ISSN XXXX-XXXX (Online) | XXXX-XXXX (Print) | Vol. 4, No. 3, July (2026), pp.125-133

Published by: IARN Institute

International Journal of Nursing and Midwifery Research

Journal homepage: https://journals.iarn.or.id/index.php/ners/index

The relationship between preconception nutritional status and the incidence of anemia among pregnant women at the Jambesari Community Health Center

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Article Info

Article history:

Received Jul 1, 2026
Revised Jul 8, 2026
Accepted Jul 15, 2026

Keywords:

Anemia;
CED;
Preconception Nutritional Status;
Pregnant women.

ABSTRACT

The prevalence of anemia among pregnant women in Indonesia remains high, reaching 51.9% in 2024. In Bondowoso Regency and the service area of the Jambesari Community Health Center, the prevalence of anemia is also relatively high, at 47.8% and 45.1%, respectively. One factor suspected to contribute to this condition is poor preconception nutritional status. To determine the association between preconception nutritional status and the incidence of anemia among pregnant women in the service area of the Jambesari Community Health Center, Bondowoso Regency. A quantitative analytical study using a cross-sectional design. A sample of 104 pregnant women in their second and third trimesters was selected using simple random sampling. Data were obtained from medical records and the Maternal and Child Health registry, then analyzed using the chi-square test (0.05). Results: A total of 55.8% respondents had CED, while 44.2% respondents did not have CED. The majority of respondents did not have anemia 55.8%, while 33.7% had mild anemia and 10.6% had moderate anemia. The results of the chi-square test indicate that there is a significant association between preconception nutritional status and the incidence of anemia in pregnant women. Pregnant women with CED nutritional status are at higher risk of developing anemia than those without CED. Continuous efforts to improve preconception nutritional status through education and early detection are essential to prevent maternal anemia. These findings provide evidence for strengthening preconception nutritional screening and counseling at primary health care centers as part of maternal health services to improve pregnancy outcomes.

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1. INTRODUCTION

Anemia during pregnancy remains one of the major public health problems worldwide because it contributes significantly to maternal and neonatal morbidity and mortality. The World Health Organization (WHO) defines anemia in pregnancy as a hemoglobin concentration below 11 g/dL during the first and third trimesters or below 10.5 g/dL during the second trimester. Physiologically, pregnancy increases maternal nutritional requirements, particularly iron and folic acid, to support fetal growth and expansion of maternal blood volume. Inadequate nutritional intake and insufficient

iron reserves before pregnancy increase the risk of anemia, which may lead to postpartum hemorrhage, preterm birth, low birth weight, intrauterine growth restriction, and even maternal death (Indonesia, 2022; World Health Organization, 2023).

Despite various prevention programs, anemia among pregnant women continues to be highly prevalent. The World Health Organization reported that approximately 40% of pregnant women worldwide suffer from anemia (World Health Organization, 2023). According to the 2023 Indonesian Health Survey (Survei Kesehatan Indonesia [SKI]), the prevalence of anemia among pregnant women in Indonesia was reported to be 27.7%. This prevalence exceeds the threshold established by the World Health Organization (WHO), which considers an anemia prevalence of 20% or higher (≥20%) to constitute a public health problem (Kementerian Kesehatan Republik Indonesia, 2024). A similar situation is observed in East Java Province, where the prevalence of maternal anemia reached 46.3%, while Bondowoso Regency reported a prevalence of 47.8%. More specifically, maternal health records from Puskesmas Jambesari indicated that 141 out of 312 pregnant women (45.1%) experienced anemia in 2024, highlighting that maternal anemia remains a substantial health concern requiring effective preventive strategies.

Maternal anemia is a multifactorial condition influenced by biological, nutritional, socioeconomic, and behavioral factors. Previous studies have identified maternal age, parity, birth spacing, educational level, iron supplementation compliance, infectious diseases, and nutritional status as important determinants of anemia during pregnancy. Among these factors, preconception nutritional status has received increasing attention because adequate nutritional reserves before conception determine maternal physiological adaptation during pregnancy. Women entering pregnancy with chronic energy deficiency (CED) or poor nutritional status generally have lower iron stores, making them more susceptible to developing anemia during gestation (Putra, A. S., & Sulastri, 2024; Tanziha, I., Damanik, M. R. M., Utama, L. J., & Rosmiati, 2016). Therefore, nutritional status before conception plays an essential role in determining maternal health outcomes throughout pregnancy.

