Exploring The Prevalence And Factors Associated With Anaemia In Pregnancy; A Cross-Sectional Study At Tema General Hospital In The Greater Accra Region, Ghana

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ABSTRACT

Background: Anemia during pregnancy has been observed s one of the most common indirect obstetric causes of maternal mortality globally with the heaviest toll in the developing world. It is responsible for poor maternal and fetal outcomes. The aim of this study was to estimate the prevalence and explore factors associated with anaemia in pregnancy among antenatal care (ANC) attendees to the Tema General Hospital in the Greater Accra Region of Ghana. **Method:** A cross-sectional descriptive study was conducted with 422 pregnant women between the ages 15-49 years, who attended the ANC clinic at the Tema General Hospital. A structured questionnaire was used to ascertain data on socio-demographic and economic, obstetric characteristics, health conditions, consumption of iron-containing foods, knowledge on anaemia, first and current haemoglobin recording of all participants. **Results:** Out of the 422 pregnant women who participated in the study, 171(41%) were found to be anaemic (Hb:<11 g/dl) with a mean Hb level of 11.05g/dl. Two hundred and fifty one representing 59.5% had no anaemia (Hb: ≥ 11g/dl), ninety (21%) were mildly anaemic (Hb: 9.0—10.9g/dl), seventy eight (18.5%) were moderately anaemic (Hb: 7.0 – 8.9g/dl) and three (1%) (Hb < 7g/dl) were severely anaemic. Bivariate analysis showed that age, marital status, occupation, family income and source of information from media were statistically significant. After adjustment for other covariates in a multiple logistic regression model, it was revealed that age, source of information from either a health worker or from the media and interpregnancy interval were statistically significant in predicting the anaemic condition of the expecting mother. **Conclusion:** There was a notably high prevalence of anaemia at Tema General Hospital over the study period. Adolescent and reproductive health education should, therefore, be encouraged at all levels care-seeking periods and information from health workers to pregnant women should be individualized and targeted towards available resources.

Keywords: Anaemia, Pregnancy, Antenatal care, Tema General Hospital, Ghana

1. INTRODUCTION

Anaemia is a condition in which the number and size of red blood cells or the haemoglobin concentration falls below an established cut-off value, consequently impairing the capacity of the blood to transport oxygen around the body [1]. The World Health Organization (WHO) defines anaemia as when the Hb levels are less than 12 g/dl in non-pregnant women and less than 11g/dl in pregnant women [2]. Anaemia is a major health problem that affects populations around the globe. It has very significant consequences for human health as well as social and economic development [3].

Anaemia is divided into three levels of severity, Mild anaemia (Hb level, 9 - 10.9g/dl), Moderate anaemia (Hb level, 7 - 8.9g/dl) and Severe anaemia (Hb level < 7g/dl) [4]. During pregnancy, haemoglobin reductions have serious pregnancy-related complications and it is linked with an increased incidence of both maternal and foetal

health and death [5]. It is the most known nutritional deficiency disorder in the world and the common cause of iron deficiency [6]. Hence, Iron Deficiency Anaemia (IDA) and anaemia have often been used interchangeably. Also, the pervasiveness of anaemia has been consistently used as a substitute for IDA [3]. Some of the predisposing factors include grand multiparity, low socioeconomic status, maternal infection, late prenatal care, HIV infection and inadequate spacing of children [7].

Improving maternal health is a high priority for the United Nations' international development agenda as part of the fifth Millennium Development Goal (MDG) set in the year 2000 and the third Sustainable Development Goal (SDG) set in the year 2015. With regards to Millennium Development Goal 5 (MDG 5), there was a significant achievement in almost all geographical regions, except in sub-Saharan Africa, which was unable to achieve the set target of reducing maternal deaths to 75% by 2015. Ghana's maternal mortality reduction was projected to be 319 per 100,000 by the end of 2015 instead of the MDG target of 54 per 100,000 [8]. This may look bleak but there have been great strides considering the fact that as of 1990, the figures were at 634 and 467 in 2000. This, however, gives some form of assurance that with the right kind of measures, maternal mortality in Ghana can be brought lower. Efforts and activities which were put in place to help Ghana achieve the MDG included the adoption of the Safe Motherhood Initiative (SMI) launched globally in 1987, together with other policy such as free antenatal care for all expecting mothers in 1998, and exempting all users from delivery fees in government health facilities in 2003 [9]. Anaemia in pregnancy is still a public health hazard in Ghana and needs frequent reviews to serve as a meaningful contribution to effective control of the disease.

