

INTERNATIONAL JOURNAL OF SCIENCE FOR GLOBAL SUSTAINABILITY

(A PUBLICATION OF FACULTY OF SCIENCE, FEDERAL UNIVERSITY GUSAU, NIGERIA)

Iron-Deficiency Anaemia in Pregnancy: Dietary Patterns, Risk Factors and Preventive Strategies—A Review

Sanusi Bello Mada^{1*}, Ahmad Balarabe Hamza¹, Bilya Bashir^{1,2}, Kabiru Usman¹, Abdulwahid Abdullahi Naibi¹,

¹Department of Biochemistry, Federal University Gusau, Nigeria.

³Department of Biochemistry and Molecular Biology, Zamfara State University, Talata-Mafara, Nigeria.

*Corresponding Author's Email: sanusibellomada@gmail.com, Phone Number: 08038152143

Received on: August, 2026

Revised and Accepted on: September, 2026

Published on: October, 2026

ABSTRACT

Iron-deficiency anaemia (IDA) remains a major public health concern during pregnancy, which accounts for approximately one-half of all anemia cases, affecting several pregnant women in resource-constrained settings due to inadequate intake of iron-rich diets, poor dietary diversity, socioeconomic constraints and infections. This review highlights IDA and dietary patterns in pregnancy focusing on the major risk factors and preventive measures. This review searched and used relevant literatures on Iron metabolism, pregnancy-related Iron requirements, epidemiology, dietary patterns, and determinants of Iron status, diagnosis, consequences, and strategies for prevention of IDA. Pregnancy substantially increases iron requirements due to maternal erythropoiesis, fetal growth, and placental development. Diets dominated by starchy staples may provide inadequate bioavailable iron, while phytates, tannins, calcium, oxalates, and phosphates inhibits absorption. Heme iron and vitamin C enhance iron availability. Reported risk factors include food insecurity, poverty, poor dietary diversity, infections, blood loss, restrictive dietary practices, and older maternal age. IDA was associated with maternal morbidity, postpartum haemorrhage, preterm birth, low birth weight, and adverse fetal development. Minimizing IDA requires integrated interventions combining nutrition education, dietary diversification, locally available iron-rich foods, appropriate iron supplementation, food fortification, and strengthened antenatal nutrition services for improvement of maternal and fetal health.

Keywords: Pregnancy, Iron-deficiency anaemia, dietary pattern, risk factors, preventive strategies.

1.0 INTRODUCTION

Anaemia is a haematological disorder characterized by a decrease in the number of red blood cells or a reduction in haemoglobin concentration, leading to impaired oxygen delivery to the body's tissues (Kolarš *et al.*, 2025). Anaemia in pregnancy is a significant global health challenge, impacting millions of women, especially those living in resource-constrained regions. Anaemia during pregnancy is linked to numerous maternal health complications, many of which can be life-threatening. These complications include a higher risk of maternal death, increased vulnerability to infections, preterm delivery, and premature rupture of membranes before labour, excessive bleeding after childbirth, and cardiovascular disorders (Obeagu and Obeagu, 2025). Iron-deficiency anaemia is a more advanced form of iron deficiency characterized by insufficient iron level accompanied by anaemia and the appearance of microcytic, hypochromic red blood cells (Camaschella, 2015). Iron-deficiency anaemia (IDA) during pregnancy is associated with adverse maternal and fetal outcomes, including increased risks of maternal and perinatal mortality, preterm birth, and low birth weight which accounts for approximately one-half of all anemia cases (Saliu *et al.*, 2021). Moreover, babies born to anaemic mothers often have

markedly reduced iron stores, which may affect their growth and development (Obeagu *et al.*, 2025).

Globally, anaemia affects approximately 500 million women of reproductive age (15-49 years) and 269 million children aged 6-59 months. In 2019, the condition was reported in about 30% (539 million) of non-pregnant women and 37% (32 million) of pregnant women within the 15-49 year age group. The burden of anaemia is highest in the African and South-East Asian regions of the World Health Organization (WHO). It is estimated that anaemia affects about 106 million women and 103 million children in Africa, while approximately 244 million women and 83 million children are affected in South-East Asia (WHO, 2023). Iron deficiency is a widespread global health problem affecting over 2 billion individuals, while iron-deficiency anaemia (IDA) continues to be the leading cause of anaemia worldwide (Iolascon *et al.*, 2024).

