Middle East Research Journal of Nursing
ISSN 2789-8679 (Print) & ISSN: 2958-2016 (Online)
Frequency: Bi-Monthly
DOI: https://doi.org/10.36348/merjn.2024.v04i06.002

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Severe Anemia in Pregnancy: Risks and Interventions – A Review

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Abstract: Severe anemia during pregnancy is a major global health concern, particularly in low- and middle-income countries, where it contributes significantly to maternal and fetal morbidity and mortality. Characterized by hemoglobin levels below 7 g/dL, severe anemia is often driven by nutritional deficiencies, infectious diseases, and genetic disorders, with iron deficiency being the most prevalent cause. This condition exacerbates pregnancy-related risks, increasing the likelihood of complications such as preeclampsia, postpartum hemorrhage, and intrauterine growth restriction. Left unaddressed, severe anemia impairs oxygen delivery to maternal and fetal tissues, adversely impacting immune function and overall health. Effective management of severe anemia in pregnancy relies on a combination of preventative and therapeutic interventions. Iron and folic acid supplementation remain foundational in anemia prevention, with intravenous iron and blood transfusions employed in critical cases. Nutritional education, emphasizing iron-rich diets and vitamin C intake, complements these clinical approaches, while treating underlying infections like malaria and hookworm is essential for reducing anemia incidence in endemic regions. Community-based health programs promoting early prenatal care and routine anemia screening play a crucial role in improving intervention success and patient adherence.

Keywords: *Severe Anemia, Pregnancy, Maternal Health, Interventions, Iron Deficiency.*

Review Paper

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How to cite this paper:
Emmanuel Ifeanyi Obeagu (2024). Severe Anemia in Pregnancy: Risks and Interventions – A Review. *Middle East Res J Nursing, 4*(6): 85-89.

Article History:
| Submit: 28.10.2024 |
| Accepted: 27.11.2024 |
| Published: 28.11.2024 |

INTRODUCTION

Severe anemia during pregnancy is a critical condition that poses a significant threat to maternal and fetal health globally, especially in low- and middle-income countries. Defined by hemoglobin levels below 7 g/dL, severe anemia is primarily attributed to iron deficiency but can also result from folate and vitamin B12 deficiencies, infections, and genetic factors such as hemoglobinopathies. With pregnancy already increasing the body's need for oxygen and nutrients, anemia further reduces the oxygen-carrying capacity of the blood, leading to various complications that endanger both the mother and the fetus. This makes addressing anemia in pregnancy not only a medical but also a public health priority, as it directly impacts maternal morbidity and mortality rates [1, 2]. Globally, anemia affects approximately 41.8% of pregnant women, with severe cases disproportionately concentrated in low-resource regions. Socioeconomic and environmental factors such as poor diet, limited access to healthcare, and high rates of infectious diseases, including malaria and HIV, exacerbate anemia's prevalence in these areas. Pregnancy itself intensifies the risk of anemia due to increased iron and nutrient requirements for fetal growth and maternal blood volume expansion. Women entering pregnancy with suboptimal iron stores are particularly vulnerable to developing severe anemia, which can compromise their health and their babies' development if not promptly addressed [3, 4].

The consequences of severe anemia in pregnancy are extensive, with serious implications for maternal and fetal outcomes. Maternal risks include increased susceptibility to infections, preeclampsia, postpartum hemorrhage, and a higher likelihood of death during childbirth. For the fetus, the impacts are equally severe, often resulting in low birth weight, preterm delivery, and in extreme cases, stillbirth or neonatal death. In addition, infants born to mothers with anemia face a higher risk of developing anemia themselves, perpetuating an intergenerational cycle of nutritional deficiencies and health challenges that contribute to overall poor population health outcomes [5, 6]. Preventive and therapeutic interventions for severe anemia in pregnancy encompass a variety of approaches, from iron supplementation and dietary modifications to blood transfusions and infection control. Iron and folic acid supplements are standard for preventing anemia in pregnancy, while intravenous iron is often used for women who fail to respond to oral supplements or have gastrointestinal issues that limit iron absorption. In cases of life-threatening anemia, blood transfusions are

necessary to stabilize the mother and protect the fetus from hypoxia. Additionally, addressing underlying infections and providing dietary education are essential components of a comprehensive anemia management strategy [7, 8]. Health education and community-based programs have proven effective in preventing anemia, particularly in high-risk populations. These programs encourage regular prenatal care, early anemia screening, and adherence to prescribed supplements. Community involvement helps in overcoming cultural and logistical barriers to healthcare access, especially in rural and low-resource settings. In regions where parasitic infections are prevalent, deworming programs and antimalarial treatments are also essential for anemia prevention. However, there remain challenges in effectively implementing these interventions, particularly in underserved areas where healthcare infrastructure may be limited [9, 10].

