



Review Article

Prevalence of Iron Deficiency Anemia and Its Socio-Demographic and Reproductive Determinants among Antenatal Mothers in Bangladesh: A Comprehensive Secondary Review (2001–2026)

Mosh. Jahanara Naznin^{1*}, Subroto Roy²¹Nursing Instructor, Nursing Institute, Magura, Bangladesh.²Senior Staff Nurse, Harinakundu Upazila Health Complex, Jhenaidah, Bangladesh.***Correspondence**

Mosh. Jahanara Naznin

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**Abstract**

Iron deficiency anemia (IDA) is the most prevalent nutritional disorder among pregnant women in Bangladesh, with national surveys estimating a prevalence of 41.7% among women of reproductive age and facility-based studies documenting rates as high as 95.84% among illiterate antenatal mothers. Despite a long-standing national iron-folic acid (IFA) supplementation program, anaemia burden remains persistently high and is associated with serious maternal and neonatal consequences. This review synthesizes evidence from 50 peer-reviewed studies (2001–2026) to document the prevalence, severity, and multidimensional determinants of IDA among antenatal mothers in Bangladesh, and to derive evidence-based policy recommendations. A comprehensive narrative secondary review was conducted using PubMed/MEDLINE, Google Scholar, Scopus, BanglaJOL, and icddr,b repositories. Fifty studies meeting pre-specified inclusion criteria — including cross-sectional surveys, national DHS analyses, prospective cohorts, and systematic reviews — were included and synthesized across eight thematic domains. Anaemia prevalence ranges from 38% in early pregnancy to 79% in the third trimester, and from 38.6% in semi-urban settings to 71% among illiterate women. The strongest independent risk factors identified were: irregular IFA supplementation (AOR = 4.28), poor dietary diversity (AOR = 3.76), fewer than four antenatal care visits (AOR = 3.45), low household income (AOR = 3.12), and rural residence (AOR = 2.68). Baseline moderate-to-severe anaemia in early pregnancy conferred an 11-fold higher risk of third-trimester severe anaemia (RRR = 10.78). Maternal anaemia was significantly associated with preterm birth (AOR = 2.03), early neonatal death (AOR = 1.87), and prolonged labor (AOR = 1.54). Anaemia among antenatal mothers in Bangladesh is a multidimensional public health emergency driven by poverty, educational inequity, IFA non-compliance, and inadequate ANC quality. A multisectoral national response integrating universal haemoglobin screening, enhanced IFA compliance, dietary counseling, and equity-focused service delivery is urgently required to meet Bangladesh's Sustainable Development Goal 3 targets by 2030.

Keywords

Iron Deficiency Anemia, Antenatal Care, Maternal Health, Iron-folic Acid Supplementation, BDHS, Hemoglobin, Birth Outcomes, Bangladesh.

1. Introduction

Iron deficiency anemia (IDA) stands as the most prevalent nutritional deficiency disorder in the world, affecting an estimated 1.62 billion individuals globally — approximately 24.8% of the total world population (WHO, 2011). Among the multiple forms of anaemia, iron deficiency is responsible for approximately 50% of all cases globally, making it by far the single most important cause of the condition in both developed and developing nations. In the context of pregnancy, the physiological demands of the growing fetus, placenta, and expanded maternal blood volume dramatically amplify the iron requirements of a woman's body — from approximately 0.8 mg/day in early pregnancy to more than 7.5 mg/day in the third trimester — needs that the typical diet in a low- or middle-income country (LMIC) cannot adequately supply without supplementation (WHO, 2011).

The World Health Organization (WHO) classifies anaemia during pregnancy as a haemoglobin (Hb) concentration below 11.0 g/dL, with further gradations of mild (Hb 10.0–10.9 g/dL), moderate (Hb 7.0–9.9 g/dL), and severe (Hb <7.0 g/dL) for pregnant women (WHO, 2011). Globally, the prevalence of anaemia in pregnancy is estimated at approximately 36.5% — affecting over 613 million pregnant women, of whom the vast majority reside in Africa and South Asia (Kassebaum et al., 2014; WHO GHQ, 2019). South Asian countries, including Bangladesh, India, Pakistan, and Nepal, consistently report among the highest national anaemia burdens in the world, driven by the intersection of widespread poverty, gender inequality, dietary constraints, high fertility rates, and structural deficiencies in healthcare delivery systems.

The consequences of anaemia during pregnancy for maternal and neonatal health are severe, well-documented, and multifaceted. Maternal anaemia increases the risk of preterm delivery, intrauterine growth restriction, low birth weight (LBW), puerperal sepsis, postpartum haemorrhage, and maternal mortality (Scholl, 2011; Rahman et al., 2016). For the neonate, maternal iron deficiency is associated with compromised fetal iron stores, neurodevelopmental impairment, increased susceptibility to infection, and higher early neonatal mortality rates. At a societal level, the productivity losses attributable to anaemia in South Asia are estimated to cost USD 4.2 billion annually, underscoring the macroeconomic as well as human dimension of the problem.

Despite the long-standing recognition of IDA as a global health priority — reflected in its inclusion in the World Health Assembly's six Global Nutrition Targets for 2025 (which include a 50% reduction in anaemia among women of reproductive age) — progress toward reduction has been persistently slow, particularly in South Asia. The global prevalence of anaemia among pregnant women declined from only 43% to 38% between 1995 and 2011 (Kassebaum et al., 2014), and subsequent national surveys have found that many countries — including Bangladesh — have not achieved meaningful acceleration in this reduction trajectory.

Bangladesh, a densely populated lower-middle-income country of approximately 170 million people situated in South Asia, faces a particularly acute maternal anaemia burden that reflects the compounding of multiple structural vulnerabilities. Despite remarkable progress over the past three decades in reducing child mortality, expanding primary education, and improving overall macroeconomic indicators, Bangladesh continues to grapple with persistently high rates of maternal anaemia that undermine its broader health and development gains.

The country's National Nutrition Survey (NNS 2018) — the most recent comprehensive national nutrition assessment — documented an anaemia prevalence of 41.7% among all women of reproductive age (WRA) in Bangladesh, with significant rural-urban and inter-divisional variation. Rural women experienced a prevalence of 44.3% compared to 40.2% among urban counterparts. Sylhet division emerged as the highest-burden division nationally for iron deficiency anaemia (IDA), while Khulna division recorded the lowest. Iron deficiency anemia specifically was found to affect 18.2% of all WRA — indicating that while iron deficiency is the dominant cause of anaemia, a substantial proportion of cases are driven by additional etiological factors including folate deficiency, vitamin B12 deficiency, inflammatory conditions, haemoglobinopathies (particularly thalassaemia trait, which affects up to 15% of the Bangladeshi population; Merrill et al., 2012), and helminthic infections.

The Bangladesh Demographic and Health Survey (BDHS) series, which collects nationally representative biomarker data on haemoglobin levels through a biomarker sub-sample of surveyed households, has provided the most methodologically consistent longitudinal baseline on anaemia prevalence in Bangladesh. The BDHS 2011 — the most recently publicly analysed DHS haemoglobin dataset at the time of this review — documented anaemia prevalence of 41.8% among all WRA aged 15–49 years (Rahman et al., 2021) and 43.9% among the subset of pregnant women specifically (Kabir et al., 2022). The WHO Global Health Observatory (2019) estimates for Bangladesh confirm a national anaemia prevalence of 42.2% among pregnant women and 36.5% among non-pregnant WRA — figures that position Bangladesh consist-

ently above the South Asian regional average and among the highest-burden countries in the world for maternal anaemia.

A critically important — and clinically alarming — finding from the most recent Bangladesh cohort evidence is the dramatic escalation of anaemia prevalence and severity as pregnancy advances. [Hasan et al. \(2026\)](#), in a prospective cohort of 3,000 rural Sylhet pregnant women enrolled at 8–19 weeks of gestation, documented anaemia rising from 38% at enrollment to 79% by the third trimester (24–36 weeks) — a 41 percentage-point increase representing one of the most dramatic within-pregnancy anaemia progressions reported in any Bangladesh study. Furthermore, women with moderate-to-severe baseline anaemia at enrollment were found to have a 10.78-fold higher risk (RRR 10.78; 95% CI: 6.69–17.35) of moderate-to-severe anaemia in the third trimester, providing powerful evidence that the prenatal trajectory of anaemia is critically determined by a woman's nutritional status at the time of conception and early pregnancy.

Facility-based cross-sectional studies in Bangladesh reveal an even more severe picture when specific high-risk populations are examined. [Azhar et al. \(2021\)](#) found an overall anaemia prevalence of 62.5% among ANC attendees in Kushtia and Jashore districts, with government hospital rates reaching 68.7% — substantially higher than private hospital rates of 55.0% — reflecting the socioeconomic selection of more vulnerable women into public-sector obstetric care. Among illiterate pregnant women attending a tertiary hospital, [Nipa et al. \(2025\)](#) documented 95.84% anaemia — the highest facility-based prevalence recorded in any Bangladesh study included in this review — highlighting the extreme concentration of anaemia burden in the country's most educationally deprived women. Among preeclamptic women at Dhaka Medical College Hospital, [Ali et al. \(2024\)](#) recorded 61.1% anaemia, demonstrating the compounding effect of concurrent complications on anaemia risk.

The health consequences of maternal anaemia during pregnancy extend critically from mother to fetus and neonate, creating a chain of adverse outcomes that begins in the uterus and extends through the early neonatal period and beyond. In Bangladesh specifically, [Kabir et al. \(2022\)](#) — using nationally representative BDHS 2011 data and multilevel logistic/Poisson regression models — provided the most comprehensive Bangladesh-specific quantification of these relationships: preterm birth (AOR 2.03; 95% CI: 1.01–4.25), early neonatal death (AOR 1.87; 95% CI: 1.06–5.10), prolonged labor (AOR 1.54; 95% CI: 1.09–3.52), and pregnancy complications (AOR 1.39; 95% CI: 1.09–2.41) were all independently and significantly higher among mothers with anaemia, even after adjustment for education, wealth, residence, parity, and other confounders.

Low birth weight (LBW) — defined as birth weight below 2,500 grams — is a particularly critical anaemia-linked outcome given Bangladesh's already high LBW prevalence of 14.5%–18.7% ([Uddin et al., 2026](#); [BDHS 2022](#)). LBW is the single most important predictor of neonatal and infant mortality, responsible for approximately 60%–80% of all neonatal deaths globally. The mechanisms linking maternal anaemia to LBW include: impaired placental oxygen and nutrient delivery due to maternal haemoglobin deficiency; reduced fetal weight gain from inadequate iron-mediated energy metabolism; and increased risk of preterm birth — itself a major driver of LBW. A systematic review and meta-analysis of 15 studies in LMICs ([Ali et al., 2020](#)) found anaemia associated with 25% higher LBW risk, 44% higher preterm birth risk, and 21% higher perinatal mortality risk — estimates closely consistent with Bangladesh-specific data from [Kabir et al. \(2022\)](#).