According to the WHO's Global Health Observatory Data, the prevalence of anemia among pregnant women in Ghana as of 2016 was 54.30%, and by WHO classification, if the prevalence of anaemia among pregnant women goes beyond 40.0% in any population group it is an indicator of a severe public health problem [10], for which clearly Ghana qualifies. Due to the significance of this pathology in the world, various countries conduct routine interventions to help reduce the condition, particularly in the groups most vulnerable such as women and young children [3].

To help curtail this challenge, the Ghana Health Service (GHS) in 2003 introduced a national policy aimed at improving haemoglobin levels during pregnancy. This is done by administering iron supplements, providing health education on nutrition, ensuring quality of care, prevention of malaria infection through the administration of Intermittent Preventive Treatment (IPT) and the mass administration of albendazole to combat helminths infestation [11]. Although efficacious interventions such as these are in place, they do not seem to be working at an optimum level as evidenced by insufficient progress in reducing maternal anaemia. The primary objective of this study, therefore, is to estimate the prevalence and explore factors connected with anaemia in pregnancy among ANC attendees at the Tema General Hospital.

2. METHODS

2.1 STUDY SETTING AND CONTEXT

Tema General Hospital is the largest public health institution in the Tema Metropolis, located in the Greater Accra Region of Ghana. The facility was established between 1954 and 1957 by J.W Harrow and Sons Limited and handed over to the government of Ghana in 1962. It was built to serve as a medical centre for workers at the nearby fishing harbour. The Hospital has a total bed complement of 280 and ten wards. It offers both General and Specialist Care services in all the major clinical disciplines on both out-patient and in-patient basis. Tema Metropolis is a virtually fully-built-up area. It is a vibrant commercial and industrial city, about the only well-planned city in the country. It has a large harbour, one of the world's biggest man-made harbours which are the main sea-port entry to Ghana. The estimated population of Tema Metropolis is about 421,708 as at the 2010 National Population and Housing Census [12]. The Metropolis is situated about 5^0 N above the Equator and has the Greenwich Meridian (longitude zero) passing through it. Tema Metropolis is considered as being the city in the center of the world.

2.2 STUDY DESIGN AND SAMPLE SIZE

The cross-sectional study design was employed for the study. The study was conducted between January and March 2019 and it adopted a quantitative approach, which examined the connection between variables. The sample size was generated based on the estimated 50% prevalence of anaemia in pregnancy at the Ablekuma South District, one of the districts in the Greater Accra Region [13]. The sample size was calculated using the Cochran's formula as shown below;

$$n = \frac{Z^2 \times pq}{e^2} = \frac{(1.96)^2 \times (0.5 \times 0.5)}{(0.05)^2} \cong 384$$

Where,

n = sample size [14].

Z = the z-score that corresponds with a 95% confidence interval which is 1.96

p = Prevalence of anaemia in pregnancy from literature review (50%).

q = Proportion of antenatal attendants who are not anaemic.

e = 5% margin of error .

A projected 10% non-response rate resulting in about 38 respondents was added to the minimum sample size to get 422 participants.

2.3 DATA COLLECTION AND MANAGEMENT

A self-administered structured questionnaire consisting of both opened and closed-ended questions was developed based on findings from reviewed literature. The questionnaire was pre-tested at the antenatal clinic

at the University of Ghana Hospital, Accra where the respondents were presumed to have the same socio-demographical characteristics as the targeted population. The pre-test was done to ascertain any unforeseen problems with the questionnaires. After the pre-testing exercise, all necessary corrections and adjustments were made before proceeding to the actual field for data collection.

The data were coded, entered, cleaned, and analyzed using Microsoft Excel version 2016 and STATA statistical software package (*StataCorp.2007. Stata Statistical Software. Release 14. StataCorp LP, College Station, TX, USA*). Univariate analysis of selected variables was conducted to generate descriptive statistics on the socio-demographic characteristics of the participants. Bivariate analyses were carried out to assess the level of association among selected variables. Finally, a multiple logistic regression model was conducted to examine the relationship between a dichotomous outcome variable (aneamic status) and selected predictors. Adjusted and unadjusted odds ratios (OR) and their 95% confidence intervals (CI) were used as indicators to measure the strength of association. A p-value less 0.05 was used as the cut-off level for statistical significance.

