

PREVALENCE AND ASSOCIATED FACTORS OF ANEMIA AMONG PREGNANT WOMEN AGED BETWEEN 15 AND 49 YEARS ATTENDING ANTENATAL CARE SERVICES IN GAKENKE DISTRICT, RWANDA

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ABSTRACT

Background: Anemia in pregnancy is a significant public health issue, it causes 30% of newborn deaths, 25% of indirect maternal deaths in low-income countries.

Objectives: To determine the prevalence and associated factors of anemia among pregnant women aged between 15 and 49 years attending antenatal care services in Gakenke district.

Methods: The study used quantitative cross-sectional design, stratified random sampling and structured questionnaires for data collection. Hemoglobin was measured on-site using a portable HemoCue 201+ device, anemia was classified according to WHO criteria. Data analysis involved descriptive statistics summarized into categorical data with frequencies and percentages, continuous in mean and standard deviation, prevalence defined based on WHO cutoff, bivariate relationship was assessed using chi-square test with significance set at p-value less than 0.05, significant variable in bivariate were processed to multivariate analysis via logistic regression and the degree of association was reported using the adjusted odds ratio and 95% confidence interval.

Results: Study involved 383 women, the prevalence rate stood at 11.5%, factors associated with anemia were: living in households with more than four members, having gravidity of three or more, consuming fortified porridge. Women who did not handle or clean food before cooking were found to be exposed to anemia. The use of long-lasting insecticidal mosquito nets was associated with lower odds of anemia compared to non-users.

Conclusions: Prevalence was 11.5% indicating a mild public health concern, and factors a linked to distal, intermediate and proximal factors.

Keywords: Prevalence, anemia, associated factors, pregnant women, antenatal care services, Gakenke, Rwanda.

INTRODUCTION

Anemia remains a significant public health issue for pregnant women, causes prematurity, low birth weight, and even death. Globally, 17.2 million pregnant women are affected, 41.8% of them experiencing anemia. In Africa, anemia contributes to high rates of newborn deaths and maternal mortality, affecting 61.3% of pregnant women. In Rwanda, anemia affects also approximately 13% of pregnant women, though estimates vary. Despite ongoing efforts to improve maternal health, anemia remains a major public health concern in the country. Research is needed to fill gaps in empirical data, understanding the prevalence and factors contributing to anemia can help inform targeted interventions and improve community-based prevention strategies.

METHODS

Study design: This study used a cross-sectional design to examine the prevalence of anemia among women aged 15-49 who attended antenatal care in Gakenke district, Rwanda.

Researcher employed stratified random sampling to reduce bias and ensure fair participation. Data were collected using structured questionnaires, and anemia was assessed by measuring hemoglobin levels on-site with a HemoCue 201+ device. Hemoglobin levels were classified according to WHO guidelines: severe for Hb<70 g/L, moderate HB 70-99 g/L, mild Hb100–109 g/L. The prevalence of anemia was analyzed descriptively, and bivariate and multivariate logistic regression were conducted to determine anemia and its associated factors.

Setting and Intervention: The study was conducted in Gakenke district, within its 23 health centers namely Busengo, Bushoka, Coko, Cyabingo, Gatonde, Janja, Kamubuga, Karambo, Mataba, Minazi, Muhondo, Muyongwe, Nemba, Nganzo, Nyange, Nyundo, Rukura, Ruli, Rushashi, Rusoro, Rutake, Rutenderi, and Rwankuba.

Study population: The study population was of 8,719 women as recorded in the Rwanda Health Management Information System for the year 2023. Inclusion criteria

included being a pregnant woman within 15 and 49 years, enrolled in ANC services, and physically present at the health centers the day of data collection. Exclusion criteria involved not being pregnant, being outside range year 15 and 49, having mental health issues, or not attending ANC services on the data collection day. The calculated sample size was 383 women by using the Yamane formula, with systematic random sampling applied across health centers in the district.

Data Collection: The study utilized primary data collected through questionnaires to measure dependent and independent variables, with responses helping to quantify these variables. Anemia prevalence was determined using the portable HemoCue 201+ device, which analyzed hemoglobin levels onsite after venipuncture. The prevalence was classified as mild, moderate, or severe based on WHO criteria. The study sample included 383 participants, drawn proportionately from a population of 8,719 using data from the Health Management Information System. Ethical approval was obtained, and permission for data collection was sought from Gakenke District authorities. Data collection was conducted by 1 research assistant at each health center. Study participants were informed about the study's objectives, their rights to consent and withdraw, and the risks and benefits involved. To minimize inconvenience, blood samples were collected as part of routine ANC services, and hemoglobin levels were analyzed onsite using the HemoCue 201+. Results were compared to WHO criteria, categorizing anemia as mild, moderate, or severe. Participants were informed of their hemoglobin results, and those with anemia were advised to for medical treatment.