In developing nations including Nigeria, iron deficiency and iron-deficiency anemia are usually caused by inadequate dietary iron intake, blood loss resulting from intestinal parasitic infections, or a combination of both factors. In contrast, in high-income countries, the condition is more often linked



to dietary practices such as vegetarianism or avoidance of red meat, as well as medical conditions including chronic blood loss and impaired iron absorption (Camaschella, 2015). Anaemia is a haematological disorder characterized by a reduction in the number of circulating red blood cells or a haemoglobin concentration below the normal physiological range, resulting in a diminished oxygen-carrying capacity of the blood (WHO, 2025). Pregnant women with a haemoglobin concentration below 11.0 g/dL were classified as anaemic. Based on the severity of haemoglobin reduction, anaemia was categorized as mild (9.0–10.9 g/dL), moderate (7.0–8.9 g/dL), or severe (<7.0 g/dL) (Dim and Onah, 2007). Therefore, this review examined Iron-deficiency anaemia, dietary patterns, risk factors and preventive strategies in pregnancy.

2.0 IRON METABOLISM AND HOMEOSTASIS

2.1 Iron absorption

The human body contains about 4 g of Iron, with more than 60% incorporated in erythrocytes and their precursor cells. The rest is distributed among different iron pools, including roughly 600 mg in the temporary stores of reticuloendothelial macrophages and about 1000 mg in hepatocytes, where it serves as a reserve that can be released to meet increased physiological iron requirements (Kolarš *et al.*, 2025). Under normal physiological conditions, daily iron requirements are met predominantly through endogenous Iron recycling, primarily from the breakdown of senescent erythrocytes by macrophages of the reticuloendothelial system. Approximately 20-25 mg of recycled iron is reutilized each day to support erythropoiesis, whereas only a small proportion is derived from dietary iron absorption (Kolarš *et al.*, 2025).

2.2 Iron transport and storage

When systemic iron requirements are low, absorbed iron is retained within enterocytes in the form of ferritin, the primary intracellular iron-storage protein. Ferritin is composed of 24 heavy (H) and light (L) chain subunits that assemble into a spherical nanocage capable of storing up to approximately 4,500 iron atoms in a soluble, non-toxic form. Because enterocytes undergo rapid turnover and are exfoliated from the intestinal epithelium every 3-5 days, iron sequestered within ferritin is lost when these cells are shed, thereby limiting intestinal iron absorption through a process known as the *mucosal block* and contributing to the maintenance of systemic iron homeostasis (Yiannikourides and Latunde-Dada, 2019). Ferritin plays a central role in maintaining cellular and systemic iron homeostasis through its primary function of sequestering and storing iron in a soluble, non-toxic, and bioavailable form. This storage function ensures a readily accessible iron reserve for essential physiological processes while

protecting cells from iron-mediated oxidative damage. Iron is indispensable for haem biosynthesis, which underpins oxygen transport, storage, and release by haemoproteins, thereby supporting normal tissue oxygenation. In addition, iron serves as a critical cofactor for numerous enzymes involved in fundamental cellular processes, including DNA synthesis through the reduction of ribonucleotides to deoxyribonucleotides, mitochondrial electron transport, energy metabolism, cell-cycle progression, and other metabolic pathways essential for cellular growth and function (Torti and Torti, 2002).

Postnatal iron homeostasis is maintained through the coordinated activities of three principal cell types: duodenal enterocytes, which absorb dietary iron; macrophages, which recycle iron from senescent erythrocytes and other cells; and hepatocytes, which serve as the primary site of iron storage and mobilize iron when systemic demand increases. During fetal development, iron is transferred from the maternal circulation to the fetus through placental syncytiotrophoblasts. A critical regulatory step in iron homeostasis is the export of intracellular iron into the plasma, a process tightly controlled by the peptide hormone hepcidin, which is synthesized predominantly by hepatocytes, including those of the fetus. Hepcidin regulates iron efflux from enterocytes, macrophages, hepatocytes, and placental syncytiotrophoblasts by modulating the activity of the iron exporter ferroportin. Iron that is not released into the circulation is retained within macrophages, hepatocytes, and, to some extent, placental tissues, where it serves as a readily available storage reserve for maintaining systemic iron balance (Ganz, 2013).

2.3 Iron Absorption, Enhancers and Inhibitors

The bioavailability of dietary iron is considerably influenced by both enhancers and inhibitors present in the diet. Important enhancers include ascorbic acid, which is found in citrus fruits, fruit juices, green leafy vegetables, cabbage, cauliflower, tubers, and certain germinated or fermented foods, such as soya sauce. Conversely, iron absorption may be inhibited by phytates found in cereal bran, cereal grains, high-extraction flour, legumes, nuts, and seeds; calcium, particularly from milk and dairy products; tannins present in tea, coffee, and cocoa; phosphates found in egg yolk; and oxalates occurring in vegetables (Gautam *et al.*, 2008).

