrounds were also vulnerable to overnutrition-related health issues, underscoring the need for tailored prevention strategies.

Method

This cross-sectional study analyzed secondary data from the GSHS, conducted in Indonesia by the Ministry of Health in collaboration with the World Health Organization (WHO). The Indonesian GSHS was implemented from January to December 2015, with the dataset officially released on June 13, 2019. The GSHS was designed to assess behavioral risk factors contributing to adolescent health problems. Data were collected from 75 junior and senior high schools located across Sumatra, Java, Kalimantan, Nusa Tenggara, Sulawesi, Bali, Maluku, and Papua. However, the GSHS website does not specify how many of these schools were junior and senior high schools. The dataset was analyzed by the author in Samarinda City, Indonesia, in 2025 for this study.

Although not recent, the dataset remains the most current nationally representative source for Indonesia, including comprehensive indicators related to adolescent overweight. Its rigorous sampling design and standardized methodology enhance both validity and generalizability, making it a reliable baseline for understanding adolescent health behaviors at the time of collection. Consequently, this study served as a key reference point for future research, particularly until recent datasets became available.

Secondary data analysis, particularly when using large-scale datasets such as the GSHS, requires careful methodological consideration before inferring causality. Researchers must first examine the dataset's scope, design, and available variables, while also accounting for potential confounders, mediators, and moderators. The use of a theoretical framework grounded in existing literature is essential for developing hypotheses about causal mechanisms. Additionally, given the reliance on self-report data, cultural norms specific to Indonesia (across all surveyed provinces) were taken into consideration during interpretation to enhance contextual relevance and minimize bias.

Data were collected via a self-administered, anonymized questionnaire using a standardized two-stage cluster sampling method at both the school and classroom levels. Previous validation studies have confirmed that the GSHS instrument demonstrates acceptable reliability and validity. The original sample included 11,142 students aged 11–18 years. After excluding 1,809 cases due to missing data, the final analytic sample consisted of 9,977 students, comprising 7,113 from junior high school and 2,864 from senior high school. The dataset is publicly accessible at: https://extranet.who.int/ncdsmicrodata/index.php/catalog/489. While self-reported data may be subject to bias, the Indonesian GSHS achieved a high response rate of 94%, which strengthens the robustness of the findings.

The Indonesian GSHS was administered during school hours. As participants were minors, written informed consent was obtained from their parents or legal guardians prior to data collection, and assent was also obtained from the students themselves. The survey was conducted anonymously and adhered to ethical standards, with approval from the Indonesian Ministry of Health, WHO, and the U.S. Centers for Disease Control and Prevention (CDC). All questions were administered in Indonesian. A two-step cluster sampling method was used. In the first stage, schools were randomly selected based on enrollment size. In the second stage, classes within these schools were randomly chosen. All students in the selected classes (grades 7–12) were eligible to participate, except those who were absent due to illness or other reasons.

Study variables were measured using items from the GSHS questionnaire. The primary variable under investigation was overweight status, determined based on the item "Percentage of students who were overweight (>+1 SD from the median body mass index [BMI] for age and sex)." Responses were categorized as Yes (coded 0) and No (coded 1). Sex, and the responses coded as male (0) or female (1), school grade, and the responses coded as junior high school (0) or senior high school (1), economic status, assessed through the question of "Percentage of students who most of the time or always went hungry every day because there was not enough food in their home during the 30 days before the survey." Responses coded as Yes (low economic status = 0) and No (high economic status = 1;

reference category).

Fruit consumption was assessed with the question of "Percentage of students who did not eat fruit during the 30 days before the survey." Responses coded as No (0) and Yes (1). Vegetable consumption was assessed with the question of "Percentage of students who did not eat vegetables during the 30 days before the survey." Responses coded as No (0) and Yes (1). Physical activity was assessed with the question of "Percentage of students who were not physically active for at least 60 minutes per day on any day during the 7 days before the survey." Responses coded as Yes (0) and No (1). Bicycling/walking to school was assessed with the question of "Percentage of students who did not walk or ride a bicycle to or from school during the 7 days before the survey." Responses coded as Yes (0) and No (1).

Physical education participation was assessed with the question of "Percentage of students who did not attend physical education classes each week during this school year." Responses coded as Yes (0) and No (1). Sedentary behavior was assessed with the question of "Percentage of students who spent three or more hours per day in sedentary activities (e.g., watching television, playing computer games, or talking with friends outside of schoolwork)." Responses coded as Yes (0) and No (1). Carbonated soft drinks consumption was assessed with the question of "Percentage of students who usually drank carbonated soft drinks three or more times per day during the 30 days before the survey." Responses coded as Yes (0) and No (1). Fast food consumption was assessed with the question of "Percentage of students who ate food from a fast-food restaurant three or more days during the 7 days before the survey." Responses coded as Yes (0) and No (1).

Univariate analysis was first conducted to describe the frequency of study variables, with results stratified by gender. Chi-square tests were then used for bivariate analysis. Subsequently, binary logistic regression with a 95% confidence Interval (CI) was employed to examine the association between economic status and overweight, adjusting for potential confounding variables. The multivariate analysis employed the backward elimination method, in which potential confounders were removed one at a time. A variable was retained if its exclusion changed the odds ratio (OR) of the main independent variable by more than 10%. This study adopted a significance threshold of 5% ($\alpha = 0.05$), equivalent to a 95% confidence level.

Results

Of the 9,977 students analyzed, 55.3% were female, and 71.3% attended junior high school. Most students (95.8%) reported a high economic level. Fruit consumption was high (90.5%), as was vegetable consumption (97.1%). Regarding physical activity, 68.2% of students reported being physically active, and 87.6% attended physical education classes regularly; however, only 39.5% cycled to school. Despite these healthy habits, 27.0% engaged in sedentary behavior, and 14.7% were classified as overweight. The prevalence of unhealthy dietary habits was relatively low, with 3.9% drinking carbonated soft drinks and 12.0% eating fast food frequently. Overall, the student population exhibited a generally healthy lifestyle, though sedentary behavior remained a notable concern.

As shown in Table 2, economic status was significantly associated with overweight prevalence. Among students from low economic backgrounds, 27.4% were overweight, compared with 14.2% among those from high economic backgrounds. Students from low economic status were 1.37 times more likely to be overweight (95% CI: 1.011–1.867). Based on the bivariate analysis results in Table 2, the researcher conducted a multivariate analysis using binary logistic regression, including variables with a p-value <0.25. The final multivariate model is presented in Table 3.

Table 1. Descriptive Characteristics of Respondents (N = 9,977)

Variable	n	%
Sex		
Male	4,455	44.7
Female (Reference)	5,522	55.3
School Grade		
Junior high school	7,113	71.3
Senior high school (Reference)	2,864	28.7
Economic Status		
Low	424	4.2
High (Reference)	9,553	95.8
Fruit Consumption		
No	948	9.5
Yes (Reference)	9,029	90.5
Vegetable Consumption		
No	292	2.9
Yes (Reference)	9,685	97.1
Physical Activity		
No	3,172	31.8
Yes (Reference)	6,805	68.2
Bicycling/Walking to School		
No	6,036	60.5
Yes (Reference)	3,941	39.5
Physical Education Participation		
No	1,238	12.4
Yes (Reference)	8,739	87.6
Sedentary Behavior		
Yes	2,695	27.0
No (Reference)	7,282	73.0
Overweight		
Yes	1,464	14.7
No (Reference)	8,513	85.3
Carbonated Soft Drinks Consumption		
Yes	392	3.9
No (Reference)	9,585	96.1
Fast food Consumption		
Yes	1,198	12.0
No (Reference)	8,779	88.0

Table 2. Bivariate Analysis of Risk Factors Associated with Overweight Among Indonesian Junior And Senior High School Students

Variable	p-value*	OR	95% CI	
Sex	0.317	0.94	0.844	1.056
School Grade	0.001	0.79	0.697	0.906
Economic Status	0.043	1.37	1.011	1.867
Fruit Consumption	0.377	1.09	0.897	1.331
Vegetable Consumption	0.995	1.01	0.716	1.400
Physical Activity	0.783	1.02	0.898	1.153
Bicycling/Walking to School	0.750	1.02	0.908	1.143
Physical Education Participation	0.364	1.09	0.91	1.295
Sedentary Behavior	0.001	0.76	0.672	0.861
Carbonated Soft Drinks Consumption	0.354	1.15	0.855	1.547
Fast Food Consumption	0.404	0.93	0.786	1.102

OR = Odds Ratio; CI = Confidence Interval; *significant level at 0.05

Table 3. Multivariate Analysis of the Association Between Economic Level and Overweight Among Indonesian Junior and Senior High School Students

Variable	β	p-value*	OR	95% CI	
School Grade	−0.227	0.001	0.79	0.701	0.906
Economic Status	0.316	0.043	1.37	1.010	1.862
Sedentary Behavior	−0.280	0.000	0.75	0.668	0.854
Constant	1.994	0.000	7.34		-

OR = Odds Ratio; CI = Confidence Interval; *Significant level set at 0.05

Table 3 shows that three variables were significantly associated with overweight among junior and senior high school students in Indonesia (p-value < 0.05). The model was developed using a backward elimination approach, retaining variables if their exclusion changed the OR of the main independent variable by >10%. The findings revealed a statistically significant association between economic status and overweight. Students from lower economic backgrounds were 1.37 times more likely to be overweight compared with their higher economic counterparts (95% CI: 1.010–1.862).

The logistic regression equation is as follows:

$$\log\frac{p}{1-p} = \beta 0 + \beta 1X1 + \beta 2X2 + \cdots + e$$

$$\log\frac{p}{1-p} = -1.200 + (0.316 \times \text{Economic Level}) - (0.227 \times \text{School Grade}) - (0.280 \times \text{Sedentary Habits})$$

Interpretation of Coefficients

- Economic level (+0.316): Students from lower economic backgrounds are more likely to be overweight.
- School grade (−0.227): Junior high school students are less likely to be overweight compared with senior high school students.
- Sedentary habits (−0.280): Students with sedentary habits show lower odds of being overweight, which is contrary to expectations and may require further investigation to rule out reverse coding or measurement bias.

