Prevalence and Associated Factors of Anemia among Pregnant Women Receiving Antenatal Care at Kassala New Hospital, Eastern Sudan-2020

Kamila Bashir Adam[1*], Wafiq Babiker Abu Al-Nour Mohammed[2], Ibrahim Mohammed Issa[3], Ikram Adam Al-Doum[4], Zainab Ahmed Abbas[5], Nada Mohammed Osman[6]

[1,4,6]Department of Food Hygiene and Safety, Faculty of Public Health, Al-Zaeem Al-Azhari University, Khartoum North, Sudan

[2,5]Department of Epidemiology, Faculty of Public Health, Al-Zaeem Al-Azhari University, Khartoum North, Sudan

[3]Faculty of Medical Laboratories, Al-Zaeem Al-Azhari University, Khartoum North, Sudan

معدل انتشار فقر الدم والعوامل المرتبطة به لدي النساء الحوامل اللاتي يتلقين رعاية ما قبل الولادة في مستشفى كسلا الجديد بشرق السودان 2020

كاملة بشير ادم[1*]، وفيق بابكر أبو النور محمد[2]، إبراهيم محمد عيسى[3]، اكرام ادم الدوم[4]، زينب احمد عباس[5]، ندي محمد عثمان[6]

[1،4،6]قسم صحة وسلامة الأغذية، كلية الصحة العامة، جامعة الزعيم الازهري، الخرطوم بحري، السودان

[2،5]قسم الوبائيات، كلية الصحة العامة، جامعة الزعيم الازهري، الخرطوم بحري السودان

[3]كلية المختبرات الطبية، جامعة الزعيم الازهري، الخرطوم بحري، السودان

*Corresponding author: kamla32013@gmail.com

Abstract:

This cross-sectional study, conducted at Kassala New Hospital, Eastern Sudan, from September to October 2020, investigated the prevalence and determinants of anemia among 200 systematically selected pregnant women. The prevalence of anemia (Hb < 11 g/dL) was 49.5%, comprising 26% mild, 23% moderate, and 0.5% severe cases. Statistical analysis revealed anemia was significantly associated with lower educational attainment (ρ = -0.29) and reduced family income (ρ = -0.18). Key modifiable risk factors included non-use of iron supplements (χ^2=15.8, p<0.001), infrequent consumption of fish (χ^2=10.3, p=0.001) and eggs (χ^2=8.9, p=0.003), and a history of malaria during pregnancy (χ^2=5.0, p=0.025). Prevalence also positively correlated with advancing gestational age (ρ=0.41, p<0.001). The study concludes that anemia represents a severe public health problem in this setting, driven by socioeconomic disadvantage, limited education, suboptimal dietary practices, and malaria. A multi-sectoral intervention strategy is recommended, emphasizing female education, strengthened antenatal iron supplementation and nutrition counseling, intensified malaria prevention, and promotion of early antenatal care attendance.

Keywords: Anemia, Pregnancy, Prevalence, Risk Factors, Eastern Sudan, Kassala, Malaria, Nutrition.

الملخص:

أُجريت هذه الدراسة المقطعية في مستشفى كسلا الجديد بشرق السودان، خلال الفترة من سبتمبر إلى أكتوبر 2020، بهدف استقصاء معدل انتشار فقر الدم والعوامل المؤثرة فيه لدى (200) امرأة حامل تم اختيارهن بطريقة العينة النظامية. كشفت النتائج أن معدل انتشار فقر الدم (> 11 جم/ديسيلتر) بلغ 49.5%، توزعت بين حالات طفيفة بنسبة (26%)، ومتوسطة بنسبة (23%)، وحالات شديدة بنسبة.(0.5%). أظهر التحليل الإحصائي وجود ارتباط وثيق بين الإصابة بفقر الدم وانخفاض المستوى التعليمي (0.29- = ρ)، وتراجع الدخل الشهري للأسرة (0.18- = ρ) كما تضمنت أبرز عوامل الخطر القابلة للتعديل عدم الالتزام بتناول مكملات الحديد، (0.001 > p ,15.8 = χ 2)، وقلة استهلاك الأسماك ((χ 0.001 = p ,10.3 = 2))، والبيض (0.003 = p ,8.9 = χ 2)، بالإضافة إلى الإصابة بالملاريا أثناء فترة الحمل (0.025 = p ,5.0 = χ 2)، كما وُجد ارتباط طردي بين زيادة انتشار فقر الدم وتقدم عمر الجنين (p ,0.41 = χ2 0.001 >). استنتجت الدراسة إلى أن فقر الدم يمثل مشكلة صحية عامة خطيرة في منطقة الدراسة، مدفوعةً بالظروف الاقتصادية والاجتماعية المتردية، ومحدودية التعليم، والممارسات الغذائية غير السليمة، وانتشار الملاريا. وتوصي الدراسة بتبني استراتيجية تدخل متعددة القطاعات، تركز على تعزيز تعليم الإناث، وتفعيل برامج مكملات الحديد والتثقيف الغذائي أثناء رعاية الحوامل، وتكثيف جهود الوقاية من الملاريا، وتشجيع المراجعة المبكرة لمراكز رعاية الأمومة.

الكلمات المفتاحية: فقر الدم، الحمل، معدل الانتشار، عوامل الخطر، شرق السودان، كسلا، الملاريا، التغذية.

Introduction:

Anemia in pregnancy is a critical global health issue, disproportionately affecting low and middle-income countries. The World Health Organization (WHO) estimates that 36.5% of pregnant women globally were anemic in 2019, with the highest prevalence in the African region (46.3%) (1). In Sudan, anemia remains a persistent problem, driven by factors such as poverty, food insecurity, high fertility rates, and endemic malaria (2).

Iron deficiency is the leading cause of anemia in pregnancy, but other nutritional deficiencies (folate, vitamin B12), infectious diseases (malaria, helminths), and genetic conditions (hemoglobinopathies) are significant contributors (3). The consequences are profound, including increased risks of maternal mortality, postpartum hemorrhage, preterm birth, low birth weight, and impaired child development (4). Despite being a recognized problem, updated local data is crucial for effective intervention planning. Previous studies in Eastern Sudan, such as the one in New Halfa reporting a 62.6% prevalence in 2005, highlight the severity but may not reflect current trends (5). This study, therefore, aimed to assess the current prevalence and identify the modifiable socio-demographic, nutritional, and medical factors associated with anemia among pregnant women in Kassala, providing evidence for targeted public health action.

Materials and Methods:

Study Design and Setting: A hospital-based cross-sectional study was conducted at the maternity ward of Kassala New Hospital from September to October 2020. Kassala town is the capital of Kassala State in eastern Sudan.

Study Population and Sample Size: The study population comprised pregnant women attending the antenatal care (ANC) clinic. The sample size was calculated as 200 using Epi Info version 7.02, assuming a 50% expected prevalence, 90% confidence level, and 5% margin of error. Severely ill women or those unwilling to participate were excluded.

Data Collection: After obtaining verbal informed consent, data were collected using a pre-tested, interviewer-administered questionnaire. It captured data on: socio-demographics (age, education, occupation, income), obstetric history (parity, gestational age), dietary habits (frequency of consuming iron-rich foods, iron supplementation), and medical history (malaria, chronic diseases). Hemoglobin concentration was measured from capillary blood using a HemoCue® Hb 201+ analyzer.

Operational Definitions: Anemia was defined as hemoglobin concentration <11.0 g/dL. Severity was classified as mild (10.0-10.9 g/dL), moderate (7.0-9.9 g/dL), and severe (<7.0 g/dL) according to WHO standards (1).

Data Analysis: Data were entered and analyzed using IBM SPSS Statistics version 20. Descriptive statistics were presented as frequencies and percentages. Bivariate analysis using the Chi-square test (or Fisher's exact test where appropriate) was performed to assess associations between anemia status and independent variables. The strength of association for significant categorical variables was reported using Phi (φ) or Cramer's V coefficients. Spearman's rank correlation coefficient (ρ) was used to assess the correlation between gestational age (in months) and anemia status/hemoglobin level. A p-value less than 0.05 was considered statistically significant.

