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Association of Maternal Age, Gravida, Birth Interval, Body Mass Index, and Mid-Upper Arm Circumference with Anemia in Pregnant Women in Tanjunganom, Nganjuk

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ABSTRACT

Anemia in pregnancy remains a significant public health concern due to its impact on maternal and neonatal health. This study aimed to analyze factors associated with anemia among pregnant women. A cross-sectional study was conducted involving 40 pregnant women in Tanjunganom Primary Health Center, Nganjuk Regency, East Java. Data were collected on maternal age, gestational age, parity, interpregnancy interval, antenatal care (ANC) attendance, nutritional status measured by body mass index (BMI) and mid-upper arm circumference (MUAC), iron supplementation, dietary habits, and socioeconomic status. Hemoglobin levels were assessed to determine anemia status. Statistical analyses included Chi-square, Fisher's Exact, and Likelihood Ratio tests. The median maternal age was 30 years (range: 20–41 years). Median BMI was 26.2 kg/m² (16.7–42.1 kg/m²), median MUAC was 27.46 cm (21–55 cm), and median hemoglobin level was 10.8 g/dL (8.0–12.9 g/dL). Anemia was identified in 57.5% of participants, comprising 47.5% mild and 10.0% moderate anemia. Household income showed a significant association with anemia (p = 0.01), with the highest prevalence among women earning Rp. 1,000,000–2,500,000 per month. Parity (p = 0.07) and weekly consumption of coffee, tea, or chocolate (p = 0.054) demonstrated borderline associations. Other factors, including maternal age, gestational age, ANC frequency, interpregnancy interval, BMI, and MUAC, were not significantly related to anemia. In summary, more than half of the pregnant women in this study experienced anemia, with socioeconomic status identified as the primary contributing factor. These findings emphasize the importance of integrating economic considerations and nutritional support into maternal health interventions.

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1. INTRODUCTION

Globally, it is estimated that 1.9 billion people are affected by anemia, including 32 million (37%) pregnant women (1,2). Iron deficiency anemia in pregnant women accounted for 22% of maternal deaths worldwide in 2019 (3–5). Based on the results of the Basic Health Research (Riskesdas) and the Indonesian Health Survey (SKI), the prevalence of anemia among pregnant

women in Indonesia was estimated at 37.1% in 2013, 48.9% in 2018, and 27.7% in 2023 (6–9). Iron deficiency anemia in pregnant women contributed to 22% of global maternal deaths in 2019 (3–5). According to data from the Indonesian Ministry of Health in 2023, the Maternal Mortality Rate (MMR) in Indonesia reached 4,482 cases, with 360 deaths caused by obstetric hemorrhage (10). The prevalence of anemia among pregnant women in Nganjuk Regency in 2021 showed an increase, with a total of 1,809 pregnant women (18.09%) compared to 1,680 pregnant women (16.85%) in 2020 (11).

Anemia in pregnant women is associated with a range of unfavorable health outcomes for both mothers and infants, including increased maternal complications, low birth weight, premature delivery, intrauterine growth restriction (IUGR), and a heightened risk of death in both mothers and newborns (1,12,13). Furthermore, anemia during pregnancy increases the probability of anemia in newborns (14,15). In response to this public health concern, the Ministry of Health of the Republic of Indonesia implemented the Integrated Maternal and Child Health Guidelines in 2020, mandating hemoglobin examinations for pregnant women during early and late pregnancy at health service facilities (16). Despite the implementation of these screening measures, progress in reducing anemia prevalence has remained below the national targets (4).

The World Health Organization (WHO) defines anemia during pregnancy as a hemoglobin concentration of less than 11 g/dL (17). Based on hemoglobin levels, anemia is categorized as mild (10–<11 g/dL), moderate (7–<10 g/dL), and severe (<7 g/dL) (18). While hemoglobin assessment does not identify the specific etiology of anemia in pregnant women, it is widely accepted as an effective tool for anemia surveillance at the population level (19,20). The development of maternal anemia is influenced by multiple factors. According to the WHO conceptual framework (2023), anemia arises from immediate causes—such as obstetric and gynecological conditions, micronutrient deficiencies, infections, and genetic disorders—as well as a range of contributing risk factors, including proximal, underlying, and structural determinants (21).