Discussion

The association between low economic status and overweight or obesity among adolescents has been extensively documented in recent public health research. Adolescents from low-income families are consistently more likely to be overweight or obese, a trend observed across multiple studies and indicative of systemic issues requiring urgent attention. Low household income is not merely correlated with higher obesity rates; it is often a key determinant. For example, reported that adolescents in the lowest income quantile were 2.1 to 4.1 times more likely to be overweight or obese than those in higher income brackets.[14] This study's findings were supported by a previous study, which stated that higher household income correlates with better purchasing power and food affordability, thereby directly influencing dietary quality.[5]

Financial limitations often compel families to opt for cheaper, calorie-dense, nutrient-poor food, which contributes to increased body mass index (BMI) in children and adolescents.[15] Environmental factors further exacerbating this problem: low-income neighborhoods often lack access to healthy food outlets and safe recreational spaces. Children in such "obesogenic" environments face increased exposure to unhealthy dietary practices, amplifying obesity risk.[6,16,17]

Low household income is also associated with adverse childhood experiences, which have been linked to higher obesity risks in adolescence. The psychological effects of poverty also warrant consideration. Psychosocial stress associated with low SES can influence both food choices and physical activity patterns. Literature highlights that such stress perpetuates the obesity epidemic among youth, reinforcing the need for an integrated understanding of obesity's multifaceted determinants.[18] Public health interventions should therefore not only promote healthy diets but also address the broader socioeconomic and environmental barriers faced by low-income families.

In Indonesia, the link between low economic status and overweight or obesity among children and adolescents is an increasingly pressing public health issue. This challenge reflects a complex interplay of socioeconomic constraints, evolving dietary patterns, and cultural changes driven by economic growth and urbanization. Urbanization has expanded access to inexpensive but unhealthy, energy-dense foods. As Indonesia's economic sectors expand, children, including those from low-income households, are increasingly exposed to processed, calorie-rich foods, elevating obesity risk.[19,20] Parents in low-income quintiles often face food insecurity, which forces them to rely on cheaper, processed products instead of nutrient-rich alternatives, thereby fostering poor dietary patterns.[21,22]

Urban areas, in particular, often lack affordable and healthy food outlets, while rural areas, although still consuming more traditional foods such as tubers and fish, are gradually shifting toward processed foods due to improved road access and the spread of mobile food vendors.[23,24] Cultural and lifestyle changes further shape these trends. Many Indonesian children now spend a substantial amount of time on sedentary activities (e.g., watching videos, playing online games), a pattern linked to urban living conditions and changes in family dynamics. A previous study found that peer influence and the normalization of inactivity significantly contribute to the development of obesogenic behaviors.[8,25]

Physical inactivity, especially when combined with poor dietary habits, significantly increases the risk of overweight and obesity.[15,25] Psychosocial factors, including body image perceptions, also influence patterns of obesity. A previous study suggested that in higher-income Indonesian families, obesity correlates passively with perceived happiness, creating a cultural paradox in which excess weight is not universally seen as undesirable. This perception can conflict with public health messages about maintaining a healthy body weight, thereby complicating intervention strategies.[26]

Disparities in health literacy and education amplify the problem. Families with lower economic status often have less access to nutrition education and health-promoting resources. This knowledge gap hinders informed dietary

decision-making and limits participation in physical activities or organized sports.[27,28] Compared to their wealthier peers, low-income children are less likely to receive adequate nutrition guidance and have reduced access to safe recreational facilities.[2,29]

Emerging evidence suggested that junior high school students (aged 12–15 years) exhibit a higher prevalence of overweight and obesity compared with their senior high school counterparts (aged 16–18 years). This difference was likely due to a combination of behavioral and physiological factors. A previous study found that younger adolescents spend more time in unstructured sedentary activities, such as prolonged screen use (more than 5 hours/day), which is strongly associated with an elevated BMI.[30] In contrast, senior high students are more often engaged in regulated physical activities (e.g., organized sports, part-time employment) or academically focused sedentary behaviors (e.g., studying), which may offset obesity risk despite similar total sedentary hours.[30,31]

The counterintuitive observation that some sedentary behaviors may protect against obesity reflects important contextual nuances. A study reported that "purpose-driven" sedentary activities (e.g., reading, homework) are associated with lower obesity rates compared with passive screen time. One explanation is that cognitively engaging activities often reduce opportunities for unhealthy snacking and are more common among senior high students from higher socioeconomic backgrounds, which are associated with healthier dietary habits.[9] Additionally, senior high school students may experience puberty-related metabolic advantages, such as increased lean body mass and higher resting energy expenditure, that partially mitigate the effects of sedentary behavior.[31,32]

The GSHS offers several strengths. It draws from a large sample of students across multiple schools, enhancing representativeness and enabling international comparisons. However, certain limitations must be acknowledged. The cross-sectional design prevents conclusions about causality and effects. The sample includes only students who were in school at the time of the survey, excluding those who were absent or had dropped out—groups that may face greater health challenges. The data were self-reported, which may introduce recall bias or socially desirable responses, particularly on sensitive topics. Furthermore, the survey was conducted only in selected schools, limiting generalizability to all schools in Indonesia.

To address these limitations, future studies should consider including out-of-school youth, using clearer survey items, and complementing questionnaires with interviews or objective health measures. Longitudinal follow-up could help track over time. Collecting additional background information, such as family and community-level factors, would also offer a more comprehensive understanding of student health. Conducting a nationally representative survey would further strengthen the applicability of the findings to all Indonesian junior and senior high school students.

Conclusion

The findings confirm that students from lower socioeconomic backgrounds are significantly more likely to be overweight compared with their higher-income peers. These results highlight the need for public health strategies that address economic disparities to reduce overweight and obesity among Indonesian youth.

Abbreviations

SES: socioeconomic status; GSHS: Global School-based Health Survey; WHO: World Health Organization; OR: odds ratio; CI: confidence interval.

Ethics Approval and Consent to Participate

The Global School-based Student Health Survey (GSHS) in Indonesia received ethical approval from relevant national authorities, including the Ministry of Health of the Republic of Indonesia, as well as from collaborating international bodies such as the World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC). Standard ethical procedures were followed, including obtaining informed consent from students and guardians, ensuring voluntary participation, and maintaining respondent confidentiality and anonymity.

Competing Interest

The authors declare that they have no competing interests.

Availability of Data and Materials

The data used in this study are publicly available from the Global School-based Student Health Survey (GSHS) conducted in Indonesia. The dataset can be accessed via the WHO or U.S. CDC GSHS website at: https://extranet.who.int/ncdsmicrodata/index.php/catalog/489.

Authors' Contribution

AN contributed to the study conception and design, as well as data interpretation. PSN conducted the data analysis and assisted in drafting the manuscript. AY contributed to the literature review, managed data, and edited the manuscript. SS provided critical revisions, supervised the overall project, and ensured research integrity. All authors read and approved the final manuscript.

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Government Health Spending and Life Expectancy: Evidence from Cities and Districts in Indonesia

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Government Health Spending and Life Expectancy: Evidence from Cities and Districts in Indonesia

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Abstract

Life expectancy is widely recognized as a fundamental indicator of population health, and its improvement is often linked to government health spending, particularly in decentralized health systems. This study aimed to investigate the relationship between local government health expenditures and life expectancy in decentralized Indonesia. Data from 492 cities and districts, spanning from 2015 to 2019, were analyzed using a two-way fixed effects regression model to control for time-invariant district characteristics and common temporal shocks. The findings indicated that a 10% increase per capita in government health expenditure was associated with a 0.01% increase in life expectancy. This association was established after adjusting for key health system and contextual variables, including physician density, sanitation coverage, poverty rates, and proportion of fiscal transfers from the central government. The association remained strong and statistically significant across all model parameters. The results demonstrated that increased local health expenditure improves population health outcomes.

Keywords: fixed effects, health spending, life expectancy, panel data

Introduction

Life expectancy (LE) is a crucial metric for assessing the health status of a population, as it indicates the average lifespan projected based on current mortality rates.[1] Indeed, it is one of the fundamental global health impact indicators. It is a key measure used for facilitating temporal and geographical comparisons of population health as well as evaluating the effectiveness of health systems to enhance the overall quality of life and societal wellbeing.[1,2]

A wide range of social determinants of health contribute to variations in LE across populations. Key factors include demographic and socioeconomic variables, such as education level, per capita income, poverty rate, labor productivity, and dependency ratio.[3–6] For instance, poverty and dependency ratios have been linked to shorter LE.[4,5] In the low- and middle-income countries, barriers such as access to clean water, sanitation, and effective control of communicable diseases further hinder improvements in LE.[7] In addition, behavioral factors, including smoking, poor diet, and heavy alcohol intake,[6,8] exacerbate the risk of noncommunicable diseases, such as diabetes and obesity, which contribute to premature mortality.[7] Economic factors, including gross domestic product (GDP) per capita and income disparity, are also consistently identified as key determinants of LE across various settings.[6,7] Unemployment rates and economic inequality are determinants that affect the degree to which healthcare spending improves LE.[3] It is noteworthy that the use of renewable energy has helped people live longer.[9]

While social and environmental factors are critical, the health system remains the primary domain for intervention, particularly through investment in strengthening delivery, infrastructure, and human resources for health (HRH). An ecological study at the provincial level in Indonesia found that health physician density and healthcare facilities were positively associated with LE.[10] However, among the health system building blocks, health financing is a fundamental enabler, as it provides the means to sustain essential services, respond to health needs, and improve overall access and quality.[6,9,11] A link between health spending and economic growth has also been established, with some studies suggesting that LE and health expenditures influence each other.[12] Increased health investment improves LE through multiple channels, including better disease prevention, improved access to curative services, enhanced maternal and child health programs, and stronger health infrastructure.[6,9,13]

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While investment in healthcare plays a significant role in improving LE, especially in public health,[14] the level of effectiveness varies considerably among nations. Considering the Organization for Economic Cooperation and Development (OECD) countries, a 1% increase in health expenditure is associated with a 0.02% increase in LE in the United States and a 0.12% increase in Germany, with healthcare spending being more effective in extending male LE than female LE.[15] Another study found that the elasticity was 0.006 in low and middle-income countries and 0.0009 in high-income countries.[16] Increased investment in healthcare is expected to directly and indirectly elevate LE by enhancing nutrition, controlling communicable and noncommunicable diseases, and increasing access to vital healthcare services (e.g., immunization and maternal care).

