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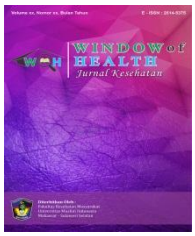

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Differences in Nutritional Intake and Upper Arm Circumference (UAC) Between Anemic and Normal Pregnant Women

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ABSTRACT

Anemia is an indirect cause of maternal mortality, with a 27.7% prevalence among pregnant women in Indonesia, including rising cases in Riau and Kampar. It increases the risk of hemorrhage, low birth weight, preterm birth, stunting, and maternal and infant mortality, influenced by inadequate nutrition and low mid-upper arm circumference. The purpose of this study was to analyze the differences in nutritional intake and upper arm circumference (UAC) between pregnant women with anemia and pregnant women without anemia. The method in this research is a comparative, observational, analytical study of two unpaired groups with a cross-sectional design. The population consisted of pregnant women with anemia and normal pregnant women in the working area of the Salo Community Health Center, Kampar District, totaling 74 samples (37 per group). The study was conducted in August-September 2025. The data collection tools used were a UAC tape, an SQ-FFQ for nutritional intake, and a digital hemoglobinometer to measure anemia. Bivariate analysis was performed using an independent samples t-test. The results show that pregnant women with anemia had lower nutritional intake scores and smaller mean UAC compared to non-anemic pregnant women. Statistical analysis confirmed significant differences between the two groups in nutritional intake ($p = 0.012$) and UAC ($p = 0.028$), with both p-values below the significance level of α 0.05. Pregnant women with anemia have lower nutritional intake and UAC, highlighting the need to improve maternal nutrition and use UAC monitoring for early anemia screening.

Keywords: Nutritional Intake; UAC; Anemia; Pregnant Women

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INTRODUCTION

Maternal anemia remains a major global public health problem and a significant contributor to maternal and perinatal morbidity and mortality. The World Health Organization (WHO) estimates that more than 700 women die every day from preventable causes related to pregnancy and childbirth, with the majority occurring in low- and middle-income countries. Anemia during pregnancy increases the risk of maternal complications such as hemorrhage, as well as adverse birth outcomes, including low birth weight, preterm birth, and perinatal mortality. Therefore, addressing maternal anemia is essential to achieving the Sustainable Development Goals (SDGs), particularly in reducing maternal and child mortality (1).

Causes of maternal mortality are classified into direct obstetric and indirect (non-obstetric) causes. Direct causes, such as hemorrhage, hypertensive disorders, and sepsis, are directly related to pregnancy and childbirth. In contrast, indirect causes, including anemia and HIV infection, are increasingly contributing to maternal mortality (2). Anemia remains a persistent global public health problem, with many countries still failing to meet reduction targets. The WHO reports that approximately 35.5% of pregnant women worldwide are affected by anemia, which negatively impacts both maternal and fetal health (3).

At the national level, anemia among pregnant women remains a significant public health concern in Indonesia and reflects the ongoing global burden of the condition. Following this trend, the prevalence of anemia in pregnant women reached 27.7% based on the 2023 Indonesian Health Survey (SKI), indicating that nearly one in three pregnant women is affected. This high prevalence underscores that anemia is not only a widespread issue but also closely linked to inadequate nutritional intake, particularly iron and other essential nutrients during pregnancy. As a result, maternal anemia increases the risk of adverse outcomes, including complications during pregnancy and poor birth outcomes (4).

The incidence of anemia among pregnant women in Riau Province showed a fluctuating trend, increasing in 2020 (45%), decreasing in 2021 (15%), and rising again in 2022 (35%) (5). At the district level, anemia cases in Kampar decreased from 755 (3.9%) in 2022 to 591 (3.0%) in 2023, then increased slightly to 617 (3.4%) in 2024. Meanwhile, in the Salo Community Health Center working area, cases increased consistently from 33 cases in 2022 to 35 cases in 2023 and 38 cases in 2024 (6)(7). These patterns suggest that although there are fluctuations at the provincial level, anemia among pregnant women remains persistent at the local level, indicating ongoing challenges in maternal nutrition and anemia prevention efforts.

Anemia has both short-term and long-term effects on maternal and child health. In the short term, it reduces productivity, physical fitness, and endurance, while in the long term, it increases the risk of childbirth hemorrhage, low birth weight, and preterm birth, which may contribute to stunting, maternal mortality (MMR), and infant mortality (IMR) (8). These adverse outcomes are closely linked to inadequate nutritional intake, particularly iron and essential nutrients, which contribute to

poor maternal nutritional status and are reflected in low upper arm circumference (UAC). Low UAC indicates chronic energy deficiency, which increases susceptibility to anemia and its complications during pregnancy. Therefore, improving nutritional intake and routinely monitoring UAC are critical strategies for early identification and prevention of anemia and its associated risks (9).

