

Original Research Article

Prevalence of anemia and its association with nutritional, reproductive health, and antenatal care factors among pregnant women in a peri-urban health facility in Kenya

Faith Wanjiku¹, Felix Blair Odhiambo^{1,2*}, Douglas S. Okenyuru¹, Ruth Salima¹

¹Department of Community Health and Development, The Catholic University of Eastern Africa, Kenya

²Department of Public Health, Daystar University, Nairobi, Kenya

Received: 24 June 2025

Revised: 22 August 2025

Accepted: 24 August 2025

*Correspondence:

Dr. Felix Blair Odhiambo,

E-mail: odhis.felix@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Anemia in pregnancy, defined by WHO as hemoglobin below 11 gm/dl, is a major public health concern, especially in sub-Saharan Africa. In Kenya, its prevalence stands at 67%, contributing to poor maternal and neonatal outcomes. In Kajiado County, food insecurity and low ANC uptake persist, yet the exact burden and associated maternal factors remain poorly documented.

Methods: A descriptive cross-sectional study was conducted at Ngong Sub-County Hospital, Kajiado County, among pregnant women aged 16-35 attending ANC clinics. Sample size of 108 was calculated using Cochran's formula, and participants were recruited through consecutive sampling. Data were collected using structured questionnaires and analyzed using SPSS 21.0. Descriptive statistics and Chi-square tests were used, with significance set at $p < 0.05$ and the data was presented in tables and pie charts.

Results: The study revealed that 5% of the women were anemic (1.9% mild and 2.8% moderate cases). No severe anemia was recorded. Significant associations were found between anemia and pregnancy trimester ($p = 0.013$) and IFAS compliance ($p = 0.000$).

Conclusions: The study found a low prevalence of anemia (5%), with pregnancy trimester and compliance with iron and folic acid supplementation significantly associated with anemia ($p = 0.013$ and $p = 0.000$ respectively). It recommends targeted antenatal programs to enhance awareness and adherence to IFAS, especially in early and late pregnancy, along with strengthened nutritional counselling, routine anemia screening, and timely interventions for improved maternal health outcomes.

Keywords: Anemia in pregnancy, Antenatal care, Nutritional status, Peri-urban Kenya, Reproductive health

INTRODUCTION

Anemia in pregnancy, defined by the World Health Organization (WHO) as a haemoglobin concentration below 11 gm/dl, remains a significant global public health challenge, particularly in low- and middle-income countries where nutritional deficiencies, parasitic infections, and limited access to quality antenatal care prevail.¹ Globally, approximately 37% of pregnant women are anaemic, contributing to 20% of all maternal deaths and increasing the risks of fetal, neonatal, and

infant mortality.² The burden varies across regions, in Sub-Saharan Africa (SSA) bears a disproportionate share of this burden, with prevalence rates of 57% followed by South-East Asia with prevalence of 48%.³ This highlights a serious public challenge in the region impacting maternal and child health.

Factors significantly associated with anemia in pregnancy include intestinal helminth infections, low iron and folic acid supplementation, primigravidity, and short birth spacing.^{4,5} Infectious diseases such as malaria,

HIV/AIDS, urinary schistosomiasis, and nutritional deficiencies of iron, folate, vitamins B₁₂ and A are also major contributors.⁶ In Kenya, the prevalence is estimated at 67%, with poor nutritional status contributing to 42% of cases and leading to increased maternal mortality, preterm births, postpartum hemorrhage, and intrauterine growth retardation.⁷⁻⁹ The WHO recommends continued iron supplementation postpartum in regions with prevalence above 40% and daily folic acid intake during pregnancy, yet adherence remains poor due to limited ANC access, weak health education, and logistical challenges.^{10,11} In Kajiado County, where food insecurity, long distances to health facilities, and low utilization of antenatal care (ANC) services are prevalent, the precise burden of anemia during pregnancy remains inadequately documented. These challenges, coupled with the adverse effects of anemia on maternal productivity, preterm delivery, and neonatal outcomes, highlight the need for targeted interventions.¹² Therefore, this study sought to determine the prevalence of anemia in pregnancy and its association with maternal age, gravidity, and the number of antenatal care visits in Kajiado County.

METHODS

The study employed a descriptive cross-sectional study design and was conducted between June 2024 and December 2024 at Ngong Sub County Hospital in Kajiado County. Eligible participants were women of reproductive age attending ANC clinics (16-35 years).

Inclusion criteria

Expectant women attending antenatal care clinic who reside in Ngong for the at least three months and agreed to participate in the study.

Exclusion criteria

Participants who were seriously unwell during the study period were excluded from the study.

