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Iron Deficiency Anaemia in Pregnant Women: Prevalence, Severity, and Predictors in Iringa Municipality, Tanzania

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ABSTRACT

Iron deficiency anaemia is a prevalent public health issue among pregnant women, particularly in low- and middle-income countries, including Tanzania, where rates range from 47% to 70.9%. This study examines the prevalence, severity, and predictors of iron deficiency anaemia among pregnant women in Iringa Municipality, Tanzania. A quantitative cross-sectional design was conducted from June 12 to July 15, 2024. A total of 545 pregnant women accessing antenatal care were randomly selected from 12 public healthcare facilities. Data were collected from clinic cards and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. The study found that 13.8% of pregnant women had anaemia, mostly moderate (54.7%) and mild (42.7%). In univariate analysis, women engaged in petty businesses had a crude odds ratio (cOR) of 0.225 (95% CI: 0.062-0.815, p = 0.023), indicating lower anaemia risk versus formal employment. The first trimester showed a cOR of 0.245 (95% CI: 0.118-0.511, p < 0.001), and the second trimester had a cOR of 0.450 (95% CI: 0.238-0.851, p = 0.014). Multivariate analysis revealed farmers had an adjusted odds ratio (aOR) of 0.175 (95% CI: 0.038-0.811, p = 0.026) while the first and second trimesters had aORs of 0.266 (95% CI: 0.122-0.580, p = 0.001) and 0.494 (95% CI: 0.253-0.967, p = 0.040), respectively. This study notes that anaemia among pregnant women is a mild public health issue, but ongoing monitoring and targeted interventions are crucial to enhance maternal and fetal health outcomes.

Keywords: Iron Deficiency Anaemia, Pregnant Women, Prevalence, Severity, Predictors

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INTRODUCTION

Iron deficiency anaemia is a significant public health concern among pregnant women globally, with a high prevalence, especially in low- and middle-income countries **(Daru et al., 2019).** It is estimated that up to 50% of pregnant women are affected by anaemia worldwide, with the prevalence being particularly high in South Asia and Central and West Africa, where it can exceed 50% **(Wemakor, 2019; Omote et al., 2020).**

In Africa, the prevalence of anaemia among pregnant women is notably high. Studies have reported prevalence rates ranging from 32% to 62.2% in Sub-Saharan Africa **(Dodzo et al., 2022; Stephen et al., 2018).** For instance, in Ghana, the prevalence was found to be 33%, while in Nigeria, it was reported as high as 55% **(Kofie et al., 2019).** In Eswatini, the prevalence was documented to be between 32% and 62.2% **(Dodzo et al., 2022).** The adverse consequences of anaemia during pregnancy in Sub-Saharan Africa are well-documented. Anaemia has been linked to an increased risk of postpartum haemorrhage, preterm birth, low birth weight, and maternal mortality **(Ganju, 2020; Harding et al., 2021; Hoque et al., 2022; Saydee et al., 2023).** These poor maternal and perinatal outcomes underscore the urgent need for comprehensive interventions to address the high burden of anaemia in the region.

The prevalence of anaemia among pregnant women in Tanzania remains high, with studies reporting rates ranging from 47% to 70.9% **(Mvandal et al., 2022; Stephen et al., 2018).** A study conducted in northern Tanzania in 2018 found the prevalence to be 56% **(Stephen et al., 2018),** while another study in Unguja Island, Tanzania, reported a prevalence of 57.1% in 2019 **(Ali et al., 2019).** A more recent study in Dar es Salaam in 2022 found an even higher prevalence of 70.9%, with 61.2% having mild anaemia, 33.2% moderate anaemia, and 5.6% severe anaemia **(Mvandal et al., 2022).**

Several factors have been associated with the high prevalence of anaemia among pregnant women in Tanzania. These include iron deficiency, malaria, helminth infections, and poor dietary intake **(Daru et al., 2019; Santi et al., 2022).** Socioeconomic status, educational level, and access to antenatal care have also been linked to the risk of anaemia during pregnancy **(Ali et al., 2019; Kintan et al., 2019; Nonye-Enyidah et al., 2021).** It is important to note that anaemia during pregnancy in Tanzania has been associated with adverse maternal and perinatal outcomes. Studies have shown that anaemia increases the risk of postpartum haemorrhage, preterm birth, low birth weight, and maternal mortality **(Hoque et al., 2022; Saydee et al., 2023).**

Efforts to address the high prevalence of anaemia among pregnant women in Tanzania are ongoing. The Tanzania Demographic and Health Surveys have reported a slight decrease in the prevalence of anaemia among pregnant women from 58% in 2004/05 to 53% in 2010 **(Stephen et al., 2018).** However, the prevalence remains unacceptably high, and continued efforts are needed to improve the management and prevention of anaemia during pregnancy in the country. This study aimed to examine the prevalence, severity, and predictors of anaemia among pregnant women attending antenatal care in Iringa Municipality, Tanzania.

