ORIGINAL RESEARCH

TOO YOUNG TO CARRY: UNDERSTANDING THE DOUBLE BURDEN OF ANEMIA AND EARLY PREGNANCY AMONG ADOLESCENTS IN RURAL TANGERANG

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ABSTRACT	Keywords
Background: Anemia in pregnancy remains a major concern, particularly among adolescents in low-resource settings. This study assessed anemia prevalence among pregnant adolescents (<20 years) at Cisoka Puskesmas, Indonesia. **Methods**: A cross-sectional design with total sampling was applied to medical records from January–December 2024. Hemoglobin was measured using the Onemed HbCheck device, with anemia defined as Hb <11.0 g/dL. Descriptive variables were analyzed using SPSS 26. **Results**: Seventy-six pregnant adolescents were included. Overall anemia prevalence was 46.1%, increasing to 54.3% in the third trimester. Mean hemoglobin declined from 11.48 g/dL in the first trimester to 10.43 g/dL in the third. Inadequate ANC utilization (<4 visits) was frequent, affecting 67.1% of participants. Moderate anemia was the predominant category, accounting for 51.4% of cases and reaching its highest proportion at 62.5% in the second trimester. **Conclusion**: Anemia among pregnant adolescents in rural Tangerang is common and increases with advancing gestation, compounded by low ANC utilization. Strengthened iron supplementation and improved adolescent-focused ANC are needed.	**Anemia, Antenatal Care, Indonesia, Pregnant Adolescents, Rural Health**

INTRODUCTION

Anemia during pregnancy remains a significant public health concern, affecting nearly 50% of pregnant women globally, with higher burdens in low-resource settings (Balarajan et al., 2011; Shand & Kidson-

Gerber, 2023). Adolescents (<20 years) face heightened risk due to the competing physiological demands of growth and pregnancy, coupled with socioeconomic and nutritional disadvantages that limit iron stores and dietary intake (Amoadu et al., 2024; Beard, 2000; Wiafe et al., 2023). In rural contexts, restricted healthcare access and cultural barriers further intensify vulnerability, contributing to poor maternal-fetal outcomes (Cohen & Powers, 2024).

The consequences of anemia in this age group are clinically significant, including elevated rates of preterm birth, low birth weight, and perinatal mortality (Pinho-Pompeu et al., 2017; Yılmaz et al., 2018). Localized evidence is essential to inform targeted prevention, yet available data from rural Indonesia remain limited. No studies in rural Tangerang have quantified anemia prevalence and trimester-specific hemoglobin patterns among pregnant adolescents, nor examined how antenatal care (ANC) utilization intersects with anemia severity.

To frame the analysis of antenatal care (ANC) utilization and iron deficiency anemia among pregnant adolescents, this study adopts the Health Belief Model (HBM) as its conceptual backbone. HBM postulates that health-seeking behaviors depend on individual perceptions of susceptibility, severity, benefits, and barriers, as well as cues to action and self-efficacy (Irawati et al., 2024). By applying HBM in this rural adolescent population, our study not only quantifies anemia prevalence and trimester-specific hemoglobin trends, but also situates these findings within a behavioral framework.

This study therefore addresses a critical gap. Its novelty lies in integrating trimester-based hemoglobin trends with anemia severity profiling and ANC utilization patterns, offering a more comprehensive understanding of adolescent pregnancy risks in rural Indonesia.

METHOD

This cross-sectional study used total sampling of all pregnant adolescents (<20 years old) who attended maternal-child health services at a rural primary health center (Cisoka Puskesmas) between January and December 2024. Data were extracted from electronic medical records; participants included those with recorded hemoglobin (Hb) levels and documented trimester at the time of measurement. Adolescents were excluded if they were ≥20 years, non-pregnant, or had pre-existing hematologic disorders (e.g., thalassemia, sickle cell disease) or chronic illnesses known to affect Hb (e.g., renal disease).

