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DIFFERENCES IN HEMOGLOBIN LEVELS BETWEEN FIRST- AND THIRD-TRIMESTER PREGNANT WOMEN AT PUBLIC HEALTH CENTER I EAST DENPASAR

PERBEDAAN KADAR HEMOGLOBIN PADA IBU HAMIL TRIMESTER I DAN III DI PUSKESMAS I DENPASAR TIMUR

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Abstract

Hemoglobin levels in pregnant women may decrease with advancing gestational age due to a greater increase in plasma volume than in erythrocyte mass. Studies comparing changes in hemoglobin levels between the first and third trimesters in the same respondents remain limited. This study aimed to determine the difference in hemoglobin levels between the first and third trimesters among pregnant women at Public Health Center I East Denpasar. This quantitative study used an analytical observational design with a paired comparative longitudinal approach and was conducted in March 2026. The sample consisted of 30 pregnant women selected using accidental sampling. First-trimester data were obtained from medical records, whereas third-trimester data were obtained through venous blood examination using a Micros ES-60 Hematology Analyzer. Data were analyzed descriptively, tested for normality using the Shapiro–Wilk test, and subsequently analyzed using a paired-samples t-test. The mean hemoglobin level in the first trimester was 12.85 g/dL, and all respondents were classified as having normal hemoglobin levels. In the third trimester, the mean hemoglobin level was 10.38 g/dL; 23 respondents were classified as having low hemoglobin levels, while 7 respondents had normal levels. The mean decrease in hemoglobin level was 2.47 g/dL. The data were normally distributed with a p-value of 0.053, while the paired-samples t-test showed $p < 0.001$. There was a significant difference in hemoglobin levels between the first and third trimesters. Regular hemoglobin monitoring is recommended to support the prevention of anemia during pregnancy.

Keywords : Hemoglobin Levels, Pregnant Women, First Trimester, Third Trimester, Anemia.

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Abstrak

Kadar hemoglobin pada ibu hamil dapat menurun seiring bertambahnya usia kehamilan akibat peningkatan volume plasma yang lebih besar daripada massa eritrosit. Kajian yang membandingkan perubahan kadar hemoglobin trimester I dan III pada responden yang sama masih terbatas. Penelitian ini bertujuan untuk mengetahui perbedaan kadar hemoglobin pada ibu hamil trimester I dan III di Puskesmas I Denpasar Timur. Metode menggunakan Penelitian kuantitatif dengan desain observasional analitik dan pendekatan longitudinal komparatif berpasangan dilaksanakan pada Maret 2026. Sampel terdiri atas 30 ibu hamil yang dipilih menggunakan accidental sampling. Data trimester I diperoleh dari rekam medis, sedangkan data trimester III diperoleh melalui pemeriksaan darah vena menggunakan Hematology Analyzer Micros ES-60. Data dianalisis secara deskriptif, diuji normalitas dengan Shapiro–Wilk, dan dilanjutkan menggunakan Paired Sample t-test. Rata-rata kadar hemoglobin trimester I sebesar 12,85 g/dL dan seluruh responden berkategori normal. Pada trimester III, rata-rata kadar hemoglobin sebesar 10,38 g/dL; sebanyak 23 responden berkategori rendah dan 7 responden berkategori normal. Rata-rata penurunan kadar hemoglobin sebesar 2,47 g/dL. Data berdistribusi normal dengan p-value 0,053, sedangkan Paired Sample t-test menunjukkan p<0,001. Terdapat perbedaan signifikan kadar hemoglobin antara trimester I dan III. Pemantauan hemoglobin secara berkala diperlukan untuk mendukung pencegahan anemia selama kehamilan.

Kata Kunci : Kadar Hemoglobin, Ibu Hamil, Trimester I, Trimester III, Anemia.

