International Journal of Health Sciences and Research
Vol.10; Issue: 8; August 2020
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Prevalence and Factors Associated with Anemia among Pregnant Women Attending Ante-Natal Clinic in the Second and Third Trimesters at Soba University Hospital, Khartoum State, Sudan (2018-2019)

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ABSTRACT

Background and objectives: Globally anemia is a major health problem especially affecting pregnant women. The study aim was to assess the prevalence and identify factors associated with anemia among pregnant women attending the Ante-Natal Clinic at Soba University Hospital.
Method: A cross-sectional hospital-based study was conducted among 322 pregnant women. The study used an interview-based questionnaire assessing socio-demographic data, pregnancy-related data, medical history, and dietary habits. Hemoglobin level was obtained from the last recorded value in the participant´s file. The data was analyzed using SPSS version 23.
Result: The overall prevalence of anemia was 22%. Illiteracy (OR=8.50, 95% CI: 2.44- 29.50, P=0.001), history of abortion (OR=4.40, 95% CI: 2.20-8.79, P=0.000), hyperemesis gravid-arum (OR=2.88, 95% CI: 1.35- 6.14, P=0.006), menorrhagia (OR=2.88, 95% CI: 1.26- 6.56, P=0.012), iron supplement (OR=0.10, 95% CI: 0.02- 0.45, P=0.003), iron supplementation ≤ 2 months (OR=2.65, 95% CI: 1.07- 6.53, P=0.034), regular iron intake (OR=0.08, 95% CI: 0.00- 0.69, P=0.022), immediate calcium intake after iron (OR=2.91, 95% CI: 1.09- 7.73, P= 0.032), ante-natal clinic visits ≤ 2 (OR=3.49, 95% CI: 1.05- 11.63, P=0.041), malaria infection during current pregnancy (OR=3.36, 95% CI: 1.38- 8.15, P=0.007), history of anemia (OR= 9.76, 95% CI: 2.42-39.43, P=0.001), regular coffee consumption after a meal (OR=4.23, 95% CI: 1.67- 10.70, P=0.002), and meat consumption ≤ 1 per week (OR=4.10, 95% CI: 1.67- 10.06, P=0.002) were significantly associated with anemia.
Conclusion: This study showed that anemia is a moderate health problem in the study area. Risk factors education and malaria preventative measures are recommended.

Keywords: Anemia, Associated factors, Pregnancy, Prevalence.

INTRODUCTION

Anemia is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs. [1] It is a major health problem in both developed and developing countries which can occur at any stage of life but young children and pregnant women are the most affected. [2]

Worldwide anemia affects 1.62 billion people (25%), among which 56 million are pregnant women. The global prevalence of anemia in pregnant women is 41.8% and the highest proportion is in Africa (57.1%). [1-3] In developing countries, the cause of anemia during pregnancy is multifactorial and including socio-demographic, dietary habits, physical and

mental health, worm infection, malaria, gynecological/obstetric history, genetic makeup, and nutritional deficiency include iron, folic acid, and vitamin B12. [3-5] Anemia contributes to one-fifth of all maternal deaths in West Africa. [6] In Pregnancy, anemia is an important factor associated with an increased risk of maternal, fetal, and neonatal mortality. Also, it is associated with poor pregnancy outcomes such as low birth weight, impaired cognitive development, reduced learning capacity, diminished school performance in children, and decreased productivity in adults. [7]

Anemia is present in pregnancy when the hemoglobin level (Hb) is <110 g/l. Anemia in pregnancy is classified as mild (100-109 g/l), moderate (70-99 g/l), and severe (< 70 g/l) based on the level of hemoglobin concentration in the blood. [8] Approximately 50% of cases of anemia are due to iron deficiency. In Sudan, anemia is a severe problem and affecting 30.70% of women of reproductive age (15-49) and 20.3% of maternal deaths are associated with anemia. [9,10] Understanding the prevalence and complexity of contributors to anemia is vitally important if better management is required. Due to scarcity of information about anemia among pregnant women in Sudan, this study set out to assess the prevalence and investigate factors associated with anemia among Sudanese pregnant mothers attending Ante-Natal Clinic (ANC) at Soba University Hospital (SUH), Khartoum State, Sudan which can be used to formulate a strategy to manage this major health problem and address these research gaps.

