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Impact of maternal anemia on neonatal outcomes: low birth weight and neonatal anemia in Uganda

Benson Okongo[1], Martha Amoding[1], Joachim Ndawula[1], Bright Hajusu[1], Isaac Morunyang[1], Christopher Lakwera[1], Enoch Muwanguzi[1], Robert Wagubi[2], Elizabeth A. John[3], Olong Clinton[4]

[1]Department of Medical Laboratory Science, Mbarara University of Science and Technology, [2]Department of Clinical Laboratories, Mbarara, Uganda, [3]Department of Microbiology and Parasitology, University of Dodoma, Dodoma, Tanzania, [4]Department of Pathology and Clinical Laboratory, Uganda Cancer Institute, Gulu, Uganda.

***Corresponding author:**
Benson Okongo,
Department of Medical Laboratory Science, University of Science and Technology, Mbarara, Uganda.

bokongo@must.ac.ug

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ABSTRACT

Objectives: The Objectives of this study were to determine the prevalence of anemia among women in their third trimester of pregnancy and establish its association with neonatal outcomes at Soroti Regional Referral hospital (SRRH).

Material and Methods: This prospective cohort study enrolled 324 women in their third trimester at SRRH (June–August 2025). Data on maternal and neonatal characteristics were collected via structured questionnaires and medical record review. Maternal venous blood and umbilical cord blood were collected at delivery and analyzed for hemoglobin using an automated hematology analyzer. Anemia was defined as hemoglobin <11.0 g/dL for mothers and <13.0 g/dL for neonates. Bivariate and multivariate logistic regression analyses were conducted to determine associations with neonatal outcomes with the level of statistical significance set at ≤ 0.05.

Results: The median maternal age was 24 years (interquartile range: 21–28.5). The prevalence of maternal anemia was 32.7% (95% confidence interval [CI]: 27.6–37.9). Maternal anemia was independently associated with low birth weight (LBW) (adjusted odds ratio [AOR] = 2.36, 95% CI: 1.28–4.38, $p = 0.006$), neonatal anemia (AOR = 6.74, 95% CI: 3.02–15.02, $p < 0.001$), and cesarean section (AOR = 2.82, 95% CI: 1.63–4.88, $p < 0.001$), which we conceptualize as an intermediate intervention-related event rather than a direct neonatal outcome.

Conclusion: The findings demonstrate a high burden of maternal anemia, with a prevalence of 32.7%, and it is strongly associated with LBW and neonatal anemia. The association with cesarean section suggests that anemia may contribute to intrapartum complications requiring operative intervention. These findings underscore the need for integrated screening, prevention, and management strategies to mitigate perinatal morbidity.

Keywords: Maternal anemia, Neonatal outcomes, Prevalence, Uganda

INTRODUCTION

Anemia in pregnancy is a global public health concern that significantly contributes to adverse maternal and neonatal outcomes.[1] Although neonatal mortality rates fell by nearly half from 2000 to 2020, the newborn period remains the most vulnerable, accounting for 47% of under-five deaths in 2022.[2] Evidence from low, middle, and high-income countries consistently links low maternal hemoglobin levels with increased risks of neonatal and maternal mortality and morbidity.[1] Crucially, maternal anemia is independently associated with postpartum hemorrhage, where compromised uterine perfusion and muscle strength can lead to fatal outcomes.[3]

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Analysis of data from 45 low- and middle-income countries indicates that the severity of maternal anemia is a critical determinant of neonatal risk, where moderate and severe anemia are significantly linked to higher neonatal and infant mortality, with severe anemia demonstrating the greatest impact. In contrast, mild anemia was not associated with any meaningful increase in mortality risk.[1] This underscores that maternal anemia, particularly in its more severe forms, is a key factor linked to poor neonatal outcomes.[4] It arises from factors such as nutritional deficiencies and infections, with iron deficiency being the most common and largely preventable cause.[5,6] Despite some progress, global reductions in anemia prevalence remain inadequate.

