Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Prevalence and factors associated with anemia among pregnant women in Nakfa district, Eritrea: A cross-sectional study

Meron Tesfay Kahsay

tesfaymeroncls@gmail.com

National Health Laboratory, Eritrea

Oliver Okotch Achila

Orotta college of medicine and health sciences

Huruy Tesfahiwet

National Health Laboratory, Eritrea

Hermon Haile Alem

Orotta national referral hospital

Ghirmay Ghebrekidan Ghebremeskel

Nakfa hospital

Samuel Tekle Mengstu

Nakfa hospital

Abiel Fessehaie Tesfazion

National Health Laboratory, Eritrea

Research Article

Keywords: prevalence, Anemia, pregnancy, Eritrea, Nakfa, predictors

Posted Date: March 13th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8599815/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background: Anemia in pregnancy is a fairly common public health problem with major implications for fetal and maternal health. Despite its importance, data on pregnancy-related anemia is hard to obtain for countries in Sub-Saharan Africa. In this study, we aimed to determine the prevalence of anemia and associated risk factors in women attending Antenatal clinic of Nakfa hospital, Nakfa sub-zone, Eritrea.

Methods: Hospital based cross-sectional study was conducted from 1st May – 31st August of 2024. In total, 283 women, visiting Nakfa hospital Antenatal Care clinic, were enrolled. Relevant metadata was collected via researcher administered questionnaire and medical records. In addition, standard phlebotomy techniques were employed to collect specimen for diagnosis of anemia. To identify and categorize anemia, the WHO criteria was employed. Data were analyzed using SPSS software version 26.

Result: The median age of the participants was 25 years [IQR: 22-28 years] with minimum and maximum age of 18 and 42 years, respectively. The overall, prevalence of anemia was 43% (95% CI: 38.9 – 48.7) with a mean hemoglobin concentration of 11.09 gm/dl (±1.64 SD). Among patients with anemia, 25% had moderate anemia and 17.6% had mild anemia. Factors associated with anemia in the bivariate analysis included level of education of mother and husband, mode of transport; and trimester. Protective factors included consumption of meat, poultry or diary; dark green vegetables; and fresh fruits. However, anemia was higher among the participants who took Iron-Folate than those who did not take (63% Vs 10%, *p<0.01*). In the multivariate analysis age was negatively associated with anemia (AOR=0.9, 95% CI: 0.8-0.9, *p=0.03*). Those who traveled by animal carrier or car (AOR=2.3, 95% CI:1.2-4.7, *p=0.01*), women in third trimester (AOR=2.7, CI:1.5-5.1, *p=0.001*), those who did not consume dark green vegetable (AOR=2.1, 95% CI:1.1-4, *p=0.002*) and participants with more than four children (AOR=3, CI:1.01-9.2, *p= 0.048*) had higher rate of anemia.

Conclusion: This study demonstrated that the prevalence of anemia is high among pregnant women attending Nakfa hospital's ANC clinic. The findings underscore the urgent need for improved ANC monitoring along with relevant public health strategies directed at addressing the problem. In addition, expanded research on anemia etiology is warranted.

Introduction

Pregnancy is a physiological condition characterized by a multiplicity of adoptive changes in response to the presence of then growing fetus [1]. One of the most consequential changes includes differential increase in plasma volume and red cell mass. These changes, lead, ultimately to reduction in hematocrit (HCT), particularly in the 2nd trimester [1, 2]. Related to these changes is an increase in the likelihood of anemia – defined by the World Health Organization (WHO) as a hemoglobin concentration < 11g/dL; in pregnant women [3]. The high likelihood of anemia among pregnant women is reflected in real world data. For example, a recent WHO report noted that the prevalence of anemia in non-pregnant women was 29.6% whereas the prevalence in pregnant women was 36.5% [4]. Others have noted that the prevalence of anemia is higher in developing countries – 18% vs 56% in developed countries [5, 6].

Anemia during pregnancy is of great concern because it contributes significantly to increased risk of maternal death during the prenatal period. It increases the risk of postpartum hemorrhage, pregnancy-induced hypertension, placenta Previa, hemorrhage and cardiac failure [7]. In Africa where the prevalence of anemia

among pregnant women is disproportionately high; adverse health outcomes for both mother and infant like maternal mortality, perinatal mortality, growth restriction and low birth weight have been reported [8]. Annually, approximately 510,000 maternal deaths occur due to complications related to pregnancy and childbirth, with nearly 20% of these deaths occurring in developing countries, often attributable to anemia [9]. To mitigate the impact of pregnancy - related anemia in developing countries; the WHO recommends day-to-day supplementation of 30–60 mg/d elemental iron (+ 400μg) and folic acid to reduce its public health impacts [10].

In terms of etiology, reports indicate that pregnancy – related anemia is associated with a multiplicity of factors including iron deficiency (resulting from prolonged negative iron balance) [11]; gestational age (more prevalence in the 3rd trimester) [12, 13]; not taking iron-folate supplementation; and a diet that is not diverse [13]. Other reports have linked it to increased nutritional demand and unmet need for micronutrients; intestinal helminthic infections, malaria, and chronic illnesses, among others [14]. In part, these constellation of factors explain of disproportionate burden of pregnancy-related anemia in developing countries where underprivileged citizens often have poor socioeconomic status, excess parity, inadequate spacing, poor alimentation, and high rate of infectious diseases. Moreover, they have poor access to medical care and preventive measures – factors which augment the risk of developing anemia [15].

Despite its importance, data on pregnancy-related anemia is hard to obtain for countries in Sub-Saharan Africa. In Eritrea, for instance, a population survey conducted in 2010, reported a prevalence of 23.8% [16]. In the interim, no studies were undertaken – an outcome which has left a significant gap in our knowledge on the prevalence of anemia among pregnant women in the country. Additional concerns with the now dated study were the fact that factors associated with anemia were not explored. At the same time, disaggregation of data with respect to the various sub-regions within the country was not undertaken. In this study, we aimed to determine the prevalence and factors associated with anemia among pregnant women in Nakfa district, Eritrea.

Methodology

Study design and setting

Hospital based cross-sectional study was done in Nakfa hospital from May 1 up to July 31 of 2024. Nakfa is found 225km from the capital Asmara and it is located in latitude and longitude of 16 .66 ^{o} and 38.4^{o} respectively, in an elevation of about 1700 meters (5,577feet) above sea level. The subzone has 11 administration regions and in 2024 the estimated population was 54,684 in Nakfa sub-zone and 26,593 in Nakfa town. Most of the people are farmers with nomadic and seminomadic life style; the rough topography of the region is the main reason of the poor transportation system there. The sub- zone has three health stations and one hospital (only the hospital has laboratory service). The hospital provides outpatient and inpatient service with: adult ward, pediatric ward, MHC ward (Maternal Health Care) and one OR (operation room) for cesarean section. It also serves as a referral hospital for the sub-zone and other nearby subzones (Adobha and karora subzones). According data from the hospital, first ANC visit rate was 104.6% in 2024 with total visit of 1122 women.

