

ASSESSMENT OF NUTRITIONAL STATUS AMONG PREGNANT WOMEN IN LOWER-MIDDLE-INCOME COUNTRIES: DETERMINANTS AND MATERNAL-NEONATAL OUTCOMES

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Abstract

Background:

Maternal malnutrition in low- and middle-income countries (LMICs) remains a major underlying contributor to maternal and child morbidity and mortality. Malnourished women may face substantially higher risks of adverse maternal outcomes compared with adequately nourished women. This review synthesizes current evidence on the prevalence, multilevel determinants, and clinical consequences of maternal nutritional depletion, with the aim of informing integrated public health strategies in resource-constrained settings.

Methods

A comprehensive literature search was conducted across electronic databases, including PubMed, Cochrane Library, CINAHL, EMBASE, and Scopus, for studies published between 2013 and 2026. Eligible studies examined maternal nutritional status using anthropometric indicators, particularly body mass index (BMI), as well as micronutrient indicators including anemia, iron, and folate status. Studies evaluating associations between maternal nutritional status, pregnancy outcomes, and offspring health in LMICs were considered for inclusion.

Results

The evidence identified three major dimensions of maternal malnutrition. First, epidemiological findings indicate a substantial global burden of maternal undernutrition, with prevalence varying considerably across LMIC settings and reaching 75.7% in some conflict-affected populations, including Mogadishu, Somalia. Second, maternal nutritional status is shaped by an interconnected range of socioeconomic, educational, cultural, and household-level determinants. Poverty (AOR = 1.49) and illiteracy (AOR = 3.6) were identified as important risk factors, while culturally rooted food restrictions, including hot-and-cold food beliefs and intentional dietary reduction during pregnancy to prevent obstructed labor, may further contribute to nutritional depletion. Third, maternal undernutrition is

strongly associated with fetal growth restriction and the development of the “small vulnerable newborn” phenotype and contributes substantially to the global burden of childhood stunting.

Conclusions

Addressing maternal malnutrition in LMICs requires a multidimensional and context-specific approach extending beyond conventional iron–folic acid supplementation. Evidence supports consideration of multiple micronutrient supplementation (MMS), appropriate calcium supplementation, and culturally tailored nutrition counseling to improve adherence and address context-specific dietary practices. Sustainable improvements require nutrition-sensitive interventions targeting structural determinants of malnutrition, including poverty, limited female education, food insecurity, and restricted economic opportunities for women.

INTRODUCTION:

Maternal malnutrition in low- and middle-income countries (LMICs) remains a major public health challenge and an important barrier to achieving global health equity. These countries bear a disproportionately high burden of maternal mortality, with approximately 94%–95% of global maternal deaths occurring in LMICs. Maternal undernutrition further increases vulnerability during pregnancy, with malnourished women reported to have approximately twice the risk of maternal mortality compared with adequately nourished women (Shenoy et al., 2023). This complex nutritional crisis is further characterized by the “triple burden of malnutrition,” referring to the coexistence of undernutrition, micronutrient deficiencies, and overweight or obesity within populations and, in some cases, within the same households (González-Fernández et al., 2024). Globally, an estimated 462 million pregnant women are affected by malnutrition, with a particularly substantial burden reported across Africa and South Asia (Zewude et al., 2024).

South Asia represents one of the regions most affected by maternal malnutrition, and Pakistan faces a considerable burden of maternal nutritional deficiencies and associated adverse pregnancy outcomes. In addition to socioeconomic and environmental determinants, sociocultural beliefs and dietary practices play an important role in shaping maternal nutritional status. For example, studies from Punjab, Pakistan, have documented the influence of

traditional humoral beliefs, including the “hot-and-cold” classification of foods. Under this belief system, nutrient-dense foods such as beef, eggs, and fish may be avoided during pregnancy because they are perceived as “hot” and potentially harmful to the mother or fetus (González-Fernández et al., 2024). Such culturally embedded dietary restrictions may contribute to inadequate intake of essential nutrients during pregnancy.