2.4 ETHICS CONSIDERATION

Ethical endorsement for the study was obtained from the Ethical Review Committee of Ensign College of Public Health. Administrative permission was also sought from the management of the Tema General Hospital prior to the start of the study. Privacy and confidentiality were maintained during data collection, as interviews were conducted at places away from the location where care was provided to the other visiting clients. No personal identifiers were recorded.

3. RESULTS

3.1 STUDY POPULATION CHARACTERISTICS

The observed mean age of the study participants was 31.43 ± 6.47 years. The women were placed in different age categories with the majority of them falling within 25-29 and 30-34 years representing 25.36% and 26.3% respectively. The categorization by marital status showed the majority of the respondents were married, thus making 274(64.93%). There were 49(11.61%) "single" pregnant women, 87(20.62%) cohabiting and 12(2.84%) who reported being either widowed, divorced or separated at the time of participating in the study.

One hundred and eleven (26.3%) of the pregnant women were self-employed doing some form of business, 185(43.84%) were employed in the formal sector, 85(20.14%) were traders and the remaining 41(9.72) were unemployed. With regards to religion, there were 321(76.07%) who professed faith in Christianity, 96 representing 22.75% who admitted being Muslims and five (5) representing 1.18% were Traditionalists.

The reported educational level at the time of the study was categorized using Tertiary, Secondary, Primary and No formal education with the majority (41.47%) attaining tertiary level education. Participants having a family

income less than GH₵300 were found to be the minority 53 (12.56%), whereas those receiving GH₵ 300-500 were in the majority representing 39.71% (Table 1).

Table 1: *Socio-demographic characteristics of the study population*

Variable	Categories	Frequency	Percentage
Age (years)	15-19	19	4.50
	20-24	43	10.19
	25-29	107	25.36
	30-34	111	26.30
	35-39	89	21.09
	Above 40	53	12.56
Residence	Tema	70	16.59
	Ashaiman	118	27.96
	Tema Newtown	82	19.43
	Afienya	55	13.03
	Sakumono	37	8.77
	Dohwenya	52	12.32
	Others	8	1.90
Marital status	Single	49	11.61
	Married	274	64.93
	Cohabiting	87	20.62
	Widowed/Divorced/Separated	12	2.84
Occupation	Self-employed	111	26.30
	Government/Private employed	185	43.84
	Trader	85	20.14
	Unemployed	41	9.72
Religion	Christianity	321	76.07
	Islam	96	22.75
	Traditional	5	1.18
Educational Level	No formal education	44	10.43
	Primary	55	13.03
	Secondary	149	35.07
	Tertiary	175	41.47
Family Income	<300	53	12.56
	300-500	85	20.14
	500-1000	166	39.34
	>1000	118	27.96

3.2 OBSTETRIC CHARACTERISTICS OF STUDY PARTICIPANTS

A great proportion of the pregnant women 339 (80.88%) had already made the recommended minimum of four antenatal visits. Seventy-two (17.1%) of the women reported not having any biological child at the time of the study, 123(29.22%) had one child and 226(53.68%) had two or more children. Of the total respondents, 74 representing 17.54% said this was their first pregnancy, 124(29.38%) were in their second pregnancy, 132(31.28%) third pregnancy and those in their fourth or more pregnancy made up 92(21.8%). 148(35.07%) of the women had a time interval of fewer than two years between their current pregnancy and last delivery, whereas 274(64.93%) had an interval of two years or more. The majority, 301(71.33%) of the respondents sought their first antenatal care visit in their first trimester while the remaining came during their second

trimester. None of them reported for the first time in their third trimester. More than half of the respondents, 258(61.41%) were currently in their second trimester with the least number 39(9.24%) in their first trimester.

Table 2: *Obstetric History of Participants*

Variables	Frequencies	Percentage
No. of ANC visit		
Less than four visits	83	19.67
Four or more visits	339	80.88
Parity		
Para zero	72	17.6
One child	124	29.38
Two or more children	226	53.55
Gravidity		
First pregnancy	74	17.54
Second pregnancy	124	29.38
Third pregnancy	132	31.28
Four or more pregnancy	92	21.80
Inter-pregnancy Interval		
Less than two years	148	35.07
More than two years	274	64.93
Gestational age at first ANC visit		
First trimester	301	71.33
Second trimester	121	28.67
Gestational age at current ANC visit		
First trimester	39	9.24
Second trimester	258	61.41
Third trimester	125	29.62

3.3 PREVALENCE OF ANAEMIA AMONG ANTENATAL ATTENDANTS

Out of the 422 respondents, 171 were found to be anaemic in one form or the other bringing the overall prevalence of anaemia among pregnant women who participated in the study to about 40.52%. Further breakdown on the level of anaemic severity showed that 21.33%, 18.48%, and 0.71% were Mild, Moderate and Severe respectively (Table 3).