Maternal anemia exerts its adverse effects primarily through a reduction in oxygen-carrying capacity, leading to placental insufficiency and subsequent impairment of fetal growth. These risks are compounded by socioeconomic disadvantage, nutritional deficits, comorbidities such as preeclampsia and human immunodeficiency virus (HIV), and inadequate antenatal care.[7,8] Consequently, maternal anemia is significantly associated with major neonatal complications, including preterm birth, low birth weight (LBW), neonatal anemia, and neonatal mortality.[1,4,9]

The prevalence of maternal anemia in the region is high (41–57%), and the prevalence of LBW is also elevated.[10,11] Anemia affects a high proportion of pregnant women in Uganda, primarily driven by malnutrition, infections like LBW HIV and malaria, and limited healthcare. The issue disproportionately impacts poorer, less-educated women in rural areas.[12,13] Maternal anemia in Uganda is significantly associated with adverse neonatal outcomes, including LBW, neonatal anemia, neonatal mortality, and pathological placental changes.[14-16]

Therefore, targeted public health strategies to address maternal anemia including improved nutrition, supplementation, and infection control are essential for mitigating its associated neonatal risks and improving birth outcomes across sub-Saharan Africa.

This study therefore was to determine the prevalence of maternal anemia and neonatal outcomes at Soroti Regional Referral Hospital (SRRH) in eastern Uganda.

MATERIAL AND METHODS

Study site

This study was conducted at SRRH, a 274-bed public tertiary facility in Soroti City, Eastern Uganda (1°42'58.0"N, 33°36'47.0"E). SRRH functions as a referral center for SRRH eight predominantly semi-urban and rural districts, delivering comprehensive maternal and neonatal healthcare. Its status as a central hub for managing complex cases, including documented maternal anemia, established it as an appropriate site for this investigation.

Study design

This was a prospective cohort study conducted between June and August 2025 to determine the prevalence of maternal anemia and its association with neonatal outcomes among pregnant women admitted to the maternity ward at SRRH.

Study population

The study participants included all mother-neonate dyads at SRRH during the study period.

Inclusion criteria

- All pregnant women admitted for delivery, willing to provide informed consent, resident within the catchment area, and their neonates born during the study period at SRRH.

Exclusion criteria

- Pregnant women who are critically ill, need urgent attention, or have been transfused during the current pregnancy were excluded.

Sample size determination

The sample size was calculated using the Kish-Leslie (1965) single population proportion formula to estimate the prevalence of neonatal anemia.

$$\frac{Z\ P(\quad P)}{}$$

Where:
n = study sample size
Z = Standard normal deviate corresponding to 95% confidence interval (CI) (= 1.96)
P = Prevalence of anemia (25.8%) prevalence of maternal anemia, based on a study in Uganda.[17]
d = margin of error on P (set at 5%)

Calculation:

$$n = \frac{1.96 \times 1.96 \times 0.258\ (1 - 0.258)}{0.05 \times 0.05}$$

n = 294.

To compensate for potential participant attrition, the sample size was increased by 10%, yielding a final sample size of 324 pregnant women.

Sampling procedure

A consecutive enrollment of all eligible mother-neonate dyads from the maternity ward and neonatal intensive care unit of SRRH was conducted, with recruitment continuing until the predetermined sample size was attained. Following a comprehensive explanation of the study protocol, written informed consent was obtained from each participating mother.

Data collection

Data were collected using a structured questionnaire adapted from the World Health Organization (WHO) Maternal and Neonatal Health Survey Tool, supplemented by a review of neonatal medical records. The variables captured included neonatal characteristics (sex, gestational age, birth weight), maternal socio-demographic factors (age, educational attainment, income), obstetric history (parity, mode of delivery, antenatal care utilization, mid-upper arm circumference [MUAC]), and maternal nutritional interventions (iron-folic acid supplementation and deworming).

Anthropometric and clinical measurements

Maternal nutritional status was assessed using MUAC. MUAC was measured with a non-stretchable tape, classifying mothers as undernourished (MUAC <23 cm) or adequately nourished (MUAC ≥23 cm). Body mass index (BMI) was correlated from weight measured during the postpartum recovery period and categorized per the WHO standards. For all 239 neonates, birth weight was measured using a calibrated digital scale, with the reported value representing the average of two measurements. Gestational age was determined primarily from the maternal last menstrual period (LMP), with the Ballard Score applied when the LMP was deemed unreliable. All outcome assessors were blinded to maternal anemia status by de-identified participant codes and delivered hemoglobin values redacted.