MATERIALS AND METHODS

Study setting: The study was conducted at SUH which is a referral hospital located in the south of Khartoum city. The current capacity of the hospital is approximately 500 beds. The obstetric department in SUH is one of the main referral centers for high-risk pregnancies in Sudan. The neonatal care unit in the hospital is one of the biggest neonatal care units in Sudan. It receives about 700-800 newborns annually.

Study design and participants: Hospital-based cross-sectional study was conducted at ANC at SUH from 9th December 2018 to 6th of January 2019. The study population was second and third-trimesters pregnant women attending ANC at SUH who haven't had severe disease. The second (≥ 13weeks-26 weeks) and the third trimesters (≥ 27 weeks) were determined by the record in the participant´s file.

Sample size determination: The sample size was calculated using a single population proportion formula ($n = Z^2pq/d^2$). Based on a 30.7% proportion of anemia among women in the reproductive age from the study carried out by World Health Organization, considering 95% confidence interval and 5% marginal error which gave a sample size of 322 pregnant women.

Sampling method: A review of the ANC attendance register showed that about 34 pregnant women in the second and third trimesters attend ANC at SUH daily. So the study was designed to be done in 4 weeks during this period the estimated number of pregnant women was about 680 women. To select the study participant's systemic random sampling method was used. The expected number of 680 pregnant women in the second and third trimesters was divided by the sample size 322 which gave a sampling interval of 2. The first participant was randomly selected from the first two women attending the ANC by picking one of two pieces of paper containing their names. Then, every second pregnant woman who came to the ANC was recruited until the desire sample size was reached.

Data collection: A pre-tested pre-coded structured questionnaire was used to interview the selected sample. The questionnaire comprised of socio-demographic characteristics (age, education level, occupation, monthly income, marital status, and head of the household), obstetric and gynecological history (gravidity, parity, inter-pregnancy spacing, history and number of abortions, pregnancy trimester,

hyperemesis gravid arum, vaginal bleeding in the current pregnancy, and menorrhagia), ANC visits (the trimester at the first ANC visit and frequency of ANC visits), iron and folic acid supplements (IFAS) (folic acid and iron intake, trimester at which iron intake was started, the regularity of iron intake, duration of iron intake, and calcium consumption (supplementation or dairy product)), medical history (malaria infection in the current pregnancy and history of anemia), and dietary habits (frequency of meals per day, tea, coffee, meat, vegetables, and fruits consumption, immediate intake of tea and coffee after a meal, and frequency of meat, vegetables, and fruits consumption per week). Hemoglobin level was obtained from the last recorded value in the participant´s file.

Data Analysis: Data management and analysis were performed using SPSS version 23. Categorical variables were presented as frequencies and percentages. To find the association between independent and dependent variables (Anemia) chi-square test and logistic regression were used with corresponding 95% confidence intervals (CI). A P-value of <0.05 was considered statistically significant.

RESULTS

Prevalence of anemia: The overall prevalence of anemia (Hb < 110 g/l) was 22%. Mild anemia was 6.8%, moderated anemia was 12.4% and severe anemia was 2.8%.

Socio-demographic, economic characteristics of the participants, and anemia: 322 pregnant women were enrolled, of them 189 (58.7%) were within the age range of 25-34 years, 163 (50.6%) had earned university education or higher, 264 (82%) were housewives, 144 (44.7%) had monthly income between 3000-5000 (Sudanese pound- SDG), 319 (99.1%) were married, and 277 (86.0%) their husbands were the head of the household. The magnitude of anemia was highest among women aged 15-24 years 25.6% (21/82) and lowest among women aged 35-45 years 19.6 %(10/51). The highest anemia prevalence was among illiterate pregnant women 53.8 %(7/13) and student mothers 27.2 %(3/11). Besides, the occurrence rate of anemia increased as monthly income decreased. Low-income pregnant women (<3000 SDG) were more anemic 23.9 %(23/96) compared to high-income women (>7000SDG) 9 %(1/11). Anemia had shown low prevalence among married women 21.6 %(69/319) and when both parents were the head of household 19.5 %(8/41) (Table 1).

