Prevalence and Associated Risk Factors for Anaemia Among Pregnant Women Attending Ante-Natal Clinic, Eswatini

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Abstract

Background: Anaemia is one of the most common nutritional deficiency diseases observed globally and it affects about a third of the world's population. Anaemia in pregnant women is a worldwide public health concern that has severe consequences for both mothers and infants, including maternal death and foetal and infant mortality. In Low-income countries (LICs), 25% of indirect maternal mortality and 30% of neonatal deaths are due to anaemia in pregnancy. Therefore, this study aimed to determine the prevalence of anaemia and assess associated factors among pregnant women attending ante-natal care (ANC) clinic in the Kingdom of Eswatini, which might help for screening, prevention and treatment of anaemia and ultimately prevent its adverse effects.

Method: A total of 550 pregnant women between 15 and 49 years from three health facilities were randomly enrolled using a cross-sectional study design, from January to March 2021. Non-probability sampling approach was used to select the appropriate study unit. A face-toface interview was done using a structured questionnaire to collect data. Multiple logistic regression was performed to assess the factors associated with anaemia among the women.

Results: The overall anaemia prevalence among pregnant women was 43.1% (95% CI: 38.947.3). The mild, moderate and severe cases of anaemia were 21.3% (95%CI: 17.9-24.9); 21.1% (95%CI: 17.8-24.7) and 0.7% (95%CI: 0.2-1.9), respectively. The prevalence of anaemia was high among women aged 20-24 (11.1%, 95%CI: 8.6-14.0) and 25-29years (11.1%, 95%CI: 8.6-14.0). Factors associated with anaemia included living in the urban area (OR=1.8, 95%CI: 1.19-2.72, p=0.005) and having anaemia 6 months before pregnancy (OR=4.64, 95%CI: 1.1518.71, p=0.031). Additionally, gestational age at first ANC also was positively associated with anaemia: 3rd trimester (OR=10.42, 95%CI: 4.27-25.4, p<0.001) and 2nd trimester (OR=1.62, 95%CI: 1.02-2.60, p=0.043)

Conclusion: Anaemia remains prevalent among pregnant women in Eswatini. Thus, a comprehensive anaemia prevention program would be justified and could lower the country's burden of anemia.

Background

Anaemia is a significant public health concern, affecting about two billion people worldwide, among which 56 million are pregnant women (1, 2). Globally, anaemia has been estimated to affect about 800 million children and women. Adolescent girls and women are at a higher risk due to menstruation and the high demand for metabolism during pregnancy (3). About 42% of pregnant women are affected by anaemia worldwide (4). In Southeast Asia, the prevalence of anaemia among pregnant women is 48%, and anaemia in pregnancy causes half of the global maternal deaths. India contributes to 80% of these deaths (5, 6). South America has the lowest prevalence of 24.1% (6). In Africa, studies have found an anaemia prevalence of 57.1% among pregnant women (2). Previous studies conducted in Tanzania have shown a varying prevalence of anaemia among pregnant women, ranging from 18–68% (7). The overall prevalence of anaemia among pregnant women was 41% in Ethiopia and 45% in Ghana (8, 9). Although

there is limited data for Southern Africa, a study in South Africa found a prevalence of 42.7% (10). There is no record of previous studies on anaemia in pregnancy in Eswatini. According to the World Health Organisation (WHO), anaemia among pregnant women is a significant health problem in LICs (11). WHO has defined anaemia in pregnancy as haemoglobin (Hb) levels of less than 11g/dl (5, 12). The different Hb levels for each anaemia class during pregnancy are 10.0–10.9 g/dl for mild, 7–9.9 g/dl for moderate, and less than 7 g/dl for severe anaemia (13). Additionally, Sub-Saharan Africa (SSA) has an estimated prevalence of 56%, compared to the 22% of high-income countries (HICs) (14, 15).

In LICs, anaemia in pregnancy significantly contributes to maternal and infant morbidity and mortality (16). Anaemia in pregnancy is considered a risk factor for the poor pregnancy outcome, resulting in life-threatening complications for both mother and foetus (12, 14). Foetal consequences include stillbirths, low weight, intrauterine growth restriction, premature babies, perinatal mortality, and neonatal sepsis (17, 18). In late pregnancy, anaemia results in poor foetal iron stores, which can irreversibly affect the brain and neurotransmitters in the foetus and postnatal babies, leading to developmental disorders (19). Effects of anaemia during pregnancy may be related to its severity; for example, mild anaemia may not affect the current pregnancy but may reduce maternal iron stores and affect subsequent pregnancies (7). In addition, anaemic pregnant women are more prone to many complications, including decreased work productivity, increased risk of cardiac diseases, preterm labour and delivery, postpartum haemorrhage, impaired immune function, and maternal mortality (7, 11). Anaemia during pregnancy has been estimated to account for 23% of the indirect causes of maternal deaths in developing countries (6, 19).

