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Identify the type and cause of anemia in pregnant women by examining peripheral blood smears

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Abstract The primary objective of this research is to identify the types and causes of anemia in pregnant women in the city of Makassar. This study employs a quantitative approach with a descriptive design and an analytical observational method using a cross-sectional approach. Purposive sampling was conducted among pregnant women in the third trimester undergoing pregnancy checks at Community Health Centers in Tamalate, Antang, and Pampang, with hemoglobin levels <11 g/dL. The findings revealed two types of anemia among the 40 respondents, namely microcytic and normocytic anemia. The distribution was 60% for microcytic anemia and 40% for normocytic anemia. Predominantly, 35% of microcytic anemia cases were attributed to iron deficiency linked to chronic disease with signs of infection, while 15% of normocytic anemias were associated with infection. The majority of pregnant women experienced a moderate degree of anemia. Peripheral blood smear examinations depicted a prevalence of microcytic anemia with characteristics of Fe-DD deficiency and infection, followed by normocytic anemia with infectious causes. Peripheral blood smears proved to be effective in describing the types and causes of anemia in pregnant women. The hope is that by understanding the specific causes, appropriate treatments can be administered to address anemia in mothers.

Keywords: anemia, pregnant women, peripheral blood smear

1. Introduction

According to the World Health Organization (WHO), the prevalence of anemia in Indonesia was reported to be 42% in 2016, slightly higher than the global average of 40% (Alemayehu et al., 2016). The causes of anemia during pregnancy in Indonesia are diverse, but iron deficiency is commonly regarded as the primary factor. Hemoglobin level measurement is the typical diagnostic method for anemia during pregnancy. The Sahli method is commonly employed for this purpose; however, it has limitations in accuracy, leading to the possibility of misdiagnosis. Additionally, the diagnostic tools used may not effectively differentiate between the types of anemia (Abbas, 2020; Adamu et al., 2017; Adebo et al., 2019).

Relying solely on hemoglobin levels often leads to the presumption of iron-folate deficiency as the cause of anemia, resulting in the administration of iron-folate tablets as a common treatment approach. However, this approach is problematic as an improper diagnosis of the specific type of anemia can render the treatment less effective and contribute to the persistently high incidence of anemia. In pregnant women, anemia is not exclusively linked to iron deficiency or microcytic anemia; it can also be attributed to various other factors, including comorbidities such as infections and chronic diseases. The likelihood of normocytic anemia in pregnant women is notably high, especially in a tropical country like Indonesia, where infectious diseases are prevalent (Alemayehu et al., 2016; Anchang-Kimbi et al., 2017).

Pregnant women with anemia in the third trimester increase the risk of potential danger to the mother and child, because the third trimester is the last period of pregnancy, when the mother does not have to face the labor process for a long time. Anemia in pregnancy has an impact on maternal and fetal morbidity and mortality, which can cause bleeding during delivery, prolonged labor and low birth weight (LBW) (Bukhari et al., 2020). Fe tablets have been given to pregnant women to prevent anemia, but the incidence of anemia is still quite high. The causes of anemia in pregnancy are multifactorial, but iron deficiency is generally considered the main cause because the diagnosis of anemia is usually based on hemoglobin measurements alone (Fallatah et al., 2020).

An inaccurate diagnosis of the specific type of anemia not only renders treatment ineffective but also contributes to the high incidence of anemia in pregnant women. Additionally, the current diagnostic tools do not allow for differentiation between normocytic, microcytic, and macrocytic types of anemia. Notably, Hb examinations conducted on pregnant women at Community Health Centers revealed instances where subjects were not confirmed after undergoing a standard complete blood count at the hospital. It is crucial to highlight that Hb examinations at primary health facilities are typically performed only during the initial visit, with no regulatory requirement for them to be conducted in the last trimester. Recognizing the



importance of these examinations in detecting complications before delivery, there is a need for reconsideration and potential policy adjustments in this regard. Early detection of risks and causes of anemia in third-trimester pregnant women serves as a crucial indicator for shaping national health policies, particularly in the context of detecting and treating anemia during pregnancy. However, it is equally important to identify potential complications before delivery. The diagnostic test performed to determine anemia is a peripheral blood smear examination. A peripheral blood smear is a diagnostic procedure used in the evaluation and diagnosis of various medical conditions. It is an appropriate action if disease or infection is suspected. A peripheral blood smear assesses blood cell elements such as erythrocytes, leukocytes and platelets (Adamu et al., 2017; Adebo et al., 2019). According to data from the Makassar City office in 2020, the reported cases of 6002 anemic pregnant women in Makassar City in 2020 emphasize the need for proactive measures and policies to address the prevalent issue of anemia during pregnancy in the region. Anemia during pregnancy can have adverse effects on both maternal and fetal health. Implementing strategies such as improving access to prenatal care, enhancing nutritional education, and providing appropriate interventions can play a crucial role in reducing the incidence and impact of anemia in pregnant women (Gebreweld et al., 2018).