MATERIALS AND METHODS

Study area

The area of study is Iringa Municipality, located in the Iringa region of Tanzania. Iringa Municipal Council is one of the five councils in the Iringa region, acting as the administrative capital and displaying an urban profile. The other councils in the region include Iringa District Council, Kilolo District Council, Mufindi District Council, and Mafinga Town Council. The

municipality is adjacent to the Iringa Rural and Kilolo district councils, positioned between latitudes 7.7° to 7.875° south of the Equator and longitudes 35.620° to 35.765° east of the Greenwich Meridian. According to the 2022 census, the population of the municipality stands at 202,490 individuals **(Mbunda et al., 2023; Ntungwa et al., 2024).**

Study design

The research conducted between June 12 and July 15, 2024, used a quantitative cross-sectional analytical design to examine the prevalence, severity, and predictors of iron deficiency anaemia in pregnant women receiving antenatal care in Iringa Municipality, Tanzania. This approach allowed data collection at a single point, providing detailed insights into the issue being studied.

Study population

The study focused on pregnant women who accessed antenatal care services within Iringa Municipality, Tanzania. Eligibility criteria for participants included being pregnant, having resided in Iringa Municipality for a minimum of six months, and providing informed consent for participation in the study. The exclusion criteria included individuals who were unable to provide informed consent due to cognitive or psychological impairments, as well as pregnant women who were temporary visitors to the antenatal clinics without having established residency in the municipality for at least six months.

Sample size and sampling procedures

Due to the limited number of public hospitals and health centers in the municipality, a deliberate selection process was implemented to include all two hospitals and four health centers available, supplemented by a random selection of six public dispensaries. This approach involved a total of 12 public healthcare facilities participating in the study. For each facility, the sample size of pregnant women was estimated based on the average monthly attendance rates and the population served by the facility to ensure proportional representation. Pregnant women were then randomly selected from each of these facilities. Cochran's formula was utilized to determine the necessary sample size for the study.

$$\text{Cochran formula: } N = \frac{Z^2 P(1-P)}{d^2}$$

Where;

N = Minimum sample size

Z = Constant, standard normal deviation (1.96 for 95% Confidence level)

P = Estimated proportion of the population (50% or 0.5) to maximize sample size in the absence of precise prevalence data

d = Acceptable margin of error (4.2% or 0.042)

$$\text{Sample size (N)} = \frac{1.96^2 \times 0.5 \times (1-0.5)}{0.042^2} = 545 \text{ Pregnant women}$$

As a result, the total sample size for the study conducted in Iringa Municipality was determined to be 545 pregnant women.

Data collection

All socio-demographic characteristics and hemoglobin (Hb) data, measured from blood samples, were recorded from the antenatal clinic cards of pregnant women during their current visits.

Data analysis

Data analysis was conducted using version 26 of the Statistical Package for Social Sciences (SPSS), which analyzed frequencies and percentages to establish a descriptive understanding of

the dataset. Chi-square tests were employed to identify significant associations between predictor variables and anaemia, while binary logistic regression offered an in-depth examination of the impacts of these predictors on the outcomes.

Definitions and scoring

Anaemia is defined by hemoglobin (Hb) concentrations falling below 11 g/dL. The prevalence of anaemia as a public health concern is classified as follows: less than 5% indicates no public health problem; between 5% and 19.9% signifies a mild public health problem; 20% to 39.9% represents a moderate public health problem; and 40% or above indicates a severe public health problem (**WHO, 2017).** In pregnant women, anaemia severity is classified into three categories: severe anaemia is defined as a haemoglobin level of less than 7 g/dL, moderate anaemia is indicated by a haemoglobin level between 7 g/dL and 10 g/dL, and mild anaemia is characterized by a haemoglobin level ranging from 10 g/dL to 10.9 g/dL **(Abdallah et al., 2022).**

Ethical considerations

Ruaha Catholic University (RUCU) granted ethical approval for this research, reference number RU/RPC/RP/2024/12. The office of the Director of the Iringa Municipal Council authorized data collection through the District Medical Officer's office and the Medical Officer in charge at the facility level. Informed consent was obtained from all study participants. All collected data were handled with the utmost confidentiality, ensuring that no personal information was disclosed.