Previous studies have shown that various factors influence the incidence of anemia in pregnant women. Nutritional status, parity, and socioeconomic status were not significantly associated, whereas adherence to iron tablet use and maternal age were significantly associated. Further analysis indicated that adherence to iron tablet consumption was the most dominant factor in anemia incidence (10), highlighting the importance of behavioral and nutritional aspects in preventing anemia during pregnancy.

A study among pregnant women in Morocco reported that of 849 respondents, 690 (82%) underwent blood testing, and 117 (16.8%) were identified with anemia. In terms of severity, most cases were mild (57.6%), followed by moderate (41.5%), and severe anemia (0.8%). Regarding risk factors, pregnant women aged over 35 years were at significantly higher risk of anemia compared to younger women ($p < 0.001$). In addition, a history of anemia outside pregnancy and in previous pregnancies was also significantly associated with anemia in the current pregnancy ($p < 0.001$) (11).

Risk factors for anemia in pregnant women include nutritional intake, bleeding during pregnancy, and thalassemia (8). Several other contributing factors include parity, age, level of knowledge, economic status, education level, and adherence to iron supplementation (12). However, most previous studies have focused on these factors separately, with limited attention to the combined role of nutritional intake and UAC as indicators of maternal nutritional status in relation to anemia. Therefore, this study examines differences in nutritional intake and UAC between pregnant women with anemia and those without.

Malnutrition and inadequate attention to nutritional needs during pregnancy are key predisposing factors for anemia among pregnant women in Indonesia. Conditions such as chronic energy deficiency (CED) reflect poor maternal nutritional status, which can be assessed using upper arm circumference (UAC). A UAC of <23.5 cm indicates undernutrition and is associated with an increased risk of anemia, as it reflects insufficient energy and nutrient reserves needed to support hemoglobin production during pregnancy (12).

Nutritional deficiencies, particularly iron, folic acid, vitamin B12, and protein, can inhibit hemoglobin formation and increase the risk of anemia (8). In Indonesia, the dietary patterns of pregnant women are still often inadequate, especially due to low intake of iron-rich foods, which contributes to iron deficiency anemia. Dietary habits during pregnancy play an important role in determining maternal and fetal nutritional status. However, poor practices—such as low meal frequency, limited dietary diversity, and consumption of tea or coffee during meals—can reduce nutrient absorption. In addition, some pregnant women intentionally restrict food intake due to cultural beliefs or fear of delivering large babies, which can lead to deficiencies in essential nutrients

and increase the risk of anemia, preterm birth, low birth weight, and maternal and fetal mortality (13).

A study among 311 pregnant women reported that 17.7% were anemic, with more than half of the cases attributed to iron deficiency. Several dietary-related factors were significantly associated with anemia, including the habit of consuming tea or coffee after meals, low dietary diversity, and low (UAC, all of which increased the risk of anemia (14). Supporting evidence from research in Sudan demonstrates that UAC is strongly correlated with body mass index (BMI) and can serve as a reliable and practical indicator of maternal nutritional status during pregnancy. Given that anemia in pregnancy is closely linked to chronic undernutrition and inadequate nutrient intake, UAC measurement provides a simple and effective approach for early identification of pregnant women at risk of anemia, particularly in resource-limited settings (15).

Anemia is closely associated with chronic energy deficiency in pregnant women. Studies show that pregnant women with anemia are more likely to experience chronic energy deficiency compared to those without anemia. Statistical analysis indicates a significant association between the two conditions ($p < \alpha$), with a higher risk of chronic energy deficiency among anemic mothers (16).

A preliminary survey of 20 pregnant women in the Salo Community Health Center working area in 2025 found that 40% were anemic, 35% had a UAC <23 cm, and 45% had the habit of consuming tea or coffee close to mealtimes, which may inhibit iron absorption. These findings indicate that anemia remains a significant problem and is closely related to nutritional factors and maternal characteristics. However, previous studies have generally examined risk factors separately, with limited focus on the combined role of nutritional intake and UAC in anemia among pregnant women. This study aims to fill this gap by analyzing the differences in nutritional intake and UAC between anemic and non-anemic pregnant women.

