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Exploring Environmental Health Determinants and Their Influence on Childhood Stunting

Baren Yoel Hindom[1], Indasah[2], Agusta Dian Ellina[2]

[1] *Post Graduate Program in Public Health Science, Universitas Strada Indonesia, Indonesia*
[2] *Public Health Science, Universitas Strada Indonesia, Indonesia*

Correspondence should be addressed to:
Baren Yoel Hindom
barenhindom2704@gmail.com

Abstract:
Stunting remains a significant public health issue in Indonesia, particularly in the eastern provinces such as West Papua, where environmental and infrastructural limitations exacerbate child health disparities. Environmental health factors—such as water quality, sanitation, and hygiene behaviors—are recognized as crucial yet underexplored determinants of stunting. This study aimed to investigate the role of environmental health conditions and community practices in contributing to stunting among children under five in the working area of Degen Public Health Center, Teluk Patipi District, Fakfak Regency, West Papua Province. A qualitative descriptive design was employed to capture the lived experiences and perceptions of mothers, health cadres, and local health officers. Data were collected from January to March 2025 through semi-structured interviews, direct observation, and a brief descriptive survey involving 66 mothers of children under the age of five. Thematic content analysis was conducted following Braun and Clarke's framework, supported by descriptive statistics to summarize demographic and stunting-related characteristics. The findings revealed four major themes influencing stunting: (1) limited access to safe water and proper sanitation facilities; (2) inadequate household waste management; (3) poor hygiene behaviors influenced by cultural practices and limited awareness; and (4) insufficient community-based health education. Quantitative data indicated that more than half of the children exhibited stunted growth, primarily in households lacking access to clean water and sanitary latrines. Environmental health factors significantly contribute to the persistence of stunting in rural Papua settings. Strengthening water, sanitation, and hygiene (WASH) infrastructure, along with culturally tailored community health education, is essential for reducing stunting prevalence and improving child health outcomes.

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INTRODUCTION

Stunting remains one of the most pressing global public health challenges, reflecting long-term nutritional deprivation, recurrent infection, and inadequate psychosocial stimulation during early childhood (Soliman et al., 2021). Stunting, defined as impaired linear growth indicated by a height-for-age z-score below -2 standard deviations of the WHO Child Growth Standards, is not merely a manifestation of malnutrition but also a critical marker of cumulative socioeconomic, environmental, and health inequities (Ramlan et al, 2025). It has irreversible consequences for cognitive development, school performance, productivity, and long-term health outcomes, including the risk of chronic diseases in adulthood (Higgisns et al., 2021). Despite global commitments to reduce stunting as part of the Sustainable Development Goals (SDG 2.2), approximately 148 million children under

five remain stunted worldwide, with the burden disproportionately concentrated in low- and middle-income countries (Tapgiken et al., 2024).

In Southeast Asia, stunting continues to represent a significant barrier to achieving equitable child health outcomes. Recent estimates indicate that countries in this region, including Indonesia, still struggle to meet global targets, despite decades of nutritional and public health interventions (Dee Pee et al., 2021). The determinants of stunting in these settings are multifactorial and interrelated, encompassing inadequate dietary intake, poor sanitation, unsafe water sources, infectious diseases, maternal undernutrition, and low household socioeconomic status (Mulyaningsih et al., 2021). Among these, environmental health factors such as access to clean water, waste disposal systems, and hygiene behaviors play a central yet often underrecognized role in shaping child growth trajectories. Unsanitary environments facilitate fecal-oral transmission of pathogens, leading to recurrent diarrhea, intestinal infections, and environmental enteropathy, which collectively hinder nutrient absorption and linear growth (Abou-Seri et al., 2022; Kurniyawan et al., 2024).

