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Overview of Erythrocyte Index Values in Pregnant Women with Anemia at Kraton Regional General Hospital, Pekalongan Regency

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ABSTRACT

Background & Objective: The erythrocyte index is the average value or corpuscular value. The erythrocyte index value includes the average erythrocyte volume obtained from the MCV value. The average hemoglobin content in erythrocytes can be seen from the MCH, while the average hemoglobin concentration in erythrocytes is determined by the MCHC value. The erythrocyte index in pregnant women with anemia shows a decrease in MCV during the early stages of iron deficiency. The severity of anemia increases if the Mean Corpuscular Hemoglobin Concentration (MCHC) also decreases. This study aims to determine the profile of erythrocyte indices in pregnant women with anemia. **Method:** This study is a descriptive studyusing total sampling with 30 respondents. **Result:** The study obtained 17 erythrocyte index values with a percentage (56.67%) indicating hypochromic microcytic anemia, and 13 erythrocyte index values with a percentage of (43.33%) indicating normochromic normocytic anemia. **Conclusion:** The results of the study on erythrocyte index profiles in pregnant women with anemia at Kraton General Hospital, Pekalongan Regency, revealed 17 samples (56.67%) with hypochromic microcytic anemia, meaning the erythrocytes are small in size and pale in color. Additionally, 13 samples (43.33%) were found to have normochromic normocytic anemia, meaning they have normal size and color.

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Introduction

The erythrocyte index is an average value that provides information about the average number of erythrocytes. Another term for the erythrocyte index is the corpuscular index. The erythrocyte index value includes the average erythrocyte volume obtained from the MCV value and the average hemoglobin content in erythrocytes can be seen from the MCH value, while the average hemoglobin concentration in erythrocytes is determined by the MCHC value. The erythrocyte index in pregnant women with anemia shows a decrease in MCV in the early stages of iron deficiency. The severity of anemia increases if the Mean Corpuscular Hemoglobin Concentration (MCHC) also decreases. (G. Jenny. Ratnawaty et al., 2018).

Anemia is a common problem worldwide and a major health issue, especially in developing countries. This condition causes chronic debility, which has a significant impact on physical health. Anemia during pregnancy, whether physiological or pathological, such as in high-risk pregnancies, is a situation where the life and health of the mother and baby are at risk. From this explanation, it can be understood that every pregnancy with high risk factors can cause negative effects such as growth disorders and inhibition, both for body cells and brain cells, while blood deficiency can reduce the oxygen supplied to body and brain cells. Pregnant women with anemia are at higher risk of postpartum hemorrhage and face morbidity or mortality for themselves and their fetuses during pregnancy, childbirth, and the postpartum period. (Hidayah et al., 2020)

According to the WHO (2017), the prevalence of anemia among pregnant women in Asia is 48.2%, and worldwide it is 41.8%. Based on health research findings, the incidence of anemia in Indonesia is high, with 37.1% of pregnant women suffering from anemia. (D. Handayani et al., 2021)

These data show that the prevalence of anemia in pregnant women is quite high and remains an obstacle to improving maternal and child health. Anemia in pregnant women has negative effects on both the mother and the fetus, such as the risk of bleeding and stunted fetal growth. Cases of anemia in pregnant women are influenced by age, number of previous pregnancies, and the interval between previous and current pregnancies. Anemia during pregnancy is also a national issue as it reflects the socioeconomic conditions of the community. Pregnancy accompanied by anemia can be prevented through the administration of iron supplements. (Endang Wahyuningsih et al., 2023)

Erythrocytes are cells in the blood that are round and concave on both sides and red in color because they contain hemoglobin. Erythrocytes measure 7.5 μm in diameter, with a thickness of 2.6 μm at the edges and 0.75 μm in the center. The structure of erythrocytes consists of a thin membrane, which allows for easy diffusion of oxygen and carbon dioxide, and mature red blood cells contain around 200-300 million. (R. Yayuningsih et al., 2023). The function of erythrocytes is to transport hemoglobin that carries oxygen and also circulate O2 to body tissues and return carbon dioxide from tissues to the lungs. Erythrocytes are covered by a strong and flexible plasma membrane, which can adjust to changes in erythrocytes as they pass through very narrow erythrocytes without damaging the cell membrane. This plasma membrane consists of 40% lipids, 10% carbohydrates, and 50% proteins, mostly in the form of integral proteins embedded in the two layers of the phospholipid membrane, including band 3 protein and glycophorin A (F. R. Rosita et al., 2016).

