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Association Between Gestational Trimester and Hemoglobin Levels among Pregnant Women at Dau Public Health Center, Malang Regency

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ABSTRACT

Physiological changes during pregnancy, particularly in the second and third trimesters, may affect maternal hemoglobin levels, which play a crucial role in oxygen transport to the fetus. Hemoglobin imbalance during pregnancy may increase the risk of maternal anemia and adverse pregnancy outcomes. This study aimed to analyze hemoglobin levels among second and third trimester pregnant women at Dau Public Health Center, Malang Regency, and to identify factors associated with hemoglobin status. This study employed a descriptive quantitative design using a total sampling technique involving 25 pregnant women, consisting of 13 second trimester and 12 third trimester respondents. Hemoglobin levels were measured using a hematology analyzer, while supporting data were collected using questionnaires related to iron tablet consumption, dietary patterns, antenatal care (ANC) visits, sleep duration, and anemia history. The results showed that the mean hemoglobin level in the second trimester was 11.75 g/dL, while in the third trimester it increased to 12.94 g/dL. Most respondents had normal hemoglobin levels (96%), while only one respondent (4%) demonstrated elevated hemoglobin levels in the third trimester. Routine iron supplementation, regular ANC visits, and adequate nutritional intake were identified as factors associated with normal hemoglobin levels. These findings indicate that most pregnant women at Dau Public Health Center maintained normal hemoglobin status during pregnancy. Regular monitoring of hemoglobin levels and nutritional education remain important to prevent maternal anemia and pregnancy complications.

Keywords: *Hemoglobin Levels, Pregnant Women, Gestational Trimester, Antenatal Care, Iron Supplementation*

ABSTRAK

Perubahan fisiologis selama kehamilan, terutama pada trimester kedua dan ketiga, dapat memengaruhi kadar hemoglobin ibu hamil yang berperan penting dalam proses transportasi oksigen ke janin. Ketidakseimbangan kadar hemoglobin selama kehamilan dapat meningkatkan risiko anemia maternal dan komplikasi kehamilan. Penelitian ini bertujuan untuk menganalisis kadar hemoglobin pada ibu hamil trimester kedua dan trimester ketiga di Puskesmas Dau Kabupaten Malang serta mengidentifikasi faktor-faktor yang berhubungan dengan status hemoglobin. Penelitian ini menggunakan desain deskriptif kuantitatif dengan teknik total sampling yang melibatkan 25 ibu hamil, terdiri dari 13 responden trimester kedua dan 12 responden trimester ketiga. Pemeriksaan kadar hemoglobin dilakukan menggunakan hematology analyzer, sedangkan data pendukung dikumpulkan melalui kuesioner terkait konsumsi tablet Fe, pola makan, kunjungan antenatal care (ANC), durasi tidur, dan riwayat anemia. Hasil penelitian menunjukkan bahwa rata-rata kadar hemoglobin pada trimester kedua sebesar 11,75 g/dL, sedangkan pada trimester ketiga meningkat menjadi 12,94 g/dL. Sebagian besar responden memiliki kadar hemoglobin normal (96%), sementara hanya satu responden (4%) menunjukkan kadar hemoglobin tinggi pada trimester ketiga. Konsumsi tablet Fe secara rutin, kunjungan ANC teratur, dan asupan nutrisi yang baik menjadi faktor yang berhubungan dengan kadar hemoglobin normal. Temuan ini menunjukkan bahwa sebagian besar ibu hamil di Puskesmas Dau mampu mempertahankan status hemoglobin normal selama kehamilan. Pemantauan kadar hemoglobin secara berkala serta edukasi gizi tetap diperlukan untuk mencegah anemia dan komplikasi selama kehamilan.

Kata kunci: Kadar Hemoglobin, Ibu Hamil, Trimester Kehamilan, Antenatal Care, Suplementasi Zat Besi

INTRODUCTION

Maternal mortality remains a major global public health challenge and is influenced by various internal and external factors affecting pregnant women. Limited access to adequate healthcare services, insufficient numbers of trained healthcare professionals, inadequate knowledge regarding proper prenatal and postnatal care, as well as socioeconomic problems such as poverty and unstable economic conditions are considered important external factors contributing to maternal mortality. In addition, several internal factors including hypertension during pregnancy, hemorrhage, postpartum infection, unsafe abortion, and anemia may significantly increase the risk of maternal complications and death(1,2).

