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COEXISTENCE OF STUNTING AND ANEMIA AMONG CHILDREN UNDER FIVE: PREVALENCE AND SHARED RISK FACTORS

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Abstract

Background: Stunting and anemia frequently co-occur in children under five, exacerbating undernutrition burdens in low- and middle-income countries (LMICs). This narrative review synthesizes evidence on the prevalence and shared risk factors of concurrent stunting and anemia in children under five. **Methods**: We searched three electronic databases: PubMed, Scopus, and Google Scholar and included studies published from January 2010 to December 2025. Search terms combined keywords related to “stunting”, “anemia”, “coexistence”, and “children under five”. **Results:** The coexistence of stunting and anemia affects approximately one in five children under five in LMICs with individual country estimates varied widely at 5.6–60.1%. Shared determinants included child age, small birth size, recurrent infections, inadequate dietary diversity and intake of animal-source foods and legumes, maternal anemia, short stature, low maternal education, household poverty, open defecation, and limited access to quality health and water, sanitation and hygiene services. **Conclusion:** Evidence supports integrated, multi-sectoral strategies that target maternal nutrition, infant and young child feeding, infection control, and environmental sanitation to reduce the coexistence of stunting and anemia in early childhood.

Keywords: iron deficiency anemia, stunting, risk factors, children under five, LMICs

Introduction

Stunting and anemia remain among the most prevalent forms of undernutrition in children under five, posing major barriers to global progress in child health and development.

The World Health Organization (WHO) defines stunting as length or height for age more than two standard deviations below the WHO Child Growth Standards median, reflecting chronic or recurrent undernutrition and infection that impair linear growth, especially in the first thousand days of life.[1] Anemia in children aged 6–59 months is conventionally defined as a hemoglobin concentration below 11 g/dL, although updated WHO recommendations propose a slightly lower cutoff of 10.5 g/dL for this age group, based on a distributional approach.[2-4]

Iron deficiency remains the leading cause of childhood anemia, but deficiencies of other micronutrients, chronic inflammation, infections, and hemoglobinopathies also contribute substantially.[5] Global estimates indicate that around 20-40% of children under five are stunted and nearly 40% of children 6–59 months are anemic.[6-9] Importantly, accumulating evidence indicates that these two conditions frequently coexist in the same child, giving rise to a "syndemic", of concurrent anemia and stunting. In public health nutrition, stunting-anemia exemplifies a syndemic, where nutritional deficits intersect with infections and social disadvantages, demanding integrated interventions. This coexistence is associated with compounded risks of morbidity, impaired neurocognitive development, reduced physical capacity, and long-term losses in human capital and economic productivity.[10]

Despite this overlap, most programs have traditionally addressed stunting and anemia as separate conditions, with distinct indicators and interventions. This reflects gaps in the existing evidence. In addition, most studies analyze stunting and anemia separately, with limited research examining their co-occurrence, shared determinants, and how they are related.

Therefore, a comprehensive synthesis of current evidence on the prevalence of concurrent stunting and anemia and their shared risk factors is needed to guide more integrated, context-specific strategies. This narrative review aims to (i) summarize global and regional patterns of coexistence of stunting and anemia among children under five, and (ii) identify shared determinants that underpin this coexistence.

Method

This review used a structured, but non-systematic, approach to identify and select relevant literature on the coexistence of stunting and anemia among children under five. We searched three main electronic databases: PubMed/MEDLINE, Scopus, and Google Scholar for articles published from January 2010 to December 2025. Search terms combined free-text keywords related to stunting, anemia, and their coexistence, for example: "stunting", "linear growth faltering", "anemia", "iron deficiency anemia", "concurrent", "coexistence", "co-morbid", "syndemic", "double burden", "children under five", "preschool".

We included original research articles and reviews that met the following criteria 1) Population: Human studies involving children under five years of age; 2) Outcomes: Quantitative data on prevalence and/or determinants of stunting, anemia, and especially their coexistence, 3) Study design: Cross-sectional surveys, cohort studies, and systematic reviews or meta-analyses examining the relationship between iron deficiency anemia and stunting. We excluded studies that reported only anemia or only stunting without data on their coexistence or explicit analysis of shared determinants; and were case reports, editorials, or opinion pieces.

From each included study, we extracted country and cohort used; age range and sample size; cut-offs for anemia and stunting, prevalence of stunting-anemia, and shared determinants. Given the narrative design, we did not perform formal risk-of-bias scoring. Findings were then organized into sections on global and regional prevalence and shared risk factors.