Erythrocyte Morphology

This refers to the shape, size, and color of red blood cells. Abnormalities in red blood cell morphology can occur due to several factors, such as disease or treatment of blood samples.

Normal Erythrocyte Morphology

Normal erythrocytes appear round and have a disc shape with a diameter of 7.5 µm. With a volume of 80 µm3, these cells are pink in color due to the presence of hemoglobin that binds oxygen. The erythrocyte membrane is composed of lipids, proteins, and carbohydrates that interact to form a dynamic fluid structure.

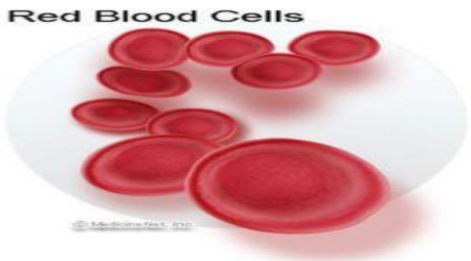

FIGURE 1. Normal Erythrocytes (F. R. Rosita et al., 2016)

Abnormal Erythrocyte Morphology

Abnormal erythrocyte morphology is observed in terms of size, shape, color, and inclusions.

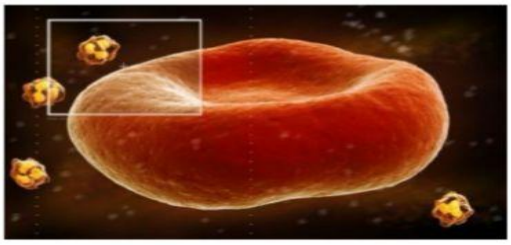

FIGURE 2. Abnormal Erythrocytes (F. R. Rosita et al., 2016)

Red Blood Cell Abnormalities

Red blood cells are formed from erythropoietin and glycoprotein hormones originating in the kidneys. Red blood cells replicate in the body and can undergo changes. If the quality of red blood cells increases, it is called polycythemia. Conversely, if red blood cells decrease, it is called anemia. (W. Wahdaniah et al., 2020). (A. R. Putr., 2021) mentions abnormalities in erythrocyte size.

Anisocytosis

Anisocytosis is a difference in the size or volume of red blood cells in a peripheral blood smear (PBS). This condition is usually found in cases of severe chronic anemia.

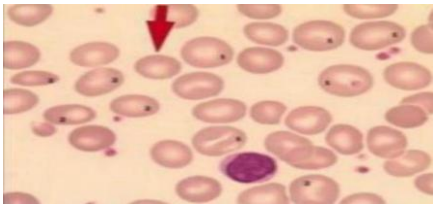

FIGURE 3. Anisocytosis

Macrocytosis

Macrocytosis is a condition in which red blood cells are larger than 8.2 µm and have a Mean Corpuscular Volume (MCV) greater than 100 fl. The presence of

macrocytes may be associated with liver disease, vitamin B12 deficiency, and folic acid deficiency. This is often found in megaloblastic anemia, a type of anemia that occurs during pregnancy.

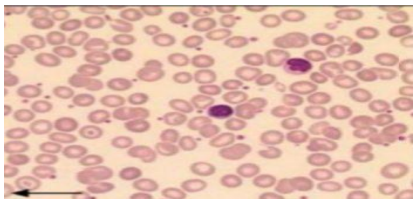

FIGURE 4. Macrocytosis

Microcytosis

Microcytosis is a condition in which red blood cells are smaller than normal (MCV) less than 80 fl. The presence of microcytic cells can be caused by iron deficiency. This is often found in sideroblastic anemia.

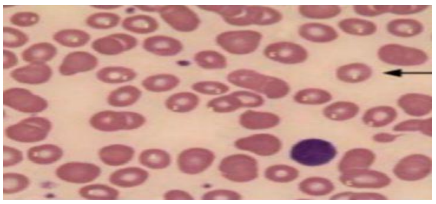

FIGURE 5. Microcytosis (R. Rahmi., 2012)

(Asiva Noor Rachmayani., 2015) mentions abnormalities in erythrocyte color as follows:

Hypochromia

Hypochromia is a condition in which red blood cells have normal hemoglobin levels. The mean cellular hemoglobin concentration (MCHC) is 32% to 36%. Normal red blood cells are red in color with a paler center. The diameter of red blood cells does not exceed one-third of the cell.