According to the World Health Organization (WHO), complications during pregnancy such as bleeding, anemia, and miscarriage occurring during the first, second, or third trimester continue to contribute substantially to maternal mortality worldwide(2,3). Pregnancy is a physiological process that causes substantial anatomical, hormonal, emotional, psychological, and musculoskeletal changes in women to support fetal growth and development(4,5). During pregnancy, especially in the second and third trimesters, maternal blood volume increases significantly to support placental development and fetal oxygenation. This physiological adaptation directly influences hemoglobin concentration in maternal circulation.

Hemoglobin is a globular protein containing iron that consists of two alpha and two beta polypeptide chains and functions primarily in oxygen transport from the lungs to body tissues, including the developing fetus(6). Adequate hemoglobin levels are essential to maintain maternal health and ensure optimal fetal growth during pregnancy. The normal hemoglobin level in pregnant women is approximately 11 g/dL(7,8). During pregnancy, iron requirements increase substantially because of plasma volume expansion, increased erythrocyte production, fetal development, and placental growth. Consequently, pregnant women undergo complex

hematological adaptations, including changes in hemoglobin concentration, to fulfill increasing oxygen demands throughout gestation.

Despite these physiological adaptations, many pregnant women experience decreased hemoglobin levels resulting in anemia. Maternal anemia remains one of the most prevalent nutritional and hematological disorders worldwide. WHO data indicate that approximately 40% of pregnant women globally experience anemia, with a high prevalence observed in Southeast Asian countries, including Indonesia(9,10). Maternal anemia has been associated with various adverse maternal and neonatal outcomes, including premature birth, low birth weight, impaired fetal growth, and increased maternal morbidity(11,12). Previous studies conducted in several regions have reported significant reductions in hemoglobin levels during the second and third trimesters as a consequence of hemodilution and increased iron requirements during pregnancy(13,14).

Several factors may influence hemoglobin levels among pregnant women, including nutritional intake, adherence to iron supplementation, antenatal care attendance, socioeconomic status, sleep quality, and previous history of anemia. Previous studies have primarily focused on maternal anemia prevalence or risk factors independently; however, studies specifically describing hemoglobin profiles between second and third trimester pregnant women at the primary healthcare level remain limited, particularly in the Malang Regency area. Therefore, this study provides scientific novelty by evaluating hemoglobin levels among pregnant women based on gestational trimester while simultaneously identifying associated maternal health factors in a community healthcare setting.

Regular monitoring of hemoglobin levels during pregnancy is essential to detect early hematological abnormalities and prevent pregnancy complications associated with anemia. Understanding hemoglobin profiles among pregnant women may contribute to improving maternal healthcare services and developing more effective nutritional interventions at primary healthcare facilities. Therefore, this study aimed to analyze hemoglobin levels among second and third trimester pregnant women at Dau Public Health Center, Malang Regency. The findings of this study are expected to provide important information regarding maternal hemoglobin status and support preventive strategies to reduce the risk of maternal anemia and pregnancy-related complications..

METHODS

This study employed a descriptive quantitative research design aimed at analyzing hemoglobin levels among second and third trimester pregnant women at Dau Public Health Center, Malang Regency. The study was conducted in February 2025 at Dau Public Health Center, Malang Regency. The study population consisted of all pregnant women who underwent antenatal examinations at Dau Public Health Center during the study period. The samples included 25 pregnant women who met the inclusion criteria, consisting of 13 second trimester pregnant women and 12 third trimester pregnant women. A total sampling technique was applied to recruit all eligible respondents.

Hemoglobin examination was performed using a hematology analyzer to measure hemoglobin levels from venous blood specimens. Venous blood samples were collected from each respondent using standardized phlebotomy procedures and subsequently analyzed in the laboratory. Additional data regarding respondent characteristics and supporting factors were collected using structured questionnaires. Data collection procedures included venous blood sampling and questionnaire administration related to demographic characteristics, iron supplementation consumption, dietary patterns, sleep duration, history of anemia, and antenatal care (ANC) attendance. The independent variables observed in this study included gestational trimester, iron tablet consumption, nutritional patterns, sleep duration, anemia history, and ANC

compliance, while the dependent variable was hemoglobin level. Data analysis was performed using descriptive statistical methods to calculate mean, median, mode, frequency, and percentage distributions of hemoglobin levels among respondents. Cross-tabulation analysis was also conducted to describe the distribution of hemoglobin levels according to supporting variables such as gestational trimester, iron supplementation adherence, dietary patterns, and other maternal factors associated with hemoglobin status during pregnancy.