Table 1: Socio-demographic characteristic and anemia among pregnant women:

Variable	Frequency (%)	Anemic (%)
Age (years)		
15-24	82 (25.5)	21 (25.6)
25-34	189 (58.7)	40 (21.2)
35-45	51 (15.8)	10 (19.6)
Education level		
Illiterate	13 (4.0)	7 (53.8)
Basic school	51 (15.8)	15 (29.4)
Secondary school	95 (29.5)	23 (24.2)
University or higher	163 (50.6)	27 (16.6)
Occupation		
Governmental	25 (7.8)	6(24.0)
Private	22 (6.8)	2(9.1)
Student	11 (3.4)	3(27.2)
Housewife	264 (82)	60(22.7)
Income	96 (29.8)	23(23.9)
< 3000	144 (44.7)	33(22.9)
3000-5000	71 (22.0)	14(19.7)
5000-7000	11 (3.4)	1(9.0)
> 7000		
Marital status	319 (99.1)	69(21.6)
Married	1 (0.3)	1(100)
Divorced	2 (0.6)	1(50.0)
Widow		
Head of the household		
Husband	277 (86.0)	62(22.4)
Both	41 (12.7)	8(19.5)
Others	4 (1.2)	1(25.0)

Obstetric/ gynecological history of the participants and anemia: 94 women (29.2%) had a history of abortion, and 64 (19.9%) aborted once. During the current pregnancy, almost all women 317 (98.4%) didn't have vaginal bleeding and 176 women (54.7%) suffered from hyperemesis gravid-arum. 41 women (12.7%) had a history of menorrhagia. Multigravida women constitute 202 (62.7%) of the participants. Of the multigravida, 112 women (34.8%) had an inter-pregnancy interval of two years. Multiparous women constitute 118 (36.6%) of the study participants. The

majority of women 237 (73.6%) were in the third trimester of pregnancy.

The magnitude of anemia was higher among pregnant women who had a history of abortion 36.5% (34/94), hyperemesis gravid arum 27.3% (48/176), and menorrhagia 36.6% (15/41) than their counterparts. Pregnant women who aborted twice or more were more anemic 56.7% (17/30). Anemia was found to increase with gravidity, parity, short inter-pregnancy space, and pregnancy trimester. Grand multigravida, grand multiparous, women with inter-pregnancy space of one year or less, and third-trimester women were the most anemic 23.4% (15/64), 23.9% (11/46), 25% (11/44), 25% (3/12), and 32.2% (55/237) respectively (Table2).

Table 2: Obstetric /gynecological history and anemia of the pregnant:

Variable	**Frequency (%)**		**Anemic (%)**	
	Yes	No	Yes(anemic)	No(anemic)
History of abortion	94 (29.2)	228 (70.8)	34(36.2)	37(16.2)
Vaginal bleeding	5 (1.6)	317 (98.4)	0.0(0.0)	71(22.4)
Hyperemesis gravid arum	176 (54.7)	146 (45.3)	48(27.3)	23(15.8)
Menorrhagia	41 (12.7)	281 (87.3)	15(36.6)	56(19.9)
Gravidity				
Primigravida	56(17.4)		11(19.6)	
Multigravida	202 (62.7)		45(22.3)	
Grand multigravida	64 (19.9)		15(23.4)	
Parity				
Nulliparous	80 (24.8)		17(21.3)	
Primiparous	78 (24.2)		17(21.8)	
Multiparous	118 (36.6)		26(22.0)	
Grand multiparous	46 (14.3)		11(23.9)	
Inter-pregnancy space				
< 1 year	12 (3.7)		3(25)	
1 year	44 (13.7)		11(25)	
2 years	112 (34.8)		26(23.2)	
≥ 3 years	98 (30.4)		20(20.4)	
Number of abortion				
1	64 (19.9)		17(26.6)	
≥ 2	30 (9.3)		17(56.7)	
Pregnancy trimester				
second trimester	85 (26.4)		16(18.8)	
third trimester	237 (73.6)		55(23.2)	

IFAS, ANC attendance of the participants, and anemia: A total of 313 (97.2%) and 299 (92.9%) have had folic acid and iron supplements respectively. Furthermore, 237 women (73.6%) started taking iron in the second trimester, 202 women (62.7%) were taking iron > 2 months, and 195 women (60.6%) had regular iron intake. 65 women (20.2%) have had calcium (supplement /dairy product) immediately after iron. The most common attendance of ANC for the first time was in the first trimester 263 (81.7%) and 299 (92.9%) attended ANC > 2times.