Sample size determination

Our source population was all pregnant mothers in Nakfa sub-zone. The sample size was estimated using the Cochran formula.

$$N = \frac{Z^2 * P(1-P)}{\varepsilon^2},$$

Where:

N = Sample size, Z = The z-score that corresponds with 95% confidence interval (1.96), P = According to the Eritrean population and health survey, prevalence of anemia in pregnancy was 23.8% [16], therefore, we considered p as 0.23, e = margin of error was taken as 5%. We calculated the minimum sample size of 278 women.

Study Population, inclusion and exclusion criteria

All pregnant women who visited the facility within the stated period (May 1 up to July 31 of 2024) were enrolled in the study. 305 participants were recruited, however, 9 (2.9%) and 13(4.2%) were excluded due to lack of co-operation and absence of critical data respectively. Ultimately, 283 participants were included in the study(fig-1).

Inclusion criteria

Pregnant women, 18 and above years old, who come to the ANC clinic of Nakfa hospital at the time of data collection, with no clinical emergency and consented to participate was eligible for the study.

Exclusion criteria

Pregnant mothers younger than 18 years, severely ill, mentally disabled, who had history of blood transfusion in the past one month and those who failed to consent were excluded.

Data collection tools and procedures

The questionnaire was developed based on the key indicators of the study and some variables that have been identified in earlier studies across developing countries [17, 18, 19]. The developed questionnaire was with 29 questions partitioned in to socio-demographic characteristics, obstetric history, medical history and nutritional history. It was originally prepared in English then it was translated in to Tigre (local language) and back translated in to English to ensure its' consistency.

Validation

Two weeks before data collection, pre-testing was done on 20 ANC attendants with similar characteristics as the actual participants. The questionnaire was then assessed robustly and modified accordingly.

Variable definition

Outcome variable

The dependent variable is hemoglobin value of mothers at the time of data collection. Anemia is defined as hemoglobin level of less than 11 g/dl: it is further categorized into mild, moderate, and severe anemia with a hemoglobin range of 10 − 10.9 g/dl, 7–9.9 g/dl, and < 7 g/dl, respectively [12].

Dependent Variables

Socio-demographic questions include

age, mothers educational level (illiterate, literate), mothers occupation (Not employed, Military recruit, others), residence (Nakfa, outside Nakfa), marital status(Married, single mom), husbands educational level(illiterate ,literate), mothers care taker (Husband or family, Relative or adopted, Single), occupation of care taker (unemployed, daily laborers, farmer, government worker, merchant, and working abroad) and mode of transport to the hospital (by animal carrier or by car, on foot) .

Obstetric and medical history includes

mother's gravidity, history of abortion (yes, no), gestational age (first trimester, second trimester, third trimester), anemia in previous pregnancy (yes, no), number of ANC visits(once,2–3 times,>3 times), current child spacing(≤ 2 years,>2 years), use of family planning (yes, no), history of neonatal death (yes, no), history of still birth (yes, no), presence of any chronic illness (yes, no), single or multiple pregnancy(single, multiple), history of vaginal bleeding (yes, no), use of family planning (yes, no) and history of malaria infection(yes, no) during this pregnancy.

Nutritional and medication history includes

consumption of nuts and seeds, consumption of meat, poultry or diary, consumption of dark green vegetables and fruits in a weekly basis. Iron-folate supplementation history in preconception and during period of gestation.

Data collection

Initially to ensure uniformity of the process, the data collectors were given orientation on how to explain the study objectives, obtain informed consent and conduct data collection. The two data collectors in the study were: one mid wife nurse and one nurse assistant trained and certified on ANC. Two supervisors and one project manager oversaw the data collection process. Data collectors conducted researcher administered questionnaire-based interview with the participants after routine ANC service. The interview was held in private ANC room and to ensure strict confidentiality, only one participant was allowed to do the interview at any one time. Average time needed to fill one questionnaire was 15 minutes. Uncertain answers were left unfilled and uncooperative subjects were excluded from the study. The Collected questionnaires were evaluated for its completeness and reliability daily by the supervisors. After the interview, the participants were referred to the laboratory for specimen collection.

Hemoglobin measurement

Hemoglobin levels were assessed using HemoCue 301 AB, SE 262 city, Sweden. Capillary blood sample, drawn using finger prick procedure, was used in this analysis. Before the sample collection date, quality control of the HemoCue machine was done at the National Health Laboratory (NHL). In addition, daily quality control was undertaken using standardized samples from the NHL.

Statistical analysis

Data was entered into CsPro version 7.1 and exported to Statistical Package for the Social Science (SPSS) version 26 for analysis. After cleaning, data was analyzed using descriptive statistics. Briefly, continuous data was analyzed using mean (standard deviation (SD), median (IQR)). Categorical variables were summarized into frequencies and proportions. Continuous variables such as age were categorized into age groups and hemoglobin values were categorized in to mild anemia (Hb 10–10.9 g/dl), moderate anemia (7–9.9 g/dl) and severe anemia (Hb < 7 g/dl). Pearson's Chi square test was used for evaluating the association between categorical variables. Variables with *p-value* of ≤ 0.25 in the bivariate analysis and with no significant collinearity were subjected in to Binary logistic regression for multivariate analysis. Statistical significance was declared at $p < 0.05$.

Result

Socio-demographic characteristics of participants

The median age of the participants was 25 [IQR: 22–28] with minimum and maximum age of 18 and 42 respectively. While, the middle aged (25–34 years old) participants were the most 151 (53.2%), the older age group (> 34 years old) holds only 12(4.2%) participants. Two third of the mothers were from out-side Nakfa town and most were traveled on foot to the hospital 205(72.2%). Furthermore, majority mothers were not employed 255(89.8%), married 266(93.7%) and under care of their husband or family 253(89.1%). As per formal education, 158(55.6%) of women and142 (50%) of their husbands were illiterate, and relatively higher number of their care takers were farmers 102(36%) (Table-1).

Obstetric history and other relevant information of participants

Majority of our participants were on second 134(48.9%) and third 124(45.3%) trimester with 2–4 children 124(44%). Family planning was not practiced by the greatest portion of our study participants 232(89.2%) and the study also revealed child spacing from the previous pregnancy was < 2 years in majority of our participants142(72.1%). History of previous abortion or neonatal death was low among the women, 46(16.5%) and 11(4.6%) respectively. Third of our study participants reported that they had anemia in the previous pregnancy, 95(34.3%). The data also show that most of the participants are with: no previous history of still birth 264(93%), having no chronic illness 278(98% of them with no either of diabetes, hypertension, cardiac problem or convulsion or epilepsy), single pregnancy 266(94%), no history of vaginal bleeding 241(85%) and with no history of malaria attack 266(94%) (Table-2).

Table-1 Socio-demographic characteristics of study participants in Nakfa sub-zone, Eritrea, 2024.

