



REVIEW ARTICLE

Child Stunting in Papua, Indonesia: Determinants and Pathways from a UNICEF Framework–Guided Narrative Review

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Abstract

Stunting remains a major public health problem in Papua, Indonesia, with burdens concentrated in remote and rural communities. This narrative review synthesized evidence on determinants of stunting among children under five and organized findings using the UNICEF framework (immediate, underlying, and basic/enabling causes). A structured Google Scholar search (2015–2025) identified 39 records; after deduplication and screening, 11 studies were included for thematic narrative synthesis. Across included studies, infection pathways—especially maternal malaria and early-life malaria exposure—were consistently associated with stunting. Case-control evidence also linked adverse birth outcomes (low birth weight and short birth length) to higher odds of later stunting. Nutrition-related determinants included inadequate diet quality, micronutrient gaps (iron and iodine), and maladaptive caregiver feeding practices during complementary feeding, while breastfeeding indicators showed mixed associations across settings. Environmental constraints, notably poor sanitation and limited access to safe water, repeatedly co-occurred with structural disadvantages such as low maternal education, poverty, rural residence, and restricted access to primary health services. The evidence supports integrated, Papua-specific action: combine malaria prevention and treatment in pregnancy with the first-1,000-days nutrition agenda, strengthen WASH infrastructure, expand routine growth monitoring and counseling, and deliver family-centered support for feeding and timely care-seeking.

Keywords: stunting; Papua; malaria; complementary feeding; WASH.

Abstrak. Stunting masih menjadi masalah kesehatan utama di Papua, Indonesia, terutama di wilayah terpencil dan perdesaan. Tinjauan naratif ini mensintesis bukti determinan stunting pada anak di bawah lima tahun dan menata temuan dengan kerangka UNICEF (segera, mendasar, dasar/pemungkin). Pencarian terstruktur di Google Scholar (2015–2025) menemukan 39 rekaman; setelah deduplikasi dan seleksi, 11 studi diinklusi dan dianalisis secara naratif tematik. Jalur infeksi—khususnya malaria pada kehamilan dan paparan malaria awal kehidupan—secara konsisten berasosiasi dengan stunting. Bukti kasus-kontrol juga menunjukkan luaran kelahiran buruk (BBLR dan panjang lahir pendek) berkaitan dengan odds stunting lebih tinggi. Jalur gizi meliputi kualitas diet rendah, defisit mikronutrien (zat besi, yodium), serta praktik pemberian makan pengasuh yang kurang tepat pada periode MP-ASI; indikator menyusui menunjukkan hasil yang bervariasi antar lokasi. Kendala lingkungan (sanitasi buruk, air minum tidak aman) sering muncul bersama kerentanan struktural seperti pendidikan ibu rendah, kemiskinan, tinggal di perdesaan, dan akses layanan primer terbatas. Temuan mendukung aksi terpadu spesifik Papua: integrasikan layanan malaria maternal dengan agenda gizi 1.000 HPK, perkuat WASH, perluas pemantauan pertumbuhan rutin dan konseling, serta dukungan keluarga untuk pemberian makan dan pencarian layanan tepat waktu, terutama di daerah endemis malaria dan distrik dengan hambatan geografis tinggi secara berkelanjutan.

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Kata kunci: stunting; Papua; malaria; MP-ASI; WASH

INTRODUCTION

Stunting remains a persistent public health and human development challenge, particularly in low- and middle-income settings where biological, environmental, and structural risks converge during the first 1,000 days of life. The World Health Organization (WHO) defines stunting as impaired linear growth, operationalized as a height-for-age (or length-for-age) z-score below -2 standard deviations from the WHO Child Growth Standards median (World Health Organization [WHO], 2025). Beyond being an anthropometric indicator, stunting reflects cumulative and often intergenerational adversity—insufficient nutrient intake, repeated infections, and constrained caregiving and service environments—that shape a child's growth trajectory over time (de Onis & Branca, 2016).

The consequences of stunting extend well beyond stature. Early-life linear growth faltering is associated with delayed cognitive and socioemotional development, poorer educational attainment, reduced adult productivity, and elevated risks of chronic disease across the life course (Black et al., 2013; Victora et al., 2021). Mechanistically, stunting is increasingly understood as a “syndrome” in which suboptimal diet quality, inflammation, environmental enteric dysfunction, and recurrent infections interact with caregiving and social conditions, making single-factor explanations insufficient for policy and practice (Humphrey, 2009; Prendergast & Humphrey, 2014). Consequently, high-quality synthesis should prioritize pathways and clusters of determinants rather than presenting isolated “lists” of risk factors.

