

Risk Factors For Maternal Anemia Among Women Attending Antenatal Care In Moroto Regional Referral Hospital. A Case- Control Study

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ABSTRACT

Background: Maternal anemia continues to be a serious public health issue because of its link to poor maternal and fetal outcomes. The study's objective was to assess the association between risk factors and maternal anemia among women attending antenatal care in Moroto Regional Referral Hospital. **Methods:** A case-control study involving 100 pregnant women -50 cases and 50 controls- was conducted between November 2021 to March 2022. Pregnant women who had hemoglobin levels below 11 g/dl at their first antenatal appointment were considered cases, while pregnant women with hemoglobin levels of 11 g/dl and higher were considered controls. A semi-structured interviewer-administered questionnaire was used to gather the data, and Stata version 15.0 was used for analysis. The risk factors for anemia in pregnant women were determined using a bivariate and multivariate logistic regression model. To find the significant link, adjusted odds ratios (AOR) with a 95% confidence interval (CI) and p-value were utilized. **Results:** The independent risk/protective factors were; residential area, wealth category, an education level (AOR=0.16, 95% CI: 0.03 -0.89), Dietary diversity score (DDS) (AOR=0.51, 95% CI: 0.14 -1.82) and gestational age (AOR=3.78, 95%CI: 1.36,10.55). **Conclusion:** In this study, the protective factors were; being an urban residential area, high education level, high wealth category, and high dietary diversity. Increasing gestational age was a risk factor. Prevention strategies should include improving livelihood and household income for women of reproductive age, advocating for and encouraging girl child education, community-based health education and counseling on nutrition, and improving household dietary diversity.

Keywords: Maternal anemia, Anemia Risk factors, Pregnancy, Antenatal care

1. INTRODUCTION

According to the World Health Organization (WHO), anemia affects 40% or more of pregnant women worldwide (1). Sub-Saharan Africa has the highest prevalence of anemia among pregnant women (57%), followed by South-East Asia (48%), and South America (24.1%) (2). In 2006, 2011, and 2016, respectively, the Uganda Demographic and Health Survey (UDHS) found that 64%, 31%, and 38% of pregnant women were anemic. Compared to the prevalence among non-pregnant women, this was much higher (3). The World Health Organization classifies anemia in pregnancy as a substantial public health risk notwithstanding recent decreases in Uganda. Furthermore, some places, especially Karamoja, are disproportionately affected (4).

Anemia in pregnant women is connected to fetal outcomes like infections, diseases, and even mortality for both the mother and the child (3). Iron deficiency, infections, genetics, and other dietary deficits are typical underlying reasons. Maternal anemia has been linked to sociodemographic characteristics such as gestational age, parity, maternal education, and the mother's work. (5). In the developing world, anemia is frequently associated with nutritional deficiency because of underlying socio-economic deprivation (3). In addition,

menstruation, obstetric difficulties, and childbirth increase the incidence of anemia in women of reproductive age (3). Pregnant women are far more likely to develop anemia if their nutritional needs are not satisfied or if they do not take iron supplements (5). Many homes in impoverished nations lack or don't have enough of the iron-rich foods required to restore blood loss in women (3).

Through the Reproductive, Maternal, Neonatal, and Child Health Sharpened Plan, the Ministry of Health in Uganda implemented deliberate efforts to improve maternal and child health outcomes (7). Additionally, the government started many multisectoral nutrition measures with assistance from development partners (3). However, the Karamoja region is a semi-arid area with recurrent food insecurity and high rates of malnutrition, and the worst performance for maternal survival (Estimated maternal mortality rate is 588 per 100,000 live births) (8) and complicated by the lifestyle of the population that is characterized by nomadic and pastoral culture. The food security and Nutrition Assessment report for 2020 indicated that 37.9% of women of reproductive age in the Karamoja sub-region have anemia (4). Currently, the underlying causes of maternal anemia in Karamoja are not well characterized and may hinder evidence-based public health interventions. Therefore, the study's objective was to assess the association between risk factors and maternal anemia among women attending antenatal care in Moroto Regional Referral Hospital in Moroto district, Karamoja.

