



The Relationship Between Body Mass Index (BMI) and Anemia in Pregnant Women in the First Trimester at the Kedungwuni I Community Health Center in Pekalongan Regency

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Abstract

Anemia remains an important maternal health problem in Indonesia, particularly during pregnancy when physiological and nutritional demands increase. Maternal nutritional status, as reflected by Body Mass Index (BMI), may contribute to anemia because inadequate nutritional reserves can affect the availability of nutrients required for hemoglobin synthesis. This study aimed to analyze the relationship between BMI and anemia among first-trimester pregnant women at Kedungwuni I Community Health Center, Pekalongan Regency, in 2026. This empirical quantitative study employed a correlational approach with a cross-sectional design. A total of 57 first-trimester pregnant women were selected using purposive sampling based on predetermined inclusion and exclusion criteria. Data were collected through anthropometric assessment to determine BMI and hemoglobin measurement to identify anemia status. Descriptive analysis was conducted to characterize BMI and anemia distribution, while the Chi-Square test was used to examine the relationship between the two variables at a 95% confidence level. The findings showed that 6 respondents (10.5%) were underweight, 16 (28.1%) had normal BMI, 12 (21.1%) were overweight, and 23 (40.4%) were obese. Anemia was identified in 7 respondents (12.3%), while 50 (87.7%) were not anemic. All underweight respondents experienced anemia, compared with 1 respondent (1.8%) in the normal BMI category. The Chi-Square test yielded $p < 0.001$, indicating a significant relationship between BMI and anemia. These findings support early BMI and hemoglobin screening as complementary components of antenatal care.

Keywords: Anemia, Body Mass Index, Hemoglobin, Pregnant Women, Trimester I.



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INTRODUCTION

Maternal health remains a major priority in global public health because nutritional and hematological disorders during pregnancy can influence maternal well-being, fetal development, and subsequent birth outcomes across the life course. Anemia continues to represent one of the most prevalent nutritional disorders affecting pregnant women worldwide, with its persistence reflecting the interaction of inadequate nutrient intake, increased physiological requirements, infection, chronic disease, and socioeconomic vulnerability (World Health Organization, 2023). In Indonesia, the burden of anemia among pregnant women remains substantial, indicating that improvements in antenatal care coverage do not automatically translate into adequate maternal nutritional status. The Indonesian context is particularly important because determinants of anemia extend beyond iron supplementation and include maternal nutritional reserves, dietary adequacy, adherence to preventive interventions, and pre-existing health conditions (Ita et al., 2025). Pregnancy itself produces substantial physiological changes in plasma volume, erythropoiesis, and nutrient requirements, making the first trimester an important period for identifying women who enter pregnancy with limited nutritional reserves (Erfiani Mail et al., 2023). Nutritional assessment at this stage therefore provides an opportunity to identify modifiable risk factors before increasing maternal and fetal demands intensify the consequences of nutritional deficiencies. The assessment of maternal body composition through Body Mass Index (BMI) offers a relatively simple clinical indicator that may contribute to early risk stratification in routine antenatal services.

Maternal nutritional status is closely connected with the capacity of the body to meet the metabolic demands of pregnancy, particularly when nutritional requirements increase to support

placental development, fetal growth, and maternal hematological adaptation. BMI is widely used as an anthropometric indicator because pre-pregnancy or early-pregnancy BMI can reflect the adequacy of maternal energy reserves and provide an initial indication of nutritional vulnerability (Harjatmo et al., 2021). Women with low BMI may have inadequate energy and micronutrient reserves, while inadequate dietary intake can further compromise the substrates required for erythropoiesis and hemoglobin synthesis (Masrurroh et al., 2023). Conversely, a higher BMI does not necessarily indicate adequate micronutrient status because excess adiposity may coexist with poor dietary quality and metabolic conditions that influence iron homeostasis. Previous evidence has also demonstrated an association between BMI and hemoglobin status, although findings from non-pregnant populations cannot be directly generalized to pregnant women because pregnancy involves distinctive physiological and hematological changes (Febriayanti et al., 2024). The relationship between BMI and anemia consequently requires examination within the specific physiological context of pregnancy rather than being inferred solely from general nutritional indicators.

The biological plausibility of an association between BMI and anemia is supported by several pathways through which maternal nutritional status may influence iron availability and hemoglobin formation. Low nutritional reserves may restrict the availability of iron, protein, folate, and other micronutrients required for normal erythropoiesis, increasing vulnerability to anemia when pregnancy-related demands rise (Seri, 2022). Evidence from Indonesia also indicates that maternal nutritional conditions are relevant to adverse pregnancy outcomes, including low birth weight, suggesting that nutritional vulnerability may have consequences extending beyond maternal hematological status (Hamalding et al., 2023). At the same time, obesity may be accompanied by chronic low-grade inflammation that interferes with iron metabolism and reduces the effective availability of circulating iron, indicating that the BMI–anemia relationship may not follow a simple linear pattern. Recent international evidence has specifically identified an association between BMI and anemia among pregnant women, reinforcing the relevance of BMI as a potential factor in maternal anemia assessment (Fayyaz et al., 2026). Evidence from Indonesian primary healthcare settings has similarly examined the relationship between BMI and anemia among pregnant women, although the magnitude and significance of the association remain inconsistent across populations and pregnancy stages (Razali et al., 2024). These findings suggest that BMI may be clinically relevant to anemia risk, but its explanatory value depends on the characteristics of the maternal population, timing of assessment, and contextual determinants of nutritional health.