Laboratory procedures

Written informed consent was secured from all participating mothers. Maternal venous blood was drawn during active labor into ethylenediaminetetraacetic acid (EDTA)-anticoagulated tubes, and participants were monitored through delivery, with a maximum follow-up period of 48 h. Umbilical cord blood was collected via venipuncture of the umbilical vein within 30 min of birth; in cases of delayed labor, delivery was conducted by cesarean section. Cord blood samples were transferred to EDTA-coated microtainers, and a complete blood count was analyzed immediately using a Nihon Kohden hematology analyzer (Nihon Kohden Corporation, Tokyo, Japan). For this study, neonatal anemia was defined as a hemoglobin concentration <13 g/dL, and maternal anemia was defined as a hemoglobin concentration <11.0 g/dL. Neonatal outcomes were defined as the occurrence of one or more of the following: Maternal or neonatal anemia, LBW (<2500 g), preterm birth, birth trauma or hemorrhagic complications, and perinatal mortality. Cesarean section was examined as an intervention-related factor rather than a primary outcome. Blood samples were labeled with study numbers only without clinical information. The laboratory technicians processing samples were blinded to participant characteristics or outcome data.

Quality control

Analytical reliability was assured by the daily calibration of laboratory equipment and the analysis of control samples, conducted in strict adherence to standard operating procedures before processing study specimens. All research personnel received comprehensive training on these protocols. A systematic data management strategy was implemented to minimize error, which included a double-data entry system in Microsoft Excel with cross-verification to identify and resolve discrepancies.

Statistical analysis

Data were captured in a Microsoft Excel spreadsheet utilizing a double-entry verification system and underwent rigorous cleaning to ensure completeness and accuracy. The validated dataset was analyzed using STATA version 16.0. Descriptive statistics were computed; categorical variables are summarized as frequencies and percentages, illustrated with pie charts and tables. Continuous variables, after assessment for normality, are reported as means with standard deviations or medians with interquartile ranges (IQRs). Bivariate and multivariate logistic regression was used to identify neonatal outcomes associated with maternal anemia, with statistical significance defined as a $p \leq 0.05$, supported by 95% CIs.

RESULTS

Maternal demographic characteristics

Mothers had a median age of 24 years (IQR: 21–28.5). Sociodemographically, most were married (85.8%), had a primary education (49.7%), were engaged in peasant farming (54.9%), and resided in rural settings (64.8%). Regarding reproductive characteristics, 62.6% were multiparous, and nearly all (91.7%) had utilized antenatal care services [Table 1].

Baseline neonatal characteristics

In this current study, the neonates' median age was 1 day (IQR: 1–2). Slightly over half were male (52.5%). The

majority were born at term (71.9%) with a birth weight ≥2500 g (80.9%). Nearly all births occurred in a hospital setting (94.5%), and two-thirds were vaginal deliveries (66.0%). Other characteristics are summarized as shown in Table 2.

Table 1: Maternal demographic characteristics (*n*=324).

Variable	Category	Frequency (*n*)	Percentage
Maternal age (years)	≤24	163	50.3
	25-29	98	30.3
	≥30	63	19.4
Maternal marital status	Married	278	85.8
	Single	44	13.6
	Separated	2	0.6
Education level	No formal education	16	5.0
	Primary	161	49.7
	Secondary	132	40.7
	Tertiary	15	4.6
Occupation	Unemployed	78	24.1
	Peasant farmer	178	54.9
	Professional	31	9.6
	Self employed	37	11.4
Place of residence	Rural	210	64.8
	Urban	114	35.1
Parity	Primiparous	121	37.4
	Multiparous	203	62.6
ANC attendance	Yes	297	91.7
	No	27	8.3
Iron supplementation	Yes	283	87.4
	No	41	12.6

ANC: Anti-natal clinic

Table 2: Baseline demographic characteristics of neonates (*n*=324).