METHOD

This study employed a comparative, observational, analytical design with two unpaired groups, using a cross-sectional approach. The study was conducted in the working area of the Salo Community Health Center, Kampar District, Riau Province, Indonesia, from August to September 2025. In this study, the dependent variable was anemia status, defined as low hemoglobin, with pregnant women classified as anemic if Hb < 11 g/dL and non-anemic if Hb ≥ 11 g/dL, measured with a digital hemoglobinometer. The main independent variables included nutritional intake, defined as the quality and quantity of macro- and micronutrient consumption, assessed using a scoring system based on the frequency and diversity of intake through a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), and UAC, an indicator of chronic nutritional status measured at the midpoint of the upper arm using a standardized measuring tape, with UAC < 23.5 cm indicating risk of chronic energy deficiency.

The population consisted of all pregnant women with anemia and those without anemia

in the study area. Samples were selected using a purposive sampling technique based on inclusion criteria: pregnant women willing to participate, residing in the study area, and having complete antenatal records. Exclusion criteria included pregnant women with chronic diseases or conditions affecting hemoglobin levels (e.g., thalassemia or acute infection). The sample size was determined using G*Power with 80% power ($1 - \beta = 0.80$), based on a previous study (OR = 11.3), yielding 36 subjects per group for a total of 72 participants. The SQ-FFQ instrument had been tested for validity and reliability in a similar population involving 30 respondents. Validity testing using Pearson correlation showed r-values ranging from 0.361 to 0.782, all exceeding the r-table value (0.361) at a 5% significance level, indicating that all items were valid. Reliability testing yielded a Cronbach's alpha of 0.82 (>0.70), indicating good internal consistency and confirming the instrument's reliability. To minimize confounding bias, variables such as maternal age, parity, socioeconomic status, education level, and adherence to iron supplementation were controlled in the analysis. Prior to bivariate analysis, the Shapiro–Wilk test indicated that the data were normally distributed ($p > 0.05$).

Therefore, bivariate analysis was conducted using an independent t-test to assess differences in nutritional intake and UAC between groups (14). This study was conducted in accordance with ethical standards and received approval under the number 090/LPPM/UPTT/VII/2025.

RESULTS

Table 1 Frequency Distribution of Age, Education, Occupation, Gestational Age, and Parity of Pregnant Women at Salo Community Health Center, Kampar District

Characteristics	Frequency	Percentage (%)
Age		
<20 th	15	20.2
20-35 th	36	48.7
> 35 th	23	31.1
Education		
Junior High School	14	18.9
High School	40	54.1
College	20	27
Occupation		
Working	27	38
Not Working	47	62
UAC		
< 23,5 cm	38	51.4
> 23,5 cm	36	48.6
Parity		
Primiparous	24	32.4
Multiparous	50	67.6
Total	74	100

Based on Table 1, it can be seen that of the 74 pregnant women aged 20-35 years, 36 respondents (48.7%) 40 (54.1%) had a high school education, 40 respondents (54.1%) were

unemployed, 38 respondents (51.4%) had a UAC < 23.5 cm, and 50 respondents (67.6%) had multiparous parity.

Table 2 Differences in Nutritional Intake and UAC Between Anemic Pregnant Women and Normal Pregnant Women at the Salo Community Health Center, Kampar District

Variable	Group				P Value
	Anemic Pregnant Women		Normal Pregnant Women		
	n	Mean ± (SD)	n	Mean ± (SD)	
Nutritional Intake	37	189.38±21.46	37	203.19±24.48	0.012
UAC	37	23.16±9.28	37	29.54±5.42	0.028

Table 2 shows that pregnant women with anemia have lower mean nutritional intake scores and lower UAC compared to those with normal status. This difference is statistically significant.

DISCUSSION

Nutritional Intake Differences Between Anemic Pregnant Women and Normal Pregnant Women at the Salo Community Health Center in Kampar District.

The results showed that the mean nutritional intake score in pregnant women with anemia was lower than in normal pregnant women, indicating significantly poorer intake. Specifically, intake of macronutrients (energy and protein) and micronutrients (iron, folic acid, vitamin B12, and vitamin C) was quantitatively lower in the anemia group, which may contribute to impaired hemoglobin synthesis and increased risk of anemia.

This study is in line with the findings of Indrawati et al., which show a significant relationship between food nutritional content and the incidence of anemia in pregnant women (p = 0.032) (17). Synthesizing these results, pregnant women with anemia consistently have lower-quality nutritional intake compared to those with normal status. Quantitatively, inadequate intake of key nutrients, particularly iron, vitamin A, and protein, is associated with decreased hemoglobin levels. Overall, both studies reinforce that balanced nutritional intake during pregnancy plays a critical role in reducing the risk of anemia and supports the development of targeted nutritional interventions.