To ensure a coherent theoretical foundation for thematic synthesis, this narrative review is anchored in the UNICEF conceptual framework of maternal and child nutrition, which organizes determinants into (1) immediate causes (inadequate dietary intake and disease), (2) underlying causes (food security, caregiving practices, and health services and healthy environments), and (3) basic/enabling causes (socioeconomic resources, governance, and structural inequities) (United Nations Children's Fund [UNICEF], 2021). This framework is particularly relevant for Papua because stunting risk is likely shaped by interacting layers of vulnerability—from household feeding and caregiving decisions to service access and broader geographic and socioeconomic constraints.

In Indonesia, stunting reduction has been a national priority for more than a decade, yet marked geographic disparities persist. Recent national monitoring continues to show that Eastern Indonesia—including Papua—experiences a substantially higher burden than many western provinces, suggesting that place-based determinants (infrastructure, service availability, market connectivity, and ecological exposures) can meaningfully shape—and sometimes amplify—conventional pathways to growth faltering (Kementerian Kesehatan Republik Indonesia, 2022; Mulyaningsih et al., 2021; Gusnedi et al., 2023; Wulandari et al., 2022). Within Papua, the burden is also heterogeneous across districts and population groups, reinforcing that local constellations of risk should be characterized explicitly rather than inferred from national averages alone, especially when policy targeting and program delivery increasingly rely on subnational profiles (Wahyudianto & Prasetyo, 2024; Wulandari et al., 2022).

Papua presents a distinct risk ecology that can intensify growth faltering through multiple, mutually reinforcing mechanisms across the immediate–underlying–basic levels described in the UNICEF determinants framework (United

Nations Children's Fund, 2021). First, high infectious exposure—including endemic malaria in several areas—may elevate stunting risk directly via inflammation and anemia and indirectly via adverse birth outcomes and reduced intake/absorption during illness (Felle & Sahiddin, 2024; Sahiddin et al., 2024; Sharp & Harvey, 1980; Kang et al., 2013; Millward, 2017). Second, long travel times and difficult geography can delay preventive and curative care (ANC/PNC, growth monitoring, IYCF counseling, and timely treatment of diarrhea/ARI), thereby weakening the protective effect of routine services and behavior-change interventions (Wahyudianto & Prasetyo, 2024). Third, limited WASH access can increase enteric pathogen exposure and repeated infections, contributing to environmental enteric dysfunction—pathways increasingly recognized as central to linear growth impairment (Humphrey, 2009; Prendergast & Humphrey, 2014; Astuti, 2022; Dwipayanti & Purnama, 2022; Kustriyanti et al., 2024). Fourth, food insecurity and market access constraints can reduce dietary diversity and protein-quality intake, particularly during the transition to complementary feeding, which is consistently linked to stunting risk when diets are monotonous and micronutrient intake is low (Dewey, 2016; Ngardita et al., 2021; Gusnedi et al., 2023; Wulandari et al., 2024). Finally, structural inequalities—including poverty and educational disadvantage—shape parental capacity to sustain adequate diets, hygienic home environments, and timely health-seeking, making “parental role” a practical leverage point for prevention strategies (Ashar et al., 2024; Wulandari et al., 2022).

Despite the growing body of research on stunting determinants in Indonesia, evidence specific to Papua remains fragmented across disciplines and study designs, often emphasizing selected variables (e.g., maternal education, feeding practices, infections, WASH, or socioeconomic status) without integrating them into a single explanatory structure. As a result, decision-makers may struggle to translate disparate findings into coherent, multi-level intervention priorities tailored to Papua's context. A narrative review is appropriate in this setting because it supports interpretive integration across heterogeneous evidence—quantitative, qualitative, and mixed-method studies—while enabling a theoretically guided organization of determinants into pathways and levels of causation (Ferrari, 2015; Grant & Booth, 2009).

Therefore, this narrative review aims to synthesize and organize the existing evidence on determinants and pathways related to stunting among children under five in Papua. Guided by the UNICEF framework, the review seeks to (1) map dominant determinants across immediate, underlying, and basic/enabling levels; (2) clarify how Papua-specific conditions—such as endemic infection exposure, service access barriers, WASH constraints, food insecurity, and rural–urban inequities—may shape risk pathways; and (3) identify actionable parent- and family-centered levers (feeding, caregiving, hygiene behaviors, and care-seeking decisions) that can be aligned with health-system and structural interventions. By providing a coherent, theory-based synthesis, this review is intended to strengthen the evidence base for designing context-sensitive stunting prevention strategies in Papua and to highlight priority gaps for future research.

METHODS

Review design and conceptual framework

This study was conducted as a narrative review, intended to integrate heterogeneous evidence (quantitative, qualitative, and mixed-methods) on stunting determinants among children under five in Papua in an interpretive but transparent manner. The review was theory-guided using the UNICEF conceptual framework of undernutrition to organize determinants across immediate causes (inadequate dietary intake and disease), underlying causes (household food security, caregiving practices, and health services/healthy environments), and basic/enabling causes (socioeconomic resources, governance, and structural inequities). This framework was applied to ensure that the synthesis moves beyond listing risk factors and instead explains plausible pathways relevant to Papua's context.