RESULTS

This study was conducted at Dau Public Health Center, Malang Regency, from March to May 2025 involving 25 pregnant women, consisting of 13 second trimester and 12 third trimester respondents. Hemoglobin examination was performed at Saiful Anwar General Hospital Laboratory, Malang, using the Sodium Lauryl Sulfate (SLS) method with a Hematology Analyzer. The findings demonstrated variations in hemoglobin levels among pregnant women according to gestational trimester and maternal health-related factors.

Table 1. Hemoglobin Levels among Second and Third Trimester Pregnant Women at Dau Public Health Center

Gestational Trimester	Hemoglobin Range (g/dL)	Category
Second Trimester	10.4 – 13.39	Normal
Third Trimester	11.5 – 15.2	Predominantly Normal

Based on Table 1, all respondents in the second trimester had hemoglobin levels within the normal range. Hemoglobin levels among second trimester respondents ranged from 10.4 g/dL to 13.39 g/dL. Meanwhile, third trimester respondents demonstrated hemoglobin levels ranging from 11.5 g/dL to 15.2 g/dL, with one respondent categorized as having elevated hemoglobin levels. Overall, most pregnant women demonstrated normal hemoglobin status during pregnancy.

Table 2. Descriptive Statistical Analysis of Hemoglobin Levels among Pregnant Women

Respondent Group	Mean	Median	Mode	Minimum	Maximum
Second Trimester	11.75	12.0	11.1	10.4	13.39
Third Trimester	12.94	12.7	12.4	11.5	15.2

The descriptive analysis showed that the mean hemoglobin level in second trimester pregnant women was 11.75 g/dL, while the mean value increased to 12.94 g/dL in the third trimester. The lowest hemoglobin level recorded in the second trimester was 10.4 g/dL, whereas the highest level was 13.39 g/dL. In the third trimester, hemoglobin levels ranged from 11.5 g/dL to 15.2 g/dL. These findings indicate that the majority of respondents maintained normal hemoglobin levels during pregnancy, although one respondent in the third trimester demonstrated elevated hemoglobin concentration.

Cross-tabulation analysis between gestational trimester and hemoglobin category is presented in Table 3.

Table 3. Cross-tabulation between Gestational Trimester and Hemoglobin Levels

Gestational Trimester	Normal n (%)	High n (%)	Total n (%)
Second Trimester	13 (52%)	0 (0%)	13 (52%)
Third Trimester	11 (44%)	1 (4%)	12 (48%)
Total	24 (96%)	1 (4%)	25 (100%)

Table 3 demonstrates that all respondents in the second trimester had normal hemoglobin levels. Among third trimester respondents, 11 pregnant women (44%) had normal hemoglobin levels, while one respondent (4%) showed elevated hemoglobin concentration. Overall, 96% of respondents had normal hemoglobin levels.

The relationship between iron supplementation consumption and hemoglobin levels is shown in Table 4.

Table 4. Cross-tabulation between Iron Supplement Consumption and Hemoglobin Levels

Iron Supplement Consumption	Normal n (%)	High n (%)	Total n (%)
Yes	23 (92%)	1 (4%)	24 (96%)
No	1 (4%)	0 (0%)	1 (4%)
Total	24 (96%)	1 (4%)	25 (100%)

Based on Table 4, most respondents routinely consumed iron supplementation during pregnancy. Among respondents who consumed iron tablets, 23 respondents (92%) had normal hemoglobin levels, while one respondent (4%) demonstrated elevated hemoglobin levels.

Table 5 presents the relationship between pregnancy complication history and hemoglobin levels.