1. INTRODUCTION

Pregnancy is a physiological process accompanied by various physical and psychological changes from early pregnancy until term (Indria, 2019). This process begins with fertilization and implantation, followed by embryonic development and fetal maturation, and is divided into three trimesters representing different stages of maternal and fetal development (Nurlina et al., 2025). One important component that changes during pregnancy is hemoglobin. Hemoglobin is a protein found in erythrocytes that functions to transport oxygen from the lungs to body tissues and carry carbon dioxide from the tissues back to the lungs. Adequate hemoglobin levels are required to maintain oxygen supply for maternal metabolism and fetal development (Istiqomaria & Bastian, 2021)

A decrease in hemoglobin levels can reduce the blood's oxygen-carrying capacity and increase the risk of anemia. In pregnant women, anemia is defined as a hemoglobin level below 11.0 g/dL in the first and third trimesters and below 10.5 g/dL in the second trimester. This condition can increase the risk of adverse maternal and fetal outcomes, including miscarriage, preterm delivery, impaired fetal growth, premature rupture of membranes, postpartum hemorrhage, and reduced nutritional quality of breast milk (Nurhajimah et al., 2024). Globally, anemia affects approximately 41.8% of pregnant women, with most cases associated with iron deficiency (Asiah & Utami, 2024). In Indonesia, the 2023 Indonesian Health Survey reported an anemia prevalence of 27.7% among pregnant women (Badan Kebijakan Pembangunan Daerah, 2023). A similar problem has also been reported in Bali Province, where the prevalence of anemia increased from 5.07% in 2019 to 5.78% in 2020. In Denpasar City, the prevalence increased from 4.7% in 2019 to 7.55% in 2020 (Dinas Kesehatan Provinsi Bali, 2021). These data indicate that anemia during pregnancy remains an important health problem requiring continued attention, including at the primary healthcare level.

Changes in hemoglobin levels during pregnancy are not only associated with iron deficiency but are also influenced by physiological adaptation. During pregnancy, plasma volume increases more than erythrocyte mass, resulting in hemodilution or blood dilution. The increase in plasma volume becomes apparent in the second trimester and reaches its peak in the third trimester. This condition causes hemoglobin concentrations to tend to decrease as gestational age advances (Kementerian Kesehatan Republik Indonesia, 2018). Although hemodilution is a physiological process that helps reduce cardiac workload and prepares the body for blood loss during delivery, declining hemoglobin levels still need to be monitored to distinguish physiological changes from conditions that may lead

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to anemia. Regular hemoglobin testing is therefore necessary to assess the blood's oxygen-carrying capacity and to detect anemia as early as possible in pregnant women.

Anemia during pregnancy can have serious consequences if it is not identified and managed appropriately (Habibah et al., 2024). This condition may cause fatigue, respiratory problems, impaired organ function, preterm delivery, postpartum hemorrhage, and disturbances in fetal growth and development (Sjahriani & Faridah, 2019). Anemia prevention can be achieved through regular antenatal care, a balanced nutritious diet, improved maternal knowledge, and routine consumption of iron tablets (Rismawati & Rohmatin, 2018). Therefore, monitoring changes in hemoglobin levels from early to late pregnancy is important as part of antenatal care to support maternal and fetal health.

Several previous studies have shown that hemoglobin levels tend to decrease with advancing gestational age. A study conducted at Gebang Public Health Center reported mean hemoglobin levels of 12.8 g/dL in the first trimester, 11.5 g/dL in the second trimester, and 10.1 g/dL in the third trimester. This decline was associated with the increased iron requirement for fetal growth and the formation of iron stores before delivery. Another study at Poasia Public Health Center also demonstrated differences in hemoglobin levels across the first, second, and third trimesters of pregnancy (Irdayanti, 2017). In addition, a study at Air Dingin Public Health Center in Padang City reported that anemia was more frequently found in the third trimester due to the increasing demand for iron and nutrients (M. U. Rizki, 2017). Similar findings were reported at Kasihan I Public Health Center in Bantul, where most third-trimester pregnant women experienced mild anemia (Astuti, 2017). These findings indicate a relatively consistent pattern that the third trimester is a period with a greater risk of decreased hemoglobin levels.