The proportion of anemia was greater among those who have had no folic acid supplementation 44.4 %(4/9), no iron supplementation 47.8 %(11/23), irregular iron intake 34.6 %(36/104), and immediate calcium intake after iron 46.2 %(30/65) compared to their counterparts. The duration of iron intake also showed a difference in the prevalence of anemia (27.8 %(27/97) in pregnant women who have had iron intake ≤ 2 months and 16.3 % (33/202) in women who have had iron intake > 2 months). Starting iron intake in the third trimester, having the first ANC visit in the second trimester, and ANC visits ≤ 2 times showed a high prevalence of anemia 25%(3/12), 24.6% (14/57), and 34.8% (8/23) respectively (Table 3).

Table 3: Iron and folic acid supplementations, Ante-Natal Clinic (ANC) attendance, and anemia of the pregnant women:

Variable	Frequency (%)		Anemic (%)	
	Yes	No	Yes	No
Folic acid supplementation	313 (97.2)	9 (2.8)	67(21.4)	4(44.4)
Iron supplementation	299 (92.9)	23(7.1)	60(20.1)	11(47.8)
Regular iron intake	195 (60.6)	104(32.3)	24(12.3)	36(34.6)
Calcium(supplement/diary product) after iron	65(20.2)	234(72.7)	30(46.2)	30(12.8)
Duration of iron intake ≤ 2 months > 2 months	 97 (30.1) 202 (62.7)		 27 (27.8) 33 (16.3)	
Trimester when the pregnant women started iron intake first trimester second trimester third trimester	 50 (15.5) 237 (73.6) 12 (3.7)		 9 (18.0) 48 (20.1) 3 (25.0)	
Trimester at the first ANC visit first trimester second trimester third trimester	 263 (81.7) 57 (17.7) 2 (0.6)		 57 (21.7) 14 (24.6) 0.0(0.0)	
Frequency of ANC visits ≤ 2 > 2	 23 (7.1) 299 (92.9)		 8 (34.8) 63 (21.1)	

Medical history, dietary habits of the participants, and anemia: Of the participant, 107 (33.2%) and 54 (16.8%) had malaria infection and a history of anemia respectively. 224 women (69.6%) consumed tea, of them, 136 (42.2%) consumed it immediately after a meal. While 207 women (64.3%) consumed coffee, 87 (27.0%) consumed it immediately after a meal. Most of the women 309 (95.9%), 320 (99.4%), and 313 (97.2%) consumed meat, vegetables, and fruits respectively. 213 (66.1%), 291 (90.4%), and 268 (83.2%) consumed meat, vegetables, and fruits ≥ 2 times per week. More than half of the ANC attendee 174 women (54.0%) consumed three meals per day.

Prevalence of anemia was observed to be higher among pregnant women who have had malaria infection 38.3 %(41/107) and history of anemia 64.8 %(35/54) than their counterparts. Pregnant women who consumed tea, coffee, had immediate tea or coffee after a meal, and not consuming meat, vegetables, and fruits reported a higher prevalence of anemia 22.3 %(50/224), 23.2 %(48/207), 27.2 %(37/136), 31 %(27/87), and 23.2 %(3/13), 50 % (1/2), and 22.2 %(2/9) respectively. Similarly, less frequent consumption (≤ 1 time per week) of meat, vegetables, fruits, and meals (≤ 2 per day) had shown more prevalence of anemia 34.4 %(33/96), 24.1% (7/29), 22.2 % (10/45), and 30.6 % (26/85) respectively (Table 4).

