



(REVIEW ARTICLE)



Understanding the complex interplay: An in-depth literature review of anemia's impact on maternal and fetal health throughout pregnancy

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Abstract

This comprehensive literature review highlights the intricate dynamics surrounding anemia and its multifaceted implications on maternal and fetal well-being during pregnancy. The analysis spans various factors influencing anemia, encompassing maternal age as a pivotal determinant. The ideal age for pregnancy, between 20-35 years, is explored as a crucial window for minimizing complications, with considerations for both physiological and psychological readiness. Conversely, pregnancies in women under 20 or over 35 are scrutinized for their heightened risks, involving physiological challenges and increased susceptibility to disorders like diabetes and hypertension. The review scrutinizes the role of anemia in precipitating complications such as placenta previa, characterized by abnormal placental implantation and associated with painless vaginal bleeding. Preeclampsia and eclampsia, distinctive hypertensive disorders, are examined, highlighting anemia's potential secondary role through hemolysis. Premature rupture of membranes (PROM) is also investigated, emphasizing anemia's association with disrupted immune responses, potentially contributing to membrane thinning and early rupture. Furthermore, the review explores the link between anemia during pregnancy and postpartum hemorrhage, elucidating the risks posed by reduced oxygen transport and the subsequent impact on uterine contractions. In conclusion, this literature review synthesizes existing knowledge to provide a comprehensive understanding of how anemia intertwines with various pregnancy-related complications, offering insights crucial for improved clinical management and maternal-fetal health outcomes.

Keywords: Anemia; Pregnancy; Pre-eclampsia; Premature

1. Introduction

Anemia during pregnancy is a multifaceted condition that extends its influence on hematological implications, significantly impacting maternal and fetal health. With a prevalence that reaches global proportions, understanding the intricate interplay between anemia and its repercussions is paramount for informed clinical management and improved outcomes for both mother and child. As the World Health Organization (WHO) highlights the significance of addressing anemia in pregnancy, this literature review endeavors to unravel the complexities associated with this condition, examining its diverse causes and exploring its cascading effects on various facets of the maternal-fetal. Maternal age emerges as a critical determinant, framing the landscape for potential complications. The optimal age bracket for pregnancy, typically considered between 20 to 35 years, represents a period where physiological and psychological readiness converge, minimizing risks. This review delves into the heightened vulnerabilities associated with pregnancies occurring in women below 20 and beyond 35 years. The physiological challenges and increased susceptibility to disorders such as diabetes and hypertension necessitate a nuanced understanding of the risks posed by anemia in these age brackets (Astutik & Ertiana, 2018).

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Anemia's impact on the pregnancy journey unfolds in various dimensions. Placenta previa, characterized by abnormal implantation leading to painless vaginal bleeding, emerges as a complication intricately linked to anemia. The classification of placenta previa into categories such as low-lying, marginal, partial, and total provides a framework for tailoring management strategies. The review emphasizes the importance of accurate diagnosis, guiding clinicians in determining the most appropriate interventions (Ishibashi et al., 2018; Kumari et al., 2022). Preeclampsia and eclampsia, hypertensive disorders of pregnancy, add another layer to the narrative. Beyond the hallmark features of hypertension and proteinuria, this review explores the secondary role of anemia in these disorders, considering hemolysis and hemoconcentration as potential contributors. These disorders, with their potential for seizures and organ damage, underscore the urgency of elucidating anemia's role in their etiology (Ives et al., 2020; Astutik & Ertiana, 2018).

Premature rupture of membranes (PROM), a condition with implications for preterm birth, introduces another chapter in this narrative. Anemia's involvement in compromising the immune response, thereby influencing the thinning of fetal membranes and promoting early rupture, is scrutinized. The intricate web of factors contributing to PROM, including nutritional deficiencies exacerbated by anemia, is explored to enhance our understanding of this complex phenomenon (Ehsanipoor & Pettker, 2018; Astutik & Ertiana, 2018). In the postpartum phase, anemia's lingering influence manifests in postpartum hemorrhage (PPH), a significant contributor to maternal morbidity and mortality. Reduced oxygen transport, a consequence of anemia, is dissected for its role in compromising uterine contractions, leading to uterine atony and substantial bleeding. The review considers anemia's contribution to the diverse causes of PPH, underscoring the need for targeted interventions to mitigate this potentially life-threatening complication (Li et al., 2022; Astutik & Ertiana, 2018).