Table 5. Cross-tabulation between Pregnancy Complication History and Hemoglobin Levels

Pregnancy Complication History	Normal n (%)	High n (%)	Total n (%)
Yes	0 (0%)	0 (0%)	0 (0%)
No	24 (96%)	1 (4%)	25 (100%)
Total	24 (96%)	1 (4%)	25 (100%)

The findings showed that none of the respondents had a history of pregnancy complications. Most respondents demonstrated normal hemoglobin levels despite the absence of previous pregnancy complications.

The association between sleep duration and hemoglobin levels is summarized in Table 6.

Table 6. Cross-tabulation between Daily Sleep Duration and Hemoglobin Levels

Sleep Duration (7–9 hours/day)	Normal n (%)	High n (%)	Total n (%)
Yes	15 (60%)	1 (4%)	16 (64%)
No	9 (36%)	0 (0%)	9 (36%)
Total	24 (96%)	1 (4%)	25 (100%)

Most respondents reported adequate sleep duration of 7–9 hours per day. Among these respondents, 15 pregnant women (60%) had normal hemoglobin levels, while one respondent (4%) demonstrated elevated hemoglobin concentration.

The relationship between anemia history and hemoglobin levels is presented in Table 7.

Table 7. Cross-tabulation between Anemia History and Hemoglobin Levels

Anemia History	Normal n (%)	High n (%)	Total n (%)
Yes	5 (20%)	0 (0%)	5 (20%)
No	19 (76%)	1 (4%)	20 (80%)
Total	24 (96%)	1 (4%)	25 (100%)

Based on Table 7, five respondents (20%) reported a previous history of anemia, and all demonstrated normal hemoglobin levels during the study period.

Table 8 presents the relationship between breakfast habits and hemoglobin levels.

Table 8. Cross-tabulation between Breakfast Habits and Hemoglobin Levels

Daily Breakfast Habit	Normal n (%)	High n (%)	Total n (%)
Yes	19 (76%)	1 (4%)	20 (80%)
No	5 (20%)	0 (0%)	5 (20%)
Total	24 (96%)	1 (4%)	25 (100%)

Most respondents routinely consumed breakfast every day, and the majority of them demonstrated normal hemoglobin levels.

The relationship between fatigue during daily activities and hemoglobin levels is summarized in Table 9.

Table 9. Cross-tabulation between Fatigue during Activities and Hemoglobin Levels

Frequent Fatigue during Activities	Normal n (%)	High n (%)	Total n (%)
Yes	6 (24%)	0 (0%)	6 (24%)
No	18 (72%)	1 (4%)	19 (76%)
Total	24 (96%)	1 (4%)	25 (100%)

Most respondents reported not experiencing frequent fatigue during daily activities, and most of them had normal hemoglobin levels. Table 10 presents the relationship between iron-rich food consumption and hemoglobin levels.

Table 10. Cross-tabulation between Iron-rich Food Consumption and Hemoglobin Levels

Table 10. Cross-tabulation between Iron-rich Food Consumption and Hemoglobin Levels

Iron-rich Food Consumption	Normal n (%)	High n (%)	Total n (%)
Yes	24 (96%)	1 (4%)	25 (100%)
No	0 (0%)	0 (0%)	0 (0%)
Total	24 (96%)	1 (4%)	25 (100%)

All respondents reported consuming iron-rich foods and vegetables. Most respondents demonstrated normal hemoglobin levels, indicating adequate nutritional support during pregnancy.

The relationship between antenatal care (ANC) attendance and hemoglobin levels is shown in Table 11

Table 11. Cross-tabulation between ANC Attendance and Hemoglobin Levels

Routine ANC Examination	Normal n (%)	High n (%)	Total n (%)
Yes	24 (96%)	0 (0%)	24 (96%)
No	0 (0%)	1 (4%)	1 (4%)
Total	24 (96%)	1 (4%)	25 (100%)

Most respondents routinely attended ANC examinations during pregnancy, and all of them demonstrated normal hemoglobin levels.

Overall hemoglobin distribution according to maternal age and gestational trimester is summarized in Table 12.