The sample size for the study was calculated using Cochran's formula, with the estimated population proportion assumed at 8% (0.08), resulting in a sample of 108 participants. Consecutive sampling was employed to recruit eligible respondents who met the inclusion criteria until the required sample size was achieved, ensuring all available and consenting expectant women attending antenatal care at Ngong Sub-County Hospital during the study period were included without selection bias.

Ethical considerations were strictly observed, including obtaining informed consent, ensuring privacy and confidentiality, maintaining voluntary participation through independent communication, and securing official approvals. A research permit was obtained from the National Commission for Science, Technology and Innovation (NACOSTI) under license No. NACOSTI/P/21/12579, and ethical clearance was granted

by the UoN/KNH Ethics and Research Committee (ERC) under number UP431/06/2021. Additional permissions were obtained from relevant local authorities. Data was collected using a structured questionnaire, cleaned and entered into SPSS version 21.0 for analysis. Descriptive statistics such as frequencies and proportions were computed, and inferential analysis was conducted using the Chi-square test, with significance set at $p < 0.05$ and a 95% confidence interval.

RESULTS

Prevalence of anemia among expectant women attending antenatal clinic in Ngong Sub County Hospital

The study assessed the prevalence and severity of anemia among 108 expectant women attending antenatal care at Ngong Sub-County Hospital. The overall prevalence of anemia was found to be 4.7% ($n=5$) while non anemic was 95.3% ($n=103$). Results are as shown below in Figure 1.

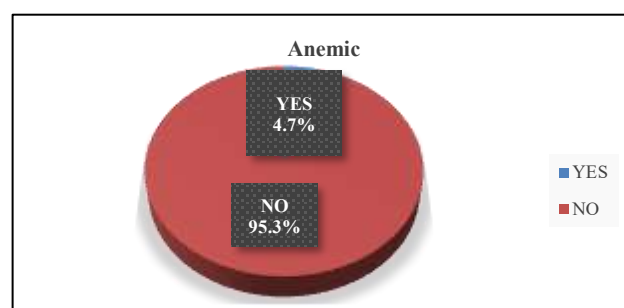


Figure 1: Prevalence of anemia among expectant women ($n=108$).

Severity of anemia among expectant women attending antenatal clinic in Ngong Sub County Hospital

Among the anemic participants, 1.9% ($n=2$) had mild anemia, and 2.8% ($n=3$) had moderate anemia. Notably, no cases of severe anemia were reported during the study period. The majority of the participants, 95.3% ($n=103$), were not anemic. See Figure 2 below.

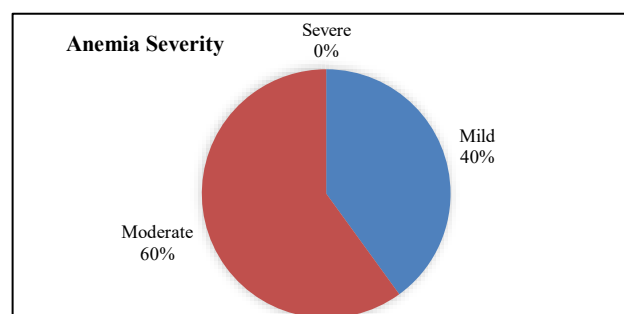


Figure 2: Severity of anemia among anemic pregnant women attending ANC in Ngong Sub-County Hospital.

Socio-demographic characteristics

The study involved 108 women whose socio-demographic characteristics revealed a predominantly young population, with the majority (37.0%) aged 21-25 years, followed by those aged 26-30 years (31.5%). Most

of the women were married (87.2%), while a small proportion were single (11.0%) or widowed (1.8%). In terms of education, a large proportion had attained primary education (92.6%), with 62% having secondary education, 14.8% having tertiary education, and 7.4% reporting informal education.

Table 1: Socio-demographic characteristics.

Variables	No. of women (n=108)	Percent
Age group (years)	16-20	20
	21-25	40
	26-30	34
	31-35	14
marital status	Single	12
	Married	95
	Widowed	2
Educational level	Primary	100
	Secondary	67
	Tertiary	16
	Informal	8
Religion	Christians	107
	Muslim	1
Residence	Urban	70
	Rural	38
Employment	Casual	42
	Permanent	7
	Self employed	7
	No Employment	52
Income (Ksh)	0-1000	49
	2000-5000	45
	6000-10,000	9
	>10,000	5

Table 2: Prevalence of anemia in relation to reproductive health characteristics.