2.4 Ferritin, transferrin and haemoglobin

Under physiological conditions, ferric iron [Fe(III)] is tightly bound to transferrin, the principal iron transport protein in plasma. Owing to the exceptionally high affinity of transferrin for iron, spontaneous dissociation of Fe(III) into the circulation is extremely limited. Consequently, a specialized mechanism is required for the transfer of iron from



transferrin to cells. This process is mediated by transferrin receptors expressed on the cell surface, which facilitate the uptake of transferrin-bound iron into cells through receptor-mediated endocytosis (Giri, 2022).

Hepcidin, a peptide hormone synthesized predominantly by hepatocytes, serves as the central regulator of systemic iron homeostasis by modulating iron availability according to physiological demands. Hepcidin exerts its effects by binding to ferroportin expressed on tissue macrophages, duodenal enterocytes, hepatocytes, and other target cells, thereby inducing its phosphorylation, internalization, ubiquitination, and subsequent lysosomal degradation. Through the removal of ferroportin from the plasma membrane, hepcidin effectively suppresses cellular iron export into the circulation, thereby regulating systemic iron availability (Cappellini *et al.*, 2022).

2.5 Iron Requirements in Pregnancy

Iron requirements among pregnant women vary across the different trimesters, with the greatest increase in iron demand occurring during the second and third trimesters (Yang *et al.*, 2024). Approximately 1 g of iron is required during pregnancy to maintain maternal iron balance and meet the demands of fetal and placental development. Following pregnancy, part of this iron is recovered as the maternal erythrocyte mass decreases to its pre-pregnancy level. However, the iron lost as a result of bleeding during delivery, which is estimated at approximately 150 mg, is not recovered. As a result, the average net loss of iron from the mother associated with pregnancy has been estimated at approximately 740 mg. Nevertheless, iron requirements differ across the three trimesters of pregnancy. During the first trimester, the estimated iron requirement is approximately 0.8 mg per day, which is lower than the requirement before pregnancy because menstruation ceases during this period (Fisher *et al.*, 2017). During the first trimester, iron requirements are relatively low because there is limited expansion of the maternal red blood cell mass and menstrual iron loss is absent. In contrast, iron demand increases markedly during the second and third trimesters as a result of enhanced maternal erythropoiesis, accelerated fetal growth, and placental development. Consequently, the amount of iron that needs to be absorbed can reach approximately 7–5 mg per day during late pregnancy (Milman, 2008). Because iron is essential for hemoglobin synthesis and oxygen transport, the expansion of maternal blood volume, fetal growth, and placental development during pregnancy substantially increase maternal iron requirements to approximately 22–27 mg/day (Jouanne *et al.*, 2021).

2.6 Epidemiology of Iron-deficiency Anaemia in Pregnancy

The burden of iron-deficiency anaemia is disproportionately higher in low- and middle-income countries (Table 1) than in high-income settings (Babah *et al.*, 2024). According to the World Health Organization (WHO), the African and South-East Asian regions bear the greatest burden of anaemia, affecting an estimated 106 million women and 103 million children in Africa, compared with 244 million women and 83 million children in South-East Asia (WHO, 2023). Osei-Ntiamoah *et al.* (2025) reported an iron-deficiency anaemia (IDA) prevalence of 81.0% among pregnant women in Ghana, highlighting the substantial burden of the condition in the study population. In Nigeria, the prevalence of iron-deficiency anaemia among pregnant women remains high, with reported estimates ranging from 25% to 46% (Ugwu & Uneke, 2020). Similarly, Babah *et al.* (2024) reported that iron deficiency was present in 41% of women with moderate-to-severe anaemia, with the prevalence increasing progressively across advancing gestational age. A recent study conducted (Table 1) in Zamfara State reported a 52% prevalence of iron-deficiency anaemia (IDA) among pregnant women attending antenatal care (ANC) at General Hospital Maru, Nigeria (Bashir *et al.*, 2026).

3.0 DIETARY PATTERNS DURING PREGNANCY

Dietary patterns refer to the quantities, proportions, variety, and combinations of different foods and beverages consumed, as well as the frequency with which they are habitually consumed. Increasing attention has been given to dietary patterns because foods and nutrients are typically consumed in combination and may interact with one another. Consequently, assessing overall dietary patterns can provide a more comprehensive understanding of dietary intake and may offer a more practical basis for developing dietary recommendations (Romieu, 2019). Dietary iron is broadly classified into two forms: heme and non-heme iron. Heme iron is obtained primarily from animal-derived foods, including meat, poultry, and seafood, and is characterized by relatively high bioavailability, with approximately 25–30% being absorbed. Non-heme iron, on the other hand, is mainly present in plant-derived foods such as grains, legumes, and vegetables and is less readily absorbed, with an estimated absorption rate of only 3–5% (Kalman *et al.*, 2025). Dietary pattern approaches are commonly employed to evaluate overall diet quality rather than focusing on individual foods or nutrients. An initial assessment of adherence to established dietary guidelines is required to characterize the diet, after which predefined dietary patterns can be evaluated according to whether they are associated with beneficial or adverse health outcomes.