Research results (18) show a significant association between nutritional status and anemia incidence in pregnant women (p = 0.001). The prevalence of anemia was substantially higher among mothers with poor nutritional status (80%) than among those with adequate nutritional status (31.9%), a difference of nearly 48 percentage points. Furthermore, the OR value of 8.53 suggests that pregnant women with poor nutritional status have more than eightfold higher odds

of developing anemia than those with adequate nutritional status. This strong magnitude of association highlights that nutritional status is a key determinant of anemia, likely mediated through inadequate intake of essential macro- and micronutrients required for optimal hemoglobin synthesis.

Based on this study's findings, which demonstrate a strong association between poor nutritional status and an increased risk of anemia, interventions should prioritize improving maternal nutritional intake. Specifically, the higher prevalence and odds of anemia among women with inadequate nutritional status indicate the need for targeted dietary strategies focusing on adequate intake of iron, folate, vitamin B12, vitamin A, and protein. These results suggest that improving both the quality and quantity of nutrient intake is essential to support optimal hemoglobin synthesis. In addition, for pregnant women identified with poor nutritional status, supplementation may be required to address specific deficiencies and reduce the risk of anemia (19).

A study conducted on Unguja Island, Tanzania, found that regular iron tablet consumption during pregnancy, adequate birth spacing, and having a number of children compatible with parental caregiving capacity can potentially reduce the incidence of anemia in pregnant women (20). These findings support the results of our study, where poor nutritional status was associated with an increased risk of anemia. In other words, in addition to improving nutrient intake, anemia prevention strategies should also consider reproductive factors and adherence to iron supplementation, as both can influence hemoglobin levels in pregnant women.

A study in Tanta showed a significant increase in mean hemoglobin levels among pregnant women, from 9.05 ± 0.98 g/dL before the program to 11.8 ± 0.95 g/dL in the second trimester and 10.74 ± 0.93 g/dL in the third trimester, reflecting improved nutritional intake (21). The program enhanced nutritional knowledge and eating habits, particularly in selecting iron-, protein-, and vitamin-rich foods that support iron absorption, which reduced anemia incidence. These improvements in nutrient intake contributed to better hemoglobin levels and improved maternal and neonatal outcomes. The findings highlight the importance of nutrition-based antenatal education, early and regular antenatal care, and routine anemia screening to ensure effective management of iron deficiency anemia and optimize pregnancy outcomes.

According to the American College of Obstetricians & Gynecologists (18), maintaining a balanced, nutritious diet during pregnancy is essential to meet the increased nutritional demands of both the mother and the fetus. Adequate nutrition supports healthy maternal adaptation and fetal growth and helps prevent complications such as anemia. In conclusion, promoting balanced nutrition and healthy dietary patterns during pregnancy is crucial for preventing and reducing anemia. Strategies include nutrition education, iron supplementation, and increased consumption of iron-rich foods, with enhanced absorption supported by vitamin C intake.

Differences in UAC Between Anemic Pregnant Women and Normal Pregnant Women at the Salo Community Health Center in Kampar District.

The results of this study show that the mean UAC of pregnant women with anemia is significantly lower than that of women without anemia at the Salo Health Center in Kampar District. UAC is an anthropometric indicator of chronic nutritional status and body energy reserves, including muscle and fat mass. A UAC below 23.5 cm is commonly used to identify pregnant women at risk of Chronic Energy Deficiency (CED). Low UAC reflects inadequate energy and protein intake, which can impair hemoglobin synthesis due to insufficient nutrients such as protein, iron, folic acid, and vitamin B12.

Based on the results of research by Lestari et al, it is known that 21.28% of pregnant women in their third trimester are at risk of CED. This risk is indicated by a UAC measurement of < 23.5 cm, which reflects poor nutritional status in pregnant women. In addition, the analysis shows a significant association between UAC and anemia in pregnant women in their third trimester. This indicates that pregnant women with low UAC are not only at risk of CEM, but also more susceptible to anemia due to a lack of macro and micro nutrients needed for hemoglobin formation(22). Previous studies report a high prevalence of anemia among women of reproductive age, around 22–23% (23), highlighting that anemia is a significant nutritional problem beyond pregnancy.