Table 3: *Prevalence and severity of anaemia*

Variable	Frequency	Percentage
Prevalence of anaemia		
Anaemia	171	40.52
No Anaemia	251	59.48
Severity of Anaemia		
Severe	3	0.71
Moderate	78	18.48
Mild	90	21.33
No Anaemia	251	59.48

3.4 CONSUMPTION OF IRON AND IRON-CONTAINING FOODS

The table below displays the consumption of iron and iron-containing foods. Pregnant women who received iron/folate were 415(98.34%) and those who took it always were 338(81.25%). Women who reported taking

eggs twice per week were in the majority 179(42.42%) with those who took meat/fish/pork twice per week amounting to over half the total number under study (54.27%). 272(64.61%) of the respondents consumed green vegetables/fruits three or more per week. Pregnant women who consumed pica/clay were 174 amounting to 41.23%.

Table 4: *Consumption of Iron and Iron Foods (N=422)*

FACTORS	RESPONSE	FREQUENCIES	PERCENTAGES
Have you been given iron/folate tables since you became pregnant?	Yes	415	98.34
	No	7	1.66
If YES, how many times do you take it?	Always	338	81.25
	Sometimes	77	18.51
	Never	1	0.24
Eggs	Never	41	9.72
	Once a week	129	30.57
	Twice per week	179	42.42
	Three or more per week	73	17.30
Meat/fish/pork	Never	1	0.24
	Once a week	36	8.53
	Twice per week	229	54.27
	Three or more per week	156	36.97
Green vegetables/fruits	Never	2	0.48
	Once a week	15	3.56
	Twice per week	132	31.35
	Three or more per week	272	64.61
Pica/Clay consumption during this current pregnancy	Yes	174	41.23
	No	248	58.77

3.5 KNOWLEDGE OF ANAEMIA AMONG

A great number of the respondents, 398(94.31%) had heard about anaemia in pregnancy with a high number of them 303(76.13%) hearing/learning it from a health worker. Four hundred and seventeen (98.53%) of the respondents knew what anaemia was and approximately all of the pregnant women knew what caused anaemia.

Table 5: *Knowledge of Anaemia*

Question	Response	Frequency	Percentage
Have you ever heard about anaemia in pregnancy?	Yes	398	94.31
	No	24	5.69
If YES, from what source did you learn of it? (N=398)	Health worker	303	76.13
	Friend	66	16.58
	Relative	77	17.59
	Media	75	18.84
	School	110	27.64
	Other	1	0.25
What is Anaemia?	Shortage of blood	417	98.82
	Leaking of blood	5	1.18
What do you think is the cause of Anaemia?	Poor dietary intake, infection	420	99.53
	Contact with an infected person	2	0.47

3.6 BIVARIATE ANALYSIS OF ANAEMIA STATUS ON SELECTED DEMOGRAPHICAL INDICATORS

A Chi-square test to assess the level of association between selected socio-demographic indicators on the anaemic status among the respondents at a chosen level of significance ($\alpha = 0.05$) revealed the woman's age and marital status at the time of participation had a statistically significant association (Fisher's exact, p-value<0.001).

Table 6: *Bivariate Analysis of Anaemia by Socio-Demographic and Economic Status*

Variables	Categories	Anaemia status		p-value
		Yes n (%)	No n (%)	
Age (years)	15-19	15(78.95)	4(21.05)	0.0001*
	20-24	28(65.12)	15(34.88)	
	25-29	45(42.06)	62(57.94)	
	30-34	42(37.84)	69(62.16)	
	35-39	28(31.46)	61(68.54)	
	Above 40	13(24.53)	40(75.47)	
Marital status	Single	25(51.02)	24(48.98)	0.0001*
	Married	95(34.67)	179(65.33)	
	Cohabiting	50(57.47)	37(42.53)	
	Widowed/Divorced/Separated	1(8.33)	11(91.67)	
Occupation	Self-employed	50(45.05)	61(54.95)	0.069
	Gov't/Private employed	66(35.68)	119(64.32)	
	Trader	32(37.65)	53(62.35)	
	Unemployed	23(56.10)	18(43.90)	
Religion	Christianity	131(40.81)	190(59.19)	0.967
	Islam	38(39.58)	58(60.42)	
	Traditional	2(40.00)	3(60.00)	
Educational Level	No formal education	18(40.91)	26(59.09)	0.254
	Primary	28(50.91)	27(49.09)	
	Secondary	62(41.89)	86(58.11)	
	Tertiary	63(36.00)	112(64.00)	
Family Income	<300	29(54.72)	24(45.28)	0.064
	300-500	36(42.35)	49(57.65)	
	500-1000	67(40.36)	99(59.64)	
	>1000	39(33.05)	79(66.95)	