Risk Factors and Pathophysiology of Severe Anemia in Pregnancy

Severe anemia during pregnancy is a multifactorial condition with risk factors spanning nutritional, infectious, genetic, and environmental domains. The most prevalent cause of anemia in pregnant women is iron deficiency, exacerbated by increased iron demands for fetal development and maternal blood volume expansion. Pregnant women typically require about twice the amount of iron as non-pregnant women to support healthy fetal growth, but dietary insufficiencies often lead to suboptimal iron stores. Folate and vitamin B12 deficiencies further contribute to anemia, as both are crucial for DNA synthesis and red blood cell production. Diets lacking in these essential nutrients, common in low-income regions, pose a significant risk for severe anemia during pregnancy [11, 12]. Infectious diseases, particularly malaria, HIV, and parasitic infections such as hookworm, are prominent contributors to anemia in pregnancy, especially in tropical and subtropical regions. Malaria, for example, directly destroys red blood cells and impairs bone marrow function, leading to hemolytic anemia. HIV infection increases the risk of anemia through chronic inflammation, which interferes with iron metabolism, and through the use of antiretroviral therapies that can suppress bone marrow function. Parasitic infections like hookworm lead to chronic blood loss from the gastrointestinal tract, further exacerbating iron deficiency. Such infections create an added burden for pregnant women, whose immune systems are naturally modulated to accommodate the fetus, making them more susceptible to infections [13, 14].

Genetic disorders also play a significant role in the risk of severe anemia during pregnancy. Hemoglobinopathies such as sickle cell disease and thalassemia are genetic conditions that alter the structure or production of hemoglobin, the molecule responsible for oxygen transport in red blood cells. Pregnant women with these conditions are at a higher risk of severe anemia due to impaired red blood cell function, increased red blood cell destruction, and difficulties in compensating for the increased oxygen demands of pregnancy. Moreover, chronic inflammatory diseases and autoimmune conditions, such as rheumatoid arthritis or systemic lupus erythematosus, contribute to the risk by causing anemia of chronic disease (ACD), where inflammation hinders iron utilization and red blood cell production [15, 16]. The pathophysiology of severe anemia in pregnancy centers on a disruption in the production, lifespan, or functionality of red blood cells, leading to inadequate oxygen transport to maternal and fetal tissues. Iron deficiency anemia, the most common form, arises when there is insufficient iron to produce hemoglobin, resulting in small, pale red blood cells with limited oxygen-carrying capacity. Inflammatory and infectious processes can cause anemia by promoting the release of cytokines, which affect iron metabolism and hinder red blood cell production. Hepcidin, an inflammatory mediator produced by the liver, plays a critical role in iron homeostasis by inhibiting iron absorption from the gut and reducing iron release from stores, compounding anemia in the presence of infections or chronic inflammation [17, 18]. Pregnancy itself intensifies the risk of anemia due to the physiologic expansion of plasma volume, which increases by approximately 50% to support fetal growth. This hemodilution effect reduces hemoglobin concentration and can mask underlying anemia, delaying diagnosis and treatment. Additionally, the body's increased demand for oxygen and nutrients during pregnancy heightens the risk of complications from anemia. The resulting reduced oxygen transport can lead to tissue hypoxia, compromising placental function and increasing the risk of adverse outcomes like intrauterine growth restriction and preterm birth [19].

Health Risks Associated with Severe Anemia in Pregnancy

Severe anemia in pregnancy poses significant health risks to both the mother and the fetus, making it a critical public health issue with implications that extend across generations. Maternal risks associated with severe anemia include increased susceptibility to infections, such as urinary tract infections and postpartum infections, due to weakened immune function. Anemia reduces the oxygen-carrying capacity of blood, leading to tissue hypoxia that can impair organ function and compromise the body’s natural defenses. This can exacerbate conditions like preeclampsia and contribute to life-threatening complications such as postpartum hemorrhage, which is more likely in anemic women due to poor blood clotting and weakened overall physical resilience [20, 21]. Another major risk associated with severe anemia in pregnancy is an elevated likelihood of maternal mortality. In cases of severe hemorrhage during childbirth, women with anemia are at a much higher risk of fatal outcomes due to the reduced baseline

hemoglobin and diminished blood reserves. Even in the absence of major bleeding, anemia-related cardiovascular strain can lead to heart failure, as the heart works harder to compensate for the lack of oxygen in the blood. This condition, known as high-output heart failure, is a dangerous complication that further underscores the critical need for timely diagnosis and intervention in cases of severe anemia among pregnant women [22, 23]. For the fetus, the risks associated with severe maternal anemia are equally severe and can result in long-term health consequences. Severe anemia in pregnancy is linked to intrauterine growth restriction (IUGR), where inadequate oxygen supply hinders normal fetal growth and development. This condition can lead to low birth weight and preterm delivery, both of which are associated with higher risks of neonatal morbidity and mortality. In some cases, severe maternal anemia can cause fetal hypoxia, leading to stillbirth or neonatal death. Even if the infant survives, low birth weight and preterm birth predispose them to developmental delays, compromised immune function, and a higher risk of chronic health conditions later in life, including metabolic and cardiovascular disorders. Additionally, infants born to anemic mothers are more likely to develop anemia themselves, perpetuating a cycle of poor health across generations [24].