Results and Discussion

Global and Regional Prevalence of Stunting, Anemia, and Their Coexistence

Table 1 shows summary of studies investigating concurrent stunting-anemia prevalence in recent years. Analyses from 27 LMICs showed that the pooled prevalence of stunting-anemia among children aged 6–59 months was about 19.5%, with substantial between-country variation and highest burdens in sub-Saharan Africa and South Asia.[10] In Ethiopia, national demographic health survey (DHS) analyses showed that around one-third of children 6–23 months were stunted (32.6%) and nearly three-quarters were anaemic (72%), with 23.9% experiencing stunting-anaemia.[11] When a wider age range was considered using pooled EDHS 2005–2016, the prevalence of stunting and anemia in children 6–59 months was 43.1% and 49.3%, respectively, and almost one in four children (24.4%) had both conditions simultaneously.[12] Similarly high levels were observed in Lesotho, where 51% of children 6–59 months were anaemic, 43% were stunted, and 35.2% were affected by both.[13] In Rwanda, the coexistence of stunting and anemia among children 6–23 months declined from 21.3% in 2010 to 16.9% in 2019–2020.[14] In Bihar, India, 68.8% of children 6–18 months were anemic, 31.0% were stunted, and 21.5% had both, whereas in a Peruvian regional sample, 71.3% were anaemic, 44.2% were stunted, and 30.4% had stunting-anaemia.[15] More recent national data from Peru reported a lower but still important coexistence prevalence of 5.6% among children 6–59 months.[16] The most extreme burden was documented in Myanmar, where 60.1% of children 6–59 months had concurrent stunting and anemia.[17] Nevertheless, this figure from Myanmar's 2016 DHS may reflect methodological biases and conflict-driven clustering in rural regions due to food insecurity, infections, and poor access, potentially overestimating national risk.[17]

Results from included studies support viewing stunting-anemia as a syndemic condition that clusters in specific populations where nutritional, infectious and social disadvantages intersect, and they highlight the need for context-specific responses that combine universal policies with targeted interventions for high-risk regions and groups.[8, 10, 18]

Table 1. Summary of studies investigating stunting-anemia prevalence and/or the shared determinants

Region/ Country	Author (Year)	Study design	Sample	Cut-offs for anemia and stunting	Stunting-Anemia Prevalence	Shared determinants
Ethiopia	Mohammed et al. (2019)[11]	Cross-sectional analysis of Ethiopian Demographic and Health Survey (EDHS) 2016	2,902 weighted children 6–23 months.	Anemia: Hemoglobin (Hb) <11 g/dL (HemoCue, altitude-adjusted) Stunting: length-for-age z-score (LAZ) <-2 SD (WHO 2006 standards)	Stunting 32.6%, anemia 72%, concurrent stunting-anemia 23.9% of children 6-23 months	Higher odds of stunting-anemia was associated with:: • **Child factors:** age ≥12 months (Adjusted odds ratio (aOR) 1.65, 95%CI: 1.57–1.73), male sex (AOR 1.25, 95%CI: 1.04–1.50), perceived small birth size (AOR 1.99, 95%CI: 1.58–2.51), and any recent infection (AOR 1.14, 95%CI: 1.00–1.30) • **Child dietary factors:** No vitamin A supplement in last 6 months (AOR 1.19, 95%CI: 1.06–1.33), no vitamin-A-rich fruits/vegetables (AOR 1.15, 95%CI: 1.04–1.27), no meat (AOR 1.55, 95%CI: 1.17–2.05), no legumes (AOR 1.38, 95%CI: 1.05–1.81), meal frequency < 3 (AOR 1.22, 95%CI: 1.04–1.37). • **Household factors:** Rural residence (AOR 1.29, 95%CI: 1.18–1.41), low household wealth (AOR 1.91, 95%CI: 1.53–2.39), caregiver with low education (AOR 2.14, 95%CI: 1.33–3.44).
	Sahiledengle et al. (2023)	Cross-sectional analysis of pooled EDHS 2005, 2011, 2016.	21,172 children 6–59 months.	Anemia: Hb <11 g/dL (HemoCue, altitude-adjusted) Stunting: LAZ <-2 SD (WHO 2006 standards).	Stunting 43.1%, anemia 49.3%, concurrent stunting-anemia 24.4% of children 6-59 months	Higher odds of stunting-anemia was associated with: • **Child factors:** Female sex (AOR 1.23, 95%CI: 1.09-1.37), , perceived small size at birth (AOR 1.47, 95%CI: 1.28–1.69). • **Maternal factors:** Anemic mother (AOR 1.25, 95%CI: 1.11–1.41), maternal short stature (AOR 1.48-2.04), low education level of mothers (AOR 3.13-3.66), low BMI (normal and overweight BMI are protective with AOR 0.82 (95%CI: 0.73–0.92) and 0.60 (95%CI: 0.45–0.81), respectively). • **Household factors**: Poor household wealth (AOR 1.15, 95%CI: 0.95–1.37), rural residence (AOR 1.41 open defecation toilet (AOR 1.57, 95%CI: 1.27–1.92).