3.7 HEALTH CONDITION IN RELATION TO ANAEMIA

From the study output, it was revealed that 259 pregnant women reported a history of having suffered from malaria and out of this number 42.86 % had anaemia with 57.14% otherwise. Those who had received anti-malaria prophylaxis were 372 and out of this 39.78% had anaemia. A weak statistical association was found between sickle cell status and anaemia. Though 60% of the respondents with sickle cell were anaemic. The study showed no statistical significance among the various health conditions under study.

Table 7: *Bivariate Analysis of Anaemia by Health Condition*

Variables	Categories	Anaemia status		p-value
		Yes n (%)	No n (%)	
Have you suffered from malaria during the current pregnancy?	Yes	111(42.86)	148(57.14)	0.224
	No	60(36.81)	103(63.19)	
Have you received Anti-malaria prophylaxis during the current pregnancy?	Yes	148(39.78)	224(60.22)	0.444
	No	23(46.00)	27(54.00)	
Do you use insecticide-treated nets?	Yes	97(41.10)	139(58.90)	0.842
	No	74(39.78)	112(60.22)	
Are you suffering from any hemorrhagic disease	Yes	40(42.55)	54(57.45)	0.721
	No	131(39.94)	197(60.06)	
What is your Sickle Cell status?	Yes	6(60.00)	4(40.00)	0.057
	No	161(39.56)	246(60.44)	
	Do not Know	4(80.00)	1(20.00)	

3.8 ANAEMIA IN RELATION TO OBSTETRIC HISTORY

Anaemia was higher among those who had no children 39(54.17%) as compared to those who had one child(39.52%) and two or more children(36.73%) p-value = 0.032. In much the same way, those who were pregnant for the first time were much more anaemic 39(52.70%) p-value=0.038.

Table 8: *Bivariate Analysis on Obstetric History of Participants*

Variables *(N= 422)*	Categories	Anaemia status		P-value
		Yes n (%)	No n (%)	
No. of ANC visit	Less than four visits	37(44.58)	46(55.42)	0.454
	Four or more visits	134(39.53)	205(60.47)	
Parity	Para zero	39(54.17)	33(45.83)	0.032*
	One child	49(39.52)	75(60.48)	
	Two or more children	83(36.73)	143(63.27)	
Gravidity	First pregnancy	39(52.70)	35(47.30)	0.038*
	Second pregnancy	51(41.13)	73(58.87)	
	Third pregnancy	53(40.15)	79(59.85)	
	Four or more pregnancy	28(30.43)	64(69.57)	
Inter-pregnancy Interval	Less than two years	61(41.22)	87(58.78)	0.836
	More than two years	110(40.15)	164(59.85)	
Gestational age at first ANC visit	First trimester	127(42.19)	174(57.81)	0.276
	Second trimester	44(36.36)	77(63.64)	

3.9 ANAEMIA IN RELATION TO IRON CONTAINING FOODS

Out of the four hundred and fifteen (415) participants who said they have been given iron/folate tablets since they became pregnant, 247(59.52%) were not anaemic. Likewise 59.17% of those who said they had been taking it always had no anaemia. All the variables were not statistically significant.

Table 9: *Bivariate Analysis of Iron-Containing Foods*

Variables	Categories	Anaemia status		p-value
		Yes n (%)	No n (%)	
Have you been given iron/folate tablets since you became pregnant?	Yes	168(40.48)	247(59.52)	1.000
	No	3(42.86)	4(57.14)	
If YES, how many times do you take it?	Never	0(00)	1(100)	0.880
	Always	138(40.83)	200(59.17)	
	Sometimes	30(38.96)	47(61.04)	
Eggs	Never	15(36.59)	26(63.41)	0.399
	Once a week	49(37.98)	80(62.02)	
	Twice per week	71(39.66)	108(60.34)	
	Three or more per week	36(49.32)	37(50.68)	
Meat/fish/pork	Never	1(100)	0(0.00)	0.278
	Once a week	15(41.67)	21(58.33)	
	Twice per week	99(43.23)	130(56.77)	
	Three or more per week	56(35.90)	100(64.10)	
Green vegetables/fruits	Never	2(100)	0(0.00)	0.252
	Once a week	4(26.67)	11(73.33)	
	Twice per week	52(39.39)	80(60.61)	
	Three or more per week	113(41.54)	159(58.38)	
Pica/Clay consumption during this current pregnancy	Yes	79(45.40)	95(54.60)	0.107
	No	92(37.10)	156(62.90)	