Characteristics	Frequency (%) N = 283
Age category	
18–24	120(42.3)
25–34	151(53.2)
>34	12(4.2)
Residence	
Nakfa	93(32.7)
Outside Nakfa	187(65.8)
Mode of transport to the hospital	
On foot	205(72.2)
By animal carrier or car	67(23.6)
Mothers educational status	
Illiterate	158(55.6)
Literate	123(43.3)
Mothers occupation	
Not employed	255(89.8)
Military recruit	6(2.1)
Others	11(3.9)
Mothers marital	
Married	266(93.7)
Single mom	7(2.5)
Mothers care taker	
Family or Husband	253(89.1)
Relative or adopted	9(3.2)
None	9(3.2)
Occupation of care taker	
Daily laborer	42(14.8)
Farmer	102(36)
Government worker	55(19.4)
Merchant	18(6.4)
Working abroad	48(17)

Characteristics	Frequency (%) N = 283
Others	8(2.8)
Husbands educational level	
Illiterate	131(46.1)
Literate	142(50)

Table-2 Obstetric history and relevant information of study participants in Nakfa sub-zone, Eritrea, 2024

Characteristics	Frequency (%) N = 283
Gestational age	
First trimester	16(5.8)
Second trimester	134(48.9)
Third trimester	124(45.3)
Gravidity	
Gravida-one	75(26.6)
Gravida 2–4	124(44)
Gravida > 4	83(29.4)
Use of family planning?	
Yes	28(10.8)
No	232(89.2)
Duration from previous pregnancy	
≤ 2(years)	142(72.1)
>2(years)	55(27.9)
History of abortion	
Yes	46(16.4)
No	235(83.6)
History of neonatal death	
Yes	11(4.6)
No	225(95.4)
Anemia in previous pregnancy	
Yes	95(34.3)
No	182(65.7)
Number of ANC visits	
1	140(50.5)
2–3	88(31.8)
>3	49(17.7)

Nutritional and medication parameters of participants

Nutritional assessment was done based on the consumption of specific diet on weekly bases. Protein rich diets like Meat, poultry or diary was consumed by most of the participants 191(67%). Consumption of Eggs and dark green vegetables were moderate, 114(40.1%) and 130(45.8%) respectively. While, consumption of Seeds and Nuts

37(13.1%) and consumption of fruits 72(25.4%) were relatively low. Besides, Iron-Folate supplementation rate was 177(62.5%) among our study participants (table-3).

Table-3 Nutritional and medication history of study participants in Nakfa subzone, Eritrea, 2024 (N = 283).

Characteristics	Count(%)
Nuts and seeds consumption at least once a week	
Yes	37(13.1)
No	231(81.6)
Meat, poultry or diary consumption at least once a week	
Yes	191(67.3)
No	86(30.3)
Egg consumption at least once a week	
Yes	114(40.1)
No	155(54.6)
Dark green vegetables consumption at least once a week	
Yes	130(45.8)
No	150(53.6)
Fruits consumption at least once a week	
Yes	72(25.4)
No	164(57.7)
Iron-folate supplementation during this pregnancy	
Yes	177(62.5)
No	106(37.5)

Iron-Folate supplementation across period of gestation

The overall Iron-Folate supplementation rate of our participants was 177(62.5%), with 7.7% (N = 22) of them took more than once. Trend of iron-folate supplementation reached its' peak value in the second trimester of the gestation (37.5%). The consumption rate during first trimester and preconception was relatively low, accounted for 6.3% and 0.4% respectively (fig-2).

Distribution of participant's mode of transport across residency

Most of the participants traveled on foot 205(72.3%) to the hospital at the time of data collection and participants from outside Nakfa used mostly animal carrier or car to travel to the hospital 65 (97%) (fig-3).

Utilization of Antenatal Care (ANC) Service of participants

In regard to ANC visit rate, 101(75%) of women in second trimester attended their first ANC visit and only one person attended four and more times. Further, only 48(39%) of the mothers in the third trimester visited ≥ 4 times to the hospital and 23(19%) had one visit rate in third trimester (table-4).

Table-4 Number of ANC visit of participants with respect to their gestational age, in Nakfa sub-zone, Eritrea, 2024.

Gestational age	Frequency of ANC visit		
	1 visit, N (%)	2–3 visit, N (%)	≥4 visit, N (%)
First trimester	14(87.5)	2(12.5)	0(0)
Second trimester	101(75.4)	32(23.9)	1(0.7)
Third trimester	23(19)	51(41.9)	48(39.3)
ANC: Antenatal care			

Prevalence of Anemia in the study participants

The prevalence of anemia in our study is 122(43%, 95% CI: 38.9–48.7) and the mean hemoglobin concentration of our study participants is 11.09 gm/dl (± SD1.64). Minimum and maximum hemoglobin values recorded was 7.2gm/dl and 15gm/dl respectively. Although, 72(25%) of our participants were in the moderate anemia category, no participant with severe anemia appeared in our study(fig-4).

Factors associated with anemia: bivariate analysis

The result of bivariate analysis showed, women illiteracy (*p = 0.018*), husband illiteracy(*p = 0.013*) being traveled by animal carrier or car (*p = 0.004*), and being in third trimester (*p < 0.01*) showed statistically significant association with higher prevalence of anemia. Those who had more than 4 children was also vulnerable to anemia with close to significance *(p = 0.05)*. As of the nutritional factors, not consuming: meat, poultry or diary *(p = 0.03)*, dark green vegetables *(p = 0.02)* and fresh fruits (*p = 0.04*) per week were associated with higher rate of anemia. Furthermore, Anemia was higher among the participants who took Iron-Folate (63% Vs 10%, *p < 0.01*) (table-5).

Table-5 Bivariate analysis of factors associated with anemia in pregnant mothers in Nakfa sub zone, Eritrea, 2024.

Characteristics	Anemia category		p-value
	Anemic count (%)	Not Anemic count (%)	
Median Age(IQR)	25(22–28)	25(22–29)	0.5
Residence			
Nakfa	34(37)	58(63)	0.17
Outside Nakfa	85(45.5)	102(54.5)	
Mothers Educational level			
Literate	43(35.2)	79(64.8)	**0.018**
Illiterate	78(48.4)	80(50.6)	
Husband's educational level			
Literate	51(35.9)	91(64.1)	**0.013**
Illiterate	66(50.8)	64(49.2)	
Mode of transport to health facility			
On foot	75(36.8)	129(63.2)	**0.004**
By animal carrier or car	38(56.7))	29(43.3)	
Occupation of care taker?			
Daily laborer	16(38.1)	26(61.9)	0.2
Farmer	49(48)	53(52)	
Government worker	19(34.5)	36(65.5)	
Working abroad	22(45.8)	26(54.2)	
Merchant	4(23.5)	13(76.5)	
Gravidity			
Gravida 1	29(39.2)	45(60.8)	0.05
Gravida 2–4	47(37.9)	77(62.1)	
Gravida >4	45(54.2)	38(45.8)	
Had Abortion			
Yes	22(47.8)	24(52.2)	0.4
No	98(41.9)	136(58.1)	
Gestational age			
First and second trimester	49(32.9)	100(67.1)	**0.001**