RESULTS

Socio-demographic characteristics of pregnant women

The majority of the women, 440 (80.7%), were aged between 20 and 35 years, which is considered the biologically optimal age for pregnancy. Meanwhile, 67 (12.3%) were under 20 years old, indicating instances of adolescent pregnancies, and 38 (7%) were over 35 years old, which is classified as advanced maternal age. In terms of marital status, most participants, 415 (76.1%), were married, while 130 (23.9%) were unmarried. Regarding educational attainment, 376 (69%) of the pregnant women had completed secondary education, followed by 89 (16.3%) who had completed only primary education.

Income levels suggest financial difficulties, as 378 (69.4%) of the women were categorized as low-income earners, and 160 (29.4%) were in the middle-income group. Occupationally, the largest group consisted of petty business workers, accounting for 284 (52.1%), followed by homemakers with 95 (17.4%). In terms of pregnancy stage, 202 (37.1%) of the women were in their first trimester, while 277 (50.8%) were in their second trimester. A majority of women, 307 (56.3%), reported having multiple pregnancies (over one parity), while those aged between 20 and 35 constituted the predominant group for first pregnancies, accounting for 393 (72.1%), as illustrated in **Table 1.**

Table 1: Socio-demographic characteristics of pregnant women (N = 545)

Variables	Frequency (n)	Percent (%)
Age (Years)		
Below 20	67	12.3
20-35	440	80.7
Above 35	38	7
Marital status		
Married	415	76.1

Unmarried	130	23.9
Education level		
No formal education	8	1.5
Primary	89	16.3
Secondary	376	69
College or university	72	13.2
Income per month (Tsh)		
Low (Less than 300,000)	378	69.4
Middle (300,000 – 1,000,000)	160	29.4
High (More than 1,000,000)	7	1.3
Occupation		
Homemaker	95	17.4
Formal employment	86	15.8
Petty business	284	52.1
Farmer	80	14.7
Trimester		
One	202	37.1
Two	277	50.8
Three	66	12.1
Parity		
One	238	43.7
Over one	307	56.3
First pregnancy's age (Years)		
Below 20	150	27.5
20-35	393	72.1
Above 35	2	0.4

Prevalence of anaemia among pregnant women

The findings indicated that 13.8% of pregnant women exhibited anaemia, characterized by hemoglobin (Hb) levels below 11 g/dL, which is categorized as a mild public health concern. Conversely, a significant majority, comprising 86.2% of the participants, demonstrated hemoglobin levels within the normal range (Hb ≥ 11 g/dL), as illustrated in **Figure 1.**