Data analysis: The study enrolled 383 pregnant women aged between 15 and 49 years. Data collection was done with a

complete data set obtained from all 383 participants. The completed collected data were coded in MS Excel and then imported into SPSS v25 for analysis. Data were checked for possible errors and any missing values before analysis, data cleaning and analysis were performed using SPSS software. Descriptive statistics were presented as categorical data with frequencies and percentages, while continuous data were summarized using means and standard deviations. Prevalence rate of anemia was defined according to WHO cutoffs. Bivariate relationships were assessed using chi-square tests, with significance set at a p-value of less than 0.05. Variables found to be significant in bivariate analysis were further examined in multivariate logistic regression. The degree of association between dependent and independent variables was reported using the adjusted odds ratio (aOR) and a 95% confidence interval

Ethics: Ethical approval was obtained from Mount Kenya University Rwanda ethical review board, and permission to collect data was secured from the Gakenke District Mayor. Participants were provided with printed informed consent forms for their voluntary participation, and consent were all received from participants. No women under the age of 18 was recorded during our data collection. Women were assured of their confidentiality. Personal information was kept anonymous to protect respondents' privacy. All procedures involving human participants were conducted in accordance with the ethical standards set by the institutional and national research committees, as well as the 1964 Helsinki Declaration and its subsequent amendments, or other comparable ethical guidelines.

RESULTS:

Bivariate analysis of sociodemographic characteristics of study participants:

Characteristic	Frequency(n)	Percent(%)
Age (Years)		
Mean & SD	29.8 & 7	
Min & Max	17 & 45	
Age categories (year)		
15-24	115	30
25 -34	156	41
35 and above	112	29.24
Body mass index		
Mean & SD	23.61 & 2.82	
Min & Max	17.2 & 36.6	

BMI category		
Underweight	7	1.83
Normal	275	71.8
Overweight	93	24.28
Obese	8	2.09
Marital status		
Widower	1	0.26
Single	49	12.8
Separate	2	0.5
Married	330	86.2
Divorced	1	0.3
Level of education		
university	5	1.31
Secondary	48	12.53
Primary	319	83.29
No formal education	11	2.87
Ubudehe Category		
One	26	6.79
Two	272	71.02
Three	69	18.02
Unknown	16	4.18
Employment status		
Unemployed	197	51.44
Self-employer	159	41.51
Public employee	15	3.92
private employee	12	3.13
Religion		
Catholic	237	61.88
Protestant	120	31.33
Others	26	6.79

Table 1:sociodemographic characteristic of study participants

In this study, the participants were selected from mothers with pregnancy aged between 15 and 49 years and attending

antenatal care services in Gakenke district, Rwanda. The presents data on participant demographics, included mean age

and its standard deviation, as well as minimum and maximum values. Additionally, the table includes age group categorization, mean BMI and its standard deviation, along with minimum and maximum BMI values. The table further categorizes BMI into underweight, normal weight, overweight, and obese, and provides information on marital status, education level, ubudehe category, employment status, and religion.

The demographic characteristics of the participants revealed several noteworthy trends and distributions across various categories. Age distribution shows a mean age of 29.8 years with a standard deviation of 7 years, ranging from a minimum of 17 years to a maximum of 45 years. Participants are predominantly distributed among different age categories: 30% are aged between 15 and 24 years, 41% fall within the 25 and 34 years, and 29.24% are aged 35 years and above. Body Mass Index (BMI) among the participants' averages stood at 23.61 with a standard deviation of 2.82, ranging from a minimum BMI of 17.2 to a maximum of 36.6. BMI categories indicate that 1.83% of participants are

underweight, 71.8% are within the normal weight range, 24.28% are overweight, and 2.09% are classified as obese.

Regarding marital status, the majority of participants (86.2%) were married, while smaller proportions identified as single (12.8%), separated (0.5%), divorced (0.3%), or widowed (0.26%).

Education levels varied widely among participants, with 83.29% having received primary education, 12.53% completing secondary education, 2.87% having no formal education, and 1.31% attaining university-level education.

Ubudehe categories, showed that 71.02% of participants were into category two, 18.02% into category three, 6.79% into category one, and 4.18% are of unknown category.

In terms of employment status, the distribution showed 51.44% of participants were unemployed, 41.51% are self-employed, while smaller percentages are employed in public (3.92%) or private sectors (3.13%). For religious, the majority of participants were Catholic (61.88%), followed by Protestant (31.33%), and a smaller fraction as belonging to other religious denominations (6.79%).

Findings on the prevalence of anemia among pregnant women aged between 15 and 49 years

Description	Frequency	Percent
Anemic	44	11.5
Non-Anemic	339	88.5
Total	383	100.0

Table 2:prevalence of anemia among pregnant women aged between 15 and 49 years

The first objective sought to determine the prevalence of anemia among pregnant women aged between 15 and 49 years attending antenatal care services in Gakenke district. The prevalence rate of anemia among the pregnant women

aged between 15 and 49 years attending antenatal care services in Gakenke district health centers stood at 11.5% and was public health issue at mild level.

Distribution of anemia according to severity

Severity of Anemia	Frequency	Percent	Cumulative Percent
Moderate Anemia (70 to 99 g/L)	15	3.9	3.9
Mild Anemia (100 to 109 g/L)	29	7.6	11.5
Total	383	100.0	

Table 3:Distribution of anemia according to severity

Based on WHO cut-off, anemia is categories as mild for hemoglobin level between 100 to 109 g/L, moderate for 70 to 99g/L, and severe when is less than 70g/L, Therefore, as reported in Table 4.3, the majority of anemic cases 7.6% were

mild anemia while 3.9% of the pregnant women reported moderate anemia. There were no severe cases of anemia reported among the targeted group of pregnant women attending antenatal care in Gakenke district.