3.10 BIVARIATE AND MULTIVARIATE ANALYSIS OF ANAEMIA BY SELECTED FACTORS

Results from unadjusted and adjusted analyses of anaemia by selected factors showed advancement in age served as a protective factor for a respondent becoming anaemic. All age groups except for 20-24 years, were all statistically significant in predicting the condition in both models compared to the reference age group of 15-19years. Also, the odds of becoming anaemic tend to decrease as one advances in age.

Despite the lack of statistical significance in any of the reported marital status in the adjusted model, it was however found that in both models, women who reported cohabiting have a higher likelihood of becoming anaemic compared to the single counterparts. For example, a cohabiting woman is about twice more likely to experience the condition after controlling for other covariates in the adjusted model. Pregnant women who worked in the government or private sectors were 57% less likely to be anaemic as compared to those unemployed (p=0.017, COR 0.43; 95% CI 0.22-0.86), it, however, lost its significance after adjustment.

The odds of pregnant women whose family income is greater than GH₵ 1000 becoming anaemic was reduced by 61% (p=0.006, COR 0.39; 95% CI 0.20-0.76) as compared to pregnant women whose family income was less than GH₵ 300. Despite the loss of statistical significance, the odds have increased to 1.12 times more likely after adjusting for all other variables.

Hearing about anaemia from a health worker was not significant in the crude model, however, after the adjustment, it showed approximately 2 times more likely when holding all other covariates constant (p=0.035, AOR 1.78; 95% CI 1.04-3.06).In much the same way, those who had heard information about anaemia from the media were 1.76 times likely to be anaemic as compared to those who had heard it from other sources (p=0.027, COR 1.76; 95% CI 1.07-2.92). Consequently, when other variables were adjusted for it revealed an increased likelihood (2.16 times more likely) holding all other covariates constant (p=0.007, AOR 2.16; 95% CI 1.23-3.79). The odds of pregnant women whose time of delivery to the time of next conception (interpregnancy interval) is two years and more had 1.96 times increased risk of being anaemic as compared to those less than two years p=0.015, (AOR 1.96; 95% CI 1.14-3.36).

The other selected variables such as educational status, iron /folate intake, and sickle cell status have not shown statistical significance in predicting the likelihood of a woman's anaemic status.

