

## Original Research Article

# The Erythrocyte Morphology of Pregnant Women with Undernutrition who Live in Archipelago Dry Land, Kupang City, East Indonesia

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**Abstract:** The prevalence of undernutrition of pregnant women remains high in Indonesia, and also deficiency of micronutrition such as iron, folic acid, or vitamin B which affected low level of hemoglobin. The insufficient hemoglobin levels in erythrocytes could disturb delivery oxygen needed to the tissues and fetus as well. The occurrence of anemia in pregnant women varies depending on diet, infections, lifestyle, environment, and socioeconomic factors. This study aims to describe the erythrocyte morphology of pregnant women in Kupang City, located in a dry island region. The research involved 24 pregnant women living in Kupang City, using a cross-sectional observational method. The results of erythrocyte morphology from peripheral blood smears showed that 12 subjects (50%) had microcytic hypochromic anemia and 1 subject (4.2%) had microcytic normochromic anemia. This indicates that, based on erythrocyte morphology, nutritional deficiencies and the possibility of chronic inflammation among pregnant women are still very high. Geographical background could be a predisposing factor for this anemia. Continuous education about adequate and balanced nutrition for pregnant women and further investigations to determine the etiology of inflammation are greatly needed.

**Keywords:** Anemia, Deficiency, Maternal, Erythrocyte Morphology.

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## INTRODUCTION

Malnutrition in pregnant women usually occurs due to multi-deficiency, where protein energy deficiency is generally accompanied by micronutrient deficiencies. Anemia always found in undernutrition maternal where erythrocytes are insufficient to meet the oxygen demands of tissues. Since this is difficult to measure directly, anemia is defined as a lower-than-normal concentration of hemoglobin (Hb), erythrocyte count, and hematocrit (Ht) [1].

According to the World Health Organization (WHO), anemia in pregnancy is diagnosed when hemoglobin (Hb) levels are <11 g/dL or hematocrit (Ht) levels are <33%. Postpartum anemia is diagnosed if Hb is <10 g/dL. The Centers for Disease Control and Prevention (CDC) define anemia as Hb <11 g/dL in the first and third trimesters, Hb <10.5 g/dL in the second trimester, and Hb <10 g/dL postpartum [2,3].

The 2018 Basic Health Research in Indonesia showed that the proportion of anemia in pregnant women was 48.9%. The most common type of anemia among pregnant women is microcytic hypochromic anemia,

usually caused by iron deficiency. According to WHO data, 36.5% of pregnant women worldwide experience anemia [4,5].

Several risk factors can lead to anemia during pregnancy and postpartum, including nutritional intake, gestational diabetes, multiple pregnancies, teenage pregnancies, inflammation, and infections during pregnancy [6-10].

In addition, anemia can also result from parasitic or bacterial infections (e.g., acute pyelonephritis), chronic viral infections (e.g., HIV), and chronic inflammatory diseases affecting the digestive system (e.g., Crohn's disease, ulcerative colitis).

## METHODS

The study design is descriptive cross-sectional, involving 24 pregnant women in Kupang City, which is located in a dry island region. The pregnant women were selected using a purposive sampling.

The inclusion criteria for pregnant women were those in their first or second trimester, willing to

participate as research subjects, and regularly attending antenatal care (ANC).

Examination of erythrocyte morphology was conducted by collecting venous blood samples from the

cubital vein, which were then stained using Giemsa staining.

## RESULTS AND DISCUSSION

### Characteristics of Pregnant Women

**Table 1: Characteristics of the subjects**

Characteristics	n	%
<b>Age</b>		
< 19 year	3	12,5
20-35 year	20	83,3
≥ 35 year	1	4,2
Average Age	25,8 years	
<b>Last Education</b>		
Primary school	2	8,3
Junior high school/ High school	19	79,2
Diploma/ Bachelor’s degree	3	12,5
<b>Occupation</b>		
Housewife	19	79,2
Private sector employee	3	12,5
Others*	2	8,3
<b>Parity</b>		
Primigravida	12	50
Multigravida	9	37,5
Grandmultigravida	3	12,5
<b>Average Mid-Upper Arm Circumference (MUAC)</b>	<b>21,1 cm</b>	
<b>Spacing of pregnancy</b>		
≥ 2 year	10	41,2
< 2 year	2	8,3
Primigravida	12	50
<b>Marital Status</b>		
Single	8	33,3
Married	16	66,7
<b>Husband's occupation</b>		
Employed	16	66,7
Not identified*	8	33,3
<b>Housing status</b>		
Own house	5	20,8
Rented/boarding house	9	37,5
Parents' house	9	37,5
Others*	1	4,2
<b>Total</b>	<b>24</b>	<b>100</b>

**Notes:** Not identified\* = Single/not married, Jobs (Others\*) = Student, Housing status (Others\*) = School Guard. The data were derived from an umbrella study titled Rikaka Biscuits as a Nutritional Supplement Formula for Pregnant Women at Sikumana Community Health Center, Kupang City.

