

MATERNAL HEALTH LITERACY AS A DETERMINANT OF PCV AND ROTAVIRUS IMMUNIZATION UTILIZATION IN INDONESIA

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Abstract

The acceleration of stunting reduction represents a critical public health priority in decentralised Indonesia. While clinical protection relies on newly introduced routine antigen series, including the Pneumococcal Conjugate Vaccine (PCV) and Rotavirus (RV) vaccine, suboptimal uptake within facilities continues to persist due to wide sub-national disparities. This study employs a national descriptive-comparative secondary data analysis approach to examine how provincial variations in maternal health literacy regarding stunting impacts correspond with actual clinical immunization coverages across Indonesia's 38 provinces, utilizing the macro-dataset from the Indonesian Nutritional Status Survey (SSGI) 2024 report. The results reveal severe structural alignment between low upstream health promotion metrics and suboptimal downstream healthcare facility utilization. Provinces within the lowest maternal literacy cluster, such as Maluku Utara (9.5%), systematically correspond with regional clusters exhibiting severe immunization coverage bottlenecks, as exemplified by historic routine utilization lows in areas like Aceh (10.1% for PCV and 2.9% for RV). Conversely, advanced health promotion networks in regions like Jawa Tengah, DI Yogyakarta, and Bali yield superior utilization coverages. Consequently, downstream clinical acceleration cannot achieve national targets without an integrated upstream health promotion engine to mitigate regional inequities.

Keywords: Healthcare Disparities, Public Health Promotion, Spatial Comparative Analysis, Secondary Data Evaluation, Sub-national Disaggregation, Vaccine Utilization Performance

Introduction

The Government of Indonesia has prioritized accelerating the reduction of national stunting prevalence as a cornerstone of its health development agenda within the National Medium-Term Development Plan (RPJMN). According to the latest macro disaggregation within the Indonesian Nutritional Status Survey (SSGI) 2024 report, national stunting prevalence was successfully reduced to 19.8% ^[1]. Despite this positive downward trend, the document simultaneously underscores a critical downstream bottleneck among older toddlers. A highly sensitive determinant triggering growth faltering after 12 months of age is the heavy burden of infectious diseases, particularly pneumonia and severe diarrhea. Clinically, recurrent infections from these two conditions induce secondary malnutrition, which in turn accelerates stunting manifestations in children ^[2]. This challenge is not exclusive to Indonesia; rather, it represents a global public health burden commonly observed across developing regions facing comparable structural vulnerabilities ^[3]. Comprehensively, global trends indicate that strengthening routine health systems is a fundamental instrument necessary to safeguard the successful uptake of newly introduced vaccines in the modern

era ^[4]. Within the Asia-Pacific region, integrating national immunization programs with infectious disease management has proven to be a primary catalyst for reducing macro-level infant and toddler morbidity ^[5].

To mitigate these risks, the Ministry of Health of the Republic of Indonesia expanded its specific interventions by rolling out mass introduction of new antigen immunization services, namely the Pneumococcal Conjugate Vaccine (PCV) to prevent pneumonia and the Rotavirus (RV) vaccine to avert acute diarrhea. The SSGI 2024 document provides detailed coverage data for these preventive services across Indonesian regions. However, the aggregation of this secondary data uncovers a fundamental health service management flaw: a wide disparity or gap in actual coverage realization across the 38 provinces of Indonesia. This discrepancy in utilizing clinical-preventive services mirrors global dynamics, where the adoption of new antigen regulations frequently encounters implementation barriers due to health system fragmentation, eroding public trust in medical authorities, or conflicting federal policy guidelines ^[6]. This problem is further exacerbated in high-migration areas, where vulnerable groups routinely confront administrative, linguistic, and insurance-related structural barriers to healthcare access ^[7].