Region/ Country	Author (Year)	Study design	Sample	Cut-offs for anemia and stunting	Stunting-Anemia Prevalence	Shared determinants
Lesotho	Gaston et al. (2022)[13]	Cross-sectional analysis of Lesotho Demographic Health Survey 2014	1,138 children 6–59 months	Anaemia: Hb <11 g/dL Stunting: height-for-age z-score (HAZ) < 2 SD (WHO standards)	Anaemia 51%; stunting 43%; both anaemia and stunting present in 35.2% of children 6–59 months	• Child age was associated with both outcomes: Children <20 months had lower stunting rate (OR: 0.44, 95%CI: 0.30-0.64), but children 20–39 months had higher anemia rate (OR: 1.70, 95%CI: 1.21-2.40) vs 40–59 months. • Other factors were not shared determinants of both stunting and anemia.
Rwanda	Nemerimana & Gbadamosi (2025)[14]	Cross-sectional analysis of Rwanda Demographic and Health Surveys (RDHS) 2010, 2014–2015, 2019–2020	3,580 children 6–23 months	Anaemia: Hb <11 g/dL Stunting: HAZ < 2 SD (WHO standards)	Both anaemia and stunting present in 21.3%, 18.4%, snd 16.9% of children 6–23 months in 2010, 2014-2015, and 2019-2020 surveys, respectively.	Higher odds of stunting-anemia was associated with: • **Child factors:** Age 12–23 vs 6–11 months (AOR 1.58-1.62, across years), male sex (AOR 1.48–1.79 across years), small/very small birth size (AOR up to 3.1 for very small, across years), multiple births in 2019-20 (AOR 3.08, 95%CI: 1.27–7.46), history of cough in prior 2 weeks in 2019-20 (AOR 1.60, 95%CI: 1.12-2.27). • **Child feeding**: Inadequate minimum acceptable diet (MAD) in 2014–15 (AOR 1.80, 95%CI: 1.1-2.91), delayed breastfeeding initiation 1–30 days post birth associated in 2019–20 (AOR 6.26, 95%CI: 2.1–16.30) • **Maternal factors**: Maternal anemia in 2014–15 (AOR 1.95, 95%CI: 1.26-3.02), maternal age <20 years (AOR 3.99, 95%CI:1.52-10.48), low education in 2010 (AOR 3.03–4.07). • **Household factors**: Poorest and poorer wealth tertiles in 2019-2020 (AOR 3.51-4.48), residence at high altitude ≥2,000 m (AOR 1.78-1.94), unimproved toilets in 2010 (AOR 1.63, 95%CI: 1.20–2.21).

Region/ Country	Author (Year)	Study design	Sample	Cut-offs for anemia and stunting	Stunting-Anemia Prevalence	Shared determinants
India	Gosdin et al. (2018)[15]	Cross sectional study	5,664 children 6–18 months	Anaemia: Hb <11 g/dL Stunting: HAZ < 2 SD (WHO standards)	Anaemia 68.8%; stunting 31.0%; both anaemia and stunting present in 21.5% of children 6–18 months	The shared determinants of stunting and anemia were male sex (OR 1.28, 95%CI: 1.15-1.42 for anemia and OR 1.28, 95%CI: 1.14-1.45 for stunting) and caste. Minimum dietary diversity and household food insecurity were only associated with anemia, while child's age, maternal factors, wealth tertile, infectious diseases, and poor handwashing practice were only associated with stunting.
Peru	Gosdin et al. (2018)[15]	Cross sectional study	688 children 6–36 months	Anaemia: Hb <11 g/dL Stunting: HAZ < 2 SD (WHO standards)	Anaemia 71.3%; stunting 44.2%; both anemia and stunting present in 30.4% of children 6–36 months	The shared determinants of stunting and anemia were middle wealth tertile (OR 1.69, 95%CI: 1.10-2.60 for anemia and OR 1.76, 95%CI: 1.12-2.75 for stunting) and consumption of non-treated water (OR 1.54, 95%CI: 1.05-2.27 for anemia and OR 1.59, 95%CI: 1.10-2.27 for stunting). Male sex, minimum dietary diversity, and poor handwashing practice were only associated with stunting.
	Rivera et al. (2024)[16]	Cross sectional analysis of Demographic and Health Survey (DHS) 2022 of Peru	19,191 children 6-59 months	Anaemia: Hb <11 g/dL Stunting: HAZ < 2 SD (WHO standards)	The prevalence of stunting-anemia was 5.6% (95%CI: 5.2-5.9) in children aged 6 to 59 months	In multivariate analyses, male sex (aOR 1.27, 95%CI: 1.05-1.52), age 12-23 month (aOR 2.89, 95%CI: 1.93-4.35), low birth weight (aOR 7.31, 95%CI:4.26-12.54), poorest wealth index (aOR 3.72, 95%CI: 1.66-8.31), and low maternal and paternal education increased the odds of the coexistence of stunting and anemia.
Myanmar	Htay et al. (2023)[17]	Cross sectional analysis of DHS 2016 of Myanmar	1150 children 6-59 month	Anaemia: Hb <11 g/dL Stunting: HAZ < 2 SD (WHO standards)	The prevalence of stunting-anemia was 60.1% in children 6-59 months	Higher odds of stunting-anemia was associated with severely stunted status (AOR 1.88, 95%CI: 1.23-2.94) and ongoing breastfeeding (AOR 1.56 95%CI: 1.01-2.42). No maternal factors were associated with the stunting-anemia syndemic.