The results showed that 44% of pregnant women with anemia were in the lowest food diversity category, indicating inadequate nutrient intake, whereas women with normal nutritional status were more often in the moderate (31%) or high (24%) food diversity categories. Body weight was significantly associated with a 0.08 cm increase in UAC (95% CI: 0.74–0.93), with a stronger effect observed in women without anemia. Although marital status and maternal age were initially associated with UAC increases in univariate analysis (95% CI: 0.83–0.93), these relationships were no longer significant after adjusting for confounders (95% CI: 0.81–1.00). Consumption of organ meats, a source of heme iron, was linked to a UAC increase of 0.21 cm (95% CI: 0.04–0.97), primarily in women without anemia. These findings indicate that dietary patterns, particularly iron-rich foods, contribute to differences in nutritional status and anemia prevalence among pregnant women (19).

The results (25) of the study show a very strong correlation between UAC and body mass index (BMI) in pregnant women up to 30 weeks of gestation (r = 0.92), confirming that UAC reflects the general nutritional status of pregnant women. In the context of pregnancy anemia, these findings indicate that pregnant women with low BMI, as reflected by MUAC values below the normal limit (22.8 cm), have a higher risk of nutritional deficiencies that contribute to anemia, while higher UAC values reflect better nutritional status. Therefore, UAC measurement can be used as an early screening indicator of anemia risk in pregnant women, especially in resource-

limited areas, as this method is simpler and more practical than BMI measurement, yet still capable of providing an overview of nutritional status associated with anemia during pregnancy.

Energy and protein supplementation have been shown to improve nutritional status and hemoglobin levels, particularly in pregnant women with anemia, highlighting the importance of targeted dietary interventions to reduce anemia risk and support overall maternal nutrition (26). This is consistent with findings from a study of 426 pregnant women in Ethiopia (142 anaemic cases and 284 controls), which reported that women with anemia were significantly more likely to have UAC < 23 cm (AOR = 3.83; 95% CI: 2.26–6.49), consume tea or coffee immediately after meals (AOR = 2.35; 95% CI: 1.39–3.99), restrict foods (AOR = 2.21; 95% CI: 1.24–3.88), not consume supplements (AOR = 1.99; 95% CI: 1.17–3.40), rarely eat fruit (AOR = 4.05; 95% CI: 1.30–15.47), have decreased appetite (AOR = 2.28; 95% CI: 1.28–4.09), and exhibit low or moderate dietary diversity scores (AOR = 3.29; 95% CI: 1.83–5.90; AOR = 2.88; 95% CI: 1.46–5.70) compared to non-anaemic women (27). Together, these findings confirm that both improving energy and protein intake through supplementation and promoting diverse, nutrient-rich diets are critical strategies to enhance nutritional status, increase hemoglobin levels, and reduce the risk of anemia in pregnant women.

Related research findings indicate that the prevalence of low UAC (< 23 cm) among pregnant women was 41%, with a significantly higher risk observed among anemic pregnant women compared to non-anemic pregnant women. After controlling for location and clustering, altitude-adjusted anemia emerged as the main nutrition-specific factor associated with an increased risk of low UAC (OR = 1.28; CI = 1.09–1.49; $p < 0.01$), indicating that anemic pregnant women are more vulnerable to chronic undernutrition. In contrast, non-anemic pregnant women were more commonly found in groups with better socioeconomic status and higher levels of literacy and numeracy, which acted as protective factors against low UAC. These findings underscore that poor maternal nutritional status, as reflected by low UAC, is closely linked to anemia, inadequate dietary intake, and social and environmental factors, highlighting the need for a multisectoral approach to improve maternal nutritional status and health outcomes during the first 1,000 days of life (28).

Monitoring UAC is important not only during pregnancy but also before conception to detect early risks of chronic energy deficiency and anemia. Improving the nutritional status of women of reproductive age through a balanced diet, adequate iron and protein intake, and ongoing nutrition education is a strategic approach to reducing anemia prevalence among both pregnant and non-pregnant women.

CONCLUSIONS AND RECOMMENDATIONS

The mean nutritional intake score of pregnant women with anemia was significantly lower than that of women without anemia, reflecting poorer dietary quality. Similarly, the mean UAC was lower in anemic women, with both differences reaching statistical significance ($p = 0.012$ and 0.028, $< \alpha$ 0.05).

These findings highlight the importance of integrating targeted nutrition education and dietary counseling into routine antenatal care to improve maternal nutritional status. Additionally, routine UAC screening for all women of reproductive age is recommended to enable early detection of nutritional deficiencies. Incorporating nutrition-sensitive interventions into existing maternal health programs can further strengthen efforts to prevent malnutrition, reduce anemia prevalence, and improve pregnancy outcomes.

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