Table 4: Medical history, dietary habits, and anemia of pregnant women:

Variable	Frequency (%)		Anemic	
	Yes	No	Yes(anemic)	No(anemic)
Malaria	107(33.2)	215(66.8)	41(38.3)	30(13.9)
History of anemia	54(16.8)	268 (83.2)	35(64.8)	36(13.4)
Tea	224 (69.6)	98 (30.4)	50(22.3)	21(21.4)
Immediate tea after a meal	136 (42.2)	88 (27.3)	37(27.2)	13(14.8)
Coffee	207 (64.3)	115 (35.7)	48(23.2)	23(20.0)
Immediate coffee after a meal	87 (27.0)	120 (37.3)	27(31.0)	21(17.5)
Meat	309 (95.9)	13 (4.0)	68(22.0)	3(23.2)
Vegetables	320 (99.4)	2 (0.6)	70(21.9)	1(50.0)
Fruits	313 (97.2)	9 (2.8)	68(21.7)	2(22.2)
Frequency of meat per week ≤ 1 ≥ 2	96 (29.8) 213 (66.1)		33(34.4) 35(16.4)	
Frequency of vegetables per week ≤ 1 ≥ 2	29 (9.0) 291 (90.4)		7(24.1) 63(21.6)	
Frequency of fruits per week ≤ 1 ≥ 2	45 (14.0) 268 (83.2)		10(22.2) 58(21.6)	
Frequency of meals per day ≤ 2 3 > 3	85 (26.4) 174 (54.0) 63 (19.6)		26(30.6) 35(20.1) 10(15.9)	

Factors associated with anemia: Among pregnant women education level (P=0.002), marital status (P=0.003), history of abortion (P=0.000), number of abortions (P=0.008), hyperemesis gravid arum (P=0.036), iron intake (P=0.000), regular iron intake (P=0.000), duration of iron intake (P=0.040), immediate calcium(supplementation/dairy products) intake after iron(P=0.000), frequency of ANC visits (P=0.048), malaria infection (P=0.000), history of anemia (P=0.000), immediate coffee intake after a meal (P=0.000), and frequency of meat per week (P=0.002) were statistically significant with anemia.

Table 5 shows the logistic regression which revealed that, illiteracy (OR=8.50, 95% CI: 2.44-29.50, P=0.001), abortion (OR=4.40, 95% CI: 2.20-8.79, P=0.000), hyperemesis gravid arum (OR=2.88, 95% CI: 1.35-6.14, P=0.006), menorrhagia (OR=2.88, 95% CI: 1.26-6.56, P=0.012), iron supplement (OR=0.10, 95% CI: 0.02-0.45, P=0.003), regular iron intake (OR=0.08, 95% CI: 0.00-0.69, P=0.022) , iron intake ≤ 2 months (OR=2.65, 95% CI: 1.07-6.53, P=0.034), immediate calcium intake after iron (OR=2.91, 95% CI: 1.09-7.73, P= 0.032), ANC visits ≤ 2 (OR=3.49, 95% CI: 1.05-11.63, P=0.041), malaria infection during current pregnancy (OR=3.36, 95% CI: 1.38-8.15, P=0.007), history of anemia (OR=9.76, 95% CI: 2.42-39.43, P=0.001), Coffee consumption after a meal (OR=4.23, 95% CI: 1.67- 10.70, P=0.002), and meat consumption ≤ 1 time per week (OR=4.10, 95% CI: 1.67-10.06, P=0.002) were significantly associated with anemia.

Table 5: Factors associated with anemia in pregnancy among pregnant women:

Variable	Description	P-value	OR	95% CI
Education level	Illiterate	0.001*	8.50	(2.44- 29.50)
	Basic school	0.099	2.12	(0.86- 5.20)
	Secondary school	.915	1.04	(0.44- 2.48)
	University or higher	-	Reference	Reference
Abortion	Yes	0.000*	4.40	(2.20-8.79)
	No	-	-	-
Hyperemesis gravid-arum	Yes	0.006*	2.88	(1.35- 6.14)
	No	-	Reference	-
Menorrhagia	Yes	0.012*	2.88	(1.26-6.56)
	No	-	Reference	-
Iron intake	Yes	0.003*	0.10	(0.02- 0.45)
	No	-	Reference	-
Regular iron intake	Yes	0.022*	.08	(0.00-0.69)
	No	-	Reference	-
Duration of iron intake	≤ 2 months	0.034*	2.65	(1.07-6.53)
	> 2 months	-	Reference	-
Immediate calcium intake after iron	Yes	0.032*	2.91	(1.09- 7.73)
	No	-	Reference	-
Frequency of ANC visits	≤ 2	0.041*	3.49	(1.05- 11.63)
	> 2	-	Reference	-
Malaria	Yes	0.007*	3.36	(1.38-8.15)
	No	-	Reference	-
History of anemia	Yes	0.001*	9.76	(2.42-39.43)
	No	-	Reference	-
Immediate coffee after a meal	Yes	0.002*	4.23	(1.67- 10.70)
	No	-	Reference	-
Meat per week	≤ 1	0.002*	4.10	(1.67- 10.06)
	≥ 2	-	Reference	-