Variable	Category	Frequency (*n*)	Percentage
Sex	Male	170	52.5
	Female	154	47.5
Gestational age	Preterm	36	11.1
	Term	233	71.9
	Post term	55	17.0
Birth weight	≥2500 g	262	80.9
	<2500 g	62	19.1
Mode of delivery	Vaginal	214	66.0
	Assisted vaginal	20	6.2
	Caesarean	90	27.8

Prevalence of maternal anemia

The overall prevalence of maternal anemia was 106/324 (32.7%) with 95% CI of (27.6–37.9%) as shown in [Figure 1].

Association between maternal anemia and neonatal adverse outcomes

Multiple neonatal outcomes were evaluated for their association with maternal anemia. These comprised birth weight, gestational age, mode of delivery, neonatal infection, birth trauma or bleeding complications, and neonatal anemia. According to bivariate logistic regression, LBW (crude odds ratio [COR] = 2.01; 95% CI 1.05–3.85), caesarean mode of delivery (COR = 2.84; 95% CI 1.64–5.02), and neonatal anemia (COR = 6.88; 95% CI 3.07–15.46) demonstrated a significant association with maternal anemia [Table 3].

Variables with a $P < 1.0$ from the bivariate analysis including the neonatal adverse outcomes associated with maternal anemia were included in a multivariate logistic regression model. After adjustment, LBW (AOR = 2.36; 95% CI 1.28–4.38), cesarean mode of delivery (AOR = 2.82; 95% CI 1.63–4.88), and neonatal anemia (AOR = 6.74; 95% CI 3.02–15.02) were independently and significantly associated with maternal anemia, as presented in Table 4.

DISCUSSION

The findings of this study reveal a substantial burden of maternal anemia and its significant impact on neonatal outcomes within the studied population. An observed prevalence of 32.7% represents a moderate public health problem according to the WHO criteria (2024), underscoring a persistent challenge in maternal nutrition.[18] The notable contrast between the high self-reported iron supplementation

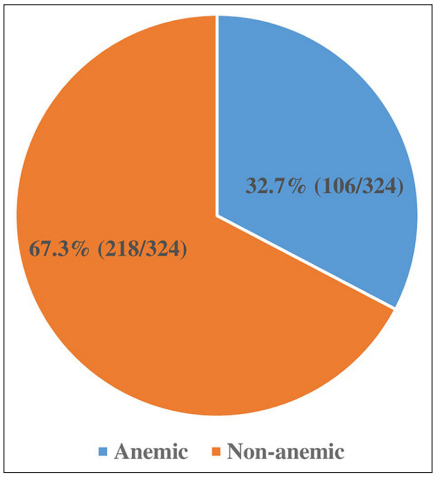


Figure 1: Pie chart showing prevalence of maternal anemia.

Table 3: Bivariate analysis of neonatal outcomes by maternal anemia status.

Variable	Category	Crude odds ratio	95% Confidence interval	*p*-value
Birth weight	≥2500 g	Ref		
	<2500 g	2.01	1.05–3.85	0.036*
Gestational age	Preterm	Ref		
	Term	0.78	0.34–1.80	0.562
	Post term	0.78	0.29–2.13	0.631
Mode of delivery	Vaginal	Ref		
	Assisted vaginal	1.43	0.49–4.16	0.512
	Caesarean	2.84	1.61–5.02	<0.001*
Neonatal infection	No	Ref		
	Yes	2.43	0.54–10.96	0.248
Birth trauma or bleeding complication	No	Ref		
	Yes	1.38	0.33–5.86	0.660
Neonatal anemia	No	Ref		
	Yes	6.88	3.07–15.46	<0.001*

*p<0.05 significant

Table 4: Multivariate regression analysis of adverse neonatal outcomes associated with maternal anemia.