Dietary patterns may also reflect regional and cultural differences in food consumption. For instance, the Brazilian dietary pattern is characterized by the consumption of rice or pasta and beans, accompanied by foods such as beef, chicken, eggs, margarine, coffee, and packaged fruit juices (Fernández-Gómez *et al.*, 2020). Although food taboos during pregnancy are widespread across Africa, the specific foods considered prohibited differ according to the particular setting. Some dietary taboos have been documented in Ghana. For example, pregnant women are traditionally discouraged from consuming snails due to the belief that doing so may result in babies or children who drool excessively. Among the Kassena and Nankana communities of the Upper East Region, pregnancy may be accompanied by adherence to a vegetarian diet, with meat and groundnuts prohibited because their consumption is believed to increase the likelihood of giving birth to “spirit children,” who are regarded as children possessing spirits (Arzoaquoi *et al.*, 2015).

4.0 RELATIONSHIP BETWEEN DIETARY PATTERNS AND IRON-DEFICIENCY ANAEMIA

Consuming foods from a variety of food groups has been suggested as an effective strategy for meeting iron requirements through dietary diversification. Pregnant women whose diets are predominantly composed of starchy foods may be at increased risk of iron deficiency when their dietary intake lacks sufficient variety (Adan *et al.*, 2023). Maintaining a high-quality and diverse diet, together with oral iron supplementation and iron fortification of foods (Table 1), can contribute to improving iron status and potentially preventing anaemia (Al-Bayyari *et al.*, 2024).

Maternal dietary patterns, including the frequency of meals consumed, represent modifiable factors that may influence fetal growth and neonatal anthropometric outcomes, including birth weight and length (Atomei *et al.*, 2025). The nutritional requirements of women increase during pregnancy and lactation to accommodate physiological changes, prepare the body for childbirth and breastfeeding, and support the normal growth and development of the fetus and infant. These requirements are primarily met through a balanced diet, with micronutrients, including vitamins and minerals, and omega-3 fatty acids playing essential roles in numerous cellular and metabolic processes. These functions include cell differentiation and proliferation, haemoglobin synthesis, oxygen transport, and mineralization (Jouanne *et al.*, 2021). In particular, adequate intake of essential micronutrients is crucial for preventing adverse health outcomes in both mothers and their offspring during the perinatal period (Cano-Ibáñez *et al.*, 2020). Adjei-Banuah *et al.* (2021) reported that

fish and other seafood, along with green leafy vegetables, were the most frequently consumed iron-rich foods among the pregnant women studied. In contrast, foods from animal sources were consumed infrequently. Nutrition-related knowledge was identified as the only significant determinant of iron-rich food consumption among the participants.

5.0 RISK FACTORS FOR IRON-DEFICIENCY ANAEMIA IN PREGNANCY

Iron deficiency in low- and middle-income countries is driven by multiple socioeconomic and nutritional factors. Poverty, food insecurity, malnutrition, and recurrent famine substantially increase the risk of iron deficiency, particularly among vulnerable populations such as children and pregnant women. Dietary practices also play a crucial role, as cereal-based diets, which are common in many developing regions, often have low iron bioavailability due to their high phytate content. Phytates bind non-heme iron to form insoluble complexes, thereby reducing intestinal iron absorption.

In contrast, chronic gastrointestinal blood loss remains a major cause of iron deficiency in adults, particularly among men and older individuals, and may indicate underlying conditions such as peptic ulcers, angiodysplasia, colorectal polyps, or gastrointestinal malignancies. Furthermore, individuals who donate blood frequently are at increased risk of iron depletion and should undergo regular assessment of their iron status to prevent the development of iron-deficiency anaemia (Camaschella, 2015). The identified risk factors for iron-deficiency anaemia (IDA) included maternal age of ≥ 35 years, a history of three or more abortions, and consumption of strong tea or coffee (Zhao *et al.*, 2022). Furthermore, Osei-Ntiamoah *et al.* (2025) reported that pregnant women aged ≥ 30 years had the highest prevalence of iron-deficiency anaemia (46.9%). Similarly, unemployed pregnant women recorded the highest prevalence (38.4%), highlighting the significant influence of socio-demographic factors on the occurrence of iron-deficiency anaemia. Low-income regions are disproportionately affected by iron-deficiency anaemia, not only because of inadequate dietary iron intake but also due to a range of additional contributing factors and pathological conditions. These include infections, particularly human immunodeficiency virus (HIV) and parasitic infections such as malaria and intestinal helminthiasis; generalized malnutrition resulting in multiple nutrient deficiencies; chronic inflammation; and genetic factors, including intrinsic red blood cell (RBC) abnormalities and haemoglobinopathies (Agarwal and Rets, 2021).