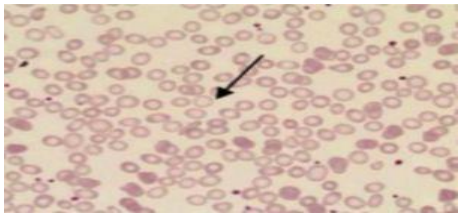

FIGURE 6. Hypochromia

Hyperchromic

Hyperchromia is a condition in which red blood cells have a higher than normal hemoglobin concentration.

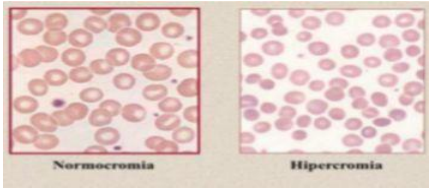

FIGURE 7. Hyperchromia

Normochromic, a condition in which red blood cells have a normal Hb concentration.

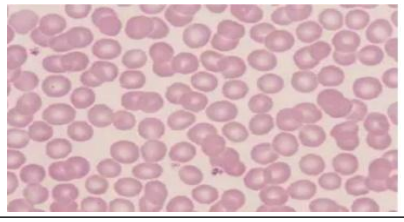

FIGURE 8. Normochromic

Polychromic, there are several colors in erythrocytes, namely basophils found in reticulocytosis.

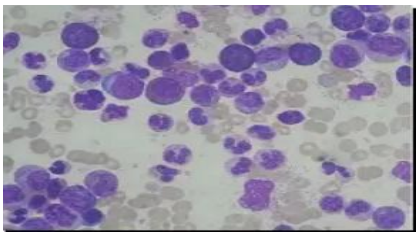

FIGURE 9. Polychromic (R. Rahmi., 2012)

(Asiva Noor Rachmayani., 2015) mentions the following abnormalities in red blood cell shape:

Poikilocytosis

Red blood cells vary in shape or are not uniform or diverse, found in severe iron deficiency, megaloblastic anemia (a condition in which the number of red blood cells decreases).

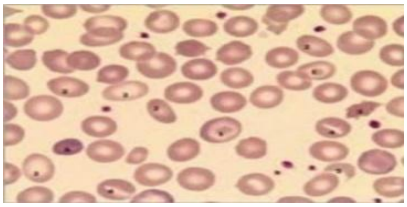

FIGURE 10. Poikilocytosis

Target Cell

In the pale center of the erythrocyte, there is a red area or this area appears dark in the center (like coffee).

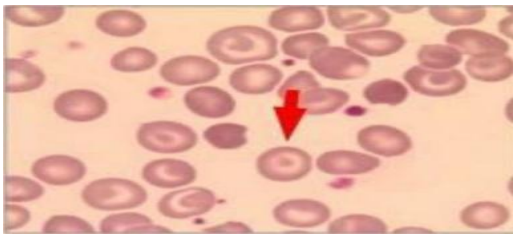

FIGURE 11. Target Cell

Ovalocyte, an oval-shaped erythrocyte with normal size.

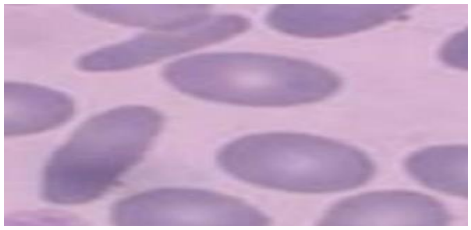

FIGURE 12. Ovalocyte

Tear Drop Cell, erythrocytes shaped like teardrops are found in megaloblastic anemia.

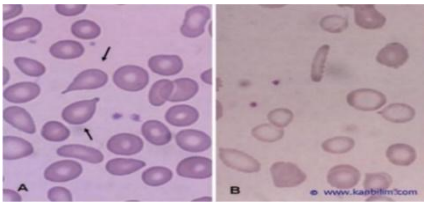

FIGURE 13. Tear Drop Cell (Asiva Noor Rachmayani., 2015)

Objective

This study aims to determine the erythrocyte index values in pregnant women with anemia at Kraton Regional General Hospital in Pekalongan Regency.