The average age of the research subjects was 25.8 years, with 12.5% of subjects being under 19 years old and 4.2% being 35 years old or older. The teenager maternal has a high risk of deficiency of nutrition, because they are in the growth age. Otherwise, we assumed that pregnancy in teenagers is an unwanted pregnancy, so they try to hide their bulging stomachs by reducing their food intake.

The majority of the subjects' highest education level was junior high school or senior high school (or equivalent), and most of them were housewives. The

mother's education level is one of the factors that influences the mother's ability to receive health and nutrition education or health promoting from health workers.

Most subjects were in their first pregnancy (primigravida), although 12.5% of the research subjects were categorized as grand multigravida. The interval between pregnancies was ≥ 2 years for multigravida and grand multigravida mothers. The number of pregnancy and interval between pregnancy is the important for

mother to restore nutritional status/ nutrition pool in their body.

Among the research subjects, 33.3% were unmarried, meaning they did not have marital status, which could affect their access to health insurance and lack of sufficient support system in the family. However, for subjects with husbands, most of the husbands were already employed. Additionally, the majority of the

research subjects lived in rented or boarding houses. This condition could related to economic status, which related to their ability to access the food.

**Morphological Features Erythrocytes in Pregnant Women**

This study was conducted based on hematological examinations performed on 24 pregnant women in Kupang City.

**Tabel 2: Hemoglobin and Erythrocyte Indices in subjects (n=24)**

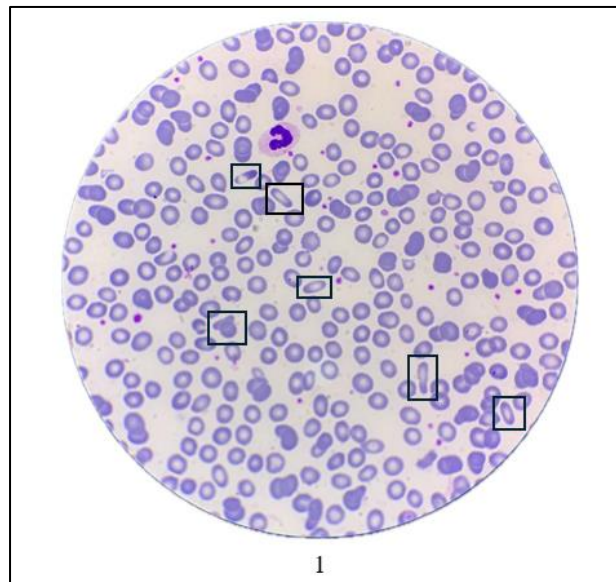
	n	%
<b>Hb</b>		
<b>Low</b>	9	37,5%
<b>Normal</b>	15	62,5%
<b>MCV</b>		
<b>Normocytic</b>	11	45,8%
<b>Microcytic</b>	13	54,2%
<b>Macrocytic</b>	-	-
<b>MCH</b>		
<b>Normochromic</b>	11	45,8%
<b>Hypochromic</b>	13	54,2%
<b>Hyperchromic</b>	-	-

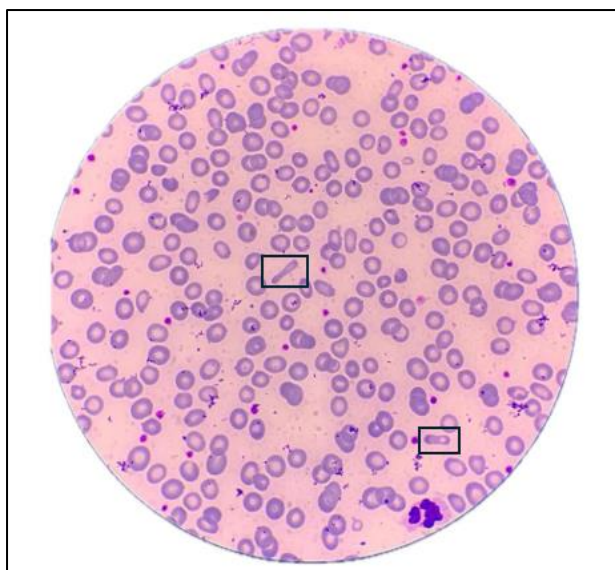
The data were derived from an umbrella study titled Rikaka Biscuits as a Nutritional Supplement Formula for Pregnant Women at Sikumana Community Health Center, Kupang City.

**Tabel 3: Erythrocyte morphology based on peripheral blood smear (n=24)**

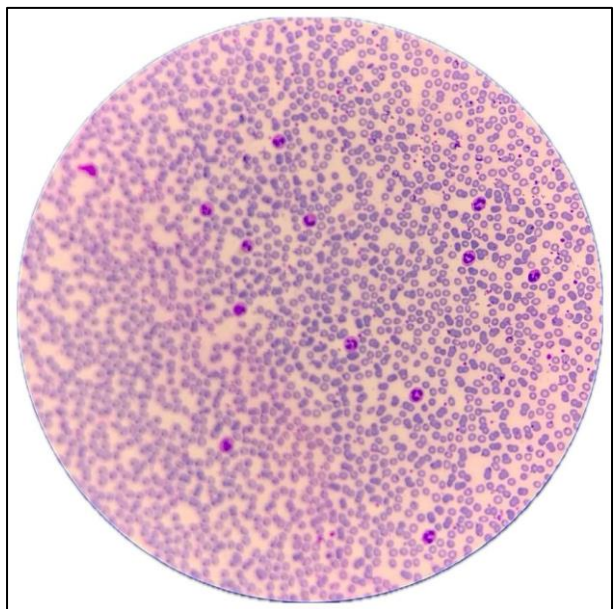
	n	%
Microcytic hypochromic	12	50%
Microcytic normochromic	1	4,2%
Normal	11	45,8%