In essence, this literature review aims to investigate the relationship between anemia and maternal-fetal health during pregnancy, shedding light on the diverse factors that contribute to its onset and the far-reaching consequences it exerts. By exploring these complexities, we aim to provide a comprehensive foundation for enhanced clinical understanding and more effective strategies in managing anemia during pregnancy.

2. Review Content

2.1. Definition of Anemia

Anemia is the reduction in the absolute number of circulating red blood cells or a condition where the number of red blood cells is insufficient to meet physiological needs. It is often diagnosed using low Hb concentration or hematocrit, but can also be diagnosed using red blood cell count, average cell volume, reticulocyte count, blood smear analysis, or Hb electrophoresis. However, in clinical practice, Hb concentration is the most common hematological assessment (Chaparro & Suchdev, 2019). Anemia is a decrease in the blood's capacity to carry oxygen or concentration when Hemoglobin (Hb) levels are < 11 g/dL. This can occur due to a decrease in red blood cell production. Anemia can also be defined as a decrease in blood Hemoglobin levels below the normal range of 12 g/dL for women and 13 g/dL for men (Katsumi, et al., 2021). Anemia is a reduction in the number of red blood cells, leading to insufficient oxygen transport. Practically, it is indicated by decreased hemoglobin levels, hematocrit, or red blood cell count. Age, gender, physiological conditions like pregnancy, and altitude can influence hemoglobin levels (Bakta, 2017).

2.2. Anemia Criteria

Determining anemia or low Hb levels is influenced by age, gender, pregnancy status, genetic factors, and environmental factors. Gender differences arise during puberty due to menstruation and iron reserves, continuing into the reproductive years. Pregnancy leads to blood volume expansion, causing a natural decline in Hb levels during the first two trimesters, gradually rising in the third trimester. Environmental conditions, altitude, and smoking habits can also affect Hb concentration (Chaparro & Suchdev, 2019).

2.3. Anemia in Pregnancy

According to WHO guidelines, anemia during pregnancy is defined as Hb levels < 11 g/dl. The CDC defines anemia in pregnancy as Hb levels $< 11\%$ in the first and third trimesters and $< 10.5\%$ in the second trimester. Anemia in pregnancy refers to a decrease in Hemoglobin or red blood cells, reducing the capacity to transport oxygen for the vital organs of the mother and fetus. Anemia in pregnancy requires serious attention in healthcare due to its potential danger to both mother and child (Manuaba, 2007; Astutik & Ertiana, 2018).

2.4. Factors Causing Anemia During Pregnancy

The ideal age for pregnancy is typically considered to be between 20-35 years, known as the healthy reproductive age. This age range is associated with lower risks of pregnancy complications that could endanger both the mother and fetus, both physiologically and psychologically. Physical and mental readiness for pregnancy is generally more stable in this age group. Pregnancy occurring in women under 20 years old may face challenges as both the physiological and psychological aspects of the mother might not be optimally prepared. Physiologically, reproductive organs may not be fully ready for pregnancy, and psychologically, the mental and emotional state of the mother is often less stable, leading to a higher risk of various health issues due to a weakened immune system. Nutrient intake optimization is crucial for pregnant women under 20 to support their own health and the development of the baby (Astutik & Ertiana, 2018).

On the other end of the spectrum, being pregnant after the age of 35 poses higher risks due to bodily changes related to aging. At this age, various changes in organ functions occur, increasing the mother's risk of diseases during pregnancy, such as diabetes, pregnancy-related hypertension (preeclampsia/eclampsia), hypertension, and cardiovascular diseases, leading to complications. Additionally, pregnancy at an older age may result in decreased immunity, making the mother more susceptible to infections and diseases that can cause anemia. Hence, sufficient energy intake is essential to support pregnancy in women above 35 (Astutik & Ertiana, 2018).

2.5. Factors Influencing Anemia on Mother and Fetus

2.5.1. Placenta Previa

Placenta previa is defined as the abnormal implantation of the placenta into the lower segment of the uterus, above it, or near the internal os, causing bleeding during the formation of the lower segment of the uterus. Placenta previa is classified into four categories: low-lying placenta, marginal placenta, partial placenta, and total placenta previa. Accurate diagnosis of the type of placenta previa is crucial for determining the best management approach (Ishibashi, et al., 2018). Characteristic of placenta previa includes painless vaginal bleeding during the second or third trimester. The initial bleeding is usually minimal and stops on its own, but it may reoccur without clear reasons after some time. Therefore, bimanual examinations should be avoided as they can lead to massive bleeding (Kumari, et al., 2022). During pregnancy, there is a decrease in hemoglobin and hematocrit levels due to increased blood and plasma volume. Anemic mothers can disrupt placental and fetal growth. Blood elevation during pregnancy serves to meet the nutritional needs of the uterus, placenta, and fetus and acts as a reserve in case of maternal blood loss during delivery (Hayati, 2020; Astutik & Ertiana, 2018).