6.0 Consequences of Iron-deficiency Anaemia in Pregnancy



IJSGS FUGUSAU VOL. 12(3)	WEBSITE: https://fugus-ijsgs.com.ng
Iron-deficiency anaemia (IDA) during pregnancy has been linked to an elevated risk of gestational diabetes mellitus. IDA may contribute to increased oxidative stress and inflammation (Table 1), which can interfere with insulin signaling pathways and consequently impair insulin sensitivity (Obeagu <i>et al.</i>, 2025). Iron-deficiency anaemia can adversely affect the health of pregnant women and their unborn children, with potential consequences including impaired mental development, reduced work productivity, and an elevated risk of maternal mortality (Adan <i>et al.</i>, 2023). Iron deficiency and iron-deficiency anaemia (IDA) have been linked to several adverse maternal outcomes, including preterm labour, a higher likelihood of caesarean delivery, postpartum haemorrhage, and maternal mortality. In the fetus and newborn, these conditions are associated with an increased risk of low birth weight and small-for-gestational-age births (Benson <i>et al.</i>, 2022). 7.0 DIAGNOSIS AND ASSESSMENT OF IRON-DEFICIENCY ANAEMIA Complete blood count (CBC) findings in iron-deficiency anaemia typically include reduced haemoglobin (Hb) concentrations, decreased mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC), and mild thrombocytosis. Peripheral blood smear findings may be unremarkable during the early stages of the condition; however, microcytic red blood cells accompanied by anisopoikilocytosis may become evident. In patients with suspected iron-deficiency anaemia, a serum ferritin concentration below 30 ng/mL is considered sufficient to establish the diagnosis (Agarwal and Rets, 2021). When the diagnosis of iron-deficiency anaemia remains uncertain, additional laboratory investigations may be warranted. Common hematological and biochemical findings used in the diagnosis of IDA includes reduced haemoglobin (Hb), decreased mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH), increased red cell distribution width (RDW), and elevated free erythrocyte protoporphyrin (FEP) concentrations. In most cases, a serum ferritin concentration below 15 µg/L or transferrin saturation (TSAT) below 7% is sufficient to confirm iron-deficiency anaemia (Leung <i>et al.</i>, 2024). Iron deficiency (ID) and iron-deficiency anaemia (IDA) can also be assessed using a combination of hematological indices and iron-related biomarkers. In otherwise healthy individuals, serum ferritin primarily reflects the amount of stored iron but provides limited information regarding the iron actually available for erythropoiesis. Therefore, additional biomarkers, including transferrin saturation (TSAT), soluble transferrin receptor (sTfR), the percentage of hypochromic erythrocytes (%HYPO), and reticulocyte haemoglobin content (CHr), can	provide useful information for detecting insufficient iron supply for red blood cell production (Iolascon <i>et al.</i>, 2024). 8.0 PREVENTIVE STRATEGIES FOR IRON-DEFICIENCY ANAEMIA IN PREGNANCY During the first round of the Delphi process, experts reached consensus on all statements regarding the importance of preventing iron deficiency (ID) and iron-deficiency anaemia (IDA) among women. Preventive iron supplementation was considered appropriate for all identified subgroups of women living in settings where adequate screening for ID/IDA is unavailable or insufficient. Consensus was also achieved regarding the recommendation of preventive iron supplementation for pregnant women regardless of the prevailing anaemia prevalence, as well as for other targeted groups of women residing in areas characterized by a high prevalence of anaemia (Pai <i>et al.</i>, 2023). Staple food fortification, including the addition of essential vitamins and minerals to foods such as rice, milk, and salt, is widely practiced to enhance their nutritional value. This approach can improve micronutrient intake at the population level while offering public health benefits with minimal risk of adverse health effects (Kumar <i>et al.</i>, 2022). Iron-fortified foods are considered among the safest and most cost-effective approaches to iron supplementation. Such foods, including cereals, dairy products, and condiments, may be fortified directly with iron or with functional ingredients containing iron that can enhance its delivery and facilitate absorption (Man <i>et al.</i>, 2022). Nutrition education interventions represent another important strategy for enhancing pregnant women's knowledge and attitudes regarding iron-deficiency anaemia and the consumption of iron-rich foods. However, the effectiveness of such interventions depends on the availability of evidence describing dietary practices and the factors influencing the consumption of iron-rich foods among pregnant women (Adjei-Banuah <i>et al.</i>, 2021). Nutrition education emphasizing a balanced diet rich in iron is an essential component of iron-deficiency anaemia (IDA) prevention programs among female adolescents. Such education can enable adolescents to make informed food choices that align with their preferences while meeting their nutritional requirements, particularly through the consumption of iron-rich foods. Dietary intake during pregnancy also warrants particular attention because maternal nutrition directly influences both maternal and fetal health. Failure to consume a balanced diet during pregnancy may increase the risk of anaemia in both the mother and fetus due to inadequate iron intake (Zulfikar <i>et al.</i>, 2025).