Information sources and search strategy

A structured literature search was conducted in Google Scholar, covering publications from 2015–2025. The final search was completed on [insert exact search date] to ensure replicability. Searches were performed using database-adapted keyword combinations representing (1) the outcome (stunting/linear growth faltering), (2) the population (children under five/toddlers), and (3) the context (Papua). To preserve consistency with the existing manuscript while making the strategy fully reproducible, the core search terms included: "stunting," "children under five," "causes/determinants/risk factors," and "Papua," complemented by Indonesian equivalents for Google Scholar (e.g., "balita," "faktor risiko," "malnutrisi"). In addition to database searches, backward citation searching of reference lists from included studies and key reviews was used to identify additional eligible articles (recorded as "other sources" in the study flow).

Eligibility criteria

Eligibility criteria were operationalized using a PEO structure to ensure objective inclusion/exclusion decisions:

- Population (P): children aged 0–59 months (under five), including toddlers/infants, and/or maternal factors explicitly linked to child stunting risk.
- Exposure/phenomenon (E): determinants/pathways associated with stunting (e.g., infection/malaria, birth outcomes, IYCF, WASH, food security, socioeconomic/education, access to health services).
- Outcome (O): stunting or linear growth impairment, preferably using standard definitions (e.g., HAZ < -2 SD) or clearly stated operational criteria.
- Context: studies conducted in Papua (including districts within Papua-related provinces as defined by the authors/study period) or, if studies outside Papua were included, they had to be demonstrably "context-relevant to Papua."

To avoid subjective selection, "context relevant to Papua" should be defined a priori as studies from settings that share core structural/ecological features that plausibly generalize to Papua's risk pathways—e.g., remote geography with limited service access, high infectious burden (including malaria-endemicity), constrained WASH infrastructure, food insecurity/market isolation, and rural–urban disparities—and the manuscript should explicitly justify relevance for each non-Papua study (ideally in the

study characteristics table). Included publication types were original empirical studies (observational, qualitative, mixed-methods, and relevant evaluations). Exclusions comprised opinion/editorial pieces, articles without accessible full text, and studies not aligned with the review focus.

Data extraction

All retrieved records were exported to Mendeley and deduplicated using DOI/title/author matching, followed by a manual check for residual duplicates. In the current review flow, 39 records were identified, 5 duplicates were removed, and 34 titles/abstracts were screened. Title/abstract screening was followed by full-text assessment of 24 articles, with 11 studies ultimately included in the synthesis. A standardized extraction form was used to capture: author/year, study location (district/setting in Papua), design, sample/population characteristics, stunting definition/ measurement, key determinants examined, main statistical indicators, and core qualitative themes

Data synthesis and thematic mapping

All included studies were synthesized using thematic narrative synthesis. First, determinants were coded inductively to capture recurring categories (e.g., infections/malaria, birth outcomes, diet and IYCF, WASH, socioeconomic/education, and service access). Next, codes were mapped deductively onto the UNICEF framework (immediate, underlying, basic/enabling causes), allowing determinants to be linked as pathways rather than isolated correlates. Where findings differed across studies, the synthesis explicitly noted inconsistency and considered whether differences could be explained by setting (rural/urban), population subgroup, measurement definitions, or study quality.

RESULTS OF STUDY

The evidence base comprised 11 studies conducted in Papua and Papua Barat (or Papua-related settings) between 2019 and 2024, covering diverse districts including Jayapura, Keerom, Nabire, Asmat, Sorong City, and Boven Digoel. The included studies were methodologically heterogeneous, including case-control studies (n = 3), cross-sectional studies (n = 6), one cross-sectional SEM study (n = 1), and one qualitative descriptive case study (n = 1). Sample sizes ranged from small facility-based samples (e.g., n = 30 at Tanah Merah Health Center) to large population-based analyses (e.g., 153,228 households and 11,887 children from a weighted national survey dataset), allowing triangulation across clinical, community, and population-level perspectives.

Study characteristics

Across studies, the target population primarily involved children under five (0–59 months), with two studies focusing on narrower age ranges such as 0–23 months and children under two years (n = 2), and one study examining early school-age children (approximately 5–7 years) to compare urban and rural nutritional status in Jayapura. Most studies explicitly evaluated stunting among under-five children, typically implying standard anthropometric classification (HAZ < -2 SD), although several studies did

not clearly restate the operational definition in the extraction matrix and should be explicitly reported in the manuscript's "Study Characteristics" table to enhance transparency. The geographic distribution indicates that Papua studies span both urban-adjacent areas (e.g., Jayapura, Sorong City) and remote or hard-to-reach districts (e.g., Asmat and Boven Digoel), which is critical for interpreting service-access and WASH pathways.