This disparity in healthcare facility utilization cannot be viewed solely through the lens of clinical logistics and vaccine supply chains within hospitals; it is deeply influenced by upstream factors within the domain of health promotion, namely public health literacy. This upstream behavioral landscape is explicitly captured in the SSGI 2024 report through evaluation metrics tracking the proportion of mothers of toddlers based on their stunting impact knowledge scores across provinces. Theoretically, health literacy serves as a primary predictor of health behavior. Drawing from the WHO's Behavioural and Social Drivers (BeSD) framework, a caregiver's internal motivation rooted in a holistic understanding of disease risks constitutes the foundational layer required before they decide to navigate downstream practical hurdles at health facilities, such as long queues or substandard service quality ^[8]. When a mother possesses high literacy regarding the long-term impacts of stunting and its correlation with infectious diseases, her awareness to engage in care-seeking behavior and actively utilize specific preventive services at healthcare facilities increases linearly. Furthermore, the implementation of massive upstream educational strategies leveraging digital literacy and interprofessional communication has proven highly effective in accelerating public acceptance of new vaccine modalities during policy transitions ^[9,10].

To date, prior literature evaluating the determinants of stunting or immunization uptake has predominantly focused on conventional demographic risk factors, such as household income, marital status, child birth order, or geographic barriers alone ^[8,11]. Conversely, studies in hospital management and health administration often audit immunization coverage strictly from vaccine supply chain logistics or the operational capacity of healthcare personnel within the facility ^[12]. Global catch-up vaccination intervention models also indicate that standardized facility procedures routinely fail to achieve target coverage if they are not paired with robust community awareness campaigns outside facility walls ^[9]. There remains a significant research gap concerning studies that explicitly integrate this upstream-downstream continuum by examining the spatial interaction between health promotion outcomes represented by maternal nutritional and stunting literacy and the clinical utility performance of new antigen immunization programs across secondary and primary health facilities using contemporary macro-data.

To address this research gap, this study proposes a national-scale, descriptive-comparative secondary data analysis approach. This method spatially evaluates and links the provincial percentage of mothers with high stunting knowledge against the actual coverage rates of PCV and Rotavirus immunizations across Indonesia's 38 provinces, utilizing the real-world dataset from SSGI 2024. By utilizing this framework, the study circumvents the need for new field interventions (non-experimental approach) and instead focuses on providing macro-level empirical evidence regarding

the extent to which community-level education maps to the success of clinical-preventive program uptake within health facilities ^[13].

The novelty of this study lies in its original contextualization against the most current national health policies. It stands as one of the few early post-release analyses of the SSGI 2024 dataset to empirically evaluate the implementation effectiveness of two relatively new antigens (PCV and Rotavirus) in Indonesia by mapping them directly to maternal health literacy pillars across 38 provinces. The findings are expected to offer scientific contributions toward strategic policy recommendations for hospital management, healthcare practitioners, and public health departments, demonstrating that downstream clinical acceleration within facilities cannot achieve optimal targets without an integrated upstream health promotion engine to mitigate regional disparities ^[14].

Method

This study employed a quantitative research design utilizing a descriptive-comparative national secondary data analysis approach. Rather than executing clinical interventions or individual-level inferential statistical modeling, this study focused on evaluating and comparing macro-aggregate spatial indicators across regional jurisdictions. All compiled data were directly extracted from the official national publication of the Ministry of Health of the Republic of Indonesia, specifically the *Indonesian Nutritional Status Survey* (SSGI) 2024 report ^[1].

The unit of analysis comprised aggregate regional metrics across 38 provinces in Indonesia to evaluate geographical distribution trends. The analytical framework incorporated one independent health promotion variable (X) and two dependent healthcare service utilization variables (Y), operationally defined as follows:

1. Maternal Health Literacy (X) The provincial percentage of mothers of toddlers achieving a high score specifically on the knowledge and attitude dimension regarding the downstream impacts of stunting, sourced from Table 5.158 of the SSGI 2024 report ^[1].
2. PCV Service Utilization (Y1): The provincial percentage of older infants/toddlers aged 4–15 months who had successfully completed the full routine regimen of the new antigen *Pneumococcal Conjugate Vaccine* (PCV1 + PCV2), sourced from Table 5.121 of the SSGI 2024 report ^[1].
3. Rotavirus Service Utilization (Y2): The provincial percentage of toddlers aged 12–23 months who had achieved full-dose clinical completion of the routine *Rotavirus* (RV) vaccine series (comprising doses 1, 2, and 3), sourced from Table 5.125 of the SSGI 2024 report ^[1].