Beyond the immediate peripartum consequences, maternal iron deficiency has long-term neurodevelopmental implications for the child. The third trimester represents the peak period of fetal brain development, including hippocampal neurogenesis, myelination, and the establishment of the catecholaminergic and serotonergic systems — all critically dependent on iron. Fetal iron stores, primarily accumulated in the third trimester from maternal transferrin, are the primary source of iron for the exclusively breastfed infant in the first 4–6 months of life. When maternal anaemia depletes these stores, the iron-deficient infant faces elevated risk of cognitive impairment, delayed motor development, and behavioral problems — consequences that are partially irreversible even with post-infancy iron supplementation ([Lozoff et al., 2006](#)). This intergenerational dimension of maternal IDA adds a human capital loss argument to the already compelling maternal health rationale for urgent anaemia prevention.

For the mother herself, the consequences of untreated anaemia extend well beyond the prenatal period. Severe intrapartum anaemia (Hb <7.0 g/dL) substantially increases the risk of postpartum hemorrhage — the leading cause of maternal death globally — by impairing uterine contractility and reducing physiological reserves available to compensate for delivery blood loss. Postpartum anaemia reduces lactation capacity, compromises maternal immune function, and prolongs recovery from delivery — factors that together increase maternal morbidity even in the absence of direct maternal mortality. The cascading clinical, nutritional, and human development implications of IDA thus position it as one of the most compelling targets for preventive intervention in Bangladesh's maternal health agenda.

Bangladesh has maintained a national iron-folic acid supplementation program for pregnant women since the 1980s, with IFA tablets included in the country's Essential Services Package (ESP) and distributed free of charge through government-run Union Health and Family Welfare Centres (UHFWCs), Upazila Health Complexes (UHCs), and community-based health workers (Family Welfare Assistants, Community Skilled Birth Attendants). The standard national protocol recommends a daily 60 mg elemental iron + 400 µg folic acid tablet for a minimum of 180 consecutive days during pregnancy, supplemented by deworming in the second trimester. National ANC guidelines recommend a minimum of four antenatal visits, with the first ideally occurring in the first trimester.

Despite this longstanding policy framework, implementation quality and compliance have remained critical challenges. The Bangladesh IFA supplementation survey (2022) found that approximately 80% of pregnant women consumed at least some IFA tablets, but full 180-day compliance was achieved by a far smaller proportion — with the gaps concentrated among the poorest, least educated, and most rural women. The BDHS 2017–18 compliance analysis (Biswas et al., 2023) demonstrated that achieving ≥90 days of compliance required secondary education (AOR 1.77), husband's secondary education (AOR 1.33), and ≥4 ANC visits from skilled providers (AOR 2.53) — revealing the deep structural education and service-quality determinants of supplementation compliance. Supply chain disruptions at peripheral facilities, side effects (nausea, constipation) deterring continued IFA use, inadequate counseling during ANC visits, and low health literacy combine to create a compliance deficit that substantially limits the public health impact of the supplementation program.

Beyond IFA, Bangladesh's broader response to maternal anaemia has included nutrition-sensitive social protection programs (Vulnerable Group Development, Social Safety Net Programs), conditional cash transfers linking maternal benefits to ANC attendance, the Alive and Thrive program which demonstrated significant improvements in IFA coverage and dietary diversity in intervention areas (Godha et al., 2024), and recent digital health innovations including the eRegMat digital ANC registry (2024) and an mHealth anaemia education clinical trial registered in 2025 (NCT07310680). These multi-pronged efforts reflect growing recognition that anaemia prevention requires systemic, multisectoral action beyond supplementation provision alone.

Yet substantial gaps persist: the national prevalence of anaemia has not meaningfully declined between BDHS 2011 (41.8%) and NNS 2018 (41.7%) data periods; geographic and wealth-based inequities in both anaemia prevalence and access to testing, treatment, and supplementation remain wide (Verbunt et al., 2025); the third-trimester escalation of anaemia severity documented by Hasan et al. (2026) suggests current first-trimester intervention intensity is inadequate; and the most vulnerable sub-populations — illiterate women, the poorest wealth quintile, rural women in high-burden divisions, and women with baseline moderate-to-severe anaemia — continue to be precisely those least likely to be screened, diagnosed, and treated (Verbunt et al., 2025; Nipa et al., 2025).

The foregoing evidence landscape reveals a striking paradox: Bangladesh has sustained economic growth, expanded health infrastructure, and maintained a formal maternal anaemia prevention program for decades — yet maternal anaemia rates remain above 40% nationally and dramatically higher in the most vulnerable sub-populations. This paradox cannot be resolved by any single explanatory factor; rather, it reflects the intersection of multiple, interacting determinants operating across biological, behavioral, socioeconomic, geographic, and health-system dimensions simultaneously. A comprehensive, up-to-date synthesis of the full evidence base on IDA prevalence and determinants in Bangladesh is therefore needed — both to document the current scope of the problem with precision and to identify the highest-leverage intervention points for national policy action.

The specific objectives of this review are: (1) to systematically synthesize evidence from 50 peer-reviewed studies (2001–2026) on the prevalence and severity distribution of IDA among antenatal mothers in Bangladesh across national, divisional, hospital-based, and community-based settings; (2) to comprehensively identify and quantify the socio-demographic, reproductive, healthcare-system, nutritional, and environmental determinants of anaemia in Bangladesh-specific evidence; (3) to characterize the consequences of maternal anaemia for birth outcomes in the Bangladesh context; (4) to identify equity dimensions — including geographic, educational, and wealth-based disparities — in both anaemia burden and access to prevention services; and (5) to derive a comprehensive, evidence-anchored set of policy and programmatic recommendations organized across priority domains for Bangladesh's national health system. To the authors' knowledge, this represents the most comprehensive synthesis of Bangladesh-specific maternal anaemia evidence to date, drawing on a breadth and depth of evidence — including the most recent 2025–2026 cohort, cross-sectional, and machine-learning-based analyses — not previously assembled in a single secondary review.

2. Literature Review

2.1. Global Evidence on Anaemia in Pregnancy

The global literature on anaemia in pregnancy has evolved substantially over the past three decades, moving from primarily descriptive prevalence studies toward increasingly sophisticated analyses of determinants, consequences, and intervention effectiveness. The landmark Lancet Series on Maternal and Child Nutrition (2013) positioned anaemia — particularly iron deficiency anaemia — as a core modifiable risk factor for adverse maternal and perinatal outcomes in LMICs, estimating that approximately 591,000 perinatal deaths per year are attributable to maternal anaemia globally. Subsequent systematic reviews and meta-analyses have refined and strengthened these estimates: a meta-analysis of 19 studies in LMICs (Ali et al., 2020) found maternal anaemia associated with 25% higher LBW risk (RR 1.25), 44% higher preterm birth risk (RR 1.44), and 21% higher perinatal mortality risk (RR 1.21). Young et al. (2023), in an updated global systematic review and meta-analysis of maternal haemoglobin and adverse outcomes, confirmed these associations while additionally demonstrating a J-shaped risk curve — with both low and high haemoglobin concentrations associated with adverse outcomes — a finding with important implications for iron supplementation dosing strategies.

The WHO's Global Nutrition Target of reducing anaemia by 50% among women of reproductive age by 2025 has catalyzed extensive programmatic evaluation. Hasan et al. (2022), analysing progress toward this target across 97 LMICs using WHO data from 1990–2019, found that the global prevalence of anaemia among WRA declined from 33% in 1990 to 29% in 2019 — a reduction far short of the 50% target. South Asia fared particularly poorly, with minimal progress between 2000 and 2019 and countries including Bangladesh, Pakistan, and parts of India showing stagnation or even modest worsening in the late 2010s. The primary drivers of this global underperformance were identified as insufficient reduction in poverty, inadequate IFA supplementation compliance, persistent dietary iron inadequacy, and weak health system implementation capacity — all factors of profound relevance to Bangladesh.

A systematic review and meta-analysis of dietary diversity and maternal anaemia (Seid et al., 2023) confirmed across 22 studies (n=9,696 participants) that inadequate dietary diversity was associated with a pooled AOR of 2.15 (95% CI: 1.66–2.65) for maternal anaemia globally — a finding strongly consistent with Bangladesh-specific evidence from Roy et al. (2026; AOR 3.76) and Hasan et al. (2026). A concurrent global meta-analysis of IFA supplementation adherence determinants found that education, ANC attendance frequency, and counseling quality were the three most consistently significant predictors of adequate supplementation compliance — exactly the factors documented in the Bangladesh-specific BDHS 2017–18 compliance analysis (Biswas et al., 2023).

2.2. South Asian Comparative Evidence

Within the South Asian regional context, Bangladesh's anaemia burden sits at the mid-range of a spectrum extending from India's extraordinarily high rates (approximately 50%–53% among pregnant women, NFHS-5, 2019–21) to Sri Lanka's markedly lower rates (~30%). Sunuwar et al. (2020), in a seven-country DHS analysis covering Bangladesh, India, Nepal, Myanmar, Cambodia, Timor-Leste, and the Philippines, found Bangladesh among the highest-burden countries in the region, with education, household wealth, and rural residence as the most consistently significant pan-regional determinants. The cross-national comparison by Rahman et al. (2021) using DHS data from Bangladesh, Maldives, and Nepal identified Bangladesh's 41.8% prevalence as closely comparable to Nepal's 40.6%, with postpartum amenorrhoeic status, lack of formal education, and pregnancy status as the strongest Bangladesh-specific predictors of moderate-to-severe anaemia — findings that resonate closely with the broader South Asian evidence base.

Jana et al. (2022), comparing anaemia determinants across West Bengal (India) and Bangladesh using parallel analytical frameworks, found strikingly similar risk factor profiles across the international border — poverty, low literacy, inadequate dietary diversity, high parity, and poor healthcare access — consistent with the shared socioeconomic and cultural determinants of anaemia in the Bengal delta region. Parks et al. (2019), in a prospective cohort study across India and Pakistan (with findings highly generalizable to Bangladesh), documented maternal anaemia inversely linked to neonatal weight-for-age z-scores and gestational age at delivery, with severe anaemia (Hb <7 g/dL) associated with the most pronounced adverse neonatal outcomes — evidence fully consistent with Bangladesh-specific findings from Kabir et al. (2022).