Another culturally and contextually relevant practice reported in some Pakistani communities is “eating down,” which refers to the intentional reduction of food intake during the second and third trimesters of pregnancy. This practice is sometimes motivated by the belief that restricting maternal food intake will result in a smaller fetus and consequently facilitate childbirth. Although potentially harmful from a nutritional perspective, this behavior may reflect an adaptive response to concerns regarding obstructed labor, particularly in settings where timely access to comprehensive emergency obstetric and surgical services is limited (Zewude et al., 2024).

Evidence from Pakistan has also contributed to the understanding of the relationship between maternal micronutrient status and neonatal outcomes in LMICs. Studies conducted among Pakistani women have reported a positive association between maternal vitamin D status before 20 weeks of gestation and neonatal Apgar scores, suggesting a potential relationship between maternal micronutrient status and early neonatal well-being (González-Fernández et al.,

2024). Furthermore, Pakistan has been an important setting for research examining multiple micronutrient supplementation (MMS) during pregnancy. Evidence indicates that MMS may provide greater benefits than iron-folic acid supplementation alone in reducing the risk of adverse birth outcomes, including stillbirth and small-for-gestational-age births (Shenoy et al., 2023). These findings highlight the importance of context-specific nutritional interventions that address both biological requirements and sociocultural determinants of maternal nutrition. Progress in addressing maternal undernutrition in LMICs was further challenged by the COVID-19 pandemic, which disrupted healthcare services, diverted health-system resources, and contributed to worsening household food insecurity. In addition, the implementation of evidence-based maternal nutrition interventions continues to be affected by inadequate governmental prioritization, limited resources, and supply-chain and logistical challenges, particularly within primary healthcare facilities (Tahlil et al., 2026). These barriers can limit access to essential nutritional supplements and reduce the effective delivery of maternal nutrition services.

Despite growing evidence regarding the prevalence, determinants, and consequences of maternal malnutrition, important gaps remain in understanding how nutritional status interacts with socioeconomic conditions, cultural practices, healthcare access, and maternal and neonatal outcomes across LMICs. Therefore, this review synthesizes the available evidence on maternal nutritional status among pregnant women in LMICs, with particular emphasis on its prevalence, associated determinants, and maternal and neonatal health outcomes. The findings may contribute to future research and support the development of evidence-informed public health interventions and maternal nutrition policies in resource-constrained settings.

1. MATERIAL AND METHOD

A comprehensive literature review was conducted to synthesize the available evidence regarding

maternal nutritional status, its determinants, nutritional interventions, and associated maternal and neonatal outcomes among pregnant women in low- and middle-income countries (LMICs). The review included evidence from systematic reviews, meta-analyses, scoping reviews, randomized controlled trials, and observational studies.

Literature Search Strategy

A comprehensive electronic literature search was conducted using PubMed/MEDLINE, Scopus, CINAHL, EMBASE, and the Cochrane Library. Studies published between January 2013 and 2026 were considered for inclusion. The search strategy incorporated a combination of Medical Subject Headings (MeSH) and relevant free-text keywords related to maternal nutrition, pregnancy, antenatal care, micronutrient deficiencies, dietary interventions, maternal nutritional status, and low- and middle-income countries.

The initial database search identified a total of **497 records** across all databases.

Eligibility Criteria

Studies were considered eligible if they:

- Included pregnant women from low- and middle-income countries.
- Examined maternal nutritional status or nutritional deficiencies.
- Investigated dietary practices or nutritional interventions during pregnancy.
- Reported maternal and/or neonatal health outcomes.
- Included systematic reviews, meta-analyses, scoping reviews, randomized controlled trials, or observational studies.
- Were published between 2013 and 2026.

Studies were excluded if they did not focus on pregnant women, were conducted outside LMICs, did not address maternal nutritional status or relevant outcomes, or did not provide sufficient information relevant to the objectives of the review.

