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# NUTRITIONAL STATUS OF PREGNANT WOMEN IN LOWER-MIDDLE-INCOME COUNTRIES: A REVIEW OF PREVALENCE, DETERMINANTS, AND MATERNAL–NEONATAL OUTCOMES

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## Abstract

***Background:*** *Maternal malnutrition in lower-middle-income countries (LMICs) serves as a primary underlying catalyst for global maternal mortality, with malnourished women facing a mortality risk twice as high as their well-nourished counterparts This review synthesizes current evidence on the prevalence, multi-level determinants, and clinical consequences of nutritional depletion to inform integrated public health strategies in resource-constrained settings.*

***Methods:*** *We searched electronic databases including PubMed, Cochrane Library, CINAHL, EMBASE, and Scopus for studies published between 2013 and 2026. The inclusion criteria targeted maternal anthropometric indicators BMI, micronutrient status (anemia, iron, folate), and their associations with gestational success and offspring health in LMICs.*

***Results:*** *Three primary dimensions were identified. First, epidemiological data indicates that nearly 462 million pregnant women are malnourished globally, with subnational prevalence reaching 75.7% in conflict-affected regions like Mogadishu, Somalia. Second, nutritional status is dictated by a "syndemic" of factors, where household poverty (AOR=1.49) and illiteracy (AOR=3.6) intersect with cultural practices, such as humoral "hot-and-cold" food taboos and the practice of "eating down" to avoid obstructed labor Third, maternal depletion is the primary driver of the "small vulnerable newborn" phenotype and is responsible for 14.4% of childhood stunting globally.*

***Conclusions:*** *Addressing this crisis requires a transition from standard iron-folic acid to Multiple Micronutrient Supplementation (MMS), the integration of routine low-dose calcium, and culturally tailored counseling to bridge the "adherence gap". Long-term solutions must incorporate nutrition-sensitive programming that addresses structural inequality through female education and financial empowerment.*

## INTRODUCTION

Maternal malnutrition in lower-middle-income countries (LMICs) remains one of the most critical barriers to global health equity, serving as a primary catalyst for the disproportionate burden of maternal mortality in these regions. Approximately 94% to 95% of all global maternal deaths occur within LMICs, where malnourished expectant mothers face a risk of mortality twice as high as those who are well-nourished (Shenoy et al., 2023). This systemic crisis is characterized by a "triple burden of malnutrition" the concurrent existence of under nutrition, micronutrient deficiencies, and overweight or obesity within the same populations and households (González-Fernández et al., 2024). Globally, nearly 462 million pregnant women are malnourished, with the highest concentration of this burden residing in Africa and South Asia (Zewude et al., 2024).

Among South Asian countries, Pakistan represents one of the most affected settings, with a substantial burden of maternal malnutrition and its associated adverse pregnancy outcomes. for understanding how complex socio-cultural determinants shape nutritional status. In regions such as Punjab, Pakistan, maternal dietary choices are frequently governed by ancestral beliefs, specifically the humeral "hot-and-cold" classification system. Under this system, nutrient-dense proteins like beef, eggs, and fish are often avoided because they are perceived as "hot" foods that could trigger miscarriage or fetal abnormalities (González-Fernández et al., 2024). Furthermore, Pakistan being the lower-middle-income country, there is practice of "eating down", the intentional reduction of food intake during the second and third trimesters of pregnancy is still reported, driven by the belief that limiting food intake will result in a smaller baby and an easier childbirth. This approach is often a rational response to the fear of obstructed labor in settings where surgical obstetric care is unavailable (Zewude et al., 2024).

Clinical evidence from Pakistan has contributed significantly to the global understanding of micronutrient status and neonatal outcomes in LMICs. Research has shown that maternal Vitamin D status before 20 weeks' gestation is positively correlated with neonatal APGAR (Appearance, Pulse, Grimace, Activity, and Respiration) scores in Pakistani cohorts (González-Fernández et al., 2024). Additionally, Pakistan has been one of the countries where multiple micronutrient supplementation (MMS) has been widely studied. Research shows that MMS is more effective than iron and folic acid supplements alone in reducing the risk of stillbirth and babies being born small for their gestational age. These findings underscore the importance of targeted interventions that account for the unique biological and behavioral landscapes of specific LMICs (Shenoy et al., 2023).