Evidence strength by study design and analytic approach

The strongest causal-leaning signals emerged from case-control designs in Jayapura and Sorong City. Two Jayapura-based case-control studies (using the same total sample size, 681 toddlers) investigated the role of maternal malaria during pregnancy and early-life malaria exposure,

supported by structured parental interviews and medical records across 14 primary health centers. In Sorong City (Kokoda Tribe), a case-control study (n = 168) quantified risk using odds ratios for birth outcomes and household exposures. Cross-sectional studies contributed consistent evidence about maternal education, household socioeconomic status, rural residence, feeding practices, and WASH, including large-scale logistic regression analyses (e.g., n = 11,887; n = 2,937) and an ecological/household-level regression model of sanitation and safe water coverage (n = 153,228 households). A qualitative descriptive study in Asmat added contextual explanations for behavioral and service utilization pathways (nutrition knowledge, food purchasing habits, and low posyandu participation).

Table 1. Thematic Analysis of Determinants of Stunting among Children Under Five in Papua

No	Theme	Supporting Studies	Key Findings
1	Infections and Malaria	Sahiddin et al. (2024); Felle & Sahiddin (2024); Mapandin (2019)	Exposure to malaria during early life and pregnancy significantly increases the risk of stunting. Children born to mothers with malaria show a higher prevalence of stunting. Infectious diseases further exacerbate poor nutritional status.
2	Biological Factors (Birth Weight/Length)	Ramdany (2023); Felle & Sahiddin (2024)	Low birth weight and short birth length increase the risk of stunting by approximately two to three times.
3	Dietary Patterns and Nutrition	Wulandari et al. (2024); Ngardita et al. (2021); Sianipar et al. (2021)	Inappropriate dietary patterns, low intake of iron and iodine, limited maternal nutritional knowledge, and unhealthy eating habits are significant contributors to stunting.
4	Breastfeeding Practices	Ngardita et al. (2021); Bumarop & Rismayanti (2023)	Exclusive breastfeeding and breastfeeding duration influence child nutritional status, although some studies report minimal effects.
5	Sanitation and Environment	Astuti (2022); Ramdany (2023); Sianipar et al. (2021)	Poor sanitation and limited access to clean water contribute to stunting. Sanitation emerged as a significant factor in multivariate regression analyses.
6	Socioeconomic Factors and Maternal Education	Wulandari et al. (2022); Felle & Sahiddin (2024); Mapandin (2019); Sianipar et al. (2021)	Low maternal education, marital status, household income, and rural residence are strongly associated with stunting. Male children and those born to unmarried mothers are at higher risk.
7	Regional Disparities (Urban vs Rural)	Mapandin (2019); Wulandari et al. (2022)	No statistically significant differences in nutritional status were observed between urban and rural children; however, rural environments continue to present higher risk due to limited access and socioeconomic constraints.

DISCUSSION

This narrative review synthesizes heterogeneous evidence on stunting among children under five in Papua and organizes the findings using the UNICEF conceptual framework (immediate, underlying, and basic/enabling determinants). Across the included Papua studies, stunting consistently emerges as a multifactorial outcome shaped by the interaction of infectious exposure (especially malaria), adverse birth outcomes (low birth weight/short birth length), suboptimal dietary intake and feeding behaviors, WASH constraints, and structural inequities (education, poverty, and rural access barriers) (Sahiddin et al., 2024; Felle & Sahiddin, 2024; Ramdany & Norma, 2023; Astuti, 2022; Wulandari et al., 2022; Wulandari et al., 2024). Importantly, while the title uses "causes," most of the available evidence—dominated by observational designs—supports associations and plausible pathways rather than definitive causal inference.

Findings from the included Papua studies indicate that infectious exposure, particularly malaria, is a prominent determinant of stunting. Two case-control studies from Jayapura reported a significantly higher likelihood of

stunting among children exposed to malaria in early life and among children born to mothers with malaria during pregnancy (Sahiddin et al., 2024; Felle & Sahiddin, 2024). These review findings align with established biological mechanisms described in the broader literature: malaria in pregnancy can contribute to intrauterine growth restriction through placental sequestration and inflammatory processes, leading to reduced nutrient and oxygen transfer to the fetus (Sharp & Harvey, 1980; Bendabenda et al., 2018). Postnatally, recurrent infection may suppress appetite, increase metabolic demands, and worsen micronutrient deficiencies—mechanisms that plausibly amplify the association between malaria-endemic ecologies and linear growth faltering (Millward, 2017).