Table 12. Distribution of Hemoglobin Levels among Pregnant Women Based on Maternal Age and Gestational Trimester

Variable	Normal n (%)	High n (%)
Age 21–25 years	7 (29%)	0 (0%)
Age 26–30 years	12 (50%)	1 (4%)
Age 31–35 years	5 (21%)	0 (0%)
Second Trimester	13 (52%)	0 (0%)
Third Trimester	11 (44%)	1 (4%)

Based on Table 12, most respondents with normal hemoglobin levels were aged 26–30 years. The only respondent with elevated hemoglobin concentration was also identified within this age group. According to gestational trimester, all second trimester respondents demonstrated normal hemoglobin levels, whereas elevated hemoglobin concentration was identified only among third trimester respondents. Overall, these findings indicate that the majority of pregnant women at Dau Public Health Center maintained normal hemoglobin levels during pregnancy regardless of maternal age and gestational trimester.

DISCUSSION

This study was conducted among 25 pregnant women at Dau Public Health Center, Malang Regency, to evaluate hemoglobin levels during the second and third trimesters of pregnancy and to identify maternal factors associated with hemoglobin status. The findings demonstrated that the majority of respondents maintained normal hemoglobin levels throughout pregnancy, indicating relatively good maternal nutritional status and adequate antenatal health monitoring. These results suggest that preventive maternal health programs implemented at the primary healthcare level may contribute positively to maintaining maternal hematological status during pregnancy.

The mean hemoglobin level among second trimester pregnant women was 11.75 g/dL, while the mean value increased to 12.94 g/dL in the third trimester. Physiologically, pregnancy is characterized by significant hematological adaptations, particularly increased plasma volume expansion that exceeds erythrocyte production during the second trimester, resulting in physiological hemodilution. This phenomenon commonly causes relative reductions in maternal hemoglobin concentration despite increased red blood cell mass. However, the present study showed that hemoglobin levels remained within the normal reference range among most respondents, indicating adequate iron intake and effective physiological adaptation during pregnancy. Similar findings have been reported by previous studies demonstrating that routine iron supplementation and adequate nutritional intake help maintain normal hemoglobin levels during pregnancy despite physiological hemodilution(7,15).

Iron requirement during pregnancy substantially increases to support maternal erythropoiesis, placental development, and fetal growth. Approximately 1000 mg of additional iron is required throughout pregnancy, including 500 mg for maternal red blood cell mass expansion, 300 mg for fetal and placental development, and 200 mg to compensate for physiological iron loss(16). Insufficient iron intake may lead to maternal anemia, which is associated with adverse maternal and neonatal outcomes, including preterm birth, low birth weight, and impaired fetal development. In the present study, most respondents routinely consumed iron supplementation and demonstrated normal hemoglobin levels. These findings support previous evidence indicating that iron supplementation remains one of the most effective preventive strategies against maternal anemia during pregnancy(17).

Maternal age was also identified as an important factor associated with hemoglobin status. Most respondents were within the reproductive age range of 20–35 years, which is considered the optimal reproductive period with lower pregnancy-related complication risks. Women within this age range generally exhibit better physiological adaptation, hormonal balance, and nutritional awareness compared to younger or older maternal age groups. Previous studies have shown that pregnancies occurring below 20 years or above 35 years are associated with increased risk of anemia due to nutritional inadequacy, metabolic imbalance, and reduced physiological reserve(18). In this study, the majority of respondents aged 26–30 years demonstrated normal hemoglobin levels, suggesting that maternal reproductive age may contribute to better hematological stability during pregnancy.

The distribution of gestational trimester demonstrated that 52% of respondents were in the second trimester and 48% in the third trimester. Interestingly, all second trimester respondents had normal hemoglobin levels, whereas one respondent in the third trimester demonstrated elevated hemoglobin concentration. Increased hemoglobin concentration during late pregnancy may be associated with hemoconcentration resulting from insufficient fluid intake or excessive iron supplementation. Although iron supplementation is necessary during pregnancy, excessive intake without regular monitoring may increase the risk of elevated hemoglobin levels and iron overload. Previous studies have suggested that excessively high maternal hemoglobin levels may contribute to increased blood viscosity, reduced placental perfusion, and impaired fetal growth(3).

Nutritional factors also demonstrated important contributions to maternal hemoglobin levels. All respondents reported consuming iron-rich foods such as green vegetables, meat, and other iron-containing dietary sources. Adequate nutritional intake, especially iron, folate, vitamin B12, and vitamin C, plays a major role in erythropoiesis and hemoglobin synthesis. Balanced nutrition may help maintain normal hemoglobin levels even among pregnant women with previous anemia history. In the present study, respondents with previous anemia history still demonstrated normal hemoglobin levels, suggesting that continuous nutritional intervention and iron supplementation may effectively improve maternal hematological status. Similar findings were reported in previous studies showing that nutritional education and dietary improvement significantly contribute to reducing maternal anemia prevalence(19).