Indonesia, as the world's fourth most populous country, continues to face persistent challenges in preventing stunting despite comprehensive national programs, such as the Gerakan Nasional Percepatan Perbaikan Gizi and Stranas Stunting (Wasono & Sukmana, 2024). The problem is especially pronounced in eastern Indonesia, including the provinces of Papua and West Papua, where rates consistently exceed the national average. These regions are characterized by difficult geographic access, limited infrastructure, low educational attainment, and cultural practices that influence food security and hygiene (Ogwu et al., 2024). Consequently, understanding stunting within these areas requires a comprehensive analysis of environmental health determinants that interact with sociocultural and economic factors.

Environmental health plays a crucial role in preventing stunting. The WHO conceptual framework for child growth highlights environmental sanitation and hygiene as upstream determinants that influence intermediary causes such as infection and nutrient absorption (WHO, 2021). Empirical evidence supports this framework: children exposed to poor sanitation and contaminated water sources are more likely to suffer from chronic undernutrition (Zavala et al., 2021; Kurniyawan et al., 2024). A study in rural Nepal, for instance, found that households without improved sanitation facilities were 1.5 times more likely to have stunted children (Sahiledengle et al., 2022). Similarly, research in sub-Saharan Africa revealed that inadequate handwashing practices and unsafe waste disposal significantly increased stunting prevalence (Momberg et al., 2021). These findings underscore the need for integrated interventions that address not only food security but also the broader environmental conditions shaping child health.

However, most existing studies on stunting in Indonesia have primarily employed quantitative or survey-based methods, focusing on socioeconomic and dietary determinants, which leaves a gap in understanding the contextual and behavioral dimensions of environmental health (Deksne et al., 2025). Few studies have qualitatively explored how community members perceive and manage sanitation, water use, and hygiene practices within their specific ecological and cultural settings. Qualitative inquiry is essential because environmental health behaviors are deeply embedded within social norms, beliefs, and local practices that cannot be captured through numerical indicators alone (Dioba et al., 2024). Moreover, rural and semi-rural communities often possess indigenous knowledge systems that influence health behaviors; if understood correctly, these could inform culturally tailored stunting prevention strategies.

The Degen Public Health Center (Puskesmas Degen) in the Teluk Patipi District, Fakfak Regency, West Papua, represents one of the areas with persistently high stunting rates in the province, according to the 2024 District Health Report. The community largely depends on natural

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water sources, such as springs and rainwater, and faces challenges related to sanitation, waste management, and access to clean water. The geographical isolation and limited health infrastructure compound these challenges, while traditional lifestyles and low public health awareness further contribute to environmental health risks. Health workers and community cadres in this area have long struggled to promote behavior change related to hygiene and sanitation due to cultural and economic constraints. Therefore, investigating environmental health factors from a community perspective is crucial to uncover the underlying mechanisms that perpetuate stunting in this context.

A qualitative descriptive approach provides the methodological flexibility necessary to explore the complex interactions between environmental factors and child growth outcomes. This design enables a detailed examination of the lived experiences, perceptions, and practices of mothers, community health workers, and local authorities (Akhter et al., 2021). By emphasizing participants' narratives, such an approach can illuminate the social and environmental realities that quantitative studies may overlook. Additionally, qualitative exploration can identify practical opportunities for community-driven solutions, aligning with Indonesia's current policy direction, which emphasizes local empowerment in stunting reduction programs (Kemenkes RI, 2023).

Understanding stunting from an environmental health perspective also aligns with global frameworks such as the One Health approach, which recognizes that child health is interconnected with environmental and social systems (Gharpure et al., 2021). Integrating environmental determinants into stunting prevention efforts requires a nuanced understanding of how households and communities interact with their surroundings, how water is collected and stored, how waste is managed, and how hygiene practices are influenced by knowledge, access, and belief systems (Yusriadi et al., 2024). In this sense, qualitative research can bridge the gap between policy and practice by providing evidence grounded in real-life experiences.