Variables		Anemic		P-value (0.05)
		Yes (%)	No (%)	
Abortion	5 (4.7)	5 (4.7)	100 (92.6)	0.699
	0 (0)	0 (0)	3 (2.8)	
Miscarriages	4 (3.8)	4 (3.8)	99 (91.7)	0.094
	1 (0.9)	1 (0.9)	4 (3.7)	
Premature rupture of membrane	5 (4.7)	5 (4.7)	102 (94.4)	0.825
	0 (0)	0 (0)	1 (0.9)	
Number of children	3 (2.8)	3 (2.9)	41 (37.1)	0.322
	1 (0.95)	1 (0.95)	29 (26.8)	
	0 (0.0)	0 (0.0)	18 (16.7)	
	0 (0.0)	0 (0.0)	11 (10.2)	
	1 (0.95)	1 (0.95)	4 (3.7)	
Gravida	3 (2.8)	3 (2.8)	41 (37.1)	0.995
	2 (1.9)	2 (1.9)	62 (57.4)	
Trimester	2 (1.9)	2 (1.9)	6 (5.6)	0.013
	0 (0)	0 (0)	22 (20.4)	
	3 (2.8)	3 (2.8)	75 (69.4)	

Table 3: Prevalence of anemia in relation to nutrition, antenatal care visits and comorbidities associated with anemia during pregnancy.

Variables	Anemic		P value (0.05)
	Yes N (%)	No N (%)	
Hypertensive	2 (1.9)	26 (24.1)	0.462
Heart complications	0 (0)	2 (1.9)	0.753
Musculoskeletal complications	3 (2.8)	57 (52.8)	0.474
Kidney diseases	0 (0)	0 (0)	0.001
ANC compliant	4 (3.8)	82 (75.9)	0.345
ANC non-Compliant	1 (0.9)	21 (19.4)	0.983
Consume foods in iron frequently	2 (1.9)	61 (56.5)	0.395
Do not consume foods rich in iron frequently	3 (2.8)	42 (38.9)	0.825
Deworm	1 (0.9)	81 (75)	0.375
Do not deworm frequently	4 (3.8)	22 (20.4)	0.953
IFAS compliant	2 (1.9)	91 (84.3)	0.000
IFA-Non compliant	3 (2.8)	12 (11.1)	1.000

Almost all participants were Christians (99.1%), and only one respondent identified as Muslim (0.9%). A majority resided in urban areas (64.8%), while 35.2% lived in rural settings. Regarding employment, nearly half (48.1%) reported having no employment, 38.9% were engaged in casual work, and both permanent employment and self-employment were reported by 6.5% each. Income levels were generally low, with 45.4% earning between Ksh 0-1,000 per month, followed by 41.7% earning Ksh 2,000-5,000. These findings reflect a population with limited economic opportunities, relatively low educational attainment, and high dependence on informal or no employment. See Table 1.

Prevalence of anemia in relation to reproductive health characteristics among expectant women

The relationship between anemia prevalence and reproductive health characteristics was assessed among 108 expectant women. Among women with no history of abortion, five (4.7%) were anemic, while none of those who had experienced abortion were found to be anemic ($p=0.699$), however no significant association was found. Similarly, women with no miscarriage history had a slightly higher prevalence (3.8%) of anemia compared to those with miscarriage experience (0.9%), though this difference was not significant ($p=0.094$). Regarding premature rupture of membranes (PROM), all 5 (4.7%) anemia cases were reported among women who had not experienced PROM, with none reported among those who had ($p=0.825$) thus showing no significant association. Analysis of parity showed that anemia was most common among women with no children 3 (2.8%) followed by those with one and four children 1 (0.9%), though no significant association was found ($p=0.322$). When examining gravidity, anemia was slightly more prevalent among primigravida women 3 (2.8%) than multigravida women 2 (1.9%), though this was not significant ($p=0.995$). Notably, a significant trend emerged in relation to pregnancy trimester ($p=0.013$) where those

with 3 (2.8%) cases were in the third trimester followed by 2 (1.9%) were in the first trimester. Results are as shown in Table 2.

Prevalence of anemia in relation to nutrition and antenatal care visits and comorbidities associated with anemia during pregnancy among expectant women