Variable	Category	Adjusted odds ratio	95% Confidence interval	*p*-value
Birth weight	<2500 g	Ref		
	≥2500 g	2.36	1.28–4.38	0.006*
Mode of delivery	Vaginal	Ref		
	Assisted vaginal	1.43	0.50–4.13	0.507
	Caesarean	2.82	1.63–4.88	<0.001*
Neonatal anemia	No	Ref		
	Yes	6.74	3.02–15.02	<0.001*

*p<0.05 significant

rate (87.4%) and the high anemia prevalence points to potential issues with supplement adherence, bioavailability, or the influence of non-iron etiologies, such as parasitic infections or other micronutrient deficiencies.[19]

This prevalence aligns with the range reported in other Sub-Saharan African contexts, including a South African meta-analysis at 31%[20] and a study from Ethiopia at 35.6%.[21] However, it is higher than the prevalence reported in Kampala at 25.8%[17] and lower than rates documented in several other regional studies, which reported prevalence of 41.82–51.26%.[22,23] This discrepancy may be explained by local variations in population demographics, dietary practices, antenatal care protocols, or the gestational timing of assessment.

Association between maternal anemia and primary neonatal outcomes

Maternal anemia was significantly associated with LBW after adjustment for confounders. This relationship is biologically plausible, given that anemia can contribute to placental insufficiency and reduced fetal oxygen supply, thereby restricting intrauterine growth.[4,24] This association is corroborated by meta-analytic evidence confirming maternal anemia as a significant risk factor for LBW.[12,25] Consequently, anemia emerges not as an isolated condition but as a key contributor to a cluster of adverse perinatal outcomes, including intrauterine growth restriction.

Multivariate analysis confirmed a strong, independent association between maternal anemia and neonatal anemia (AOR = 6.74, $p < 0.001$). This finding is physiologically coherent, as maternal iron deficiency directly compromises fetal iron stores,[9] a mechanism supported by longitudinal evidence linking maternal anemia to lower infant ferritin levels.[26] This connection underscores a critical intergenerational cycle of deficiency, wherein anemic mothers are more likely to have anemic infants, who subsequently face heightened risks of impaired cognitive and physical development.

Association between maternal anemia and mode of delivery (intermediate factor)

The study also identified a significant association between maternal anemia and cesarean delivery (AOR = 2.82, $p < 0.001$). It is important to emphasize that cesarean section is an intervention rather than a clinical outcome. This association is consistent with existing literature indicating that anemia may increase the risk of intrapartum complications such as maternal fatigue and fetal distress that necessitate operative intervention.[27,28] Nevertheless, we agree that a third-trimester hemoglobin measurement would provide a stronger temporal framework as our results were an association at the time of admission rather than a predictive risk factor.

This finding positions anemia not merely as a nutritional biomarker but also as a potential modifiable factor for labor abnormalities, suggesting that its effective antenatal management could contribute to reducing caesarean section rates.

Clinical and public health implications

Based on the study findings, the high prevalence of maternal anemia and its significant association with adverse outcomes carry important clinical and public health implications. Clinically, these results advocate for enhanced antenatal screening and risk stratification, as anemia should alert clinicians to a higher likelihood of LBW and neonatal anemia, as well as potential intrapartum complications that may lead to cesarean delivery. Furthermore, the strong link between maternal and neonatal anemia necessitates an integrated, dyadic care model where both mother and newborn are evaluated and managed concurrently.

From a public health perspective, the findings highlight an urgent need for targeted nutritional interventions and health system strengthening focused on women of reproductive age. Preventing and treating anemia, particularly in younger pregnant populations, could mitigate a key risk factor for poor neonatal outcomes and operative delivery. This positions anemia not merely as a common deficiency but also as a critical modifiable risk factor within maternal and child health programs.

Limitations of the study

First, the study's single-center, hospital-based design may limit the generalizability of findings to lower-risk community populations. The measurement of hemoglobin solely at admission to delivery also restricts insights into anemia's impact across pregnancy and may be influenced by peripartum blood loss.

Our analysis was limited to total hemoglobin without delineating specific etiologies (e.g., iron deficiency, malaria, HIV), constraining targeted intervention strategies. Incomplete documentation of key confounders (HIV missing in ~40%; pre-pregnancy BMI rarely recorded; active malaria not routinely collected) precluded full adjustment, and despite using admission weight as a BMI proxy and adjusting for parity, residual confounding from unmeasured dietary, genetic, or inflammatory factors remains possible. We therefore frame our findings as hypothesis-generating, and advocate for prospective Ugandan studies with systematic collection of etiological and confounder data to confirm independent effects.