DISTAL FACTORS ASSOCIATED WITH ANEMIA AMONG PREGNANT WOMEN

Bivariate analysis of anemia status in pregnancy based on distal factors

Variable	Anemia				Chi-square	p-value
	YES		NO			
	n	%	n	%		
Age					2.15	0.34
15-24years	11	9.57	104	90.43		
25-34 Years	16	10.26	140	89.47		
35 and above	17	15.18	95	84.82		
Marital status					0.223	0.63
Single	7	13.46	45	86.54		
Married	37	11.21	293	88.79		
Education					0.0017	0.96
Primary/less	38	11.52	292	88.48		
Secondary/above	6	11.32	47	88.68		
Employment					0.0139	0.906
Unemployed	23	11.68	174	88.32		
Employee	21	11.29	165	88.71		
Ubudehe category					5.8621	0.119
One	2	7.69	24	92.31		
Two	26	9.56	246	90.44		
Three	13	18.84	56	81.16		
Unknown	3	18.75	13	81.25		
BMI					0.4327	0.756
Underweight	1	14.29	6	85.71		
Normal	33	12	242	88		
Overweight	9	9.68	84	90.32		
Obese	1	12.5	7	88.5		
Family earning					0.988	0.32
< 100000	43	11.88	319	88.12		
>100000	1	4.76	20	95.24		

Household Members					12.3713	0.002
Less than 3	11	5.79	179	94.21		
Four	17	18.48	75	81.52		
5&above	16	15.84	85	84.52		
Religion						
Catholic	27	11.39	210	88.61	0.4409	0.802
Protestant	13	10.83	107	89.17		
Others	4	15.38	22	84.62		

Table 4: Anemia status in pregnancy based on distal factors

Age: The chi-square test shows no significant association between age groups and the presence of anemia ($\chi^2 = 2.15$, $p = 0.34$). Anemia prevalence appears to vary slightly across age categories, with 9.57% among those aged 15-24 years, 10.26% among 25-34 years, and 15.18% among those aged 35 and above.

Marital Status: There is no significant association observed between marital status and anemia prevalence ($\chi^2 = 0.223$, $p = 0.63$). Anemia rates are 13.46% among singles and 11.21% among married individuals.

Education: The chi-square test indicates a statistically significant association between education level and anemia ($\chi^2 = 0.0017$, $p = 0.96$). Anemia prevalence is 11.52% among those with primary education or less, and 11.32% among those with secondary education or higher.

Employment: There is a marginal association between employment status and anemia prevalence ($\chi^2 = 0.0139$, $p = 0.906$). Rates are 11.68% among the unemployed and 11.29% among employees.

Ubudehe Category: The chi-square test shows a noticeable trend but not statistically significant association between Ubudehe category and anemia ($\chi^2 = 5.8621$, $p = 0.119$). Anemia prevalence varies across categories: 7.69% in

category One, 9.56% in category Two, 18.84% in category Three, and 18.75% in the Unknown category.

BMI: There is no significant association found between BMI categories and anemia prevalence ($\chi^2 = 0.4327$, $p = 0.756$). Anemia rates are 14.29% among underweight individuals, 12% among normal weight, 9.68% among overweight, and 12.5% among obese individuals.

Family Earning: The chi-square test indicates no significant association between family earning and anemia prevalence ($\chi^2 = 0.988$, $p = 0.32$). Anemia rates are 11.88% among families earning less than 100,000 units and 4.76% among those earning more than 100,000 units.

Household Members: There is a statistically significant association between the number of household members and anemia prevalence ($\chi^2 = 12.3713$, $p = 0.002$). Anemia rates are 5.79% in households with less than 3 members, 18.48% with four members, and 15.84% with five or more members.

Religion: No significant association is found between religious affiliation and anemia prevalence ($\chi^2 = 0.4409$, $p = 0.802$). Anemia rates are 11.39% among Catholics, 10.83% among Protestants, and 15.38% among those of other religions.

INTERMEDIATE FACTORS ASSOCIATED WITH ANEMIA

Bivariate analysis of distribution of anemia status in pregnancy based on intermediate factors

Variable	Anemia				Chi-square	p-value
	YES		NO			
	n	%	n	%		
Gravidity					7.4039	0.007
Less than two	27	16.67	135	83.33		

Three & above	17	7.69	204	92.31		
Number of parities					2.6705	0.102
Less than two	34	13.39	220	86.61		
Three & above	10	7.75	119	92.25		
Age of pregnancy (weeks)					13.7129	0.008
6-12	6	8.11	68	91.89		
13-19	7	14.29	42	85.71		
20-26	19	21.59	69	78.41		
27-33	5	5.81	81	94.19		
34-40wks	7	8.14	79	91.86		
Number of ANC visits						
Less than three	32	11.64	243	88.36	0.021	0.885
Four & above	12	11.11	96	88.89		
Spacing between this and previous pregnancy (year)					3.4159	0.065
less than three	14	14.58	82	85.42		
Four & above	8	6.84	109	93.16		
Taking Iron supplements in this pregnancy					0.3388	0.561
Yes	40	11.83	298	88.17		
No	4	11.49	41	91.11		

Table 5:distribution of anemia status in pregnancy based on intermediate factors

Firstly, gravidity, which refers to the number of pregnancies a woman has experienced, showed a notable relationship with anemia prevalence. Participants with three or more pregnancies exhibited a significantly lower prevalence of anemia (7.69%) compared to those with fewer than two pregnancies (16.67%). This finding suggests that multiple pregnancies may confer some protective factors against developing anemia, possibly due to physiological adaptations or better maternal health management practices acquired through experience.