Moreover, several factors have been identified as contributing factors of anaemia among pregnant women. Iron deficiency is the most common cause; it is usually accompanied by a deficiency of other nutrients (8, 13). Around 40% of women begin their pregnancy with decreased iron stores, which becomes insufficient to meet the increased iron needs during pregnancy (2, 20). Other factors include physiological haemodilution, underlying inflammatory conditions, and malnutrition, leading to insufficient vitamins, proteins, iron, and iodine (11, 13). In addition, in SSA, infections like malaria, helminths, and Human Immunodeficiency Virus (HIV) also contribute to anaemia in pregnancy (13, 21). Despite the broader scope of the problem, little research data has been explored about the severity of anaemia at ANC clinic in this study area; hence, there is a need to identify and treat anaemia to avoid its complications in pregnancy (1, 11). Furthermore, assessing the different factors contributing to anaemia in pregnancy is essential for effective anaemia management during pregnancy and provides the information necessary for planning and policy-making (7, 9). Despite its known effect on the population, the available data regarding the determinants of anaemia during pregnancy in the Kingdom of Eswatini is limited. Hence, this study aimed to determine the prevalence and risks associated with anaemia among pregnant women attending ante-natal clinics (ANC) in the three health facilities in the Kingdom of Eswatini to provide information on screening, prevention, and treatment of anaemia.

Methods And Materials

Study design and population

The study participants were pregnant women aged 15–49 years, attending ANC in healthcare facilities from January to March 2021. The women were recruited from three randomly selected healthcare facilities (Mankayane Government Hospital, Mbabane Government Hospital, and Raleigh Fitkin Memorial (RFM) Hospital) in the Kingdom of Eswatini. All pregnant women attending ANC in these three healthcare facilities, meeting the inclusion criteria and provided written informed consent were included.

Sample size

To estimate the prevalence of anaemia, assuming 95% confidence and an acceptable margin of error of 5% and maximum variability, i.e., 50% (given unknown prevalence), a sample size of 384 participants was required. The sample size was further increased by a margin of 10% to account for potential refusal and multiplied by a design effect (D) of 1.3, and the final sample size of the study was 550 pregnant women.

Sampling strategy

The recruitment of participants was done using non-probability sampling, where participants were recruited as they came in and as long as they met the inclusion criteria. Informed consent was obtained from the participants, and enrolment was equally offered to the participants irrespective of culture, religion, race, and social class. Trained research assistants explained the study aims and procedures to the women willing to participate while waiting to receive health services. As part of obtaining informed consent, potential risks or possible discomforts associated with participating in the study were discussed. After obtaining written informed consent, the recruitment of participants began, which were all pregnant women aged 15–49 years seeking ANC services from the study sites. Recruitment continued until the desired sample size was reached. All women who met the criteria were recruited into the study. Those who agreed to participate were assigned an anonymous participant identification number (e.g., C01-P001 for Mankayane Government Hospital; Patient number 1). There was no linkage with the patient's name and other personally identifiable information with the study findings and results, but only through the participant identification number.

Data collection procedure

A face-to-face interview using a structured questionnaire was used by research assistants to collect the relevant information in a consultation room where privacy was considered. The questionnaire included sections on socio-demographic characteristics, obstetrics information, nutritional data, and medical history. Data were entered and stored into SPSS version 27. In addition, each participant was assigned a unique identifier which was used to link the questionnaire and the results.

Specimen collection and testing

The specimen used for analysis was an ethylenediaminetetraacetic acid (EDTA) tube collected by venipuncture by the laboratory staff for full blood count (FBC). These specimens were processed in the laboratories of the same hospitals (Mankayane, Mbabane, and RFM). The Hb result (from the FBC) was used to determine whether the patient was anaemic or not, using the WHO criteria of Hb concentration < 11g/dl in pregnant women. The degree of severity of anaemia in pregnancy was classified into three:

- Mild anaemia: 10.0–10.9 g/dl
- Moderate anaemia: 7.0–9.9 g/dl
- Severe anaemia: <7.0 g/dl

Quality control

Questionnaires were pre-tested prior to the actual data collection. The collected data were checked for consistency and completeness daily. All procedures and methods were performed in accordance with the relevant guidelines, regulations and standard operating procedures (SOPs).

Statistical analysis

Data were processed and analysed using the STATA version15.0 (Stata Corp. College Station, Texas, USA). Data were checked for possible errors and any missing values before analysis. Descriptive and inferential statistics were used for analysis. Categorical variables were summarised using frequencies and proportions, while continuous variables were presented using mean and standard deviation. To identify factors associated with the outcome of interest, a bivariate logistic regression analysis was performed for each independent variable, and crude odds ratio (COR) with 95% confidence intervals was obtained. The strength of statistical association was measured by adjusted odds ratio (AOR) and 95% confidence intervals.