Given the persistent disparities in stunting prevalence and the scarcity of qualitative research exploring the environmental health dimensions in Papua and West Papua, this study seeks to fill an important gap in the literature. It examines how environmental health factors, including sanitation practices, water access, waste management, and hygiene behaviors, impact the incidence of stunting among children under five in the working area of the Degen Public Health Center. By engaging mothers, health cadres, and local health officers as participants, the study aims to generate context-specific insights that can inform culturally sensitive and sustainable public health interventions.

Ultimately, this research contributes to the growing body of evidence that emphasizes the need for stunting prevention to move beyond nutritional supplementation and address the underlying environmental and social determinants of health. By employing a qualitative descriptive design, the study not only captures the complexity of environmental influences on child growth but also amplifies the voices of communities often marginalized in national policy discourse. The findings are expected to guide policymakers, healthcare providers, and development partners in designing integrated, community-based interventions to improve environmental health and child nutrition outcomes in Indonesia's eastern regions.

METHOD

This study employed a qualitative descriptive design to explore and describe environmental health factors and their relationship to stunting among children under five in the working area of the Degen Public Health Center, Teluk Patipi District, Fakfak Regency, West Papua, Indonesia. The descriptive qualitative approach was chosen because it allows an in-depth exploration of participants' experiences, perceptions, and contextual factors influencing environmental health practices related

to child growth. This design is suitable when the objective is to provide a comprehensive understanding of a phenomenon as it occurs naturally in the community, without manipulating variables. The study adhered to the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines to ensure methodological rigor and transparency.

The research was conducted in the working area of the Degen Public Health Center, located in the Teluk Patipi District of Fakfak Regency, West Papua Province. The region is characterized by a semi-rural geography with limited infrastructure, high dependence on non-piped water sources (such as natural springs and rainwater), and a predominantly agricultural livelihood. The area was selected purposively because it had reported a high prevalence of stunting in the 2024 provincial health surveillance report. Additionally, the region faces typical environmental health challenges common in eastern Indonesia, including inadequate sanitation, limited access to clean water, and low household incomes.

Participants in this study included mothers of children under five years old and community health workers (kader) directly involved in child health programs. A total of 66 mothers were included in the initial descriptive assessment, while 12 key informants (8 mothers, three health cadres, and one environmental health officer) were selected for in-depth interviews.

The sampling technique employed was purposive sampling with maximum variation, designed to capture different perspectives based on socioeconomic background, educational level, and environmental conditions. Inclusion criteria included: (1) mothers with children under five who had been residing in the study area for at least six months, (2) willingness to participate voluntarily, and (3) ability to communicate in Indonesian or the local dialect. Exclusion criteria included mothers whose children had congenital diseases or chronic illnesses unrelated to nutrition. Participant recruitment was facilitated through collaboration with the Degen Public Health Center and community leaders. Prior to data collection, all participants were provided with detailed information about the study's objectives, confidentiality, and their rights to voluntary participation.

Data were collected from January to March 2025 using a combination of structured observation, in-depth interviews, and a short descriptive survey to capture quantitative characteristics. The quantitative survey focused on demographic and stunting-related indicators (such as age, gender, anthropometric status, and parental occupation). Anthropometric data were validated using child health records and measured in accordance with the WHO Child Growth Standards. Qualitative data were collected using semi-structured interviews guided by an interview protocol that explored key themes: (1) perceptions of environmental health and sanitation, (2) hygiene behavior and household practices, (3) water and waste management, and (4) community and health worker efforts in stunting prevention. Each interview lasted approximately 45–60 minutes and was conducted either at the participants' homes or at the local health center, depending on convenience and privacy considerations. All interviews were audio-recorded with the participants' consent and supplemented by field notes to capture nonverbal expressions and contextual observations.