The study assessed the prevalence of anemia among pregnant women in relation to nutritional practices, antenatal care (ANC) visits, and comorbidities. Among hypertensive women, 2 (1.9%) were anemic while 26 (24.1%) were not, with no significant association ($p=0.462$). Regarding heart complications, none of the women with such complications were anemic, while 2 (1.9%) were not anemic ($p=0.753$), indicating no significance. In terms of musculoskeletal complications, 3 (2.8%) of the affected women were anemic, while 57 (52.8%) without the complication were not anemic, showing no significant relationship ($p=0.474$). Concerning kidney disease, no cases were reported among participants, yet the p-value was 0.001, indicating a statistically significant result that may warrant further scrutiny. Regarding ANC, 4 (3.8%) of the compliant group were anemic and 82 (75.9%) were not ($p=0.345$), while among non-compliant women, 1 (0.9%) was anemic and 21 (19.4%) were not ($p=0.983$); both associations were not significant. In terms of iron-rich food consumption, 2 (1.9%) of those who frequently consumed such foods were anemic versus 61 (56.5%) who were not ($p=0.395$), while among those who did not frequently consume iron-rich foods, 3 (2.8%) were anemic and 42 (38.9%) were not ($p=0.825$); neither showed significant differences. Deworming practices showed that 1 (0.9%) of those who dewormed was anemic compared to 81 (75%) who were not ($p=0.375$), while among those who did not deworm frequently, 4 (3.8%) were anemic and 22 (20.4%) were not ($p=0.953$); both associations were not significant. However, a significant relationship was observed with iron and folic

acid supplementation (IFAS): among compliant women, only 2 (1.9%) were anemic while 91 (84.3%) were not ($p=0.000$), indicating a strong protective association, whereas among IFAS non-compliant women, 3 (2.8%) were anemic and 12 (11.1%) were not ($p=1.000$), showing no statistical significance. Results are as illustrated in Table 3 below.

DISCUSSION

Anemia prevalence in the study population

The study conducted at Ngong Sub-County Hospital revealed an overall anemia prevalence of 4.7% among pregnant women, with 1.9% presenting mild anemia and 2.8% moderate anemia. This prevalence is significantly lower than the national average of 67% reported in Kenya and the regional average of 57% in SSA.^{3,7} Such a marked difference underscores a localized deviation from broader epidemiological patterns and suggests a relatively more favorable maternal health status in this urban sub-county. The findings may point to the effectiveness of targeted health interventions in the area, particularly concerning ANC access, iron and folic acid supplementation, and nutritional practices. The lack of severe anemia further suggests that even when anemia is present, its clinical impact may be mitigated through early detection and consistent management.

Several contextual factors could explain this comparatively low prevalence. Ngong Sub-County, being semi-urban and in proximity to Nairobi, may benefit from better health infrastructure, improved health-seeking behavior, and access to health education. The study population also reflected a high level of ANC compliance and iron supplementation, both of which are known protective factors against anemia. The role of urbanization cannot be overstated enhanced access to health services, diversified diets, and exposure to maternal nutrition programs such as those promoted by Nutrition International in Kajiado County likely contribute to improved maternal health outcomes. Furthermore, continuous public health education and a strong presence of community-based health volunteers could have a ripple effect in reducing nutritional deficiencies.¹²

Association between anemia and reproductive health characteristics

In term of abortion, the present study found no statistically significant association between abortion and anemia among the study participants. None of the women who reported a history of abortion were found to be anemic, while 5 (4.7%) of those without such a history had anemia. This counterintuitive result may reflect the study's small sample size and the relatively low overall anemia prevalence (4.7%), which limit the power to detect potential associations. Furthermore, it is possible that women who had experienced abortions received

targeted post-abortion care, including iron supplementation and follow-up, thereby reducing their anemia risk. The setting of the study, Ngong Sub-County Hospital, may also play a role, as the facility likely offers integrated reproductive health services that mitigate the long-term health effects of abortion through counselling, nutritional support, and routine hemoglobin monitoring. However, this finding contrasts with broader literature suggesting a potential link between abortion and anemia. In particular, studies such as that by Yosef and others in southwest Ethiopia have reported increased anemia risk in women with a history of spontaneous or induced abortions, attributing this to acute blood loss during the procedure and insufficient nutritional recovery.⁵ Similarly, Abdallah et al. identified abortion-related complications, especially when unmanaged or recurrent, as contributing factors to iron deficiency anemia in Tanzanian women.³ These findings emphasize the importance of quality post-abortion care, especially in low-resource settings where delays in care and poor follow-up remain common challenges. Thus, the absence of a significant association in the current study may not imply a lack of relationship but rather highlight the influence of effective post-abortion interventions and possibly underreporting due to social stigma.