2.5.2. Preeclampsia

Preeclampsia is a pregnancy-related hypertensive disorder accompanied by proteinuria due to new-onset organ damage that occurs after 20 weeks of pregnancy until 6 weeks postpartum. The foundation of this condition is hypertension and proteinuria, although systemic organ dysfunction can occur (Ives, et al., 2020). Eclampsia involves tonic-clonic seizures, focal or multifocal onset, accompanied by signs of preeclampsia and without finding any other cause (Ives, et al., 2020). Eclampsia is a disorder caused by severe preeclampsia, making preeclampsia a precursor to eclampsia. Anemia related to the onset of eclampsia is secondary anemia due to hemolysis in specific cases. Another factor is hemoconcentration, which can increase hemoglobin and hematocrit levels (Astutik & Ertiana, 2018).

2.5.3. Premature Rupture of Membranes (PROM)

Premature Rupture of Membranes (PROM), or Premature Rupture of Membranes (PROM), is the condition where the amniotic sac breaks before the onset of labor. If the rupture occurs before 37 weeks of gestation, it is termed "premature rupture of membranes before delivery" (Ehsanipoor & Pettker, 2018). PROM is also defined as the rupture of membranes before the onset of labor, occurring in primiparas with an opening of less than 3 cm and in multiparas with less than 5 cm (Mochtar, 2013; Astutik & Ertiana, 2018). The main cause of PROM is not precisely known, but several factors, including anemia, can potentially lead to PROM. Anemia occurs due to low hemoglobin levels in pregnant women and can affect nutritional deficiencies for both the mother and fetus. This can impact the immune system and the body's response to infections, leading to a decrease in natural killer cell activity. If the mother is detected with an infection, an imbalance in Matrix Metalloproteinase (MMP) production may occur due to disrupted collagenolytic processes. This results in inflammation, thinning of the fetal membranes, and increased susceptibility to rupture (Cunningham, et al., 2005; Astutik & Ertiana, 2018).

2.5.4. Postpartum Hemorrhage (PPH)

Postpartum Hemorrhage (PPH) is a condition where a mother loses 500 ml of blood during vaginal delivery or 1000 ml during cesarean section within 24 hours after delivery (Li, et al., 2022). Based on the time of occurrence, postpartum hemorrhage is divided into two types: primary postpartum hemorrhage (early postpartum hemorrhage), which involves bleeding of more than 500 cc within the first 24 hours after childbirth. The second type is secondary postpartum hemorrhage (late postpartum hemorrhage), involving bleeding of more than 500 cc after 24 hours post-delivery (Hardianti, 2020; Heydarpour et al., 2019).

Various causes can lead to postpartum hemorrhage in mothers, including uterine atony, retained placenta, birth canal lacerations, and coagulopathies. However, another factor that can increase the risk of postpartum hemorrhage is anemia during pregnancy. Anemia, characterized by reduced hemoglobin levels in the mother's body, results in decreased oxygen transport to vital organs. This poses a significant risk to both the mother and fetus if anemia is not adequately addressed by the end of pregnancy. The lack of oxygen supply to the uterine muscles causes ineffective uterine contractions, leading to uterine atony and substantial bleeding (Astutik & Ertiana, 2018)

3. Conclusion

In conclusion, this comprehensive review underscores the intricate impact of anemia on maternal and fetal health during pregnancy. From its association with complications like placenta previa, preeclampsia, and PROM to its role in postpartum hemorrhage, anemia emerges as a critical factor influencing various aspects of the maternal-fetal dyad. Recognizing the nuanced interplay of anemia with different pregnancy-related complications is imperative for tailored clinical interventions, ultimately improving outcomes for both mothers and infants. As we navigate the complex terrain of anemia in pregnancy, this synthesis of existing knowledge lays the groundwork for future research and enhanced clinical practices.

Compliance with ethical standards

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Disclosure of conflict of interest

All the authors declare no conflict of interest.

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