Study Selection

Following the initial database search, duplicate records were identified and removed. The remaining records underwent screening based on their titles and abstracts according to the predefined eligibility criteria. Potentially relevant articles were subsequently assessed through full-text review. After completion of the screening and eligibility assessment process, **22 studies** met the inclusion criteria and were included in the final review.

Data Extraction

Data from the included studies were extracted using a standardized data-extraction format. Relevant information included study characteristics, geographical setting, study design, participant characteristics, maternal nutritional indicators, nutritional interventions, dietary practices, determinants of nutritional status, and reported maternal and neonatal outcomes.

Data Synthesis

Because of substantial heterogeneity among the included studies with respect to study designs, populations, interventions, geographical settings, and outcome measures, a **narrative thematic synthesis** was undertaken rather than a quantitative meta-analysis. Findings were systematically reviewed and organized into major thematic areas related to maternal nutritional status in LMICs.

The extracted evidence was compared across studies to identify consistent patterns, similarities, and differences in the prevalence of maternal malnutrition, associated socioeconomic, demographic, dietary, and cultural determinants, and maternal and neonatal health outcomes. The thematic synthesis facilitated the integration of evidence from diverse study designs and geographical settings while also identifying existing evidence gaps and priorities for future research.

2. Results:

Thematic Analysis

A comprehensive synthesis of the available literature identified three closely interrelated

themes describing maternal nutrition and health in low- and middle-income countries (LMICs). The first theme addresses the **prevalence and geographical variation of maternal malnutrition**, highlighting considerable differences across and within LMICs. The second theme examines the multilevel socioeconomic, environmental, healthcare-related, and sociocultural determinants that influence maternal nutritional status. The third theme focuses on the maternal and neonatal consequences of nutritional deficiencies, including adverse pregnancy outcomes and the potential perpetuation of an intergenerational cycle of malnutrition and poor health. These themes are interconnected rather than independent, as geographical differences in maternal malnutrition are closely associated with socioeconomic and cultural conditions, which subsequently influence maternal, fetal, and child health outcomes.

Theme 1: Prevalence and Geographical Variation of Maternal Malnutrition

Maternal malnutrition remains a major global public health concern and an important challenge to health equity. An estimated 462 million pregnant women worldwide are affected by malnutrition, with a particularly substantial burden reported in Africa and South Asia (Zewude et al., 2024). Although some middle-income countries have made progress in reducing the prevalence of low pre-pregnancy body mass index (BMI), maternal short stature, defined as a height below 145 cm, and anemia remain persistent nutritional concerns in many resource-constrained settings (González-Fernández et al., 2024).

Considerable geographical variation has been observed in the prevalence of maternal undernutrition. A systematic review and meta-analysis conducted across Africa reported a pooled prevalence of maternal undernutrition of 23.5% up to 2018, demonstrating the continuing importance of maternal malnutrition as a public health concern across the continent (Desyibelew & Dadi, 2019). However, the burden varies considerably according to socioeconomic and

humanitarian circumstances. Although rural populations frequently experience higher levels of food insecurity and undernutrition, facility-based evidence from Mogadishu, Somalia, reported a prevalence of maternal undernutrition of 75.7% among pregnant women attending public hospitals. This high prevalence has been associated with displacement, poverty, and other challenges affecting conflict-affected populations (Tahlil et al., 2026).

South Asia similarly experiences a substantial burden of maternal malnutrition. In India, localized studies have reported maternal undernutrition rates approaching 40% in some populations (González-Fernández et al., 2024). At the same time, the nutritional profile of South Asian populations is changing, with overweight and obesity becoming increasingly prevalent while undernutrition, anemia, and micronutrient deficiencies continue to affect large numbers of women (Miller et al., 2025). This emerging pattern represents a **double burden of malnutrition**, in which undernutrition and overnutrition coexist within the same population. The ongoing nutrition transition has also contributed to the emergence of a household double burden of malnutrition (DBM), characterized by maternal overweight or obesity occurring alongside child undernutrition, including stunting. Globally, this phenomenon affects approximately 16% of households and has been reported at particularly high levels in countries such as Indonesia (30.6%) and Ethiopia (23%) (González-Fernández et al., 2024). The increasing availability and consumption of inexpensive, energy-dense, but nutrient-poor foods may contribute to this changing nutritional pattern.