In the current study, miscarriage was also not significantly associated with anemia, although a slightly higher anemia prevalence was observed among women with no miscarriage history compared to those who reported experiencing a miscarriage. While this might appear counterintuitive, the small number of anemic cases and possible recall bias could have influenced the observed outcomes. It is also plausible that women with a history of miscarriage received focused medical care, including iron supplementation and monitoring in subsequent pregnancies, thus lowering their anemia risk. In well-functioning maternal care systems, miscarriage is often a trigger for enhanced medical follow-up, which can include nutritional counselling and anemia prevention strategies, potentially explaining this result.¹³ Contrary to the findings of this study, several studies in SSA and beyond have documented a significant relationship between miscarriage and maternal anemia. Abdallah et al highlighted that women with prior miscarriages often experience iron depletion due to bleeding and poor recovery, especially in settings where nutritional rehabilitation is limited.³ Stephen and others also emphasized miscarriage as a predictor of anemia, particularly in low-income areas where women face barriers to post-miscarriage care.¹ These inconsistencies highlight the complexity of anemia's multifactorial nature, where variables such as the severity of miscarriage, timing, medical intervention, and baseline maternal health play a significant role. Therefore, while the current study did not find a statistically significant link, the broader evidence base suggests miscarriage may be a contributing factor to maternal anemia, especially in under-resourced settings.

This study found no significant association between premature rupture of membranes (PROM) and anemia. All five anemia cases were reported among women who had not experienced PROM, and none were found among those who had, suggesting no direct link in this population. One explanation for this finding could be the timing and management of PROM within the healthcare setting. Women experiencing PROM may have been promptly managed through hospital-based care, including fluid therapy and prophylactic supplementation, which may have protected them from developing anemia. Additionally, PROM may not directly cause significant blood loss or iron depletion unless associated with infection or preterm delivery, both of which were not prominent in this study population. Nevertheless, findings from other regions suggest that PROM could indirectly influence anemia risk, especially when it leads to infection or preterm labor. According to Yosef et al, obstetric complications such as PROM, when unmanaged, can increase systemic inflammation and physiological stress, which may exacerbate anemia, particularly in already vulnerable women.⁵ Balcha et al, also note that PROM, when associated with underlying infections or recurrent preterm labor, may contribute to poor maternal nutritional status and blood loss, elevating anemia risk.⁴ Thus, the lack of association in this study may reflect effective hospital-based management or the low incidence of complicated PROM. It also underscores the importance of context, including the role of health systems in mitigating the adverse outcomes associated with obstetric emergencies.

Regarding parity and gravidity, no statistically significant relationship was found between anemia and parity or gravidity. This suggests that the number of pregnancies or children a woman has had did not influence her anemia status in this population. It is possible that multiparous women in this setting have developed physiological adaptations to the demands of pregnancy, such as improved iron absorption and utilization, which buffer against anemia.² Furthermore, multiparous and multigravida women may be more experienced in health-seeking behaviors, including early ANC attendance and adherence to iron and folic acid supplementation protocols. In contrast, Balcha et al, and Sentongo and others identified multiparity and multigravidity as significant risk factors for anemia, particularly in areas with high fertility rates and limited nutritional interventions.^{4,6} These studies argue that repeated pregnancies can deplete iron reserves, especially in the absence of dietary supplementation. The lack of association in the present study might also reflect successful implementation of community health education and nutritional programs, as suggested in the Nutrition International report on Kajiado County.¹²

Unlike the other reproductive health characteristics, pregnancy trimester was significantly associated with anemia, with the highest proportion of anemia cases occurring in the third trimester. This finding is consistent

with existing literature, which attributes increased anemia risk in the third trimester to heightened fetal iron demands and hemodilution due to plasma volume expansion.^{1,2} As pregnancy progresses, iron requirements escalate to support fetal growth, placenta development, and increased maternal red blood cell mass. If not adequately supplemented, maternal iron stores become insufficient, leading to anemia. This trend was similarly reported by Abdallah et al, who found that third-trimester pregnancies were significantly associated with moderate-to-severe anemia in Tanzanian women.³ On the other hand, a study by Riang'a and others in rural Kenya did not find a strong association between trimester and anemia, which they attributed to the high uptake of early iron and folic acid supplementation and consistent ANC follow-up.⁹ These contrasting results suggest that while biological demands play a critical role, their impact may be mitigated by timely and effective nutritional interventions.