Region/ Country	Author (Year)	Study design	Sample	Cut-offs for anemia and stunting	Stunting-Anemia Prevalence	Shared determinants
Least developed countries	Dessie et al. (2025)[10]	Systematic review and meta analysis	55,589 children under five in 27 least developed countries	Anaemia: Hb <11 g/dL Stunting: HAZ < 2 SD (WHO standards)	The pooled prevalence of stunting-anemia among children aged 6–59 months was about 19.5%,	Higher odds of stunting-anemia was higher in children who did not consume meat (aOR 1.5, 95%CI: 1.2–2.1), did not receive iron supplementation (aOR 2.9, 95%CI: 1.3-6.2), and did not consume vitamin A-rich fruits (aOR 1.2, 95%CI: 1.1-1.3).

Shared Risk Factors

Across the included studies from Ethiopia, Rwanda, Lesotho, India, Peru, Myanmar, and multi-country analyses, a consistent pattern of shared determinants emerged for stunting, anaemia, and their concurrent occurrence in children under five.[10-15, 17]

Child-Level Factors: Birth status and Feeding Practices

Older age within the under-five period, particularly from 12 to 35 months, was repeatedly associated with a higher probability of concurrent stunting and anemia, reflecting the window when linear growth faltering and iron depletion coincide with increased exposure to infections and inadequate complementary feeding.[11, 12, 14, 15] Analyses of Ethiopian DHS showed that children perceived as small at birth have significantly higher odds of stunting-anemia, with estimates around 1.5-2-fold increased risk after adjustment.[11, 12] Similarly, in Peru and Rwanda, low birth weight and small birth size were associated with higher stunting-anemia odds up to 7 times.[14, 16] In terms of sex, male children tended to have higher odds of anemia, stunting, or both in India, Peru, and Rwanda,[14-16] but pooled analysis of Ethiopian DHS showed higher odds in girls.[12]

Dietary and feeding practices emerged as immediate, modifiable determinants that simultaneously influence linear growth and iron deficiency status. Low dietary diversity and inadequate minimum acceptable diet were consistently associated with higher co-occurrence of stunting and anemia.[10, 11, 14, 15] Insufficient meal frequency below WHO recommendations (<3 times per day) was also associated with the syndemic, indicating that both total energy and nutrient density of complementary feeds matter for preventing simultaneous undernutrition and micronutrient deficiency.[11] Furthermore, based on a pooled analyses by

Dessie et al, the likelihood of anemia–stunting comorbidity was higher among children who did not consume meat and did not receive iron supplementation, with adjusted odds ratios of 1.5 (95% CI: 1.2–2.1) and 2.9 (95% CI: 1.3–6.2), respectively.[10] Suboptimal breastfeeding practices, especially delayed initiation beyond the first hour or day of life contributed to higher odds of stunting-anemia coexistence in Rwanda (Adjusted OR 6.26, 95%CI: 2.1–16.30), possibly by increasing early infection risk and compromising energy and micronutrient intake during the critical period.[14] An explanantion to this is that diets dominated by low-quality, mainly plant-based staples provide inadequate high-quality protein, indispensable amino acids and zinc, which are required to stimulate insulin and thyroid hormone-mediated anabolic signalling at the growth plate. This same dietary pattern also limits iron intake and bioavailability, predisposing to iron-deficiency anaemia.[19]