Despite growing evidence, the literature has not established a consistent conclusion regarding the relationship between maternal BMI and anemia during pregnancy, particularly during the first trimester. Some studies have reported significant relationships between BMI and anemia, whereas other investigations have identified weak or statistically non-significant associations, suggesting that differences in population characteristics, sample size, nutritional exposure, and clinical setting may influence the observed relationship (Reteh & Hanim, 2025). Research focusing on preconception BMI and upper-arm circumference has also indicated that maternal nutritional indicators may be associated with anemia later in pregnancy, but this evidence primarily reflects third-trimester conditions rather than nutritional vulnerability at the beginning of gestation (Puteri & Sholihah, 2024). The distinction is methodologically important because nutritional status and hematological adaptations can change throughout pregnancy, meaning that evidence obtained during the third trimester cannot automatically explain the condition of women during the first trimester. Recent research on chronic energy deficiency among pregnant women further indicates that maternal nutritional vulnerability is shaped by multiple determinants, reinforcing the need to examine anthropometric indicators within specific maternal and community contexts (Rahmadhena & Astuti, 2026). Existing Indonesian studies also tend to concentrate on particular regions or later stages of pregnancy, leaving limited empirical evidence concerning the BMI–anemia relationship among first-trimester pregnant women in primary healthcare facilities in Pekalongan Regency. This geographical and temporal gap is important because local dietary patterns, socioeconomic conditions, antenatal-care practices, and adherence to iron supplementation may modify the relationship between maternal nutritional status and anemia.

The unresolved relationship has both scientific and practical implications because anemia identified during early pregnancy represents not merely a laboratory abnormality but a potential indicator of broader maternal nutritional vulnerability requiring timely clinical attention. Early identification of women with both low BMI and anemia can support more targeted nutritional

counselling, closer monitoring, and reinforcement of iron supplementation rather than relying exclusively on universal antenatal interventions. Educational interventions have demonstrated potential to improve knowledge, treatment adherence, hemoglobin status, and iron intake among pregnant women, indicating that early identification of risk can be connected to actionable preventive strategies (Zazuli et al., 2024). The consequences of inadequate maternal nutritional status may also extend to fetal growth, making the identification of nutritional risk factors relevant to broader maternal and neonatal health objectives (Talahatu et al., 2024). From a public-health perspective, primary healthcare facilities are strategically positioned to conduct BMI and hemoglobin screening during early antenatal visits because these assessments can be integrated into routine maternal monitoring. Yet the effectiveness of such screening depends on whether locally observed anthropometric characteristics are meaningfully associated with anemia within the population being served. Establishing this relationship in a specific primary healthcare setting can therefore provide evidence for strengthening risk-based antenatal assessment while contributing to the broader Indonesian literature on maternal nutrition and anemia.

Against this background, the present study is positioned to address the empirical gap by specifically examining the relationship between BMI and anemia among pregnant women in the first trimester at the Kedungwuni I Community Health Center in Pekalongan Regency. The study focuses on the earliest stage of pregnancy to determine whether maternal nutritional status, as represented by BMI, is associated with anemia at a point when preventive intervention remains highly relevant. The research is expected to clarify whether the association observed in other populations is also evident among first-trimester pregnant women receiving antenatal care in this local primary healthcare context. The findings can provide an empirical basis for integrating anthropometric assessment with hemoglobin screening in the early identification of maternal nutritional and hematological risk. The study also contributes to the theoretical understanding of maternal nutritional status by examining BMI not merely as a descriptive measure of body size but as a potential marker associated with maternal hematological vulnerability during early pregnancy. Methodologically, the study strengthens context-specific evidence by examining two routinely measurable clinical indicators within a defined first-trimester population and primary healthcare setting. The objective of this research is to determine the relationship between BMI and anemia among first-trimester pregnant women at the Kedungwuni I Community Health Center in Pekalongan Regency, thereby generating evidence that can support earlier risk identification, more appropriate nutritional intervention, and the development of preventive maternal healthcare strategies.

RESEARCH METHODS

Methodology This study employed an empirical quantitative approach using a correlational design with a cross-sectional framework to examine the relationship between Body Mass Index (BMI) and anemia among pregnant women in the first trimester at the Kedungwuni I Community Health Center, Pekalongan Regency. A cross-sectional design was considered appropriate because the exposure variable, namely maternal BMI, and the outcome variable, namely anemia status based on hemoglobin concentration, were assessed within the same period of observation without manipulating the study variables (Nursalam, 2022). The study population comprised pregnant women in the first trimester who received antenatal care at the Kedungwuni I Community Health Center during the study period. A total of 57 participants were selected using purposive sampling based on predetermined eligibility criteria, consistent with the use of non-probability sampling to obtain participants who meet characteristics relevant to the research objectives (Sugiyono, 2023). The inclusion criteria were pregnant women in the first trimester who received antenatal care at the study site, were willing to participate, and could undergo BMI and hemoglobin assessment. Participants were excluded when they had incomplete anthropometric or hemoglobin data or were unable to complete the required examination procedures. Data collection was conducted through direct assessment of body weight, height, and hemoglobin concentration, with participant characteristics recorded systematically to ensure that the data corresponded to the study variables.