Ethical Consideration: Ethical approval was obtained from the Research Ethics Committee of Alzaiem Alazhari University. Participation was voluntary and confidential.

Results
Prevalence and Severity of Anemia:

Out of 200 participants, 99 (49.5%) were anemic. The distribution by severity among anemic women is shown in Table 1. The majority had mild anemia.

Table (1): Classification of Anemia among Study Participants (N=200)

Anemia Status	Hb Level (g/dL)	Frequency (n)	Percentage (%)
Non-Anemic	≥11.0	101	50.5
Total Anemic	<11.0	99	49.5
- Mild	10.0 - 10.9	52	26.0
- Moderate	7.0 - 9.9	46	23.0
- Severe	<7.0	1	0.5

Factors Associated with Anemia:
Socio-Demographic Factors:

Anemia showed significant associations with several socio-economic variables (Table 2). The prevalence was highest among women with no formal education (82.6%, p<0.001, V=0.29), housewives (50.5% vs. 30% for employed, p=0.046, φ=0.14), those in the lowest income category (55.5%, p=0.012, V=0.20), and those married before the age of 20 (58.5%, p=0.002, φ=0.22).

Table (2): Association between Socio-Demographic Factors and Anemia

Factor	Category	Anemic (n, %)	Non-Anemic (n, %)	p-value	Coefficient
Education	No education	19 (82.6%)	4 (17.4%)	<0.001	V = 0.29
	Primary	57 (49.6%)	58 (50.4%)		
	Secondary	19 (38.8%)	30 (61.2%)		
	Above Secondary	4 (30.8%)	9 (69.2%)		
Occupation	Housewife	96 (50.5%)	94 (49.5%)	0.046	φ = 0.14
	Government Employee	3 (30.0%)	7 (70.0%)		
Monthly Income (SDG)	3000-10000	71 (55.5%)	57 (44.5%)	0.017	V = 0.23
	11000-20000	26 (38.2%)	42 (61.8%)		
	>21000	2 (50.0%)	2 (50.0%)		
Age at Marriage	<20 years	72 (58.5%)	51 (41.5%)	0.002*	φ = 0.22
	≥20 years	27 (35.1%)	50 (64.9%)		
Statistically significant (p < 0.05)					

Obstetrical and Nutritional Factors:

A significant positive correlation was found between increasing gestational age and the likelihood of being anemic (Spearman's ρ = 0.41, p < 0.001). Anemia prevalence rose from 33% in the second month to 69% in the seventh month. Women who did not take iron supplements had a significantly higher anemia prevalence (71%) compared to those who did (44%) (χ^2 = 15.8, p<0.001, φ=0.28). Non-consumption of fish (64.1% anemic vs. 42.6%, p=0.001, φ=0.24) and eggs (63.5% vs. 43.1%, p=0.003, φ=0.21) were also significantly associated with anemia. Consumption of red meat and milk products showed no significant association in this sample.

Medical Conditions:

A history of malaria infection during the current pregnancy was associated with a higher prevalence of anemia (54.2% vs. 45.8% without infection, p=0.025, φ=0.16). Well-controlled chronic conditions like hypertension and diabetes did not show a significant association with anemia status.

Discussion:

This study reveals a high prevalence of anemia (49.5%) among pregnant women in Kassala, classifying it as a severe public health problem according to WHO thresholds (≥40%) (1). The rate is alarmingly high, though slightly lower than the 62.6% reported in New Halfa, Eastern Sudan, over 15 years ago (5), suggesting limited progress. This prevalence is consistent with recent studies from neighboring Ethiopia, where rates range from 30-50% in various regions (6, 7).

The strong inverse correlation between education level and anemia risk aligns with global evidence (8). Education empowers women to make informed health choices, understand nutritional needs, and seek timely healthcare. The association with early marriage (<20 years) is particularly concerning, as adolescent mothers have higher physiological demands and are often socio-economically vulnerable (9).