Third, while we observed an association between maternal anemia and cesarean section, our study design does not allow us to determine whether anemia directly causes the need for cesarean delivery or whether other unmeasured factors contribute to both. Future studies should employ mediation analyses to better disentangle the relationships between maternal anemia, intrapartum complications, and mode of delivery.

CONCLUSION

In summary, this study demonstrates that maternal anemia is a prevalent and significant public health concern, substantially elevating the risk of LBW and neonatal anemia. The association with cesarean section, while not a direct neonatal outcome, suggests that maternal anemia may contribute to intrapartum complications necessitating operative intervention. These findings underscore the necessity of adopting integrated antenatal strategies that extend beyond standard iron supplementation.

Key priorities for public health initiatives should include enhancing the quality of and adherence to iron supplementation programs; integrating screening and management of concomitant conditions, such as parasitic infections; fortifying maternal nutritional education; and utilizing maternal anemia status in intrapartum clinical risk assessment. Effectively mitigating maternal anemia is therefore essential to disrupt the intergenerational cycle of adverse health outcomes and to optimize perinatal health.

Authors' contributions: BO: Conceptualization, resources, study design, literature review, clinical investigation, data collection; MA, JN, BH, IM and CL: Clinical investigation, resources, methodology, validation, and data collection; EM, RW and EAJ: Manuscript drafting, editing, and critical revision; CO: Data analysis, statistical analysis, manuscript review.

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Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given consent for clinical information to be reported in

the journal. The patient understands that the patient's names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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REFERENCES