Influence of antenatal care and supplementation on anemia

ANC compliance is widely considered a protective factor against pregnancy-related complications, the current study found no significant association between ANC compliance or non-compliance and anemia prevalence. This may be due to factors such as late initiation of ANC visits, where many women delay their first visit until the second or third trimester missing the critical window for early detection and prevention of anemia. Another possible explanation is low-quality service delivery, such as inadequate hemoglobin monitoring, poor counselling, or stockouts of essential supplements during ANC sessions. These system-level gaps may neutralize the expected benefits of routine ANC attendance. This aligns with findings from Balcha and others, who observed that although many women attended ANC, the prevalence of anemia remained high due to inconsistencies in the delivery of essential services like nutritional education and supplementation.⁴ Contrasting evidence from Stephen et al and Abdallah et al, suggests that frequent and high-quality ANC is significantly associated with lower anemia prevalence, especially when combined with routine supplementation and deworming interventions.^{1,3} The discrepancy in this study may reflect localized structural barriers, such as healthcare worker shortages, inadequate equipment, or poor health-seeking behavior that limits full utilization of ANC benefits. Furthermore, studies from WHO emphasize that for ANC to reduce anemia risk effectively, it must be comprehensive, consistent, and timely.² Therefore, mere attendance may not suffice if not accompanied by quality service delivery, early engagement, and adherence to ANC guidelines, especially in resource-constrained settings like Kajiado County.

Unlike ANC compliance, iron and folic acid supplementation (IFAS) showed a strong and statistically significant association with reduced anemia prevalence, confirming its effectiveness in preventing maternal

anemia. This result is consistent with WHO, which recommends daily IFAS throughout pregnancy in regions where anemia prevalence exceeds 40%, citing it as a cornerstone in maternal nutritional programs.¹⁰ In the current study, (84.3%) of IFAS-compliant women were not anemic, while only (1.9%) of them were anemic. This protective trend underscores the biological efficacy of IFAS in correcting micronutrient deficiencies, particularly in iron-deficient populations. Supporting studies, such as Njiru et al and Luwangula and others, have shown that improved education and consistent IFAS supply significantly reduce anemia burden among pregnant women.^{7,11} However, not all literature is in full agreement. For instance, Riang'a et al, noted that despite widespread IFAS distribution in rural Kenya, implementation fidelity was low, with women often discontinuing supplements due to gastrointestinal side effects, cultural beliefs, or forgetfulness.⁹ Similarly, Abdallah and others emphasized that adherence, not just availability, is critical for IFAS impact.³ These nuances highlight that while the efficacy of IFAS is well-established, its real-world effectiveness depends on proper counselling, consistent supply chains, and community awareness. Therefore, scaling up IFAS programs should be accompanied by behavior change communication and systems strengthening to ensure uptake, adherence, and sustained impact on maternal anemia prevention.

In this study, the lack of a significant association between hypertension and anemia suggests that hypertension may not play a central role in influencing hemoglobin levels in the sampled population. While some literature suggests that hypertensive disorders in pregnancy, particularly preeclampsia and eclampsia, can interfere with placental perfusion and lead to fetal complications, the direct relationship between hypertension and maternal anemia remains inconclusive.¹⁴ The non-significant finding may be attributed to the likelihood that hypertensive cases were either mild, effectively managed, or that the link between hypertension and anemia operates through indirect and less prominent pathways such as impaired nutrient transfer or adverse effects of antihypertensive medications rather than hypertension itself being a primary cause of anemia. Moreover, this result may reflect limitations in data capture or clinical underreporting. In resource-constrained settings, pregnant women may not receive comprehensive diagnostic evaluations for hypertension unless severe symptoms are present. As highlighted by Stephen and others, the quality and completeness of comorbidity screening during antenatal visits often vary, which can affect data accuracy.¹ If hypertensive conditions were underdiagnosed or misclassified, the study would lack the statistical power to detect an association.

Heart complications were also not significantly associated with anemia in this population. Given the extremely small number of respondents with reported heart conditions, the statistical comparison lacks sufficient sample variability

to yield meaningful insights. This outcome may suggest that clinically recognized cardiac diseases are rare in the study population, or it could reflect substantial underreporting or lack of diagnosis, particularly in settings where specialized cardiologic assessment is unavailable.¹⁵ In high-resource environments, chronic heart failure and congenital heart diseases are known contributors to anemia due to mechanisms like chronic inflammation, renal hypoperfusion, or hemodilution but such mechanisms might go undetected in limited ANC screening. Additionally, the detection of cardiac comorbidities in pregnancy requires access to echocardiography or at least electrocardiography, which are rarely routine in most Kenyan maternal health settings.¹⁵ Therefore, while the lack of association might suggest limited influence of heart disease on anemia in this context, it is equally plausible that undiagnosed structural heart conditions or functional abnormalities were not captured. As recommended by WHO, a comprehensive approach to maternal risk assessment, including pre-existing non-communicable diseases, is essential to contextualize findings like these. Future studies could benefit from more robust screening protocols to capture latent cardiac dysfunctions.²