Current Interventions for Managing Severe Anemia in Pregnancy

Effective management of severe anemia in pregnancy requires a multifaceted approach that addresses both the underlying causes and the immediate health needs of the mother and fetus. Nutritional supplementation, particularly with iron and folic acid, forms the cornerstone of anemia prevention and treatment in pregnancy. Oral iron supplements are commonly prescribed as they are cost-effective and widely accessible; however, in cases where severe anemia does not respond to oral iron, intravenous (IV) iron therapy is an alternative that can rapidly replenish iron stores. IV iron is particularly beneficial for women who experience gastrointestinal side effects from oral iron or have poor iron absorption due to underlying medical conditions. In some cases, erythropoiesis-stimulating agents (ESAs) may be used alongside iron therapy to stimulate red blood cell production, especially in women with chronic diseases that impair bone marrow function [25]. Blood transfusions are a crucial intervention for pregnant women with life-threatening anemia. This intervention is generally reserved for cases where anemia is severe enough to jeopardize maternal or fetal health, or when a rapid increase in hemoglobin levels is necessary, such as during labor or in preparation for delivery. Blood transfusions are effective in quickly restoring oxygen-carrying capacity, but they come with risks, including transfusion reactions and infections. Therefore, they are typically administered in hospital settings where patients can be closely monitored. Additionally, transfusion safety is paramount, especially in regions where screening for transfusion-transmissible infections may be limited. The judicious use of blood transfusions is part of a broader strategy to manage severe anemia safely and effectively [26].

Infection control and treatment are also essential in managing severe anemia in pregnancy, particularly in regions with a high prevalence of malaria, HIV, and parasitic infections. Malaria prophylaxis and treatment during pregnancy are critical in malaria-endemic regions, as malaria can exacerbate anemia through red blood cell destruction and increased iron loss. Deworming medications are also recommended to treat hookworm and other intestinal parasites that contribute to chronic blood loss and iron deficiency. For HIV-positive pregnant women, antiretroviral therapy (ART) can help mitigate anemia-related complications, as it reduces viral load and inflammation that often contribute to anemia. Together, these infection management strategies are crucial for reducing anemia severity in vulnerable populations and improving overall maternal health [26]. Dietary education and community health programs complement medical interventions by promoting sustainable dietary practices that support healthy iron levels. Pregnant women are encouraged to consume iron-rich foods, such as red meat, legumes, and leafy green vegetables, along with vitamin C-rich foods to enhance iron absorption. Health education programs are particularly impactful in low-resource settings where anemia is often linked to nutritional deficiencies. Community health workers play a key role in educating women on affordable, locally available dietary sources of iron and guiding them on prenatal supplementation adherence. These programs not only improve anemia outcomes but also raise awareness about the importance of prenatal care and routine health check-ups.[24] Emerging research in anemia management focuses on innovative interventions, such as slow-release iron formulations and injectable iron that may reduce side effects and improve patient adherence. Additionally, novel approaches like iron-fortified foods and micronutrient powders offer promising solutions for reaching women in remote or underserved areas. Genetic screening for hemoglobinopathies, such as sickle cell disease and thalassemia, is also increasingly recognized as an important tool in anemia management, allowing for early identification and specialized care for affected women. Inflammation-targeted therapies are another area of interest, as inflammation from chronic infections or autoimmune conditions can hinder iron metabolism. Anti-inflammatory treatments tailored to individual needs could offer new hope for women with inflammation-related anemia [26].

CONCLUSION

Severe anemia in pregnancy is a complex and pressing health issue with far-reaching impacts on maternal and fetal health. It is closely linked to increased risks of maternal mortality, infections, and

cardiovascular complications, as well as fetal growth restriction, preterm birth, and long-term developmental challenges. Addressing severe anemia in pregnancy is therefore critical to improving health outcomes for mothers and children and to breaking the cycle of intergenerational anemia and malnutrition. Given the multifactorial nature of anemia in pregnancy, effective interventions must be equally comprehensive, combining nutritional supplementation, infection control, blood transfusions, and educational programs that promote long-term dietary health.

The management of anemia in pregnancy has made significant strides through the development of more effective iron supplementation methods, the use of IV iron and blood transfusions for critical cases, and community-based health programs that promote awareness and preventive care. However, challenges remain, especially in resource-limited settings where access to prenatal care and safe transfusions is limited. Innovations in anemia treatment, including slow-release iron and iron-fortified foods, as well as targeted treatments for anemia related to chronic inflammation, offer promising advances but require further research and accessibility to make a broader impact.

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