Ethical consideration

The study was approved by the Eswatini Health and Human Research Review Board

(EHHRRB) (SHR264/2020) and UKZN Biomedical Research Ethics Committee (BREC/00002158/2020). The ethics committees approved the form used to obtain written informed consent from the participants before participating in the study. The study purpose, objectives, and procedures were explained to the patients before signing the consent form. Therefore, all pregnant women aged 15–49 years seeking ANC services from the study sites were eligible for the study. According to the Eswatini national guidelines for HIV testing and counselling, the consenting age is 12 years (22).

Results

Characteristics of the study population

A total of 550 pregnant women aged 15–49 years were enrolled in the study from January to March 2021 from three randomly selected hospitals (Mankayane Government, Mbabane Government, and RFM) in the Kingdom of Eswatini. The mean (± standard deviation [SD]) age for the enrolled women was 27.2 (± 6.4) years (Table 1). Above half (52.9%) of the participants were aged 20–29 years, 68.4% had high school level education, and 61.8% were unemployed. The majority (65.1%) of the women were single, and 56.6% lived in urban areas.

Approximately 80% of the participants' household monthly income was less than $343, with many family members in the household mean of 4.0 (± 2.3). The gestational age was from 5 to 40 weeks, with a mean (± SD) of 29.0 (± 7.74) weeks. About 36.6 % of the participants were pregnant for the first time, and 40.4% reported an inter-pregnancy interval of ≥ 4 years. The mean (± SD) age at first pregnancy was 21.0 (± 3.9), ranging from 14 to 39 years. In addition, 74.9% were taking iron supplements during their current pregnancy. 40.4% of participants ate meat, 33.8% dairy products, 85.5% fruits and vegetables ≥ four times during the week, and 51.8% were not eating fish. The women's mid-upper arm circumference ranged from 19 to 43cm, with a mean (± SD) of 27.4 (± 3.8). A large number of the participants were not infected with HIV (68.7%), were not on any chronic medication (66.7%), and did not have any sexually transmitted infections (98.4%) or worm infestation (99.3%), 6 months before the study. The haemoglobin results ranged from 5.9–15.5g/dl with a mean (± SD) of 11.1 (± 1.6). In addition, 96.7% of participants had no history of anaemia in previous pregnancies, while 97.5% did not have anaemia 6 months before the study (Table 1).

Table 1
Socio-demographic characteristics of the study population (N = 550)

Variable	n (%)
Age: n (%)	
Mean(± SD)	27.2 (± 6.4)
15–19	75 (13.6)
20–29	291 (52.9)
30–39	173 (31.5)
40–49	11 (2.0)
Family members in household: Mean(± SD)	4.0 (± 2.3)
Residence: n(%)	
Rural	239 (43.5)
Urban	311 (56.6)
Marital status: n(%)	
Single	358 (65.1)
Married	192 (34.9)
Employment status: n(%)	
Unemployed	340 (61.8)
Employed	173 (31.5)
Self-employed	37 (6.7)
Level of education: n(%)	
Never been to school	5 (0.9)
Primary	85 (15.5)
High school	376 (68.4)
Tertiary	84 (15.3)
Household monthly income: n(%)	
Less than E5000 ($343)	434 (78.9)
E5000-E10 000	84 (15.3)
More than E10 000	32 (5.8)
Gestational age (weeks)	

Variable	n (%)
Mean(± SD)	28.0 (± 7.7)
1–12 (1st trimester)	18 (3.3)
13–26 (2nd trimester)	201 (36.6)
27–40 (3rd trimester)	331 (60.2)
Gestational age at 1st ANC: Mean(± SD)	17.4 (± 6.2)
Age at 1st pregnancy: Mean (± SD)	21.0 (± 3.9)
Gravidity: n(%)	
1	201 (36.6)
2	145 (26.4)
3	99 (18.0)
4 and above	105 (19.1)
Parity: n(%)	
0	214 (38.9)
1	151 (27.5)
2	98 (17.8)
3	58 (10.5)
4 and above	29 (5.3)
Number of ANC visits: n(%)	
1	122 (22.2)
2	131 (23.8)
3	134 (24.4)
4 and above	163 (29.6)
Inter-pregnancy interval: n(%)	
No previous child	214 (38.9)
1	23 (4.2)
2	35 (6.4)
3	56 (10.2)
4 and above	222 (40.4)