Previous studies have generally focused on the incidence of anemia, factors influencing anemia, or comparisons of hemoglobin levels among different groups of pregnant women. Discussion regarding the decline in hemoglobin levels as part of physiological hemodilution, particularly through paired measurements in the same respondents from the first to the third trimester, remains limited. The novelty of this study lies in comparing first- and third-trimester hemoglobin levels in the same pregnant women using a paired comparative longitudinal approach in a primary healthcare setting. This study is expected to strengthen the understanding of changes in hemoglobin levels during pregnancy and provide a practical basis for healthcare professionals to improve monitoring and early detection of anemia. Based on this research gap, this study aimed to determine and analyze differences in hemoglobin levels between the first and third trimesters among pregnant women at Public Health Center I East Denpasar.

2. RESEARCH METHOD

This study was a quantitative study with an analytical observational design and a paired comparative longitudinal approach. The study was conducted at Public Health Center I East Denpasar in March 2026 by comparing hemoglobin levels in the same respondents during the first and third trimesters. Secondary data on first-trimester hemoglobin levels were obtained from medical records, while primary data for the third trimester were obtained through venous blood examination using a Micros ES-60 Hematology Analyzer. The study population consisted of all pregnant women who underwent hemoglobin testing during the first and third trimesters. A total of 30 pregnant women were selected using accidental sampling. The study received ethical approval from the Health Research Ethics Committee of STIKES Wira Medika Bali under approval number 817/E1.STIKESWIKA/EC/VI/2026. The independent variables were the first and third trimesters, while the dependent variable was hemoglobin level measured in g/dL on a ratio scale. Hemoglobin levels were categorized as normal when >11 g/dL and as anemia when <11 g/dL. Data were analyzed using SPSS version 26 through descriptive analysis, the Shapiro–Wilk normality test, and a paired-samples t-test with a significance level of 0.05.

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3. RESULT AND DISCUSSION

The study involved 30 pregnant women who underwent hemoglobin level testing during the first and third trimesters. Respondent characteristics based on age group are presented in Table 1.

Table 1. Respondent Characteristics by Age

Age Group	Number (n)	Percentage (%)
18–35 years (young adults)	22	73,3
36–45 years (middle-aged adults)	8	26,7
Total	30	100

Table 1 shows that most respondents were in the 18–35-year age group, comprising 22 respondents (73.3%), while 8 respondents (26.7%) were aged 36–45 years.

The hemoglobin levels based on category, mean, standard deviation, minimum, and maximum values are presented in Table 2.

Table 2. Hemoglobin Levels of Pregnant Women in the First and Third Trimesters

Trimester	Low, n (%)	Normal, n (%)	Mean (g/dL)	SD	Min (g/dL)	Max (g/dL)
First Trimester–	0 (0,0)	30 (100,0)	12,85	0,7075	11,7	14,3
Third Trimester	23 (76,7)	7 (23,3)	10,383	0,6041	9,5	11,6

Note: SD = standard deviation

Table 2 shows that all respondents in the first trimester had hemoglobin levels within the normal category. In the third trimester, most respondents had low hemoglobin levels, accounting for 23 respondents (76.7%). The mean hemoglobin level decreased from 12.85 g/dL in the first trimester to 10.38 g/dL in the third trimester, with a mean decrease of 2.47 g/dL.

Before hypothesis testing, the Shapiro–Wilk normality test was performed on the differences in hemoglobin levels between the first and third trimesters. The results of the normality test are presented in Table 3.

Table 3. Results of the Normality Test for Differences in Hemoglobin Levels

Variable	*Statistik Shapiro–Wilk*	df	*p-value*
Difference in hemoglobin levels	0,931	30	0,053

Table 3 shows a p-value of 0.053, indicating that the differences in hemoglobin levels were normally distributed. Therefore, the comparison of hemoglobin levels was continued using a paired-samples t-test.