Data processing was conducted descriptively through systematic comparative tabulation using Microsoft Excel software. The analytical phases involved organizing and aligning the raw percentage points of the three baseline variables from all 38 provinces into a unified matrix. Subsequently, regional ranking and geographic cluster grouping were performed to evaluate whether provinces with high maternal health literacy demonstrated a corresponding spatial trend of elevated new antigen immunization coverages at public healthcare facilities, and vice versa. The core variable operationalization parameters and the baseline descriptive distribution bounds of the real national dataset are centered and summarized in Table 1.

Table 1. Macro-Baseline Descriptive Characteristics of Maternal Literacy and New Antigen Immunization Coverages Based on the SSGI 2024 Report (N = 38)

Variable	Core Document Source Indicator	Minimum (%)	Maximum (%)	National Mean (%)
Maternal Literacy (X)	High Knowledge on Stunting Impacts	9.5	46.5	26.9
PCV Utilization (Y1)	Complete PCV Regimen for Ages 4–15 Mos.	10.1	93.9	66.6
Rotavirus Utilization (Y2)	Complete RV Series for Ages 12–23 Mos.	2.9	52.4	24.2

Through this spatial comparative approach, structural variations and coverage disparities across Indonesian regions can be objectively mapped. The descriptive macro-findings were then narratively synthesized and triangulated with established health promotion and hospital management literature to generate contextual policy recommendations for public health stakeholders.

Result and Discussion

This section delineates the macro-level empirical findings compiled from the SSGI 2024 report across 38 provinces in Indonesia, followed by a comprehensive, multi-layered synthesis. To evaluate the geographic distribution and spatial patterns of upstream health promotion outcomes alongside downstream preventive clinical service utilization, the data are organized into distinct regional clusters based on baseline statistical bounds.

Macro-Spatial Distribution of Maternal Literacy and New Antigen Uptake

The analysis reveals substantial regional disparities across the Indonesian archipelago regarding both maternal stunting literacy and the completion of the newly introduced routine immunization regimens. To standardize the evaluation of spatial variance across all N = 38 provinces, the core operational values encompassing the minimum, maximum, and national mean points were mathematically computed.

To visualize the overarching baseline variance before transitioning into regional grouping, the raw percentage characteristics of each macro-indicator are presented in centered format in Table 2.

Table 2. Provincial Disaggregation Parameters of Maternal Literacy and New Antigen Immunization Series (N = 38)

Strategic Variable	Key Provincial Performance Metric	Minimum (%)	Maximum (%)	National Mean (%)
Maternal Literacy (X)	High Knowledge on Stunting Impacts	9.5	46.5	26.9
PCV Utilization (Y1)	Complete PCV Regimen for Ages 4–15 Mos.	10.1	93.9	66.6
Rotavirus Utilization (Y2)	Complete RV Series for Ages 12–23 Mos.	2.9	52.4	24.2

To mathematically determine the magnitude of regional divergence for each public health pillar, the absolute range (R) of provincial coverage was evaluated using the following spatial identity equation:

$$R = V_{\{\max\}} - V_{\{\min\}}$$

Where R represents the total provincial percentage range of health indicator distribution, $V_{\{\max\}}$ denotes the maximum percentage recorded by the highest-performing province within the specific SSGI 2024 table, and $V_{\{\min\}}$ signifies the minimum percentage captured by the lowest-performing province. By substituting the real-world parameters from Table 2 into equation (1), the structural disparity index for Maternal Literacy (X) is established at 37.0%, while downstream service gaps expand significantly to 83.8% for complete PCV immunization (Y1) and 49.5% for full-dose Rotavirus coverage (Y2).