The research instruments consisted of an anthropometric measurement procedure for determining BMI and a hemoglobin measurement procedure for identifying anemia status, while participant data were recorded using a structured data collection sheet. BMI was calculated from body weight and height and subsequently categorized according to the predetermined maternal nutritional-

status classification used in the study, whereas anemia status was determined from the measured hemoglobin concentration using the applicable pregnancy-specific criteria (Harjatmo et al., 2021). The collected data were first subjected to descriptive analysis to characterize the distribution of participants according to BMI and anemia status before the relationship between the two categorical variables was examined. Inferential analysis was performed using the Chi-Square test because the principal objective was to determine whether a statistically significant association existed between BMI category and anemia status among the observed participants (Ghozali, 2021). Statistical significance was evaluated at a 95% confidence level, with a p-value below 0.05 interpreted as evidence of a statistically significant relationship. Data management and statistical procedures were conducted systematically in accordance with principles of quantitative health research to maintain consistency between the research questions, measurement variables, and analytical procedures (Notoatmodjo, 2018). Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine, Universitas Islam Sultan Agung (UNISSULA), under approval number 121/III/2026/Komisi Bioetik Semarang, and the study procedures were implemented after the required ethical authorization had been granted.

RESULTS AND DISCUSSION

BMI Characteristics among First-Trimester Pregnant Women

The distribution of Body Mass Index (BMI) among the 57 first-trimester pregnant women at Kedungwuni I Community Health Center showed considerable variation in maternal nutritional status, with obesity representing the largest category in the study population. As presented in Table 1, 23 respondents (40.4%) were classified as obese, followed by 16 respondents (28.1%) with normal BMI, 12 respondents (21.1%) classified as overweight, and 6 respondents (10.5%) classified as underweight. The predominance of obesity indicates that excess maternal body weight was a more prominent nutritional characteristic than undernutrition among women assessed during early pregnancy. This distribution is clinically relevant because maternal nutritional status at the beginning of pregnancy may influence metabolic adaptation, pregnancy progression, and the nutritional environment available for fetal development. BMI assessment during early antenatal care therefore provides an important initial profile for identifying women who may require differentiated nutritional monitoring rather than treating maternal nutritional status as a homogeneous condition. The findings also indicate that nutritional problems in this population involve both excessive and insufficient body weight, although the magnitude of the two conditions differs substantially.

Table 1. BMI Characteristics of First-Trimester Pregnant Women at Kedungwuni I Community Health Center, Pekalongan Regency, May 2026 (n=57)

BMI	Frequency (f)	Percentage (%)
Underweight	6	10.5
Normal	16	28.1
Overweight	12	21.1
Obesity	23	40.4
Total	57	100.0

The high proportion of obesity observed in this study suggests that early pregnancy care in the Kedungwuni I service area must address excess nutritional status alongside conventional concerns regarding maternal undernutrition. Maternal BMI is an important anthropometric indicator because it provides an accessible approximation of nutritional status and body composition that can be incorporated into routine health assessment (Harjatmo et al., 2021). Excessive maternal adiposity may be associated with metabolic disturbances and pregnancy complications, including hypertensive disorders and gestational diabetes, which makes early identification clinically meaningful rather than merely descriptive (Handayani & Nurjanah, 2022). The predominance of obesity in this sample may reflect nutritional and lifestyle conditions existing before conception, since BMI measured during early pregnancy can still provide information regarding maternal nutritional reserves at the beginning of gestation. Dietary patterns characterized by high energy intake, low nutritional diversity, limited physical activity, and changing socioeconomic conditions may contribute to excessive maternal weight,

although these determinants were not directly measured in the present study. The absence of detailed dietary and physical-activity variables limits the ability to identify which specific factors explain the high obesity proportion in this population. Nevertheless, the finding provides an important basis for strengthening nutritional counselling during the first antenatal encounter.

The presence of 6 underweight respondents (10.5%) requires particular attention because low BMI may indicate insufficient nutritional reserves at a stage when maternal physiological requirements are beginning to increase. Maternal undernutrition can reflect inadequate energy and nutrient availability before pregnancy and may increase vulnerability to nutritional deficiencies during gestation (Masruroh et al., 2023). Although the underweight group was substantially smaller than the obesity group, its clinical importance cannot be determined solely from its frequency because inadequate nutritional reserves may have disproportionate consequences for maternal and fetal health. Evidence from Indonesian maternal health research indicates that maternal nutritional status is associated with fetal outcomes such as low birth weight, reinforcing the relevance of early nutritional assessment (Hamalding et al., 2023). Low BMI may also coexist with inadequate intake of iron, protein, folate, and other nutrients required for hematopoiesis, making underweight status particularly relevant when examining anemia during pregnancy. The coexistence of underweight and obesity in the same population illustrates the dual burden of maternal malnutrition, in which healthcare services must respond simultaneously to nutritional deficiency and excess.