Secondly, while not statistically significant, the number of parities (number of live births) also demonstrated a trend in relation to anemia prevalence. Participants with three or more parities showed a lower prevalence of anemia (7.75%)

compared to those with fewer than two parities (13.39%). This trend hints at a potential cumulative benefit associated with multiple childbirths, although further investigation with a larger sample size might clarify its significance. Thirdly, the age of pregnancy, categorized by weeks of gestation, exhibited a significant association with anemia prevalence. Anemia rates varied considerably across different stages of pregnancy: 8.11% for pregnancies between 6-12 weeks, 14.29% for 13-19 weeks, 21.59% for 20-26 weeks, 5.81% for 27-33 weeks, and 8.14% for 34-40 weeks. This variation underscores the dynamic nature of nutritional demands and physiological changes throughout pregnancy, where mid-pregnancy stages (20-26 weeks) particularly showed the highest prevalence of anemia, likely reflecting increased maternal and fetal nutritional requirements during this period.

PROXIMAL FACTORS ASSOCIATED WITH ANEMIA

Bivariate analysis of distribution of anemia status in pregnancy based on proximal factors

Variable	Anemia				Chi-square	p-value
	YES		NO			
	n	%	n	%		
Frequency of eating beef meat (month)					0.4466	0.738
One to Three	2	7.69	24	92.31		
Never	15	12.3	107	87.7		
Frequency of eating fruits and vegetables (week)					5.1446	0.076
one to three	20	8.89	205	91.11		
Four and above	18	17.48	85	82.52		
Does not	6	10.91	49	89.09		
Taking fortified porridge					6.9007	0.009
Yes	16	19.75	65	80.25		
No	28	9.27	274	90.73		
Frequency of eating fish (month)					0.3199	0.572
One & above	7	9.59	66	90.41		
Does not	37	11.94	273	88.06		
Frequency of eating fruits and vegetables (week)					5.1446	0.076
Does not	6	10.91	49	86.09		
One to three	20	8.89	205	91.11		
Four & above	18	17.48	85	82.52		
Frequency of drinking milk (week)					1.80405	0.175
Does not	16	9.09	160	90.91		
One & above	28	13.53	179	86.47		
Consuming tea					0.7731	0.379
Yes	5	8.2	56	91.8		
No	39	12.11	283	87.89		
Use modern contraceptive methods (last 6 months)					3.0934	0.079
Yes	21	15.33	116	84.67		
No	23	9.35	233	90.65		
Any history of abortion (last 6 months)					0.0403	0.841

Yes	3	10.34	26	89.66
No	41	11.49	313	88.42

Table 6:distribution of anemia status in pregnancy based on proximal factors

Frequency of eating beef meat: The analysis of factors influencing anemia prevalence among the study participants found significant and non-significant variable;

Anemia rates were 7.69% among women who consume beef 1 to 3 times per month and 12.3% among those who never consumed beef. The frequency of eating beef meat per month was not statistically significant associated with anemia. ($\chi^2 = 0.45$, $p = 0.74$).

Frequency of eating fruits and vegetables in a week: was not statistically significant level ($\chi^2 = 5.14$, $p = 0.08$), there was a trend suggesting that higher consumption of fruits and vegetables (4 times or more per week) might correlate with lower prevalence of anemia (17.48% vs. 8.89% among those consuming 1-3 times per week).

Taking fortified porridge: In this study consuming fortified porridge was associated with lower odds of anemia ($\chi^2 = 6.90$, $p = 0.009$). Anemia prevalence was 19.75% among non-consumers of fortified porridge compared to 9.27% among consumers.

Frequency of eating fish in month: there was no significant association found between fish consumption and anemia ($\chi^2 = 0.32$, $p = 0.57$). Anemia rates were 9.59% among those consuming fish 1 time or more per month and 11.94% among non-consumers.

Frequency of drinking milk in a week: Similarly, milk consumption did not show a significant association with anemia ($\chi^2 = 1.80$, $p = 0.18$). Anemia rates were 9.09% among non-consumers of milk and 13.53% among those consuming milk 1 time or more per week.

Consuming tea/coffee/green tea: There was no significant association observed between consumption of these beverages and anemia prevalence ($\chi^2 = 0.77$, $p = 0.38$). Anemia rates were 8.2% among consumers of these beverages and 12.11% among non-consumers.

Use of modern contraceptive methods in the last 6 months: While not statistically significant ($\chi^2 = 3.09$, $p = 0.08$), there was a suggestive trend indicating a potential relationship between contraceptive use and anemia. Anemia prevalence was 15.33% among users of modern contraceptives compared to 9.35% among non-users.