DISCUSSION

According to this study, the prevalence of anemia among pregnant women attending ANC was 22%. This finding is much lower than the anemia prevalence in central Sudan reported at 43.5% and in eastern Sudan where anemia was reported to be 62.6%. [11,12] It is similar to the result revealed by a study conducted in North Ethiopia 21.6% and much lower than a study conducted in Kenya reported at 57%. [13,14] This result may be explained by

the fact that anemia is common in the second and third trimesters so pregnant women in the first trimester weren't included in this study. Also, the variation could be because women who came to the ANC at SUH for follow up were referred from Primary Health Care (PHC) unit.

This study found a significant association between women's educational level and anemia. Illiterate pregnant women were about 8 folds more likely to be anemic compared to those who had earned university education or higher degrees. This result is consistent with data obtained in India and Saudi Arabia, which indicated a low level of education was significantly increase the risk of anemia. [15-16] A possible explanation for this result may be the lack of adequate knowledge regarding iron-rich food and the importance of IFAS among illiterate women.

The study demonstrated that pregnant women who had a history of abortion were significantly four times more likely to develop anemia than those who had no history of abortion. This finding match those observed in earlier studies, which found a significant association between the history of abortion and anemia in pregnancy. [17,18] The observed increase in anemia could be attributed to increased blood loss with abortion which might affect the iron store in the body. Hyperemesis gravid arum in the current pregnancy significantly increased the risk of developing anemia about three times compared to pregnant women who had no hyperemesis gravid arum. This finding in line with previous studies that found hyperemesis gravid arum significantly associated with anemia. [19] Hyperemesis gravid arum is exaggerated nausea and vomiting occurs in pregnancy. Thus, vitamin deficiency and electrolyte disturbance might be a possible cause. The probability of being anemic among pregnant women who had a history of menorrhagia was significantly about 3 times to be higher compared to those who had normal menstruation flow. This is in line with previous studies in Ethiopia. [17,20] This result is likely to be related to excessive iron loss following menorrhagia or excessive menstrual bleeding.

This study revealed that some obstetric characteristics were protective against anemia. Pregnant women who have had iron supplementation during current pregnancy were 90% less likely to develop anemia compared to those who have had no iron supplementation. This result agrees with findings from studies in Ethiopia and Vietnam, in which a lack of iron supplementation during the current pregnancy was one of the most significant factors associated with an increased risk of anemia. [21,22] Also, regular iron intake during pregnancy decreased the risk of developing anemia by 92% compared to irregular intake. Studies in Saudi Arabia and the Philippines showed similar results. [23,24] Iron is important for hemoglobin synthesis. During pregnancy, the total blood volume increases by about 1.5 liters and the plasma volume increases more compared to red cell mass which leads to hem dilution and reduction of hemoglobin concentration. Also, there is an increasing demand for iron to the growing fetus. Thus, iron storage in pregnant women decreases more than non-pregnant women. In the developing countries, iron supplementation tablets are recommended for pregnant women as diet only is not enough to meet the requirement. Regular iron intake improves hemoglobin levels among pregnant women and protects from anemia.

On the other hand, having iron supplementation ≤2 months significantly increases the risk of developing anemia among pregnant women about three times compared to having iron supplementation >2 months. This finding corroborates with previous studies in Turkey and India, which indicated a short duration of iron intake during pregnancy significantly increases the risk of developing anemia. [25,26] As pregnancy continues, mobilization of iron stores happens to meet maternal and fetal needs. Taking iron supplements for more

than 2 months is quite important to keep sufficient stores of iron and improve hemoglobin concentration to complete pregnancy without consequences.