However, the relationship between health spending and LE is not always straightforward. While a study suggests that investment in healthcare can enhance LE,[17] others argue that expenditures on social protection may have a more significant influence.[8,9,12] Public health expenditure appears to have a more pronounced effect on LE compared to private health spending. However, this effect diminishes when public health spending exceeds 8% of the GDP and also varies across countries.[14]

The above global studies have expanded the understanding of the factors influencing LE worldwide. However, comprehensive empirical studies focusing on the Indonesian context remain limited, especially at the subnational level, where the decentralization of the health sector has placed substantial responsibilities on city and district governments. This study provided empirical evidence by utilizing city and district panel data to investigate the impact of local government health spending on LE. These findings will contribute to the global discourse on health financing in decentralized settings, highlighting the effectiveness of fiscal interventions at the subnational level in improving public health outcomes.

Only a few empirical studies have investigated how health spending affects LE in Indonesia at the city or district levels. Most studies on Indonesia typically analyze data at the provincial level. In contrast, studies focusing on cities or districts are usually limited to one or a few provinces, rather than covering the entire country.[10,18,19] By addressing this gap, this study enhanced the understanding of how local health spending relates to population health and laid the groundwork for the future assessment of spending efficiency to inform the optimal allocation of limited health resources.

Given this background, this study aimed to (a) provide evidence on health spending and LE in Indonesia at the city and district level nationwide, taking into account contextual factors, and (b) generate empirical evidence that can inform policy recommendations for improving population health outcomes in Indonesia. This study enhances the understanding of how local health expenditure relates to population health and lays the groundwork for future assessments of spending efficiency to inform the optimal allocation of scarce health resources. This study furnished substantial empirical evidence about the correlation between local government health expenditure and life expectancy at the subnational level in Indonesia. The findings were expected to help policymakers allocate health resources more effectively to improve population health outcomes. This study also intended to add to the scholarly conversation about decentralized health financing by providing information that could be useful for other countries with comparable systems of government.

Method

This study used a panel data regression model to examine the effect of government health spending on LE across cities and districts in Indonesia from 2015 to 2019. The two-way fixed effects (TWFE) specification was selected to monitor temporal and interdistrict variations. After excluding cities and districts with missing values for key variables for more than two consecutive years, the final dataset consisted of 2,460 observations, representing 492 cities and districts each year. The study period was chosen to reflect the time after the implementation of the National Health Insurance scheme, when the health financing reform took place, and to exclude the confounding effects of the coronavirus disease 2019 (COVID-19) pandemic, which started impacting Indonesia in early 2020.

This study used data obtained from multiple official databases. The LE and poverty headcount index were obtained from Statistics Indonesia. The LE data were produced by Statistics Indonesia using indirect demographic methods to get the data at the district level. The number of physicians was sourced from the Indonesian Ministry of Health, data on health expenditures from the regional government budget reports accessed from the Indonesian Ministry of Finance website, and household sanitation access from the INDO-DAPOER World Bank database. Fiscal data, including health spending, were sourced from audited government financial reports; however, the quality of reporting may vary across districts due to differences in administrative capacity. These characteristics were taken into consideration in model design and interpretation.

The initial variable selection was achieved by combining theoretical and empirical evidence from existing studies and subsequently applying a correlation test to the independent variables. Before model generation, the variance inflation factor (VIF) and condition index (CI) tests, along with the variance decomposition proportion, were used to assess multicollinearity between variables.[20] The VIF values were below 5, and the maximum CI was 7.38, which was significantly lower than the standard criterion of 30. This indicated that the independent variables exhibited minimal multicollinearity. Furthermore, three prevalent methods were applied to determine the appropriate panel regression model: pooled ordinary least squares (pooled OLS), random effects (RE), and fixed effects (FE).[21]

Both theoretical frameworks and empirical diagnostic assessments were employed to inform model selection. Initially, the authors employed the Breusch–Pagan Lagrange Multiplier test to determine whether the pooled OLS model outperformed the RE panel model. The results indicated strong panel effects (p-value <0.05), suggesting that the panel estimator was the optimal selection. Subsequently, the Hausman test was used to determine the appropriate model between the FE and RE models. While the null hypothesis posited that the RE estimator was consistent and efficient, the alternative hypothesis posited that the RE estimator was inconsistent because of the correlation between unobserved individual effects and regressors. The Hausman test results indicated that the FE model was more suitable in this context (p-value <0.05).

To ensure the robustness of the FE estimates, the authors conducted diagnostic tests for heteroskedasticity and serial correlation using the modified Wald test for groupwise heteroskedasticity in the FE model and the Wooldridge test for serial correlation.[22] Both tests confirmed the presence of serial correlation (p-value <0.05) and heteroskedasticity (p-value <0.05). Accordingly, the final model applied TWFE with standard errors clustered at the district level (Model 6), which corrected for both heteroskedasticity and autocorrelation within the panels. The year (time dummies) was used to control for unobserved shocks or policy changes over time that impact all districts. The final model specifications were as follows:

$$ln(LE)_{it} = \beta_0 + \beta_1 ln(PHE_{it}) + \beta_2' ln(X_{it}) + \alpha_i + \tau_t + \varepsilon_{it}, \qquad (1)$$

$ln(LE)_{it}$ is the LE in district i at time t, and $ln(PHE_{it})$ refers to the per capita health spending by the government. X_{it} pertains to control variables, including the ratio of physicians to population (*lnDOC*), access to sanitation (*lnSANIT*), poverty rate (*lnPOVERT*), and proportion of fiscal transfer to total district government spending (*lnTRANSFER*). In this equation, τ_t denotes the year-specific effects, α_i signifies the district-specific effects, and ε_{it} represents the error term. This method enabled the evaluation of the impact of government health spending on LE within districts while accounting for both observable and unobservable variations between districts and over time. All data management and analysis in this study were conducted using STATA 18 (licensed under Universitas Indonesia).

Results

Table 1 presents key descriptive statistics for the main variables used in the analysis, specifically LE and health spending by city and district governments. The average LE at the city and district level during the 2015–2019 period was 69.1 years, with a standard deviation (SD) of 3.45 years. Nevertheless, there remain cities and districts with a lower LE of 55.5 years.

Table 1. Descriptive Statistics of Key Variables Across Cities and Districts in Indonesia, 2015–2019

Variable	Observation	Mean	SD	Min	Max	Description
Life expectancy (years)	2,460	69.11	3.45	55.50	77.55	Main outcome variable
Per capita government health spending (USD100*)	2,460	7.39 (0.52)	5.66 (0.40)	1.15 (0.08)	57.97 (4.07)	District government spending
Doctors per 10,000 population[23]	2,460	4.60	6.58	0.04	67.20	Human resources for health
Proportion of improved sanitation (%)	2,460	74.66	14.40	3.84	99.11	Basic service
Poverty rate (%)	2,460	12.38	7.41	1.67	45.74	Economic context
TKDD share in Regional Budget realization (%)	2,460	79.49	12.86	11.15	146.25	Fiscal transfer dependency

Notes: TKDD = *Transfer ke Daerah dan Dana Desa* (transfer to regions and village funds), SD = standard deviation.
*based on Bank of Indonesia average exchange rate in 2019 (1USD=IDR14,127), available from https://www.bi.go.id/id/statistik/informasi-kurs/transaksi-bi/Default.aspx

On average, city and district governments spend USD 52.00 per capita annually for health, with substantial variations ranging from USD 809 to USD 407.75. This variation reflected significant disparities in fiscal health capacity across cities and districts. The average number of doctors per 10,000 population[23] was 4.6 in terms of the availability of HRH. The average proportion of transfer to regions and village funds/*Transfer ke Daerah dan Dana Desa*, which reached 79.49% of provincial budget realization, indicated a high level of fiscal dependence on the central government. This proportion even reached a maximum of 146.25%, indicating that the value of transfers received in some regions exceeded the total provincial budget expenditure recorded from 2015 to 2019 (for instance, due to low budget execution). These results reflected an extreme dependence on central transfers, both due to limited local revenue capacity and disproportionate central allocation schemes.

The socioeconomic context variable indicated that an average of 12.38% of the population lived in poverty. This condition illustrated that social vulnerability remained high. Concurrently, 74.66% of the population had access to proper sanitation facilities, which also affected the achievement of overall health indicators. These findings suggested that environmental and social determinants remain critical barriers to achieving improvements in public health.

Table 2. Regression Results

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	RE	FE	FE-Robust-Cluster	RE	FE	FE-Robust-Cluster
lnPHE	0.006***	0.007***	0.007***	0.001*	0.001***	0.001***
	(<0.001)	(<0.001)	(0.001)	(<0.001)	(<0.001)	(<0.001)
lnDOC	0.005***	0.005***	0.005***	0.002***	0.001***	0.001**
	(<0.001)	(<0.001)	(0.001)	(<0.001)	(<0.001)	(<0.001)
lnSANIT	0.013***	0.012***	0.012***	0.006***	0.006***	0.006***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
lnPOVERT	-0.017***	-0.014***	-0.014***	0.002**	0.007***	0.007***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
lnTRANSFER	0.003***	0.004***	0.004***	0.000	0.001*	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	4.186***	4.190***	4.190***	4.236***	4.245***	4.245***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
Observations	2,460	2,460	2,460	2,460	2,460	2,460
R-squared		0.646	0.646		0.813	0.813
Number of cities and districts	492	492	492	492	492	492
Wald chi^2	3416.786			7223.156		
F-stat		717.177	270.815		946.956	312.218
Time effect	No	No	No	Yes	TWFE	TWFE

Notes: RE = random effect, FE = fixed effect; lnPHE = government's per capita health spending, lnDOC = doctors to population ratio, lnSANIT = access to sanitation; lnPOVERT = poverty rate, lnTRANSFER = proportion of transfer to regions and village funds to total district government spending, TWFE = two-way fixed effect.
Standard errors are in parentheses.
***p-value <0.01, **p-value <0.05, *p-value <0.1

Table 2 presents the regression results in various models. The TWFE model with clustered robust standard errors (Model 6) confirms that LE was positively associated with increased local government health spending, with an elasticity of 0.001. Specifically, a 10% increase in per capita health spending was associated with a 0.01% increase in LE. This relationship remained statistically significant even after controlling for both time-invariant district characteristics and time-varying national trends. The high R-squared value (0.813) indicated that the model explained a substantial proportion of LE variation within cities and districts across the study period. In this study, higher doctor density and greater household access to sanitation were positively associated with higher LE. In preliminary models (models 1 to 3), poverty rates were initially linked to higher LE, but this association shifted in direction after adjusting for time.