Several previous studies have demonstrated a significant relationship between maternal nutritional status and anemia among pregnant women. According (Ariendha, D. R., Setyawati, I., Utami, K., & Hardaniyati, 2022; Bria, G. E., & Rohmah, 2023; Fatkhiyah, N., Salamah, U., Indrastuti, A., & Nurfiati, 2022) consistently reported that mothers with poor nutritional status were more likely to experience anemia during pregnancy. However, most of these studies assessed nutritional status during pregnancy or combined it with other risk factors such as maternal age, parity, knowledge, and adherence to iron tablet consumption. Consequently, evidence regarding the association between preconception nutritional status and maternal anemia remains relatively limited, particularly at the primary healthcare level.

Strengthening nutritional interventions during the preconception period has become a strategic priority in maternal health programs. The Indonesian Ministry of Health recommends nutritional screening before pregnancy through Body Mass Index (BMI) assessment and Mid-Upper Arm Circumference (MUAC) measurement to identify women at risk of chronic energy deficiency (CED). Likewise, WHO emphasizes that preconception care, including nutritional assessment, iron and folic acid supplementation, and nutrition counseling, is fundamental for preventing anemia and improving pregnancy outcomes (World Health Organization, 2023). Nevertheless, implementation of these interventions is often constrained by limited preconception screening, inadequate nutritional knowledge, and suboptimal utilization of reproductive health services. Consequently, scientific evidence is needed to strengthen preventive programs based on maternal nutritional conditions before pregnancy.

Based on the existing literature, a significant research gap remains regarding the role of preconception nutritional status as an early determinant of maternal anemia, particularly in primary health care settings with a high burden of anemia. Previous studies have predominantly examined maternal nutritional status during pregnancy or focused on anemia management after conception,

while limited evidence has explored whether nutritional status before pregnancy influences the development of anemia during pregnancy. Furthermore, studies evaluating this association at the primary health care level in high-prevalence areas, such as the Jambesari Community Health Center, are still scarce. Therefore, this study specifically assesses preconception nutritional status using pre-pregnancy nutritional indicators to provide evidence supporting the integration of preconception nutritional screening into routine maternal health services as an early strategy for preventing anemia during pregnancy.

Research on the relationship between preconception nutritional status and the incidence of anemia in pregnant women is expected to contribute to the development of anemia prevention programs that begin during the preconception period. The results of this study can serve as a scientific basis for strengthening nutritional status screening of women of childbearing age through LILA and BMI measurements, improving nutrition education and preconception counseling, and optimizing the administration of iron and folic acid supplements before pregnancy. Thus, efforts to prevent anemia will not only focus on the pregnancy period but will also begin before conception, thereby more effectively reducing the risk of anemia and various pregnancy complications.

Therefore, this study aims to analyze the relationship between preconception nutritional status and the incidence of anemia among pregnant women in the working area of Puskesmas Jambesari. The findings are expected to contribute to the development of evidence-based maternal nutrition programs by strengthening preconception care, nutritional counseling, and early screening strategies for anemia prevention at the primary healthcare level.

2. RESEARCH METHOD

This study employed a quantitative analytical research design using a cross-sectional approach, in which the independent and dependent variables were measured simultaneously to determine the relationship between variables (Setia, 2016). The study was conducted at the Jambesari Primary Health Center (Puskesmas Jambesari), Bondowoso Regency, Indonesia, from January to February 2026 using secondary data obtained from medical records and Maternal and Child Health (MCH) registers of pregnant women recorded between October and December 2025.