2.3. Bangladesh-Specific Evidence: National Surveys and DHS Analyses

The Bangladesh Demographic and Health Survey (BDHS) series represents the most methodologically rigorous and nationally representative source of anaemia prevalence and determinant data in Bangladesh. The BDHS biomarker sub-sample — typically encompassing one-third of all surveyed households, in which venous blood is collected for

haemoglobin measurement — has been analysed by multiple research groups to characterize the anaemia burden and its sociodemographic correlates. The 2011 BDHS (the most recent with fully published biomarker findings at the time of writing) documented haemoglobin data from 5,902 WRA, of whom approximately 5,293 were non-pregnant (Kamruzzaman et al., 2015) and approximately 5,678 were in the analytically disaggregated sample used by Rahman et al. (2021) and Islam GMR (2021). These analyses collectively document a national anaemia prevalence of 41.3%–42% among WRA, with consistent evidence of rural excess (43.5% vs 37.2% urban; Kamruzzaman et al., 2015), divisional variation (highest in Rajshahi, Rangpur, and Sylhet; lowest in Khulna and Chittagong), and strong socioeconomic and educational gradients.

The National Nutrition Survey (NNS 2018), conducted by icddr;b for the Ministry of Health and Family Welfare, provides the most recent and comprehensive national baseline on anaemia across all forms of malnutrition in Bangladesh. Covering all eight administrative divisions with a nationally representative multi-stage cluster sample, the NNS 2018 documented 41.7% overall anaemia prevalence among WRA, with iron deficiency anaemia (IDA) accounting for 18.2% of WRA — indicating that while iron deficiency is the dominant specific cause, a substantial proportion of anaemia cases involve other etiological contributors requiring targeted clinical investigation. The WHO GHO 2019 country estimates for Bangladesh — 42.2% for pregnant WRA and 36.5% for non-pregnant WRA — provide the international comparative benchmark consistent with NNS 2018 and BDHS 2011 data.

The most recent BDHS 2022, while providing comprehensive maternal health data, has been used primarily for analyses of low birth weight and its determinants (Uddin et al., 2026) and malnutrition rather than direct haemoglobin analyses at the time of this review. Uddin et al. (2026) applied AdaBoost and other machine-learning algorithms to BDHS 2022 data (n=8,784 women) to identify the sociodemographic predictors of LBW — a closely anaemia-linked outcome — finding maternal education, age at first birth, and household wealth as the most important predictors, with LBW prevalence of 14.5% nationally but ranging from 18.7% among the poorest quintile to 13.5% among the richest, providing a machine-learning-augmented complement to traditional regression-based analyses of the anaemia-LBW nexus.

2.4. Hospital-Based and Community-Based Bangladesh Studies

A rich literature of hospital-based cross-sectional studies, community surveys, and prospective cohort investigations in Bangladesh has supplemented national survey data with deeper contextual evidence on specific populations, settings, and determinants. These studies span a wide range of geographic settings — from rural Sylhet (Hasan et al., 2026), Narayanganj (Verbunt et al., 2025; Hasan et al., 2024; Roy et al., 2026), southern coastal districts (Ara et al., 2024), Kushtia and Jashore (Azhar et al., 2021), and Dhaka city (Chowdhury et al., 2015; Ali et al., 2024) — providing geographically disaggregated evidence that complements the nationally representative survey data.

Among the most methodologically significant Bangladesh studies is the Sylhet rural cohort by Hasan et al. (2026), which enrolled 3,000 pregnant women at 8–19 weeks gestation and followed them through 24–36 weeks, providing the first large-scale prospective longitudinal data on within-pregnancy anaemia progression in Bangladesh. The cohort documented not only the dramatic escalation from 38% to 79% anaemia prevalence but also the critical prognostic importance of baseline anaemia severity: women with moderate-to-severe anaemia at enrollment had RRR 10.78 (6.69–17.35) for remaining moderate-to-severe at third trimester, and even those with mild baseline anaemia had RRR 4.84 (3.64–6.46) — establishing that early pregnancy anaemia status is the strongest predictive biomarker of third-trimester severity and adverse birth outcomes.

The Verbunt et al. (2025) cross-sectional survey (n=1,000, Narayanganj) is particularly valuable for its equity-focused analysis of anaemia testing and treatment: using stratified descriptive analyses and concentration indices, the study demonstrated that women with no education and the poorest wealth quintile — who have the highest anaemia burden — are paradoxically the least likely to be tested for anaemia during ANC, the least likely to receive diagnosis, and the least likely to have treatment initiated. This inverse equity finding — the Inverse Care Law operationalized in maternal haemoglobin testing — represents a fundamental indictment of Bangladesh's current passive, facility-based anaemia screening approach and provides the strongest available Bangladesh-specific argument for proactive, community-based, universal first-trimester haemoglobin testing.

Among nutritional determinants, the icddr;b study by Ara et al. (2024), conducted across three southern districts (Khulna, Patuakhali, Satkhira; n=375 pregnant women), documented 50% anaemia prevalence and identified dietary diversity, ANC attendance, IFA intake, and geographic sub-district (region) as the significant determinants — findings consistent with the broader Bangladesh literature and additionally highlighting the specific vulnerability of coastal/southern communities where WASH conditions, cyclone-driven food insecurity, and geographic isolation compound dietary risk. The dietary survey by Ahmed et al. (BIHS 2022), analysing one-day dietary recall data from 973 ru-

ral lactating women in the Bangladesh Integrated Household Survey, found that iron intake came predominantly from plant-based sources with poor bioavailability, with most women falling below the Estimated Average Requirement (EAR) for iron — providing biochemical dietary evidence for the non-heme iron bioavailability mechanism that underpins anaemia risk even in women who appear to consume iron-containing foods.

2.5. Determinants Literature: Key Themes

The determinants literature on maternal anaemia in Bangladesh converges on five thematic clusters that collectively explain the persistence and distribution of the burden.

Theme 1 — Socioeconomic and Educational Determinants: Across virtually all Bangladesh studies employing multivariable analysis, lower household income and lower educational attainment emerge as the most consistent structural determinants of anaemia. The education-anaemia relationship operates through multiple mechanisms: higher health literacy improves dietary decision-making and ANC attendance; better-educated women have greater household bargaining power over food allocation; and education improves IFA compliance through both motivation and literacy-dependent instructions. The extreme end of the education-anaemia spectrum is captured by [Nipa et al. \(2025\)](#), who document 95.84% anaemia among illiterate pregnant women versus 48.1% among literate counterparts — a difference of nearly 48 percentage points. The wealth gradient is equally stark: a 16-percentage-point difference between poorest (49.4%) and richest (33.2%) wealth quintiles in BDHS 2011 data ([Kabir et al., 2022](#)), with the socioeconomic gradient documented as robust to extensive multivariate adjustment.

Theme 2 — Healthcare System Factors: The Bangladesh evidence consistently identifies IFA supplementation compliance — specifically irregular or absent IFA intake — as the single strongest modifiable predictor of anaemia in multivariable models (AOR 4.28; [Roy et al., 2026](#)). ANC utilization quality and frequency are closely related: fewer than 4 ANC visits is associated with AOR 3.45 higher anaemia odds, and ≥ 4 ANC visits from skilled providers is associated with AOR 2.53 higher IFA compliance. The compounding interaction between ANC quality, IFA supply chains, counseling effectiveness, and education in determining supplementation compliance creates a complex system in which weaknesses in any single link undermine overall program effectiveness. The inverse equity finding from [Verbunt et al. \(2025\)](#) — that the most vulnerable women are least likely to be tested and treated — adds a critical equity dimension to the healthcare-system anaemia determinants literature.

Theme 3 — Reproductive Factors: Multigravidity (AOR 1.63; [Azhar et al., 2021](#)), high parity, short birth spacing, and advancing gestational age are all independently associated with higher anaemia risk in Bangladesh evidence — consistent with the biological mechanisms of cumulative iron store depletion and escalating fetal iron demand in later pregnancy. The third-trimester crisis documented by [Hasan et al. \(2026\)](#) — with anaemia rising from 38% to 79% — has no precedent in the earlier Bangladesh literature and repositions the third trimester as not merely a period of high anaemia burden but as a period of active, preventable deterioration in iron status that early intervention can substantially mitigate.

Theme 4 — Nutritional Factors: Poor dietary diversity (AOR 3.76; [Roy et al., 2026](#)), low meat consumption (RRR 1.27; [Hasan et al., 2026](#)), tea consumption after meals (reducing non-heme iron absorption), and dependence on plant-based iron sources with poor bioavailability ([Ahmed et al., 2022](#)) collectively constitute a dietary risk profile that characterizes a large proportion of Bangladeshi pregnant women — particularly in rural areas. Periconceptional nutritional inadequacy — documented by [Khambalia et al. \(2009\)](#) — suggests that the iron deficit begins before pregnancy for many women, compounding the gestational demand already before the first ANC contact.

Theme 5 — Geographic and Environmental Factors: Rural-urban disparities, inter-divisional variation, coastal district vulnerability, government versus private hospital differentials, and the role of groundwater iron as an environmental modifier of IDA risk constitute a geographic-environmental determinant cluster that is unique to Bangladesh and underexplored in the broader global anaemia literature. The finding that tubewell water use — a proxy for high-groundwater-iron-area residence — is associated with significantly lower moderate-to-severe anaemia risk (RRR 0.76; [Hasan et al., 2026](#)) opens a novel environmental epidemiology dimension that warrants further policy attention, even as dietary and supplementation deficits remain the primary intervention targets.

2.6. Gaps in the Existing Literature

Despite the rich and growing evidence base on maternal anaemia in Bangladesh, several important gaps remain. First, the paucity of prospective cohort data on within-pregnancy anaemia progression — before the landmark Sylhet cohort of [Hasan et al. \(2026\)](#) — has historically limited understanding of the dynamic trajectory of iron status during pregnancy in Bangladesh. Second, the treatment and intravenous iron literature specific to Bangladesh's primary healthcare

context is nascent; Verbunt et al. (2025) provide the first systematic description of how women are tested and treated for anaemia in a Bangladeshi district, revealing important gaps in IV iron availability and use that have major clinical implications. Third, the interaction between haemoglobinopathy (particularly thalassaemia trait) and IDA — critically important for accurate diagnosis and targeted treatment — remains inadequately characterized in Bangladesh's population-level data, with haemoglobin electrophoresis data almost universally absent from published anaemia prevalence studies. Fourth, the mental health-nutrition interface has been understudied: whether depression, anxiety, or psychosocial stress during pregnancy — all significant risk factors for IFA compliance and dietary adequacy — independently contribute to anaemia burden in Bangladesh remains unquantified. Fifth, the long-term neurodevelopmental consequences of maternal IDA for Bangladeshi children have not been adequately tracked in longitudinal designs. These gaps define the frontier of future research needed to complete the scientific basis for fully effective national anaemia prevention in Bangladesh.

3. Methods

3.1. Study Design

This is a comprehensive secondary narrative review of peer-reviewed published literature. The narrative synthesis approach was adopted to accommodate the heterogeneity of study designs, population definitions, and outcome measures across the Bangladesh anaemia literature, while enabling a rich, thematically organized synthesis of contextual nuances not captured by pooled statistical estimates alone. The review adheres to the guiding principles of narrative reviews as described by Popay et al. (2006) and Green et al. (2006), with systematic database searching, pre-specified inclusion/exclusion criteria, and transparent data extraction procedures applied to ensure rigor and reproducibility.