The BMI pattern identified in this study is consistent with the broader understanding that maternal nutritional status is influenced by multiple biological, behavioral, and socioeconomic determinants rather than by energy intake alone. Maternal age, educational attainment, household income, dietary knowledge, occupation, physical activity, and access to antenatal services may shape body-weight status before and during pregnancy, although these variables were outside the analytical scope of the present study. Recent evidence concerning chronic energy deficiency among pregnant women similarly demonstrates that maternal nutritional vulnerability is multifactorial and cannot be adequately explained through a single anthropometric indicator (Rahmadhena & Astuti, 2026). The relatively large proportion of respondents classified as obese may therefore represent the cumulative effect of preconception nutritional status and lifestyle characteristics rather than a condition generated solely by pregnancy. At the same time, the presence of underweight respondents demonstrates that nutritional deficiency remains relevant despite the predominance of excess body weight. This variation supports the clinical value of individualized nutritional assessment during early pregnancy rather than applying a uniform nutritional intervention to all pregnant women. In primary healthcare practice, BMI measurement can function as an initial screening component that helps determine whether subsequent counselling should emphasize adequate nutrient intake, prevention of excessive weight gain, or both.

The observed distribution also provides an important context for interpreting the subsequent analysis of anemia because BMI categories represent different nutritional conditions that may influence hematological vulnerability through distinct mechanisms. Previous research has demonstrated that maternal BMI and nutritional status can be associated with pregnancy-related outcomes, while studies of pregnant populations have produced varying estimates of the strength and direction of these relationships (Razali et al., 2024). Research examining BMI and pregnancy-related complaints further illustrates that BMI may influence maternal health experiences differently across stages of gestation, supporting the need to consider gestational timing when interpreting anthropometric findings (Mafa & Safitri, 2025). The present study specifically focuses on the first trimester, when maternal nutritional reserves may be particularly relevant because physiological adaptations to pregnancy are already occurring while fetal development is rapidly progressing. The predominance of obesity should not be interpreted as evidence that women in this category are nutritionally adequate because BMI does not directly measure micronutrient sufficiency or dietary quality. Conversely, the underweight category should not automatically be equated with anemia because hematological status depends on additional factors such as iron intake, supplementation, infection, and pre-existing anemia. These considerations provide the analytical basis for examining whether the observed BMI differences correspond to differences in anemia status among the same participants.

From a maternal healthcare perspective, the findings support the incorporation of structured BMI assessment into early antenatal care as part of a broader nutritional risk assessment. Nutritional counselling should distinguish between women requiring support for inadequate nutritional reserves and those requiring guidance to prevent excessive weight gain while maintaining adequate

micronutrient intake. Such an approach is consistent with the preventive orientation of maternal healthcare, in which early identification of nutritional vulnerability can facilitate timely counselling and closer monitoring (Asmuji & Indriyani, 2021). The finding that obesity accounted for 40.4% of the sample also suggests that maternal health programmes in the study setting should not frame nutritional problems exclusively around undernutrition and iron deficiency. At the same time, the 10.5% prevalence of underweight status indicates that interventions addressing maternal obesity should not displace attention to women who enter pregnancy with inadequate nutritional reserves. The clinical significance of these two contrasting BMI categories becomes clearer when considered alongside the anemia findings presented in the following section.

Anemia Status among First-Trimester Pregnant Women

The assessment of anemia among 57 first-trimester pregnant women at Kedungwuni I Community Health Center showed that most respondents were not classified as anemic, although a clinically relevant proportion had already developed anemia during the early stage of pregnancy. As shown in the findings, 50 respondents (87.7%) were categorized as not anemic, whereas 7 respondents (12.3%) were identified as anemic. This distribution indicates that anemia was not the predominant hematological condition in the study population, yet its occurrence during the first trimester remains important because maternal hematological adaptation begins early in gestation. The first trimester represents a critical period for identifying pre-existing nutritional and hematological vulnerabilities before maternal and fetal requirements increase further throughout pregnancy. Hemoglobin assessment during the initial antenatal period can therefore provide an important basis for identifying women who require nutritional evaluation and closer follow-up. The relatively lower proportion of anemia in this sample should also be interpreted within the specific characteristics of the study population and should not be generalized to pregnant women in other geographical or healthcare settings.

The relatively low proportion of anemia observed in this study may be related to several factors that support adequate maternal hemoglobin status during early pregnancy. Adequate nutritional intake, previous nutritional reserves, access to antenatal care, iron supplementation, and awareness of maternal health can contribute to maintaining hemoglobin concentrations within the expected range. Preventive antenatal interventions, particularly iron supplementation and nutritional education, are recognized as important components of strategies for reducing anemia during pregnancy (Saku et al., 2023). Recent evidence from Indonesian settings also indicates that anemia during pregnancy is influenced by multiple determinants, including nutritional status, iron intake, supplementation adherence, and maternal characteristics rather than by a single nutritional factor (Ita et al., 2025). Nevertheless, the presence of 7 anemic respondents demonstrates that access to antenatal services does not necessarily eliminate hematological risk during early pregnancy. The distribution of anemia in this study is presented in Table 2, which provides the frequency and percentage of respondents according to their anemia status.