The results of the paired-samples t-test comparing hemoglobin levels between the first and third trimesters are presented in Table 4.

Table 4. Results of the Paired-Samples t-Test for Hemoglobin Levels in the First and Third Trimesters

Comparison	Mean Difference	SD	SE	95% CI	t	df	*p-value*
First - Third Trimester	2,4667	0,2383	0,0435	2,3777–2,5556	56,698	29	<0,001

Note: SD = standard deviation; SE = standard error; CI = confidence interval.

Table 4 shows that there was a significant difference in hemoglobin levels between the first and third trimesters, with a t-value of 56.698 and $p < 0.001$. Hemoglobin levels in the first trimester were

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higher than those in the third trimester, with a mean difference of 2.4667 g/dL. Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted.

The study findings showed a significant difference in hemoglobin levels among pregnant women between the first and third trimesters at Public Health Center I East Denpasar. The mean hemoglobin level in the third trimester was lower than that in the first trimester; therefore, the alternative hypothesis was accepted. These findings indicate that hemoglobin levels change as gestational age advances. This change is important to consider because most respondents had normal hemoglobin levels in the first trimester but experienced a decline to low levels in the third trimester.

All respondents in the first trimester had hemoglobin levels within the normal category, with a mean value of 12.85 g/dL. This condition indicates that, in early pregnancy, the blood's capacity to transport oxygen remains adequate. During the first trimester, the increase in plasma volume has not yet reached its maximum level; therefore, hemodilution has not substantially reduced hemoglobin concentration. In addition, maternal iron stores may still help meet the physiological needs of the mother and support fetal development during early pregnancy (Sudrajat, 2022). These findings are also consistent with the concept that hemoglobin levels within the normal range indicate that oxygen transport to maternal and fetal tissues is still functioning adequately (Rismawati & Rohmatin, 2018).

The findings in the first trimester are consistent with the study by Nurhajimah et al (2024), which reported a mean hemoglobin level of 12.8 g/dL among first-trimester pregnant women. The similarity of these findings indicates that hemoglobin levels in early pregnancy tend to be higher than those in later stages of pregnancy. At this stage, physiological changes such as increased plasma volume and greater iron requirements have begun to occur but have not yet reached their peak. Therefore, hemoglobin levels in the first trimester can still be maintained within the normal range.

In contrast to the first trimester, the mean hemoglobin level in the third trimester decreased to 10.38 g/dL. A total of 23 respondents (76.7%) had hemoglobin levels in the low category, while the remaining seven respondents had normal levels. These findings indicate that pregnant women are more susceptible to decreased hemoglobin levels in late pregnancy. During the third trimester, iron requirements increase to support fetal growth, placental development, and preparation for delivery. At the same time, plasma volume increases more markedly than erythrocyte mass, resulting in hemodilution and a decrease in hemoglobin concentration in the blood (Sudrajat, 2022)

The findings in the third trimester are consistent with the study by Nurhajimah et al (2024) which reported a mean hemoglobin level of 10.1 g/dL among third-trimester pregnant women. Rizki et al (2017) also found that anemia was more frequently observed in the third trimester due to increasing iron and nutritional requirements. Similar findings were reported by Astuti (2017) who found that most third-trimester pregnant women experienced mild anemia. The consistency of these findings reinforces the view that the third trimester is a period requiring greater attention in hemoglobin monitoring.

The paired-samples t-test showed a significant difference in hemoglobin levels between the first and third trimesters, with $p < 0.001$. The mean decrease in hemoglobin levels from the first to the third trimester was 2.47 g/dL. These findings support the explanation that physiological changes during pregnancy can affect hemoglobin concentration. The increase in plasma volume becomes apparent in the second trimester and reaches its peak in the third trimester, while the increase in erythrocyte mass does not occur in the same proportion. Consequently, the blood becomes more diluted and the measured hemoglobin concentration decreases (Sudrajat, 2022).