Despite these insights, progress in reducing maternal under nutrition across LMICs was severely disrupted by the COVID-19 pandemic, which redirected essential healthcare resources and exacerbated household food insecurity. Furthermore, the implementation of evidence-based interventions is often hindered by low government prioritization and logistical supply chain failures in primary health centers (Tahlil et al., 2026).. This review synthesizes the prevalence, determinants, and outcomes of maternal under nutrition among pregnant women in LMICs. The findings may help guide future research and support evidence-informed public health interventions and maternal nutrition policies in income settings.

### Review Questions

1. What is the prevalence of nutritional status among pregnant women in lower-middle-income countries?
2. What factors are associated with the nutritional status of pregnant women in lower-middle-income countries?
3. What kind of maternal and neonatal outcomes are associated with the nutritional status of pregnant women in lower-middle-income countries?

### Objectives

1. To determine the prevalence of nutritional status among pregnant women in lower-middle-income countries.

2. To identify the factors associated with the low nutritional status of pregnant women in lower-middle-income countries.
3. To examine the association between maternal nutritional status and maternal and neonatal health outcomes in lower-middle-income countries.

**Methodology**

A comprehensive literature search was performed in PubMed/MEDLINE, Scopus, CINAHL, EMBASE, and the Cochrane Library to identify studies published between 2013 and 2026. The search strategy combined Medical Subject Headings (MeSH) and free-text keywords related to maternal nutrition, pregnancy, antenatal care, micronutrient deficiencies, dietary interventions, and low- and middle-income countries (LMICs). The initial search yielded 497 records across all databases.

After removing duplicate records and applying the predefined inclusion and exclusion criteria through title, abstract, and full-text screening, 22 studies were included in the final review. Eligible studies included systematic reviews, meta-analyses, scoping reviews, randomized controlled trials, and observational studies conducted among pregnant women in LMICs that reported maternal nutritional status, nutritional interventions, dietary practices, or maternal and neonatal outcomes. Data from the included studies were extracted using a standardized form and synthesized narratively because of the heterogeneity in study designs, interventions, and outcome measures.

The findings from the included studies were carefully reviewed and organized into major thematic areas to provide a comprehensive understanding of maternal nutritional status in lower-middle-income countries. Data were compared across studies to identify recurring patterns, similarities, and differences in the prevalence of maternal malnutrition, its determinants, and associated maternal and neonatal outcomes. This thematic synthesis enabled the integration of evidence from diverse study designs and geographical settings while highlighting existing knowledge gaps and areas requiring further research.

**Results**

A rigorous analysis of the available published literature identified three interrelated themes that characterize maternal nutrition and health in lower-middle-income countries (LMICs). The first theme highlights the prevalence and geographic variation of maternal malnutrition, demonstrating substantial disparities across and within LMICs. The second theme explores the complex interplay of multilevel determinants, including socioeconomic conditions, cultural beliefs, dietary practices, limited access to healthcare, and other structural barriers that influence maternal nutritional status. The third theme focuses on the maternal and neonatal outcomes associated with poor nutrition, illustrating how maternal malnutrition contributes to adverse pregnancy outcomes and perpetuates an intergenerational cycle of poor health and undernutrition. These themes are closely interconnected rather than independent, as the geographic distribution of maternal malnutrition largely reflects underlying socioeconomic and cultural determinants, which subsequently shape the health and developmental outcomes of both mothers and their children.