During antenatal clinic visits, Hb was measured using an Onemed HbCheck Hemoglobin Test Meter (Indonesia). Anemia was defined following WHO criteria as Hb < 11.0 g/dL. Severity categories were: mild (Hb 10.0–10.9 g/dL) and moderate (Hb 7.0–9.9 g/dL); no severe anemia (Hb <7.0 g/dL) was observed. ANC utilization was assessed based on the number of visits recorded in the clinic registry; "adequate" ANC was defined as ≥4 visits, while fewer was considered "inadequate."

Data were entered and analyzed in SPSS 26.0 (IBM, USA). Descriptive statistics (proportions, means ± standard deviations) were calculated for anemia prevalence, trimester-specific Hb levels, and ANC compliance. Due to the nature of total sampling, no sample size calculation was performed. 3 records with missing key variables (Hb values or trimester data) were excluded. This study utilized available electronic medical records with prior permission from Cisoka Rural Health Center, conducted in accordance with ethical research standards under ethical approval number B/400.7/V/PKM-CSK/2025.

RESULTS

A total of 76 pregnant adolescents with complete hemoglobin data were included in this study, yielding an anemia prevalence of 46.1% (n = 35). Most participants were aged 18–19 years (59.2%), in accordance with the study's <20-year inclusion criteria. The largest proportion of hemoglobin measurements occurred in the third trimester (38.2%). Antenatal care (ANC) utilization was low, with 67.1% of participants attending fewer than four visits across the entire pregnancy.

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Table 1. Study Population Characteristics

Categories	Total (n=76)	Percentage (%)
Age Groups		
15–16 years	8	10.5
17–18 years	23	30.3
19–20 years	45	59.2
Trimester		
1st trimester	25	32.9
2nd trimester	22	28.9
3rd trimester	29	38.2
ANC Compliance		
<4 ANC visits	51	67.1
≥4 ANC visits	25	32.9
Hypertension		
Yes	1	1.3
No	75	98.7
Anemia		
Yes	35	46.1
No	41	53.9

Mean hemoglobin levels demonstrated a clear decline with advancing gestation (mean ± SD): first trimester = 11.48 ± 1.50 g/dL, second trimester = 11.07 ± 1.27 g/dL, and third trimester = 10.43 ± 1.14 g/dL. This pattern paralleled the increase in anemia prevalence from 22.9% in the first and second trimesters to 54.3% in the third trimester.

Anemia severity also varied by gestational age. Moderate anemia accounted for 51.4% of all anemic cases and was most prominent in the second trimester (62.5%). In contrast, mild anemia was slightly more frequent in the first (50.0%) and third trimesters (52.6%). Across the cohort, moderate anemia represented the largest single severity category, indicating that clinically relevant anemia was common even in a relatively young population.

Table 2. Hemoglobin Trends by Trimester Among Pregnant Adolescents

Trimester	Mean Hemoglobin (g/dL) ± SD	N	p
First	11.48 ± 1.5	25	0,103
Second	11.07 ± 1.27	22	
Third	10.43 ± 1.14	29	
Total	10.96 ± 1.36	76	

DISCUSSION

Our study reveals several critical findings regarding anemia among pregnant adolescents in rural Tangerang. The high prevalence of anemia (46.1%) is particularly concerning, with more than half (54.3%) of third-trimester adolescents being affected. We observed a clear declining trend in hemoglobin levels across gestation, from 11.48 g/dL in the first trimester to 10.43 g/dL in the third trimester. Moderate anemia was predominant (51.4%), especially during the second trimester, while inadequate antenatal care (ANC) utilization was common, with 67.1% of participants attending fewer than four visits.

Table 3. Anemia Prevalence and Severity by Trimester

Trimester	Total Anemia (n)	Anemia Percentage (%)	Mild Anemia (n)	Mild Anemia (%)	Moderate Anemia (n)	Moderate Anemia (%)
1st	8	22.9%	4	50.0%	4	50.0%
2nd	8	22.9%	3	37.5%	5	62.50%
3rd	19	54.3%	10	52.6%	9	47.4%
Total	35	100%	17	48.6%	18	51.4%

We found a concerning anemia prevalence of 46.1% among pregnant adolescents in rural Tangerang. This rate is substantially higher than the 14% reported among urban Jakarta adolescents and the 36.2% among pregnant women aged 15-24 years in the 2018 Indonesian Basic Health Research, yet lower than the 90.1% prevalence found in pregnant adolescents in rural India (Andriastuti et al., 2020; Kuntari & Supadmi, 2024; Toteja et al., 2006). These disparities likely reflect varying levels of healthcare access and nutritional status across different settings (Samuel et al., 2020). Our findings corroborate existing evidence that adolescents face heightened vulnerability to anemia compared to adult pregnant women, due to their ongoing growth requirements combined with pregnancy demands (Annan et al., 2021; Sekhar et al., 2016; Walsh et al., 2024).