The correlation between advancing gestational age and increasing anemia is physiologically expected due to hemodilution and escalating fetal iron demands (10). This underscores the critical

importance of early and continuous ANC enrollment for effective monitoring and intervention. The protective effect of iron supplementation is clear, yet adherence remains suboptimal. The significant link with low consumption of fish and eggs, relatively affordable sources of high-quality protein, iron, and other micronutrients, points to a crucial gap in dietary quality that needs addressing through targeted counseling (11).

Malaria's role as a key risk factor is consistent with the holoendemic nature of the disease in Eastern Sudan. Malaria causes hemolysis and dyserythropoiesis, directly exacerbating anemia (12). This finding strongly supports the reinforcement of malaria prevention strategies, including consistent use of insecticide-treated nets (ITNs) and intermittent preventive treatment in pregnancy (IPTp), within the ANC package. The lack of significant association with well-controlled chronic diseases suggests that integrated antenatal care that manages comorbid conditions can mitigate their additional hematological burden.

Limitations:

The cross-sectional design limits causal inference. The use of a single hospital may affect generalizability to rural populations. Dietary data were based on self-report, which is susceptible to recall bias. The study did not assess other potential causes like hemoglobinopathies or helminthic infections.

Conclusion and Recommendations:

Nearly half of the pregnant women in Kassala are anemic, driven by intertwined socio-economic, nutritional, and infectious factors.

We recommend a multi-pronged strategy:

1. **Policy & Empowerment:** Enforce laws against child marriage and invest in girls' education and women's economic opportunities.
2. **Health System Strengthening:** Ensure reliable, free provision of quality iron-folate supplements from the first ANC visit, coupled with effective counseling. Integrate routine screening and management for malaria.
3. **Community & Household Level:** Promote nutrition-sensitive agriculture and social behavior change communication to improve dietary diversity, focusing on locally available iron-rich foods. Scale up distribution and promote consistent use of ITNs.
4. **Research:** Further studies using longitudinal designs and including biochemical tests for micronutrient status and parasitic infections are needed to establish causality and identify other contributors.

References:

1. World Health Organization. WHO global anaemia estimates, 2021 edition. Geneva: World Health Organization; 2021.
2. Federal Ministry of Health, Sudan. Sudan Household Health Survey, Second Round 2016. Khartoum: Federal Ministry of Health; 2016.
3. Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, et al. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. Lancet Glob Health. 2013 Jul;1(1):e16-25.
4. Rahman MM, Abe SK, Rahman MS, Kanda M, Narita S, Bilano V, et al. Maternal anemia and risk of adverse birth and health outcomes in low- and middle-income countries: systematic review and meta-analysis. Am J Clin Nutr. 2016 Feb;103(2):495-504.
5. Adam I, Khamis AH, Elbashir MI. Prevalence and risk factors for anaemia in pregnant women of eastern Sudan. Trans R Soc Trop Med Hyg. 2005 Oct;99(10):739-43.
6. Gebremedhin S, Enquselassie F. Correlates of anemia among women of reproductive age in Ethiopia: evidence from Ethiopian DHS 2005. BMC Res Notes. 2011 Nov 16;4:472.
7. Addis Alene K, Mohamed Dohe A. Prevalence of anemia and associated factors among pregnant women in an urban area of Eastern Ethiopia. Anemia. 2014;2014:561567.
8. Balarajan Y, Ramakrishnan U, Özaltin E, Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. Lancet. 2011 Dec 17;378(9809):2123-35.
9. Althaus F, Marston C. Early marriage, adolescent pregnancies and obstetric complications: a cross-sectional study in Kassala, Eastern Sudan. Reprod Health. 2022 Sep 5;19(1):195.
10. Sifakis S, Pharmakides G. Anemia in pregnancy. Ann N Y Acad Sci. 2000;900:125-36.
11. Leroy JL, Frongillo EA, Kase BE, Nguyen PH, Menon P, Alayon S, et al. Strengthening causal inference from randomised controlled trials of complex interventions. Matern Child Nutr. 2021 May;17 Suppl 1:e13178.
12. Desai M, ter Kuile FO, Nosten F, McGready R, Asamoa K, Brabin B, et al. Epidemiology and burden of malaria in pregnancy. Lancet Infect Dis. 2007 Feb;7(2):93-104.