The data were derived from an umbrella study titled Rikaka Biscuits as a Nutritional Supplement Formula for Pregnant Women at Sikumana Community Health Center, Kupang City.





2



3

Description: 1) Hypochromic erythrocyte appearance with cigar cells, 2) Hypochromic, microcytic erythrocyte appearance with several cigar cells, 3) Increased segmented neutrophils/granulocytes.

The data were derived from an umbrella study titled Rikaka Biscuits as a Nutritional Supplement Formula for Pregnant Women at Sikumana Community Health Center, Kupang City.

In Table 2, 37.5% of subjects were found to have anemia, 54.2% had microcytic morphology based on their MCV, and 54.2% had hypochromic morphology based on their MCH. Table 3 shows that 50% of subjects experienced microcytic hypochromic anemia, and 4.2% experienced microcytic normochromic anemia.

Anemia is caused by inhibited hematopoiesis mediated by cytokines and decreased iron release into erythrocytes from the reticuloendothelial system. certain bacteria (e.g., *Staphylococcus*) utilize iron for enzymatic reactions. Iron is derived not only from the destruction of transferrin but also from erythrocytes through the breakdown of heme molecules [11,12].

Signs and symptoms of iron deficiency anemia in pregnant women are similar to general anemia symptoms, which are due to decreased oxygen delivery to tissues. In early stages, patients may experience low tolerance for physical activity, shortness of breath during mild exertion, and fatigue. In more severe anemia, clinical signs and symptoms become more apparent, including reduced performance and endurance, apathy, restlessness, cognitive and concentration difficulties, shortness of breath, palpitations, dizziness, orthostatic hypotension, pallor, and systolic murmur at the mitral valve. The severity of symptoms also correlates with existing comorbidities, such as heart or lung disorders, where manifestations become more pronounced. Anemia

symptoms can be classified as acute or chronic. Acute anemia causes sudden shortness of breath, dizziness, and fatigue. In contrast, chronic anemia, such as iron deficiency, develops gradually and often goes unnoticed until erythrocyte levels are severely low [13,14].

In certain diseases like anemia, erythrocytes may exhibit abnormal shapes, sizes, or colors. To identify these abnormalities, blood smears should be observed in areas near the thin edges, where erythrocytes are spread closely together without overlapping [15].

Based on Hb levels, MCV, MCH, and red blood cell morphology, it can be concluded that the anemia in these subjects is chronic iron deficiency anemia. Tables 2 and 3 indicate that some pregnant women with iron deficiency still have normal Hb levels.

This suggests that the degree of deficiency in the first and second trimesters of pregnancy can vary, despite government programs requiring pregnant women to take iron supplementation tablets. Deficiencies and disruptions in Hb production among pregnant women may be caused by imbalanced nutritional intake, as evidenced by the average mid-upper arm circumference of the subjects being 21.1 cm (Table 1). Micronutrient sufficiency must be preceded by adequate and balanced macronutrient intake. Thus, providing iron tablets without meeting adequate energy and protein needs cannot correct the anemia status of pregnant women [16].

Dietary patterns also influence anemia in pregnant women. Pregnant women require higher amounts of iron to increase red blood cell production and to form the fetus and placenta, making them more susceptible to anemia. Therefore, pregnant women need a balanced diet to meet the needs of both mother and fetus [17,18].

Nutritional deficiencies, whether macronutrient or micronutrient, are influenced by the adequacy and balance of nutrient intake, which in turn is affected by access to diverse food sources. Access to food depends on the availability of food in the vicinity of the pregnant woman.

Kupang City, located in a dry island region with minimal rainfall (effective for only three months), makes it difficult for food crops to grow, especially due to the rocky and coral island characteristics. Based on its geographical location, Kupang City is part of an archipelago surrounded by the sea, offering great potential for marine food resources. However, this potential has not yet been maximally utilized by the community. Therefore, frequent nutritional education is necessary, both at the community and personal levels [16,19].

## CONCLUSION

Based on the results and discussion, it can be concluded that 9 subjects (37.5%) had low hemoglobin levels, 13 subjects (54.2%) showed microcytic characteristics, and 13 subjects (54.2%) exhibited hypochromic characteristics.

Therefore, it is important for pregnant women to regularly check their hemoglobin levels and erythrocyte indices, as well as maintain a balanced diet to ensure the well-being of both the mother and the fetus. Increasing a nutrition and health promoting for pregnant woman to eat more sea food as protein and micronutrient sources, specially in dry seasons.

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