The data were analyzed through a thematic content analysis approach following Braun and Clarke’s six-step framework: (1) data familiarization, (2) initial coding, (3) theme identification, (4) theme review, (5) theme definition and naming, and (6) reporting. Audio recordings were transcribed verbatim in Indonesian and later translated into English for analysis. The research team independently coded the transcripts and discussed emerging themes to reach consensus. NVivo 12 Plus software was used to assist with data management and ensure systematic coding. Quantitative data derived from the descriptive survey (frequency and percentage distributions) were analyzed using Microsoft Excel. The results were presented in a single, integrated table that summarized

respondent characteristics and stunting status. These quantitative findings were used to support and triangulate qualitative interpretations.

To ensure the trustworthiness of this qualitative study, the researchers rigorously applied four key criteria: credibility, dependability, confirmability, and transferability throughout the research process. Credibility was achieved through prolonged engagement in the field, allowing the researchers to build rapport with participants and gain a deep understanding of the local context. Data triangulation from multiple sources, including mothers, community health cadres, and environmental health officers, strengthened the authenticity of the findings. Member checking was also conducted by presenting preliminary interpretations to selected participants to verify the accuracy of the data representation. Dependability was maintained through detailed documentation of research procedures, including interview guides, coding frameworks, and analytic decisions, ensuring transparency and consistency across stages of data collection and analysis. Confirmability was enhanced through reflexive journaling and peer debriefing sessions, enabling the researchers to examine their own assumptions and minimize bias during critical interpretation. Finally, transferability was supported by providing rich contextual descriptions of the study setting, participants' characteristics, and community conditions in the Degen Public Health Center area of West Papua. These descriptions allow readers to assess the relevance and applicability of the findings to other similar contexts. Collectively, these strategies ensured methodological rigor and strengthened the reliability of interpretations, allowing the study to present a credible, balanced, and contextually grounded understanding of how environmental health factors influence stunting among children under five in this region.

This study received ethical approval from the Public Health Science, Strada Indonesia University. All research procedures were conducted in strict accordance with the ethical guidelines and principles established by the institution, ensuring the protection of participants' rights, confidentiality, and well-being throughout the study. Informed consent was obtained from all participants prior to data collection, and the study protocol was reviewed and approved under the official ethical clearance number, affirming compliance with national and international standards for research involving human subjects.

RESULT

Table 1. Characteristics of respondents and stunting status

Variable	Category	Frequency (n)	Percentage (%)
Child age (months)	12–24	36	54.55
	25–35	14	21.21
	36–47	9	13.64
	48–59	7	10.61
Child sex	Female	44	66.67
	Male	22	33.33
Mother's occupation	Housewife (IRT)	36	54.55
	Entrepreneur	8	12.12
	Farmer	19	28.79
	Self-employed/Other	3	4.55
Stunting status by sex	Male	26	52.00
	Female	24	48.00
Stunting status by age group	0–12	7	14.00
	13–24	23	46.00
	25–36	20	40.00
Stunting status by anthropometry	Severely short ("Very short")	16	32.00
	Short ("Short")	34	68.00

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The characteristics of the sample reveal that more than half (54.55%) of the children were aged 12–24 months, a life stage marked by rapid growth and high nutritional needs. The proportion declined in the older age groups (21.21% for 25–35 months; 13.64% for 36–47 months; 10.61% for 48–59 months). In terms of sex distribution, two-thirds of the children (66.67%) were female, indicating a higher representation of girls in the study sample. This may warrant consideration when interpreting gender-related nutritional risk, although in many contexts, the risk of stunting may differ by sex.

Regarding maternal occupation, 54.55% of mothers were homemakers, reflecting limited formal economic engagement. The next largest group was farmers (28.79%), followed by entrepreneurs (12.12%) and other self-employed (4.55%). This occupational profile suggests that socioeconomic constraints influence household food security, childcare time allocation, and exposure to environmental health risks.