Previous research has identified multiple factors that contribute to the development of anemia during pregnancy, including socioeconomic conditions, frequency of antenatal care visits, nutritional status, parity, gravidity, interpregnancy interval, gestational age, iron supplementation, and dietary patterns (22–24). Evidence from studies conducted by Derson (2017) and Deriba (2020) indicates that pregnant women with mid-upper arm circumference (MUAC) values below the recommended standard were 3.8 times and 5.0 times more likely to experience anemia, respectively (25,26). In light of these findings, the present study seeks to examine the relationship between maternal age, parity, birth spacing, body mass index (BMI), and mid-upper arm circumference (MUAC) and the occurrence of anemia among pregnant women.

2. METHOD

A cross-sectional study was conducted to examine the association between maternal age, parity, birth interval, body mass index (BMI), and mid-upper arm circumference (MUAC) with anemia among pregnant women. The study was carried out in the catchment area of Tanjunganom Primary Health Center, Nganjuk Regency, East Java, Indonesia, between September and November 2025.

The study population comprised all pregnant women in their second and third trimesters who attended antenatal care (ANC) services at the health center during the study period. A purposive sampling technique was employed to recruit 40 respondents who met the inclusion criteria. Eligible participants were second- or third-trimester pregnant women with singleton pregnancies, who had received ANC services, possessed a Maternal and Child Health (MCH) handbook, and provided informed consent. Exclusion criteria included a history of chronic medical conditions such as eclampsia, hypertension, hyperemesis gravidarum, diabetes mellitus, hypothyroidism, or renal disorders.

Data collection involved structured questionnaires to obtain demographic characteristics, ANC history, parity, and birth interval. Anthropometric measurements (BMI and MUAC) and hemoglobin assessment were performed by trained midwives. Hemoglobin concentration was measured using the HemoCue 301 analyzer, standardized according to World Health Organization (WHO) guidelines. Ethical approval for the study was granted by the Research Ethics Committee (Approval No. 258/UN6.KEP/EC/2025). Data were analyzed using STATA version 26 software.

3. RESULTS AND DISCUSSION

Table 1. Characteristics of study participants

Variable	Median (Min-Max)	n (%)
Maternal age (years)	30 (20-41)	
BMI at first ANC visit (kg/m^2)	26.2 (16.7-42.1)	
MUAC (cm)	27.46 (21-55)	
Hemoglobin level (g/dL)	10.8 (8-12.9)	
Gestational age		
Second trimester		17 (42.5%)
Third trimester		23 (57.5%)
Maternal age		
Not at risk		27 (67.6%)
At risk		13 (32.5%)
Formal education		
Junior/Senior High School		31 (77.5%)
Diploma (D1/D2/D3)		2 (5.0%)
Bachelor/Master/Doctoral		7 (17.5%)
Maternal occupation		
Housewife		33 (82.5%)
Civil serant/military/police		1 (2.5%)
Employee		4 (10.0%)
Entrepreneur		2 (5.0%)
Family income		
< Rp. 1.000.000		17 (42.5%)
Rp. 1.000.000- Rp. 2.500.000		16 (40.0%)
Rp. 2.500.000- Rp. 5.000.000		6 (15.0%)
> Rp. 5.000.000		1 (2.5%)
Number of antenatal care visits		
2-4 visits		23 (57.5%)
>4 visits		17 (42.5%)
Number of pregnancy (Gravida)		
Gravida 1-3		35 (87.5%)
Gravida ≥4		5 (12.5%)
Birth Interval		
<2 years		8 (20.0%)
≥2 years		32 (80.0%)
Iron supplementation (per week)		
1-3 times/week		8 (20.0%)
≥4 times/week		32 (80.0%)
Consumption of coffee/tea/chocolate (per week)		
No		13 (32.5%)
Yes		27 (67.5%)
MUAC status (cm)		
<23,5 cm (low)		16 (40.0%)
≥23,5 cm (normal)		24 (60.0%)
BMI at first ANC visit (kg/m^2)		
<18,5 (underweight)		6 (15.0%)
≥ 18,5 (normal)		34 (85.0%)
Anemia status		
Normal		17 (42.5%)
Anemia		23 (57.5%)
Mild		19 (47.5%)
Moderate		4 (10.0%)