Table 1: Iron-deficiency Anaemia Biomarkers and Outcomes among pregnant women

Target Population(s)	Parameters Assessed	Key outcomes	Author(s)
Exactly, 97 pregnant women attending ANC at General	Serum ferritin, Hb, PCV, and socio-demographic/obstetric factors	The high prevalence of IDA highlights inadequate Iron and low consumption of iron-rich foods	Bashir <i>et al.</i> (2026)
Pregnant women and non-pregnant controls in Specialist Hospital, Sokoto, Nigeria	Hb, PCV, serum Iron and serum ferritin.	Pregnancy is accompanied by increased iron requirements. Monitoring iron status throughout pregnancy is important for identifying and preventing IDA.	Mohammad <i>et al.</i> (2025)
Exactly, 11,582 pregnant women were screened in Lagos and Kano States, Nigeria; 872 women with moderate/severe anaemia were included in the study	IDA, serum ferritin, gestational age, dietary intake, green leafy vegetables, edible kaolin clay, and soybeans.	Regular consumption of green leafy vegetables may be beneficial, whereas certain practices such as edible kaolin consumption may increase the risk of IDA. Targeted nutrition education could help address potentially harmful dietary practices.	Babah <i>et al.</i> (2024)
The study employed 198 pregnant women aged 19-45 attending ANC Clinics in Northern Jordan	Hb, serum ferritin, IDA, dietary diversity, diet quality, gestational age, and Iron supplementation	Improving dietary diversity and diet quality, together with Iron supplementation, could improve maternal Iron status and help prevent IDA.	Albayyari <i>et al.</i> (2024)
A study employed 270 pregnant women from six kebeles in Bolosso Bombe District, Southern Ethiopia	Hb, serum ferritin, CRP, MUAC, ANC follow-up, birth spacing, and duration of menstrual bleeding	Although, IDA prevalence was relatively low, maternal nutritional status, ANC utilization, reproductive spacing, and menstrual history may influence IDA risk and should be considered in preventive strategies.	Laelago <i>et al.</i> (2023)
The study used 1,206 pregnant women in Qinghai, China; 104 had IDA	IDA, maternal characteristics, prenatal care, Iron supplementation, tea/coffee consumption, and pregnancy outcomes	Advanced maternal age, multiple abortions, and excessive tea/coffee consumption may increase IDA risk and adversely affect maternal and neonatal outcomes. While adequate prenatal care and Iron supplementation provide protective effect against IDA.	Zhao <i>et al.</i> (2022)
The research used 446 pregnant women in Haramaya District, Eastern Ethiopia.	Serum ferritin, Hb, IDA, dietary diversity, meal frequency, and ANC.	Poor dietary diversity and inadequate meal frequency may contribute to IDA during pregnancy, while regular ANC provides an opportunity for prevention and management.	Fite <i>et al.</i> (2022)
A study of 180 women in early pregnancy, Khartoum, Sudan	Hb, serum ferritin, serum magnesium, hs-CRP, age, parity, gestational age and BMI.	The association between Magnesium status and Hb suggests that micronutrient deficiencies beyond iron may contribute to anaemia and should be considered in prevention and management strategies.	Eltayeb <i>et al.</i> (2018)

9.0 CONCLUSION

Iron-deficiency anaemia (IDA) remains a major global public health concern, disproportionately affecting pregnant women in resource-constrained settings. Its occurrence is influenced by inadequate dietary iron intake, poor dietary diversity, food insecurity, socioeconomic constraints, and factors affecting iron bioavailability. The nutritional demands of pregnancy further increase the need for adequate iron and other essential micronutrients to support maternal physiological changes and normal fetal development. Dietary diversification through the consumption of foods from different food groups,

particularly iron-rich foods, represents an important strategy for improving iron intake. However, the bioavailability of dietary iron is influenced by both enhancers, such as ascorbic acid, and inhibitors, including phytates, calcium, tannins, phosphates, and oxalates.

ACKNOWLEDGEMENT

The authors gratefully acknowledge and appreciate the TETFund-IBR (TETF/DR&D/CE/UNI/GUSAU/IBR/2026/VOL. 1) and the Federal University Gusau, Nigeria, for the

financial support provided towards this research and the publication of this article.