Among the subsample assessed for stunting (n = 50), 52.00% of the stunted children were male and 48.00% female, suggesting near-parity of stunting by sex in this context. The age distribution of stunting shows a concentration in the 13–24 months age group (46.00%), followed by the 25–36 months age group (40.00%), and a relatively low percentage of 14.00% in the 0–12 months age group. This indicates that the critical period for stunting in this community may be during early toddlerhood. According to anthropometric classification, most stunted children (68.00%) were classified as “Short,” while 32.00% were classified as “Very short,” indicating a significant subset is experiencing severe growth faltering. These quantitative findings provide a foundational understanding for the qualitative component of the study, which explores how environmental health factors shape the observed patterns of stunting.

Data analysis generated three major themes and seven subthemes describing how environmental health conditions influence stunting among children under five in the Degan Public Health Center area. The themes reflect the interaction between household environmental factors, community practices, and maternal perceptions toward hygiene and nutrition.

Theme 1: Household Sanitation and Hygiene Practices

Subtheme 1.1 – Limited Access to Clean Water

Most households reported difficulties in obtaining clean and safe water. The primary sources were rainwater, river water, or shallow wells that often dried up during the dry season. Poor water quality was perceived as usual, and water treatment practices were rare.

> *“We often use river water for cooking and bathing because the well dries up in the dry season. Sometimes the water is yellowish, but we still use it.” (P1)*

This limited access to clean water contributed to frequent episodes of diarrhea and skin infections among children, which in turn affected nutritional absorption and growth.

Subtheme 1.2 – Inadequate Sanitation Facilities

A large proportion of respondents lacked access to private toilets. Shared latrines or open defecation were common, especially in areas distant from community infrastructure.

> *"There is no toilet at home, so we go to the river or behind the house. It has been like that for years." (P2)*

Environmental contamination from open defecation increased the risk of recurrent infections in children and perpetuated poor hygienic conditions at the household level.

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Theme 2: Environmental Conditions and Disease Exposure

Subtheme 2.1 – Improper Waste Disposal

Household waste management was inadequate, with most families burning or disposing of garbage near their homes or in nearby rivers. This created unsanitary surroundings that attracted flies and other vectors.

"We usually burn the trash or throw it behind the house. There is no garbage truck coming here." (P3)

Such practices contributed to environmental pollution and facilitated the transmission of infectious diseases, including diarrhea and respiratory infections.

Subtheme 2.2 – Recurrent Infections and Health Vulnerability

Mothers consistently linked their children's poor growth with frequent illnesses, particularly diarrhea, respiratory infections, and fever. However, few understood the direct connection between environmental exposure and stunting.

"My child often gets diarrhea, especially during the rainy season when the water turns dirty. Sometimes it lasts for several days." (P4)

Children with recurrent infections were more likely to exhibit signs of growth faltering, reflecting the cyclical relationship between environmental hygiene, infection, and nutrition.

Theme 3: Knowledge, Perceptions, and Cultural Practices

Subtheme 3.1 – Limited Knowledge on Hygiene and Nutrition

Many mothers were unaware of the link between environmental cleanliness and child growth. Hygiene practices, such as hand washing and safe food handling, were applied inconsistently.

"We did not know that dirty water or not washing hands could make children sick or short." (P5)

This lack of awareness suggests gaps in health education and limited community outreach from local health workers.

Subtheme 3.2 – Cultural Beliefs and Feeding Practices

Cultural norms influenced early feeding behaviors. Several mothers introduced adult food or rice-based meals to infants before six months, believing it would strengthen them.

"We believe children should eat rice early so they will grow strong. That is what our parents did." (P6)

These beliefs often conflicted with recommended feeding practices, contributing to inadequate nutrient intake.

Subtheme 3.3 – Barriers to Health-Seeking Behavior

Physical distance to health facilities, transportation challenges, and economic constraints limited mothers' ability to access health services or participate in community health programs.

"The Puskesmas is far, and we have to take a boat. We only go if the child is seriously ill." (P7)

This limited access delayed early detection and intervention for malnutrition cases, exacerbating the risk of chronic stunting.