However, it is critical to distinguish what is directly evidenced in Papua versus what is inferentially supported by external literature. The Papua case-control studies provide the strongest within-review signal of malaria–stunting association, while mechanistic explanations (placental dysfunction, inflammation) are primarily supported by non-Papua biomedical evidence and should be presented as plausible pathways rather than findings generated by the Papua studies themselves (Sharp & Harvey,

1980; Bendabenda et al., 2018). This distinction strengthens interpretability and prevents the discussion from appearing detached from the review dataset.

Across the included evidence, low birth weight (LBW) and short birth length appear repeatedly as salient biological correlates of later stunting, particularly in case-control work (Ramdany & Norma, 2023; Felle & Sahiddin, 2024). In Sorong City (Kokoda Tribe), LBW (<2,500 g) and birth length <48 cm were associated with meaningfully higher odds of stunting, suggesting that fetal growth restriction may set an early trajectory of vulnerability (Ramdany & Norma, 2023). In Jayapura, malaria in pregnancy was associated with child stunting even after stratified analyses, supporting a pathway in which prenatal infection contributes to birth-size deficits that then elevate stunting risk (Felle & Sahiddin, 2024; Sahiddin et al., 2024). In a UNICEF-framework interpretation, these findings reinforce that “immediate” and “underlying” determinants often operate through birth outcomes as intermediate biological pathways, implying that stunting prevention in Papua requires stronger attention to maternal health and pregnancy exposures—not only infant feeding after birth.

Diet-related determinants are visible across multiple included studies, though measurement and analytic approaches vary. A cross-sectional study in Nabire found that inappropriate feeding behaviors—linked to parents’ feeding style—were associated with higher stunting odds, suggesting that daily household practices may be a practical leverage point for risk reduction (Wulandari et al., 2024). In Keerom, SEM-based analysis indicated relationships between breastfeeding/consumption factors and stunting, alongside micronutrient gaps (notably iron and iodine), highlighting that dietary adequacy may be constrained less by calories and more by diet quality and micronutrient density (Ngardita et al., 2021). A qualitative case study in Asmat further contextualized these dietary pathways: limited maternal knowledge for processing nutritious local foods, unhealthy purchasing habits, and low participation in community services were described as contributors to poor child nutrition (Sianipar et al., 2021).

At the same time, the included evidence also shows inconsistency—particularly around breastfeeding. In Tanah Merah, exclusive breastfeeding showed minimal association with stunting, contrasting with other datasets and broader literature indicating protective effects (Bumarop & Rismayanti, 2023; Ngardita et al., 2021). This inconsistency likely reflects differences in (1) how breastfeeding was operationalized, (2) sample size and statistical power, and (3) contextual effect modification—where the benefits of breastfeeding may be partially offset in environments with high infectious burden, suboptimal complementary feeding, or severe WASH constraints. As a narrative review, the appropriate interpretation is not to treat breastfeeding as “non-important,” but to emphasize that in Papua, breastfeeding effects may be conditional on the broader household and environmental risk context.

Environmental and WASH determinants are strongly represented in the included evidence base. An ecological regression analysis across Papua and West Papua highlighted sanitation coverage as a significant predictor of stunting prevalence, underscoring the structural role of environmental conditions in growth outcomes (Astuti, 2022). Case-control work in Sorong City also reported elevated stunting odds where clean water access was limited (Ramdany & Norma, 2023). These Papua findings are highly consistent with established external evidence that inadequate WASH can increase enteric pathogen exposure, resulting in repeated infections and environmental enteric

dysfunction, which impairs nutrient absorption and contributes to chronic growth faltering (Humphrey, 2009; Prendergast & Humphrey, 2014). Thus, while the Papua studies provide the contextual association signals, the enteric dysfunction mechanism should be clearly identified as supporting explanatory literature rather than a measured outcome in the included studies.

At the basic/enabling level, the included population-based studies show a consistent gradient: lower maternal education and socioeconomic disadvantage are associated with higher stunting risk, and rural residence introduces compounding barriers (Wulandari et al., 2022; Ashar et al., 2024). In Papua and West Papua, mothers with lower educational attainment had higher adjusted odds of having stunted children, and rural residence was associated with increased stunting likelihood, reflecting constrained access to services, information, and economic resources (Wulandari et al., 2022; Ashar et al., 2024). These findings also align with the premise that Papua-specific geography—long distances, difficult terrain, and uneven service distribution—can weaken preventive and curative delivery (Wahyudianto & Prasetyo, 2024). Therefore, an integrated interpretation is that education and household poverty shape stunting both directly (through food purchasing power and caregiving resources) and indirectly (through the ability to access and effectively use health and nutrition services).