History of abortion in the last 6 months was fund to have no association between abortion history and anemia prevalence ($\chi^2 = 0.04$, $p = 0.84$). Anemia rates were 10.34% among those with a history of abortion and 11.49% among those without.

In brief, fortified porridge consumption showed a significant protective effect against anemia, other dietary factors such as beef, fruits, vegetables, fish, and milk, tea/coffee, use of modern contraceptives and history of abortion did not exhibit significant associations.

Bivariate analysis of anemia status in pregnant women having history of diseases or infections

Variable	Anemia				Chi-square	p-value
	YES		NO			
	n	%	n	%		
Tested for HIV status					0.6636	0.415
Unknown status	41	11.2	325	88.8		
Positive	3	11.49	339	88.51		
Ever been diagnosed with sexual transmissible infections (6months)					0.658	0.959
Yes	2	11.11	16	88.89		
No	42	11.51	323	88.49		
Ever been diagnosed with worm infections (6 months)					1.5903	0.207
Yes	12	15.58	65	84.42		
No	32	10.46	274	89.54		

Ever had an history of chronic medication (6 months)					0.0549	0.815
Yes	1	14.29	6	85.71		
No	43	11.44	333	88.56		
Ever had an history of anemia in previous pregnancy					0.7316	0.392
Yes	2		20	80		
No	42	11.26	331	88.74		
Ever had an history of anemia 6 months before pregnancy					2.199	0.138
Yes	5	20.83	19	79.17		
No	39	10.86	320	89.14		
Ever had an history febrile illness in the last 6 month					0.7912	0.374
Yes	0		6	100		
No	44	11.67	333	88.33		
Have you ever had an history of Nausea & vomiting (last 3 months)					1.4155	0.234
Yes	15	14.71	87	85.29		
No	29	11.32	252	89.68		
Home has a toilet with slab and cover					1.9706	0.16
Yes	20	9.43	192	90.57		
No	24	14.04	147	85.96		
Frequency of routinely washing hands on daily basis					0.0599	0.807
Less than three	19	11.05	153	88.95		
Four & above	25	11.85	186	88.15		
Consume/drink improved water					1.5965	0.206
Yes	18	9.42	173	90.58		
No	26	13.54	166	86.46		
Handling/cleaning food before cooking them					24.583	0.001
Yes	24	7.67	289	92.33		
No	20	28.57	50	71.43		
Sleeping under long-lasting insecticidal mosquito nets					51.4416	0.001
Sometimes	14	12.73	96	87.27		
Every day	13	56.52	10	43.48		
Not Use	17	6.8	233	93.2		

Table 7: Anemia status in pregnant women having history of diseases or infections

Ever been tested for HIV status, there was no significant association between HIV testing status and anemia prevalence ($\chi^2 = 0.66$, $p = 0.42$). Anemia rate was (11.2%) unknown HIV status and (11.49%) for those who tested positive

Ever been diagnosed with sexually transmitted infections (STIs) in the last 6 months was found to had no significant association observed ($\chi^2 = 0.66$, $p = 0.96$). Anemia prevalence was 11.11% among women diagnosed with STIs compared to 11.51% among those without.

Women ever been diagnosed with worm infections in the last 6 months showed no significant association ($\chi^2 = 1.59$, $p = 0.21$). Women diagnosed with worm infections had a slightly higher anemia prevalence (15.58%) compared to those without (10.46%).

Being on chronic medication in the last 6 months was found no significant association ($\chi^2 = 0.05$, $p = 0.82$). Anemia prevalence was 14.29% among women with a history of chronic medication and 11.44% among those without.

Anemia prevalence was comparable between women with a history of anemia in a previous pregnancy (20%) and those without (11.26%), for those with history of anemia in previous pregnancy; the chi-square test did not show a significant association ($\chi^2 = 0.73$, $p = 0.39$).

While not statistically significant, there was a trend indicating higher anemia prevalence among women with a history of anemia 6 months before pregnancy ($\chi^2 = 2.20$, $p = 0.14$). Prevalence was 20.83% among those with a history versus 10.86% among those without.

History of febrile illness like Malaria in the last 6 months: No significant association was found ($\chi^2 = 0.79$, $p = 0.37$). None

Bivariate analysis of anemia status in pregnancy based on food habit, alcohol and smoking

of the women who reported a febrile illness had anemia, possibly due to the small sample size ($n=6$).

Anemia prevalence was 14.71% among those with a history of nausea and vomiting compared to 11.32% among those without history of nausea & vomiting for at least 3 months, with the chi-square test ($\chi^2 = 1.42$, $p = 0.23$).

Prevalence was 9.43% among those with a toilet with slab and cover versus 14.04% among those without. Household which has a toilet with slab and cover did not become statistically significant, there was a trend suggesting lower anemia prevalence among households with proper sanitation facilities ($\chi^2 = 1.97$, $p = 0.16$). furthermore, the frequency of routinely washing hands on a daily basis was not statistically significant ($\chi^2 = 0.06$, $p = 0.81$), anemia prevalence was similar regardless of handwashing frequency.

Anemia prevalence was 9.42% among consumers of improved water compared to 13.54% among non-consumers, for women who drink improved water: did not show a significant association ($\chi^2 = 1.60$, $p = 0.21$).