Characteristics	Anemia category		p-value
	Anemic count (%)	Not Anemic count (%)	
Third trimester	66(53.2)	58(46.8)	
Anemia in previous pregnancy?			
Yes	46(48.4)	49(51.6)	0.19
No	73(40.3)	108(59.7)	
Number of ANC visit in the current pregnancy			
1	51(36.7)	88(63.3)	0.1
2–3	42(47.7)	46(52.3)	
>3	25(51)	24(49)	
Time gap from the previous pregnancy (years)			
≤ 2	59(41.5)	83(58.5)	0.3
>2	27(49.1)	28(50.9)	
Use of family planning?			
Yes	8(28.6)	20(71.4)	0.09
No	105(45.3)	127(54.7)	
Previous history of neonatal death?			
Yes	4(40)	6(60)	0.9
No	95(41.9)	132(58.1)	
Consumption of Nuts and seeds at least once a week			
Yes	16(44.4)	20(55.6)	0.8
No	99(42.9)	132(57.1)	
Consumption of meat, poultry or diary at least once a week			
Yes	74(38.9)	116(61.1)	**0.03**
No	45(52.3)	41(47.7)	
Consumption Egg at least once a week			
Yes	45(39.8)	68(60.2)	0.3
No	70(45.2)	85(54.8)	
Consumption of Dark green vegetables			
Yes	46(35.7)	83(64.3)	**0.02**

Characteristics	Anemia category		p-value
	Anemic count (%)	Not Anemic count (%)	
No	74(49.3)	76(50.7)	
Consumption of Fruits at least once a week			
Yes	23(32.4)	48(67.6)	**0.04**
No	76(46.3)	78(53.7)	
Iron-Folate supplementation			
Yes	111(63.1)	65(36.9)	**< 0.001**
No	11(10.4)	95(89.6)	

Factors associated with anemia: multivariate analysis

Multivariate analysis showed that age was negatively associated with anemia in pregnancy (AOR=0.9, 95% CI: 0.8-0.9, *p=0.03*). Those who traveled by animal carrier or car to the hospital had 2.3 times odds of having anemia as compared to those who traveled on foot (AOR=2.3, 95% CI:1.2-4.7, *p=0.01*) and mothers in third trimester had 2.7 times odds of having anemia as compared to in first or second trimester (AOR=2.7, CI:1.5-5.1, *p=0.001*). Another noteworthy finding was, those who did not consume dark green vegetables had higher odds of anemia (AOR=2.1, 95% CI:1.1-4, *p=0.002*). Furthermore, participants with more than four children had higher odds of anemia as compared to women in their primary pregnancy (AOR=3, CI:1.01-9.2, *p= 0.048*) (Table-6).

Table-6 Multivariate analysis of factors associated with anemia in pregnancy in Nakfa sub-zone, Eritrea, 2024.

Characteristics	CIR (95% CI)	p-value	AOR (95% CI)	p-value
Age	0.9(0.8–0.9)	**0.045**	0.9(0.8–0.9)	**0.03**
Residence				
Nakfa town	1(ref)			
Outside Nakfa town	0.4(0.1–1.1)	0.08		
Mothers Educational level				
Literate	1(ref)			
Illiterate	1.4(0.7–3.1)	0.3		
Mode of transport to health facility				
On foot	1(ref)		1(ref)	
By animal carrier or by car	3(1.3–6.6)	**0.006**	2.3(1.2–4.7)	**0.01**
Occupation of care taker?				
Merchant	1(ref)			
Working abroad	1.9(0.4–9.1)	0.3		
Government worker	1.3(0.3–5.7)	0.7		
Farmer	1.7(0.4–7.7)	0.4		
Daily laborer	1.3(0.2–6.3)	0.7		
Gravidity				
Gravida 1	1(ref)		1(ref)	
Gravida 2–4	0.8(0.3-2)	0.6	1.09(0.4–2.5)	0.8
Gravida > 4	2.3(0.6–7.7)	0.1	3(1.01–9.2)	**0.048**
Gestational age				
First and second trimester	1(ref)		1(ref)	
Third trimester	2.3(1.04–5.3)	**0.03**	2.7(1.5–5.1)	**0.001**
Anemia in previous pregnancy?				
Yes	1(ref)			
No	0.5(0.2–1.2)	0.14		
Number of ANC visit in the current pregnancy				

CIR= Crude Incidence Ratio, AOR= Adjusted Odds Ration, CI= Confidence Interval

Characteristics	CIR (95% CI)	p-value	AOR (95% CI)	p-value
1	0.8(0.2–2.3)	0.7		
2–3	1.3(0.5–3.5)	0.5		
>3	1(ref)			
Consumption of meat, poultry or diary at least once a week				
Yes	1(ref)	0.2		
No	1.5(0.7–3.07)			
Consumption of Dark green vegetables at least once a week				
Yes	1(ref)	**0.04**	1(ref)	
No	2.1(1.03–4.5)		2.1(1.1-4)	**0.02**
Consumption of Fruits at least once a week				
Yes	1(ref)	0.8		
No	1.1(0.4–2.6)			
CIR= Crude Incidence Ratio, AOR= Adjusted Odds Ration, CI= Confidence Interval				

P- Values highlighted in bold indicates statistically significant (< 0.05).

Discussion

Anemia remains a major public health concern with important implications for both maternal and fetal outcomes. According to the WHO, anemia is classified as a condition of moderate public health significance [3]. This study assessed the prevalence of anemia and its associated factors among pregnant women in the Nakfa sub-zone, Eritrea.

Women aged over 34 years accounted for the smallest proportion of participants (4.2%). This finding may be explained by the widespread practice of early marriage in the region, which contributes to higher fertility at younger ages. A comparable age distribution was reported in a study conducted in Asmara, Eritrea, where 13.1% of participants were aged over 34 years [20]. These findings suggest similarities in socioeconomic and cultural contexts across the country. In the present study, most participants traveled on foot to attend ANC services (72.2%), which likely explains most of our participants resided close to Nakfa town. This supports the assumption that proximity to healthcare facilities influences ANC attendance.

At the time of data collection, 75% of women in their second trimester were attending for the first time to the ANC service, moreover only 39% of women in the third trimester had completed four or more ANC visits. The WHO recommends a minimum of eight antenatal contacts during pregnancy [21] to ensure timely detection and management of maternal and fetal complications. ANC attendance in this study was lower than that reported in

Asmara, where 24.6% of women initiated ANC during the second month of pregnancy [20]. Improved accessibility in urban settings, including shorter travel times to health facilities, may account for this difference. Nevertheless, the ANC utilization pattern observed in this study is consistent with findings from Ghana [22].

Daily iron–folate supplementation throughout pregnancy is recommended by the Ministry of Health of Eritrea in accordance with WHO guidelines [10, 20]. However, only 63% of participants in this study reported receiving iron–folate supplements. Enhancing ANC attendance and strengthening supplementation programs are therefore essential. Although the supplementation coverage observed in this study was lower than reported in Cameroon and Tanzania, where coverage exceeded 90% [23, 24], it was higher than that reported in Uganda [7]. The variation in supplementation coverage across countries likely reflects differences in health system capacity, supply chain management, and program implementation.