A key contribution of this review is to foreground the family/parent interface as a realistic intervention hub that connects multiple determinant levels. Across included studies, parental determinants appear through maternal education, feeding behaviors, breastfeeding and complementary feeding practices, and care-seeking during child illness episodes (Wulandari et al., 2022; Wulandari et al., 2024; Ngardita et al., 2021; Sianipar et al., 2021). In practice, mothers and caregivers are the proximate decision-makers for diet quality, hygiene routines, and timely use of services; thus, parent-centered strategies may deliver “cross-cutting” benefits even when structural conditions are slow to change. Nevertheless, the evidence base also indicates that caregiver practices are constrained by enabling resources—food security, WASH infrastructure, and service availability—so family-focused interventions must be designed as part of an integrated package rather than as a standalone behavior-change solution.

Implications for Multi-Level Interventions

In line with the UNICEF framework, intervention recommendations are strongest when linked explicitly to determinants found in the included Papua studies. At the household level, priorities should include strengthening caregiver capacity for age-appropriate complementary feeding, dietary diversity, and responsive feeding practices—especially during the 6–23 month window that appears particularly vulnerable in Papua datasets (Ngardita et al., 2021; Ashar et al., 2024; Wulandari et al., 2024). Household-level prevention should also address routine hygiene behaviors (safe child feces disposal, handwashing at critical times, safe water handling), which plausibly reduce infection-mediated growth impairment in settings with constrained infrastructure (Ramdany & Norma, 2023; Humphrey, 2009).

At the service-delivery level, the review findings point to the importance of integrating malaria prevention and case management with maternal-child nutrition programming. Given evidence linking maternal/early-life malaria exposure to stunting in Papua, ANC and child

services should emphasize early detection and treatment of malaria, anemia prevention, and targeted counseling for IYCF and growth monitoring—particularly in malaria-endemic districts (Sahiddin et al., 2024; Felle & Sahiddin, 2024). Strengthening routine contact points (posyandu and primary care) is also supported by qualitative evidence from Asmat regarding low participation and persistent traditional practices that impede uptake (Sianipar et al., 2021).

At the environmental level, sanitation and clean water access are central. The included ecological and case-control evidence indicates that improving sanitation coverage and safe water access should be treated as core stunting-prevention infrastructure in Papua, not as peripheral “supporting” actions (Astuti, 2022; Ramdany & Norma, 2023). This aligns with external evidence linking WASH constraints to enteric dysfunction and growth impairment (Prendergast & Humphrey, 2014).

At the structural level, maternal education and poverty-related constraints require multisectoral action. Evidence from population-based analyses in Papua and West Papua indicates that improving maternal education and reducing socioeconomic disadvantage are likely to produce downstream improvements in feeding behaviors, health literacy, and service uptake (Wulandari et al., 2022; Ashar et al., 2024). Investments in rural connectivity and equitable service distribution are particularly relevant in Papua, where geographic barriers can systematically reduce the reach and effectiveness of health interventions (Wahyudianto & Prasetyo, 2024).

CONCLUSION

This narrative review indicates that stunting among children under five in Papua emerges from interacting determinants across multiple levels of causation. Evidence from the included studies consistently highlights infection-related risks—particularly malaria exposure during pregnancy and early life—as an important pathway associated with growth faltering (Sahiddin et al., 2024; Felle & Sahiddin, 2024; Mapandin, 2019). This infection pathway plausibly interacts with adverse birth outcomes, where low birth weight and short birth length were reported as elevating stunting risk by approximately two to three times in Papua-related datasets (Ramdany & Norma, 2023; Felle & Sahiddin, 2024). Nutritional determinants—especially inadequate dietary patterns and micronutrient gaps—remain central, with several studies indicating suboptimal intake (e.g., iron and iodine) and inappropriate feeding behaviors that increase vulnerability during the complementary-feeding period (Ngardita et al., 2021; Wulandari et al., 2024; Sianipar et al., 2021). Environmental determinants, particularly sanitation and limited access to safe water, also recur as structural exposures that plausibly sustain repeated infection and growth impairment (Astuti, 2022; Ramdany & Norma, 2023; Prendergast & Humphrey, 2014). Finally, socioeconomic constraints and maternal characteristics—especially lower maternal education, poverty-related limitations, and rural residence—appear to shape both exposure and response capacity, including caregiving practices and timely service utilization (Wulandari et al., 2022; Ashar et al., 2024).

Several limitations should be considered when interpreting these conclusions. First, as a narrative review, this synthesis integrates heterogeneous evidence but does not provide pooled estimates, and causal inference remains limited because most included studies are observational.

Second, no formal quality appraisal or risk-of-bias assessment was conducted, which reduces certainty about the strength and consistency of evidence across determinants and may allow lower-quality studies to exert disproportionate influence. Third, heterogeneity in study settings, measurements, and analytic approaches—along with the possibility of selection and publication bias—may affect which determinants appear most prominent and may limit generalizability across districts and population groups in Papua.