Variable	n (%)
Taking Iron supplements: n(%)	
Yes	412 (74.9)
No	138 (25.1)
Mid-upper arm circumference (MUAC): Mean (± SD)	27.4 (± 3.8)
Meat consumption per week: n(%)	
Does not eat	12 (2.2)
1	76 (13.8)
2	92 (16.7)
3	148 (26.9)
4 and above	222 (40.4)
Fish consumption per week: n(%)	
Does not eat	285 (51.8)
1	177 (32.2)
2	54 (9.8)
3	19 (3.5)
4 and above	15 (2.7)
Fruit and vegetables consumption per week: n(%)	
1	8 (1.5)
2	23 (4.2)
3	49 (8.9)
4 and above	470 (85.5)
Dairy consumption per week: n(%)	
Does not eat	36 (6.6)
1	129 (23.5)
2	104 (18.9)
3	95 (17.3)
4 and above	186 (33.8)
Haemoglobin (Hb): Mean (± SD)	11.1 (± 1.59)

Variable	n (%)
HIV status: n(%)	
Negative	378 (68.7)
Positive	172 (31.3)
STI in the last 6 months: n(%)	
No	541 (98.4)
Yes	9 (1.6)
Worm infestation in the last 6 months: n(%)	
No	546 (99.3)
Yes	4 (0.7)
Are you on chronic medication: n(%)	
No	367 (66.7)
Yes	183 (33.3)
Anaemia in previous pregnancy: n(%)	
No	532 (96.7)
Yes	18 (3.3)
Anaemia 6 months before pregnancy: n(%)	
No	536 (97.5)
Yes	14 (2.6)

Anaemia prevalence

The overall anaemia prevalence was 43.1% (95% CI: 38.9–47.3). The mild, moderate and severe cases of anaemia were 21.3% (95%CI: 17.9–24.9); 21.1% (95%CI: 17.8–24.7) and 0.7% (95%CI: 0.2–1.9), respectively. Anaemia prevalence was higher among women living in the urban area (27.6%, 95%CI: 23.9–31.6) as compared to women living in rural area (15.5%, 95%CI: 12.5–18.8) (Table 2). The prevalence of anaemia was high among women aged 20–24 (11.1%, 95%CI: 8.6–14.0) and 25-29years (11.1%, 95%CI: 8.6–14.0). Single women had a higher prevalence, 31.1% (95%CI: 27.2–35.1) as compared to those who were married, 12.0% (95%CI: 9.4–15.0). The highest prevalence was among the unemployed (27.5%, 95%CI: 23.831.4), those who had a high school education (29.8%, 95%CI: 26.0-33.8) and women who had a household monthly income of less than E5000 ($343) (35.5%, 95%CI: 31.5–39.6). The highest prevalence was among those who were pregnant for the first time (17.8%, 95%CI: 14.7-

21.3). The prevalence declined with increasing gravidity (gravida 1 (16.7%, 95%CI: 13.720.1); 2 (11.1%, 95%CI: 8.6–14.0) and 3 (7.8%, 95%CI: 5.7–10.4); increasing parity (para 0 (17.8%, 95%CI: 14.7–21.3); 1 (11.6%, 95%CI: 9.1–14.6) and 2 (6.9%, 95%CI: 4.9–9.4) and age at 1st pregnancy (15–19 (18.7%, 95%CI: 15.6–22.2); 25–29 (5.3%, 95%CI: 3.6–7.5) and 30–34 (0.9%, 95%CI: 0.3–2.1). It increased with an increase in gestational age (1st trimester (1.1%, 95%CI: 0.4–2.4); 2nd trimester (14.0%, 95%CI: 11.2–17.2) and 3rd trimester (28.0%, 95%CI: 24.3–32.0). At first ANC visit, the prevalence was highest in the second trimester (29.5%, 95%CI: 25.7–33.5) (Table 2).

Table 2: The prevalence of anaemia among pregnant women (15–49 years) in Eswatini (N=550)

Variable	Anaemic (N=550)	% (95%CI)	P-value
Overall prevalence	237	43.1% (95% CI: 38.9-47.3)	
Age (years)			
15-19	40	7.3 (5.2-9.8)	
20-24	61	11.1 (8.6-14.0)	
25-29	61	11.1 (8.6-14.0)	**0.039**
30-34	35	6.4 (4.5-8.7)	
35-39	38	6.9 (4.9-9.4)	
40-44	2	0.4 (0.04-1.3)	
Family members in household			
1-4	160	29.1 (25.3-33.1)	
5-9	75	13.6 (10.9-16.8)	**0.025**
10-14	2	0.4 (0.04-1.3)	
Residence			
Rural	85	15.5 (12.5-18.8)	
Urban	152	27.6 (23.9-31.6)	**0.002**
Marital status			
Single	171	31.1 (27.2-35.1)	
Married	66	12.0 (9.4-15.0)	**0.003**
Employment status			
Unemployed	151	27.5 (23.8-31.4)	
Employed	72	13.1 (10.4-16.2)	0.667
Self-employed	14	2.5 (1.4-4.2)	
Level of education			
Never been to school	2	0.4 (0.04-1.3)	
Primary	41	7.5 (5.4-10.0)	
High school	164	29.8 (26.0-33.8)	0.416
Tertiary	30	5.5 (3.7-7.7)	
Household monthly income			