**Theme 1: Prevalence and Geographic variation of Maternal Malnutrition**

The global burden of maternal malnutrition remains a confounding barrier to health equity, with nearly 462 million pregnant women malnourished worldwide (Zewude et al., 2024). While some middle-income countries have succeeded to reduce the prevalence of low pre-pregnancy body mass index (BMI), whereas rates of maternal short stature (height <145 cm) and anemia remain stagnant in less developed regions (González-Fernández et al., 2024). At the regional level, a systematic review conducted across Africa estimated that the pooled prevalence of maternal under nutrition was 23.5% up to 2018, highlighting that maternal under nutrition remains a major public health concern across the continent. (Desyibelew & Dadi, 2019). A critical synthesis of the data reveals an "urban disadvantage" in conflict-affected areas: while rural women are traditionally 1.5 to 2.6 times more likely to be undernourished due to food insecurity,

facility-based studies in Mogadishu, Somalia, report an alarming prevalence of 75.7% driven by mass displacement and urban poverty (Tahlil et al., 2026).

In South Asia, the crisis is equally profound. India holds a significant absolute burden, with localized under nutrition rates reaching approximately 40% (González-Fernández et al., 2024). Another recent review from South Asia demonstrated that maternal malnutrition presents a double burden, with overweight becoming more prevalent than underweight in some populations, while anemia and micronutrient deficiencies remain widespread. (Miller et al., 2025). Furthermore, a complex "nutrition transition" is creating a household double burden of malnutrition (DBM), where maternal overweight or obesity coexists with child stunting in the same home. This DBM affects approximately 16% of households globally and is particularly prevalent in Indonesia (30.6%) and Ethiopia (23%), signaling a shift toward diets that are energy-dense but nutrient-poor (González-Fernández et al., 2024). In Pakistan, maternal under nutrition also remains a significant public health concern. National survey data indicate that 14.4% of women of reproductive age are undernourished**,** while community-based evidence from Kurram District reported an under nutrition prevalence of 16.3% among pregnant and lactating women (Habib et al., 2026).

Though, all the above findings demonstrate that the burden of maternal malnutrition extends beyond differences in prevalence, reflecting substantial variation across geographical, socioeconomic, and humanitarian contexts. The observed disparities indicate that maternal nutritional status is shaped by a complex interplay of demographic, economic, and environmental factors, warranting a closer examination of the determinants of maternal malnutrition.

**Theme 2: Multi-Level Determinants and Socio-Cultural Barriers**

The nutritional status of pregnant women is dictated by a "syndemic" of socioeconomic deprivation and deeply rooted cultural behaviors. Household poverty and maternal illiteracy are the most dominant distal predictors across LMICs, with illiterate women in some regions being 3.6 times more likely to be undernourished (Zewude et al., 2024). Another study conducted reported maternal malnutrition in low- and middle-income countries (LMICs) is influenced by multiple interconnected factors, including young maternal age, low educational attainment, poverty, food insecurity, poor sanitation, limited access to quality antenatal care, and socio-cultural practices such as food taboos and gender-based dietary inequalities.

These determinants collectively reduce dietary diversity, limit access to nutrition and healthcare services, and increase women's vulnerability to under nutrition during pregnancy (Miller et al., 2025). A recent systematic review from Sub-Saharan Africa found that approximately 41% of pregnant women practiced food taboos, with poor maternal education, inadequate nutrition knowledge, and lack of antenatal care being the major contributing factors (Belew et al., 2025). Furthermore, inadequate access to quality antenatal care, insufficient nutrition counselling, financial constraints, transportation difficulties, and weak maternal nutrition programmes continue to impede the early identification and management of maternal malnutrition, particularly among rural and marginalized populations (Ali et al., 2026; Miller et al., 2025). Another study found these factors are compounded by environmental risks; living in households with unimproved sanitation increases the transmission of hookworms, causing chronic blood loss, while the use of solid cooking fuels induces systemic inflammation that suppresses red blood cell production (Tirore et al., 2024).

Crucially, in countries like Pakistan, these structural barriers intersect with ancestral belief systems, such as the humoral "hot-and-cold" food classification. In regions like Punjab, Pakistan, nutrient-dense proteins such as beef, eggs, and fish are often avoided because they are perceived as "hot" foods that could trigger miscarriage or fetal abnormalities. A professional synthesis of this behavior reveals a paradox of rational malnutrition: the practice of "eating down" intentionally restricting food in the third trimester is documented across Pakistan, Senegal, and

Nepal as a risk-mitigation strategy to avoid delivering an oversized baby where surgical obstetric care is unavailable or unaffordable.