Anemia prevalence was 7.67% among those who handled or cleaned food before cooking versus 28.57% among those who did not, handling/cleaning food before cooking found to be associated with anemia at bivariate level. With ($\chi^2 = 24.58$, $p < 0.001$).

Anemia prevalence was 6.8% among regular users of mosquito nets, compared to 56.52% among those who used them sometimes and 93.2% among non-users.

Sleeping under long-lasting insecticidal mosquito nets was also found to be associated with consistent use of mosquito nets ($\chi^2 = 51.44$, $p < 0.001$).

	Anemia				Chi-square	p-value
Variable	YES		NO			
	n	%	n	%		
Any foods which are avoided during pregnancy					0.1505	0.698
Yes	31	11.92	229	88.08		
No	13	10.57	110	89.43		
Any food taboos during pregnancy					1.8671	0.172
Yes	12	16	63	84		
No	32	10.39	276	89.61		
Craving for non-food substances					0.1505	0.698
Yes	31	11.92	229	88.08		
No	13	10.57	110	89.51		

Smoking cigarette or other product					0.0224	0.881
Yes	1	10	9	90		
No	43	11.53	330	88.47		
Do you consume alcohol					0.1505	0.698
Yes	31	11.92	229	88.08		
No	13	10.57	110	89.43		

Table 8: anemia status in pregnancy based on food habit, alcohol and smoking

The table 4.8. showed that women who avoided specific foods during pregnancy, 11.92% had anemia, compared to 10.57% among those who did not. However, there was no significant association between avoiding certain foods and anemia ($\chi^2 = 0.15$, $p = 0.70$).

For women adhering to food taboos during pregnancy, the prevalence of anemia was 16%, whereas it was 10.39% among those who did not adhere to such taboos. Nevertheless, no significant association was observed between adherence to food taboos and anemia ($\chi^2 = 1.87$, $p = 0.17$).

Among women with cravings for non-food substances during pregnancy, 11.92% had anemia, compared to 10.57% among

those without cravings. The study did not find a significant association between craving for non-food substances and anemia ($\chi^2 = 0.15$, $p = 0.70$).

Similarly, among smokers, the prevalence of anemia was 10%, while it was 11.53% among non-smokers. However, smoking cigarettes or other products did not reveal a significant association with anemia ($\chi^2 = 0.02$, $p = 0.88$).

Lastly, among women who consumed alcohol during pregnancy, 11.92% had anemia, compared to 10.57% among non-consumers. The study did not find a significant association between alcohol consumption and anemia ($\chi^2 = 0.15$, $p = 0.70$).

Multivariate analysis of factors associated with anemia among pregnant women aged between 15 and 49 years attending antenatal care service in Gakenke district.

Variable	Unadjusted OR(uOR)	95% CI		P-value	adjusted OR(aOR)	95% CI		P-value
Household Members								
Less than 3 (ref)	Ref							
Four	3.68	1.65	8.25	0.001	3.18	1.29	7.8	0.011
Five & above	3.06	1.36	6.88	0.007	3.02	1.11	8.25	0.030
Gravidity								
Less than two	Ref							
Three & above	0.41	0.21	0.79	0.008	0.34	0.14	0.808	0.014
Age of Pregnancy								
6-12	Ref							
13-19	1.88	0.59	6	0.281	1.93	0.49	7.49	0.341
20-26	3.12	1.17	8.29	0.022	2.27	0.75	6.86	0.145
27-33	0.69	0.2	2.39	0.569	0.78	0.2	2.94	0.717
34-40	1	0.32	3.13	0.994	0.78	0.21	2.82	0.712

Taking fortified porridge								
Yes	Ref							
No	0.41	0.21	0.81	0.01	0.32	0.13	0.75	0.009
Handling/cleaning food before cooking them								
Yes	Ref							
NO	4.81	2.47	9.36	0.001	3.76	1.61	8.73	0.002
Sleeping under long-lasting insecticidal mosquito nets								
Every day	Ref							
Sometimes	0.11	0.041	0.3	0.001	0.18	0.05	0.64	0.008
Not Use	0.056	0.02	0.14	0.001	0.09	0.02	0.3	0.001

Table 9:Multivariate analysis factors associated with anemia among pregnant women aged between 15 and 49 years attending antenatal care service in Gakenke district

Prevalence of anemia: The prevalence rate of anemia among the pregnant women aged between 15 and 49 years attending antenatal care services in Gakenke district, Rwanda at 11.5%.

Factors associated with anemia:

As per the findings, this analysis examines how various factors are associated with anemia, using both unadjusted odds ratios (uOR) and adjusted odds ratios (aOR) with its respective p-values and 95% CI to account for potential confounding variables. The findings highlight significant relationships between household size, gravidity, dietary practices, food handling, and the use of insecticidal mosquito nets.

DISTAL FACTORS ASSOCIATED WITH ANEMIA

Household Size: The analysis showed that household size is a significant predictor of the anemia. Women living in households with four members have 3.68 times higher odds of experiencing the anemia compared to those in households with fewer than three members (uOR = 3.68, 95% CI: 1.65–8.25, p = 0.001). After adjusting for other factors, this association remains strong, with an adjusted odds ratio of 3.18 (95% CI: 1.29–7.8, p = 0.011). Similarly, individuals in households with five or more members are also at an increased risk, with unadjusted odds of 3.06 (95% CI: 1.36–6.88, p = 0.007) and adjusted odds of 3.02 (95% CI: 1.11–8.25, p = 0.030). the findings of this study highlight the similar results as those presented by in several studies.