Pakistan continues to face a considerable burden of maternal undernutrition. National data indicate that approximately 14.4% of women of reproductive age are undernourished, while community-based evidence from Kurram District reported a prevalence of undernutrition of 16.3% among pregnant and lactating women (Habib et al., 2026).

Overall, the available evidence demonstrates substantial variation in maternal nutritional

status across geographical, socioeconomic, and humanitarian contexts. These disparities indicate that maternal malnutrition is influenced by a combination of demographic, economic, environmental, and healthcare-related factors, highlighting the importance of examining its underlying determinants.

Theme 2: Multilevel Determinants and Sociocultural Barriers

Maternal nutritional status is influenced by multiple and interconnected socioeconomic, demographic, environmental, healthcare-related, and sociocultural factors. Household poverty and limited maternal education are among the most consistently reported determinants of maternal undernutrition across LMICs. In some settings, women with no formal education have been reported to have approximately 3.6 times higher odds of being undernourished than women with higher educational attainment (Zewude et al., 2024).

Other important determinants include younger maternal age, household poverty, food insecurity, inadequate sanitation, limited access to quality antenatal care, insufficient nutrition knowledge, and sociocultural practices such as food taboos and gender-related inequalities in household food distribution (Miller et al., 2025). Collectively, these factors may reduce dietary diversity, restrict access to essential nutrients, and increase women's vulnerability to nutritional deficiencies during pregnancy.

Food taboos represent an important sociocultural determinant. A systematic review and meta-analysis conducted in Sub-Saharan Africa found that approximately 41% of pregnant women practiced food taboos. Limited maternal education, inadequate nutrition knowledge, and insufficient antenatal care were among the factors associated with these practices (Belew et al., 2025). Avoidance of specific foods during pregnancy may reduce dietary diversity and limit the intake of important macronutrients and micronutrients.

Healthcare-system barriers further contribute to maternal nutritional vulnerability. Limited access to quality antenatal services, inadequate nutrition

counseling, financial constraints, transportation difficulties, and weaknesses in maternal nutrition programmes may hinder the early identification and management of nutritional deficiencies, particularly among rural and socially marginalized populations (Ali et al., 2025; Miller et al., 2025). Environmental conditions may also exacerbate nutritional deficiencies. Inadequate sanitation can increase exposure to parasitic infections, including hookworm, which may contribute to chronic blood loss and anemia. In addition, household exposure to smoke from solid cooking fuels may contribute to inflammatory processes and other physiological changes that adversely affect maternal health and hematological status (Tiore et al., 2024).

In Pakistan, structural determinants may intersect with culturally established dietary beliefs. Traditional humoral concepts, including the “hot-and-cold” classification of foods, may influence maternal dietary choices. In some communities in Punjab, nutrient-dense foods such as beef, eggs, and fish may be avoided because they are considered “hot” and are believed to increase the risk of miscarriage or fetal abnormalities.

Another reported practice is “**eating down**,” whereby pregnant women intentionally reduce their food intake, particularly during the later stages of pregnancy, because of the belief that a smaller fetus may facilitate childbirth. Similar practices have been reported in Pakistan and other resource-constrained settings. Such behaviors may be influenced by concerns about obstructed labor and limited access to affordable or timely emergency obstetric services. Although these practices may be intended to reduce perceived childbirth-related risks, they may inadvertently contribute to inadequate maternal energy and nutrient intake.