Less than E5000 ($343)	195	35.5 (31.5-39.6)	
E5000-E10 000	31	5.6 (3.9-7.9)	0.234
More than E10 000	11	2 (1.0-3.6)	
Gestational age			
1-12 (1st trimester)	6	1.1 (0.4-2.4)	
13-26 (2nd trimester)	77	14.0 (11.2-17.2)	0.125
27-40(3rd trimester)	154	28.0 (24.3-32.0)	
Gestational age at 1st ANC			
1-12(1st trimester)	37	6.7 (4.8-9.2)	
13-26(2nd trimester)	162	29.5 (25.7-33.5)	**<0.001**
27-40(3rd trimester)	38	6.9 (4.9-9.4)	
Age at 1st pregnancy			
15-19	103	18.7 (15.6-22.2)	
20-24	97	17.6 (14.5-21.1)	
25-29	29	5.3 (3.6-7.5)	0.613
30-34	5	0.9 (0.3-2.1)	
35-39	1	0.2 (0.0-1.0)	
40-44	2	0.4 (0.04-1.3)	
Gravidity			

1	92	16.7 (13.7-20.1)	
2	61	11.1 (8.6-14.0)	0.716
3	43	7.8 (5.7-10.4)	
4 and above	41	7.5 (5.4-10.0)	
Parity			
0	98	17.8 (14.7-21.3)	
1	64	11.6 (9.1-14.6)	
2	38	6.9 (4.9-9.4)	0.632
3	27	4.9 (3.3-7.1)	
4 and above	10	1.8 (0.9-3.3)	
Number of ANC visits			
1	53	9.6 (7.3-12.4)	
2	58	10.5 (8.1-13.4)	0.525
3	63	11.5 (8.9-14.4)	
4 and above	63	11.5 (8.9-14.4)	
Inter-pregnancy interval			
No previous child	98	17.8 (14.7-21.3)	
1	15	2.7 (1.5-4.5)	
2	12	2.2 (1.1-3.9)	0.115
3	24	4.4 (2.8-6.4)	
4 and above	88	16 (13.0-19.3)	
Taking Iron supplements			
Yes	175	31.8 (27.9-35.9)	0.615
No	62	11.3 (8.6-14.2)	
Fish consumption per week			
Does not eat	130	23.6 (20.1-27.4)	
1	78	14.2 (11.4-17.4)	
2	18	3.3 (2.0-5.1)	0.341
3	6	1.1 (0.4-2.4)	

4 and above	5	0.9 (0.3-2.1)	
Fruit& vegetables consumption per week			
1	4	0.7 (0.2-1.9)	
2	7	1.3 (0.5-2.6)	0.628
3	22	4.0 (2.5-6.0)	
4 and above	204	37.1 (33.0-41.3)	
Dairy consumption per week			
Does not eat	15	2.7 (1.5-4.5)	
1	57	10.4 (7.9-13.2)	
2	56	10.2 (7.8-13.0)	0.115
3	39	7.1 (5.1-9.6)	
4 and above	70	12.7 (10.1-15.8)	
HIV status			
Positive	100	18.2 (15.0-21.7)	**<0.001**
Negative	137	24.9 (21.3-28.7)	
STI in the last 6 months			
Yes	7	1.3 (0.5-2.6)	**0.034**
No	230	41.8 (37.7-46.1)	
Worm infestation in the last 6 months			
Yes	1	0.2 (0.0-1.0)	0.463
No	236	42.9 (38.7-47.2)	
Are you on chronic medication			
Yes	104	18.9 (15.7-22.4)	**<0.001**
No	133	24.2 (20.7-28.0)	
Anaemia in previous pregnancy			
Yes	11	2.0 (1.0-3.6)	0.116
No	226	41.1 (36.9-45.3)	
Anaemia 6 months before pregnancy			

Yes	11	2.0 (1.0-3.6)	**0.007**
No	226	41.1 (36.9-45.3)	