The study population consisted of all second- and third-trimester pregnant women who attended antenatal care services at Puskesmas Jambesari during the study period, totaling 140 individuals. The sample size was calculated using the Slovin formula with a 5% margin of error to obtain a sample that is representative of the population, so that the research results are expected to have a high degree of accuracy and be able to describe the characteristics of the population with an acceptable margin of error. Based on these calculations, the sample size was determined to be 104 respondents. Participants were selected through simple random sampling, providing each eligible individual with an equal probability of being included in the study (Sugiyono, 2021). The inclusion criteria were pregnant women in the second or third trimester with complete records of preconception nutritional status and hemoglobin levels documented in medical records or MCH registers. Pregnant women with chronic diseases, such as thalassemia, tuberculosis, or HIV infection, as well as incomplete medical records, were excluded from the study.

The independent variable was preconception nutritional status, assessed using Mid-Upper Arm Circumference (MUAC) measurements recorded before pregnancy in the medical records or Maternal and Child Health (MCH) registers. MUAC was measured at the midpoint between the acromion and olecranon processes of the non-dominant upper arm using a non-stretch measuring tape as part of routine preconception health services. Based on the Indonesian Ministry of Health guidelines, participants with a MUAC of <23.5 cm were classified as having chronic energy deficiency (CED), whereas those with a MUAC of ≥23.5 cm were classified as having normal nutritional status. The dependent variable was the incidence of anemia during pregnancy, determined from hemoglobin (Hb) levels recorded in the medical records according to the World Health Organization criteria and classified as non-anemia, mild anemia, moderate anemia, or severe anemia.

Secondary data were collected through document review of medical records, MCH registers, maternal health reports, and the primary healthcare information system. Data collection was performed using a structured data extraction form to ensure consistency and completeness of the recorded information.

The research procedure consisted of the following sequential steps: (1) obtaining ethical approval and institutional permission; (2) identifying the study population from medical records and MCH registers; (3) selecting eligible participants using simple random sampling; (4) extracting data on preconception nutritional status and hemoglobin levels from the selected records; (5) verifying and validating data completeness and accuracy; (6) entering and analyzing the data using IBM SPSS Statistics; and (7) interpreting the findings to determine the relationship between preconception nutritional status and anemia among pregnant women.

Data analysis was performed using IBM SPSS Statistics. Descriptive (univariate) analysis was used to summarize respondents' characteristics, preconception nutritional status, and anemia status using frequencies and percentages. Inferential (bivariate) analysis was conducted using the Chi-Square test to examine the association between preconception nutritional status and anemia incidence. Statistical significance was determined at a 95% confidence level with a p-value of <0.05. When the assumptions of the Chi-Square test were not fulfilled due to expected cell frequencies below the required threshold, an appropriate alternative statistical test was applied.

This study received ethical approval from the Health Research Ethics Committee of Poltekkes Kemenkes Malang under Ethical Clearance Number DP.04.03/F.XIII.31/0417/2026. All research procedures complied with the ethical principles of respect for persons, beneficence, non-maleficence, justice, and confidentiality of participants' information.

3. RESULTS AND DISCUSSIONS

This study involved 104 pregnant women who met the inclusion criteria. Most of the respondents were aged 21–35 years (73.1%), had an educational background ranging from elementary school to junior high school (72.1%), and were either primigravida or multigravida in relatively equal proportions, totaling 92 (88.4%); the majority were in their third trimester of pregnancy (78.8%). These characteristics indicate that the majority of respondents were in the healthy reproductive age group; however, their relatively low educational level has the potential to influence their knowledge and behaviors regarding nutritional intake before and during pregnancy.

Based on the research findings, the following are the results regarding the distribution of preconception nutritional status and the prevalence of anemia among pregnant women.

Table 1. Distribution of preconception nutritional status and prevalence of anemia among pregnant women

Description	n	%
Preconception Nutritional Status		
Chronic Energy Deficiency (CED)	58	55,8
Normal	46	44,2
Anemia Prevalence		
No Anemia	58	55,8
Mild Anemia	35	33,7
Moderate Anemia	11	10,6

Source: Secondary data analyzed using SPSS 20

The study results show that more than half of the respondents (55.8%) had a preconception nutritional status classified as Chronic Energy Deficiency (CED). These findings indicate that nutritional problems among women of childbearing age remain quite high in the study area. Preconception nutritional status is an important indicator because it reflects the energy and nutrient reserves needed to meet increased physiological demands during pregnancy. Women who enter pregnancy with poor nutritional status tend to have low iron reserves, making them more susceptible to impaired hemoglobin production and anemia during pregnancy.