**Theme 3: Maternal-Neonatal Outcomes and the Intergenerational Cycle**

The consequences of these nutritional deficits extend from the womb into adulthood, driving a persistent cycle of scarcity. Maternal under nutrition is the primary driver of intrauterine growth restriction (IUGR), accounting for 25% to 50% of all cases in South Asia (González-Fernández et al., 2024). In LMICs, malnourished mothers face a mortality risk twice as high as those who are well-nourished, with severe anemia being responsible for up to half of all life-threatening postpartum hemorrhage cases (Shenoy et al., 2023).

These insults during the critical "First 1,000 Days" force permanent metabolic adaptations in the fetus, leading to the "small vulnerable newborn" (SVN) phenotype. Evidence from 137 LMICs indicates that maternal under nutrition is directly responsible for 14.4% of all childhood stunting (Zewude et al., 2024). Furthermore, children born to malnourished mothers face a heightened risk of cognitive impairments and chronic cardio metabolic diseases in adulthood (González-Fernández et al., 2024). A critical synthesis suggests that breaking this cycle requires health systems to move beyond simple supplementation toward nutrition-sensitive programming that empowers women financially and improves household decision-making power (Shenoy et al., 2023).

Furthermore, this intergenerational cycle is increasingly characterized by the household double burden of malnutrition (DBM), a phenomenon where maternal overnutrition (overweight or obesity) coexists with child undernutrition, such as stunting or anemia, within the same family unit. Affecting approximately 16% of households in LMICs, this divergence is frequently driven by an accelerated "nutrition transition" toward cheap, energy-dense but nutrient-poor staples, particularly in rapidly urbanizing environments. The cycle is further cemented by maternal short stature (stature < 145 cm), which remains stagnant in less developed regions and acts as a primary anatomical predictor of restricted fetal growth and inadequate gestational weight gain. Breaking this persistent loop requires not only medical intervention but also interactive, culturally tailored dietary counseling to address deep-seated fears and behavioral taboos, such as the practice of "eating down," that continue to compromise both maternal recovery and neonatal development (Lassi et al., 2021)

**Discussion**

The findings of this review underscore that maternal malnutrition in lower-middle-income countries (LMICs), particularly within urban slum environments like Karachi, is a multifaceted crisis driven by biological, structural, and deeply rooted socio-cultural determinants (Shenoy et al., 2023). While global initiatives have targeted clinical supplementation, a significant "adherence gap" persists due to a failure to account for community-level behavioral drivers (Lassi et al., 2021).

**1. The Biological and Gestational Risk Profile**

Evidence indicates that the second trimester serves as a critical biological "inflection point" where the risk of under nutrition peaks (AOR = 8.59) (Tahlil et al., 2026). This stage coincides with a dramatic escalation in physiological demands, with daily iron requirements jumping from 0.8 mg/day in the first trimester to 4–5 mg/day in the second (Nutritional Status Review, 2024). In urban poor settings, where "hidden hunger" is prevalent, even mothers with a normal pre-pregnancy BMI often fail to achieve minimum gestational weight gain, highlighting that anthropometry alone is an insufficient indicator of nutritional safety in these communities (Lassi et al., 2021).

**2. Socio-Cultural Barriers and the Paradox of Rational Malnutrition**

A central finding is the "paradox of rational malnutrition," where pregnant women in Pakistan and similar South Asian contexts intentionally practice "eating down" during the second and third trimesters. This behavior is not a result of ignorance but is a protective strategy to avoid delivering an oversized baby and facing obstructed

labor (dystocia) in settings where surgical obstetric care is inaccessible or unaffordable (Lassi et al., 2021) This is further complicated by ancestral humoral belief systems that classify nutrient-dense proteins like beef, eggs, and fish as "hot" believed to cause miscarriage while favoring "cool" but less nutrient-dense foods like buttermilk.