Risk factors associated with anaemia among pregnant women

Table 3 shows the risk factors associated with anaemia among pregnant women. Based on the univariate analysis: increasing age (25-29yrs: OR = 0.52, 95%CI: 0.30–0.90, p = 0.02; 40-44yrs OR = 0.19, 95%CI: 0.04–0.96, p = 0.045), being married (OR = 0.57, 95%CI: 0.4–0.82, p = 0.03) and increasing number of family members in household (OR = 0.15, 95%CI: 0.033–0.64, p = 0.011) were inversely associated with anaemia. Living in the urban area (OR = 1.73, 95%CI: 1.23–2.45, p = 0.002), being on chronic medication (OR = 2.32, 95%CI: 1.61–3.33, p < 0.001), having anaemia 6 months before pregnancy (OR = 5.03, 95%CI: 1.39–18.24, p = 0.014) and being HIV positive (OR = 2.44, 95%CI: 1.69–3.53, p < 0.001) were positively associated with anaemia. Gestational age at first ANC visit was also positively associated with anaemia where those in the 3rd trimester (OR = 9.59, 95%CI: 4.21–21.83, p < 0.001) were about 6-fold more likely to be anaemic as compared to those in the 2nd trimester (OR = 1.67, 95%CI: 1.08–2.59, p = 0.021). Additionally, going through the result of multivariate analysis, increasing age (25-29yrs: OR = 0.43, 95%CI: 0.23–0.81, p = 0.008; 40-44yrs OR = 0.15, 95%CI: 0.02–0.85, p = 0.033), being married (OR = 0.61, 95%CI: 0.38–0.98, p = 0.039) and increasing number of family members in household (OR = 0.18, 95%CI: 0.036–0.92, p = 0.039) remained inversely associated with anaemia. Living in the urban area and having anaemia 6 months before pregnancy (OR = 1.8, 95%CI: 1.19–2.72, p = 0.005 and OR = 4.64, 95%CI: 1.15–18.71, p = 0.031, respectively) remained statistically significant factors of anaemia. Gestational age at first ANC visit also remained positively associated with anaemia where those in the 3rd trimester (OR = 10.42, 95%CI: 4.27–25.4, p < 0.001) were about 6-fold more likely to be anaemic as compared to those in the 2nd trimester (OR = 1.62, 95%CI: 1.02–2.60, p = 0.043) (Table 3).

Table 3
Risk factors associated with anaemia among pregnant women (15–49 years) in Eswatini (N = 550)

Risk factors	Anaemic	Unadjusted (Univariate)		Adjusted (Multivariable)	
	n(%)	OR (95%CI)	Pvalue	OR (95%CI)	P-value
Residence Rural	85 (15.5)	1 (ref)		1 (ref)	
Urban	12 (27.6)	1.73 (1.23–2.45)	**0.002**	1.8 (1.19–2.72)	**0.005**
Marital Status					
Single	171 (31.1)	1 (ref)		1 (ref)	
Married	66 (12)	0.57 (0.40–0.82)	**0.003**	0.61 (0.38–0.98)	**0.039**
Age (years)					
15–19	40 (7.3)	1 (ref)		1 (ref)	
20–24	61 (11.1)	0.81 (0.46–1.43)	0.467	0.69 (0.37–1.28)	0.238
25–29	61 (11.1)	0.52 (0.30–0.90)	**0.020**	0.43 (0.23–0.81)	**0.008**
30–34	35 (6.4)	0.52 (0.28–0.96)	**0.037**	0.41 (0.19–0.87)	**0.020**
35–39	38 (6.9)	0.81 (0.43–1.53)	0.516	0.60 (0.28–1.31)	0.204
40–44	2 (0.4)	0.19 (0.04–0.96)	**0.045**	0.15 (0.02–0.85)	**0.033**
STI in the last 6 months					
No	230 (41.8)	1 (ref)		1 (ref)	
Yes	7 (1.3)	4.73 (0.97–22.99)	0.054	3.9 (0.63–24.06)	0.143
Are you on chronic medication					
No 133 (24.2)		1 (ref)		1 (ref)	
Yes 104 (18.9)		2.32 (1.61–3.33)	**< 0.001**	1.37 (0.36–5.21)	0.641
Anaemia 6 months before pregnancy					
No 226 (41.1)		1 (ref)		1 (ref)	
Yes 11 (2.0)		5.03 (1.39–18.24)	**0.014**	4.64 (1.15–18.71)	**0.031**
Family members in household					
1–4	160 (29.1)	1 (ref)		1 (ref)	

Risk factors	Anaemic	Unadjusted (Univariate)		Adjusted (Multivariable)	
5–9	75 (13.6)	0.97 (0.67–1.40)	0.878	1.18 (0.76–1.81)	0.465
10–14	2 (0.4)	0.15 (0.033–0.64)	**0.011**	0.18 (0.036–0.92)	**0.039**
HIV					
Negative	137 (24.9)	1 (ref)		1 (ref)	
Positive	100 (18.2)	2.44 (1.69–3.53)	**< 0.001**	2.17 (0.56–8.44)	0.263
Gestational age at 1st ANC					
1–12(1st trimester)	37 (6.7)	1 (ref)		1 (ref)	
13–26(2nd trimester)	162 (29.5)	1.67 (1.08–2.59)	**0.021**	1.62 (1.02–2.60)	**0.043**
27–40(3rd trimester)	38 (6.9)	9.59 (4.21–21.83)	**< 0.001**	10.42 (4.27–25.4)	**< 0.001**