1.1. Aim

The researchers plan to undertake a study with the primary objective of identifying the types and causes of anemia in pregnant women. The chosen methodology involves a detailed examination of peripheral blood smears. This approach is anticipated to provide comprehensive insights into the specific characteristics and underlying reasons for anemia among pregnant women, facilitating a more nuanced understanding of the condition and informing potential interventions and treatments.

2. Materials and Methods

This research was conducted at three Community Health Centers in the Makassar region which have the highest incidence of anemia in pregnant women, namely Tamalatea, Pampang and Antang Community Health Centers. The study utilized an analytical observational approach with a cross-sectional design. The population under consideration included all third-trimester pregnant women with anemia (Hb <11 g%) who independently sought examinations at the three selected Makassar City Health Centers. These centers were chosen based on the highest recorded incidence of anemia in 2020: Tamalatea Health Center with 19 cases, Antang Health Center with 31 cases, and Pampang Health Center with 37 cases. The research spanned three months, from September to November 2022, and adhered to the following inclusion criteria: third-trimester pregnant women with anemia (Hb <11 g%) who expressed a willingness to participate in the research. A total of 40 pregnant women with anemia were identified, and 3 ml blood samples were collected. These samples underwent peripheral blood examinations at the Wahidin Sudirohusodo Hospital laboratory in Makassar City. This research has received ethical approval no: RK.89/KEPK/STIK/VIII/2022, all samples were previously given informed consent regarding the actions to be carried out and have agreed to it. This research maintains the confidentiality of information during the research and after the research by storing research information and using coding for each sample.

3. Results

Table 1 shows distribution characteristics research subject, majority subject doesn't work (82,5%) and majority types of anemia is microcytic anemia (60.5%).

Table 1 Characteristics of research subjects.

	Characteristics	Frequency (n)	Percentage (%)
Work	Work	7	17,5
	Doesn't work	33	82,5
Education	Basic education (elementary school, middle school, high school)	30	75,0
	Higher education	10	25,0
Parity	≥ 4 times	6	15,0
	< 4 times	34	85,0
Age	< 20 years and > 35 years	8	20,0
	20-35 years	32	80,0
Degree of anemia	Mild anemia	16	40,0
	Moderate anemia	24	60,0
Types of anemia	Microcytic anemia	25	60,5
	Normocytic anemia	15	37,5

Table 2 shows causes of anemia in pregnant women based on peripheral blood smear and majority subject with microcytic anemia with features of Fe-DD deficiency by infection.

Table 2 Causes of Anemia in Pregnant Women Based on Peripheral Blood Smear.

Peripheral Blood Smear	Frequency (n)	Percentage (%)
Normocytic anemia with impaired renal function	2	5,0
Normocytic anemia with peripheral blood analysis within normal limits	2	5,0
Normocytic anemia with an infectious cause	6	15,0
Normocytic anemia with features of chronic disease accompanied by signs of infection	4	10,0
Normocytic anemia with neutrophilia	1	2,5
Normocytic anemia with features of chronic disease characterized by impaired liver function	1	2,5
Microcytic anemia with features of iron deficiency characterized by decreased liver function	1	2,5
Microcytic anemia with features of iron deficiency	2	5,0
Microcytic anemia with features of Fe-DD deficiency is characterized by chronic disease	3	7,5
Microcytic anemia with features of Fe-DD deficiency is characterized by infection	14	35,0
Microcytic anemia is a picture of leukocytes with signs of infection	4	10,0

4. Discussion

The characteristics of the research subjects, as presented in Table 1, reveal that the majority of pregnant women experiencing anemia are not employed. This observation aligns with findings from Abbas's research in Baghdad (2020), where pregnant women who were employed had a higher likelihood of being anemic (27%) compared to pregnant women who were not anemic (32%) (Langdon et al., 2014). Similarly, the data shows that the percentage of pregnant women not engaged in employment is higher among those with anemia (73%) compared to non-anemic pregnant women (68%). Housework undertaken by mothers working at home (housewives) involves strenuous tasks such as laundry, house cleaning, cooking, and childcare. The demands of such domestic work can lead to fatigue and high stress levels, impacting the pregnancy process, potentially contributing to anemia. This phenomenon is not exclusive to housewives; mothers working outside the home, who may be required to put in long hours at work, can also experience similar challenges (Makassar City Health Service, 2021).