Method

This study used a descriptive research design to determine the erythrocyte index values at Kraton Regional General Hospital in Pekalongan Regency. The study was conducted from March to April 2025. The population in this study consisted of 30 pregnant women with anemia at Kraton Regional General Hospital in Pekalongan Regency. The sample was taken using total sampling. The examination was conducted at Kraton Regional General Hospital in Pekalongan Regency. Data analysis technique: the data obtained from the research results were compiled in tables. They were then analyzed and narrated to determine the profile of erythrocyte index values in pregnant women with anemia.

Results

After conducting research on the description of erythrocyte index values in pregnant women with anemia at the Kraton Regional General Hospital in Pekalongan Regency. A total of 30 samples were obtained in March-April 2025.

TABLE 1. Results of Erythrocyte Index Examination in Pregnant Women at Kraton Regional General Hospital, Pekalongan Regency.

No.	Hb	MCV	MCH	MCHC	Type of Anemia
1.	6,9 g/dl	60.30 fL	17.60 Pg	29.10 %	Hypochromic Microcytic
2.	8.0 g/dl	83.10 fL	28.20 Pg	33.90 %	Normochromic Normocytic
3.	8.4 g/dl	66.90 fL	21.40 Pg	31.90 %	Hypochromic Microcytic
4.	9.0 g/dl	75.90 fL	25.80 Pg	34.00 %	Hypochromic Microcytic
5.	9.6 g/dl	83.90 fL	26.60 Pg	34.00 %	Hypochromic Microcytic
6.	8.9 g/dl	74.30 fL	23.80 Pg	32.00 %	Hypochromic Microcytic
7.	9.2 g/dl	66.10 fL	21.80 Pg	33.00 %	Hypochromic Microcytic
8.	9.6 g/dl	83.10 fL	29.50 Pg	35.60 %	Normochromic Normocytic
9.	9.1 g/dl	70.10 fL	22.90 Pg	32.60 %	Hypochromic Microcytic
10.	10.0 g/dl	74.50 fL	25.00 Pg	33.60 %	Hypochromic Microcytic
11.	9.7 g/dl	74.20 fL	25.00 Pg	33.70 %	Hypochromic Microcytic
12.	10.4 g/dl	78.10 fL	26.70 Pg	34.20 %	Hypochromic Microcytic
13.	10.4 g/dl	69.30 fL	22.00 Pg	31.80 %	Hypochromic Microcytic
14.	10.3 g/dl	94.30 fL	34.60 Pg	36.40 %	Normochromic Normocytic
15.	9.8 g/dl	83.80 fL	28.30 Pg	33.80 %	Normochromic Normocytic
16.	9.4 g/dl	83.90 fL	29.20 Pg	34.80 %	Normochromic Normocytic
17.	10.6 gdl	83.00 fL	28.60 Pg	34.50 %	Normochromic Normocytic
18.	10.3 g/dl	81.30 fL	29.20 Pg	35.90 %	Normochromic Normocytic
19.	10.6 g/dl	86.40 fL	28.70 Pg	33.20 %	Normochromic Normocytic
20.	10.7 g/dl	81.40 fL	27.60 Pg	33.90 %	Normochromic Normocytic
21.	10.9 g/dl	84.50 fL	29.10 Pg	34.40 %	Normochromic Normocytic
22.	10.5 g/dl	82.30 fL	28.20 Pg	34.20 %	Normochromic Normocytic
23.	10.3 g/dl	80.70 fL	27.60 Pg	34.20 %	Hypochromic Microcytic
24.	10.5 g/dl	77.30 fL	26.40 Pg	34.20 %	Hypochromic Microcytic
25.	7.3 g/dl	62.50 fL	19.30Ppg	30.80 %	Hypochromic Microcytic
26.	7.5 g/dl	58.20 fL	17.40 Pg	29.90 %	Hypochromic Microcytic
27.	8.3 g/dl	72.30 fL	23.20 Pg	32.00 %	Hypochromic Microcytic
28.	6.3 g/dl	66.60 fL	19.17 Pg	29.60 %	Hypochromic Microcytic
29.	10.3 g/dl	66.00 fL	22.70 Pg	32.40 %	Normochromic Normocytic

30.	5.2 g/dl	83.70 fL	29.20 Pg	34.90 %	Hypochromic Microcytic

TABLE 2. Percentage of Erythrocyte Index in Pregnant Women with Anemia

Type of Anemia	Number of samples	Percentage %
Hypochromic Microcytic	17	56,67%
Normochromic Normocytic	13	43,33%
Total	**30**	**100%**

Discussion

Based on Table 1, the results of erythrocyte index examinations in pregnant women with anemia at Kraton Regional General Hospital, Pekalongan Regency, showed that 17 samples had microcytic hypochromic anemia and 13 samples had normocytic normochromic anemia.