Interestingly calcium intake (supplementation or dairy products) was observed to have a positive association with anemia. Pregnant women who have had calcium immediately after iron supplementation were about three folds to be anemic compared to those who have had no calcium immediately after iron supplementation. This finding is in agreement with studies carried out in the UK and Croatia, which indicated calcium intake significantly associated with anemia among pregnant women. [27,28] This might be due to the reason that in pregnancy micronutrient is needed especially calcium as it has a crucial role in bone, muscle, and nerve development of the fetus. Calcium inhibits bioavailability of non-heme iron which can deplete the iron store even though Ca-Fe interaction hasn't been elicited yet

In this study, a positive correlation was found between the frequency of ANC visits and anemia. Pregnant women who visited ANC ≤ 2 times were 3 folds more likely to be anemic compared to those visited ANC > 2 times. This finding is in agreement with previous studies in Ethiopia, which found that decreased frequency of ANC visits significantly increased the risk of anemia. [29,30] Women who visit ANC less frequently miss opportunities for detecting anemia and health problems related to pregnancy as early as possible.

The proportion of anemia was significantly more among mothers having malaria attacks during current pregnancy compared to those having no malaria attack. Malaria attacks increased the risk of developing anemia 3 times. This is in line with the local study [12] and regional studies in Ethiopia and Nigeria. [20,31] This is possible because malaria parasites destroyed red blood cells rapidly and the body cannot generate them at the same rate. History of anemia also revealed to have a significant association with anemia. Pregnant women with a history of anemia were about 10 folds more likely to be anemic than those who had no history of anemia. This finding supports previous researches, which demonstrated a significant association between a history of anemia and current pregnancy anemia. [32,33] Pregnancy may be a state in which there are much needs for iron which may be diminished throughout pregnancy, so, women who enter pregnancy with low hemoglobin concentration may suffer from anemia.

Another important finding was that coffee intake immediately after a meal significantly associated with anemia. Pregnant women who consumed coffee immediately after a meal were 4 times to be anemic than those who didn't consume the coffee immediately after a meal. This finding is in keeping with studies in Yemen and Ethiopia, which found a significant association between the consumption of coffee after a meal and pregnancy anemia. [34,35] This might be because consuming coffee after a meal inhibits the absorption of non-heme iron which available mainly through fruits and vegetables. Thus, contribute to anemia by depleting the body store of iron.

Moreover, the odds of developing anemia among pregnant with meat consumption ≤ 1time per week were significantly 4 times greater than the odds of pregnant women with meat consumption ≥ 2 times per week. Similar results were demonstrated from studies in Ethiopia. [36,37] During pregnancy, iron-rich food must be consumed to keep a sufficient iron store in the body for the mother and fetus. Meat is the main source for heme iron so more frequent consumption can prevent anemia during pregnancy.

Limitation of the study: First, cross-sectional hospital-based nature, second, the study was conducted at a single ANC, and finally, hemoglobin level was obtained from the participant´s file instead of laboratory measures. Further community-based studies

should be undertaken to emphasize these results.

CONCLUSION

In conclusion, this study has shown that anemia is a moderate public health problem in the study area. The investigation of anemia has shown that education level, history of abortion, hyperemesis gravid arum, menorrhagia, iron supplementation, duration and regularity of iron intake, immediate calcium intake after iron, frequency of ANC visits, malaria infection in the current pregnancy, history of anemia, coffee intake after a meal, and frequency of meat intake per week was significantly associated with anemia among pregnant women in the study area. At ANC pregnant women should receive nutritional counseling on iron supplementation and dietary habits. Preventative measures against malaria are recommended for pregnant women.

ACKNOWLEDGMENT

The author wishes to acknowledge Dr. Elfatih Malik, Associated Professor, Faculty of Medicine, University of Khartoum of his scientific and technical support.

Funding and conflict of interest

The authors held all the financial issues of this study. The authors report no conflict of interest regarding this report.

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How to cite this article: Mohamed NEB, Hassan RHA. Prevalence and factors associated with anemia among pregnant women attending Ante-Natal Clinic in the second and third trimesters at Soba University Hospital, Khartoum State, Sudan (2018-2019). Int J Health Sci Res. 2020; 10(8):195-204.

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