The prevalence of anemia among pregnant women in this study was 43%, which is classified as a severe public health problem according to WHO criteria [25]. This prevalence is higher than reports from sub-Saharan Africa overall (35.6%) [13], Northern Uganda (24.7%) [26], the Mbeya region of Tanzania (25.5%) [27], Tigray in northern Ethiopia (7.9%) [12], and Ethiopia at the national level (26.3%) [14]. Conversely, it is lower than the prevalence reported in West Gonja District, Ghana (55.8%) [22], Somaliland (50.6%) [9], Sudan (53.0%) [28], and Bangladesh (58.9%) [29]. Such variation may be attributed to differences in socioeconomic conditions, dietary practices, geographic settings, and national health policies.

Although 25% of participants were classified as having moderate anemia, no cases of severe anemia were identified. This finding is consistent with reports from other studies [8, 17], but contrasts with findings from Somaliland, where 12.1% of pregnant women had severe anemia [9]. The absence of severe anemia in the present study may reflect the positive role of ANC services in Eritrea in early identification and management of anemia.

In the bivariate analysis, a higher prevalence of anemia was observed among women who reported iron–folate supplementation compared with those who did not (64% vs. 36%). This association should be interpreted cautiously, as the cross-sectional design precludes causal inference. Iron–folate supplementation may have been initiated as a therapeutic intervention among women already diagnosed with anemia. Additionally, suboptimal adherence to supplementation could limit its effectiveness. Inconsistencies with our finding have been reported elsewhere [14, 30], underscoring the need for longitudinal studies to clarify the relationship between supplementation and anemia.

Multivariable analysis demonstrated a negative association between maternal age and anemia, indicating a higher burden among younger women. This finding contrasts with results from Cameroon [23]. Women who traveled to health facilities by car or animal carrier had 2.3 times higher odds of anemia compared with those who traveled on foot. Notably, in our study, 97% of women who used car or animal transport resided outside Nakfa town(fig-3), suggesting that longer travel distance may contribute to increased anemia risk.

Women in their third trimester had 2.7 times higher odds of anemia compared with those in the first or second trimester, consistent with findings from previous studies [9, 14, 17]. Increased physiological demand for iron and folate during late pregnancy may partly explain this association. Reduced dietary intake in the third trimester, particularly of nutrient-rich foods [24], may further exacerbate anemia risk.

In this study, women who did not consume dark green leafy vegetables had a significantly higher risk of anemia (adjusted odds ratio [AOR] = 2.1, 95% CI: 1.1–4.0). Similar associations have been reported in Tanzania and other

settings [24, 27]. Parity was also significantly associated with anemia. Women with more than four children had threefold higher odds of anemia (AOR = 3.0, 95% CI: 1.01–9.2), consistent with findings from other studies [9, 14].

Limitation and strength of the study

One of the major drawbacks of this study is, the outcome we found is sensitive to any inaccuracy of the response from the study subjects. Secondly, given that this study is a cross-sectional study, it cannot conclude causal relationship. Larger sample size with additional variables like: stool examination, blood cell morphology evaluation and assessment of adherence to Iron-Folate supplementation would have also given this research broader insight. However, considering the study is inclusive in terms of representation, it reflects the burden of anemia in pregnancy in the region.

Conclusion

The magnitude of anemia in Nakfa sub-zone is comparatively high (43%), which may have profound negative effect in the health of mother and child. Factors that are associated with anemia in pregnancy in the present study are; younger age, being traveled by car or animal carrier, being in the third trimester and not consuming dark green vegetables often times. Therefore, we suggest that greater effort should be applied in reducing this burden by improving dietary practices, giving more attention to the pregnant mothers in the third trimester and providing better health care facility and transport system to the remote sites of the region. Finally, our recommendation is further robust study to be done.

Abbreviations

ANC
Antenatal Care
WHO
World Health Organization
NHL
National Health Laboratory
CI
Confidence Interval
COR
Crude Odds Ratio
AOR
Adjusted Odds Ratio
Vs
Versus

Declarations

Ethics approval and consent to participate

Permission was sought from the Health Research Ethics and Protocol Review Committee of the Eritrean Ministry of Health (Letter of reference 29/02/2023) and from the administration of study hospital. An official consent

form was signed by every participant before data collection and full confidentiality of the participants were strictly respected.

Consent for publication

Not applicable.

Data availability

The data set supporting the conclusions of this article is available from the corresponding author upon reasonable request.

Competing interests

The authors declare no competing interests.

Funding

No funding obtained for this study.

Authors Contribution

MTK, STM, GGG conceived the study and formulated the study design and participated in data collection. MTK, GGG supervised the data collection process and performed other administrative functions. MTK, OOA, GGG, HT, HHA, STM and AFT did the statistical analysis and data presentation. MTK, OOA, GGG, HT, HHA, STM and AFT wrote and edited the first draft of the manuscript. All authors read and approved the final manuscript.

Acknowledgement

The authors thank Zahra Mohammed for her great assistance in the data collection and all Nakfa Hospital staff who supported us throughout study.

References

1. Flick AA, Kahn DA. Maternal Physiology during pregnancy and Fetal and Early Neonatal Physiology. Current Obstetrics and Gynecologic Diagnosis and Treatment. 11th ed. New York: McGrawHill; 2013. p. 16379.
2. Marya RK. Medical Physiology. 3rd ed. New Delhi: CBS Publishers and Distributors Ltd.; 2010.
3. World Health Organization. Hemoglobin concentrations for the diagnosis of anemia and assessment of severity (No. WHO/NMH/NHD/MNM/11.1). 2011.
4. World Health Organization. Anemias. Geneva: World Health Organization. Available from: https://www.who.int/healthtopics/anaemia [Last accessed on 2022 may 10].
5. WHO. Iron Deficiency Anemia: Assessment, Prevention and Control: A Guide for Program Managers. Geneva, Switzerland: UNICEF, United Nations University, WHO; 2001.
6. Murphy JF. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Vitamin and mineral nutrition information system. Geneva: World Health Organization (2011).
7. M. A. Mbule, Y. B. Byaruhanga, M. Kabahenda, and A. Lubowa. Determinants of anemia among pregnant women in rural Uganda, Rural and Remote Health. vol. 13, no. 2, p. 2259, 2013.
8. Lebso M, Anato A, Loha E (2017) Prevalence of anemia and associated factors among pregnant women in Southern Ethiopia: A community based cross-sectional study. PLoS ONE 12(12): e0188783.