2. METHODS

2.1 STUDY DESIGN AND SETTING

This was a case-control study conducted between November 2021 to March 2022 at Moroto Regional Referral Hospital (MRRH). Pregnant women who were cases had hemoglobin levels below 11 g/dl, while pregnant women who were controls had hemoglobin levels that were either equal to or higher than 11 g/dl. MRRH is located in Moroto Municipality, Moroto District, Karamoja subregion, North Eastern Uganda. MRRH is the referral hospital for the Karamoja subregion and covers a catchment area of 9 districts in the region which include: Moroto, Napak, Nakapiripirit, Nabilatuk, Koboong, Karenga, Kotido, Abim and Amudat (8). The Hospital offers comprehensive ANC services in line with the WHO Goal-oriented ANC protocol adopted by the Ministry of Health (9).

2.2 STUDY POPULATION AND ELIGIBILITY CRITERIA

Pregnant women coming for their initial antenatal care visit (first contact) in their current pregnancy who have given informed consent to take part in the study regardless of age and parity. These pregnant women are presumed to have not received any routine intervention to pregnant women such as ferrous-folate supplementation, intermittent presumptive treatment for malaria, and de-wormers. Participants were excluded from the study if they were severely ill due to difficulty in getting informed consent and if they presented with acute obstetric complications.

3. DATA COLLECTION

3.1 QUESTIONNAIRES

Qualified staff nurses working at the MRRH ANC clinic served as trained research assistants who conducted face-to-face interviews with participants using a semi-structured questionnaire. The questionnaire captured the socio-demographic, socio-economic, hygiene and sanitation, nutrition, and dietary intake of the participants.

3.2 HEMOGLOBIN DETERMINATION

The hemoglobin level for each participant was determined using a complete blood count (CBC) machine Huma Count 80^{TS} available in the hospital. A blood sample (2mls) from each participant was collected through venipuncture of a superficial vein in the upper limb, a complete blood count was done, and the hemoglobin level was recorded. Pregnant women with hemoglobin levels below 11 g/dl were chosen as cases (anemic) and those with levels of 11 g/dl or higher were chosen as controls according to WHO guidelines (non-anemic) (11).

3.3 DIETARY DIVERSITY SCORE

The Minimum Dietary Diversity for Women was assessed using the food frequency questionnaire (FFQ), which was created based on commonly consumed local foods (MDD- W). A dichotomous population-level indicator of diet diversity validated for women aged 15 to 49 based on 10 food groups measured by 24-hour dietary recall is known as the Minimum Dietary Diversity for Women (MDD-W) (12). The dietary intake was modified into ten-food-group FFQ according to the Food and Agricultural Organization Minimum Dietary Diversity for Women (FAO-MDD-W): 1) Grains, white roots, tubers, and plantains, 2) Pulses (beans, peas, and lentils, 3) Nuts and seeds, 4) Dairy, 5) Meat, poultry, and fish, 6) Eggs, 7) Dark green leafy vegetables, 8) Other vitamin A-rich fruits and vegetables, 9) Other vegetables, 10) Other fruits (12). The FFQ had a dichotomous indication that indicated whether or not the pregnant women had consumed any of the ten food groups the day before or the night before (24-hour –recall).

3.4 QUALITY CONTROL

The research assistants were recruited from the qualified staff offering ANC services at Moroto Regional Referral Hospital. Training on data quality and data collection tools was done for the research assistants. Daily updates were sought from the research assistants to review progress and address challenges with data collection. The data collection tool was pretested in a nonparticipating health facility to improve validity and reliability. Regular cross-checking and inspection of the collected data were done to ensure accuracy, consistency, and uniformity.

4. DATA MANAGEMENT

4.1 DATA ENTRY

Double entry of collected data was done in a predesigned SurveyCTO, a digital platform for data entry and collection with a logical check, and the entered data was saved and backed up regularly. Data was downloaded from the SurveyCTO digital software in Ms. Excel (XLS) format and imported into STATA version 15 for analysis. The hard copy of the collected data was stored securely under lock and key.

4.2 DATA ANALYSIS

Stata 15.0 was used to analyze the data. Frequencies and percentages were used in the univariate analysis to describe the distribution of the variables. The risk factors for anemia in pregnant women were determined using a bivariate and multivariate logistic regression model. To find the significant link, adjusted odds ratios (AOR) with a 95% confidence interval (CI) and p-value were utilized. Possession of a list of nonproductive assets in a household was assessed and used to determine the wealth index of a participant.

4.3 ETHICAL CONSIDERATION

The Gulu University Research Ethics Committee provided ethical approval (Reference: GUREC-2021-98). The management of Moroto Regional Referral Hospital approved the collection of data. All eligible research participants were given a thorough explanation of the study's goal and the necessity of their involvement before providing their written informed permission. Participants with anemia, depending on the severity, were supported to access appropriate interventions within the hospital according to Ministry of Health guidelines.