Taken together, the findings indicate that maternal malnutrition is not solely a consequence of inadequate food availability. Rather, it results from the interaction of economic hardship, food insecurity, educational limitations, environmental exposures, healthcare barriers, and culturally embedded dietary practices.

Theme 3: Maternal and Neonatal Outcomes and the Intergenerational Cycle of Malnutrition

Maternal nutritional deficiencies have important consequences for maternal, fetal, and neonatal health and may influence health trajectories beyond the early years of life. Maternal undernutrition is an important contributor to fetal growth restriction and intrauterine growth restriction (IUGR), with estimates suggesting that maternal undernutrition accounts for approximately 25%–50% of IUGR cases in South Asia (González-Fernández et al., 2024).

Maternal malnutrition is also associated with an increased risk of adverse maternal outcomes. Women experiencing significant nutritional deficiencies, particularly severe anemia, may be more vulnerable to complications during pregnancy and childbirth. Severe maternal anemia has been associated with a substantial proportion of life-threatening postpartum hemorrhage cases, emphasizing the importance of preventing and managing maternal nutritional deficiencies during pregnancy (Shenoy et al., 2023).

The effects of maternal undernutrition may extend from pregnancy into infancy, childhood, and adulthood. The **first 1,000 days**, encompassing pregnancy and the first two years of life, represent a critical developmental period during which nutritional deficiencies can have lasting consequences. Evidence from 137 LMICs suggests that maternal undernutrition contributes approximately 14.4% of the global burden of childhood stunting (Zewude et al., 2024).

Children born to mothers experiencing nutritional deficiencies may also have an increased risk of impaired cognitive development and chronic cardiometabolic conditions later in life (González-Fernández et al., 2024). These findings demonstrate how inadequate maternal nutrition can contribute to a cycle in which nutritional disadvantage is transmitted across generations.

The intergenerational burden is further complicated by the household double burden of malnutrition (DBM), in which maternal overweight or obesity coexists with child undernutrition, including stunting or

micronutrient deficiencies, within the same household. This pattern is increasingly associated with the nutrition transition, particularly in rapidly urbanizing settings where inexpensive, energy-dense, and nutrient-poor foods are becoming more widely available (González-Fernández et al., 2024).

Maternal short stature, defined as height below 145 cm, represents another important marker of long-term nutritional disadvantage. Persistent short stature may reflect cumulative nutritional deprivation across the life course and is associated with restricted fetal growth and other adverse pregnancy outcomes.

The available evidence therefore indicates that maternal malnutrition has consequences extending beyond pregnancy and the neonatal period. Addressing this intergenerational cycle requires interventions that extend beyond nutritional supplementation alone. Nutrition-sensitive approaches incorporating women's education, economic empowerment, household food security, improved antenatal care, and culturally appropriate nutrition counseling may be necessary to address both immediate nutritional deficiencies and their underlying determinants (Lassi et al., 2021; Shenoy et al., 2023).

Overall Synthesis

The findings across the three themes demonstrate that maternal malnutrition in LMICs is a multidimensional and interconnected public health problem. Its prevalence varies substantially across geographical and socioeconomic settings, while its determinants encompass poverty, food insecurity, education, environmental conditions, healthcare access, and sociocultural practices. Maternal nutritional deficiencies are subsequently associated with important maternal, fetal, and neonatal outcomes and may contribute to the continuation of nutritional disadvantage across generations.

These findings support the need for context-specific interventions that combine nutritional supplementation and dietary interventions with improvements in antenatal care, maternal education, food security, healthcare accessibility,

socioeconomic empowerment, and culturally sensitive nutrition counseling.

Conclusion

This systematic review demonstrates that maternal malnutrition in low- and middle-income countries (LMICs) is a multifaceted public health challenge arising from the interaction of socioeconomic deprivation, environmental conditions, inadequate access to healthcare, food insecurity, and culturally embedded dietary practices (González-Fernández et al., 2024; Zewude et al., 2024). The available evidence indicates a substantial and persistent burden of maternal undernutrition, with particularly high prevalence reported in conflict-affected, rural, and resource-constrained settings. These findings underscore the disproportionate vulnerability of socially and economically marginalized populations to nutritional deficiencies (Tahlil et al., 2026).