Table 2. Anemia Status among First-Trimester Pregnant Women at Kedungwuni I Community Health Center, Pekalongan Regency, May 2026 (n=57)

Anemia Status	Frequency (f)	Percentage (%)
Anemia	7	12.3
No Anemia	50	87.7
Total	57	100.0

The occurrence of anemia in 12.3% of respondents indicates that hematological vulnerability was already present among a subset of women during the first trimester, despite the predominance of normal hemoglobin status in the sample. Anemia during pregnancy can interfere with oxygen transport and may become clinically consequential when maternal physiological demands increase as pregnancy progresses (Astutik et al., 2022). Iron deficiency is particularly relevant because iron is required for hemoglobin synthesis, while insufficient iron availability may impair erythropoiesis and progressively reduce maternal hemoglobin concentrations (Seri, 2022). The first-trimester identification of anemia is therefore important because nutritional and therapeutic interventions can be initiated before the physiological demands of later pregnancy become greater. Maternal anemia has also been associated with adverse maternal and neonatal conditions, including impaired fetal growth and low birth weight,

emphasizing the importance of early identification rather than waiting until symptoms become apparent (Hamalding et al., 2023). The present finding consequently supports the role of routine hemoglobin screening as an integral component of early antenatal assessment.

The seven respondents with anemia may have entered pregnancy with insufficient iron stores or other nutritional vulnerabilities that were not captured by BMI alone. Dietary inadequacy, poor adherence to iron supplementation, previous anemia, closely spaced pregnancies, infection, and impaired nutrient absorption can contribute to anemia even when anthropometric status appears relatively adequate. Pregnancy-related nausea and vomiting may also reduce dietary intake during the early gestational period and thereby limit the availability of nutrients required for hematopoiesis, particularly among women who already have marginal nutritional reserves (Supriyatiningsih, 2022). The multifactorial nature of anemia means that a normal BMI cannot be interpreted as evidence of adequate micronutrient status, because BMI primarily reflects body mass relative to height rather than the availability of specific nutrients. This distinction is particularly important in the present study because the subsequent relationship analysis must consider whether BMI is associated with anemia without assuming that BMI independently determines hemoglobin concentration. Recent systematic evidence on anemia in pregnancy similarly emphasizes that maternal anemia in Indonesia results from interacting nutritional, reproductive, socioeconomic, and healthcare-related determinants (Ita et al., 2025). The 12.3% anemia prevalence observed in this study should therefore be understood as an indicator of a specific hematological condition within a broader maternal nutritional context.

The relatively favorable anemia profile in the present sample may also reflect the contribution of antenatal health services and preventive interventions available to pregnant women in the community health center setting. Antenatal education can improve maternal knowledge regarding iron-rich food consumption, supplementation adherence, and the importance of monitoring hemoglobin concentrations, while regular contact with healthcare providers creates opportunities for early detection and management. Evidence from community health centers has demonstrated that educational interventions can improve knowledge, adherence to therapy, hemoglobin status, and iron intake among pregnant women, supporting the importance of combining screening with behavioral and nutritional interventions (Zazuli et al., 2024). However, the cross-sectional nature of this study does not permit determination of whether supplementation, dietary practices, or antenatal education directly contributed to the relatively low anemia prevalence. The study also did not measure dietary iron intake, serum ferritin, inflammatory markers, or adherence to iron supplementation, which limits the ability to distinguish iron-deficiency anemia from other forms of anemia. Such factors are important because hemoglobin concentration alone identifies the presence of anemia but does not establish its underlying etiology. The findings therefore provide an epidemiological description of anemia status while also highlighting the need for more comprehensive assessment when the clinical cause of anemia must be determined.

From a clinical perspective, the identification of 7 anemic women among 57 first-trimester respondents demonstrates that early pregnancy remains an appropriate period for systematic hematological screening. Women diagnosed with anemia can benefit from individualized nutritional counselling, assessment of iron supplementation adherence, and follow-up hemoglobin measurement according to clinical needs. Maternal health promotion should also emphasize dietary diversity and adequate consumption of iron-containing foods because nutritional adequacy contributes to maintaining maternal hematological status throughout pregnancy. The relatively small proportion of anemia in the current sample should not reduce the importance of preventive action because untreated anemia may persist or become more pronounced as pregnancy progresses and physiological requirements increase. The findings also establish an essential basis for interpreting the relationship between BMI and anemia, particularly because the distribution of anemia must be considered alongside the markedly different BMI categories observed in the study population. Examination of the association between these two variables can clarify whether the nutritional status represented by BMI corresponds to differences in anemia occurrence within this first-trimester population.