5. RESULTS

5.1 PARTICIPANTS SOCIO-DEMOGRAPHIC CHARACTERISTICS

The study involved 100 women, 50 cases and 50 controls, who were receiving First ANC at Moroto Regional Referral Hospital. Urban dwellers made up the majority of the participants (56% Cases and 82% Controls). The majority of individuals (70% cases and 78% controls) were under the age of 30, were either unemployed or self-employed (86% cases and 86% Controls), and had attained a primary or secondary level of education (56% cases and 76% Controls). Christianity was the more dominant religion practiced among the study participants (94% Cases and 92% Controls), and most participants were either married or cohabiting (94% Cases and 92% Controls). To investigate the independent effects of wealth on disease status, a participant's list of non-productive household assets was used to create a household wealth index using Principal Component Analysis (PCA), which showed that the majority of households fell into the middle wealth category and none fell into the lowest wealth category. (Table 1)

Table 1: Participants' Socio-demographic characteristics by cases and controls

Indicator	Cases N (% of 50)	Controls N (% of 50)
Residence Status		
Urban	28(56.0)	41(82.0)
Rural	22(44.0)	9(18.0)

Age Category		
<30	35(70.0)	39(78.0)
30 and over	15(30.0)	11(22.0)
Employment Status		
Not Employed	23(46.0)	21(42.0)
Self-employed	20(40.0)	22(44.0)
Civil Servant	7(14.0)	7(14.0)
Education Level		
None	14(28.0)	2(4.0)
Primary	15(30.0)	18(36.0)
Secondary	13(26.0)	20(40.0)
Tertiary	8(16.0)	10(20.0)
Religious Affiliation		
Christians	47(94.0)	46(92.0)
Muslims and Others	3(6.0)	4(8.0)
Marital Status		
Single	3(6.0)	4(8.0)
Married/Cohabiting	47(94.0)	46(92.0)
Wealth Category		
Second Lowest	23(46.0)	5(10.0)
Medium	14(28.0)	23(46.0)
Second Highest	12(24.0)	18(36.0)
Highest	1(2.0)	4(8.0)

5.2 PARTICIPANT'S OBSTETRIC AND NUTRITIONAL CHARACTERISTICS

A greater proportion of research participants were able to afford and eat at least six different types of food (36 % Cases and 58 % Controls). The majority of participants had at least two meals per day (50 % Cases and 68 %Controls). The majority of the women had at least two previous pregnancies (parity) with a gestational age of 28 weeks or more before this study (56 % controls versus 48 % Cases) and were in their second trimester ($\geq$ 16 weeks) of pregnancy (76 % Cases and 56 % Controls) (see table 2)

Table 2: Participants' obstetric and nutrition characteristics by case and controls.

Indicator	Cases N (% of 50)	Control N (% of 50)	P-values
Number of food types eaten			
< 4	20(40.0)	9(18.0)	1.000
4-5	12(24.0)	12(24.0)	0.163
6+	18(36.0)	29(58.0)	0.011
Frequency of daily meals eaten			
< 2	25(50.0)	16(32.0)	1.00
2 and over	25(50.0)	34(68.0)	0.069
Parity			
<2 Children	22(44.0)	26(52.0)	1.00
$\geq$ 2 Children	28(56.0)	24(48.0)	0.424
Gestation			
Trimester 1	12(24.0)	22(44.0)	1.00
Trimester 2+	38(76.0)	28(56.0)	0.037

5.3 RISK FACTORS ASSOCIATED WITH MATERNAL ANEMIA

Participants' residence, level of education, types of food they ate, and gestation time were all significantly linked with anemia. Higher levels of education were linked to a lower risk of anemia among the study participants. Those with a primary level of education had an 84% reduced risk of anemia (AOR=0.16, 95 percent CI: 0.03, 0.89) compared to those with no education, while those with a secondary level of education had an 88% lower risk (AOR=0.12, 95 percent CI: 0.02, 0.68). Being anemic was not substantially linked to having a tertiary degree in education. Meanwhile, as the variety of food types consumed by the expectant women increased, the risk of anemia among participants decreased. (Table 3)

Mothers who ate between 4-5 food categories (Moderate Dietary Diversity) had a 49 % lower risk of anemia (AOR=0.51, 95 % CI: 0.14,1.82), while those who ate at least 6 food types (High Dietary Diversity) had a 75 % lower risk of anemia (AOR=0.25, 95 % CI: 0.07,0.84). (Low Dietary Diversity). Anemia, on the other hand, became more likely as the pregnancy progressed. Women in their second trimester had a 3.78-fold increased risk of becoming anemic compared to those in their first trimester (AOR=3.78, 95 percent CI: 1.36,10.55). The number of pregnancies a woman had was not linked to anemia in any way (Table 3).