A total of 40 pregnant women participated in this study. The median maternal age was 30 years (range: 20–41), with 67.5% classified as not at risk (<35 years) and 32.5% as at risk (≥35 years). Most respondents were in their third trimester (57.5%), and the remainder in the second trimester (42.5%). The median Body Mass Index (BMI) at the first antenatal care (ANC) visit was

26.2 kg/m² (range: 16.7–42.1), and the median mid-upper arm circumference (MUAC) was 27.46 cm (range: 21–55 cm). Hemoglobin levels ranged from 8 to 12.9 g/dL, with a median of 10.8 g/dL.

Regarding education, 77.5% of respondents had completed junior or senior high school, 17.5% held a university degree, and 5.0% had diploma-level education. Most participants were housewives (82.5%), while others worked in the private sector (10.0%), were self-employed (5.0%), or served as civil servants/military/police personnel (2.5%). Family income varied, with 42.5% earning less than Rp. 1,000,000 per month, 40.0% earning between Rp. 1,000,000 and Rp. 2,500,000, 15.0% earning between Rp. 2,500,000 and Rp. 5,000,000, and only 2.5% earning more than Rp. 5,000,000.

In terms of pregnancy-related indicators, 57.5% of respondents had 2–4 ANC visits, while 42.5% had more than four visits. Most women were gravida 1–3 (87.5%), and only 12.5% had four or more pregnancies. The majority had a pregnancy spacing of ≥2 years (80.0%), and 20.0% had spacing of less than 2 years. Iron supplementation was adequate in 80.0% of respondents (≥4 times/week), while 20.0% reported intake of 1–3 times/week. Additionally, 67.5% reported weekly consumption of coffee, tea, or chocolate, while 32.5% did not.

MUAC status showed that 60.0% had normal measurements (≥23.5 cm), and 40.0% were below the recommended threshold. BMI at first ANC visit indicated that 85.0% had normal nutritional status (≥18.5 kg/m²), while 15.0% were underweight. The prevalence of anemia was 57.5%, with 47.5% classified as mild and 10.0% as moderate; the remaining 42.5% had normal hemoglobin levels.

Table 2. Association of determinant factors with pregnancy anemia

Variabel	Anemia Status				Total		*p*
	Anemia		Normal				
	n	%	n	%	N	%	
Maternal age							0,408[a]
Not at risk	15	37.5	12	30.0	27	67,5	
At risk	9	22.5	4	10.0	13	32.5	
Gestational age							0.896 [a]
Second trimester	10	25.0	7	17.5	17	42.5	
Third trimester	14	35.0	9	22.5	23	57.5	
Family income							0.01[c]
< Rp. 1.000.000	6	15.0	11	27.5	17	42.5	
Rp. 1.000.000- Rp. 2.500.000	14	35.0	2	5.0	16	40.0	
Rp. 2.500.000- Rp. 5.000.000	3	7.5	3	7.5	6	15.0	
> Rp. 5.000.000	1	2.5	0	0	1	2.5	
Number of antenatal care visits							0.601[a]
2-4 visits	13	32.5	10	25.0	23	57.5	
>4 visits	11	27.5	6	15.0	17	42.5	
Number of pregnancy (Gravida)							0.07[b]
Gravida 1-3	19	47.5	16	40.0	35	87.5	
Gravida ≥4	5	12.5	0	0	5	12.5	
Birth Interval							0.690 [b]
<2 years	4	10.0	4	10.0	8	20.0	
≥2 years	20	50.0	12	30.0	32	80.0	
BMI at first ANC visit (kg/m²)							0.373[b]
<18,5 (underweight)	5	12.5	1	2.5	6	15.0	
≥ 18,5 (normal)	19	47.5	15	37.5	34	85.0	
Consumption of coffee/tea/chocolate (per week)							0,054[a]
No	5	12.5	8	20.0	13	32.5	
Yes	19	47.5	8	20.0	27	67.5	
MUAC status (cm)							0.114 [a]
<23,5 cm (low)	12	30.0	4	10.0	16	40.0	
≥23,5 cm (normal)	12	30.0	12	30.0	24	60.0	