Upstream-Downstream Interprofessional Alignment and Disparity Mapping

The spatial data mapping uncovers a compelling geographic alignment between low upstream health promotion metrics and suboptimal downstream clinical service utilization, indicating that disparities in preventive health interventions are closely associated with deficiencies in curative and rehabilitative healthcare services. The analysis of regional patterns presented by the Ministry of Health of the Republic of Indonesia demonstrates that the weakest baseline performance across multiple public health dimensions is not randomly distributed but is instead heavily concentrated within the same regional cluster in Eastern Indonesia. This geographic concentration suggests the presence of systemic inequalities that simultaneously affect health literacy, access to healthcare, and the effectiveness of health service delivery. Specifically, Maluku Utara records the lowest national proportion of maternal stunting impact literacy at only 9.5%, reflecting a substantial deficiency in community awareness regarding the causes, consequences, and prevention of stunting during the critical maternal and child health period. Such limited health literacy represents a fundamental weakness in the hulu (upstream) component of the healthcare system, where health promotion and disease prevention activities are expected to build knowledge and encourage healthy behaviors. This severe lack of public health literacy appears to correspond directly with persistent bottlenecks in the hilir (downstream) healthcare sector within neighboring regions, where the utilization of essential clinical services remains below national expectations. The observed spatial relationship indicates that inadequate investment in upstream health promotion may contribute to lower demand for preventive and curative services, delayed healthcare-seeking behavior, and ultimately poorer health outcomes. Consequently, the geographic overlap between weak health promotion indicators and low clinical service utilization underscores the necessity of adopting integrated, region-specific strategies that simultaneously strengthen community health education, preventive interventions, and access to quality healthcare services to reduce persistent regional disparities and improve overall health system performance ^[1].

The most profound clinical utilization shortfall is observed in the province of Aceh, which exhibits the lowest national coverage for both complete PCV immunization at 10.1% and complete Rotavirus vaccination at a critically low 2.9%. These findings indicate substantial deficiencies in the uptake of essential childhood immunization services and suggest that the challenge extends beyond vaccine availability to broader barriers affecting healthcare utilization. This co-occurrence supports the theoretical foundations of health behavior models, which posit that caregivers' perceptions of disease severity, susceptibility, and the benefits of preventive interventions serve as key psychological drivers of healthcare-seeking behavior before they decide to overcome logistical and financial barriers to accessing health facilities. When maternal health literacy regarding stunting and its infectious determinants is severely compromised, caregivers are less likely to recognize the

importance of complete childhood immunization, reducing acceptance of newly introduced vaccines and increasing vaccine hesitancy. Consequently, public demand for these vaccine modalities declines, resulting in persistently low service utilization at primary healthcare centers and reinforcing the link between inadequate upstream health promotion and poor downstream healthcare performance ^[15].

Conversely, high-performing provinces demonstrate that robust health promotion infrastructures are strongly associated with superior healthcare facility performance, illustrating the important role of upstream interventions in improving downstream health service utilization. This relationship is evident in Jawa Tengah, which records the highest maternal stunting literacy score at 46.5% while also maintaining consistently high and stable immunization coverage, indicating that greater public awareness is accompanied by stronger engagement with preventive healthcare services. Similarly, DI Yogyakarta achieves the highest national coverage for complete PCV immunization at 93.9%, while Bali records the highest complete Rotavirus vaccination coverage at 52.4%, demonstrating exceptional performance in the implementation of newly introduced childhood immunization programs. These provinces are characterized by well-integrated health communication networks, effective community empowerment initiatives, active involvement of local stakeholders, and advanced digital health literacy campaigns that facilitate the dissemination of accurate health information and encourage positive health-seeking behaviors. Collectively, these findings suggest that the successful introduction and sustained uptake of new vaccines during periods of policy transition depend not only on the availability of vaccine supplies or healthcare facilities but also on continuous, multi-sectoral community engagement extending beyond clinical settings through coordinated health promotion, education, and cross-sector collaboration. Consequently, the high immunization coverage observed in DI Yogyakarta and Bali reflects a well-functioning health administration framework in which strong public health literacy, effective communication systems, sustained community participation, and accessible healthcare services collectively reduce barriers to clinical service utilization, strengthen public trust in immunization programs, and enhance the overall performance and resilience of preventive healthcare services ^[8].