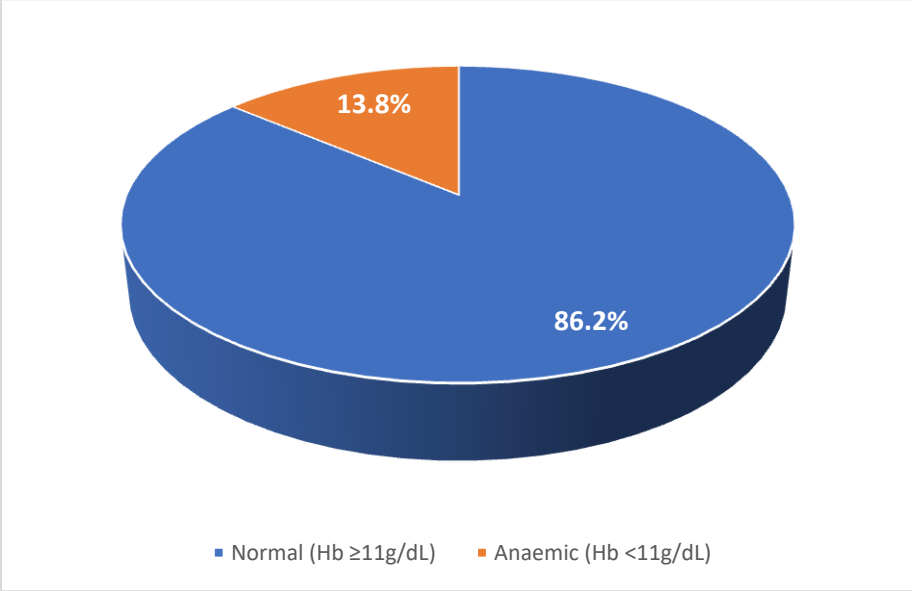

Figure 1: Prevalence of anaemia among pregnant women

Distribution of anaemia among pregnant women according to severity

In assessing anaemia among pregnant women, the severity of the condition was classified into three categories. Severe anaemia is reported in only 2.6% of cases. The moderate anaemia category represents the largest subgroup, encompassing 54.7% of the population under investigation. Additionally, 42.7% of pregnant women were found with mild anaemia, as presented in **Figure 2.**

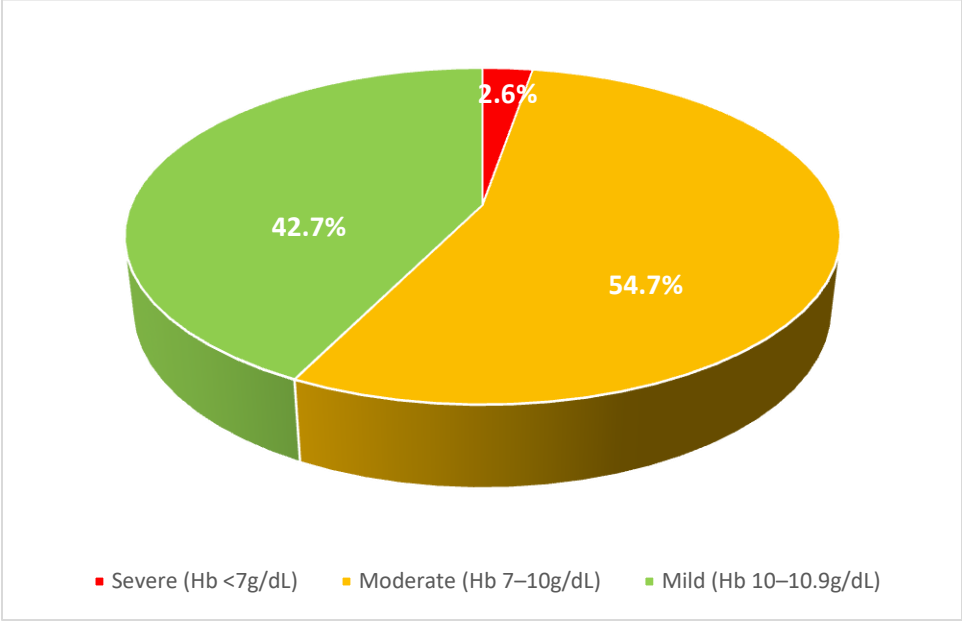

Figure 2: Distribution of anaemia among pregnant women according to severity

Bivariate analysis of anaemia predictors among pregnant women

In the bivariate analysis examining predictors related to anaemia among pregnant women, education level demonstrated a statistically significant association with a P-value of 0.037.

Additionally, occupation was found to be significant with a P-value of 0.023, and trimester also showed a noteworthy association with a P-value of 0.001. Conversely, variables such as age, marital status, income, parity, and the age at first pregnancy did not exhibit a statistically significant relationship with anaemia among the study participants, as detailed in **Table 2.**

Table 2: Bivariate analysis of anaemia predictors among pregnant women

Predictor variables	**Hb Status**		**Chi-square**	**P-value**
	Anaemic (%)	**Normal (%)**		
Age (Years)				
Below 20	2.0	10.3		
20-35	10.8	69.9	0.456	0.796
Above 35	0.9	6.1		
Marital status				
Married	10.8	65.3	0.304	0.581
Unmarried	2.9	20.9		
Education level				
No formal education	0.4	1.1		
Primary	2.4	13.9	8.504	**0.037***
Secondary	7.9	61.1		
College or university	3.1	10.1		
Income per month (Tsh)				
Low (Less than 300,000)	9.4	60.0		
Middle (300,000 – 1,000,000)	4.2	25.1	0.075	0.963
High (More than 1,000,000)	0.2	1.1		
Occupation				
Homemaker	2.6	14.9		
Formal employment	3.1	12.7	9.556	**0.023***
Petty business	7.5	44.6		
Farmer	0.6	14.1		
Trimester				
One	3.1	33.9)		
Two	7.3	43.5)	15.124	**0.001***
Three	3.3	8.8		
Parity				
One	5.3	38.3	0.885	0.347
Over one	8.4	47.9		
First pregnancy's age (Years)				
Below 20	4.4	23.1		
20-35	9.2	62.9	3.204	0.202
Above 35	0.2	0.2		