Table 3: Factors associated with maternal anemia: Bivariate and Multivariate Result

Indicator	COR (95% CI)	P-values	AOR (95% CI)	P-values
Residence Status				
Urban	1.00	1.000	1.000	1.000
Rural	3.58(1.44, 8.91)	0.006	1.44(0.43,4.78)	0.551
Age Category				
<30	1.00	1.000	1.00	1.000
30 and over	1.519(0.62,3.74)	0.363	1.00	0.363
Employment Status				
Not Employed	1.00	1.000	1.00	1.000
Self-employed	0.83(0.36 1.94)	0.666	1.00	0.666
Civil Servant	0.91(0.27,3.04)	0.882	1.00	0.882
Education Level				
None	1.00		1.00	1.000
Primary	0.12(0.02, 0.61)	0.011	0.16(0.03,0.89)	0.036
Secondary	0.09(0.02, 0.48)	0.004	0.12(0.02, 0.68)	0.016*
Tertiary	0.11(0.02, 0.66)	0.015	0.20(0.03, 1.30)	0.092*
Religious Affiliation				
Christians	1.00	1.000	1.00	1.000
Muslims and Others	0.73(0.16, 3.46)	0.980	1.00	0.696
Marital Status				
Single	1.00	1.000	1.00	1.000
Married/Cohabiting	1.36(0.17, 3.35)	0.696	1.00	0.696
Wealth Category				
Second Lowest	1.00	1.000	1.00	1.000
Medium	0.13(0.04, 0.43)	0.001	1.00	0.001
Second Highest	0.14(0.04,0.49)	0.002	1.00	0.002
Highest	0.05(0.004,0.60)	0.002	1.00	0.002
Food Types Eaten				
< 4	1.00	1.000	1.00	1.000
4-5	0.45(0.15, 1.38)	0.163	0.51(0.14,1.82)	0.302

6+	0.28(0.10, 0.75)	0.011	0.25(0.07,0 .84)	0.025*
Gestation				
Trimester 1	1.00	1.000	1.00	1.000
Trimester 2+	2.49(1.06, 5.86)	0.037	3.78(1.36,10.55)	0.011*

AOR = adjusted odds ratio; CI = confidence interval; COR = crude odds ratio; * = statistically significant.

6. DISCUSSION

Despite a decrease in prevalence over the preceding decades, anemia remains a major cause of poor maternal and fetal outcomes in Uganda (6,13) The prevalence and underlying causes of anemia in pregnancy in Uganda have wide regional variations with the Karamoja region being disproportionately affected (4). To prevent anemia in pregnancy and its consequences, it is therefore vital to tailor public health interventions to the regional context.

In this study, the main predictors of anemia in pregnancy in the Karamoja region were low dietary diversity, increased gestational period, and low educational level. Our findings showed that consuming fewer than four food varieties (low dietary diversity) were linked with an increased risk of acquiring anemia. When compared to eating less than four different types of food, consuming six or more different food types (high dietary diversity) was linked to a 75% lower risk of anemia. This result is in line with other studies conducted in southern Ethiopia's Durame Town (14) and another in Tigray, Ethiopia, which discovered that anemia during pregnancy was statistically significantly associated with a diet diversity score (DDS) of less than 3 (15). Increased meal frequency and a varied diet can help pregnant women meet their increased energy and food needs during this unique time. Mineral and vitamin deficiencies brought on by a diet with little variety can have an impact on iron status. Consuming a variety of meals from various food groups provides the body with essential nutrients for healthy growth and development as well as illness prevention, while a diet that is too monotonous might result in micronutrient shortages, such as maternal anemia (16). Pregnant women are recommended to increase their meal frequency and eat a more varied diet. For adolescent girls and women of reproductive age, it is crucial to extend the reach of nutrition-specific and nutrition-sensitive methods, such as food fortification and the community-level integration of nutrition programs with other maternal and child health treatments (17).