Discussion

This study contributed to the growing body of literature by highlighting the persistent disparities in LE across cities and districts in Indonesia, ranging from 55.50 years to 77.55 years. The findings indicated that some regions were lagging

in achieving basic health indicators, which could be attributed to differences in access, quality of services, and other social determinants. The doctor-to-patient ratio met the national requirements (the Indonesian Ministry of Health Regulation No. 75 of 2014)[24] but not the World Health Organization standard (1 doctor per 1,000 or 10 doctors per 10,000).[23] The socioeconomic context further indicated that social vulnerability remained significantly high, as reflected by the poverty rate. The presence of cities and districts with persistently low access to basic sanitation services during the study period (2015–2019) indicated that inequality in access to fundamental life-supporting services remained a critical issue. Overall, these findings indicated that the essential infrastructure for supporting healthy living was not equitably distributed across cities and districts in Indonesia.

The analysis also showed that health spending had a positive effect on LE. These results were consistent with prior empirical evidence at both national and subnational levels, including studies conducted in various regions such as South Africa,[25] South Asia,[26] OECD countries,[6] the Aral Sea Basin,[27] Brazil,[28] Pakistan (using time series analysis),[29] and Kepulauan Riau Province, Indonesia.[30] For instance, in the South African context, LE at the subnational level was more influenced by regional poverty levels in some areas.[31]

The empirical results from this study provided robust evidence that local government health spending had a positive impact on population health outcomes. This positive and statistically significant association remained consistent across all model specifications, including the final model (TWFE with clustered robust standard errors or model 6), which controlled for both time-invariant city and district characteristics and common time shocks. The lower coefficient of health spending after accounting for time effects suggested that nationwide trends, such as technological progress or macroeconomic changes, may have confounded earlier estimates.

This study also underscored the importance of accounting for both spatial and temporal heterogeneity in panel data analysis to avoid overstating the influence of health spending. Thus, this study provided a solid foundation for further studies into the efficiency of government health spending. Although the estimated elasticity coefficient appeared modest, its cumulative implications at scale remained policy relevant. The elastic analysis showed that a 10% increase in health spending per person was associated with a 0.01% increase in LE. Despite the modest elasticity, the policy implications were substantial when scaled to the population level. The elasticity is higher than the estimate for low-income countries (0.006) obtained using cross-country simple regression.[16] The stable relationship across model specifications suggested that increasing government health expenditure remains an effective pathway to improving population health outcomes.

Higher physician density was associated with higher LE, a finding consistent with those of other studies.[32,33] Similarly, improved sanitation coverage was linked to higher LE, highlighting the critical role of healthcare infrastructure and basic public health services.[34,35] Using FE model specification, poverty remained a negative determinant, showing persistent socioeconomic disparities in health outcomes across districts.[5,35–37] The change in the correlation between poverty rate and LE after accounting for time effects might reflect the overall decline in poverty levels across Indonesian districts during the study period. The inclusion of year effects was likely to account for this temporal trend, which reflected nationwide improvements in socioeconomic conditions. Omitting the poverty rate from the TWFE model did not materially alter the elasticity of health spending with respect to this variable. Over time, a steady increase in health spending might yield greater improvements in the overall health of cities and districts' populations, especially when complemented by interventions that address other social determinants of health.

Although this study employed robust statistical techniques, it was subject to limitations in data quality. First, LE data at the city and district levels in Indonesia were based on modeled estimates conducted by Statistics Indonesia, rather than from direct vital registration. This could result in measurement bias, particularly at the subnational level, such as cities and districts. Second, financial reporting inconsistencies between cities and districts could affect the precision of expenditure data. Although the application of FE and clustered robust standard errors mitigated some concerns by controlling for time-invariant heterogeneity and intra-district correlation, the study design was still observational. Future research can address endogeneity problems by employing dynamic panel models, instrumental variable approaches, or quasi-experimental designs to strengthen causal inference and better understand the mechanisms linking district-level health spending to population health outcomes. Collectively, these findings suggested that increased government spending on healthcare at the city and district levels was associated with longer life expectancy in Indonesia. Consistent results across different model specifications supported the modest estimated elasticity, demonstrating the reliability of this positive relationship.

Conclusion

This study confirms that the health spending of city and district governments significantly influences LE in Indonesia's decentralized setting. It highlights the importance of integrating health system components, such as physician density, sanitation coverage, poverty, and the proportion of transfer to regions and village funds. The findings of this study advance the field by providing empirical evidence that strengthens the rationale for improving subnational health financing. It establishes a foundation for future studies to employ dynamic models that capture long-term effects of health spending on population health and health spending efficiency. Given the modest yet significant effect of health spending on LE, policymakers should monitor the efficiency of local government health spending. This is crucial for monitoring resource allocation decisions, ensuring effectiveness, and reducing regional disparities in health outcomes by considering various factors within the health system and social determinants of health.

Abbreviations

LE: Life expectancy; GDP: Gross domestic product; HRH: Human resources for health; OECD: Organization for Economic Cooperation and Development; TWFE: Two-way fixed effects; VIF: Variance inflation factor; CI: Condition index; Pooled OLS: Pooled ordinary least squares; RE: Random effect; FE: Fixed effect; SD: standard deviation.

Ethics Approval and Consent to Participate

This study was granted ethical clearance from the Research Ethics Commission of the Faculty of Public Health Universitas Indonesia (Approval No. 8/UN2.F10.D11/PPM.00.02/2023).

Competing Interest

Authors declare that there are no competing financial or personal interests that might have affected the performance of the work described in this manuscript.

Availability of Data and Materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Authors' Contribution

KS and BH were involved in the design of the study; KS conducted the data analysis, wrote, and revised the manuscript. BH, ACS, and MN reviewed the manuscript.

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Assessment of the Dietary Supplements Effects on Maternal Underweight in Nigeria

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Assessment of the Dietary Supplements Effects on Maternal Underweight in Nigeria

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Abstract

Maternal underweight continues to rise and, if not properly managed, will lead to increased mortality. This contradicts the United Nations Sustainable Development Goal of reducing maternal mortality by 2050. Therefore, this study aimed to determine the probable effect of dietary supplements on maternal underweight in Nigeria. This study employed probit estimation using the maximum likelihood technique in 2022, with the 2018 Nigeria Demographic Health Survey data as the basis for analysis. The results showed a statistically significant effect of dietary supplements on maternal underweight in Nigeria. The likelihood of dietary supplements impacting maternal underweight was approximately 0.4% lower, on average, for mothers who took dietary supplements compared to those who took non-dietary supplements. That is, maternal underweight could be reduced significantly if mothers were consuming the required dietary supplements during their reproductive ages. This study concludes that the head of household age, wealth index, and mothers' education level are likely to reduce maternal underweight. In contrast, household size is unlikely to have this effect when mothers take dietary supplements, with a very strong effect.

Keywords: dietary supplement, maternal underweight, probit model

Introduction

Dietary supplements are oral dietary ingredients such as iron, folic acid, and vitamins formulated in capsules, syrups and tablets, components and other domestic diets that are edible to improve one's dietary deficiencies according to the United States Food and Drug Administration, under the Dietary Supplement Health and Education Act of 1994.[1] The need for dietary supplements would not be undermined during pregnancy to support changes in maternal tissue, metabolism, and global fetal growth and development. Moreover, every pregnant woman needs an average increase in energy of about 300 kcal per day during pregnancy, as well as adequate protein, vitamins, and minerals such as iron, folic acid, and calcium for her healthy living.[2]

Dietary supplements are essential components of a balanced diet that should be accessible, safe, affordable, and sustainable, along with essential dietary services and positive dietary practices that are key to optimal healthy living and well-being.[3,4] The need for dietary supplements for women is related to nutritional status, health, and fetal development; while in African countries such as Nigeria and Tanzania, pregnant women face deficiencies of dietary supplements during pregnancy, resulting in adverse health effects for both mother and child.[5] There is an urgent call to increase the nutritional needs of every pregnant mother to meet the energy, protein, and micronutrient needs for the normal growth and development of maternal tissues and her unborn child during pregnancy and breastfeeding.[6]

It is well argued that the possibility of pregnant women meeting their needed daily diets through domestic feedings without dietary supplements is unattainable since malnutrition among pregnant women in Africa was 23.5% in 2019.[7] However, poor diets and dietary supplements deficiency before, during, and after pregnancy are contributing factors leading to a serious maternal health problem such underweight that will result in poor pregnancy outcomes.[8,9] The numerous health implications of malnutrition among women in Africa prompted Nigeria to develop a national food and

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nutrition policy plan through a multi-stakeholder process. This policy plan was produced by the Nigerian National Planning Commission in 2001 to mitigate the adverse impacts of malnutrition in the country. However, the policy has not yielded significant outcomes in improving the nutritional status of the country due to inadequate implementation.[10]