Based on the distribution of anemia prevalence, 55.8% of respondents did not have anemia, while the remaining 44.2% had anemia, consisting of mild anemia (33.7%) and moderate anemia (10.6%). Although the majority of respondents did not have anemia, the proportion of pregnant women with anemia remains relatively high, necessitating attention in prevention efforts. The incidence of anemia during pregnancy is influenced not only by nutritional status but also by dietary patterns, adherence to iron supplementation, infectious diseases, and the quality of antenatal care.

Table 2. Association between preconception nutritional status and the incidence of anemia in pregnant women

No	Preconception Nutritional Status	Anemia in Pregnant Women						Total		*n*	Chi Square
		Tidak Anemia		Anemia Ringan		Anemia Sedang					
		f	%	f	%	f	%	f	%	0.002	12.701
1	CED	24	41,4	24	41,4	10	17,2	58	55,8		
2	Normal	34	73,9	11	23,9	1	2,2	46	44,2		
Total		58	58,8	35	33,7	11	10,6	104	100		

Source: Secondary data analyzed using SPSS 20

The results of the Chi-Square test showed a p-value of 0.002 ($p < 0.05$), indicating a significant association between preconception nutritional status and the incidence of anemia in pregnant women. Women with preconception nutritional status classified as KEK were more likely to experience anemia than those with non-KEK nutritional status. In the KEK group, 41.4% had mild anemia and 17.2% had moderate anemia, whereas in the non-KEK group, only 23.9% had mild anemia and 2.2% had moderate anemia. These results indicate that poor nutritional status prior to pregnancy is associated with an increased risk of anemia during pregnancy.

Discussion

Preconception Nutritional Status of Pregnant Women at the Jambesari Community Health Center

Based on the frequency analysis of preconception nutritional status, it was found that out of 104 respondents, the majority—58 women (55.8%)—had Chronic Energy Deficiency (CED), while 46 women (44.2%) did not have CED. This indicates that the majority of pregnant women experienced CED prior to pregnancy.

Preconception nutritional status, as measured by LILA, is a key indicator for assessing long-term energy and nutrient reserves in women of childbearing age. Women with an LILA <23.5 cm are classified as having chronic energy and nutrient deficiency (KEK), which reflects low reserves of energy and nutrients, including iron, which plays a role in hemoglobin formation (Indonesia, 2022). This condition can result in mothers lacking sufficient iron reserves to meet the increased demands during pregnancy, thereby increasing the risk of anemia (Fauzianty, A., 2022). Furthermore, nutritional status is a key determinant of anemia incidence among pregnant women; those with poor nutritional status face a higher risk of anemia compared to those with good nutritional status due to limited intake of micronutrients such as iron, folic acid, and vitamin B12 (Ariendha, D. R., Setyawati, I., Utami, K., & Hardaniyati, 2022). Other studies have also noted that pre-pregnancy malnutrition contributes to low iron stores in the body, thereby increasing susceptibility to anemia during pregnancy (Putra & Sulastri, 2024).

These findings suggest that the high proportion of pregnant women with preconception nutritional status classified as KEK (55.8%) indicates that preconception nutritional problems remain quite prevalent in the community. This condition is likely influenced by inadequate fulfillment of nutritional needs before pregnancy as well as low nutritional knowledge, which can limit access to nutritious food and health services. This view is supported by the data in Table 4.2 on the characteristics of respondents based on education level, the majority of whom have only completed elementary through junior high school (72.1%), which may affect their understanding of the importance of adequate nutrition before and during pregnancy. Long-term nutritional deficiencies

can lead to low reserves of essential nutrients such as iron, folic acid, and protein, which play a role in hemoglobin formation (Stephenson et al., 2020). This condition is evident in the study results, where pregnant women with KEK nutritional status were more likely to experience anemia (34 women) compared to those without KEK (12 women), indicating that poor preconception nutritional status can be a key factor increasing the risk of anemia during pregnancy. These data reinforce the finding that suboptimal iron stores prior to pregnancy can prevent the body from meeting the increased demand for iron during pregnancy.