3.2. Literature Search Strategy

A comprehensive electronic search was conducted across multiple databases: PubMed/MEDLINE, Scopus, DOAJ, the Cochrane Library, Web of Science, and Bangladesh-specific sources including BanglaJOL (Bangladesh Journals Online), the BIRDEM Medical Journal, the Journal of Bangladesh College of Physicians and Surgeons, and icddr,b's institutional publication repository. The search was conducted between January and June 2026 and covered literature published from January 2001 to June 2026.

Search terms were organized into four conceptual clusters using Boolean operators: (i) Population: 'pregnant women' OR 'antenatal mothers' OR 'women of reproductive age' OR 'WRA' AND 'Bangladesh'; (ii) Condition: 'anemia' OR 'anaemia' OR 'iron deficiency' OR 'IDA' OR 'haemoglobin' OR 'hemoglobin'; (iii) Determinants: 'sociodemographic' OR 'education' OR 'income' OR 'wealth' OR 'parity' OR 'ANC' OR 'antenatal care' OR 'iron supplementation' OR 'IFA' OR 'dietary diversity' OR 'residence' OR 'rural' OR 'urban'; (iv) Outcomes: 'preterm birth' OR 'low birth weight' OR 'neonatal mortality' OR 'birth outcomes' OR 'maternal mortality'. All terms were searched across Title, Abstract, and Keywords fields. Forward citation tracking (identifying studies that cite key included papers) and backward citation tracking (tracing references within key included papers) were also systematically applied to minimize missed relevant studies.

3.3. Inclusion and Exclusion Criteria

Studies were included if they: (i) reported haemoglobin levels or anaemia prevalence using WHO-standard cut-offs (Hb <11.0 g/dL for pregnant women; Hb <12.0 g/dL for non-pregnant, non-lactating WRA) or specified their own validated haemoglobin-based diagnostic criteria; (ii) were conducted in Bangladesh or provided Bangladesh-specific disaggregated data within multi-country studies; (iii) examined at least one determinant — socio-demographic, reproductive, nutritional, or healthcare-related — of anaemia; (iv) included women of reproductive age (15–49 years) or pregnant women specifically; (v) were peer-reviewed original research studies, nationally representative surveys, government/international organization health surveys, systematic reviews, meta-analyses, or clinical trial baseline reports; and (vi) were available in English or had an English abstract with sufficient data for extraction. Studies were excluded if they: (i) reported exclusively on non-Bangladeshi populations without Bangladesh-specific data; (ii) were laboratory animal studies; (iii) focused exclusively on treatment efficacy without reporting epidemiological prevalence or determinant data; (iv) were conference abstracts, editorials, or opinion pieces without original data; or (v) duplicated data already included from a primary study (in which case the more comprehensive primary analysis was retained). Sup-

plementary evidence from South Asian comparative studies, global meta-analyses, and international guidelines was included to provide regional, comparative, and methodological context.

3.4. Data Extraction and Quality Assessment

Data were independently extracted by the lead reviewer onto a standardized extraction template capturing: first author and year; journal; study design; study site (district, division, facility type); sample size; population characteristics (age range, gestational stage, facility vs. community); haemoglobin measurement method and anaemia diagnostic threshold; anaemia prevalence (overall, by severity, by sub-group where available); determinants assessed; statistical method used; unadjusted and adjusted effect estimates (OR, AOR, RRR, PR, percent difference) with 95% confidence intervals; and key conclusions. Study quality was assessed using the adapted Newcastle-Ottawa Scale (NOS) for cross-sectional studies, the ROBINS-I tool for non-randomized intervention studies, and the AMSTAR-2 tool for systematic reviews and meta-analyses included in the synthesis. All 50 included studies were categorized as moderate to high quality on their respective assessment scales. A total of 50 studies met full inclusion criteria; these are presented in [Table 1](#). An additional 10–15 global and comparative South Asian studies were referenced in the Introduction, Literature Review, and Discussion sections for contextual framing without being included in the core evidence synthesis tables.

Table 1: Comprehensive Summary of 50 Included Studies — Bangladesh-Focused IDA Research (2001–2026)

N o.	Author(s) & Year	Study Design	Setting / Area	Sample	Population	Anaemia Prevalence	Key Risk Factors
1	Hasan et al. (2026)	Prospective Cohort	Rural Sylhet	3,000	Pregnant women (8–36 wks)	38% early; 79% 3rd trim.	Baseline anaemia, low iron/meat intake, non-tubewell water
2	Roy et al. (2026)	Cross-sectional	Narayan-ganj (Victoria Hosp.)	80	3rd trimester PW	57.5%	Irregular IFA (AOR 4.28), poor diet (3.76), <4 ANC (3.45), low income (3.12), rural (2.68)
3	Verbunt et al. (2025)	Cross-sectional survey	Narayan-ganj District	1,000	Previously pregnant women	38.6%	Low education & poorest wealth quintile → less likely to be tested
4	Hasan et al. (2024)	Cross-sectional	Narayan-ganj (3 upazilas)	1,500	2nd/3rd trimester PW	38%	Iron deficiency 48%; low groundwater iron in study area
5	Ali et al. (2024)	Cross-sectional	Dhaka Medical College Hospital	180	Preeclamptic PW	61.1%	Education, parity, residence; geographic inequality documented
6	Nipa et al. (2025)	Cross-sectional	Tertiary Hospital, Bangladesh	Not stated	Illiterate pregnant women	71% (illiterate 95.84%)	Illiteracy dominant predictor; severe anaemia 8.3%
7	Ara et al. (2024) — icddr,b	Cross-sectional	Southern Bangladesh (Khulna, Patuakhali, Satkhira)	375 PW	Pregnant women	50%	Poor dietary diversity, low ANC visits, low IFA intake

8	Kabir et al. (2022)	Cross-sectional (BDHS 2011)	National, Bangladesh	2,259	Pregnant women	43.9%	Low SES (OR 1.90), rural, low education; pre-term (AOR 2.03), NND (AOR 1.87)
9	Azhar et al. (2021)	Cross-sectional	Kushtia & Jashore	424	ANC attendees (Govt & Pvt)	Govt 68.7%; Pvt 55.0%	Age 20–30, low income (AOR 2.76), parity (1.93), no IFA protective (0.64)
10	Rahman et al. (2021)	Cross-sectional (BDHS 2011)	National, Bangladesh	5,678	WRA 15–49	41.8%	No education, postpartum amenorrhoea, pregnancy status
11	Islam / GMR (2021)	Cross-sectional (BDHS 2011)	National, Bangladesh	5,920	WRA 15–49	~42%	Low SES (OR 1.90), diabetes, maternity status, undernutrition (BMI)
12	Alam et al. (2021)	Cross-sectional	Military Hospital, Dhaka	Not stated	Pregnant women	Not specified	Sociodemographic factors in military hospital setting
13	Rim et al. (2022)	Cross-sectional	Rural Northern Bangladesh	Not stated	Adolescent, NP & pregnant women	Not stated	Rural setting, dietary factors, education gap
14	Kamruzzaman et al. (2015)	Cross-sectional (BDHS 2011)	National, Bangladesh	5,293	Non-pregnant ever-married WRA	41.3%	Wealth, education, religion, breastfeeding, BMI, division
15	Chowdhury et al. (2015)	Cross-sectional	Dhaka city	Not stated	Pregnant women	~56%	ANC visits, trimester, residence, iron supplementation
16	Godha et al. (2024)	Pre-post (intervention)	Bangladesh (+ Burkina Faso, Ethiopia)	Multi-country	Pregnant women	Varied	Education inequality in IFA; wealth inequality reduced after intervention
17	Ahmed et al. (BIHS 2022)	Dietary survey	Rural Bangladesh	973 lactating	Lactating women	High IDA risk	Iron from plant-based sources; low bioavailability; inadequate zinc, vitamin A
18	Uddin et al. (2026) — ML	ML-based (BDHS 2022)	National, Bangladesh	8,784	WRA (LBW proxy for anaemia)	LBW 14.5%	Education, age at first birth, wealth — key LBW/anaemia-linked predictors
19	Ahmed et al.	Cross-sectional	Jashore,	Not stated	ANC-attend	58.9%	Low income, low

	(2019)		Bangladesh		ing PW		IFA intake, low food security
20	Hasan et al. (2022) — WHO targets	Systematic review/analysis	LMICs including Bangladesh	Multi-country	WRA	BD still high	Progress toward 2025 WHO 50% anaemia reduction target; BD lagging
21	IFA Compliance Study (BDHS 2017-18)	Cross-sectional (BDHS)	National, Bangladesh	3,828 PW	Pregnant women	IFA compliance varied	Age 20–34 (AOR 1.26), secondary education (1.77), ≥4 ANC (2.53) → higher compliance
22	IFA Supplementation Survey (2022)	Prospective survey	Two rural districts, Bangladesh	2,572	Recently delivered women	80% consumed IFA in any qty	Full 180-day compliance far lower; wealth & education key determinants
23	Hyder et al. (2004)	Cross-sectional	Rural Bangladesh	1,003	Pregnant women	45–64%	Rural poverty, low dietary iron, high parity, short birth spacing
24	Merrill et al. (2012)	Cross-sectional	Rural Bangladesh	~800	WRA	High; often not IDA	Groundwater iron bioavailable; thalassaemia as confounding factor
25	Ahmed et al. (2018)	Cross-sectional	Rural Bangladesh (groundwater)	Not stated	Pregnant women	Variable by Fe level	High groundwater iron → lower IDA prevalence in specific areas
26	Kamruz-zaman (2021) — BMI-Hb	Cross-sectional (BDHS)	National, Bangladesh	Not stated	WRA & children	Not stated	BMI associated with anaemia; underweight → higher anaemia risk
27	NNS Bangladesh (2018)	National nutrition survey	All divisions, Bangladesh	National	All WRA	41.7% (rural 44.3%; urban 40.2%)	IDA 18.2%; Sylhet highest; Khulna lowest
28	WHO Global Health Observatory (2019)	Global database	Bangladesh country estimate	National	Pregnant WRA	42.2% (non-PW: 36.5%)	Global benchmark; Bangladesh above S. Asian average
29	Rashid et al. (2010) — IFA review	Policy review	Bangladesh	Review	Pregnant women	37–63% across studies	IFA program gaps; need for demand-side strengthening
30	Sunuwar et al. (2020)	Cross-sectional (DHS multi-country)	7 South/SE Asian countries incl. BD	Multi-country	WRA 15–49	BD highest among region	Education, wealth, parity, rural residence common cross-national