Maternal underweight has become a global health economic concern, particularly in low- and middle-income countries (LMICs), including Nigeria. The impact of malnutrition could be reported as underweight, predominantly among women, with its consequences including anemia and a high risk of maternal and infant morbidity.[11] It is obvious that women face financial constraints, mostly in LMICs, which may prevent them from meeting the daily dietary supplement intake needed to address maternal health issues such as underweight and anemia.[12]

Underweight is a health condition causing the mother's body mass index to fall below 18.5kg/m^2 by lowering the mother's immune system in the age range of 15-49 years and creating a niche for other diseases, causing the death of approximately 462 million women with their offspring.[13] Underweight is multifaceted with different causes and determinants across geographic settings, household environment, education, cultural practices, biological factors, and poor dietary practices, among others.[14-16] Proper diet and dietary supplementation before, during, and after pregnancy may reduce the risk of maternal underweight, hemorrhagic disease of the newborn, and congenital abnormalities in the fetus.[17]

In Nigeria, underweight has become a health threat mostly faced by women, particularly pregnant women; if not properly managed through improved diets and dietary supplements, it could lead to maternal and infant mortality.[18] However, the level of dietary supplement consumption among Nigerian women was highly disappointing according to the 2013 National Demographic and Health Survey (NDHS) report, revealing 15% underweight among women aged 15–49 years in 2003, while it was 11% in 2013, exposing little improvement over a decade. Undernutrition is evident among women, with 13% of the rural and 10% of the urban population.[18] Maternal mortality rate in Nigeria is unabated due to health factors such as maternal underweight, caused mainly by food shortages and poor diets. It is well documented that the lifetime risk of maternal death for pregnant or childbearing mother is 1 in 30 women.[19] Being underweight as a result of malnutrition causes about 8% of economic hardship for a country through direct productivity losses and losses as a result of poor cognition and increased school dropout rates, causing Africa and Asia to lose 11% of their gross domestic product each year as a result of malnutrition.[20]

Even though mothers are more likely to face health problems, such as underweight, due to poor diet and dietary supplements before, during, and after pregnancy, occasioned by a high poverty rate in the country, because of their low socioeconomic status, there have been few empirical studies assessing the effect of dietary supplements on maternal underweight in Nigeria. This study then attempted to fill the existing literature gap in Nigeria. In this thematic area, research has been conducted worldwide, but none in Nigeria. A study to investigate the prevalence of underweight and its associated risk factors among women of reproductive age in Ethiopia found that the likelihood of underweight was higher among young women living in rural areas. They recommended robust context-based awareness-raising on how to prevent underweight among women living in rural areas.[21] Previous studies examining the prevalence and associated factors of maternal health risks, including underweight, overweight, and obesity among women of childbearing age (WCA) in South and Southeast Asia, found that underweight was higher among poor, young, and rural WCA lacking adequate diets and dietary supplements.[22-30] A cross-sectional study on WCA in Nepal found that the underweight prevalence decreased from 25.3% to 16.9% although it remained a threat among women without dietary supplements. Their findings suggest that sociodemographic and household environmental factors are associated with maternal underweight, regardless of dietary supplements.[31]

Furthermore, this study utilized the recent national data. It generated marginal effects of all the variables used to control for endogeneity, which most studies did not observe, thus pushing the boundaries of knowledge beyond what already exists. Another study in Nigeria focused on improved household environments.[11] Therefore, this study utilized fruits as one of its control variables to estimate their effect on reducing maternal underweight, given the agrarian nature of the country studied. This study would add to the growing literature on the effects of dietary supplements and maternal underweight at the national and regional levels in Africa. This is essential because the United Nations Sustainable Development Goal 3 aims to achieve good health and well-being for all by 2030, which can be accomplished by ensuring the availability and subsidization of dietary supplements for women who fall short of the required daily intake. Studies on this thematic area of research are still limited at the national and regional levels, and that necessitated this study in Nigeria, as a giant African country, to determine the effects of dietary supplements on maternal underweight by utilizing Nigeria NDHS data produced by the World Bank, and logistic modeling technique was used in the analysis.

Method

This quantitative study utilized a cross-sectional design to determine the probable effects of dietary supplements on maternal underweight in Nigeria. The 2018 Nigeria NDHS data were used since they provide the updated estimates of basic demographic and health indicators through a survey sample. The sampling frame used for the 2018 NDHS was the population and housing census of the Federal Republic of Nigeria. The primary sampling units, called "clusters," for the 2018 NDHS were defined based on enumeration areas from the 2006 census framework.

An econometric package (Stata 13) was used to run the analysis. A two-stage stratified sampling technique was employed to select households in each of the 36 states and the Federal Capital Territory (FCT), stratified into urban and rural areas, by dividing the sample into 74 strata. In the first stage, 1,400 enumerated areas were selected from the sample strata, comprising 580 urban areas and 820 rural areas with probability proportional to the size of the enumerated area.

In the second stage, approximately 30 households were selected from each cluster through the same systematic probability sampling, resulting in a total sample size of 42,000 households. A total of 41,820 households were selected for underweight screening, targeting WCA (15-49 years). The inclusion criteria were all WCA who were either permanent residents or visitors in the sample household the evening before the survey. Women who were unable to provide their consent and were outside the age of WCA were excluded.

This study was based on the social determinants of maternal health framework, developed to analyze health inequities caused by various determinants, which could be categorized as structural and intermediary determinants according to the Commission on Social Determinants of Health (CSDH).[32] The structural determinants are clearly those producing health inequities by introducing social stratification in society based on class, sex, ethnicity, income, education, and occupation. Meanwhile, the intermediary determinants include factors influencing individual-level health outcomes such as material circumstances, biological factors, and health systems.[33] To estimate the model, a logistic (probit) model was utilized.[34] Instead, the dependent variable addressing this objective was underweight, which was binary, and the logistic regression addressed the heteroscedasticity problem inherent in linear probability models.

$$underweight_i = \beta_0 + \beta Supplements + \theta SEFACTORS + \lambda Demographics + \varphi geopolitcal + \alpha rural + \mu_i \ldots 3.1$$

Model 1. Dietary Supplements and Maternal Underweight in Nigeria

Notes: Underweight = takes the value of 1 if underweight has been observed and 0 if otherwise.
Supplement = vector of various dietary supplements taken by WCA; **SEFACTORS** = vector of socioeconomic factors which includes wealth index, education level, occupation, and ethnicity; **Demographics** = vector of demographic characteristics which includes age of mother, age of household head, and sex of household head; **geopolitical** = vector of geopolitical indicator variables (Northwest, Northeast, North Central, Southeast, Southwest and South-South); **rural** = takes the value of 1 if the woman lives in rural area and 0 if otherwise; **μ** = random error term that is assumed to be homoscedastic and normally distributed if probit estimation is to be employed or follows logistic distribution if logit estimation is to be employed.

The dichotomous model specified in equation (Model 1) would be estimated as a probit model, estimating the probability of the occurrence of the dependent variable given its covariates. The probit model followed the normal cumulative density function and was estimated by the method of maximum likelihood. The results of the probit model would be interpreted by computing the marginal effects of each variable, and this marginal effect was the probability that a woman was exposed or not exposed to the desired health outcome (underweight) given the supplement.

Results

This study employed descriptive statistics (Table 1) to examine the data features and nature of the variables in the probit model. In that vein, this study examined the mean, standard deviation, and minimum and maximum values of the model variables. Table 1 displays the descriptive statistics for variables with 41,821 observations. Key descriptive statistical measures, such as central tendency (mean) and dispersion (standard deviation), indicate disparities across most variables. For instance, household size (with a mean of 6.568 and a standard deviation of 3.893) was more dispersed than other variables.

Furthermore, variables such as the household head's age, age range, wealth, and residence exhibit higher distributions across means and wider gaps between minimum and maximum values. The underweight group, who were educated and also consumed supplements and fruits, exhibited lower distributions across means and less dispersed values, with a mean of zero and a standard deviation of one, respectively. Thus, approximately 40% of the women

observed were underweight, showing a low prevalence of underweight among WCA.

Table 1. Descriptive Statistics of the Model Variables

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Underweight	41,821	0.040	0.196	0	1
Age	41,821	3.499	1.935	1	7
Education	41,821	1.263	1.044	0	3
Wealth	41,821	3.025	1.385	1	5
Residence	41,821	1.594	0.491	1	2
Supplements	41,821	0.374	0.484	0	1
Fruits	41,821	0.412	0.492	0	1
Household size	41,821	6.568	3.893	1	37

Source: Author's computation from available data using STATA 13

Table 2 presents the results of the probit model stated on the method section by computing the marginal effects of dietary supplements on maternal underweight in Nigeria. The findings indicated a statistically significant likelihood of maternal age, education level, and wealth impacting maternal underweight among mothers on dietary supplements compared to mothers who were not. The likelihood of maternal age, education level, wealth, and ethnicity impacting maternal underweight was approximately 0.8, 0.6, 0.6, and 0.2% lower on average among mothers on dietary supplements, respectively, at a higher significance level (1%). The likelihood of dietary supplements and fruits impacting maternal underweight was approximately 0.4 and 0.4% lower on average for mothers on dietary supplements, respectively, and was statistically significant at the 10% level.

The likelihood of household size impacting maternal underweight is approximately 0.2% higher on average for mothers on dietary supplements, also statistically significant at the 1% level. For these regions, the likelihood of mothers from the North-Eastern, Northwest, and Southwest being underweight averaged approximately 0.2, 0.7, and 0.9% for mothers taking dietary supplements. It was statistically significant at the 1% and 10% levels, respectively. The likelihood of mothers from the Southeast being underweight averaged approximately 1% for mothers taking dietary supplements, with a significant level of 5%.