In Table 2, the results of the percentage of erythrocyte index examination in pregnant women with anemia at Kraton Regional General Hospital, Pekalongan Regency, showed that 17 samples (56.67%) had hypochromic microcytic anemia, where the red blood cells were smaller than normal and had lower hemoglobin levels than usual. Several factors causing microcytic hypochromic anemia in pregnant women include iron deficiency, thalassemia, anemia caused by chronic diseases, and sideroblastic anemia. Anemia caused by iron deficiency during pregnancy occurs due to a decrease in iron levels in the blood, caused by insufficient iron reserves, which ultimately reduces hemoglobin formation and disrupts the maturation process of red blood cells. Iron deficiency in pregnant women can cause various disorders and complications for both the mother and the fetus. (K. P. Suburwibowo., 2024). Thirteen samples (43.33%) were found to have normochromic normocytic anemia, which is characterized by red blood cells of normal size, shape, and color. The causes of normochromic normocytic anemia can be acute blood loss, hemolysis, chronic disease, infection, kidney disorders, and bone marrow failure. One type of normochromic normocytic anemia is aplastic anemia, which is caused by a disorder in the stem cells in the bone marrow, resulting in insufficient red blood cell production. (R. Yolanda et al., 2023).

The normal MCV erythrocyte index value ranges from 82 to 92 fl, indicating that red blood cell size is within normal limits (normocytic), meaning that red blood cell volume is normal. A low MCV value (<82 fl) indicates that the erythrocytes are small (microcytic) or have small cell anemia, which means that the erythrocyte volume is abnormal due to iron deficiency. A high MCV value (>92 fl) indicates that the red blood cell size exceeds the normal standard.

A normal MCH erythrocyte index value is between 27-31 pg, which indicates that the hemoglobin color in red blood cells is also normal or normocytic, signifying sufficient iron intake from food. A low MCH value (<27 pg) indicates that the hemoglobin color in erythrocytes is pale or hypochromic due to iron deficiency or low iron intake in foods such as vegetables and fruits. However, if the MCH value is low (<31 pg), this means that the hemoglobin color in red blood cells is increased or hyperchromic.

A normal MCHC erythrocyte index ranges from 32-37%, indicating that the hemoglobin concentration in erythrocytes is normal (normochromic). A low MCHC value (<32%) indicates a low hemoglobin concentration in erythrocytes (hypochromic). Conversely, a high MCHC value (>37%) indicates a higher than normal hemoglobin concentration in the blood (hyperchromic).

There are several factors that can cause anemia in pregnant women. Some of these include the mother's educational background, age, compliance with iron tablet consumption, interval between pregnancies, and the mother's nutritional status. These causes can lead to iron deficiency anemia or affect pregnancy outcomes, such as babies born with abnormal birth weight, premature birth, or miscarriage.

In this study, no cases of macrocytic anemia were found in the samples tested. This indicates that vitamin B12 or folic acid deficiency is not the main cause of anemia among pregnant women. This study is in line with the literature stating that anemia due to iron deficiency is the most common form of anemia experienced during pregnancy. This emphasizes the importance of early detection and the provision of appropriate iron supplements as part of antenatal care programs. (S. Jupri Arni., 2023).

Conclusion

Based on the results of erythrocyte index examinations in pregnant women with anemia at the Kraton District Hospital in Pekalongan Regency, it can be concluded that the results of erythrocyte index examinations in pregnant women showed that 17 patients (56.67%) had microcytic hypochromic anemia and 13 patients (43.33%) had normocytic normochromic anemia. These results indicate that the majority of pregnant women with anemia have microcytic hypochromic anemia, where the erythrocytes are smaller in size and paler in color.

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