INTERMEDIATE FACTORS ASSOCIATED WITH ANEMIA

Gravidity: Gravidity, or the number of pregnancies, shows a protective effect. Individuals with three or more pregnancies have lower odds of the anemia compared to those with fewer

than two pregnancies, with an unadjusted odds ratio of 0.41 (95% CI: 0.21–0.79, p = 0.008). This effect strengthens after adjusting for other variables, with an adjusted odds ratio of 0.34 (95% CI: 0.14–0.808, p = 0.014).

PROXIMAL FACTORS ASSOCIATED WITH ANEMIA

Taking Fortified Porridge: Dietary practices, specifically the consumption of fortified porridge, show a strong association with the anemia. Women who do not take fortified porridge have significantly lower odds of experiencing the anemia compared to those who do, with an unadjusted odds ratio of 0.41 (95% CI: 0.21–0.81, p = 0.01) and an adjusted odds ratio of 0.32 (95% CI: 0.13–0.75, p = 0.009). This suggests that fortified porridge consumption may reduce the risk of the anemia.

Food Handling Practices: Food handling is another critical factor associated with anemia in pregnant women. women who do not handle or clean food before cooking have a much higher likelihood of experiencing the anemia, with adjusted odds of 3.76 (95% CI: 1.61–8.73, p = 0.002) as found in this study. This indicates that improper food handling practices significantly increase the risk of the anemia.

Use of Insecticidal Mosquito Nets: Finally, the use of long-lasting insecticidal mosquito nets shows a protective effect. Those who only sometimes sleep under mosquito nets have much lower odds of experiencing the anemia compared to individuals who use them every day (uOR = 0.11, 95% CI: 0.041–0.30, p = 0.001; aOR = 0.18, 95% CI: 0.05–0.64, p = 0.008). Non-users of mosquito nets face even lower odds of the anemia, with an unadjusted odds ratio of 0.056 (95% CI: 0.02–0.14, p = 0.001) and an adjusted odds ratio of 0.09 (95%

CI: 0.02–0.30, $p = 0.001$). This suggests that mosquito net use may play an important role in preventing the anemia.

The multivariate analysis results indicated that household size and improper food handling practices are associated with higher odds of the anemia, while increased gravidity, taking fortified porridge, and regular use of insecticidal mosquito nets are associated with reduced odds. These findings highlight important behavioral and environmental factors that could influence the risk of the anemia, providing insights for potential interventions.

DISCUSSION:

Prevalence of anemia

The findings concur with previous researchers who showed that anemia among pregnant women is associated with various factors during pregnancy. The findings showed that the prevalence rate compares with the national prevalence rate of 13% and falls below the national level. The results indicate that even though the prevalence of anemia in Gakenke district is lower than that reported at the national level. As reported in other findings from RDHS conducted in different period in Rwanda, the prevalence has been declining among the pregnant women national wide over time. For instance, the report showed anemia among women with pregnancy aged between 15 and 49 years were 26% in 2005, 18% between the year 2007 and 2008, 17% in 2010 (Housing Survey, 2010) and 19% between the year 2014 and 2015 (RDHS, 2020), and 13% in 2020 according to RDHS findings (Nuwabaine, *et al.*, 2022). Hence, the prevalence reported in this study (11.5%) has also shown a decline as compared to previous report. In 2014/2015, reports showed that Northern province accounts for 15% women with anemia where Gakenke district had a prevalence rate of 14%, while in the period 2019-2020 Gakenke had 6% prevalence rate (NISR & MOH, 2021) while this studies found 11.5%.

Factors associated with anemia

Household size: This study found that household size is a significant associated with of the anemia among pregnant women. Women living in households with four members have high of odds of anemia compared to other, with an adjusted odds ratio of 3.18 (95% CI: 1.29–7.8, $p = 0.011$). Similarly, individuals in households with five or more members are also at an increased risk, with adjusted odds of 3.02 (95% CI: 1.11–8.25, $p = 0.030$). This suggests that larger household sizes may increase the likelihood of the anemia. Findings from this study are similar to others which were found the association between household size and anemia among pregnant women as follows:

According to Gebre and Mulugeta (2015), anemia is a global health concern affecting both poor and wealthy nations, indicating that it is not merely a problem of economic status but a broader issue linked to nutritional deficiencies and

overall health. In their study, they found that women from larger households had 1.72 times higher odds of being anemic compared to those from smaller households (AOR: 1.72).

Similarly, Tulu *et al.* (2019) found that larger family sizes were significantly associated with anemia among women in Ethiopia. Their analysis revealed that women living in households with more than five members had 2.3 times higher odds of anemia compared to those in smaller families (AOR: 2.3). The authors concluded that the higher burden of anemia in larger households could be due to limited access to food and healthcare resources, which are crucial for preventing anemia

Habyarimana, *et al.*, 2020 found that household size was identified as a significant risk factor for anemia among women of reproductive age. The findings showed that with each additional family member, the likelihood of anemia increased by 5% (OR: 1.045, $p = 0.0088$).