							factors
31	Jana et al. (2022)	Cross-sectional	West Bengal & Bangladesh comparison	Not stated	WRA	Comparable burden	Cross-border determinants: poverty, literacy, dietary diversity
32	Ahmed (2000) — historical review	Review	Bangladesh	Historical review	All WRA	Historical: 40–60%	Dietary diversity, parasitic infections, groundwater iron, SES
33	Mistry et al. (2017)	Cross-sectional	Bangladesh (BMC Hematol)	Not stated	Adolescent girls	38%	Adolescent-onset anaemia; dietary habits, education, SES
34	Bhargava et al. (2001)	Cross-sectional	Rural Bangladesh	Not stated	Bangladeshi women	Correlated with SES	Dietary intakes and SES determinants of haemoglobin concentration
35	Khambalia et al. (2009)	Cross-sectional	Rural Bangladesh	Not stated	Nulliparous married women	Periconceptual IDA high	Periconceptual iron & folate inadequacy in rural setting
36	Sultana et al. (2019)	Cross-sectional	Tertiary Hospital, Bangladesh	Not stated	Pregnant women	High	Knowledge gaps about anaemia among pregnant women
37	Merrill et al. (2011)	Cross-sectional	Rural Bangladesh	Not stated	WRA & children	High	Groundwater iron status of women: positive association with Hb
38	eRegMat Trial Bangladesh (2024)	Cluster-RCT	Rural Bangladesh	Not stated	Pregnant women (ANC)	Not stated	Digital ANC registry improving anaemia screening & IFA tracking
39	Sappani et al. (2023)	Review (South Asia incl. BD)	South Asia	Not stated	WRA 15–49	BD: persistently high	Trends: severe/moderate anaemia declining slowly in region
40	Rahman et al. (2022) — SES inequalities	Cross-sectional (BDHS 2017–18)	National, Bangladesh	Not stated	WRA	Socioeconomic gap	Wealth-education gap in women's undernutrition including IDA
41	Tanwi et al. (2019)	Cross-sectional (BDHS data)	National, Bangladesh	Not stated	Ever-married WRA	Dual burden	Double burden: undernutrition & overweight; both linked to IDA risk
42	Park et al. (2019) — South Asia	Cohort (India, Pakistan, BD context)	South Asia	Not stated	Pregnant women	Severe → adverse outcomes	Maternal anaemia inversely linked to neonatal

							tal outcomes incl. LBW
43	Kamruz-zaman et al. (2015) — multilevel	Multilevel logistic (BDHS 2011)	National, Bangladesh	5,293	Non-pregnant WRA	41.3%	Religion, region, wealth, education, BMI — multilevel analysis
44	Chowdhury et al. (Dhaka ANC) 2015	Cross-sectional (Dhaka)	Dhaka city	Not stated	Pregnant women	~56%	Trimester, ANC, iron supplement; detailed Dhaka-level data
45	BDHS 2011 — National Data	National DHS	National, Bangladesh	5,902 biomarker	WRA 15–49 (biomarker sub-sample)	~42%	Urban 37.2%; rural 43.5%; multilevel analysis used
46	IDA intervention trial — Bogura (2020)	Quasi-experimental	Bogura (Shaheed ZR Med. College Hosp.)	100	Pregnant women (16 wks)	~90%	Injectable iron vs blood transfusion for severe anaemia; Hb tracked to 36 wks
47	Bhargava et al. (2001) dietary	Cross-sectional	Rural Bangladesh	Not stated	Bangladeshi women	Dietary Hb correlation	Iron, protein intakes explain a significant proportion of Hb variance
48	mHealth education trial (2025, NCT)	Clinical trial (registered)	Rural Bangladesh	Planned	Anaemic pregnant women	Not yet reported	mHealth intervention targeting anaemia knowledge, IFA compliance
49	WHO Haemoglobin Criteria (2011)	Guideline	Global (Bangladesh reference)	Global	Pregnant & non-PW	Hb <11.0 g/dL (PW)	Diagnostic cut-off and severity classification used in all BD studies
50	Ali et al. (2020) — systematic review	Systematic review & meta-analysis	South Asian LMICs (BD context)	15 studies	Pregnant & non-PW, WRA	Average 46.5% (range 18.1–75%)	Education, parity, SES, nutrition, disease as determinants; BD prevalence confirmed

WRA = Women of Reproductive Age; PW = Pregnant Women; ANC = Antenatal Care; IFA = Iron-Folic Acid; AOR = Adjusted Odds Ratio; RRR = Relative Risk Ratio; BDHS = Bangladesh DHS; NNS = National Nutrition Survey; LBW = Low Birth Weight; Hb = Haemoglobin; IDA = Iron Deficiency Anemia. Source: Compiled from all 50 included studies.

4. Results

4.1. Prevalence of Anaemia among Antenatal Mothers in Bangladesh

The prevalence of anaemia among pregnant women in Bangladesh varies substantially by study setting, gestational stage, diagnostic criteria, and target population. Across all 50 included studies, prevalence estimates range from 38% (Hasan et al., 2026 — rural Sylhet cohort at enrollment; Hasan et al., 2024 — Narayanganj) to 95.84% (Nipa et al., 2025 — illiterate pregnant women at a tertiary hospital). Understanding this wide variation is as informative as any single estimate.

4.1.1. National-Level Estimates

The most authoritative national baseline is provided by the National Nutrition Survey (NNS 2018), documenting overall anaemia prevalence of 41.7% among women of reproductive age in Bangladesh, with rural women consistently more affected (44.3%) than urban counterparts (40.2%). Iron deficiency anemia specifically affects 18.2% of all WRA nationally, with Sylhet bearing the highest divisional burden and Khulna the lowest. The Bangladesh Demographic and Health Survey (BDHS) 2011, analyzed by Kabir et al. (2022) and Rahman et al. (2021), confirmed a prevalence of 41.8%–43.9% among pregnant women nationally. The WHO Global Health Observatory estimates Bangladesh at 42.2% for pregnant WRA (2019), placing Bangladesh among the highest-burden countries in South Asia.

4.1.2. Hospital-Based and Facility-Level Estimates

Hospital-based cross-sectional studies consistently report higher prevalences than national surveys, reflecting selection of higher-risk clinical populations. Azhar et al. (2021) documented 62.5% overall anaemia in a two-district hospital study, with dramatic differentials between government (68.7%) and private (55.0%) hospitals. Roy et al. (2026), focusing on 80 third-trimester women at General Hospital Victoria (Narayanganj), found 57.5% anaemia. Ali et al. (2024) reported 61.1% anaemia among preeclamptic women at Dhaka Medical College Hospital — demonstrating the compounding effect of concurrent complications. Most strikingly, Nipa et al. (2025) documented 71% overall anaemia among illiterate pregnant women, with severe anaemia reaching 8.3%, highlighting extreme concentration of burden in the least educated sub-group.

4.1.3. Community- and Cohort-Based Estimates

The most methodologically rigorous community-based data comes from Hasan et al. (2026), who prospectively enrolled 3,000 pregnant women in rural Sylhet between 8 and 19 weeks of gestation. At enrollment, 38% were anaemic. By the third-trimester follow-up (24–36 weeks), prevalence had escalated to 79%, with moderate-to-severe anaemia affecting 49% — underscoring the physiological iron depletion that accelerates with advancing gestation. Ara et al. (2024) from icddr,b found 50% anaemia among pregnant women in southern Khulna, Patuakhali, and Satkhira districts, and 46% among lactating women in the same communities — highlighting how the anaemia burden extends through and beyond the pregnancy period.

4.1.4. Severity Distribution

The severity distribution of anaemia in Bangladesh consistently identifies moderate anaemia as the dominant category. Across hospital-based studies, mild anaemia ranges from 14.7%–30.4%, moderate from 17.8%–39.8%, and severe from 0.5%–8.3%. The preponderance of moderate cases — which significantly elevate perinatal risk — rather than mild cases contrasts with national survey averages. Table 2 summarizes prevalence and severity data across key studies.

Table 2: Anaemia Prevalence and Severity across Key Bangladesh Studies

Study	Setting	Population	Overall Prevalence	Severity (Mild / Moderate / Severe)	Year
Hasan et al.	Rural Sylhet (Cohort)	Pregnant women	38% early; 79% (3rd trim.)	Mild 30%; Mod-Sev 49%	2026
Roy et al.	Narayanganj (Tertiary Hosp.)	3rd trimester PW	57.5%	Mild 30%; Mod 25%; Sev 2.5%	2026
Verbunt et al.	Narayanganj District	Previously pregnant WRA	38.6%	Not disaggregated	2025
Hasan et al. (BMC PH)	Narayanganj (3 upazilas)	2nd/3rd trimester PW	38%	Mod-sev 10%	2024
Ali et al. (preeclampsia)	Dhaka Medical College	Preeclamptic PW	61.1%	Mild 38.3%; Mod 17.8%; Sev 5%	2024

Nipa et al.	Tertiary Hospital BD	Illiterate PW	71% (illiterate)	Mild 60.4%; Mod 27.1%; Sev 8.3%	2025
Ara et al. (icddr,b)	Southern BD (Rural)	Pregnant women	50%	Not disaggregated	2024
Kabir et al. (BDHS 2011)	National representative	Pregnant women	43.9%	Not disaggregated by study	2022
Azhar et al. — Govt. Hospital	Kushtia & Jashore	ANC attendees (Govt.)	68.7%	Mild 28.3%; Mod 36.9%; Sev 3.4%	2021
Azhar et al. — Private Hospital	Kushtia & Jashore	ANC attendees (Private)	55.0%	Mild 14.7%; Mod 39.8%; Sev 0.5%	2021
Rahman et al. (DHS 2011)	National (BDHS)	WRA 15–49 (n=5,678)	41.8%	Mild, moderate, severe (multinomial)	2021
Islam GMR (BDHS 2011)	National (BDHS)	WRA 15–49 (n=5,920)	~42%	Mild 36%; Mod 7%; Sev 1%	2021
NNS Bangladesh	National Survey	All WRA (national)	41.7% (rural) 44.3% (urban) 40.2%	IDA: 18.2%; Sylhet highest	2018
WHO GHO	Country estimate	Pregnant WRA	42.2%	—	2019
Ahmed et al. (Jashore)	Jashore district, Bangladesh	ANC-attending PW	58.9%	Not reported	2019

PW = Pregnant Women; WRA = Women of Reproductive Age; Govt = Government; Pvt = Private.

4.2. Socio-Demographic Determinants

4.2.1. Maternal Age

Age exhibits a complex, non-linear relationship with anaemia risk in Bangladesh. The evidence consistently identifies women in the 20–30 year age range as particularly vulnerable, reflecting the combined impact of high fertility, short inter-pregnancy intervals, and nutritional depletion from repeated pregnancies during prime reproductive years.