Regarding educational status, the majority of pregnant women with basic education levels, namely elementary-high school, suffer from anemia. This research is in line with research by Rezk et al. (2015) of 2,740 pregnant women in Menoufia Egypt, there were (51,3%) pregnant women with anemia and (48,7%) pregnant women without anemia where there were (50,7%) pregnant women are anemic and (49,2%) pregnant women are not anemic with basic education status. For pregnant women with high education status, there are (43,8%) pregnant women who are anemic and (46,4%) pregnant women who are not anemic (Sharief et al., 2024). High education is assumed to mean that it will be easy to obtain information and have a lot of knowledge, but low education can hinder the influence of acceptance of newly obtained information (Ministry of Health RI, 2019), so it can be assumed that higher education will make it easier to absorb the information obtained. Insufficient knowledge about pregnancy is also a factor causing anemia.

Regarding parity, the data indicates that anemia in pregnant women is most prevalent among those with a low-risk parity of less than four times. This finding aligns with the results of a study by Tanziha et al. (2016), which similarly demonstrated that there is no significant relationship between parity and the incidence of anemia in pregnant women in Indonesia (Nurana et al., 2024). The occurrence of anemia during pregnancy is frequently observed in mothers who are having their first child or experiencing their initial pregnancy, as found in this study. First-time pregnancies elevate health risks due to the mother's lack of prior pregnancy experience. Mothers undergoing their first pregnancy often need time to adjust, making anemia more prevalent in this group. Beyond primiparous pregnancies, anemia in mothers with high parity can be linked to the mother's iron intake. It's noteworthy that higher parity becomes riskier when associated with shorter pregnancy intervals (Neil, 2017).

The age category analysis reveals that the majority of pregnant women fall into the low-risk age group, specifically between 20-35 years. This finding is consistent with a study conducted by Olatunbosun et al. (2014) on pregnant women in Nigeria, which observed a tendency for anemia in pregnant women with high-risk ages (<20 and >35 years). However, the research did not find a significant relationship between pregnant women with high-risk ages and low-risk ages concerning the presence or absence of anemia. The obtained p-value of 0.77 suggests a lack of statistical significance in this association Cahyani et al., 2023. The evidence supports the notion that anemia can occur in pregnant women across all age groups. In other words, being too old or too young within all age ranges does not seem to have a significant impact on the incidence of anemia in pregnant women. Pregnancy, by its nature, poses a heightened risk of iron deficiency since an increased amount of iron is required to support the growing fetus and placenta, as well as to boost maternal red blood cell mass. This increased demand for iron during pregnancy can make women of all ages susceptible to anemia (Okia et al., 2019). In situations demanding elevated iron levels, pregnancies occurring in younger or older women may be more susceptible to anemia. The nutritional needs of pregnant women are influenced by the quantity of food consumed, and this impact is more pronounced in younger and older age groups. Malnutrition, particularly in mothers aged below 20 years and above 35 years, can heighten the risk of anemia. Pregnant women below 20 years of age may experience competition for nutrient consumption between the growing