Maternal Factors

Across the included studies, several maternal factors consistently emerged as determinants of the coexistence of stunting and anaemia in children under five. In pooled Ethiopian DHS analyses, children of anemic mothers had higher odds of concurrent stunting-anemia (AOR 1.25, 95%CI 1.11–1.41), and maternal short stature was strongly associated with this condition, with AORs ranging from 1.48 for mothers 145–155 cm to 2.04 for those <145 cm compared with taller mothers.[12] In the same dataset, low maternal education showed one of the strongest determinants, with children of mothers with no education having 3.66-fold higher odds of stunting-anemia compared with mothers with higher education.[12] Similar patterns were reported in Rwanda, where maternal anemia in 2014–2015 (AOR 1.95, 95%CI 1.26–3.02), maternal age <20 years (AOR 3.99, 95%CI 1.52–

10.48), and low maternal education in 2010 (AOR 3.03–4.07) all increased the likelihood of stunting-anemia in children aged 6–23 months.[20] In Peru, analysis of the 2022 DHS similarly showed that low maternal (and paternal) education substantially increased the odds of stunting-anemia.[16] Low maternal education as the most consistent association with stunting-anemia likely reflects the combined effects of limited access to health and nutrition information, lower use of antenatal and child-health services, and greater exposure to poverty and poor living conditions.[21-23] Parenting practices may serve as an intermediary factor linking maternal sociodemographic characteristics to nutritional problems in children.[24]

Household and Environmental Factors

Household-level socioeconomic and environmental conditions emerged as powerful and recurrent determinants of concurrent stunting-anaemia across the included studies. In Ethiopia, children from rural, poorer households had markedly higher odds of concurrent stunting-anemia, even after controlling for child diet and infections, indicating that low wealth and residence in resource-constrained environments structure exposure to both inadequate diets and infectious disease.[11, 12] In pooled EDHS 2005–2016, children in households practising open defecation (AOR 1.57, 95%CI 1.27–1.92) and with unimproved flooring and solid fuel use were associated with higher prevalence of stunting-anemia, even after accounting for individual-level factors.[12] Similar socioeconomic and environmental gradients were observed in Rwanda and Peru, where the poorest wealth tertiles, unimproved toilets, and use of non-treated water substantially increased the likelihood of stunting-anaemia, while even middle wealth households in Peru experienced elevated risk when drinking untreated water.[14-16] These findings align with broader evidence that household poverty, food insecurity and inadequate water, sanitation, and hygiene (WASH) are shared determinants of child stunting and anaemia in low- and middle-income countries.[18, 25, 26] These results highlight the importance of combining specific and sensitive nutrition interventions for stunting and anemia in children under five.[27]

It is important to note that findings summarized in this review included data derived from cross-sectional surveys, which precludes causal inference and makes it difficult to disentangle temporality between determinants and stunting-anemia. In addition, the studies varied in age ranges and sampling frames which complicates direct comparison of prevalence estimates. Evidence was also concentrated in certain regions, especially sub-Saharan Africa and parts of South Asia, while other high-burden contexts had little or no data, limiting global generalizability.

Nevertheless, the review provides several important insights for policy, programmes and research. First, it confirms that concurrent stunting and anaemia affect a substantial proportion of children in many low- and middle-income countries, and that this burden is highly concentrated in settings marked by poverty, poor diet quality, inadequate WASH, and maternal undernutrition. Second, the identification of consistent shared determinants at child (age, birth size, feeding practices), maternal (anemia, short stature, low education) and household/environmental levels (low wealth, open defecation, unsafe water) reinforce the need for multisectoral strategies that: 1) prioritize high-impact nutrition-specific interventions, 2) leverage nutrition-sensitive social protection, 3) implement nutrition-sensitive agriculture, and 4) strengthen the health environment (WASH).[27-29] Indonesia's Stunting Reduction program exemplifies this approach, reducing national prevalence through community health worker-led health posts integrating maternal iron supplementation, complementary feeding, and WASH improvements.[30-33] Finally, the gaps identified point to research priorities, including prospective cohorts to clarify causal pathways and intervention trials that evaluate combined nutrition-specific and nutrition-sensitive packages using stunting-anemia as a key outcome.

Conclusion

The coexistence of stunting and anemia affects about one in five children under five globally, and at least one in four in several high-burden countries such as Ethiopia and Lesotho. This syndemic concentrates among poorer, rural households, children with small birth size and frequent infections, and those born to anemic, short, or less-educated mothers. This pattern underscores the need for integrated strategies that combine interventions for maternal nutritional status, improved complementary feeding, infection prevention, and WASH and social protection interventions.

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Conflict of Interest

There is no conflict interest of this publication.

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