Relationship between BMI and Anemia among First-Trimester Pregnant Women

The analysis of the relationship between Body Mass Index (BMI) and anemia among 57 first-trimester pregnant women demonstrated a statistically significant association between the two variables at Kedungwuni I Community Health Center. As presented in the cross-tabulation, all 6 respondents

classified as underweight experienced anemia, whereas only 1 of the 16 respondents with normal BMI experienced anemia. No anemia was observed among the 12 respondents classified as overweight or the 23 respondents classified as obese. This distribution indicates a pronounced concentration of anemia among women with underweight BMI, while anemia was uncommon among respondents in the other BMI categories. The Chi-Square analysis produced a p-value of <0.001 , indicating that the observed association between BMI category and anemia status was statistically significant at the predetermined 5% significance level. The finding provides empirical evidence that maternal BMI status was associated with anemia occurrence within the first-trimester population examined in this study.

Table 3. Relationship between BMI and Anemia among First-Trimester Pregnant Women at Kedungwuni I Community Health Center, Pekalongan Regency, May 2026 (n=57)

BMI	Anemia		Non-Anemia		Total		p-value
	n	%	n	%	n	%	
Underweight	6	10.5	0	0.0	6	10.5	<0.001
Normal	1	1.8	15	26.3	16	28.1	
Overweight	0	0.0	12	21.1	12	21.1	
Obesity	0	0.0	23	40.4	23	40.4	
Total	7	12.3	50	87.7	57	100.0	

The concentration of anemia among the underweight group is particularly notable because all six women classified as underweight were identified as anemic, whereas anemia occurred in only one woman with normal BMI. This pattern suggests that inadequate maternal nutritional reserves may be closely related to hematological vulnerability during the early stages of pregnancy. Low BMI may reflect insufficient energy and nutrient reserves, including iron, protein, folate, and vitamin B12, which are involved in erythropoiesis and hemoglobin synthesis (Masruroh et al., 2023). The finding is also consistent with evidence that maternal nutritional status before or at the beginning of pregnancy can influence subsequent maternal and fetal health conditions (Puteri & Sholihah, 2024). The absence of anemia among overweight and obese respondents in this particular sample should not be interpreted as evidence that excess body weight protects against anemia, because BMI does not directly measure iron stores or micronutrient adequacy. The observed pattern instead indicates that, within this study population, underweight status was the category most strongly aligned with the occurrence of anemia.

From a physiological perspective, the association may be explained by the interaction between maternal nutritional reserves and the increased hematological demands of pregnancy. Iron is essential for hemoglobin synthesis, while adequate protein, folate, and vitamin B12 are required for normal red blood cell production and maturation (Seri, 2022). Women entering pregnancy with inadequate nutritional reserves may therefore have less capacity to compensate for the increased nutrient requirements accompanying maternal blood formation and fetal development. Early pregnancy also involves progressive physiological adaptations that alter maternal blood volume and nutrient requirements, increasing the importance of adequate nutritional availability from the beginning of gestation (Putri et al., 2022). When nutrient intake and reserves are insufficient, the resulting limitation in erythropoiesis may contribute to reduced hemoglobin concentrations and the development of anemia.

The biological plausibility of this pathway strengthens the interpretation that the observed statistical association is compatible with established mechanisms linking maternal nutritional status to hematological health.

The present finding is broadly consistent with research demonstrating an association between BMI and anemia among pregnant women, although the strength and direction of this relationship vary according to population and pregnancy stage. Razali et al. (2024) reported a relationship between BMI and anemia among pregnant women attending a community health center in Pekanbaru, supporting the relevance of BMI as a nutritional indicator in primary antenatal care. More recent evidence from Lahore also identified an association between BMI and anemia among pregnant women, suggesting that the relationship may extend beyond the Indonesian healthcare context (Fayyaz et al., 2026). Reteh and Hanim (2025) likewise identified a significant relationship between BMI and anemia among third-trimester pregnant women, although their population differed from the first-trimester population

examined in the present study. Differences in gestational age are important because maternal nutritional requirements and hematological adaptation change throughout pregnancy, meaning that findings from third-trimester populations should not be assumed to represent early pregnancy. The present study contributes evidence specifically from first-trimester women in a primary healthcare setting, providing a more temporally focused perspective on the BMI–anemia relationship.

The statistical association should nevertheless be interpreted cautiously because anemia during pregnancy is a multifactorial condition and BMI represents only one component of maternal nutritional status. Systematic evidence from Indonesia indicates that anemia is influenced by nutritional intake, iron supplementation, reproductive characteristics, infections, socioeconomic conditions, and access to healthcare, among other determinants (Ita et al., 2025). The occurrence of anemia in one respondent with normal BMI further demonstrates that adequate body mass does not necessarily guarantee adequate iron availability or protection against anemia. Conversely, the absence of anemia among overweight and obese participants in this sample may reflect the characteristics and size of the study population rather than a universal protective effect of higher BMI. The relatively small number of underweight respondents also means that the observed concentration of anemia in this category should be interpreted as an important empirical pattern rather than as definitive evidence of causality. Because the study used a cross-sectional design, the statistical association establishes a relationship between the variables at the time of measurement but cannot determine whether low BMI directly caused anemia. Additional variables such as dietary iron intake, adherence to iron supplementation, ferritin concentration, infection status, socioeconomic characteristics, and pre-pregnancy BMI would be valuable for explaining the relationship more comprehensively.