Incidence of Anemia Among Pregnant Women at the Jambesari Community Health Center

Based on the results of the frequency of anemia incidence, it was found that out of 104 respondents, the majority of pregnant women 58 women (55.8%) did not have anemia. Meanwhile, 35 women (33.7%) had mild anemia, 11 women (10.6%) had moderate anemia, and no cases of severe anemia were found. This indicates that, in general, the hemoglobin levels of the pregnant women in this study were good, although a portion of the respondents still had anemia.

Anemia in pregnant women is a condition characterized by a hemoglobin level of <11 g/dL, which is generally caused by iron deficiency due to increased iron requirements during pregnancy for red blood cell formation, fetal growth, and placental development (World Health Organization, 2023). Anemia during pregnancy can lead to various complications, such as preterm birth, low birth weight, and an increased risk of maternal and infant mortality (Amin, M., Salsabilah, M., Pratama, M. I., Salsabila, M., Satria, M. D., & Az-Zahra, 2024). In addition, the incidence of anemia in pregnant women is influenced by various factors, such as nutritional status, dietary patterns, adherence to iron supplementation, and the frequency of antenatal care visits (Liyew, A. M., 2021). Dietary patterns that do not meet iron requirements and a lack of nutrient-rich foods are among the main causes of anemia in pregnant women (Hasanah, S. H., & Liayana, 2025).

These findings indicate that the high proportion of pregnant women who did not experience anemia (55.8%) is due to the fact that most respondents were in relatively good health during pregnancy. This condition may be influenced by various factors, one of which is the characteristics of the respondents, the majority of whom 76 women (73.1%) were within the healthy reproductive age range of 21–35 years. Within this age range, reproductive function and the body's ability to meet nutritional needs during pregnancy are generally more optimal compared to when women are too young or too old. According to the Indonesian Ministry of Health (2022), the age range of 20–35 years is considered a safe reproductive age because the reproductive organs have developed optimally and the body's ability to meet nutritional needs during pregnancy is better, resulting in a lower risk of pregnancy complications, including anemia.

Nevertheless, there were still 46 respondents (44.2%) who had anemia, consisting of 35 respondents (33.7%) with mild anemia and 11 respondents (10.6%) with moderate anemia. The researchers hypothesized that this condition could be influenced by poor preconception nutritional status (KEK), as the study results indicated that pregnant women with KEK nutritional status were more likely to experience anemia than those without KEK. According to (Stephenson, J., 2018), pre-pregnancy nutritional status is a key factor determining a mother's physical readiness to meet the increased nutritional demands of pregnancy. Women who are deficient in energy and micronutrients before conception tend to have low iron stores, putting them at higher risk of developing anemia during pregnancy.

In addition, the educational background of the respondents which was dominated by elementary and junior high school graduates, totaling 75 people (72.1%) also has the potential to influence their understanding of nutritional needs before and during pregnancy. Notoatmodjo's theory (2018) explains that educational level is one of the factors influencing an individual's health knowledge and behavior. The higher the educational level, the easier it is for a person to accept, understand, and apply health information, including information regarding nutritional needs and the prevention of anemia during pregnancy. Conversely, a low educational level can lead to limitations in understanding the importance of meeting nutritional needs and efforts to prevent anemia. Therefore,

sustained promotive and preventive efforts are needed to improve the nutritional status of women of childbearing age and prevent anemia in pregnant women.

The Relationship Between Preconception Nutritional Status and the Incidence of Anemia in Pregnant Women

Based on the results of the Chi-Square test examining the relationship between preconception nutritional status (LILA) and the incidence of anemia in pregnant women, a Pearson Chi-Square value of 12.701 was obtained, with a significance level (p-value) of 0.002 ($p < 0.05$). This indicates that there is a significant association between preconception nutritional status and the incidence of anemia in pregnant women; therefore, the research hypothesis (H1) is accepted. The cross-tabulation results show that mothers with KEK nutritional status had a higher proportion of anemia, namely 24 (41.4%) with mild anemia and 10 (17.2%) with moderate anemia, compared to mothers without KEK, who had only 11 (23.9%) with mild anemia and 1 (2.2%) with moderate anemia. Although the majority of respondents in both groups did not have anemia, the incidence of anemia was more prevalent in the KEK group.