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The qualitative results highlight that environmental health determinants, such as abysmal sanitation, unsafe water, and weak community hygiene behaviors, are deeply intertwined with social and cultural contexts. Stunting is not solely a nutritional issue but the cumulative result of repeated environmental exposure, insufficient health literacy, and structural inequities in access to clean water and healthcare. These findings underscore the need for integrated, community-based environmental health interventions that combine behavioral change communication, infrastructure improvement, and culturally sensitive health education to reduce the risk of stunting among vulnerable populations.

DISCUSSION

This qualitative study explored the environmental health factors contributing to stunting among children under five in the Degan Public Health Center area, Teluk Patipi District, Fakfak Regency, West Papua Province. The findings revealed three interrelated dimensions: (1) inadequate sanitation and hygiene practices, (2) poor environmental conditions leading to repeated infections, and (3) limited maternal knowledge and sociocultural influences that shape health behaviors. Collectively, these dimensions illustrate the multifactorial nature of stunting within a geographically isolated and resource-constrained setting.

The results confirm that environmental determinants play a pivotal role in the persistence of childhood stunting. Previous global analyses highlighted that unsafe water, sanitation, and hygiene (WASH) conditions contribute to up to 50% of stunting cases in low- and middle-income countries (Silva et al., 2023). In the current study, limited access to clean water, inadequate latrine facilities, and open defecation were dominant issues. These findings are consistent with research in other rural Indonesian regions, such as East Nusa Tenggara and Papua, where WASH-related infections contribute significantly to impaired growth (Saputra et al., 2025).

The observed dependence on river or rainwater mirrors the environmental vulnerability of many coastal Papuan communities, where geographical isolation restricts infrastructure development. Water scarcity, compounded by seasonal fluctuations, forces residents to rely on unsafe sources, increasing the risk of enteric infections. Such recurrent infections are known to impair intestinal integrity, resulting in environmental enteric dysfunction (EED), a subclinical condition that reduces nutrient absorption and contributes to linear growth retardation (Modern, G., 2021).

Moreover, inadequate waste disposal practices such as burning or dumping garbage near the river create an environment conducive to pathogen transmission and vector proliferation. These local observations align with findings from rural Bangladesh and Ethiopia, where household waste mismanagement has been linked to higher rates of diarrhea and malnutrition (Mebrahtom et al., 2022). Such conditions illustrate how environmental exposures and infectious disease cycles reinforce each other, perpetuating stunting even when food availability improves.

The limited adoption of hygiene practices, particularly handwashing with soap, was a recurring theme. Mothers in this study frequently reported washing hands only when visibly dirty or during meal preparation, rather than at critical times such as after defecation or cleaning a child. This pattern reflects both knowledge gaps and the scarcity of water and soap. Studies in other Indonesian provinces, such as South Sulawesi and Central Java, similarly identified hygiene behavior as a critical determinant of child health outcomes (Wulandari et al., 2025).

Insufficient hygiene knowledge also aligns with global evidence that maternal health literacy has a significant impact on child nutrition and infection rates. For instance, a large-scale study in India found that mothers with low WASH-related knowledge were 2.5 times more likely to have stunted children (Tosepu et al., 2023). In the present study, most mothers were unaware of the

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connection between water quality and stunting, viewing diarrhea as a “normal” part of childhood rather than a preventable condition. This normalization of illness reflects broader social learning processes in marginalized communities, where repeated exposure to poor sanitation conditions leads to environmental habituation.

Cultural norms also played a substantial role in shaping feeding and hygiene behaviors. Many participants adhered to traditional practices such as early introduction of solid foods and shared feeding, based on inherited beliefs rather than biomedical guidance. These findings echo results from similar studies in remote Indonesia, where traditional feeding practices are deeply rooted and often resist public health messaging (Caraka et al., 2024). The perception that early rice feeding promotes strength suggests a limited understanding of nutrition, prioritizing satiety over nutrient diversity.