https://doi.org/10.1371/ journal.pone.0188783

9. Mohamed Mussa Abdilahi, Jonah Kiruja, Badra Osman Farah , Farduus Mohamed Abdirahman , Ahmed Ismail Mohamed , Jama Mohamed and Abdeta Muktar Ahmed. Prevalence of anemia and associated factors among pregnant women at Hargeisa Group Hospital, Somaliland. BMC Pregnancy and Childbirth (2024) 24:332 https://doi.org/10.1186/s12884-024-06539-3
10. WHO. Global prevalence of anemia in 2011. Geneva: Health organization; 2011.
11. Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, Peña-Rosas JP, Bhutta ZA, Ezzati M, Group NIMS. Global, regional, and national trends in hemoglobin concentration and prevalence of total and severe anemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. Lancet Glob Health. 2013;1(1): e16–25.
12. Brhane Berhe , Fitsum Mardu, Haftom Legese, Aderajew Gebrewahd, Guesh Gebremariam, Kebede Tesfay, Getachew Kahsu, Hadush Negash and Gebre Adhanom. Prevalence of anemia and associated factors among pregnant women in Adigrat General Hospital, Tigrai, northern Ethiopia, 2018. BMC Res Notes (2019) 12:310 https://doi.org/10.1186/s13104-019-4347-4
13. Meseret Belete Fite, Nega Assefa and Bizatu Mengiste. Prevalence and determinants of Anemia among pregnant women in sub-Saharan Africa: a systematic review and Meta-analysis. Archives of Public Health (2021) 79:219. https://doi.org/10.1186/s13690-021-00711-3
14. Geta TG, Gebremedhin S, Omigbodun AO (2022). Prevalence and predictors of anemia among pregnant women in Ethiopia: Systematic review and meta-analysis. PLoS ONE 17(7): e0267005. https://doi.org/10.1371/journal. pone.0267005
15. Ashraf MA Hussain, Qais Ismaeel kadhem, Nibras Alaa Hussain. Prevalence of anemia in a sample of pregnant women in Babylon Governorate, Iraq. Revista Latinoamericana de Hipertensión. Vol. 15 - Nº 4,2020.
16. National Statistics Office (NSO) [Eritrea] and Fafo AIS. 2013. Eritrea Population and Health Survey 2010. Asmara, Eritrea: National Statistics Office and Fafo Institute for Applied International Studies.
17. Anthony Wemakor. Prevalence and determinants of anemia in pregnant women receiving antenatal care at a tertiary referral hospital in Northern Ghana. BMC Pregnancy and Childbirth (2019) 19:495. https://doi.org/10.1186/s12884-019-2644-5
18. Abel Gebre and Afework Mulugeta.Prevalence of Anemia and Associated Factors among Pregnant Women in North Western Zone of Tigray, Northern Ethiopia: A Cross-Sectional Study. Hindawi Publishing Corporation Journal of Nutrition and Metabolism Volume 2015, Article ID 165430, 7 pages http://dx.doi.org/10.1155/2015/165430
19. Mekdemariam Getachew, Mebrahtu Abay, Hiwet Zelalem, Tirhas Gebremedhin, Teklit Grum and Alemayehu Bayray. Magnitude and factors associated with adherence to Iron-folic acid supplementation among pregnant women in Eritrean refugee camps, northern Ethiopia. BMC Pregnancy and Childbirth (2018) 18:83 https://doi.org/10.1186/s12884-018-1716-2
20. Meron Berhe Tsegai1, Abiel Habtom Berhe, Semhar Berhane Tesfaezgi, Dawit G Weldemariam, Kifleyesus Tedla Petros, Hana Bereket Weldetinsae, Eyasu H Tesfamariam. Knowledge, Attitude, and Practice Regarding Supplemental Iron and Folic Acid Amongst Women Delivering in Edaga-Hamus Community Hospital: A Cross-Sectional Study in Asmara, Eritrea, International Journal of Women's Health 2023:15 1593–1609
21. WHO recommendations on antenatal care for a positive pregnancy experience. World health organization,Geneva,2016.http://www.who.int/reprodctivehealth/publications/maternal_perinatal_health/anc-

positive-pregncncy-experience/en/(Accesed on December01, 2016).

22. Basil Addayire Tibambuya, John Kuumuori Ganle &, Muslim Ibrahim. Anaemia at antenatal care initiation and associated factors among pregnant women in West Gonja District, Ghana: a cross-sectional study. The Pan African Medical Journal. 2019; 33:325. doi:10.11604/pamj.2019.33.325.17924
23. Henri, E., Valere, M.K., Lucas, E.E., Calixte, P.I., Ngalame, C.M., Grâce, T.T., Ekobo, A.S. and Moukoko, C.E.E. (2019). Hematological Profile and Risk Factors of Anemia in Pregnant Women: A Cross Sectional Descriptive and Analytical Study in Douala Cameroon. Open Journal of Obstetrics and Gynecology, 9, 968-980. https://doi.org/10.4236/ojog.2019.97094
24. Lema EJ, Seif SA. Prevalence of anemia and its associated factors among pregnant women in Ilala Municipality - Tanzania: Analytical cross-sectional study. Medicine 2023; 102:23 (e33944).
25. World Health Organization, worldwide prevalence of anemia 1993-2005: WHO global database on anemia, 2008.
26. Samson Udhoa, Joyce Nankumbib , Mariam Namutebib , David Mukunyac,d, Grace Ndeezie and James K Tumwine. Prevalence of anemia in pregnancy and associated factors in northern Uganda: a cross-sectional study. South African Journal of Clinical Nutrition 2023; 36(4):136–141 https://doi.org/10.1080/16070658.2022.2148909
27. Abdallah F, John SE, Hancy A, Paulo HA, Sanga A, Noor R, et al. (2022). Prevalence and factors associated with anemia among pregnant women attending reproductive and child health clinics in Mbeya region, Tanzania. PLOS Glob Public Health 2(10): e0000280. https://doi.org/ 10.1371/journal.pgph.0000280
28. Ishag Adam, Yassin Ibrahim and Osama Elhardello, Prevalence, types and determinants of anemia among pregnant women in Sudan: a systematic review and meta-analysis. BMC Hematology (2018) 18:31. https://doi.org/10.1186/s12878-018-0124-1
29. Ahmed, S., Al Mamun, Md.A., Mahmud, N., Farzana, N., Sathi, M.S.A., Biswas, B.K., Datta, A. and Ahmad, T. (2019). Prevalence and Associated Factors of Anemia among Pregnant Women Receiving Antenatal Care (ANC) at Fatima Hospital in Jashore, Bangladesh: A Cross-Sectional Study. Food and Nutrition Sciences,10,1056-1071.https://doi.org/10.4236/fns.2019.109076
30. Berrick Otieno, Cyrus Mutie, Salwa Elmawi, Marttin Kyania Mulala, Makorani Y'Dhidha-a-Mjidho, Isaac Kyalo1, Mwaswere Juma, and Osman Abdullahi. Prevalence and Predictors of Anaemia in Pregnant Women Receiving Antenatal Care at Kilifi County Referral Hospital, Kenya. *African Journal of Health Sciences Volume 36, Issue No.5, September – October 2023*