To strengthen the evidence base for Papua-specific programming, future research should prioritize (1) longitudinal studies that clarify temporal pathways linking malaria exposure, adverse birth outcomes, anemia, infection recurrence, and growth trajectories; (2) community-based intervention trials that test integrated packages combining maternal malaria services with first-1,000-days nutrition support, and that include implementation outcomes (coverage, adherence, and feasibility in remote settings); (3) standardized reporting of stunting definitions and determinant measures to improve comparability across districts; and (4) mixed-methods studies that explain how caregiver decision-making interacts with enabling conditions—food security, WASH infrastructure, and service accessibility—to shape intervention uptake and impact. Building this agenda will help move from descriptive associations toward actionable, context-sensitive strategies that reflect the distinct risk ecology of Papua.

DECLARATION

Conflicts of interest

The authors declare no conflict of interest

Ethics approval and consent to participate

This study is a literature review based on secondary data obtained from previously published articles. It did not involve direct interaction with human participants or the collection of primary data. Therefore, ethical approval and informed consent were not required for this study.

Artificial Intelligence-Assisted Technology

Artificial intelligence-assisted technology was not used in the data collection, data analysis, or interpretation of the findings in this study.

Consent for publication

Written informed consent for publication was obtained from all participants.

Availability of data and materials

All data analyzed in this study are derived from published articles that are publicly available. The datasets supporting the conclusions of this review are included within the article and its referenced sources.

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Authors' contributions

Author 1: conceptualized the study, designed the review framework, conducted the literature search, performed data analysis, and drafted the manuscript.

Author 2: contributed to literature screening, data extraction, and thematic analysis.

Author 3: contributed to literature screening, data extraction, and thematic analysis.

Author 4: assisted in data interpretation and critically revised the manuscript for important intellectual content

Author 5: contributed to the synthesis of findings and supported manuscript revision. All authors read and approved the final version of the manuscript

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ADDITIONAL INFORMATION

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APPENDIX

No	Author	Judul	Lokasi Penelitian	Children' s age S	Sample size	Study design	Result
1	Sahiddin, M., Ishak, H., Arsin, A. A., & Pramestiyani, M. (2024).	Impact of early-life malaria exposure on childhood stunting: A case-control study in high endemic malaria area, Papua, Indonesia	Jayapura	children aged over one yearold	sample calculation resulted in 227 participants forthe case group. With a case-to-control sample ratio of1:2, the control group included 454 participants, bringing the total sample size to 681.	Case-control. Sample size calculation yielded 227 participants for the case group. With a 1:2 case-to-control ratio, 454 participants were included in the control group (total = 681). Simple random sampling of 681 children from 14 primary health centers (PHCs). Data were obtained from medical records and structured parental interviews.	<ol style="list-style-type: none"> 45.1% of mothers with malaria had children who were stunted. Malaria exposure was associated with an increased risk of stunting.
2	Bumarop, A. M., & Rismayanti, T. (2023).	Factors Influencing The Stunting Incidence Of Children Aged 6 – 2 Years At The Tanah Merah Health Center, Boven Digoel District Papua Province Period 13 April – 13 May 2023	Boven Digoel District Papua Province	Aged 6 – 2 Years	30	Descriptive analytic study with a cross-sectional design. Univariate and bivariate analyses were conducted using SPSS.	No association was found between stunting and maternal age or maternal education. Exclusive breastfeeding showed only a minimal effect on stunting occurrence.
3	Ramdany, R., & Norma (2023).	Risk Factors for Stunting Among Children Under Five Years of Age in The Kokoda Tribe, Sorong City	Sorong City	12-59 months	168 (Cases: 84; Controls: 84)	Case-control design focusing on parents and children aged 12–59 months registered at Integrated Health Posts (Posyandu) in 8 selected villages in Sorong City (population: 1,890 children). Samples were selected using purposive sampling (84 cases; 84 controls). Data collection used a stunting risk-factor questionnaire for toddlers, along with measurements of body length/height, weight, and mid-upper arm circumference (MUAC). Data were analyzed using odds ratios (ORs) computed in SPSS.	Children with birth length <48 cm had 2.652 times higher odds of stunting than those with birth length ≥48 cm. Children with birth weight <2,500 g had three times higher odds of stunting than those with birth weight ≥2,500 g. Lack of access to clean water increased stunting risk by 2.013 times, and mothers who did not consume iron supplements during pregnancy had a threefold higher risk of having stunted children.
4	Felle, Z., & Sahiddin, M. (2024).	Unraveling Potential Confounding Variables in the Association Between Maternal Malaria and Child Stunting in Papua: A Case-Control Study with Mantel-Haenszel Analysis	Jayapura	Toddlers aged 0-59 months	681 (Cases: 227; Controls: 454)	Case-control study conducted in 14 PHCs from May to September 2023. Stunted and non-stunted toddlers were selected using probability sampling. Data collection included questionnaires and anthropometric measurements. Statistical analysis used the Mantel-Haenszel chi-square	The crude OR for the effect of malaria during pregnancy on child stunting was 1.746, indicating a significant association (95% CI: 1.062–2.872). Stratified analyses produced adjusted ORs for several factors: child sex (1.78), low birth weight (1.652), basic immunization status (1.771), breastfeeding status (1.753), maternal age (1.732), occupation (1.828), ethnicity (1.722), and family