REFERENCES

- Adan, S. I., Chege, P., & Bor, W. (2023). Dietary Diversity and Iron Status in Pregnant Women Attending the Antenatal Clinic at Narok County Referral Hospital, Kenya. *African Journal of Nutrition and Dietetics*, 2(1), 1-9.
- Adjei-Banuah, N. Y., Aduah, V. A., Ziblim, S. D., Ayanore, M. A., Amalba, A., & Mogre, V. (2021). Nutrition knowledge is associated with the consumption of iron rich foods: a survey among pregnant women from a rural district in Northern Ghana. *Nutrition and metabolic insights*, 14, 11786388211039427.
- Agarwal, A. M., & Rets, A. (2021). Laboratory approach to investigation of anemia in pregnancy. *International Journal of Laboratory Hematology*, 43, 65-70.
- Al-Bayyari, N., Al Sabbah, H., Hailat, M., AlDahoun, H., & Abu-Samra, H. (2024). Dietary diversity and iron deficiency anemia among a cohort of singleton pregnancies: a cross-sectional study. *BMC Public Health*, 24(1), 1840.
- Arzoaquoi, S. K., Essuman, E. E., Gbagbo, F. Y., Tenkorang, E. Y., Soyiri, I., & Laar, A. K. (2015). Motivations for food prohibitions during pregnancy and their enforcement mechanisms in a rural Ghanaian district. *Journal of ethnobiology and ethnomedicine*, 11(1), 59.
- Atomei, O. L., Vicoveanu, P., Iațcu, C. O., Gliga, F. I., Craciun, C. C., & Tarcea, M. (2025). Associations between maternal meal frequency patterns during pregnancy and neonatal anthropometric outcomes: a quantitative cross-sectional study. *Nutrients*, 17(15), 2437.
- Augusto, A. L. P., de Abreu Rodrigues, A. V., Domingos, T. B., & Salles-Costa, R. (2020). Household food insecurity associated with gestational and neonatal outcomes: a systematic review. *BMC Pregnancy and Childbirth*, 20(1), 229.
- Babah, O. A., Akinajo, O. R., Beňová, L., Hanson, C., Abioye, A. I., Adaramoye, V. O., ... & Larsson, E. C. (2024). Prevalence of and risk factors for iron deficiency among pregnant women with moderate or severe anaemia in Nigeria: a cross-sectional study. *BMC pregnancy and childbirth*, 24(1), 39.
- Bashir, B., Mada, S. B., Usman, K., Aguh, B. I., & Isah, M. (2026). Assessment of Iron Deficiency Anaemia among Pregnant Women Attending Antenatal Care at General Hospital Maru, Zamfara State, Nigeria.
- Benson, A. E., Shatzel, J. J., Ryan, K. S., Hedges, M. A., Martens, K., Aslan, J. E., & Lo, J. O. (2022). The incidence, complications, and treatment of iron deficiency in pregnancy. *European journal of haematology*, 109(6), 633-642.
- Camaschella, C. (2015). Iron-deficiency anemia. *New England journal of medicine*, 372(19), 1832-1843.
- Cano-Ibáñez, N., Martínez-Galiano, J. M., Luque-Fernández, M. A., Martín-Peláez, S., Bueno-Cavanillas, A., & Delgado-Rodríguez, M. (2020). Maternal dietary patterns during pregnancy and their association with gestational weight gain and nutrient adequacy. *International journal of environmental research and public health*, 17(21), 7908.
- Cappellini, M. D., Santini, V., Braxs, C., & Shander, A. (2022). Iron metabolism and iron deficiency anemia in women. *Fertility and sterility*, 118(4), 607-614.
- Dim, C. C., & Onah, H. E. (2007). The prevalence of anemia among pregnant women at booking in Enugu, South Eastern Nigeria. *Medscape general medicine*, 9(3), 11.
- Fernández-Gómez, E., Luque-Vara, T., Moya-Fernández, P. J., López-Olivares, M., Gallardo-Vigil, M. Á., & Enrique-Mirón, C. (2020). Factors influencing dietary patterns during pregnancy in a culturally diverse society. *Nutrients*, 12(11), 3242.
- Fisher, A. L., & Nemeth, E. (2017). Iron homeostasis during pregnancy. *The American journal of clinical nutrition*, 106, 1567S-1574S.
- Ganz, T. (2013). Systemic iron homeostasis. *Physiological reviews*, 93(4), 1721-1741.
- Gautam, C. S., Saha, L., Sekhri, K., & Saha, P. K. (2008). Iron deficiency in pregnancy and the rationality of iron supplements prescribed during pregnancy. *The Medscape Journal of Medicine*, 10(12), 283.
- Giri, N. C. (2022). Role of transferrin in iron metabolism. In *Iron Metabolism-A Double-Edged Sword*. IntechOpen.
- Iolascon, A., Andolfo, I., Russo, R., Sanchez, M., Busti, F., Swinkels, D., ... & from EHA-SWG Red Cell and Iron. (2024). Recommendations for diagnosis, treatment, and prevention of iron deficiency and iron deficiency anemia. *Hemasphere*, 8(7), e108.
- Jouanne, M., Oddoux, S., Noël, A., & Voisin-Chiret, A. S. (2021). Nutrient requirements during pregnancy and lactation. *Nutrients*, 13(2), 692.
- Kalman, D., Hewlings, S., Madelyn-Adjei, A., & Ebersole, B. (2025). Dietary heme iron: a review of efficacy, safety and tolerability. *Nutrients*, 17(13), 2132.
- Kolarš, B., Mijatović Jovin, V., Živanović, N., Minaković, I., Gvozdenović, N., Dickov Kokeza, I., & Lesjak, M. (2025). Iron deficiency and iron deficiency anemia: a comprehensive overview of established and emerging concepts. *Pharmaceuticals*, 18(8), 1104.
- Kumar, S. B., Arnipalli, S. R., Mehta, P., Carrau, S., & Ziouzenkova, O. (2022). Iron deficiency anemia: efficacy and limitations of nutritional and