Girma *et al.* (2020) found that women from larger families were more likely to experience anemia, with the odds increasing due to the strain on resources and potential nutritional deficiencies in such households.

Gravidity and parities: This study found that Gravidity, women with three or more pregnancies have lower odds of the anemia compared to those with fewer than two pregnancies, with an adjusted odds ratio of 0.34 (95% CI: 0.14–0.808, $p = 0.014$). On other hand a study conducted by Bezerra *et al.* (2018), in Brazil, demonstrated that Pregnant women who had more than one child had a higher risk of anemia comparing women of more than 2 children with an AOR of 1.61, and 95% CI ranging between 1.36 to 1.91.

Lakew *et al.*, in 2015 found that pregnant women who had little spacing between pregnancies were also found to be more likely to have anemia with 1.9 times higher odds of developing anemia (AOR: 1.9, 95% CI: 1.3–2.7) compared to those with adequate spacing. (Lakew *et al.* 2015);

Consuming fortified porridge: This study found that dietary practices, specifically the consumption of fortified porridge, show a strong association with the anemia. Women who do not take fortified porridge have significantly lower odds of experiencing the anemia compared to those who do, with an unadjusted odds ratio of 0.41 (95% CI: 0.21–0.81, $p = 0.01$) and an adjusted odds ratio of 0.32 (95% CI: 0.13–0.75, $p = 0.009$). This suggests that fortified porridge consumption may reduce the risk of the anemia. Similarly, study conducted by Chakrabarti, *et al.*, 2018; and study by Ara, *et al.*, 2019 showed a significant association between consuming fortified food and anemia. Women who consume fortified food during pregnancy has the low risk of anemia.

Nguyen *et al.*, 2018 (Vietnam), Nguyen *et al.* conducted research in Vietnam to assess the impact of various micronutrient-fortified foods on the prevalence of anemia

among pregnant women. Their study focused on evaluating the consumption of a variety of micronutrient-fortified foods by pregnant women. Their findings indicated that women who regularly consumed fortified foods had a lower prevalence of anemia (AOR 0.72, 95% CI 0.60-0.86) compared to those who did not.

Garcia et al., 2019 (Brazil) conducted a study in Brazil focusing on the impact of iron-fortified porridge consumption on maternal health outcomes, including anemia prevalence and found that women who included iron-fortified porridge in their diet had significantly lower odds of developing anemia (AOR 0.61, 95% CI 0.46-0.80) compared to those who did not consume it.

Food handling practices: Food handling is another critical factor. Individuals who do not handle or clean food before cooking have a much higher likelihood of experiencing the anemia, with unadjusted odds of 4.81 (95% CI: 2.47–9.36, $p = 0.001$) and adjusted odds of 3.76 (95% CI: 1.61–8.73, $p = 0.002$). This indicates that improper food handling practices significantly increase the risk of the anemia.

Similarly, to other studies, Nguyen et al., (2021) showed using regression analysis that improved health and cleanliness had contributed to 9% of the changes in hemoglobin levels among pregnant women in India. Stephen et al. (2018) found that in Tanzania, a reduced families defecating in open space accounted for 12% of the adjustment of anemia predominance among WRA. Additionally, Iruhiriye et al. (2019), access to clean sanitation facilities were responsible for 3% of the anemia improvement in Rwandan women.

Use of insecticidal mosquito nets: Finally, the use of long-lasting insecticidal mosquito nets shows a protective effect. Those who only sometimes sleep under mosquito nets have much lower odds of experiencing the anemia compared to individuals who use them every (aOR = 0.18, 95% CI: 0.05–0.64, $p = 0.008$). Non-users of mosquito nets with an adjusted odds ratio of 0.09 (95% CI: 0.02–0.30, $p = 0.001$). This suggests that mosquito net use may play an important role in preventing the anemia. On other hand, Hill et al., 2018 (Tanzania) conducted a study to assess the impact of ITNs on maternal anemia during pregnancy and found that the use of insecticide mosquito-net utilization was associated with a reduction in the prevalence of anemia among pregnant women (AOR 0.65, 95% CI 0.54-0.78).

Future studies: Conducting longitudinal studies to explore the progression of anemia throughout pregnancy and its implications for maternal and child health. Such studies could provide valuable insights into effective interventions and management strategies to improve outcomes for both mothers and their children.

Conclusion: The study found that the prevalence of anemia among pregnant women in Gakenke district is 11.5% and

anemia is at mild level as public health issue. And several factors were identified as contributing to this condition; the study found pregnant women living in households with more than four members, women with gravidity of three or more has high odds of anemia while women who consuming fortified porridge has a protective factor. Women who did not handle or clean food before cooking were also found to be high risk of anemia. The use of long-lasting insecticidal mosquito nets was associated with lower odds of anemia compared to non-users and inconsistent use of mosquito nets had high risks of anemia. Factors age, marital status, education, employment, ubudehe category, body mass index, family earning religion, parities, frequency of eating beef meat per month, eating fruits and vegetables in a week, history of febrile disease, chronic medication were not statistically significant.

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