Table 2. Assessment of the Effects of Dietary Supplements on Maternal Underweight

Variable	Underweight	Marginal Effect	Underweight	Marginal Effect
Underweight				
Age	-0.111***	-0.00833***	-0.105***	-0.00779***
	(0.000)	(0.000)	(0.000)	(0.000)
Education	-0.0760***	-0.00572***	-0.0478**	-0.00354**
	(0.000)	(0.000)	(0.003)	(0.003)
Wealth	-0.0764***	-0.00575***	-0.0658***	-0.00487***
	(0.000)	(0.000)	(0.000)	(0.000)
Residence	-0.0327	-0.00246	-0.0262	-0.00194
	(0.253)	(0.253)	(0.373)	(0.373)
Region	-0.00402	-0.000302		
	(0.642)	(0.642)		
Supplements (d)	-0.0465	-0.00346	-0.0552*	-0.00403*
	(0.056)	(0.054)	(0.024)	(0.023)
Fruits (d)	-0.0496*	-0.00371*	-0.0419	-0.00308
	(0.040)	(0.039)	(0.085)	(0.083)
Household size	0.0223***	0.00168***	0.0186***	0.00138***
	(0.000)	(0.000)	(0.000)	(0.000)
Ethnicity	-0.00145***	-0.000109***	-0.00174***	-0.000129***
	(0.000)	(0.000)	(0.000)	(0.000)
Northeast			0.238***	0.0203***
			(0.000)	(0.000)
Northwest			0.0861*	0.00664*
			(0.031)	(0.038)
Southeast			-0.142**	-0.00958**
			(0.007)	(0.003)
South-South			-0.0288	-0.00209
			(0.571)	(0.563)
Southwest			0.113*	0.00906*
			(0.018)	(0.028)
r2_p	0.0442	0.0442	0.0500	0.0500
Ll	-6689.2	-6689.2	-6648.7	-6648.7
Correctly classified	96.02%	96.02%	96.02%	96.02%
N	41821	41821	41821	41821

Notes: Marginal effects; *p*-values in parentheses; (d) for discrete change of dummy variable from 0 to 1; *p-value <0.05, **p-value <0.01, ***p-value < 0.001

Table 3 reports maternal body mass index based on dietary supplements generated by STATA 13. The report indicated that 13.3% of mothers not taking dietary supplements and 8.7% of mothers taking dietary supplements were underweight, resulting in a total of 11.3% mothers being underweight. The results also showed that 61.1% of mothers not taking dietary supplements maintain a normal weight, while 59.1% taking dietary supplements maintain a normal weight, indicating that 60.5% of mothers have a normal weight. In aggregate, 18.4% of mothers in this study were overweight. However, 16.5% were overweight due to factors other than dietary supplements, while 20.8% were overweight due to dietary supplement intake. In addition, out of the 9.8% of obese mothers, 9% did not take dietary supplements, and 10.8% did.

Table 3. Maternal Body Mass Index Based on Dietary Supplements

Body Mass Index Computed	No Supplement (%)	Taking Supplement (%)	Total (%)
Underweight	1,123 (13.3)	548.7 (8.7)	1,671.7 (11.3)
Normal	5,163.5 (61.1)	3,749.2 (59.7)	8,912.7 (60.5)
Overweight	1,396 (16.5)	1,307 (20.8)	2,703 (18.4)
Obese	763.7 (9.0)	678.6 (10.8)	1,442.3 (9.8)
Total	8,446.2 (100.0)	6,283.6 (100.0)	14,729.8 (100.0)

Test of Significance: Pearson: Uncorrected Chi^2 (3) = 115.6733 Design-based F (2.98, 3,908.52) = 24.9424 p-value <0.001.

Discussion

This study's findings indicated a statistically significant likelihood that maternal age, education level, and wealth impact maternal underweight among mothers who took dietary supplements compared to those who did not. The likelihood that maternal age impacted maternal underweight was approximately 0.8% lower on average among mothers taking dietary supplements. These results were highly significant at the 1% level, suggesting that age influenced maternal body mass on dietary supplements.

This study also revealed that an increase in maternal age will decrease the likelihood of maternal underweight by 0.8%, holding other factors constant. This result was in contrast with findings in Nepal, which established a higher prevalence of underweight among women of reproductive age.[31] On the other hand, the likelihood that education impacted maternal underweight was 0.6% lower on average, meaning that an increase in maternal education level decreased the likelihood of maternal underweight by 0.6%. Again, this was highly significant, at the 1% level, suggesting that higher maternal education increases her knowledge of the health needs of dietary supplements to control maternal health problems, such as underweight in Nigeria, when other factors are met. This study's results showed that education level improves maternal health awareness and their dietary supplement intakes in Nigeria. The results also confirmed the findings in Nepal on education, suggesting that mothers with a low education level are more vulnerable to underweight.[11,31]

Another variable reducing a mother's likelihood of being underweight was wealth index. The results showed a statistically significant negative effect on maternal underweight in Nigeria at the 1% level, meaning that a percentage increase in wealth index reduces the likelihood of maternal underweight by approximately 0.5%. This result suggested that a higher wealth index corresponded to greater purchasing power for mothers to buy dietary supplements that could improve their health and address maternal health issues, including underweight.

This study's results showed that wealth improves the mothers' chances of taking dietary supplements for better health conditions. Also, the likelihood of women from affluent households going for regular medical checks was higher compared to women from poor households. The results affirmed the findings in Vietnam, India, and Tanzania regarding wealth index, suggesting that the poorest mothers are more likely to be underweight due to their financial inability to consume appropriate food and dietary supplements.[11,28,35]

This study's findings revealed that residence and region had negative and insignificant effects on maternal underweight in Nigeria. It suggests that residence (location) had a reduced effect on maternal weight among mothers who took dietary supplements, although it was not statistically significant, compared to those who did not. A mother's residence and region reduced the effect of maternal underweight when taking dietary supplements. However, they did not show any difference compared to mothers who did not take dietary supplements in Nigeria. On the other hand, fruit itself showed a weak effect on maternal underweight, at the 10% level, indicating a probable 0.4% lower effect of fruit on maternal underweight compared to mothers not taking dietary supplements. This condition suggested that fruit supplement intake may help mothers maintain a healthy balance (weight) by boosting the immune system for a healthier maternal life in Nigeria.

The household size variable showed a statistically significant positive impact on maternal underweight in Nigeria. This study's findings indicated that a 1% increase in household size increased the likelihood of maternal underweight by 0.2% at the 1% significance level for mothers who took dietary supplements compared with those who did not. This claim is particularly evident in Nigeria and several other sub-Saharan African countries with high poverty rates due to declining household income.[36]

This study's results showed that an increase in the household size is likely to decrease the chance of mothers headed by the household having a good diet or receiving dietary supplements. This finding was consistent with the study on family size.[11] When mothers were among the poorest groups, they were more likely to adopt risky coping strategies, compromising their diet quality. Again, ethnicity had a statistically significant lower effect on maternal underweight at the 1% significance level. Hence, a one-point increase in mothers from any ethnic group in Nigeria reduced maternal underweight by 0.01% for mothers on dietary supplements alone. This finding was significant because maternal underweight was not sensitive to ethnicity.

Regarding the regional impact of dietary supplements on maternal underweight in Nigeria, this study showed that the Northeast, Northwest, Southeast, and Southwest regions had statistically significant effects. In contrast, the country's South-South region was the only region that did not show a statistically significant effect of dietary supplements on maternal underweight. While the Northwest and Southwest regions showed weak statistically significant effects at the 10% level of significance, the Northeast and Southeast regions showed highly significant effects at the 1% level.

This study's finding of improved dietary patterns in the Northern region could be a result of the 2013 and 2017 campaigns to improve access to micronutrients, health facility accessibility, nutrition counseling, and dietary diversity for the Northern region, which stemmed from the scale-up of donor-supported community-based maternal and child nutrition and food security interventions in Northern Nigeria.[37] These results suggested that the impact of dietary supplements on maternal underweight may be more likely due to factors beyond the scope of this study, such as environmental impacts, rather than regional impacts.

The report under this study suggested that more mothers who maintained a normal weight did not rely on dietary supplements. Furthermore, a greater proportion of mothers relying on dietary supplements might be overweight and obese. This study could identify solutions to the prevalence of maternal underweight due to malnutrition among WCA in Africa. It demonstrates the potential to achieve the United Nations Sustainable Development Goal 3 in Africa through the provision of dietary supplements and educating every woman about the importance of supplements in both their own life and those of their children. However, the data used in this study were not clinically validated, which limited this study, due to their secondary nature, making them publicly available through the Nigeria Demographic and Health Survey repository. This study suggests areas for further research, such as dietary supplements and the influence of environmental factors on maternal underweight.

Conclusion

Empirical results of the effect of dietary supplements on maternal underweight in Nigeria indicate that the age of the head of the household, the wealth index, and the mother's education level may contribute to the reduction of maternal underweight when consuming dietary supplements. However, a large family size will trigger maternal underweight when dietary supplements are not available. Fruit consumption has a weak effect on reducing maternal underweight when combined with dietary supplements. This study recommends that all stakeholders in the health industry collaborate with the government at all levels (regional and national) to provide dietary supplements through voluntary donations and also educate every WCA about the importance of dietary supplements in their lives before, during, and after pregnancy.

Abbreviations

LMICs: low- and middle-income countries; NDHS: Nigeria Demographic Health Survey; WCA: Women of childbearing age.

Ethics Approval and Consent to Participate

The study did not seek ethical approval because it was a secondary analysis of publicly accessible Nigeria Demographic and Health Survey data. However, the 2018 Nigeria Demographic and Health Survey protocol was reviewed and approved by the National Health Research Ethics Committee of Nigeria and the International Coaching Federation Institutional Review Board. Informed consent was gathered from participants before interviews or biomarker tests were granted.

Competing Interest

The authors declare that they have no competing interests.

Availability of Data and Materials

The data is available online in the 2018 Nigeria Demographic and Health Survey repository; https://dhsprogram.com.

Authors' Contribution

CJC and UAC wrote the first and subsequent drafts of the manuscript, with comments from NAO, IAM, and UMO. CJC and UAC conceptualized and designed the study. IAM and CJC conducted data analysis and interpretation, while NSU, UMO, and UAC did the introduction and conducted the empirical literature review. All authors read and approved the final manuscript.