Table 10: *Bivariate and Multivariate Analysis of Anaemia by Selected Factors*

Variables	Categories	COR	95% CI	P- Value	AOR	95%CI	P- Value
Age (years)	15-19 *(Ref.)*	1			1		
	20-24	0.50	0.14-1.77	0.281	0.41	0.10-1.59	0.196
	25-29	0.19	0.06-0.62	0.006*	0.13	0.03-0.54	0.005*
	30-34	0.16	0.05-0.52	0.002*	0.10	0.02-0.45	0.002*
	35-39	0.12	0.04-0.40	0.001*	0.07	0.02-0.32	0.001*
	Above 40	0.09	0.02-0.31	0.001*	0.06	0.01-0.27	0.001*
Marital status	Single *(Ref.)*	1			1		
	Married	0.51	0.28-0.94	0.031*	0.86	0.40-1.86	0.699
	Cohabiting	1.30	0.64-2.62	0.468	1.87	0.82-4.25	0.135
	Widowed/Divorced/Separated	0.09	0.01-0.73	0.024*	0.22	0.02-1.96	0.173
Occupation	Unemployed*(Ref.)*	1			1		
	Self Employed	0.64	0.31-1.32	0.228	1.42	0.53-3.82	0.483
	Gov't/Private employed	0.43	0.22-0.86	0.017*	1.01	0.38-2.70	0.990
	Trader	0.47	0.22-1.01	0.052	0.91	0.29-2.82	0.864
Educational Level	No formal education*(Ref.)*	1			1		
	Primary	1.50	0.67-3.33	0.322	1.19	0.47-3.03	0.710
	Secondary	1.04	0.53-2.06	0.908	0.59	0.25-1.37	0.218
	Tertiary	0.8	0.41 -1.60	0.547	0.62	0.24-1.61	0.325
Family Income	<300*(Ref.)*	1			1		
	300-500	0.56	0.28-1.13	0.107	0.95	0.40-2.23	0.906
	500-1000	0.54	0.29-1.00	0.053	1.39	0.56-3.43	0.475
	>1000	0.39	0.20-0.76	0.006*	1.12	0.41-3.09	0.822
Health worker	No*(Ref.)*	1			1		
	Yes	1.18	0.75-1.84	0.473	1.78	1.04-3.06	0.035*
Media	No*(Ref.)*	1			1		
	Yes	1.76	1.07-2.92	0.027*	2.16	1.23-3.79	0.007*
Interpregnancy Interval	Less than Two Years*(Ref.)*	1			1		
	Two years and More	0.96	0.64-1.44	0.831	1.96	1.14-3.36	0.015*
Given Iron/Folate	No*(Ref.)*	1			1		
	Yes	0.91	0.20-4.10	0.899	0.40	0.08-2.11	0.283
Sickle Cell Status	Without sickle cell*(Ref.)*	1			1		
	With sickle cell	2.29	0.64-8.25	0.204	3.48	0.80-15.09	0.095
	Don't know	6.11	0.68 - 55.17	0.107	5.84	0.56-60.46	0.139

Note: p-values with asterisks were generated from Fisher's exact test between anaemia and corresponding variables. P-value <0.05 are statistically significant

4. DISCUSSION

The observed prevalence of anaemia in this study was 41% with less than 1% of pregnant women being severely anaemic. This study further found age, marital status, occupation, family income, parity, gravidity, interpregnancy interval, hearing information about anaemia through a health worker and the media to be significantly associated with anaemic conditions of the respondents.

With reference to the WHO criteria of anaemia in a population, it shows anaemia is still a severe public health problem at Tema General Hospital. This result is similar to the study done at Sunyani Municipal Hospital which was also slightly over 40% [5]. The results were however higher than the study done in Tanzania in the Mbulu District in Manyara Region which placed the prevalence at 30.2% and lower than the study done in Nairobi, Kenya with a prevalence of 57% [15]. Compared to the study done by USAID in 2011 on "*Cross-country Comparison of Anemia Prevalence"*, Africa's prevalence of pregnant women was pegged at 55.8%, Asia at 42% and Europe 18.7% [16]. With reference to this study, the slightly lower prevalence may be partly due to the study being conducted at a more urbanized community with the majority of the participants having some sort of formal education with only about 10% having no formal education. Also, it can be due to easy access to health care facilities and health care information through the mass media being it the television or radio.

The odds of being less anaemic were observed to rise as maternal age advanced. The results obtained from the analysis bewrayed women who were pregnant aged 20 years and above were significantly less likely to be anaemic compared to those between the ages 15-19 years. This result was consistent with the various age groups in both the bivariate and multivariate logistic regression. Similar studies were done in other parts of the country such as the Sekyere-West District in the Ashanti Region [17] and Bolgatanga Regional Hospital in Northern Ghana [18] also revealed a lower prevalence of anaemia was significantly associated with increasing age of the women. This current study was however in contradiction with other studies such as the study done in Sunyani Municipal Hospital in Ghana [5] and Pumwani Maternity Hospital in Nairobi, Kenya [15] by Anlaakuu, (2015) and Okube *et al.*, (2016) respectively, which showed the odds of being anaemic rose as maternal age advanced.

These results obtained may be attributed to the fact that younger pregnant women belong to the physically active group, undergoing rapid growth and having increased nutritional requirements that pregnancy puts on their bodies. Also, pregnant women with advanced age having more knowledge on the modalities for preventing anaemia through experience and a better understanding of the significance of the illness as compared to the younger age group of 15-19 years.

The prevalence of anaemia was higher in married pregnant but lower in participants who were widowed/divorced/separated as compared to single pregnant women. This could have happened because married women in the Ghanaian traditional home, after preparing family meals tend to serve the best part of the meals to their husbands and children and feed on the least food left hence denying themselves of adequate and

essential nutrition. On the other hand, those who are widowed/separated/divorced eat what they want without compromising on their nutrition for anyone else.