The baseline findings regarding socioeconomic and geographic influences in Indonesia are strongly supported by historical household-level evidence demonstrating that social and economic conditions remain fundamental determinants of healthcare utilization. Previous studies underscore that socioeconomic factors, including maternal education, household income, urban residency, health insurance ownership, and access to health information, are consistently associated with the completeness of childhood vaccination across Indonesian provinces. Mothers with higher educational attainment are generally more likely to understand the benefits of immunization, recognize disease risks, and seek preventive healthcare services, while families residing in urban areas or covered by health insurance typically experience fewer financial and geographical barriers to accessing healthcare. Conversely, when these baseline socioeconomic conditions are compromised, substantial regional, economic, and cultural disparities emerge, limiting access to essential health services, reducing vaccine uptake, and hindering equitable healthcare delivery. These persistent inequalities ultimately create significant obstacles to achieving universal immunization coverage and improving maternal and child health outcomes across Indonesia ^[16].

This dynamic mirrors urban slum environments in other developing countries. Highlight that low uptake of essential vaccines is concentrated within specific marginalized populations, such as the Pashtun ethnicity in high-risk squatter settlements, driven by a lack of formal maternal education, paternal underemployment, and physical distance from vaccination centers ^[17]. Furthermore, spatial variations in new antigen distribution represent a major administrative hurdle in decentralized health networks. Demonstrate that even when nationwide PCV coverage scales up over time, profound

spatial gaps persist between different regions, with pastoralist and nomadic areas lagging behind urban capitals due to underlying maternal literacy gaps and socioeconomic differences ^[18].

Integrating Information Technology and Hospital Management Systems

The wide macro-regional disparities identified in the SSGI 2024 dataset underscore the need for more advanced, adaptive, and context-specific health communication strategies to ensure that preventive health information reaches diverse populations across Indonesia. These findings suggest that conventional one-size-fits-all communication approaches may be insufficient to address the varying levels of health literacy, technological access, and healthcare utilization observed among different provinces. Previous evidence indicates that the implementation of mobile phone text message reminders can significantly improve the uptake, completeness, and timeliness of routine childhood immunizations by reminding caregivers of scheduled vaccination visits, reinforcing key health messages, and encouraging adherence to recommended immunization schedules. Such digital reminder systems have been shown to be particularly beneficial in resource-limited settings where routine follow-up mechanisms are often constrained by shortages of healthcare personnel and logistical resources. However, despite their demonstrated effectiveness, the adoption and sustainability of digital health technologies in low- and middle-income countries (LMICs) continue to face substantial structural challenges, including unstable mobile network coverage, limited digital literacy, low parental reading abilities, inconsistent access to electricity, and the continued absence of mobile phone ownership among socioeconomically disadvantaged households, all of which may reduce the overall effectiveness and equity of these interventions ^[19].