Musculoskeletal complications also showed no significant association with anemia. This could indicate that common musculoskeletal conditions during pregnancy such as back pain, pelvic girdle pain, or joint discomfort have minimal or no physiological impact on hematologic status. These conditions are generally mechanical in nature, resulting from weight gain and hormonal changes affecting ligament laxity, rather than from inflammatory or systemic disease processes that might contribute to hemoglobin reduction. Hence, it is plausible that the observed lack of association reflects a genuine absence of pathophysiological linkage between musculoskeletal complaints and maternal anemia. However, it is also important to consider the likelihood of broad or vague classification of musculoskeletal disorders in the study.¹⁶ The term “musculoskeletal complications” may have included both mild, self-limiting discomforts and more severe conditions such as inflammatory arthritis or autoimmune-related myopathies, which are more likely to influence anemia through chronic inflammation or medication use. Without clinical characterization or severity grading, the potential impact of more serious musculoskeletal disorders may have been obscured by a larger proportion of benign cases.¹⁷

Regarding nutritional practices and their role in anemia, the current study revealed no significant association between iron-rich food consumption and anemia among pregnant women, with p values of 0.395 for frequent consumers and 0.825 for non-consumers. While this finding appears counterintuitive given that dietary iron intake is a foundational factor in anemia prevention it may be influenced by several methodological limitations. First, recall bias is a major concern in self-reported dietary assessments; pregnant women may overestimate

or inaccurately recall their intake of iron-rich foods, leading to exposure misclassification.¹⁸ Additionally, the study likely did not account for dietary diversity, bioavailability of iron, or enhancers/inhibitors of iron absorption (e.g., vitamin C versus phytates). For example, even if iron-rich foods such as liver or green leafy vegetables are consumed, iron absorption can be impaired if consumed with tea or in the absence of vitamin C-rich foods. Furthermore, the study's categorization of food frequency as simply "frequent" or "non-frequent" may have oversimplified complex eating behaviors.¹⁹

To enhance the validity of dietary assessments in future research, it is essential to adopt quantitative tools such as validated food frequency questionnaires (FFQs) or 24-hour dietary recalls. Moreover, using biomarkers such as serum ferritin or transferrin saturation could offer objective insights into iron status that dietary surveys alone cannot capture. Studies such as those by Stephen et al., and Rianga et al., have emphasized that without precise measurements of nutrient intake and absorption, the nutritional determinants of anemia can remain obscured.^{1,9}

Concerning deworming, the study also found no statistically significant association between deworming and anemia prevalence, with *p* values of 0.375 among those who dewormed and 0.953 among those who did not. While deworming is widely recognized as a preventive strategy against anemia especially in regions with high helminthic infections such as hookworm or schistosomiasis this lack of significance may reflect context-specific epidemiology. In urban or peri-urban areas like Ngong Sub-County, the burden of soil-transmitted helminths (STH) is likely lower due to better sanitation, piped water, and less frequent contact with contaminated soil, thereby diminishing the anemia-related impact of deworming. Additionally, the data collected might not have adequately captured frequency, timing, or type of deworming agents used, thus limiting the ability to assess dose-response relationships. Moreover, data granularity was lacking in this study; for instance, no information was provided about co-existing parasitic infections (e.g., malaria, schistosomiasis), which are known to interact with helminth infections to amplify anemia risk.⁶ In comparison, Yosef et al., found significant associations between infection-related factors and anemia only when detailed diagnostic testing was incorporated.⁵

CONCLUSION

The study revealed a low prevalence (4.7%) of anemia among expectant women attending ANC at Ngong Sub-County Hospital, with no severe cases identified. While most socio-demographic and reproductive health factors showed no significant association with anemia, pregnancy trimester and compliance with iron and folic acid supplementation were significantly linked. Strengthening

IFAS adherence may further reduce anemia risk during pregnancy.

Recommendations

Based on the findings, the study recommends enhancing awareness and education on the importance of iron and folic acid supplementation (IFAS) during pregnancy through targeted antenatal care programs. Health providers should emphasize adherence to IFAS and nutritional counselling, particularly for women in the first and third trimesters. Additionally, routine screening and monitoring for anemia should be strengthened to ensure early detection and timely intervention.