Discussion

This is the first study assessing prevalence and risk factors for anaemia in pregnancy in the Kingdom of Eswatini. The present study shows a high prevalence of anaemia in pregnancy, 43.1%. Differences in severity of anaemia was observed with mild, moderate, and severe cases of anaemia at 21.3%, 21.1%, and 0.7%, respectively. The prevalence of anaemia was high among women aged 20–24 (11.1%) and 25-29years (11.1%). The highest prevalence was among pregnant women for the first time (17.8%), and it increased with an increase in gestational age. The prevalence declined with increasing gravidity, increasing parity, and age at 1st pregnancy shows the risk factors associated with anaemia among pregnant women. The univariate analysis showed that increasing age, being married, and increasing family members in household were inversely associated with anaemia while living in the urban area, being on chronic medication, having anaemia 6 months before pregnancy, and being HIV positive were positively associated with anaemia. Gestational age at first ANC visit was also positively associated with anaemia where those in the (OR = 9.59) were about 6-fold more likely to be anaemic than those in the 2nd trimester (OR = 1.67). Multivariate analysis showed that being in the 3rd trimester at first ANC visit was the most severe risk for anaemia in pregnancy (OR = 10.4).

According to WHO, the prevalence in this study (43.1%) shows that this is a public health concern, which states that anaemia is a public health problem if its prevalence is ≥ 5.0%, and a severe problem if prevalence is ≥ 40% (7, 15). Other researchers have reported the prevalence of anaemia during pregnancy, ranging from 32–62.2% and 57% in Sub-Saharan Africa countries (15). Similar prevalence was found in South East Asian countries (48%) (6), Northern Tanzania (47%) (15), Kenya (40%) (23), and South Africa

(43%) (4). Lower prevalence has been reported in Lesotho (33.2%) (24), Botswana (34%) (25), Ethiopia (36.6%), and Nigeria (37.6%) (17). Higher prevalence was reported in Eastern Kenya (57%) (26), Pakistan (56.4%) (27), and North East India (60%) (6). The variations in prevalence may be due to different causes of anaemia, dietary differences, population differences, study design, and differences in methodology used in determining haemoglobin levels (23, 27). Regarding the differences in severity, the similar prevalence was reported in Northern Ghana (8) and Egypt (28), where the mild and moderate anaemia cases were similar.

In this study, anaemia prevalence was highest and the same among women aged 20–24 and 2529 years (11.1%). These findings are consistent with a study in India reporting the highest prevalence of anaemia (63.3%) in a similar age group range (6). Another study in Northern Ghana reported similar findings, where anaemia prevalence in the age group 20 years and below was 51.5% compared to 47.8% in those older than 35years (29). High prevalence in younger ages might have been due to the lack of awareness, poor knowledge of antenatal services, and failure to seek prenatal care early and take care of themselves during pregnancy (5, 17). However, there were contrasting reports from other African studies from Ethiopia and Nigeria, where the highest prevalence was reported among participants of the age group 30–39 years in Ethiopia and the Nigerian study reported the highest prevalence among participants in the age group of 20years and below (9, 17). This might have been because of increased body weakness, multiple pregnancies, labour, and being subjected to other illnesses leading to a predisposition to anaemia as age advances (9, 26). This study reported anaemia prevalence higher among women living in the urban area (27.6%) than women living in rural areas (15.5%). Consistent findings were reported in a study in Southern Nigeria (17). This is contrary to other studies in India and Northern Ethiopia, where anaemia prevalence was high among pregnant women living in rural areas compared to those living in urban areas (6, 30). This may be because of limited access to health facilities and limited resources for adequate and proper nutrition during pregnancy (16, 30, 31). Based on the finding of this study, anaemia prevalence was highest in women with a monthly household income of less than $343 (35.5%). These findings are consistent with a study in Ethiopia, where women from lower socio-economic classes had a higher prevalence of anaemia than those from higher socio-economic classes (2, 18). The women from lower socio-economic status were perceived as unable to afford good quality food (2, 12). The highest prevalence was among the unemployed, pregnant women (27.5%). A study in Nigeria also reported consistent findings, and they stated that the participants had little or no income to buy the right food required to prevent anaemia (17). One study in Kenya showed contrasting results of the high prevalence among the employed participants (26). They stated that the employed participants had no time to rest or attend ANC clinics compared to housewives (26). The highest anaemia prevalence was reported among pregnant who was in the 3rd trimester of their pregnancy. Consistent results were reported in Egypt (28) and Ghana (8). This might have been due to reducing iron stores due to increasing demand for iron for both the mother and foetus, as pregnancy progress (2, 18).