According to this study, the risk of anemia increased sharply as gestation increased. Anemia was 3.78 times more common in second-trimester women than in first-trimester women. This is congruent with research conducted in Kampala, the country's capital, by Mohamoud NK et al. (5). This finding may indicate that the cases already had anemia before becoming pregnant and the anemia merely worsened as the pregnancy went on, but this discovery has to be further examined with a prospective study (1). Due to the growing fetus's increasing nutritional needs and increased hemodilution, there is a correlation between anemia and gestational age. Hemoglobin, hematocrit, and plasma volume levels rise at the end of the second trimester after dropping

throughout the first trimester. If adequate precautions are not followed, a drop in hemoglobin concentration might have a detrimental impact on the mother's health (16). It is, therefore, necessary to routinely conduct nutrition education for pregnant women residing in rural areas, who have often a low level of education, to make the right healthy food choices.

The number of pregnancies (parity) a woman ever had was not significantly related to anemia in this study, however, this is contrary to the known association between parity and anemia in different contexts (2, 5). Our findings may be explained by the inadequate number of cases to allow for multiple categorizations and the limited power to show effect. Multiparous women are believed to have low or no iron storage resulting from its depletion by repeated pregnancies and they are therefore more likely to have anemia if dietary requirements are not met. This is because a cycle of deteriorating health from pregnancy to pregnancy occurs when these women are unable to replace blood loss during childbirth and their anemia becomes exacerbated by the demand for breastfeeding. Repeated childbirth and breastfeeding take their toll on the level of various micronutrients in their body, especially iron (21).

This study found some risk of developing anemia among rural women at bivariate analysis but was not significant at multivariate analysis due to other confounders in the Karamoja region. Lack of access to healthcare, ignorance of a healthy diet, and going barefoot, which could expose them to hookworm, are possible causes of anemia in rural women (22, 23, 24). This study also discovered a connection between wealth and the onset of anemia. Women in the upper wealth quintile had a decreased risk of anemia compared to those in the lower wealth quintile. This conclusion is in line with one from a study conducted in Eastern Africa (17). Women in the upper wealth category could be able to purchase a variety of foods compared with those of the lower category and would therefore have a lower risk of developing anemia (22). Therefore, interventions to reduce household poverty are likely to reverse the current trend of maternal anemia in Karamoja and similar regions.

This study found that having no education was substantially related to maternal anemia, which is consistent with other East African studies (21, 25). Compared to women with a university education, those with less education had a higher risk of developing anemia. Pregnant women with education are more likely to earn more money and eat a wider variety of nutrient-rich foods including vitamins and minerals, which may help to reduce nutritional deficiency anemia and make them less likely to develop anemia. Women who are educated have access to knowledge on excellent dietary habits, are more likely to adopt healthy lifestyles, and may have good hygienic practices that protect them from anemia.

7. CONCLUSION

In this study, residential area, wealth status, level of education, dietary diversity score, and gestation time were all substantially linked with anemia in the first ANC attendees. Poor fetal and maternal outcomes are linked to

maternal anemia. There is a need for development programs to integrate interventions that address these underlying causes of maternal anemia for sustainable development. Prevention strategies should include improving livelihood and household income for women of reproductive age, advocating for and encouraging girl child education, community-based health education and counseling on nutrition, and improving household dietary diversity. A community-based study of all possible factors for maternal anemia, with a sizable sample size and a solid research design, is recommended.

LIST OF ABBREVIATIONS

ANC	Antenatal Care
CBC	Complete Blood Count
COVID-19	Corona Virus disease 2019
DALYs	Disability Adjusted Life Years
DHIS	District Health Information Software
DHS	Demographic Health Survey
FAO	Food and Agricultural Organization
FFQ	Food Frequency Questionnaire
Hb	Hemoglobin
MDD-W	Minimum Dietary Diversity for women
MOH	Ministry of Health
MRRH	Moroto Regional Referral Hospital
MUAC	Mid-Upper Arm Circumference
PCA	Principal Component Analysis
SOPs	Standard Operating Procedures
UDHS	Uganda Demographic Health Survey
UNICEF	United Nations Children’s Emergency Fund
USAID	United States Agency for International Development
WHO	World Health organization

DECLARATIONS

Ethics approval and consent to participate

The Gulu University Research Ethics Committee provided ethical approval (Reference: GUREC-2021-98). The management of Moroto Regional Referral Hospital approved the collection of data. All of the eligible research subjects gave their written informed consent after being fully informed of the study's objectives and the necessity of their participation.

Consent for publication

Not applicable.

Availability of data and materials

The corresponding author can provide the data that were gathered and examined during the study upon request.

Disclosure

The university played no part in developing the study's plan, gathering, analyzing, and interpreting the data, or writing the report.

Competing interests

The authors declare that they have any competing interests.

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