***** P<0.05 is statistically significant

Binary logistic regression of anaemia predictors among pregnant women

The analysis of predictors related to the risk of anaemia among pregnant women was conducted using binary logistic regression, incorporating both univariate and multivariate analyses to identify significant contributors, as described in **Table 3.**

Univariate analysis

The univariate analysis indicated that occupations and trimester showed a significant relationship with anaemia among pregnant women. Women engaged in petty businesses showed a significantly lower crude odds ratio (cOR) of 0.225 (95% CI: 0.062-0.815) with a p-value of 0.023, suggesting a protective effect against anaemia compared to those in formal employment. For trimester analysis, the first trimester was associated with a significantly reduced likelihood of anaemia (cOR = 0.245, 95% CI: 0.118-0.511, $p < 0.001$), while the second trimester also showed lower odds (cOR = 0.450, 95% CI: 0.238-0.851, $p = 0.014$). Both trimesters convey a trend of reduced anaemia risk compared to the third trimester, which serves as the reference category.

Multivariate analysis

In the multivariate analysis, the relationship between occupation and anaemia adjusted for other confounders revealed that farmers had a significantly reduced adjusted odds ratio (aOR) of 0.175 (95% CI: 0.038-0.811, $p = 0.026$), suggesting that after accounting for other variables, being a farmer may lower the risk of anaemia. For trimester analysis, both the first and second trimesters continued to display significantly lower odds of anaemia at aORs of 0.266 (95% CI: 0.122-0.58, $p = 0.001$) and 0.494 (95% CI: 0.253-0.967, $p = 0.04$), respectively, reinforcing the enhanced anaemia risk in the third trimester.

Table 3: Binary logistic regression of anaemia predictors among pregnant women

Predictor variables	**Univariate Analysis**		**Multivariate Analysis**	
	cOR (95% C.I)	**P-value**	**aOR (95% C.I)**	**P-value**
Age (Years)				
Below 20	1.296 (0.414-4.059)	0.656	2.032 (0.482-8.57)	0.334
20-35	1.022 (0.384-2.722)	0.965	1.208 (0.422-3.458)	0.724
Above 35	Reference		Reference	
Marital status				
Married	1.181 (0.654-2.133)	0.582	1.566 (0.769-3.189)	0.217
Unmarried	Reference		Reference	
Education level				
Primary	0.513 (0.093-2.823)	0.443	0.522 (0.078-3.47)	0.501
Secondary	0.387 (0.076-1.98)	0.255	0.445 (0.073-2.698)	0.379
College or university	0.927 (0.171-5.026)	0.93	0.916 (0.128-6.545)	0.930
No formal education	Reference		Reference	
Income per month (Tsh)				
Low (Less than 300,000)	0.936 (0.11-7.933)	0.951	2.222 (0.227-21.71)	0.492
Middle (300,000 – 1,000,000)	1.007 (0.116-8.757)	0.995	1.356 (0.146-12.609)	0.789
High (More than 1,000,000)	Reference		Reference	
Occupation				
Homemaker	0.976 (0.506-1.883)	0.943	0.759 (0.227-2.545)	0.656
Petty business	0.225 (0.062-0.815)	**0.023***	0.819 (0.319-2.102)	0.679

Farmer	1.425 (0.656-3.1)	0.371	0.175 (0.038-0.811)	**0.026***
Formal employment	Reference		Reference	
Trimester				
One	0.245 (0.118-0.511)	**<0.001***	0.266 (0.122-0.58)	**0.001***
Two	0.45 (0.238-0.851)	**0.014***	0.494 (0.253-0.967)	**0.04***
Three	Reference		Reference	
Parity				
One	0.787 (0.478-1.297)	0.348	0.787 (0.424-1.462)	0.448
Over one	Reference		Reference	
First pregnancy's age (Years)				
Below 20	0.19 (0.012-3.151)	0.247	0.389 (0.017-9.072)	0.557
20-35	0.146 (0.009-2.368)	0.176	0.262 (0.012-5.811)	0.397
Above 35	Reference		Reference	