At the same time, the coexistence of maternal undernutrition, overweight, obesity, and micronutrient deficiencies reflects the emerging **double and triple burden of malnutrition** associated with the nutrition transition in many LMICs (González-Fernández et al., 2024). This changing nutritional landscape presents additional challenges for maternal and child health systems and may contribute to a range of adverse pregnancy and neonatal outcomes.

The review further highlights the important role of sociocultural determinants in shaping maternal dietary behavior. Practices such as food taboos and “eating down” may be influenced by culturally established beliefs and concerns regarding pregnancy and childbirth. Although these practices may be perceived by communities as protective, they can contribute to reduced dietary diversity and inadequate intake of essential nutrients during pregnancy (Shenoy et al., 2023).

Maternal nutritional deficiencies are associated with important adverse pregnancy and neonatal outcomes, including low birth weight, preterm birth, small-for-gestational-age birth, fetal growth restriction, and increased vulnerability to maternal complications (González-Fernández et

al., 2024; Shenoy et al., 2023). Furthermore, the effects of maternal malnutrition may extend beyond the immediate pregnancy and contribute to an intergenerational cycle of undernutrition, impaired child development, and increased susceptibility to chronic disease.

Overall, the evidence suggests that maternal malnutrition should be addressed through an integrated approach that combines direct nutritional interventions with strategies targeting the broader socioeconomic, environmental, healthcare, and cultural determinants of maternal nutrition.

Recommendations

Based on the findings of this review, the following recommendations are proposed:

1. Strengthen maternal micronutrient interventions:

Multiple micronutrient supplementation (MMS) should be considered alongside established antenatal nutritional interventions, with appropriate low-dose calcium supplementation where recommended, to improve maternal nutritional status and reduce adverse pregnancy and neonatal outcomes (Shenoy et al., 2023; Zewude et al., 2024).

2. Enhance culturally appropriate nutrition counseling:

Antenatal nutrition counseling should promote the consumption of affordable, locally available, and nutrient-dense foods while addressing culturally embedded dietary restrictions and misconceptions. Particular attention should be given to practices such as food taboos and “eating down” through respectful, culturally sensitive health education (Tahlil et al., 2026; Zewude et al., 2024).

3. Improve access to quality antenatal care:

Health systems should strengthen routine nutritional screening, counseling, supplementation, and early identification and management of maternal nutritional deficiencies, particularly among women living in rural, conflict-affected, and socioeconomically disadvantaged communities.

4. Address underlying socioeconomic determinants:

Policies should promote female education, household economic empowerment, food security, and equitable access to essential healthcare services. Addressing these structural determinants is essential for achieving sustainable improvements in maternal nutrition (Shenoy et al., 2023).

5. Strengthen water, sanitation, and hygiene (WASH) services:

Improvements in access to safe water, sanitation, and hygiene infrastructure should be integrated into maternal nutrition programmes to reduce infection-related nutritional losses and improve overall maternal health (Tirore et al., 2024).

6. Adopt multisectoral strategies:

Maternal nutrition programmes should involve collaboration among healthcare providers, public health authorities, education sectors, community organizations, and policymakers. Such collaboration can facilitate coordinated interventions addressing nutrition, food security, education, sanitation, healthcare access, and women's socioeconomic empowerment.

Overall Recommendation

A comprehensive and context-specific multisectoral approach is essential to address the immediate nutritional needs of pregnant women while simultaneously targeting the structural and sociocultural determinants of malnutrition. Strengthening maternal nutrition interventions across the continuum of care may contribute to improved maternal and neonatal health, reduction of preventable adverse pregnancy outcomes, and progress toward the Sustainable Development Goals (SDGs).

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