These findings are consistent with the study by Irdayanti (2017), which demonstrated differences in hemoglobin levels among pregnant women across the first, second, and third trimesters. The results also support the findings of Nurhajimah et al. (2024), who reported a decreasing pattern in hemoglobin levels from the first to the third trimester. The similarity of these findings indicates that advancing gestational age is accompanied by hematological changes that may reduce hemoglobin levels (Ariastuti, 2021). However, this decline still requires monitoring because low hemoglobin levels

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can reduce oxygen supply to maternal and fetal tissues and increase the risk of complications during pregnancy (Sjahriani & Faridah, 2019).

The findings of this study do not indicate that all decreases in hemoglobin levels during the third trimester are caused solely by physiological processes. Increased iron and nutritional requirements may also contribute when they are not matched by adequate intake. Therefore, hemoglobin testing is necessary to distinguish changes related to physiological adaptation from decreases that have progressed toward anemia. Such testing is an important component of antenatal care for detecting anemia and determining appropriate follow-up (Rismawati & Rohmatin, 2018). Preventive efforts can be supported through regular antenatal examinations, a balanced nutritious diet, improved maternal knowledge, and consistent consumption of iron supplementation tablets.

The strength of this study lies in the use of a paired comparative longitudinal approach. Hemoglobin levels in the first and third trimesters were obtained from the same respondents, allowing changes in hemoglobin levels to be observed within the same individuals. This approach reduces variation in results that may occur when measurements are performed in two different groups of pregnant women. This study also provides empirical evidence regarding changes in hemoglobin levels during pregnancy in a primary healthcare setting, particularly at Public Health Center I East Denpasar.

This study was limited to 30 respondents from a single study site who were selected using accidental sampling. Therefore, the findings should be interpreted according to the characteristics of the respondents and the context of Public Health Center I East Denpasar. First-trimester data were obtained from medical records, whereas third-trimester data were obtained through direct examination, resulting in different data sources at the two measurement points. The study also did not analyze other factors that may be associated with hemoglobin levels, such as nutritional status, adherence to iron supplementation, dietary patterns, parity, and interpregnancy interval.

Theoretically, this study strengthens the explanation of hematological changes during pregnancy, particularly the decrease in hemoglobin concentration resulting from a greater increase in plasma volume than in erythrocyte mass. The findings also provide additional evidence that these changes become more apparent in the third trimester. From a practical perspective, the findings emphasize the importance of regular hemoglobin monitoring, particularly toward the end of pregnancy. Healthcare professionals should strengthen education regarding adherence to iron supplementation and the consumption of foods containing iron, folic acid, and other supportive nutrients. For public health centers, these findings may serve as a basis for evaluating antenatal care services, particularly in the early detection and prevention of anemia among pregnant women.

Future studies are recommended to involve larger numbers of respondents across broader study settings and to use more representative sampling techniques. Further research should also examine nutritional status, dietary patterns, parity, interpregnancy interval, and adherence to iron supplementation. The regularity and manner in which pregnant women consume iron supplements should be assessed more specifically so that factors associated with decreased hemoglobin levels can be explained more comprehensively.

4. CONCLUSION

The study findings showed that hemoglobin levels in the first trimester were within the normal range, whereas in the third trimester they tended to decrease, with most respondents classified as having low hemoglobin levels. There was a significant difference in hemoglobin levels between the first and third trimesters, indicating that regular hemoglobin monitoring is important to support the early detection of anemia during pregnancy. Healthcare professionals are advised to strengthen hemoglobin testing, particularly in the third trimester, and provide education regarding adherence to iron supplementation and adequate intake of iron-rich foods. Future researchers are recommended to investigate other factors associated with hemoglobin levels, such as nutritional status, dietary patterns, parity, interpregnancy interval, and adherence to iron supplementation.

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