**3. Household Power Dynamics and Decision-Making**

Maternal diet is rarely an individual choice; it is a household-level decision dictated by husbands and mothers-in-law. Husbands typically control the financial resources for food purchases, while mothers-in-law often manage intra-household food allocation, frequently reinforcing traditional taboos over modern medical advice (Lassi et al., 2021).Studies show that women with lower educational attainment (maternal illiteracy AOR = 3.6) have significantly less influence over these nutritional decisions, which perpetuates the cycle of maternal depletion (Zewude et al., 2024).

**4. Structural Determinants and the Urban Slum Context**

The urban poor in informal settlements face unique risks compared to rural populations. While rural residents may have agricultural access to fresh produce, the urban poor rely on market-based food systems where household poverty (AOR = 1.49) often leads to a reliance on cheap, energy-dense, but nutrient-poor staples (Tirore et al., 2024). Furthermore, environmental factors common in Karachi's slums, such as the use of solid cooking fuels, induce systemic inflammation that can suppress red blood cell formation and worsen anemia severity (AOR = 1.10) (Tirore et al., 2024).

**5. Bridging the Adherence Gap**

Current facility-based interventions frequently fail to reach non-ANC utilizing women. To be effective, community-based programs must transition from standard iron-folic acid (IFA) to Multiple Micronutrient Supplementation (MMS), which reduces the risk of low birth weight by 12% to 14% (González-Fernández et al., 2024; Nutritional Status Review, 2024). However, successful implementation requires culturally tailored dietary counseling that uses visual aids to demystify supplements and addresses the specific fears associated with "eating down" and "hot" foods (Lassi et al., 2021).

**Conclusion**

This systematic review highlights that maternal malnutrition in lower-middle-income countries (LMICs) is a complex public health challenge driven by the interaction of socioeconomic deprivation, environmental conditions, limited access to healthcare, and deeply rooted cultural practices (González-Fernández et al., 2024; Zewude et al., 2024). The evidences demonstrates a substantial burden of under nutrition, with particularly high prevalence reported in conflict-affected and resource-constrained settings, emphasizing the disproportionate vulnerability of marginalized populations (Tahlil et al., 2026). The coexistence of undernutrition and overweight within the same communities further reflects the ongoing nutrition transition in many LMICs, increasing the risk of adverse maternal and neonatal health outcomes (González-Fernández et al., 2024).

The review also highlights the influence of cultural beliefs and practices, such as food taboos and "eating down," which, although often adopted as perceived protective strategies, contribute to inadequate maternal nutrition and poor pregnancy outcomes (Shenoy et al., 2023). Maternal nutritional deficiencies are strongly associated with adverse outcomes, including low birth weight, preterm birth, small-for-gestational-age infants, and the perpetuation of an intergenerational cycle of malnutrition and poor health (González-Fernández et al., 2024; Shenoy et al., 2023).

**Recommendations**

Addressing maternal malnutrition in LMICs requires integrated nutrition-specific and nutrition-sensitive interventions. Expanding the use of Multiple Micronutrient Supplementation (MMS), alongside recommended low-dose calcium supplementation during pregnancy, should be prioritized to improve maternal and neonatal

outcomes (Shenoy et al., 2023; Zewude et al., 2024). Nutrition counselling should promote the consumption of affordable, locally available nutrient-rich foods while addressing harmful cultural beliefs and practices, including food taboos and "eating down," through culturally appropriate health education (Tahlil et al., 2026; Zewude et al., 2024).

In addition, governments and policymakers should strengthen female education, improve household food security, enhance water, sanitation, and hygiene (WASH) infrastructure, and expand access to quality antenatal care to address the underlying determinants of maternal malnutrition (Shenoy et al., 2023; Tirore et al., 2024). A comprehensive, multisectoral approach is essential to improve maternal nutrition, reduce adverse maternal and neonatal outcomes, and support progress toward the Sustainable Development Goals.