*Data were analyzed using x^2 (a), Fisher's Exact Test (b), or Likelihood Ratio Test (c)

Table 2 presents the association between selected determinant factors and pregnancy anemia. There was no statistically significant association between maternal age and anemia status

(p=0.408[a]). Similarly, gestational age (trimester II vs III) showed no significant difference in anemia prevalence (p=0.896[a]). Family income was significantly associated with anemia (p=0.01[c]), where women with monthly income between Rp. 1,000,000–2,500,000 had the highest proportion of anemia (35.0%), compared to other income groups.

The number of antenatal care visits was not significantly associated with anemia (p=0.601[a]). Gravida status showed a borderline association (p=0.07[b]), with higher anemia prevalence among women with gravida 1–3 (47.5%) compared to those with ≥4 (12.5%). Interpregnancy interval and BMI were not significantly associated with anemia (p=0.690[b] and p=0.373[b], respectively). Consumption of coffee, tea, or chocolate more than once per week showed a near-significant association with anemia (p=0.054[a]), with 47.5% of anemic women reporting such intake. Mid-upper arm circumference (MUAC) was not significantly associated with anemia status (p=0.114[a]), although women with MUAC <23.5 cm had a higher proportion of anemia (30.0%) compared to those with normal MUAC.

In 2021, the prevalence of anemia among pregnant women in Nganjuk Regency was reported at 18.1% (11). This proportion is considerably lower than the regional estimate provided by the World Health Organization, which indicated that 47.8% of pregnant women in Southeast Asia were affected by anemia in 2019 (27). During the second and third trimesters, physiological changes such as hemodilution occur alongside increased nutritional requirements, thereby heightening the likelihood of reduced hemoglobin concentrations (28–31). Pregnancy is also accompanied by elevated erythropoietin (EPO) levels, which enhance erythropoiesis and consequently increase the body's demand for iron intake (32). Under normal physiological conditions in pregnancy, plasma volume expands by approximately 40–60%, leading to a state of hypervolemia, while red blood cell mass increases by only 20–50% (33). Because the expansion of plasma volume exceeds the rise in red blood cell mass, blood dilution occurs [34]. This imbalance results in what is known as physiological or dilutional anemia, typically reflected by a reduction in hematocrit levels to approximately 30–32% (33).

Hemodilution in pregnancy represents a normal physiological adaptation that supports the growth and development of the fetus and placenta. This adaptation is regulated in part by hormonal changes, particularly increased levels of estrogen and aldosterone, which promote fluid retention (34). Hemodilution provides several physiological advantages during pregnancy. One key benefit is the reduction of cardiac workload, as the maternal cardiovascular system must accommodate increased demands throughout gestation. The resulting hypervolemia enhances cardiac output, while decreased blood viscosity facilitates circulation and lowers peripheral resistance, contributing to better blood pressure regulation. Another advantage of hemodilution is the reduction of iron loss during the postpartum period. Maternal blood volume expansion typically begins around the tenth week of pregnancy and reaches its maximum between 32 and 36 weeks of gestation (35).