ACKNOWLEDGEMENTS

Authors deep gratitude goes to the County administration for granting us permission to conduct this study. Authors also appreciate all who contributed significantly to the successful completion of this research project.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee of the University of Nairobi/Kenyatta National Hospital (KNH)

REFERENCES

1. Stephen G, Mgongo M, Hussein Hashim T, Katanga J, Stray-Pedersen B, Msuya SE. Anaemia in pregnancy: prevalence, risk factors, and adverse perinatal outcomes in Northern Tanzania. *Anemia*. 2018;2018(1):1846280.
2. World Health Organization (WHO). (2025). Anemia Fact sheet. Available from: <https://www.who.int/news-room/fact-sheets/detail/anaemia>. Accessed on 7 April 2025.
3. Abdallah F, John SE, Hancy A, Paulo HA, Sanga A, Noor R, et al. Prevalence and factors associated with anaemia among pregnant women attending reproductive and child health clinics in Mbeya region, Tanzania. *PLOS Glob Public Health*. 2022;2(10):e0000280.
4. Balcha WF, Eteffa T, Tesfu AA, Alemayehu BA, Chekole FA, Ayenew AA, et al. Factors associated with anemia among pregnant women attended antenatal care: a health facility-based cross-sectional study. *Ann Med Surg*. 2023;85(5):1712-21.
5. Yosef T, Gizachew A, Fetene G, Girma D, Setegn M, Tesfaw A, et al. Infectious and obstetric determinants of anemia among pregnant women in Southwest Ethiopia. *Front Glob Women's Health*. 2024;5:1421884.
6. Ssentongo P, Ba DM, Ssentongo AE, Ericson JE, Wang M, Liao D, et al. Associations of malaria, HIV, and coinfection, with anemia in pregnancy in sub-Saharan Africa: a population-based cross-

- sectional study. *BMC Pregnancy Childbirth*. 2020;20(1):379.
7. Njiru H, Njogu E, Gitahi MW, Kabiru E. Effectiveness of public health education on the uptake of iron and folic acid supplements among pregnant women: a stepped wedge cluster randomised trial. *BMJ Open*. 2022;12(9):e063615.
8. Ajayi KV, Bolarinwa O, Adekunle TE, Alawode OA, Siuluta N, Shongwe S, et al. Prevalence and determinants of preterm birth among women of reproductive age in Kenya: a multilevel analysis of the 2022 Demographic Health Survey. *Therapeutic advances in reproductive health*. 2025;19:26334941251327181.
9. Rianga'a RM, Nangulu AK, Broerse JEW. Implementation fidelity of nutritional counselling, iron and folic acid supplementation guidelines and associated challenges in rural Uasin Gishu County, Kenya. *BMC Nutr*. 2020;6(1):78.
10. World Health Organization. Daily iron and folic acid supplementation during pregnancy. 2024. Available from: <https://www.who.int/tools/elena/interventions/daily-iron-pregnancy>. Accessed on 7 April 2025.
11. Luwangula AK, McGough L, Tetui M, Wamani H, Ssenono M, Agabiirwe CN, et al. Improving Iron and Folic Acid Supplementation Among Pregnant Women: An Implementation Science Approach in East-Central Uganda. *Glob Health Sci Pract*. 2022;10(6).
12. Nutrition International. Nutrition Investment Case: Kajiado County. Nutrition International. 2021. Available from: https://www.nutritionintl.org/wp-content/uploads/2021/03/Kenya_County_Investment_Case_Kajiado.pdf. Accessed on 7 April 2025.
13. Burayu ET, Degefa BD. Exploration of iron deficiency anemia and its associated factors among pregnant women seeking antenatal care in public health facilities of southwestern Ethiopia. A mixed study. *AJOG Glob Rep*. 2024;4(4):100417.
14. Karrar SA, Martingano DJ, Hong PL. Preeclampsia. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2025
15. Tegene E, Mohammed A, Godebo T, Desu G, Tadasa E. Prevalence of anemia and associated factors in patients with heart failure admitted to Jimma university medical center. *BMC Cardiovasc Disord*. 2025;25(1):253.
16. Fiat F, Merghes PE, Scurtu AD, Almajan Guta B, Dehelean CA, Varan N, et al. The main changes in pregnancy- therapeutic approach to musculoskeletal pain. *Medicina*. 2022;58(8):1115.
17. Hakim A. Hypermobility Ehlers-Danlos Syndrome. [2024]. In: Adam MP, Feldman J, Mirzaa GM, Pagon RA, Wallace SE, Amemiya A, eds. *GeneReviews®*. Seattle (WA): University of Washington, Seattle; 1993-2025.
18. Gibore NS, Ngowi AF, Munyogwa MJ, Ali MM. Dietary Habits Associated with Anemia in Pregnant Women Attending Antenatal Care Services. *Current developments in nutrition*, 2020;5(1):nzaa178.
19. Moustarah F, Daley SF. Dietary Iron. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2025.

Cite this article as: Wanjiku F, Odhiambo FB, Okenyori DS, Salima R. Prevalence of anemia and its association with nutritional, reproductive health, and antenatal care factors among pregnant women in a peri-urban health facility in Kenya. *Int J Community Med Public Health* 2025;12:4310-8.