Figures

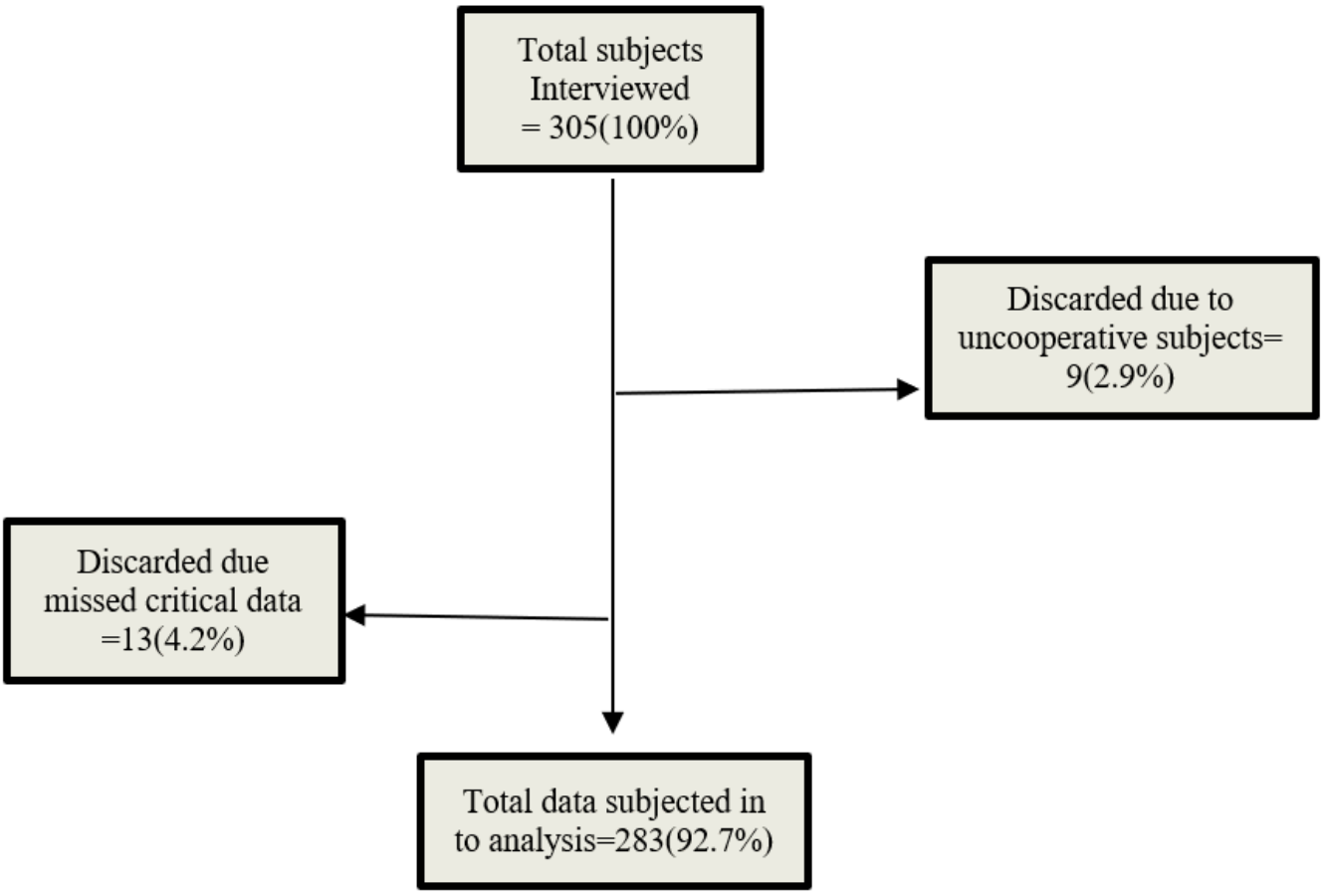


Figure 1

Flow diagram of participant recruitment for the study in Nakfa sub-zone, Eritrea, 2024.

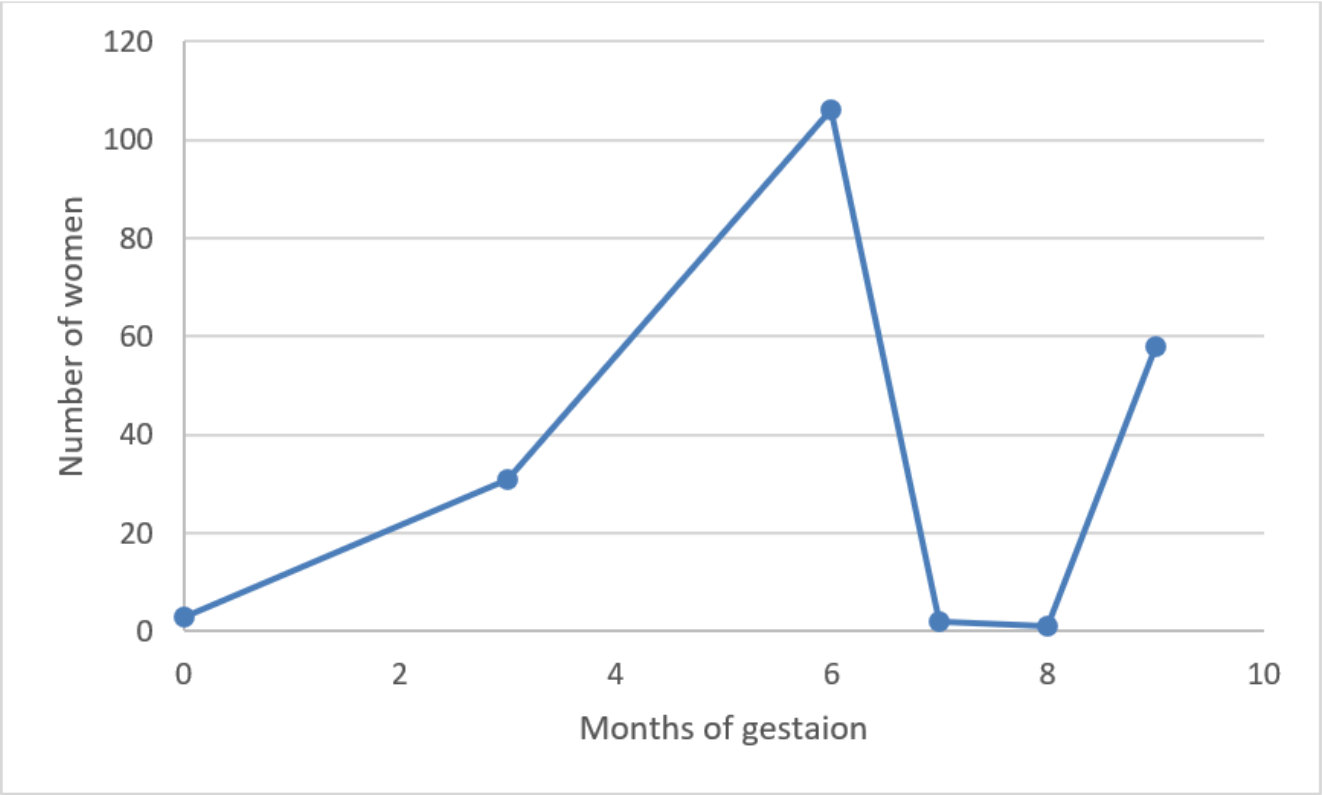


Figure 2

Trends of Iron-Folate supplementation across months of gestation among women in Nakfa sub-zone, Eritrea, 2024.