Pregnancy outcomes are generally more favorable when conception occurs between the ages of 20 and 35 years, as this period is associated with optimal reproductive health and a lower likelihood of obstetric complications (36). This advantage is closely linked to both the biological maturity and psychological readiness of the mother. Conversely, pregnancies occurring before the age of 20 are associated with an increased risk of anemia, largely due to the incomplete development of the reproductive system (37). During adolescence, higher nutritional intake is required to support ongoing physical growth and reproductive maturation; therefore, pregnancy at a young age imposes additional nutritional demands compared with pregnancies in women over 20 years of age (38). The risk of anemia also increases with a higher number of pregnancies. Women with multiple prior pregnancies are more likely to develop anemia during gestation than first-time mothers (39–41). In particular, mothers who have experienced more than three previous deliveries face a greater risk of serious obstetric complications, such as hemorrhage, and have an increased likelihood of anemia in subsequent pregnancies (42).

Short intervals between pregnancies have been linked to a higher likelihood of anemia among pregnant women (43). Women who conceive again within two years are particularly vulnerable, as insufficient time is available to restore nutritional stores depleted during the previous pregnancy. In such cases, maternal iron reserves must support both post-pregnancy recovery and the requirements of the subsequent gestation. A minimum interval of two years is generally needed to replenish iron levels through adequate intake of iron- and protein-rich foods

and to allow full physiological and anatomical recovery (44). In addition, higher consumption of green tea and coffee has been associated with an increased prevalence of iron deficiency. Women who consumed three or more cups per day exhibited significantly higher rates of iron deficiency compared with those who reported minimal intake ($p < 0.05$) (45). Pregnant women who regularly consumed beverages containing caffeine were found to have approximately double the risk of developing anemia, likely because caffeine inhibits the absorption of non-heme iron and reduces its bioavailability (46).

Body Mass Index (BMI) is a simple anthropometric indicator calculated from an individual's weight and height and is commonly used to assess nutritional status (47). BMI is generally classified into underweight (<18.5), normal weight (18.5–24.9), overweight (25.0–29.9), and obesity (≥30). This measure is particularly useful for evaluating adult nutritional conditions, including both insufficient and excessive body weight (48). Previous research conducted at the Sekapuk Ujung Pangkah Gresik Community Health Center demonstrated a significant association between BMI and the occurrence of anemia among pregnant women, with a reported p-value of 0.04 ($p < 0.05$) (49).

Mid-upper arm circumference (MUAC) is widely used as a rapid screening indicator for nutritional status and has been shown to correlate strongly with body mass index (BMI) (50). MUAC assessment reflects muscle mass and overall nutritional condition, as the measurement is relatively stable and less influenced by fluid accumulation compared with measurements taken from the lower limbs, which are more susceptible to edema (51,52). MUAC is commonly applied to identify chronic energy deficiency (CED), using a cutoff value of 23.5 cm (53). Based on this threshold, MUAC values are categorized as low (<23.5 cm) or normal (≥23.5 cm) (54). Evidence from a study on anemia prediction in pregnancy indicated that MUAC combined with iron supplementation status, using data from Riskesdas, produced a predictive model with high diagnostic performance, demonstrating a sensitivity of 94.3%, a specificity of 90%, and an area under the ROC curve of 60.7% (55).

4. CONCLUSION

Among the 40 pregnant women studied, the prevalence of anemia was 57.5%, comprising 47.5% mild and 10.0% moderate anemia. Family income was significantly associated with anemia ($p = 0.01^{c}$), with the highest prevalence (35.0%) observed among women earning Rp. 1,000,000–2,500,000 per month. Gravida status ($p = 0.07^{b}$) and weekly consumption of coffee, tea, or chocolate ($p = 0.054^{a}$) showed borderline associations with anemia. In contrast, maternal age ($p = 0.408^{a}$), gestational age ($p = 0.896^{a}$), frequency of antenatal care visits ($p = 0.601^{a}$), pregnancy spacing ($p = 0.690^{b}$), body mass index ($p = 0.373^{b}$), and mid-upper arm circumference ($p = 0.114^{a}$) were not significantly associated with anemia. These findings indicate that socioeconomic factors and certain dietary behaviors are more strongly associated with anemia during pregnancy than maternal age, parity, or anthropometric indicators of nutritional status.

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