## REFERENCES

Akombi, B. J., Agho, K. E., Hall, J. J., Wali, N., Renzaho, A. M. N., & Merom, D. (2017). *Stunting, wasting and underweight in sub-Saharan Africa: A systematic review*. *International Journal of Environmental Research and Public Health, 14*(8), 863. https://doi.org/10.3390/ijerph14080863

Bourassa, M. W., Osendarp, S. J. M., Adu-Afarwuah, S., Ahmed, S., Ajello, C., Bergeron, G., Black, R. E., Christian, P., Cousens, S., de Pee, S., et al. (2019). *Review of the evidence regarding the use of antenatal multiple micronutrient supplementation in low- and middle-income countries*. *Annals of the New York Academy of Sciences, 1444*(1), 6–21. https://doi.org/10.1111/nyas.14121

Dassie, G. A., Lemi, H., Getachew, T., & Ayana, S. (2026). *Maternal diet quality during pregnancy and birth outcomes in low- and middle-income countries: A scoping review*. *BMC Nutrition, 12*, Article 17. https://doi.org/10.1186/s40795-025-01229-5

Desyibelew, H. D., & Dadi, A. F. (2019). *Burden and determinants of malnutrition among pregnant women in Africa: A systematic review and meta-analysis*. *PLoS ONE, 14*(9), e0221712. https://doi.org/10.1371/journal.pone.0221712

Dewidar, O., John, J., Baqar, A., Madani, M. T., Saad, A., Riddle, A., Ota, E., Kung'u, J. K., Arabi, M., Raut, M. K., Klobodu, S. S., Rowe, S., Hatchard, J., Busch-Hallen, J., Jalal, C., Wuehler, S., & Welch, V. (2023). *Effectiveness of nutrition counseling for pregnant women in low- and middle-income countries to improve maternal and infant behavioral, nutritional, and health outcomes: A systematic review*. *Campbell Systematic Reviews, 19*(4), e1361. https://doi.org/10.1002/cl2.1361

Gernand, A. D., Schulze, K. J., Stewart, C. P., West, K. P., Jr., & Christian, P. (2016). *Micronutrient deficiencies in pregnancy worldwide: Health effects and prevention*. *Nature Reviews Endocrinology, 12*(5), 274–289. https://doi.org/10.1038/nrendo.2016.37

González-Fernández, D., Muralidharan, O., Neves, P. A., & Bhutta, Z. A. (2024). *Associations of maternal nutritional status and supplementation with fetal, newborn, and infant outcomes in low-income and middle-income settings: An overview of reviews*. *Nutrients, 16*(21), 3725. https://doi.org/10.3390/nu16213725

Miller, F., Sethi, V., Schoenaker, D., Chowdhury, R., Verma, R. K., Hirst, J., Nair, M., Benedetto, C., Sriram, U., Murira, Z., & Saville, N. M. (2025). *Preconception malnutrition among women and girls in South Asia: Prevalence, determinants, and association with pregnancy and birth outcomes*. *The Lancet Regional Health – Southeast Asia, 36*, Article 100573. https://doi.org/10.1016/j.lansea.2025.100573

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Belew, A. K., Mengistu, B., Lakew, A. M., & Muhammad, E. A. (2025). Food taboo practices and associated factors among pregnant women in Sub-Sahara Africa: A systematic review and meta-analysis. *Journal of Health, Population and Nutrition, 44*(1), Article 24. https://doi.org/10.1186/s41043-025-00770-0

Ali, S. T., Rizvi, S. A., Talat, M., Abuzar, S., Azhar, M., & Rehman, M. (2025). *Barriers to timely and adequate antenatal care: A systematic review of socioeconomic, cultural, psychosocial, and health-system factors across high and low resource settings*. **BMC Pregnancy and Childbirth, 26**(1), 96. https://doi.org/10.1186/s12884-025-08565-1

Habib, I., Fazid, S., Aleem, S., Alshehri, A. A. A., & Ul Haq, Z. (2026). *Maternal undernutrition in focus: Determinants among pregnant and lactating women in Kurrum District, Pakistan: A community-based study. Pakistan Journal of Medical Sciences, 42*(2), 385–392. https://doi.org/10.12669/pjms.42.2.13164