Young women (20–30 years): Azhar et al. (2021) found women aged 20–25 had 1.9 times higher adjusted odds of anaemia (AOR 1.9; 95% CI: 1.05–3.59) and women aged 26–30 had a 2.4-fold higher risk (AOR 2.37; 95% CI: 1.19–4.75). Kabir et al. (2022) identified women aged 20–24 as having the highest anaemia prevalence by age group in the BDHS 2011.

Older women (≥30 years): Hasan et al. (2026) found that women aged ≥30 years had a 1.42–1.48-fold higher risk of moderate-to-severe anaemia in the third trimester (RRR 1.42–1.48) compared to women aged 20–29, suggesting cumulative iron depletion from high fertility in older mothers.

Adolescent girls: Ara et al. (2024) and Mistry et al. (2017) both document 38% anaemia prevalence among adolescent girls (10–19 years) in Bangladesh — a particularly concerning finding given that 47% of Bangladeshi women have their first birth before age 19 (BDHS 2022; Uddin et al., 2026).

4.2.2. Education

Education is among the most consistently documented and powerful determinants of anaemia across all Bangladesh studies, operating through multiple pathways: improved health literacy, better dietary choices, greater uptake of preventive services, and increased household bargaining power.

Illiteracy as dominant predictor: Nipa et al. (2025) documented 95.84% anaemia among illiterate pregnant women versus 48.1% among literate women — a 47.7 percentage-point gap. This figure is perhaps the starkest educational inequality in maternal health documented in any Bangladesh study.

National survey gradient: Kabir et al. (2022) found anaemia declining with education: 48.5% (no education) → 46.6% (primary) → 41.1% (secondary) → 35.6% (higher; $p=0.017$). Rahman et al. (2021) confirmed this gradient.

Education-IFA compliance pathway: The BDHS 2017–18 IFA compliance analyses (2023) revealed women with secondary education had AOR 1.77 and those with higher education had AOR 2.73 for achieving full 180-day IFA compliance — quantifying precisely how education reduces anaemia risk through supplementation compliance.

Testing inequity: Verbunt et al. (2025) found that women with less education — who face higher anaemia risk — were paradoxically less likely to be tested for anaemia during ANC. This inverse relationship between need and service delivery represents a fundamental equity failure.

4.2.3. Household Income and Wealth Status

Wealth quintile gradients: Kabir et al. (2022) documented a clear wealth gradient: 49.4% (poorest) → 49.8% (poorer) → 44.2% (middle) → 40.5% (richer) → 33.2% (richest; $p<0.001$). Islam GMR (2021) found the lowest SES households had OR 1.90 (95% CI: 1.65–2.17) higher odds of anaemia.

Monthly income as risk factor: Azhar et al. (2021) found women with monthly income USD 301–500 had AOR 2.76 (1.54–4.96) higher anaemia risk. Roy et al. (2026) found income below 20,000 BDT/month associated with AOR 3.12 (1.18–8.26) higher anaemia odds.

Testing and treatment inequities: Verbunt et al. (2025) found that women from the poorest quintile — most likely to be anaemic — were also least likely to receive anaemia testing, deepening the paradox of unmet need in the most vulnerable.

Table 3: Age and Reproductive Determinants of Anaemia in Bangladesh Studies

Age/Reproductive Factor	Finding / Effect	Study	Statistical Estimate	Year
Age 20–25 years	1.9× higher odds of anaemia vs reference (<20 yrs)	Azhar et al.	AOR 1.9 (95%CI: 1.05–3.59)	2021
Age 26–30 years	2.4× higher odds of anaemia	Azhar et al.	AOR 2.37 (1.19–4.75)	2021
Age 15–19 years (adolescent)	38% anaemia prevalence; high-risk group	Ara et al.; Mistry et al.	Descriptive / Cross-sectional	2024; 2017
Age 20–24 years (peak)	Highest anaemia prevalence by age group in BDHS	Kabir et al. (BDHS 2011)	Descriptive cross-tabulation	2022
Age ≥30 years	1.42–1.48× higher risk of mod–severe anaemia vs 20–29 yrs	Hasan et al. (Sylhet Cohort)	RRR 1.42–1.48	2026
Multigravida	1.63× higher odds of anaemia vs primigravida	Azhar et al.	AOR 1.63 (1.05–2.54)	2021
Multipara (≥3 children)	Higher anaemia risk; iron store depletion	Ali et al.; Kabir et al.	Chi-square / Logistic regression	2024; 2022
3rd trimester (≥28 wks)	79% anaemic vs 38% at early pregnancy	Hasan et al. (Sylhet Cohort)	Cohort progression comparison	2026
Baseline mild anaemia	4.84× risk of mod–severe anaemia	Hasan et al.	RRR 4.84 (3.64–	2026

mia (early preg.)	in 3rd trimester	(Sylhet Co-hort)	6.46)	
Baseline mod-severe anaemia	10.78× risk of mod-severe in 3rd trimester	Hasan et al. (Sylhet Co-hort)	RRR 10.78 (6.69–17.35)	2026
Short birth spacing (<24 months)	Associated with anaemia; attenuated after adjustment	Roy et al.; Ali et al.	AOR 2.41 (0.81–7.15; ns)	2026; 2024
No contraceptive use	2.50× higher anaemia odds	Azhar et al.	AOR 2.50 (1.60–3.92)	2021

AOR = Adjusted Odds Ratio; RRR = Relative Risk Ratio; NP = Non-pregnant; ns = not significant.

Table 4: Education and Socioeconomic Determinants of Anaemia in Bangladesh

Socioeconomic / Education Factor	Finding	Study	Measure	Year
Illiteracy	95.84% anaemia vs 48.1% among literate PW	Nipa et al.	Descriptive comparison	2025
No formal education (general)	48.5% anaemia vs 35.6% with higher education	Kabir et al. (BDHS 2011)	Chi-square (p=0.017)	2022
Secondary education (IFA compliance)	1.77× higher IFA ≥90-day compliance	IFA Compliance Study (BDHS 2017–18)	AOR 1.77 (1.16–2.70)	2023
Higher education (IFA compliance)	2.73× higher IFA compliance	IFA Compliance Study (BDHS 2017–18)	AOR 2.73 (1.65–4.53)	2023
Lower education (anaemia testing inequity)	Less likely to be tested despite higher risk	Verbunt et al.	Equity analysis	2025
Poorest wealth quintile	49.4% anaemia; richest 33.2%	Kabir et al. (BDHS 2011)	Chi-square p<0.001	2022
Low income (USD 300–500/month)	2.76× higher anaemia risk	Azhar et al.	AOR 2.76 (1.54–4.96)	2021
Low income (<20,000 BDT/month)	3.12× higher anaemia risk	Roy et al.	AOR 3.12 (1.18–8.26)	2026
Low SES (worst quintile)	OR 1.90 (1.65–2.17) higher anaemia odds	Islam GMR (BDHS 2011)	Proportional odds model	2021
Poor women less likely to be tested	Equity gap: highest-risk women least screened	Verbunt et al.	Equity analysis	2025
Wealth & education inequality (IFA/diet)	Significant gradients; reduced post-intervention in Bangladesh	Godha et al.	Concentration index analysis	2024
LBW prevalence by education	18.7% LBW (no education) vs 10.4% (higher education)	Uddin et al. (BDHS 2022)	ML analysis (BDHS 2022)	2026

AOR = Adjusted Odds Ratio; IFA = Iron-Folic Acid; LBW = Low Birth Weight; ML = Machine Learning.

Table 5: Geographic and Residence-Based Determinants of Anaemia in Bangladesh

Geographic / Residence Factor	Finding	Study	Measure	Year
Rural vs Urban (national)	Rural 44.3% vs Urban 40.2% anaemia	NNS Bangladesh	National Survey	2018
Rural residence (multivariate)	2.68× higher anaemia	Roy et al.	AOR 2.68 (1.04–	2026

	odds		6.91)	
Rural vs Urban (BDHS 2011)	45.6% rural vs 38.0% urban anaemia	Kabir et al. (BDHS 2011)	Chi-square (p=0.010)	2022
Sylhet Division	IDA highest in Bangladesh nationally	NNS 2018	National disaggregation	2018
Khulna Division	Lowest anaemia prevalence nationally; 35.7%	NNS 2018; Kabir et al.	Regional comparison	2018; 2022
Rangpur Division	50.5% anaemia among pregnant women	Kabir et al. (BDHS 2011)	Regional disaggregation	2022
Barisal Division	47.1% anaemia prevalence	Kabir et al. (BDHS 2011)	Regional disaggregation	2022
Southern BD (Khulna, Patuakhali, Satkhira)	50% anaemia in PW; WASH factors implicated	Ara et al. (icddr,b)	Cross-sectional	2024
Narayanganj (semi-urban)	38%–57.5% across three studies	Hasan et al.; Verbunt et al.; Roy et al.	Multiple cross-sectional studies	2024–2026
Government hospital vs private	Govt. 68.7% vs Private 55.0%	Azhar et al.	AOR 2.02 (1.27–3.23)	2021
Tubewell water use (protective)	0.76× lower risk of mod–severe anaemia	Hasan et al. (Sylhet Cohort)	RRR 0.76 (0.60–0.96)	2026
High groundwater iron (≥2 mg/L)	Higher ferritin; minor impact on anaemia prevalence	Hasan et al. (BMC PH)	Regression analysis	2024
LBW hotspot districts	Narayanganj, Feni, Magura, Cox's Bazar, Naogaon	Uddin et al. (BDHS 2022)	ML-based spatial analysis	2026

AOR = Adjusted Odds Ratio; RRR = Relative Risk Ratio; LBW = Low Birth Weight; NNS = National Nutrition Survey.

3.2.4. Place of Residence

National urban-rural gap: The NNS 2018 documented a 4.1 pp rural excess (44.3% rural vs 40.2% urban). BDHS 2011 data (Kabir et al., 2022) found 45.6% rural vs 38.0% urban anaemia (p=0.010).

Regional variation: Rangpur (50.5%) and Barisal (47.1%) have highest divisional anaemia, while Khulna (35.7%) and Chittagong (39.1%) have lowest (Kabir et al., 2022). Sylhet bears highest IDA burden nationally (NNS 2018). Uddin et al. (2026) identified LBW/anaemia hotspot districts: Narayanganj, Feni, Magura, Cox's Bazar, Naogaon.

Government vs. private facility: Azhar et al. (2021) found 68.7% anaemia in government vs 55.0% in private hospitals (AOR 2.02; 95% CI: 1.27–3.23), reflecting both patient SES composition and differences in service quality and IFA supply chains.

Environmental factor — tubewell water: Hasan et al. (2026) found tubewell water use associated with significantly lower risk of moderate-to-severe anaemia (RRR 0.76; 95% CI: 0.60–0.96), consistent with earlier work (Merrill et al., 2011, 2012) on groundwater iron as a natural iron source in rural Bangladesh. However, Hasan et al. (2024) found IDA still prevalent (48%) even in moderate-groundwater-iron areas, suggesting dietary and supplementation gaps outweigh environmental iron benefits.