1. Tsamantioti E, Alfvén T, Hossin MZ, Razaz N. Maternal anaemia and risk of neonatal and infant mortality in low- and middle-income countries: A secondary analysis of 45 national datasets. BMJ Glob Health 2025;10:e014654.
2. World Health Organization. World Health Statistics 2025: Monitoring Health for the SDGs, Sustainable Development Goals. Geneva: World Health Organization; 2025.
3. Harrison RK, Lauhon SR, Colvin ZA, McIntosh JJ. Maternal anemia and severe maternal morbidity in a US cohort. Am J Obstet Gynecol MFM 2021;3:100395.
4. Moges S, Kussa S, Endale A, Lajore BA, Mekango DE. Understanding anemia and predictors of adverse maternal and neonatal outcomes: A multicenter prospective cohort study in southern Ethiopia. Matern Fetal Med 2025;7:76-84.
5. Benson AE, Shatzel JJ, Ryan KS, Hedges MA, Martens K, Aslan JE, *et al.* The incidence, complications, and treatment of iron deficiency in pregnancy. Eur J Haematol 2022;109:633-42.
6. Obeagu EI, Prajapati SK, Maurya SD. Anemia in pregnancy: Exploring non-iron deficiency causes. Int J Med Sci Pharma Res 2025;11:1-7.
7. Singh S, Rathoria E, Srivastava M, Rathoria R, Bansal U, Sharma K. Impact of maternal anemia on neonatal outcomes. Int J Contemp Pediatr 2024;11:1781-7.
8. Obeagu, E.I., The impact of anemia on the immune system during pregnancy: A review. Int J Med Sci Pharm Res 2025;11:28-33.
9. Zhao B, Sun M, Wu T, Li J, Shi H, Wei Y. The association between maternal anemia and neonatal anemia: A systematic review and meta-analysis. BMC Pregnancy Childbirth 2024;24:677.
10. Fente BM, Asnake AA, Negussie YM, Asmare ZA, Asebe HA, Seifu BL, *et al.* Estimating the impact of maternal anemia on low-birth-weight in Sub-Saharan African countries: Propensity score matching analysis. BMC Pregnancy Childbirth 2025;25:783.
11. Belete NK, Belete AG, Assefa DT, Sorrie MB, Teshale MY. Effects of maternal anemia on low-birth-weight in Sub-Sahara African countries: Systematic review and meta-analysis. PLoS One 2025;20:e0325450.
12. Nankinga O, Aguta D. Determinants of Anemia among women in Uganda: Further analysis of the Uganda demographic and health surveys. BMC Public Health 2019;19:1757.
13. Bongomin F, Olum R, Kyazze AP, Ninsiima S, Nattabi G, Nakyagaba L, *et al.* Anemia in Ugandan pregnant women: A cross-sectional, systematic review and meta-analysis study. Trop Med Health 2021;49:19.
14. Ngonzi J, Tibaijuka L, Kintu TM, Kihumuro RB, Onesmus A, Onesmus B, *et al.* Prevalence and Risk Factors for Newborn Anemia in Southwestern Uganda: A Prospective Cohort Study. [Research Square]; 2023. p. rs.3.rs-3054549.
15. Ngonzi J, Tibaijuka L, Mwanje Kintu T, Kihumuro RB, Ahabwe O, Byamukama O, *et al.* Prevalence and risk factors for newborn anemia in Southwestern Uganda: A cross-sectional study. Anemia 2024, p.5320330.
16. Edelson PK, Cao D, James KE, Ngonzi J, Roberts DJ, Bebell LM, *et al.* Maternal anemia is associated with adverse maternal and neonatal outcomes in Mbarara, Uganda. J Matern Fetal Neonatal Med 2023;36:2190834.
17. Mahamoud NK, Mwambi B, Oyet C, Segujja F, Webbo F, Okiria JC, *et al.* Prevalence of anemia and its associated socio-demographic factors among pregnant women attending an antenatal care clinic at Kisugu health center IV, Makindye division, Kampala, Uganda. J Blood Med 2020;11:13-8.
18. WHO. Guideline on Haemoglobin Cutoffs to Define Anaemia in Individuals and Populations. Geneva: World Health Organization; 2024.
19. Shaduka E. An Investigation into the Aetiology of Anaemia in Pregnant Women in Namibia. Islamabad: Namibia University of Science and Technology; 2022.
20. Dorsamy V, Bagwandeen C, Moodley J. The prevalence, risk factors and outcomes of anaemia in South African pregnant women: A systematic review and meta-analysis. Syst Rev 2022;11:16.
21. Fite MB, Assefa N, Mengiste B. Prevalence and determinants of Anemia among pregnant women in sub-Saharan Africa: A systematic review and Meta-analysis. Arch Public Health 2021;79:219.
22. Liyew AM, Tesema GA, Alamneh TS, Worku MG, Teshale AB, Alem AZ, *et al.* Prevalence and determinants of anemia among pregnant women in East Africa; a multi-level analysis of recent Demographic and Health Surveys. PLoS One 2021;16:e0250560.
23. Tirore LL, Areba AS, Tamrat H, Habte A, Abame DE. Determinants of severity levels of anemia among pregnant women in Sub-Saharan Africa: Multilevel analysis. Front Glob Womens Health 2024;5:1367426.
24. Rawat N, Kharakwal S. Prevalence of anemia in women in Bundhelkhand region, India: Its maternal and neonatal outcomes. Int J 2025;13:1107-16.
25. Young MF, Oaks BM, Tandon S, Martorell R, Dewey KG, Wendt AS. Maternal hemoglobin concentrations across pregnancy and maternal and child health: A systematic review and meta-analysis. Ann N Y Acad Sci 2019;1450:47-68.
26. Chen Y, Zhong T, Song X, Zhang S, Sun M, Liu X, *et al.* Maternal anaemia during early pregnancy and the risk of neonatal outcomes: A prospective cohort study in Central China. BMJ Paediatr Open 2024;8:e001931.
27. Adam I, Salih Y, Hamdan HZ. Association of maternal anemia and cesarean delivery: A systematic review and meta-analysis. J Clin Med 2023;12:490.
28. Cançado RD. Iron deficiency anemia in women: Pathophysiological, diagnosis, and practical management. Rev Assoc Méd Bras (1992) 2023;69 Suppl 1:e2023S112.

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