fetus and the mother. These young mothers may struggle to meet the iron requirements of their developing fetus. On the other hand, pregnant women above 35 years of age often face anemia due to diminished iron stores, as the body draws on these reserves. Pregnancy at the age of 35 signifies entry into the early stages of the degenerative phase, characterized by suboptimal body function and an increased susceptibility to various health issues. Therefore, pregnancies occurring below the age of 20 and beyond 35 are considered at-risk pregnancies for the development of anemia (Olatunbosun et al., 2014; Rawat et al., 2016). In terms of the severity of anemia, the majority of pregnant women in this study exhibit moderate anemia. This finding contrasts with a study conducted by Melku et al. (2014), where 64% of pregnant women experienced mild anemia, 30% experienced moderate anemia, and 6% experienced severe anemia. The discrepancy in results highlights variations in the prevalence and severity of anemia among different study populations and settings (Rezk et al., 2015). As mentioned earlier, aside from iron deficiency, chronic diseases are identified as a cause of anemia in pregnant women. This study identifies insufficient intake of animal and vegetable foods as one of the contributing factors to anemia. Iron is crucial for the production of red blood cells, which play a vital role in oxygen and nutrient transportation, blood flow, embryo growth, and maintaining the optimal condition of the placenta. When conditions are favorable and dietary intake is adequate, yet the pregnant woman still experiences anemia, further investigation is needed to explore other potential causes. The occurrence of moderate anemia in the majority of pregnant women during the third trimester, with hemoglobin levels ranging from 7,0 to 8,9 g/dL, suggests a significant health concern. This level of anemia can have adverse effects on both maternal and fetal well-being. Addressing the root causes, such as absorption issues, drug or alcohol consumption, and maternal illnesses, is crucial for effective intervention and management. Implementing strategies to improve nutritional intake, providing necessary supplements, and closely monitoring the health of pregnant women can contribute to reducing the prevalence and severity of anemia during pregnancy. The scoping review by Sharief et al., (2024) indicates that chronic diseases and infections such as HIV, malaria, and parasitic infestations are major contributors to normocytic anemia in pregnant women, especially in developing regions with socio-economic and healthcare access disparities. The findings emphasize that most cases involve mild to moderate anemia, underscoring the need for improved maternal health interventions. Public health initiatives and awareness campaigns may also play a role in preventing and managing anemia in this population (Risksesdas, 2019). Iron deficiency can stem from the consumption of foods that are low in iron, particularly animal protein, both before and during pregnancy. Merely relying on dietary iron may fall short of meeting the increased demands of the mother and the developing fetus during pregnancy. The blood volume increases by up to 50% during pregnancy to cater to the needs of both the mother and the growing fetus. Consequently, to prevent a deficiency in red blood cells, it becomes imperative to supplement iron to ensure an adequate supply during this crucial period.

The prevalence and types of anemia can indeed vary across populations and regions due to different factors such as dietary habits, healthcare access, and genetic factors. Microcytic anemia is often associated with iron deficiency, which is a common cause of anemia, especially in pregnant women. Normocytic anemia, on the other hand, can have various underlying causes, including chronic diseases or inflammation. It's interesting to observe similarities in findings across different studies and regions, as it provides valuable insights into the global patterns of anemia. If you have any specific questions or if there's anything else you'd like to discuss further (Risksesdas, 2019). The results of this research are not in line with the research of Alemayehu et al. (2016) who studied the prevalence, severity and determinants of anemia in pregnant refugee women in Sudan, the majority of study participants experienced normocytic anemia with a percentage of 56,2%, followed by microcytic anemia with a percentage of 42,3% and macrocytic anemia with a percentage of 1,5% (Anchang-Kimbi et al., 2017). The prevalence of microcytic morphological characteristics in this study aligns with established theories linking iron deficiency to anemia in pregnant women. The recognition of normocytic erythrocytes in 40% of pregnant women may be attributed to hemodilution, a common physiological occurrence during pregnancy that leads to a decrease in hemoglobin levels. This phenomenon emphasizes the importance of considering both iron deficiency and hemodilution when assessing anemia in pregnant women (Sari,2021). Absolutely, the morphological characteristics provide valuable information, but it's crucial to recognize that they don't always correlate directly with the underlying causes. Microcytic anemia, often associated with iron deficiency, could be linked to various factors, including infection. Similarly, normocytic anemia can have multiple causes, and infectious factors could contribute. The complex interplay of factors influencing anemia, especially in pregnant women, underscores the need for a comprehensive approach to diagnosis and treatment. Further investigations and a thorough understanding of the individual's health status are essential for effective management. A person's body will easily get infections when they have anemia, this happens because anemia can reduce the body's resistance which causes a person to become infected easily. This shows that infection is an important factor in causing anemia and anemia occurs as a result of inflammation and the need for food intake that does not contain enough iron.

You've provided comprehensive information about normocytic anemia and its various causes, including hemolytic anemia, anemia due to acute renal failure, anemia after bleeding, anemia related to chronic disease, and sideroblastic anemia. Additionally, you highlighted the importance of iron supplementation and dietary adjustments, especially during pregnancy, to address anemia. It's crucial to identify the specific cause of anemia to tailor the treatment approach effectively. You rightly mentioned that knowing the cause helps in providing targeted solutions (Tanziha et al., 2016).

5. Conclusions

Peripheral blood smear examination helps identify the type and cause of anemia, with microcytic anemia being particularly prevalent, especially associated with Fe-DD deficiency and infection. The emphasis of this study on understanding the characteristics of anemia in pregnant women and its potential causes is invaluable for informing appropriate intervention and treatment. It is hoped that future researchers can carry out further laboratory examinations of the causes of the infections found.

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Conflict of Interest

The authors declare no conflicts of interest.

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