- comprehensive mitigation strategies. *Nutrients*, 14(14), 2976.
- Leung, A. K., Lam, J. M., Wong, A. H., Hon, K. L., & Li, X. (2024). Iron deficiency anemia: an updated review. *Current pediatric reviews*, 20(3), 339-356.
- Man, Y., Xu, T., Adhikari, B., Zhou, C., Wang, Y., & Wang, B. (2022). Iron supplementation and iron-fortified foods: a review. *Critical Reviews in Food Science and Nutrition*, 62(16), 4504-4525.
- Milman, N. (2006). Iron and pregnancy—a delicate balance. *Annals of hematology*, 85(9), 559-565.
- Muhammad, A.S., Aliyu, S., Mada, S. B. (2021). Dyslipidemia linked Cardiovascular Risk among Pregnant Women Attending Aminu Kano Teaching Hospital Kano: A longitudinal Study. *Journal of Taibah University Medical Sciences*, 16(6): 870-877.
- Obeagu, G. U., & Obeagu, E. I. (2025). Complications of anemia in pregnancy: An updated overview for healthcare professionals. *Medicine*, 104(35), e44246.
- Obeagu, G. U., Altraide, B. O., & Obeagu, E. I. (2025). Iron deficiency anemia in pregnancy and related complications with specific insight in Rivers State, Nigeria: a narrative review. *Annals of medicine and surgery*, 87(6), 3435.
- Osei-Ntiamoah, B., Nartey, Y., & Korsah, K. A. (2025). Prevalence and Risk Factors of Iron Deficiency Anemia in Pregnancy in Ghana. *Food Science & Nutrition*, 13(12), e71293.
- Pai, R. D., Chong, Y. S., Clemente-Chua, L. R., Irwinda, R., Huynh, T. N. K., Wibowo, N., ... & Mahdy, Z. A. (2023). Prevention and management of iron deficiency/iron-deficiency anemia in women: an Asian expert consensus. *Nutrients*, 15(14), 3125.
- Romieu, I. (2019). Dietary Factors and Cancer. *Encyclopedia of Cancer*. 501-511.
- Torti, F. M., & Torti, S. V. (2002). Regulation of ferritin genes and protein. *The Journal of the American Society of Hematology*, 99(10), 3505-3516.
- Ugwu, N., & Uneke, C. (2020). Iron deficiency anemia in pregnancy in Nigeria--A systematic review. *Nigerian journal of clinical practice*, 23(7), 889-889.
- WHO (2023). Anemia. Accessed on 4th September 2026. Available from: **Anaemia**
- WHO (2025). Anemia. Accessed on 5th September 2026. Available from: **Anaemia**
- Yang, J., Chang, Q., Du, Q., Liu, X., Dang, S., & Tian, X. (2024). Maternal iron nutrition during pregnancy and fetal intrauterine growth. *Nutrition Journal*, 23(1), 140.
- Yiannikourides, A., & Latunde-Dada, G. O. (2019). A short review of iron metabolism and pathophysiology of iron disorders. *Medicines*, 6(3), 85.
- Zhao, D., Zhang, C., Ma, J., Li, J., Li, Z., & Huo, C. (2022). Risk factors for iron deficiency and iron deficiency anemia in pregnant women from plateau region and their impact on pregnancy outcome. *American journal of translational research*, 14(6), 4146.
- Zulfikar, R. R. O., Mariani, E., Gunawan, C., Sitorus, N. L., Dilantika, C., Sundjaya, T., ... & Basrowi, R. W. (2025). Improving iron deficiency anemia (IDA) prevention and management strategies in Indonesia: an expert opinion. *The Open Public Health Journal*, 18(1).