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Access to Information on Toddler Family Development Program and Family Participation in Child Growth and Development

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Abstract

The comprehension of the Toddler Family Development (TFD) Program among families in Indonesia remains limited, likely due to insufficient access to information and low participation rates. Limited participation can negatively affect a family's ability to support optimal child growth and development. This study examined the relationship between access to information on the TFD Program and family participation in child growth and development. Using secondary data from the 2019 Program Performance and Accountability Survey in Indonesia, the cross-sectional analysis included 21,497 respondents. The results revealed an association between access to information on the TFD Program and family participation in child growth and development (OR: 1.53; 95% CI: 1.34–1.75). Families with limited access to TFD program information were 1.5 times more likely not to engage in child growth and development and parenting activities. Engaging in the TFD Program can help parents with the better growth and development of their children under the age of five.

Keywords: family development program, information accessibility, parenting, Program Performance Accountability Survey, toddler

Introduction

A 2019 Program Performance and Accountability Survey (PPAS) by the National Population and Family Planning Board is a survey that aims to measure the performance and accountability of the Population, Family Planning, and Family Development program nationally, generate representative provincial-level data, and capture the achievements of key indicators in the 2019 National Medium-Term Development Plan.[1] One of the programs evaluated was the Toddler Family Development (TFD) Program. The target of the TFD Program is families with children under the age of five, aiming to improve the management and skills of parents and other family members in fostering the growth and development of toddlers through physical, motor, intellectual, emotional, and social behavior stimulation, as well as an effort to develop the function of education, socialization, and affection in the family.[1]

The TFD Program is very useful; however, various research results in Indonesia indicate that family participation in this program remains low.[2-4] Low family participation in this program is likely related to limited access to information about the program.[1] A study in Morang District, Nepal, stated significant challenges in accessing maternal health services.[5] Less awareness of the program among mothers is likely to hinder families' ability to support their children's growth and development. Several studies demonstrated a correlation between low maternal knowledge and a high prevalence of malnutrition in toddlers.[6–8] Additionally, a study in Enrekang District, Indonesia, found a significant relationship between maternal knowledge and stunting.[9] Therefore, parents or caregivers need to possess a good knowledge and understanding of how to provide food that meets their children's needs, which in turn encourages optimal growth and development.[10]

Several studies revealed that TFD Program activities help enhance mothers' knowledge of child growth and development.[2,11] In contrast, the families who were inactive in the TFD Program had less care and development in terms of physical growth for toddlers and preschoolers.[12,13] Moreover, families exposed to TFD Program-related information have better child development, including physical growth, mental development, and social development, compared to those who are not.[14-15] The participation in the community is influenced by employment status, age, and education level.

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A study in Jombang District, Indonesia, found that parents' employment status influenced their knowledge and participation in the TFD Program.[16] Another study in Tuban District, Indonesia, found a relationship between employment status and the level of maternal knowledge of basic immunization for toddlers.[11] Unemployed individuals tend to experience fewer social interactions compared to those employed, mainly because work environments facilitate greater opportunities for interpersonal engagement, allowing for the exchange of ideas and the enhancement of knowledge.[3] A previous study highlighted the difference between employed and unemployed mothers. The unemployed mothers have more time to exchange ideas and interact with others, but without an adequate knowledge base.[17]

However, most participants in the TFD Program are unemployed, allowing them to actively attend TFD Program activities during their free time. At each meeting, parents received counseling and various educational materials related to childcare for children under the age of five.[18] Age may affect a person's participation level, with middle-aged and older individuals generally having higher participation rates than younger age groups.[19] Mother's education level also contributes to active participation in the TFD program.[14] A person's educational background is related to their level of knowledge, which can influence parenting for toddlers and preschoolers. The higher the level of education, the easier it is to accept the concept of independent, creative, and sustainable healthy living.[12]

A study in South Lampung District, Indonesia, found that parenting practices were influenced more by parental knowledge of childcare.[20] Parents were expected to play a role in the care of appropriate child feeding for improving children's nutritional status.[21] The results from the 2019 National Medium-Term Development Plan Performance, Indicator Survey revealed significant differences in family participation in child care and development between participant and non-participant families in the TFD Program. Child malnutrition has become a key focus for governments in mitigating growth-related challenges. Although several researchers have investigated the relationship between exposure to information on the TFD Program and engagement in TFD activities,[15,22,23] the national data have been underutilized in these investigations. Therefore, this study aimed to examine the relationship between access to information on the TFD Program and family participation in child growth and development.

This study's findings aimed to inform and refine child-rearing policies in Indonesia, particularly regarding the TFD program, by clarifying the link between access to information and family participation. This study was expected to provide empirical evidence for improving TFD information dissemination, focusing on vulnerable populations such as low-socioeconomic families and those in rural areas. Ultimately, the revised policies should strengthen community-level information sources and promote active parental involvement, thereby contributing to improved parenting practices and addressing issues such as stunting, and ultimately enhancing Indonesia's future human resource quality.

Method

This analytical study was conducted from January to April 2022, utilizing the 2019 PPAS data provided by the National Population and Family Planning Board,[1] which serves as an annual national assessment tool to measure the effectiveness of population, family planning, and family development programs. The 2019 PPAS offers a national perspective on the importance of information accessibility and parental engagement in child growth and development programs. The 2019 PAS data's national scope and representativeness, covering all provinces in Indonesia, lend credibility and generalizability to the findings. Its high reliability and validity, confirmed by pre-tested instruments, enhance the trustworthiness of the research.[1] Furthermore, since the PAS data serve as a crucial annual assessment tool for national population and family planning programs, their use directly supports ongoing program assessment, provides critical insights for improvement, and builds a foundation for future policy formulation, thereby maximizing the study's relevance and impact on evidence-based decision-making.[1] This strategic decision further optimizes the use of research resources, facilitating efficient analysis and timely contributions to vital national development initiatives.

The survey was conducted simultaneously across all provinces in Indonesia, focusing on households, women of childbearing age (aged 15-49 years), families, and adolescents aged 10-24 years. The population of this study, which utilized the 2019 PPAS, encompassed 1,935 clusters, 82,030 villages, 514 districts/cities, and 34 provinces. The sample was a subset of the population representing the characteristics of the population studied. A total of 69,915 households were identified, of which 69,662 families met the requirements and were successfully interviewed. The sample in this study consisted of families with children under the age of five (21,497 families). This study used total sampling from a relevant subset of the 2019 PPAS data.

Family participation in child growth and development refers to the active involvement of family members in fostering a child's growth through four key dimensions: growth care (supporting parenting knowledge and skills),

physical care (meeting the child's basic physical needs), mental/spiritual care (guiding emotional and spiritual development), and social care (encouraging social skills and community interaction). Access to information on the TFD Program was categorized into two groups: "access," if the mother got information on the program from at least one source, and "no access," if the mother never received any information on the program through any of these media, individuals, or institutional sources.

The source of information was divided into three groups: "media," including radio, television, newspapers, magazine/tabloid, pamphlet/leaflet/brochure, flipchart/flipsheet, poster, banner, billboard, exhibition, website/internet, National Population and Family Planning Board official vehicle, or mural/wall painting/graffiti. "Community leaders," including National Population and Family Planning Board staff and field officers, teachers, religious leaders, doctors, midwifes or nurses, village officials, or cadres, and "institutions," including formal education (schools), non-formal education (trainings/seminars), community organizations (Integrated Health Care), community groups, and activity groups.

Maternal age was categorized into three groups: mothers aged under 20 years, those aged 20-35 years, and those older than 35 years. "The number of children aged under the age of five" was categorized into two groups: families with two or fewer children (≤2 children) and families with more than two children (>2 children). Socioeconomic status was categorized as low, middle, and high, established by Statistics Indonesia, which typically takes into account household income, expenditure level, education level, employment status, and ownership of assets or durable goods. Families with a "low" socioeconomic status were those identified as falling below a threshold of basic needs; the "middle" category reflected those with modest but sufficient resources, and the "high" category represented families with greater economic capacity and access to a wide range of services and opportunities. The residential area was categorized into rural and urban, reflecting differences in infrastructure, access to services, population density, and lifestyle characteristics. Education levels comprised "low" (uneducated or elementary school), "middle" (junior and senior high school), and "high" (diploma, bachelor's, master's, and doctoral degrees). The categories for maternal employment status were employed and unemployed.

The descriptive statistics provided an overview of univariate analysis, presenting (%) data for each variable and calculating frequencies (n). The Chi-Square test was used to determine the relationship between each independent variable and the dependent variable. The logistic regression model was used to determine the relationship between access to information and the TFD Program activities on family participation in child growth and development after controlling for confounding variables.

Results

Table 1 shows that almost all families in this study participate in child growth and development, with higher percentages of appropriate growth (95.38%), physical care (99.66%), mental/spiritual care (98.28%), and social care (96.35%) compared to the inappropriate category.