***** P<0.05 is statistically significant, cOR=Crude Odds Ratio, aOR=Adjusted Odds Ratio, C.I = Confidence Interval

DISCUSSION

The findings indicated that 13.8% of pregnant women in Tanzania exhibited iron deficiency anaemia, characterized by hemoglobin (Hb) levels below 11 g/dL, which is categorized as a mild public health concern. However, studies conducted in Tanzania and other regions have reported varying prevalence rates of anaemia among pregnant women. In Tanzania, a study by **Mlugu et al. (2020)** found a higher prevalence of anaemia at 68.5% among pregnant women in the Southeast Tanzania. Another study by Mkama reported a prevalence of 52.6% in the Ifakara, Morogoro region **(Mkama, 2021).** Also, a study by **Sunguya et al. (2021)** highlighted the high burden of anaemia among pregnant women in Tanzania, with regional differences observed. The severity of anaemia among pregnant women also varied across studies. Furthermore, **Ngimbudzi et al. (2021)** found that the majority of pregnant women in Mkuranga District, Tanzania, experienced moderate anaemia, followed by mild anaemia, which aligns with this study.

Across Africa, studies also reported varying prevalence rates. In Nigeria, **Omote et al. (2020)** found a prevalence of 59.6% while in Ethiopia, the prevalence ranged from 27.9% to 44.3% **(Al-Marzouqi & Zakia, 2024).** In Ghana, the prevalence was reported to be as high as 70% in Northern Ghana, and 57.1% in Southern Ghana, but lower at 34.4% in Sekondi-Takoradi **(Wemakor, 2019).**

Studies outside Africa have also reported varying prevalence rates of anaemia among pregnant women. In China, the prevalence of anaemia among pregnant women was found to be 25% **(Tan et al., 2020).** In India, the prevalence of anaemia among pregnant women has been reported to be in the range of 33.0% to 89.0% **(Garhwal et al., 2020).** These studies are consistent with others many studies around the world. In Bangladesh, the prevalence was reported to be 73% **(Suryanarayana et al., 2017),** while in Pakistan, it was reported to be as high as 90.5% **(Mahamoud et al., 2020).**

This study has identified an increased likelihood of anaemia among specific occupational groups, notably the univariate analysis indicated that women engaged in petty business showed likelihoods of decreasing anaemia, compared to formal employment while farmers reported decreased likelihoods in multivariate analysis. A related trend has been observed in Nigeria, where research found that unemployment significantly increased the odds of anaemia among

pregnant women **(Ogbuabor et al., 2022).** These findings underscore the importance of considering occupational factors and socioeconomic status in understanding the risk of anaemia.
This study examines the relationship between anaemia and the stages of pregnancy, revealing a decreased likelihood of anaemia in the first and second trimesters compared to the third trimester in both univariate and multivariate analyses. Supporting this observation, Puri et al. highlighted that pregnant women in their third trimester exhibited significantly higher anaemia rates than those in the second trimester, with a clear trend of increasing prevalence as gestational age advanced **(Puri et al., 2024).** This is corroborated by Jugha et al., who found that women in the third trimester were 3.2 times more likely to be anaemic compared to those in earlier trimesters, reinforcing the association between gestational age and anaemia prevalence **(Jugha et al., 2021).** Furthermore, Dodzo et al. noted that physiological changes during pregnancy, such as hemodilution, exacerbate anaemia in the third trimester, making it a critical period for monitoring and intervention **(Dodzo et al., 2022).** The findings from various studies reveal differing rates of anaemia among pregnant women in Tanzania, underscoring a significant public health challenge. While this study identifies anaemia as a mild public health issue, it emphasizes the importance of ongoing monitoring and targeted interventions to enhance maternal and fetal health outcomes.

LIMITATIONS

Although this study provides a strong analysis of socioeconomic and demographic factors, it has limitations, as it does not account for unmeasured confounding variables such as lifestyle choices, access to healthcare, and environmental influences. Future researchers are encouraged to collaborate to address these limitations and improve our overall understanding of this important issue.

CONCLUSION

The study on the prevalence of anaemia among pregnant women reveals that while 13.8% of participants exhibit anaemia, the majority (86.2%) maintain hemoglobin levels within the normal range, indicating a mild public health problem. The analysis highlights that the severity of anaemia is predominantly moderate (54.7%) and mild (42.7%) among pregnant women. Binary logistic regression showed significant associations in occupation and pregnancy trimesters. The mild public health findings reported in this study emphasize the importance of ongoing monitoring and support for pregnant women to ensure better health outcomes for both mothers and their babies.

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