Preconception nutritional status is a key factor influencing maternal health during pregnancy. Women with chronic energy deficiency (CED) tend to have low iron stores, making them unable to meet the increased iron requirements during pregnancy necessary for hemoglobin production, fetal growth, and increased blood volume (World Health Organization, 2023). In addition, hemodilution occurs during pregnancy due to an increase in plasma volume, which causes hemoglobin levels to decrease physiologically; consequently, iron requirements are higher than under normal conditions (Stephenson, J., 2018). If iron stores prior to pregnancy are insufficient, the mother will be more susceptible to anemia. Other studies have also shown that women with poor nutritional status before pregnancy are at higher risk of developing anemia compared to women with good nutritional status, due to insufficient intake of energy and micronutrients such as iron, folic acid, and vitamin B12 (Liyew, A. M., 2021; Pasricha, S. R., Drakesmith, H., Black, J., Hipgrave, D., & Biggs, 2013).

Based on these results, the findings indicate that the association between preconception nutritional status and the incidence of anemia suggests that nutritional status prior to pregnancy plays a fundamental role in determining the mother's health status during pregnancy. Mothers with good nutritional status (not suffering from iron deficiency) tend to have more optimal iron stores, enabling them to adapt to increased needs during pregnancy, whereas mothers with iron deficiency have limited iron stores and are therefore at higher risk of developing anemia. This aligns with the theory that nutritional status is a fundamental determinant of anemia because it is directly related to the body's iron availability and its ability to produce red blood cells (Black, R. E., Victora, C. G., Walker, S. P., 2020). However, the fact that there are still mothers with iron deficiency who do not develop anemia, as well as mothers without iron deficiency who do develop anemia, indicates that the occurrence of anemia is multifactorial. Other factors, such as adherence to iron supplement intake, dietary patterns during pregnancy, infections, and the quality of antenatal care, also play a role in determining the anemia status of pregnant women (Liyew, A. M., 2021).

The implications of this study are the need to strengthen preconception nutritional screening at community health centers. Since the study shows a link between preconception nutritional status and the incidence of anemia in pregnant women, early detection through mid-upper arm circumference (MUAC) and body mass index (BMI) measurements in women of childbearing age and engaged couples should be conducted routinely. The results of this screening can serve as the basis for providing nutrition education, iron and folic acid supplementation, and preconception counseling so that the risk of anemia can be prevented before pregnancy occurs. Thus, anemia prevention programs shift from a curative approach during pregnancy to a promotive and preventive approach starting from the preconception period.

4. CONCLUSION

This study demonstrates that the majority of pregnant women in the service area of the Jambesari Community Health Center had preconception nutritional status classified as Chronic Energy Deficiency (CED), and anemia remained prevalent among pregnant women. A significant association was identified between preconception nutritional status and the incidence of anemia during pregnancy, indicating that nutritional status before conception is an important determinant of maternal anemia. These findings highlight the importance of strengthening promotive and preventive strategies through nutritional screening, nutrition education, and comprehensive preconception care to improve the nutritional status of women of reproductive age before pregnancy.

The findings provide evidence that preconception nutritional assessment can serve as an effective early screening tool to identify women at risk of developing anemia during pregnancy. Therefore, integrating routine preconception nutritional screening into reproductive health services at primary health care centers should be considered as part of maternal anemia prevention policies. Strengthening MUAC and BMI assessment, nutrition counseling, anemia screening, and iron–folic acid supplementation for women of reproductive age and prospective brides may help reduce the burden of maternal anemia and improve pregnancy outcomes.

Future studies should investigate additional determinants of maternal anemia, including dietary intake, adherence to iron supplementation, parity, birth spacing, socioeconomic status, educational level, infectious diseases, and access to antenatal care. Prospective cohort or longitudinal studies are also recommended to establish causal relationships and evaluate the effectiveness of preconception nutrition interventions in preventing anemia during pregnancy.

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