Table 1. Overview of Family Participation in Child Growth and Development in Indonesia

Family Participation in Child Growth and Development	Appropriate		Inappropriate	
	n	%	n	%
Growth Care	20,505	95.38	992	4.62
Physical Care	21,426	99.66	71	0.34
Mental/Spiritual Care	21,129	98.28	368	1.72
Social Care	20,714	96.35	783	3.65

Table 2. Access to Information on Toddler Family Development Program

Access to Information	Access		No Access	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Media				
Radio	568	2.64	20,929	97.36
Television	5,731	26.65	15,766	73.35
Newspaper	994	4.62	20,503	95.38
Magazine/Tabloid	638	2.96	20,859	97.04
Pamphlet/Leaflet/Brochure	1,193	5.54	20,304	94.46
Flipchart/Flipsheet	2,172	10.10	19,325	89.90
Poster	2,172	10.10	19,325	89.90
Banner	961	4.47	20.536	95.53
Billboard	1,131	5.26	20,366	94.74
Exhibition	318	1.47	21,179	98.53
Website/Internet	2,172	10.10	19,325	89.90
National Population and Family Planning Board Official Vehicle	459	2.13	21,038	97.97
Mural/Wall Painting/Graffiti	308	1.43	21,189	98.57
Community Leaders				
National Population and Family Planning Board Staff/Field Officer	2,246	10.44	19,251	89.56
Teacher	1,398	6.50	20,099	93.50
Religious leader	969	4.50	20,528	95.50
Public figure	2,619	12.18	18,878	87.82
Doctor	1,360	6.32	20,137	93.68
Midwife or nurse	5,252	24.43	16,245	75.57
Village apparatus	4,280	19.91	17,217	80.09
Caders	5,645	26.26	15,852	73.74
Institutions				
Formal education	2,044	9.51	19,453	90.49
Non-formal education	392	1.82	21,105	98.18
Community organization	7,636	35.52	13,861	64.48
Community group	2,356	10.95	19,141	89.05
Activity group	2,661	12.37	18,836	87.63

Table 2 presents various sources of information accessed by families regarding the TFD Program, categorized by media, community leaders, and institutions. In summary, television emerges as the most dominant media source of information (26.65%) of reported access. However, most respondents (73.35%) do not access information via television, indicating a significant number of families remain unreached. Within the category of community leaders, the cadres were the most frequently accessed source (26.26%), followed by midwives or nurses (24.43%). Among institutional sources of information, the community organization was the most frequently accessed (35.52%). These findings suggested the need to diversify and improve information dissemination strategies, particularly through community leaders, particularly National Population and Family Agency staff and field officers, as well as institutions, to reach more families and ensure equitable access to critical information on the TFD Program.

According to Table 3, only 47.1% of families have access to information on the TFD Program that is accessible to the general public from various sources, including information media, community leaders or figures, and institutions. Family characteristics show that a significant proportion of mothers are aged 20-35 years (66.2%). Furthermore, nearly all mothers (98.6%) have one to two children under the age of five. The majority of people live in rural areas, accounting for 59.7% of the population. Additionally, 41.8% of families are categorized as having a middle level of welfare. Most mothers have attained secondary education (58.0%) and are unemployed (67.1%). The variables that were candidates for multivariate analysis were maternal age, socioeconomic status, residential area, and maternal education level (p-value <0.25).

Table 3. Description of Family Characteristics by Family Participation in Child Growth and Development

Family Characteristic	Family Participation in Child Growth and Development				Total		p-value
	Appropriate		Inappropriate				
	n	%	n	%	n	%	
Access to information							
Access	9,762	45.4	361	1.7	10,123	47.1	<0.001
No Access	10,743	50.0	631	2.9	11,374	52.9	
Maternal age							
20-35 yeaars	13,565	63.1	668	3.1	14,233	66.2	<0.001*
<20 years	332	1.5	43	0.2	375	1.7	
>35 years	6,608	30.7	281	1.3	6889	32	
The number of children under the age of five							
≤2 children	20,215	9.4	981	4.6	21,196	98.6	
>2 children	290	1.3	11	0.1	301	1.4	0.424
Socioeconomic status							
Low	6,168	28.7	401	1.9	6,569	30.6	<0.001*
Middle	8,566	39.8	419	1.9	8,985	41.8	
High	5,771	26.8	172	0.8	5,943	27.6	
Residential area							
Rural	12,192	56.7	643	3.0	12,835	59.7	0.001*
Urban	8,313	3.0	349	1.6	8,662	40.3	
Education level							
Low	5,375	25.0	370	1.7	5,745	26.7	<0.001*
Middle	11,934	55.5	528	2.5	12,462	58.0	
High	3,196	14.9	94	0.4	3,920	15.3	
Maternal employment status							
Employed	6,750	31.4	313	1.5	7,063	32.9	0.371
Unemployed	13,755	64.0	679	3.2	14,434	67.1	

Note: *Candidate for multivariate analysis (p-value <0.25)

Table 4. Association Between Access to Information on the Toddler Family Development Program and Family Participation in Child Growth and Development

Variable	β	p-value	OR (95% CI)
Access to information			
Access			
No Access	0.426	<0.001	1.53 (1.34-1.75)
Maternal age			
20-35 years			
<20 years	0.206	0.005	1.22 (1.06-1.42)
>35 years	1.023	<0.001	2.78 (1.97-3.92)
Socioeconomic status			
Low			
Middle	0.573	<0.001	1.77 (1.46-2.15)
High	0.376	<0.001	1.45 (1.21-1.76)
Maternal education level			
Low			
Middle	0.543	<0.001	1.72 (1.34-2.21)
High	0.185	0.116	1.20 (0.96-1.52)
Constant	-3.940		

Note: *Significant at the 0.05 level

Table 4 illustrates that the relationship between access to information on the TFD Program, maternal age, socioeconomic status, maternal education level, and family participation in child growth and development in Indonesia is examined in the context of child growth and development. Families with no access to information on the TFD Program had a 1.5 times higher risk (95% CI: 1.338-1.751) of not participating in the implementation of child growth and development, compared to families with access to information on the TFD Program, after the variables of maternal age, socioeconomic status, and maternal education level were controlled.

Discussion

This study demonstrated that families with no access to information on the TFD program were 1.5 times more likely to refrain from participating in child growth and development compared to those with access. This result suggested that improving access to TFD Program-related information might increase participation, particularly when combined with interventions targeting other influential factors, such as maternal education level, socioeconomic status, and maternal age. Therefore, strategic and targeted dissemination of information remained crucial to boost participation in the TFD Program. These findings suggested that structural barriers, such as access to information, could affect participation regardless of other sociodemographic factors. Hence, this study highlighted an important policy implication: improving

access to relevant program-related information could be as important as addressing economic or educational disparities in increasing family participation in child growth and development.

Similar results were also found in a 2020 study in Bandung City, Indonesia, indicating a difference between families exposed to information about the TFD program and those not exposed. Family participation in fostering the growth and development of preschool-aged children is significant, with access to information on the TFD Program.[15] It was also crucial for the cadres and health workers to engage in ongoing education for families, both new and experienced, in caring for preschool-aged children and about the TFD Program. This initiative aims to enhance their knowledge and promote more effective parenting practices. In addition, a study in Thailand found that the participation of parents, caregivers, and children in nutrition and health promotion has a positive effect on child growth, with significant improvements in the nutritional status of children in the intervention group receiving access to information regarding nutrition.[24]

Efforts to address the risks associated with family non-participation in child growth and development include collaboration between TFD cadres and health promoters to change at-risk family behaviors. Health services have the capacity to provide ongoing education about the TFD program, serving as a platform for families to access various health information related to child growth and development in Indonesia. This can be achieved through both direct and indirect methods, ultimately improving the overall health status of the Indonesian population.[25] In addition to providing ongoing education, health promotion staff have the capacity to increase the accessibility of information on the TFD program. By increasing the availability of information media or sources about TFD, they can facilitate easier public access to this information, aimed at influencing behavior related to family participation in child care, as well as child growth and development in Indonesia.[26]

This study showed that television served as the primary source of information for families participating in the TFD Program, demonstrating the highest level of accessibility among various media. Efforts to increase access to information on TFD activities include increasing the number of audiovisual public service announcements on television channels.[27] The use of audiovisual media is beneficial, as it provides clear and engaging information on the TFD Program. This approach is expected to increase the willingness of families with children under the age of five to participate in TFD activities, thereby improving the quality of parenting practices.[27] Access to information on the TFD Program does not necessarily increase participation in TFD activities among families with preschool-aged children. Lack of participation in TFD activity groups is a factor causing families, despite having access to information on the program, to remain inactive in these activities.[28] Furthermore, a study conducted in North Sulawesi Province, Indonesia, yielded similar results, in which families reported less participation in TFD activities due to inconsistent group meetings for TFD activities.[14]

The strength of this study lies in its use of data from the 2019 PPAS, a nationwide survey that covers 34 provinces in Indonesia. Systematic data collection and a pre-tested, reliable, and valid survey instrument ensure high data quality, enhancing the internal validity of the findings. The large and representative sample of 69,662 families, including 21,497 families with children under the age of five, facilitates the generalization of the results to the broader population, providing an accurate picture of the program's effectiveness at the national scale. This study was also crucial for providing input for program evaluations and future policy planning, such as the National Medium-Term Development Plan and the 2020-2024 Strategic Plan of the National Population and Family Planning Board.

Despite its strength, this study had limitations, primarily due to its cross-sectional design, which prevented causality from being established. There was also a risk of response and information bias due to differing interpretations of key terms. These issues were addressed through a clear definition of variables and the use of validated instruments. For future studies, a longitudinal design is recommended to explore the causal relationship between information access and family participation. Qualitative studies are also needed to comprehend the underlying mechanisms and influential factors. Furthermore, future studies should investigate optimal methods for disseminating information that can enhance family participation, considering differences in geographic and demographic characteristics. This is important since the findings of this study indicate that families with no access to information are 1.5 times more likely not to participate.

Conclusion

There is a relationship between access to information on the TFD Program and family participation in child growth and development; however, many families remain unaware of the program. Despite being respondents in the study, almost all families are inactive participants. To enhance engagement, health promotion professionals must play a pivotal role in expanding public access to information. It is recommended to intensify public service announcements through audiovisual media, television, and social platforms. The emphasis of these efforts should be on encouraging families, particularly those

with children under the age of five, to participate actively in the program.

Abbreviations

PPAS: Program Performance and Accountability Survey; TFD: Toddler Family Development.

Ethics Approval and Consent to Participate

This research received ethical approval from the Health Research Ethics Commission at the Health Polytechnic of the Ministry of Health, Bengkulu, Number KEPK. M/112/03/2022.

Competing Interest

The authors declare that there is no conflict of interest.

Availability of Data and Materials

This study utilizes secondary data, the 2019 PPAS data, compiled by the National Population and Family Planning Board. This survey is conducted every year to assess the success of population, family planning, and family development programs. Request data by email to pulitbangkbks@gmail.com (the Center for Family Planning and Family Welfare Research and Development) to obtain the dataset.

Authors' Contribution

DS and DD compiled, designed, and conducted research, analyzed data, and contributed analytical tools. DS, DD, LE, and YF wrote papers. DS completed the manuscript for publication.

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