While automated digital communication systems offer considerable potential to expand the reach and efficiency of health information dissemination, a significant gap remains between providing basic vaccine awareness and ensuring that caregivers receive personalized, context-specific information that addresses their individual concerns. Digital platforms are generally effective for delivering reminders and standardized educational messages but are often unable to respond to complex questions, misconceptions, or culturally rooted beliefs that influence vaccination decisions. Consequently, many parents continue to require direct, meaningful interactions with healthcare workers, who play a critical role in building trust, correcting misinformation, and providing individualized counseling regarding vaccine safety, effectiveness, and potential side effects. Such interpersonal communication becomes particularly important for caregivers who are uncertain, hesitant, or exposed to conflicting health information from social media or community networks. Therefore, relying exclusively on digital platforms without integrating personalized, interprofessional communication may unintentionally leave vulnerable caregivers with unresolved doubts, perpetuate vaccine hesitancy, and ultimately increase the likelihood of delayed or incomplete childhood immunization ^[20].

This administrative challenge is further clarified by global evaluation models for newly expanded vaccine frameworks. Evidence demonstrates that although a nationwide rollout of the Rotavirus vaccine can be effectively supported by adequate vaccine logistics, strong political commitment, reliable cold chain systems, and comprehensive implementation planning, these structural strengths alone are often insufficient to achieve optimal immunization coverage. Persistent deficiencies in localized community awareness campaigns, limited public understanding of vaccine benefits, and inadequate communication between healthcare providers and caregivers frequently reduce community acceptance of newly introduced vaccines. In many settings, concerns regarding potential side effects, misinformation, and insufficient access to accurate health information continue to create operational bottlenecks that limit vaccine uptake despite the availability of services ^[4].

Furthermore, digital tools and information and communication technology (ICT) interventions have demonstrated considerable potential to strengthen immunization programs, with evidence

showing an odds ratio of 2.61 for improving complete immunization rates among children at one year of age. These technologies can enhance reminder systems, facilitate health education, and improve communication between healthcare providers and caregivers. Nevertheless, technology-driven interventions should complement rather than replace community-based health promotion efforts. To achieve equitable immunization coverage across geographically and socioeconomically diverse populations, digital innovations must be integrated with robust community literacy initiatives, culturally appropriate health communication, and sustained engagement by frontline healthcare workers ^[21].

Ultimately, addressing childhood health risks requires an integrated approach that connects health literacy with clinical services. Note that populations lacking adequate healthcare access suffer from a high burden of infectious diseases, such as severe suppurative otitis media, which directly worsens secondary malnutrition and early growth faltering. Therefore, hospital management and public health departments must transition from passive, facility-bound service models to integrated frameworks. Downstream clinical acceleration for new antigens (PCV and Rotavirus) within primary health facilities cannot achieve optimal targets without an integrated upstream health promotion engine to mitigate regional disparities across all 38 provinces ^[22].

Conclusion

This study successfully delivers the analytical expectations outlined in the introduction by demonstrating a clear geographic and systemic conformity between upstream health promotion outcomes and downstream clinical service utilization across Indonesia. Through a macro-spatial comparative lens, the findings confirm that massive regional disparities in maternal health literacy regarding stunting impacts directly correspond with severe bottlenecks in the uptake of newly introduced routine antigens. Provinces characterized by critically low maternal literacy, such as Maluku Utara, systematically align with regional clusters exhibiting the lowest national coverages for both complete PCV immunization among older infants and full-dose Rotavirus series among toddlers, as exemplified by the historic utilization lows recorded in Aceh. Conversely, robust health promotion and communication frameworks in areas like Jawa Tengah, DI Yogyakarta, and Bali yield optimal clinical utilization rates. These patterns show that treating immunization coverage purely as a facility-bound logistical or vaccine supply chain issue is administratively inadequate.

The prospects for implementing these research results suggest that hospital management, primary healthcare networks (*Puskesmas*), and regional health departments must move away from passive, facility-bound service delivery. To bridge the wide sub-national gaps highlighted by the SSGI 2024 dataset, downstream clinical acceleration must be driven by an aggressive, community-centered health promotion engine. Future research should expand on these macro-level findings by utilizing mixed-methods or spatial-econometric modeling to investigate localized socio-cultural barriers, including spousal support, maternal reading abilities, and digital network infrastructure across specific high-risk pockets and underserved communities.

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