Sleep duration and lifestyle factors were also associated with maternal hemoglobin status. Most respondents reported adequate sleep duration of 7–9 hours per day and did not frequently experience fatigue during daily activities. Adequate sleep may support physiological recovery, hormonal regulation, and erythrocyte regeneration during pregnancy. Although sleep duration alone may not directly determine hemoglobin levels, sufficient rest contributes to maintaining overall maternal health and reducing physiological stress during pregnancy (20). Additionally, routine breakfast habits observed among most respondents may contribute to better nutritional intake and energy balance, supporting adequate hemoglobin synthesis. Pregnant women who routinely consume breakfast generally demonstrate better dietary quality and lower risk of anemia compared to those who skip meals(21).

Regular antenatal care (ANC) attendance was another important factor identified in this study. Most respondents routinely attended ANC examinations and demonstrated normal hemoglobin levels. ANC services provide opportunities for early detection of hematological abnormalities, nutritional counseling, monitoring of iron supplementation, and evaluation of maternal health status during pregnancy. In contrast, the only respondent with elevated hemoglobin concentration reported irregular ANC attendance, suggesting that inadequate monitoring may contribute to suboptimal management of maternal hematological conditions. Previous studies have emphasized that routine ANC attendance is strongly associated with improved maternal health outcomes and reduced anemia prevalence during pregnancy(22).

The novelty of this study lies in the comprehensive evaluation of maternal hemoglobin profiles among second and third trimester pregnant women at the primary healthcare level by integrating multiple maternal health-related factors, including iron supplementation, nutritional patterns, sleep duration, breakfast habits, anemia history, and ANC attendance. Previous studies have predominantly focused only on anemia prevalence or isolated risk factors, whereas the present study provides a broader overview of maternal hemoglobin status and its multidimensional determinants in community-based maternal healthcare settings. In addition, this study identified a relatively uncommon finding of elevated hemoglobin concentration during the third trimester, highlighting the importance of balanced iron supplementation and regular hematological monitoring during pregnancy. Overall, this study confirms that maternal hemoglobin levels during pregnancy are influenced by multiple interrelated physiological, nutritional, and behavioral factors. Maintaining optimal hemoglobin levels requires not only adequate iron supplementation but also balanced nutrition, sufficient rest, routine ANC attendance, and continuous maternal health education. These findings provide important evidence for strengthening preventive maternal healthcare programs aimed at reducing anemia risk and improving maternal and fetal health outcomes during pregnancy.

CONCLUSION

This study demonstrated that the mean hemoglobin level among third trimester pregnant women (12.94 g/dL) was higher than that of second trimester pregnant women (11.75 g/dL) at Dau Public Health Center, Malang Regency. Most respondents in both gestational trimesters had hemoglobin levels within the normal range, while only one respondent in the third trimester demonstrated elevated hemoglobin concentration. These findings indicate that maternal hemoglobin levels tend to increase during the third trimester, potentially influenced by several factors including iron supplementation consumption, nutritional status, dietary patterns, and regular antenatal care attendance. The results of this study emphasize the importance of continuous monitoring of maternal hemoglobin levels during pregnancy to maintain optimal maternal and fetal health. Adequate nutritional intake, routine iron supplementation, and regular antenatal examinations appear to contribute positively to maintaining normal hemoglobin levels among pregnant women.

Pregnant women with normal hemoglobin levels are encouraged to maintain balanced nutritional intake, routinely consume iron supplementation according to medical recommendations, and continue regular antenatal care (ANC) examinations to support maternal and fetal well-being throughout pregnancy. Meanwhile, pregnant women with elevated hemoglobin levels should undergo further consultation and evaluation by healthcare professionals to identify potential underlying causes and prevent possible complications related to hemoconcentration and impaired blood circulation. Continuous hematological monitoring remains essential to ensure that maternal hemoglobin levels remain within a safe physiological range during pregnancy.

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