These cultural practices are further reinforced by limited access to formal health services. The long distance to the health center and the need for costly boat transportation discouraged routine visits. As a result, growth monitoring and early detection of malnutrition were rarely performed. Similar structural barriers were reported in studies from rural Papua New Guinea and the Solomon Islands, where geographic isolation hinders health service delivery and contributes to poor child growth outcomes (Seidu et al., 2021). Thus, stunting in the Degan community cannot be understood solely as a biological or behavioral problem but as a product of environmental inequity and geographic exclusion.

An important insight from this study is the synergistic relationship between environmental and social determinants. While environmental contamination directly affects child health, the way families interpret and respond to these risks is mediated by cultural values, gender roles, and socioeconomic status. Mothers, often the primary caregivers, often carry the double burden of domestic responsibilities and limited agency in influencing household sanitation decisions. The gendered dimension of stunting has been discussed in global health literature as a neglected determinant (Rahmawati & Putri, 2023). In the current study, women limited decision-making power over household resources and infrastructure investment perpetuated dependence on unsafe practices, such as shared latrines and unfiltered water use.

Furthermore, the overlap between poverty, knowledge gaps, and environmental exposure creates a vicious cycle. Poor households are more likely to inhabit unsanitary environments, have limited education, and experience recurrent infections, each of which compounds the risk of stunting. This multidimensional vulnerability is consistent with the conceptual framework for child undernutrition, which emphasizes that environmental health factors mediate both immediate (disease, diet) and underlying (socioeconomic) causes of stunting (Rahut et al., 2024).

From a public health perspective, these findings underscore the importance of integrating WASH and nutrition interventions that are tailored to local contexts. Traditional top-down approaches focusing solely on dietary supplementation or growth monitoring are insufficient. Instead, interventions should prioritize community participation and behavior change communication that acknowledges local beliefs and constraints. Studies from similar community-based programs in Indonesia and sub-Saharan Africa demonstrated that combining hygiene education with environmental infrastructure improvements led to measurable reductions in child stunting (Rafizar et al., 2025).

For nursing and community health practice, the results highlight the importance of nurse-led, culturally sensitive health promotion. Nurses and community health workers are often the first and most trusted sources of health information. They play a crucial role in promoting health literacy, modeling hygiene behaviors, and fostering the connection between environmental awareness and child development outcomes. Evidence from nurse-led interventions in low-resource settings shows

improvements in both maternal practices and child nutritional status when culturally adapted educational modules are implemented (Mohammed et al., 2025).

Policymakers should view stunting as a multisectoral issue that bridges environmental health, maternal education, and rural development. Infrastructure programs aimed at improving access to clean water and sanitation must be integrated with nutrition-sensitive initiatives. Moreover, given the unique geographical and cultural landscape of West Papua, locally tailored strategies involving indigenous leadership and traditional institutions are essential. Strengthening partnerships between local governments, health centers, and communities can enhance sustainability.

Future research should focus on employing longitudinal and mixed methods approaches to capture the causal pathways between environmental exposure, infection, and growth outcomes. Moreover, evaluating the effectiveness of culturally contextualized WASH interventions could provide valuable insights into scalable solutions for remote communities across Indonesia and similar settings globally.

CONCLUSION

This study confirms that environmental health factors, including abysmally poor sanitation, limited access to clean water, and inadequate hygiene practices, are significant contributors to childhood stunting in the Degan community. These environmental determinants are inextricably linked to sociocultural practices, economic constraints, and structural barriers to healthcare access. Addressing stunting, therefore, requires a comprehensive, community-based, and culturally attuned strategy that integrates environmental health, maternal education, and health service accessibility.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this research. All procedures were conducted independently, and no financial, personal, or professional relationships influenced the study design, data collection, analysis, or interpretation of the results.

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