The observed trimester-specific hemoglobin decline, particularly the significant drop to 10.43 g/dL in the third trimester, aligns with established physiological changes during pregnancy (Churchill et al., 2019; Eweis et al., 2021; Kumbang et al., 2022). This pattern reflects the combined effects of hemodilution and increasing iron demands (Agbozo et al., 2020). Notably, our results contrast with studies of well-supplemented populations where compliant pregnant women sustained consistent or rising hemoglobin levels, implying potential iron intake or absorption deficiencies in our study population (Adanikin et al., 2015; Habib et al., 2009). The low ANC compliance (67.1% with <4 visits) is especially concerning as it indicates missed opportunities for early anemia detection and timely intervention (Ikeanyi & Ibrahim, 2015; Konje et al., 2022).

While older adolescents (19-20 years) in our cohort may benefit from better nutritional status compared to their younger counterparts, they still demonstrated substantial anemia risk. This finding emphasizes the need for careful monitoring of all pregnant adolescents regardless of age. The strong association between inadequate ANC attendance and anemia prevalence in pregnant adolescents highlights the critical importance of regular prenatal care for early

detection and effective management of this condition (Jufar, 2013; Obai et al., 2016).

These findings have important clinical implications. Targeted iron and folic acid supplementation should be prioritized, particularly during the second and third trimesters when anemia prevalence and severity peak. Community-based education programs are urgently needed to improve ANC attendance and compliance with supplementation regimens. Future research should employ longitudinal designs to better understand causal relationships and investigate potential confounding factors like dietary patterns and parasitic infections.

This study applies the Health Belief Model (HBM), which explains health behavior through perceived susceptibility, severity, benefits, barriers, self-efficacy, and cues to action. Among pregnant adolescents, perceived vulnerability to anemia may be low, while barriers such as limited transport, family disapproval, stigma, and low autonomy can hinder ANC attendance and iron-tablet adherence. Prior studies confirm HBM's usefulness in predicting adherence to anemia-prevention behaviors (Aisah et al., 2022; Ghaderi et al., 2017).

Adolescent pregnancy in rural areas also carries sociocultural stigma, which may discourage early disclosure and ANC seeking (Ghaderi et al., 2017). Combined with high micronutrient demands and restricted decision-making power, these factors create a double burden of biological and structural vulnerability. As our study reflects only the biological dimension, future research should examine the sociocultural determinants through mixed-method approaches.

This study has important limitations. The cross-sectional design precludes causal inference, and data derive from a single rural Puskesmas, limiting generalizability. Confounding factors such as dietary iron intake, supplement adherence, parasitic infections, and socioeconomic variables could not be assessed due to the constraints of retrospective electronic records. Additionally, sociocultural factors were not captured, though they may significantly influence antenatal behavior and anemia risk. Future research should employ

longitudinal and mixed-methods designs to examine both biological and psychosocial determinants, and to evaluate interventions based on HBM or other behavioral frameworks tailored to adolescents.

In conclusion, anemia remains a severe public health challenge among pregnant adolescents in rural Tangerang, with particularly high prevalence in later gestation. These findings call for integrated interventions combining nutritional support with strengthened ANC services to address this preventable yet pervasive health issue in vulnerable adolescent populations.

CONCLUSIONS

This cross-sectional study revealed an anemia prevalence of 46.1% among pregnant adolescents (<20 years) in Cisoka Puskesmas. These findings highlight the critical need for trimester-specific nutritional interventions and improved antenatal care in pregnant adolescents.

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