Jaiswal, V., Joshi, A., Jha, M., Hanif, M., Arora, A., Gupta, S., Shah, M., Ang, S. P., Aujla, S., et al. (2024). *Association between calcium supplementation and gestational hypertension and preeclampsia: A meta-analysis of 26 randomized controlled trials. Current Problems in Cardiology, 49*(1), 102217. https://doi.org/10.1016/j.cpcardiol.2023.102217

Lassi, Z. S., Padhani, Z. A., Rabbani, A., Rind, F., Salam, R. A., Das, J. K., & Bhutta, Z. A. (2020). *Impact of dietary interventions during pregnancy on maternal, neonatal, and child outcomes in low- and middle-income countries. Nutrients, 12*(2), 531. https://doi.org/10.3390/nu12020531

Nnamani, J. E., Agu, U. F., Okafor, B. C., Aransiola, M. M., Ezeamii, J. C., Benson, O. C., Appiah, L., & Nwokedi, V. U. (2024). *A review on micronutrient malnutrition in pregnant women and children under five years: Review article. Journal of Pharmacy and Integrated Research, 2*(3), 1–12.

Owais, A., Merritt, C., Lee, C., & Bhutta, Z. A. (2021). *Anemia among women of reproductive age: An overview of global burden, trends, determinants, and drivers of progress in low- and middle-income countries. Nutrients, 13*(8), 2745. https://doi.org/10.3390/nu13082745

Shenoy, S., Sharma, P., Rao, A., Aparna, N., Adenikinju, D., Iloegbu, C., Pateña, J., Vieira, D., Gyamfi, J., & Peprah, E. (2023). *Evidence-based interventions to reduce maternal malnutrition in low- and middle-income countries: A systematic review. Frontiers in Health Services, 3*, 1155928. https://doi.org/10.3389/frhs.2023.1155928

Shinde, S., Wang, D., Yussuf, M. H., Mwanyika-Sando, M., Aboud, S., & Fawzi, W. W. (2022). *Micronutrient supplementation for pregnant and lactating women to improve maternal and infant nutritional status in low- and middle-income countries: Protocol for a systematic review and meta-analysis. JMIR Research Protocols, 11*(9), e40194. https://doi.org/10.2196/40194

Tahlil, A. A., Abdillahi, N. A., Adam, J. A., Ali, A. A., Ahmed, F. M., Abdi, Z. O., et al. (2026). *Prevalence of undernutrition and its associated factors among pregnant women attending antenatal care services in public hospitals in Mogadishu, Somalia. PLoS ONE, 21*(7), e0347187.

International Journal of Advanced Research

Tirore, L. L., Areba, A. S., Habte, A., Desalegn, M., & Kebede, A. S. (2024). *Prevalence and associated factors of severity levels of anemia among women of reproductive age in sub-Saharan Africa: A multilevel ordinal logistic regression analysis*. *Frontiers in Public Health, 11*, 1349174. https://doi.org/10.3389/fpubh.2023.1349174

Victora, C. G., Christian, P., Vidaletti, L. P., Gatica-Dominguez, G., Menon, P., & Black, R. E. (2021). *Revisiting maternal and child undernutrition in low-income and middle-income countries: Variable progress towards an unfinished agenda*. *The Lancet, 397*(10282), 1388–1399. https://doi.org/10.1016/S0140-6736(21)00394-9

Wang, D., Nguyen, C. H., & Fawzi, W. W. (2023). *The effects of antenatal interventions on gestational weight gain in low- and middle-income countries: Protocol for a systematic review*. *JMIR Research Protocols, 12*, e48234. https://doi.org/10.2196/48234

Zewude, S. B., Beshah, M. H., Ahunie, M. A., Arega, D. T., & Addisu, D. (2024). *Undernutrition and associated factors among pregnant women in Ethiopia: A systematic review and meta-analysis*. *Frontiers in Nutrition, 11*, 1347851. https://doi.org/10.3389/fnut.2024.1347851

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