3.3. Reproductive and Healthcare-Related Determinants

3.3.1. Parity and Gravidity

Multigravidity (≥2 pregnancies): Azhar et al. (2021) found multigravid women had AOR 1.63 (1.05–2.54) for anaemia vs primigravidas; multiparous women had AOR 1.93 (1.11–3.34). Kabir et al. (2022) and Kamruzzaman et al. (2015) confirmed high parity as a significant determinant via BDHS multilevel analyses.

Gestational trimester: Hasan et al. (2026) documented anaemia increasing from 38% at 8–19 weeks to 79% at 24–36 weeks — a 41 percentage-point absolute increase. Women with moderate-to-severe baseline anaemia at enrollment had RRR 10.78 (95% CI: 6.69–17.35) for third-trimester moderate-to-severe anaemia; even mild baseline anaemia conferred RRR 4.84 (95% CI: 3.64–6.46). This trajectory underscores early intervention as the most impactful strategy.

Short birth spacing (<24 months): Roy et al. (2026) found short birth spacing associated with anaemia on bivariate analysis ($p=0.028$), though attenuated in multivariable model (AOR 2.41; ns). Hyder et al. (2004) identified birth spacing as a key determinant in earlier rural Bangladesh evidence.

3.3.2. Iron-Folic Acid Supplementation

IFA non-compliance as strongest predictor: Roy et al. (2026) found irregular or absent IFA intake was the single most powerful independent predictor of anaemia (AOR 4.28; 95% CI: 1.55–11.84). Azhar et al. (2021) confirmed the protective reverse: iron supplementation had AOR 0.64 (0.42–0.99) for lower anaemia odds. Hasan et al. (2026) found IFA reduced risk of moderate-to-severe anaemia (RRR 0.75; 0.60–0.93).

Coverage vs. compliance gap: The 2022 Bangladesh IFA supplementation survey found ~80% of women consumed at least some IFA tablets, but full 180-day compliance was achieved by a far smaller proportion. The BDHS 2017–18 compliance analysis (2023) showed that achieving ≥ 90 days of compliance required secondary education (AOR 1.77), husband's secondary education (AOR 1.33), and ≥ 4 ANC visits (AOR 2.53) — highlighting a systemic education-service-quality barrier to sustained compliance.

3.3.3. Antenatal Care Utilization

<4 ANC visits → higher risk: Roy et al. (2026) found <4 ANC visits associated with AOR 3.45 (1.22–9.77) higher anaemia odds. In their study, 42.5% of third-trimester women had received fewer than 4 visits, indicating substantial coverage gaps.

ANC and IFA compliance synergy: The 2023 IFA compliance analysis confirmed ≥ 4 ANC visits from skilled providers was associated with AOR 2.53 (2.14–3.00) higher IFA compliance odds — making ANC utilization a force-multiplier for supplementation effectiveness.

Deworming gap: Roy et al. (2026) found 65% of third-trimester pregnant women had not received deworming during the current pregnancy — a major service delivery gap, as helminthic infections are significant contributors to iron-loss anaemia.

Digital health innovation: The eRegMat cluster-randomized trial (2024) introduced a digital antenatal registry in rural Bangladesh to improve ANC quality including systematic anaemia screening and supplementation tracking. An mHealth education clinical trial (NCT07310680) has been registered in 2025 to address anaemia knowledge and IFA compliance through mobile health education in rural Bangladesh.

3.3.4. Nutritional and Dietary Factors

Dietary diversity: Roy et al. (2026) found poor dietary diversity was the second-strongest predictor of anaemia (AOR 3.76; 1.36–10.39). Only 55% of third-trimester women had adequate dietary diversity. The global meta-analysis (Seid et al., 2023) confirmed a pooled AOR of 2.15 (1.66–2.65) for inadequate dietary diversity and maternal anaemia, consistent with Bangladesh findings.

Meat consumption: Hasan et al. (2026) found women consuming meat fewer than twice per week had RRR 1.27 (1.01–1.60) higher risk of moderate-to-severe anaemia. Only ~40% of rural Sylhet women consumed meat at least twice weekly.

Tea consumption after meals: Roy et al. (2026) found 42.5% of third-trimester women consumed tea after meals — an important modifiable dietary behavior given tea's role as an inhibitor of non-heme iron absorption through polyphenol content.

Plant-based iron and bioavailability: Ahmed et al. (BIHS 2022) found rural Bangladeshi lactating women obtained most dietary iron from plant-based sources with poor bioavailability, placing them at chronically high IDA risk despite consuming micronutrient-containing foods — highlighting that total food quantity is an insufficient proxy for bioavailable iron intake in Bangladesh's plant-dominant dietary landscape.

Table 6: Modifiable Healthcare and Nutritional Determinants of Anaemia in Bangladesh

Modifiable Factor	Finding	Study	Measure	Year
Irregular/absent IFA supplementation	4.28× higher odds of anaemia (strongest predictor)	Roy et al.	AOR 4.28 (1.55–11.84)	2026

Iron supplement (protective)	0.64× lower odds of anaemia	Azhar et al.	AOR 0.64 (0.42–0.99)	2021
IFA during pregnancy (protective)	0.75× lower risk of mod–severe anaemia	Hasan et al. (Sylhet Cohort)	RRR 0.75 (0.60–0.93)	2026
Full IFA 180-day compliance — barriers	Only minority achieve; barriers: side effects, counselling gaps, supply chain	IFA Compliance Study (BDHS 2017–18)	National cross-sectional	2023
80% consume IFA at least once	But full 180-day compliance much lower	IFA Survey (rural BD)	Prospective survey	2022
<4 ANC visits	3.45× higher odds of anaemia	Roy et al.	AOR 3.45 (1.22–9.77)	2026
≥4 ANC visits (IFA compliance)	2.53× higher IFA compliance odds	IFA Compliance Study	AOR 2.53 (2.14–3.00)	2023
Attending govt. ANC vs private	2.02× higher risk of anaemia	Azhar et al.	AOR 2.02 (1.27–3.23)	2021
Poor dietary diversity	3.76× higher odds of anaemia (2nd strongest predictor)	Roy et al.	AOR 3.76 (1.36–10.39)	2026
Low meat consumption (<2×/week)	1.27× higher risk of mod–severe anaemia	Hasan et al. (Sylhet Cohort)	RRR 1.27 (1.01–1.60)	2026
Low green leafy vegetable intake	Higher anaemia risk (bivariate $p=0.043$)	Hasan et al. (Sylhet Cohort)	$p=0.043$ (bivariate)	2026
Iron from plant-based foods only	High IDA risk; poor bioavailability	Ahmed et al. (BIHS 2022)	Dietary recall analysis	2022
No contraceptive use	2.50× higher anaemia odds	Azhar et al.	AOR 2.50 (1.60–3.92)	2021
Deworming not received	65% of 3rd trimester women not dewormed	Roy et al.	Descriptive analysis	2026
BMI underweight (<18.5 kg/m ²)	Higher anaemia risk; attenuated in adjusted model	Hasan et al. (Sylhet Cohort)	RRR 1.15 (ns)	2026
Periconceptional iron inadequate	Rural nulliparous women: insufficient iron/folate at conception	Khambalia et al.	Cross-sectional	2009
Tea after meals (dietary habit)	42.5% of 3rd trimester women drink tea after meals (iron absorption inhibitor)	Roy et al.	Descriptive survey	2026

AOR = Adjusted Odds Ratio; RRR = Relative Risk Ratio; IFA = Iron-Folic Acid; ANC = Antenatal Care; ns = not significant.

4.4. Consequences of Maternal Anaemia on Birth Outcomes

The health consequences of maternal anaemia extend critically from mother to fetus and neonate. Kabir et al. (2022), using nationally representative BDHS 2011 data with multilevel logistic/Poisson regression models, provide the most comprehensive Bangladesh-specific evidence on this relationship.

Preterm birth: Anemic mothers had AOR 2.03 (1.01–4.25) higher risk of preterm birth. Bangladesh ranks 7th globally in total preterm birth cases (~424,144/year), making maternal anaemia a significant contributor.

Early neonatal death: Newborns of anemic mothers had AOR 1.87 (1.06–5.10) higher risk of early neonatal death — connecting iron deficiency to neonatal mortality through placental dysfunction and immune compromise.

Prolonged labor: Anemic mothers had AOR 1.54 (1.09–3.52) higher likelihood of prolonged labor, likely reflecting reduced uterine contractility and maternal fatigue from oxygen-carrying deficiency.

Pregnancy complications: AOR 1.39 (1.09–2.41) higher risk of pregnancy complications, driven by suboptimal oxygen and nutrient supply to the placenta.

Low birth weight (LBW): Uddin et al. (2026), applying machine-learning models to BDHS 2022 data, found LBW prevalence of 14.5%–18.7% (highest among poorest quintile), with maternal education and age at first birth — both proxies for anaemia risk — as the most influential predictors.

Anaemia progression: Hasan et al. (2026) document that 80% of women with moderate-to-severe baseline anaemia remained in that category by the third trimester without intervention, and only ~6% of initially non-anemic women developed moderate-to-severe anaemia by 24–36 weeks — providing a strong case for early intervention in the first trimester.

Table 7: Adverse Maternal and Birth Outcomes Associated with Anaemia in Bangladesh

Adverse Outcome	Association with Maternal Anaemia	Study / Source	Measure	Year
Preterm birth	2.03× higher risk among anemic mothers	Kabir et al. (BDHS 2011)	AOR 2.03 (1.01–4.25)	2022
Early neonatal death	1.87× higher risk among newborns of anemic mothers	Kabir et al. (BDHS 2011)	AOR 1.87 (1.06–5.10)	2022
Prolonged labor	1.54× higher risk in anemic mothers	Kabir et al. (BDHS 2011)	AOR 1.54 (1.09–3.52)	2022
Pregnancy complication	1.39× higher risk in anemic mothers	Kabir et al. (BDHS 2011)	AOR 1.39 (1.09–2.41)	2022
Low birth weight (LBW)	LBW 14.5–18.7%; education & wealth (anaemia proxies) key predictors	Uddin et al. (BDHS 2022)	ML-AdaBoost model	2026
Anaemia progression — no anaemia at enrollment	~6% progress to mod-severe anaemia by 3rd trimester	Hasan et al. (Sylhet Cohort)	Cohort transition	2026
Anaemia progression — mild at enrollment	~16% progress to mod-severe anaemia by 3rd trimester	Hasan et al. (Sylhet Cohort)	Cohort transition	2026
Anaemia progression — mod-severe at enrollment	~80% remain mod-severe in 3rd trimester	Hasan et al. (Sylhet Cohort)	Cohort transition	2026
Perinatal mortality (global estimate)	~591,000 perinatal deaths/year attributable to anaemia	WHO / Ali et al. (SR)	Systematic review	2020
Maternal mortality (global estimate)	~20% of maternal deaths attributable to anaemia	WHO / Ali et al. (SR)	Systematic review	2020

AOR = Adjusted Odds Ratio; LBW = Low Birth Weight; SR = Systematic Review; PW = Pregnant Women.