This study showed that being on chronic medication was a risk for developing anaemia in pregnancy. Similarly, a study from India noted an association between anaemic pregnant women with a chronic illness in pregnancy or the recent past (11). There is a relative deficiency of iron in the body; therefore, the

body cannot effectively use iron to generate new blood cells. Iron reserves are already low in these patients (11, 32). Also, this study found that HIV was associated with anaemia in pregnancy, where those infected with HIV had a 2.5 chance of developing anaemia. In Uganda, a study showed similar findings, where pregnant women infected with HIV were twice more likely to have anaemia than their HIV-negative counterparts (33). HIV infection is associated with lower serum folic acid and ferritin levels, and the use of antiretroviral drugs, especially Zidovudine, is associated with anaemia (4, 33). There was a significant association between gestational age at first ANC and anaemia in pregnancy. In this study, those in the 3rd trimester was about 6-fold more likely to be anaemic than those in the 2nd trimester. Consistent findings were reported in Ethiopia, where women in the second and third trimesters were 3.1 and 3.7 times more likely to develop anaemia than those in the first trimester (2). During pregnancy, physiological haemodilution occurs as the pregnancy progresses, worsening anaemia in the third trimester (16). Furthermore, areas of residence, particularly those residing in urban area may also impact pregnancy women. For instance, pregnant women living in a rural area versus living in an urban area has been investigated as a potential contributing factor for risk of developing anaemia among women (31). In addition, a study from Ethiopia affirmed that pregnant women in rural areas were almost 2-times more at risk of developing anaemia than those in urban areas (30). The possible explanation for this could be attributed to a lack of proper information about ANC as well as inaccessibility to health care facilities (30).

Strengths and limitations of the study

The limitations of this study were that this was a hospital-based study, so results could only be generalized to women attending ANC and not all pregnant women in the population. In addition, the study design was cross-sectional, so it was impossible to identify and establish cause and effect relationships. Nevertheless, the findings shed some light on anaemia in pregnancy and the associated risks, and they provide a platform for further studies. The study's strengths were that the diagnosis of anaemia was based on laboratory analysis and did not depend on clinical assessment. This is the first study on prevalence and risks associated with anaemia in pregnancy, and it gives perspective to the burden of anaemia in the Kingdom. It also serves as a benchmark for further research into the role of other factors that may contribute to understanding anaemia in pregnancy.

Conclusion

The results of this study highlight prevalence and associated risk factors for anaemia among pregnant women attending ANC in Eswatini and indicate potential factors for interference to alleviate the anaemia burden in Eswatini. The findings show that anaemia among pregnant women attending ANC in Eswatini is associated with the place of living and gestational age at first ANC, among others. Also, this study concludes that the prevalence of anaemia is high among pregnant women in Eswatini. Furthermore, the study has provided essential information about anaemia and associated risk factors that can contribute to policy development and prevention strategies. Finally, the findings provide epidemiological knowledge about the distribution of anaemia. This is crucial to guide the continuous awareness and health

education on the implication of anaemia and the importance of prevention and reducing the risk of anaemia in pregnancy.

Abbreviations

ANC	**Ante-natal care**
AOR	**Adjusted Odds Ratio**
BREC	Biomedical Research Ethics Committee
CI	Confidence interval
COR	Crude Odds Ratio
FBC	Full Blood Count
EHHRRB	Eswatini Health and Human Research Review Board
Hb	Haemoglobin
HICs	High Income Countries
HIV	Human Immunodeficiency Virus
LICs	Low Income Countries
OR	Odds ratio
RFM	Raleigh Fitkin Memorial
SD	Standard deviation
SSA	Sub-Saharan Africa
STI	Sexually transmitted infections
UKZN University of KwaZulu-Natal	
WHO World Health Organisation	

Declarations

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Authors' contributions

RD conceived the study and design. RD and TGG simplified acquisition of the data. RD, and REO analysed the data. RD, TGG, and REO interpreted the data. RD, TGG, and REO drafted the manuscript. RD, TGG, and REO provided critical review and final approval of the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

Data from this study is the property of the Government of Eswatini and University of KwaZuluNatal and cannot be made publicly available. All interested readers can access the data set from Eswatini Health and Human Research Review Board (EHHRRB) and the University of KwaZulu-Natal Biomedical Research Ethics Committee (BREC) from the following contacts:

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Competing interests

The authors declare that they have no competing interests

Consent for publication

Not applicable

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