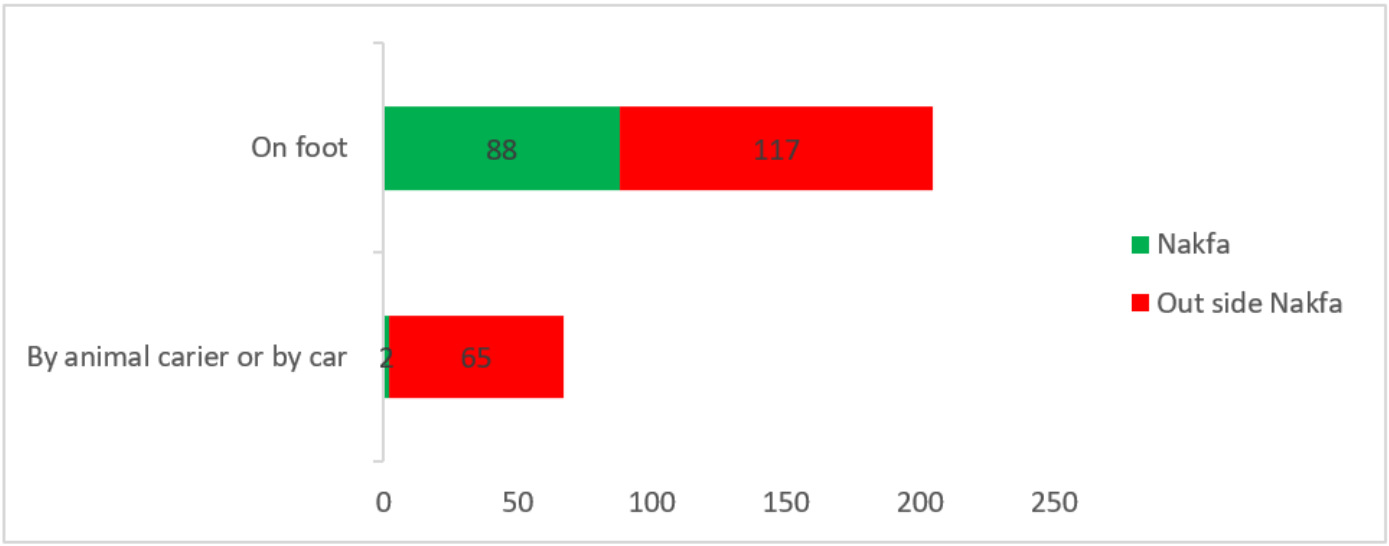


Figure 3

Mode of transport of women with respect to their residence in Nakfa sub-zone, Eritrea, 2024.

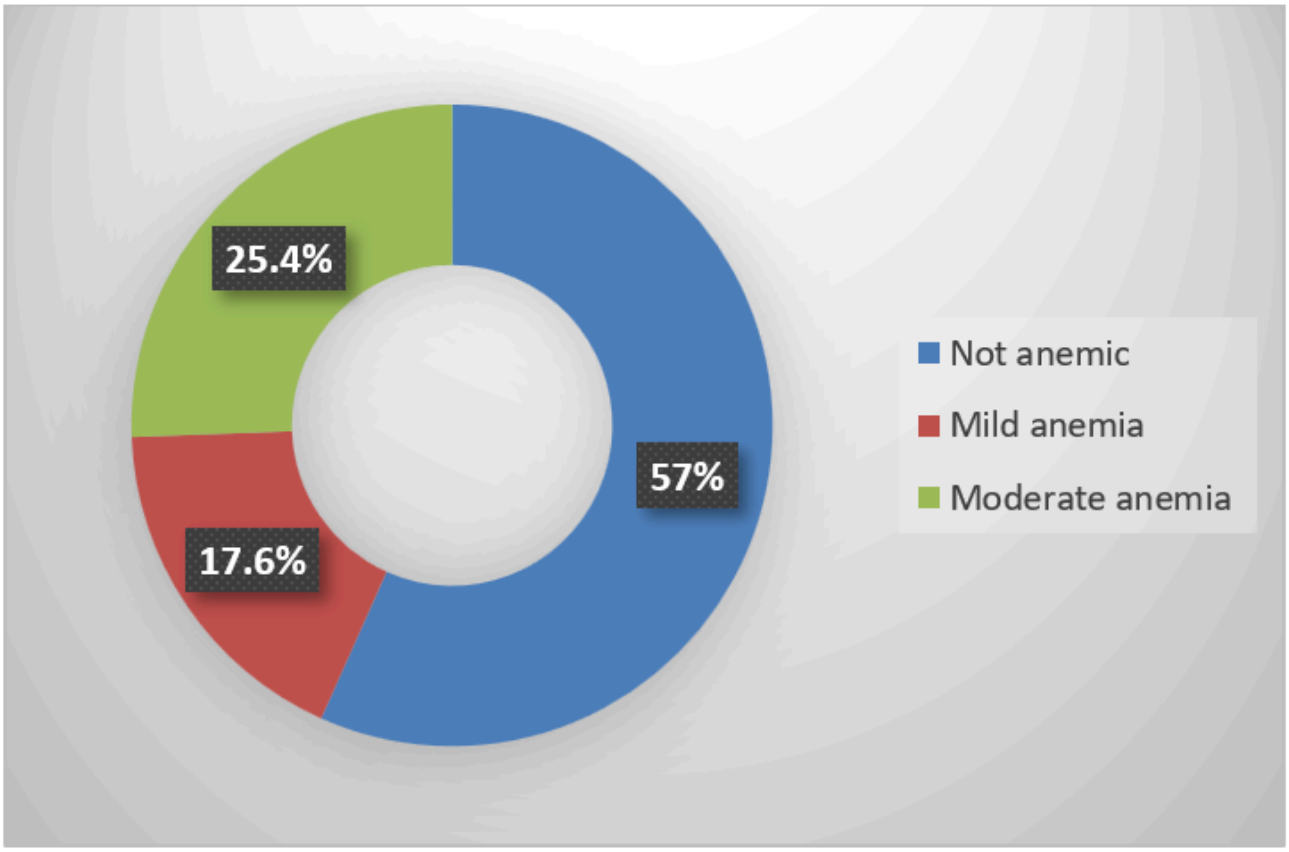


Figure 4

prevalence of anemia in Nakfa sub-zone, Eritrea, 2024. The pi-chart shows the proportion of mild anemia (hemoglobin value,10-10.9 g/dl), moderate anemia (hemoglobin value,7-9.9 g/dl) and not anemic (hemoglobin value, ≥11g/dl) in our participants.