						method; the cutoff for identifying confounding was set as a >10% change in the coefficient estimate.	income (1.764). No potential confounder was identified in the maternal malaria-child stunting relationship because changes in the coefficient estimate were
5	Wulandari et al, (2024).	Perilaku makan dengan kejadian stunting pada balita: Studi cross-sectional di Kecamatan Nabire Papua	Kecamatan Nabire Papua	aged 12 to 59 months	106 toddlers,	This study was conducted observational with cross-sectional design. Subjects were collected using purposive sampling method	46.2% of toddlers were stunted, indicating a substantial stunting prevalence. Most respondents (56.6%) exhibited inappropriate feeding behaviors, which may contribute to undernutrition. A significant association was observed between stunting and feeding behavior (based on parental feeding style) ($p = 0.008$; OR = 3.200), suggesting that inappropriate feeding behavior is linked to higher odds of stunting.
6	Astuti, Y. R. (2022).	Pengaruh Sanitasi dan Air Minum Terhadap Stunting di Papua dan Papua Barat	Papua and West Papua Barat.	Toddler	153,228 toddler households	Quantitative approach using descriptive and inferential statistics with multiple linear regression.	There was a simultaneous effect of the percentage of households with access to adequate sanitation and safe drinking water on stunting prevalence in Papua and West Papua, indicating that decreases in these percentages were associated with increased stunting among children under five. When examined separately, only adequate sanitation access had a significant impact on stunting prevalence, highlighting sanitation as a key determinant in stunting prevention in the region.
7	Wulandari et al. (2022)	The Targets for Stunting Prevention Policies in Papua, Indonesia: What Mothers' Characteristics Matter?	Papua and West Papua Barat	0-59 months (toddlers)	11,887 (2017 PSG data; weighted analysis)	Cross-sectional study using binary logistic regression.	Lower maternal education increased stunting risk: elementary school or below (AOR 1.263), junior high school (AOR 1.222), and senior high school (AOR 1.122). Unmarried mothers had higher risk (AOR 1.138) than widowed/divorced mothers; married mothers had lower risk (AOR 0.936). Maternal age, male child sex, and rural residence also increased stunting risk.
8	Sianipar et al. (2021)	Improving Human Resources as Local Food Processors to Accelerate Stunting Prevention to Realize the SDGs: Case Study in Asmat, Papua	Asmat, Papua	Not specified (focus on families with toddlers)	Not reported (qualitative; purposive sampling)	Qualitative, descriptive study using purposive sampling.	Reported causes of stunting in Asmat included limited maternal knowledge in processing nutritious local foods, habitual purchase of unhealthy foods, low participation in integrated health services (posyandu), limited clean water, and community dependence on long-standing practices. Proposed solutions included direct education, provision of nutritious food assistance, and intensive mentoring/support.
9	Ngardita et al. (2021)	The Influence of Factors of Breastfeeding and Food Consumption on Stunting Incidence among Preschool Children in Keerom	Keerom, Papua	6-59 months	324 toddlers	Cross-sectional study analyzed using SEM.	Significant relationships were found between consumption factors ($r = 0.052$) and breastfeeding ($r = -0.015$) with stunting occurrence. Energy, protein, and vitamin A intake were generally adequate; however, iron and iodine intake remained low. Early initiation of breastfeeding,

		District, Papua Province, Indonesia					exclusive breastfeeding, and breastfeeding duration were associated with nutritional status.
10	Mapandin, W. Y. (2019)	Stunting Status of New Children Entering Elementary School Between Urban and Rural Areas in Jayapura City, Papua	Jayapura, Papua	Primary school entry age ($\approx 5-7$ years)	84 students	Descriptive analytic, cross-sectional study.	No significant differences in nutritional status (based on height-for-age and BMI-for-age) were found between children in urban and rural areas. Energy and protein deficiencies occurred in both settings. Low household socioeconomic status and high infection burden worsened children's nutritional status.
11	Ashar, H. et al. (2024)	Factors related to stunting in children under 2 years old in the Papua, Indonesia	Papua	0-23 month	2.937 children	Cross-sectional study using logistic regression.	Eight variables were significantly associated with stunting: residence (rural), maternal age, maternal education, maternal occupation, economic status, child age (12-23 months), male sex, and not practicing early breastfeeding initiation (EBFI). Children living in rural areas had AOR 1.168; male children had AOR 1.348; and children aged 12-23 months had AOR 3.381.

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