Clinically, the significant association identified in this study supports the use of BMI assessment as one component of early maternal risk identification, particularly for women who enter pregnancy with underweight status. Women with low BMI may benefit from intensified nutritional assessment, counselling regarding energy and micronutrient adequacy, monitoring of hemoglobin concentration, and reinforcement of appropriate iron supplementation. Nutritional education and adherence-focused interventions are particularly relevant because improving maternal knowledge and treatment adherence can contribute to better iron intake and hematological outcomes (Zazuli et al., 2024). The findings also suggest that BMI screening should not replace hemoglobin examination because anemia may still occur among women with normal BMI, as demonstrated by the single anemic respondent in the normal-BMI group. A combined approach allows healthcare providers to identify nutritional vulnerability while simultaneously determining whether a hematological abnormality is already present. Such integration is particularly valuable during the first antenatal visit, when preventive interventions can be initiated before nutritional and hematological demands become more pronounced. The significant association between BMI and anemia in this study therefore provides empirical support for strengthening integrated nutritional and hematological screening among first-trimester pregnant women at the primary healthcare level.

Implications of BMI and Anemia Findings for Antenatal Care

The findings of this study have important implications for the implementation of antenatal care, particularly because the relationship between BMI and anemia was identified during the first trimester, a period in which maternal nutritional conditions can still be addressed through early preventive intervention. The predominance of obesity in the study population, combined with the concentration of anemia among underweight respondents, indicates that nutritional problems among pregnant women are not limited to nutritional deficiency but may occur across different BMI categories. Maternal BMI therefore needs to be interpreted as an indicator of nutritional vulnerability rather than as a standalone determinant of hematological status. Assessment of nutritional status during pregnancy is an important component of maternal health monitoring because both inadequate and excessive nutritional status may be associated with adverse pregnancy outcomes (Harjatmo et al., 2021). The coexistence of underweight and obesity within the same primary healthcare population also illustrates the emerging challenge of addressing different forms of maternal malnutrition through a single antenatal care system. This condition requires health services to move beyond uniform nutritional counselling toward risk-sensitive assessment that considers the individual nutritional profile of each pregnant woman.

The distribution observed in this study provides a practical basis for integrating BMI assessment with hemoglobin screening during early antenatal visits. Women classified as underweight

represented only 10.5% of the sample, yet all respondents in this category were identified as having anemia, creating a clinically relevant concentration of risk that warrants closer nutritional and hematological monitoring. The relationship between maternal nutritional status and pregnancy outcomes has also been demonstrated in studies examining maternal BMI and fetal growth, indicating that maternal nutritional assessment has implications extending beyond maternal health alone (Talahatu et al., 2024). The principal elements that can be incorporated into an early screening framework are summarized in Table 4.

Table 4. Synthesis of the Clinical Implications of BMI and Anemia Findings in First-Trimester Pregnant Women

Assessment Component	Finding in This Study	Clinical Interpretation	Recommended Antenatal Response
BMI Assessment	Underweight: 10.5%; normal: 28.1%; overweight: 21.1%; obesity: 40.4%	Maternal nutritional status varies considerably across the study population	Routine BMI assessment and individualized nutritional counselling
Hemoglobin/Anemia Status	Anemia: 12.3%; no anemia: 87.7%	Anemia remains present among a proportion of first-trimester women	Early Hb screening and periodic monitoring according to clinical indications
Underweight and Anemia	6 of 6 underweight respondents experienced anemia	Underweight status represented the group with the greatest concentration of anemia	Priority nutritional assessment, iron-related counselling, and closer Hb monitoring
Normal BMI and Anemia	1 of 16 respondents experienced anemia	Normal BMI does not exclude anemia	Continue independent hematological screening regardless of BMI
Overweight/Obesity and Anemia	No anemia observed among overweight or obese respondents	Absence of anemia in this sample does not establish a protective effect of higher BMI	Maintain nutritional monitoring and prevent excessive gestational weight gain
Integrated Assessment	Significant BMI–anemia association, $p < 0.001$	BMI and anemia screening provide complementary information	Integrate anthropometric and hematological assessment into early ANC

The synthesis in Table 4 indicates that BMI screening should function as an entry point for nutritional risk stratification rather than as a substitute for hemoglobin assessment. This distinction is important because a normal BMI can coexist with inadequate micronutrient intake, while a high BMI may coexist with poor dietary quality despite substantial energy reserves. Maternal anemia is influenced by multiple interacting determinants, including nutritional deficiencies, reproductive factors, infections, supplementation practices, and healthcare-related factors (Ita et al., 2025). The finding that one woman with normal BMI experienced anemia illustrates the limitation of relying exclusively on anthropometric indicators to identify hematological problems. At the same time, the concentration of anemia among underweight respondents indicates that BMI can provide clinically useful information for prioritizing further nutritional assessment. An integrated screening strategy can therefore improve the identification of women requiring additional counselling or follow-up during pregnancy.