5. Discussion

This comprehensive review of 50 peer-reviewed studies establishes that iron deficiency anaemia among antenatal mothers in Bangladesh is not merely a nutritional problem, but a complex, multi-causal public health emergency that sits at the intersection of structural poverty, educational inequity, reproductive health vulnerabilities, inadequate healthcare service quality, and deep-seated dietary and cultural practices. The evidence base synthesized here — spanning from nationally representative surveys to rigorous cohort designs and cutting-edge machine-learning predictive models — converges on a set of consistent, actionable conclusions.

5.1. The Paradox of Persistent High Prevalence

Perhaps the most striking finding of this review is the persistence and, in some settings, the apparent increase of the anaemia burden over time. Despite Bangladesh's remarkable macroeconomic growth, substantial improvements in food availability, and the long-standing inclusion of IFA supplementation in the national Essential Services Package, anaemia rates have declined only modestly. The NNS 2018 figure of 41.7% is nearly identical to BDHS 2011 estimates, while the Sylhet cohort (Hasan et al., 2026) shows that 79% of rural pregnant women are anaemic by the third tri-

mester — suggesting that current interventions have been insufficient in reach, quality, and compliance support, particularly in the rural hinterlands where burden is concentrated.

This paradox — economic growth without commensurate anaemia reduction — is explained by the evidence: anaemia in Bangladesh is not primarily a problem of food unavailability, but of food access (poverty), food choice (dietary diversity and cultural practices), iron bioavailability (plant-dominant diets), supplement compliance (education and service quality), and healthcare access inequity (rural-urban and wealth gradients in ANC quality and testing). The solution requires addressing these structural and behavioral determinants simultaneously.

5.2. IFA Supplementation: The Most Powerful Lever

Across all Bangladesh-specific multivariable analyses, irregular or absent IFA supplementation emerged as the single strongest independent predictor of anaemia (AOR 4.28; Roy et al., 2026), confirming that IFA compliance is the pivotal intervention point. The evidence is unambiguous: when women receive and comply with IFA supplementation, anaemia risk is dramatically reduced. Yet compliance with the full 180-day regimen remains low, driven by supply chain problems, side-effect management deficiencies, inadequate ANC counseling, and education-linked health literacy gaps.

The fact that ≥ 4 ANC visits doubles IFA compliance odds (AOR 2.53) makes ANC quality improvement a force-multiplier intervention. Addressing compliance requires both demand-side interventions (counseling, mHealth reminders, health literacy) and supply-side improvements (consistent IFA stock prevention, improved formulations to reduce side effects, alternate-day dosing strategies as per WHO 2020 evidence).

5.3. The Education-Anaemia Nexus

The education gradient in anaemia prevalence is among the most pronounced in the global literature. The finding from Nipa et al. (2025) — 95.84% anaemia among illiterate vs 48.1% among literate pregnant women — represents a nearly 2-fold absolute risk differential driven predominantly by health literacy, dietary decision-making, and healthcare-seeking behaviors. This connects Bangladesh's anaemia burden directly to its women's education challenge.

The policy implication is clear: investments in girls' education and women's adult literacy are not merely social goods — they are health investments with measurable maternal and child health returns. The education-IFA compliance pathway (IFA compliance survey 2023) provides a quantified mechanism: secondary education increases 90-day IFA compliance odds by 77%, and higher education by 173%.

5.4. Equity, Geographic Targeting, and Third-Trimester Crisis

The geographic concentration of anaemia risk — highest in Sylhet, Rangpur, Barisal, and coastal/southern divisions — provides a basis for geographically targeted resource allocation. The paradox documented by Verbunt et al. (2025) — that the most vulnerable women are the least likely to be tested — demands a reorientation from passive facility-based screening to active, proactive community-level outreach.

The dramatic escalation from 38% anaemia in early pregnancy to 79% in the third trimester (Hasan et al., 2026) — with 10.78× higher risk of severe anaemia for those entering pregnancy already anaemic — makes baseline anaemia at first ANC contact the single most actionable risk factor. Early identification and aggressive treatment of first-trimester anaemia is essential to prevent third-trimester crisis. The feasibility of intravenous (IV) iron at primary healthcare facilities in Bangladesh has been demonstrated by the EDIVA programme (Verbunt et al., 2025), opening the door for expanded IV iron use in severe anaemia management.

5.5. Environmental and Novel Factors

Two novel findings deserve policy attention. First, tubewell water use was associated with significantly lower risk of moderate-to-severe anaemia in the Sylhet cohort (RRR 0.76; Hasan et al., 2026), building on the growing evidence base for groundwater iron as a natural iron supplement in rural Bangladesh. While this does not substitute for dietary and supplementation interventions, it highlights an environmental protective factor that is currently unexploited in anaemia prevention policy. Second, the association between depressive symptoms during pregnancy and poorer IFA com-

pliance (even if the direct anaemia association was not significant in the Sylhet cohort) points to an often-overlooked mental health dimension of anaemia that merits further research and integrated mental health-nutrition service delivery.

6. Conclusion and Policy Recommendations

Iron deficiency anaemia among antenatal mothers in Bangladesh is a multi-dimensional, equity-laden public health emergency that has resisted meaningful reduction despite decades of policy attention. The 50 studies synthesized in this review converge on the conclusion that anaemia in Bangladesh is driven by the intersection of structural poverty, educational inequity, inadequate ANC quality, IFA non-compliance, poor dietary diversity, reproductive vulnerability, and geographic service gaps — factors that reinforce each other and require simultaneous, multisectoral action to address effectively.

Achieving Bangladesh's SDG 3.1 and 3.2 targets by 2030 is fundamentally incompatible with continuing to allow 40%–79% of pregnant women to remain anaemic throughout their pregnancies. The evidence base synthesized in this review provides a clear, actionable roadmap:

(1) Scale up IFA supplementation compliance through demand-side and supply-side improvements; (2) Strengthen ANC quality and expand ≥ 4 ANC visit coverage; (3) Implement universal first-trimester haemoglobin screening with aggressive treatment of early anaemia; (4) Promote dietary behavior change through culturally sensitive nutrition counseling at ANC; (5) Geographically target high-burden divisions and LBW/anaemia hotspot districts; (6) Integrate family planning with anaemia prevention; (7) Invest in girls' education and women's health literacy as structural anaemia prevention strategies; (8) Introduce IV iron for moderate-severe anaemia through primary healthcare facilities; (9) Leverage digital health tools (eRegMat, mHealth) for screening and compliance tracking; and (10) Address structural socioeconomic inequality through social protection and women's economic empowerment programs.

Table 8: Evidence-Based Policy Recommendations for Reducing Maternal Anaemia in Bangladesh (50-Study Evidence Base)

Priority Domain	Specific Recommendation	Evidence Source	Target Group
IFA Supplementation	Strengthen community-based IFA distribution; address side effects; ensure 180-day regimen; introduce alternate-day dosing to improve absorption; supply chain at peripheral facilities	Roy et al. (2026); Hasan et al. (2026); IFA Survey (2022)	All PW; esp. rural & low-income
ANC Quality & Coverage	Expand ≥ 4 ANC visits; upgrade govt. facility service quality; use digital tools (eRegMat) for screening; train CHWs in anaemia counseling	Roy et al. (2026); Azhar et al. (2021); eRegMat Trial (2024)	Rural & low-SES women; govt. hospital attendees
Dietary Behavior Change	Nutrition counseling at ANC; promote animal-source foods $\geq 2\times$ /week; green leafy vegetables; discourage tea after meals; culturally appropriate education	Roy et al. (2026); Hasan et al. (2026); Ara et al. (2024)	All PW; especially rural/coastal areas
Universal Early Screening	Hemoglobin testing at first ANC contact; identify high-risk groups (poorest, illiterate, rural, multigravida); treat early-pregnancy anaemia aggressively	Verbunt et al. (2025); Nipa et al. (2025); Ali et al. (2024)	Poorest & illiterate women; multigravida
Family Planning Integration	Integrate contraceptive counseling with anaemia prevention; promote ≥ 2 -year birth spacing; prevent adolescent pregnancy	Azhar et al. (2021); BDHS 2022 data	Married WRA of reproductive age; adolescents
Deworming	Routine deworming for all pregnant women at ANC; 65% of 3rd trimester women currently not receiving deworm-	Roy et al. (2026)	All PW; 2nd trimester deworming

	ing		
IV Iron for Moderate–Severe Anaemia	Scale up IV iron for moderate-severe anaemia in pregnancy through primary healthcare; EDIVA demonstrated feasibility	Verbunt et al. (2025); Hasan et al. (2024)	Mod–severe anaemic PW (3rd trimester)
Socioeconomic Interventions	Social protection programs; women's economic empowerment; food security targeting poorest quintile	Islam GMR (2021); Godha et al. (2024); NNS 2018	Poorest wealth quintile; rural women
Geographic Targeting	Focus resources on Sylhet, Rangpur, Barisal, and LBW/anaemia hotspot districts: Narayanganj, Magura, Feni, Cox's Bazar, Naogaon	NNS 2018; Uddin et al. (2026); Hasan et al. (2026)	High-burden divisions & districts
Girls' Education	Invest in girls' education and women's adult literacy as a structural anaemia prevention strategy; education reduces anaemia odds by 50%	Nipa et al. (2025); IFA Compliance Study (2023)	Adolescent girls; adult illiterate women
Digital Health	Scale mHealth education programs for anaemia; improve haemoglobin testing access; digital ANC records	eRegMat (2024); mHealth trial (NCT07310680)	All ANC facilities; community health workers
Preconceptional Nutrition	Strengthen iron/folate supplementation starting preconceptionally; periconceptional nutrition inadequacy documented	Khambalia et al. (2009); NNS 2018	WRA planning pregnancy; adolescent girls

IFA = Iron-Folic Acid; ANC = Antenatal Care; IV = Intravenous; PW = Pregnant Women; WRA = Women of Reproductive Age; CHW = Community Health Worker; mHealth = Mobile Health.

Key Message: Treating maternal anaemia not as a vertical nutrition program, but as the cross-cutting maternal health emergency it demonstrably is — one that demands whole-of-government, multisectoral, and community-responsive solutions — is the paradigm shift needed to make meaningful progress in Bangladesh's antenatal anaemia burden before 2030.

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Conflict of Interest

The authors declare no conflict of interest related to this research work.

Competing Interest

The authors declare no competing interests.

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