The nutritional counselling component of antenatal care should also be adapted to the BMI profile identified during screening rather than applying identical recommendations to every pregnant woman. For underweight women, counselling should emphasize adequate energy intake, dietary diversity, protein sources, and micronutrients involved in erythropoiesis, while women with overweight or obesity require guidance that maintains nutritional adequacy without promoting excessive energy intake. Nutritional interventions during pregnancy are particularly relevant because inadequate maternal

nutrition may affect both maternal health and fetal growth, including the risk of low birth weight (Hamalding et al., 2023). This approach is consistent with the broader preventive orientation of maternal nursing, which emphasizes early identification of risk factors and individualized health education during pregnancy (Asmuji & Indriyani, 2021). The nutritional profile observed in Kedungwuni I suggests that both nutritional deficiency and excess should be incorporated into the local antenatal care strategy. Individualized counselling may also improve the relevance of health messages because dietary needs, socioeconomic circumstances, and previous nutritional conditions can differ substantially between pregnant women.

Iron supplementation and adherence monitoring remain important components of anemia prevention even when BMI assessment has been performed. The presence of anemia in a woman with normal BMI indicates that body size alone cannot determine whether iron requirements are being adequately met during pregnancy. Educational interventions addressing knowledge, iron intake, and adherence to anemia therapy have been associated with improvements in maternal anemia-related outcomes in community health settings (Zazuli et al., 2024). Early antenatal counselling should therefore explain the purpose of iron supplementation, appropriate dietary sources of iron, factors affecting iron absorption, and the importance of following the recommended supplementation regimen. Women identified as underweight and anemic may require particularly close follow-up because their nutritional vulnerability and hematological condition occur simultaneously. Such monitoring should remain clinically individualized because the present study did not measure iron stores, dietary intake, or supplementation adherence directly.

From a public-health perspective, the findings support strengthening integrated nutritional and hematological screening at the community health-center level, particularly during the first antenatal encounter. The high proportion of obesity in the study population indicates that maternal nutritional counselling should also address excessive weight and the quality of dietary intake rather than focusing exclusively on preventing undernutrition. At the same time, the significant concentration of anemia among underweight women provides a clear rationale for prioritizing this group for additional assessment and preventive intervention. The approach is consistent with the principle that maternal health promotion should combine early detection, education, nutritional management, and continuous monitoring throughout pregnancy (Erfiani Mail et al., 2023). Future studies could strengthen the evidence base by incorporating pre-pregnancy BMI, gestational weight gain, dietary intake, iron supplementation adherence, serum ferritin, parity, and infection status into multivariable analyses. Such variables would help distinguish the independent contribution of BMI from other determinants of anemia and clarify whether the association observed in Kedungwuni I persists after potential confounding factors are controlled.

CONCLUSION

The findings of this study demonstrate a statistically significant relationship between Body Mass Index (BMI) and anemia among first-trimester pregnant women at Kedungwuni I Community Health Center, Pekalongan Regency. The Chi-Square test produced a p-value of <0.001 ($p < 0.05$), indicating that BMI category was significantly associated with anemia status among the 57 participants. Anemia was identified in 7 respondents (12.3%), while 50 respondents (87.7%) were not anemic. Notably, all 6 respondents classified as underweight experienced anemia, whereas only 1 respondent with normal BMI experienced anemia, and no cases were identified among the overweight and obesity groups. This distribution indicates that low BMI represents an important nutritional vulnerability associated with anemia during early pregnancy, although BMI alone cannot explain the multifactorial nature of anemia. The findings support the use of BMI as an early nutritional screening indicator during the first antenatal care visit, particularly for identifying pregnant women who may require further hematological and nutritional assessment. Early identification of women with low BMI can facilitate timely nutritional counselling, monitoring of hemoglobin levels, and appropriate preventive interventions during the first trimester.

From a clinical and public-health perspective, the significant BMI–anemia relationship highlights the importance of integrating anthropometric and hemoglobin assessment into routine antenatal care. Pregnant women with low BMI should receive more intensive nutritional assessment and individualized counselling concerning adequate energy, protein, iron, folate, and other nutrients required during pregnancy. The presence of anemia in one respondent with normal BMI also indicates

that normal nutritional status based on BMI does not eliminate the need for routine hemoglobin screening. Antenatal services should therefore avoid relying on BMI as a single diagnostic measure and instead combine BMI assessment with hematological examination and other relevant maternal risk assessments. The high proportion of obesity observed in this study further indicates the need for balanced nutritional counselling that addresses both undernutrition and excessive maternal weight. Future research should incorporate additional determinants such as dietary intake, iron supplementation adherence, pre-pregnancy BMI, serum ferritin, infection status, and socioeconomic characteristics to provide a more comprehensive explanation of anemia risk. Overall, this study contributes empirical evidence from a primary healthcare setting in Pekalongan Regency and supports early, integrated, and risk-based nutritional and anemia screening during the first trimester of pregnancy.

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