Contrary to this finding a study was done in Kenya by Chrispinus Siteti,(2014) and in Burkina Faso by Meda *et al.*, (1999), that discovered the risk of developing anaemia during pregnancy was equal irrespective of marital status [19], [20]. Another study by Masukume *et al.*, 2015 that looked into risk factors and birth outcomes of anaemia in early pregnancy in a nulliparous cohort showed not having a marital partner was associated with an increased risk of developing anaemia in early pregnancy [21].

This study analyzed the employment status of pregnant women, whether or not they were doing some income-generating activities and overall family income to assess their socio-economic status. There was a significant association between the occupation of the respondents and anaemia as those who were government or private-sector workers had a decreased tendency of being anaemic as opposed to being unemployed. This can be because the majority of the respondents who worked in these sectors were tertiary educated, hence prudent to assume they will have more knowledge on the prevention of anaemia as opposed to those who were unemployed and having a much lower educational status. This finding is supported by a study carried out by Xu *et al.*, (2016) in China on the prevalence, sociodemographic and lifestyle determinants of anaemia during pregnancy. It is viewed that being employed would translate into a good socio-economic status and hence being able to afford good nutrition [22]. Other studies by Daru et al., 2018, have also contradicted this belief, as a study done in India revealed that the odds of women having anaemia were higher among pregnant women who were employed (OR = 1.33, $p < 0$ .01) compared to those who were unemployed [23].

This study showed participants with a high family income had a lower prevalence of becoming anaemic as compared to those with a low family income. These findings may have resulted due to the location this research was conducted at, as Tema is a more urbanized community with the majority of the inhabitants being in the middle–class group. However, it is important to note that participants to this study could have also come from urbanized rural communities like Tema New Town, Tema Manhean and Ashaiman. This information is consistent with current knowledge and findings from Chowdhury *et al.*, (2015) in Dhaka and Derso *et al.*, (2017) in Ethiopia [24],[25]. High-income earners have a higher probability of being able to afford more varieties of food, pay more attention to balanced nutrition, afford healthcare and generally make better health choices as opposed to low-income earners.

Participants who had heard about anaemia from a health worker were about 2 times more likely to be anaemic in the adjusted analysis. Also results from pregnant women who had heard the information from the media both through the bivariate and multivariate analysis was statistically significant and it showed they had a greater chance of being anaemic as compared to hearing from other sources. This information was however not expected as health workers and information from the media are supposed to be authentic and hence should

effect some form of positive impact on the public. These results may be due to the fact that information from these sources is too generalized and not targeted to the available resources these women may have readily. Hence, if they do not have the resources to acquire foods or change in lifestyle recommended for them through these platforms, they abandon the advice totally.

This study showed increased parity and gravidity were associated with a lesser risk of getting anaemia such as those who had conceived two or more children and pregnant women with four or more pregnancies were less likely to be anaemic as compared to those who had no children. This information is however not in isolation as studies done by Ahenkorah, (2015) in Ghana [18], Lubeya, (2017) in Zambia [26], and in Nigeria [27] all revealed an inclination towards more prime gravidas having anaemia than the multigravida. This result is in variance with other studies conducted by Kassa *et al*., (2017) in Ethiopia, Nwizu *et al*., (2011) in northern Nigeria and Taner *et al.*, (2015) which showed that primigravida women were less likely to develop anaemia during pregnancy compared to multigravida women because anaemia in pregnancy would tend to increase with rising parity owing to the effect of repeated pregnancy in depleting the iron store of a pregnant woman. The results obtained from these study may have been due to multiparous and multigravida women gaining extra knowledge and experience after successive pregnancies/birth on how to better curb anaemia [28], [29], [30].

Interpregnancy interval associated with anaemia in this study revealed an increased prevalence of anaemia among those whose birth interval was two years and more. This study corroborates with the study done in Lusaka district, Zambia by Lubeya, (2017) where the trend of anaemia was inclined towards those with an inter-delivery time of 36 months and more [26]. This is a contradiction to other studies like Kassa *et al.*, (2017), John, (2014) and Nwizu *et al.*, (2011) which supports the traditionally accepted fact that shorter interpregnancy interval increases the risk of adverse obstetric outcomes and delays the mother's recovery from the effects of previous pregnancies [28], [31] [29]. The current results may have been due to women not consciously planning for pregnancies hence even after the said gap of two years their bodies are not being prepared for another pregnancy while those who have children lesser than two years may even still be breastfeeding hence eating healthier and being very conscious of their health.

Even though there was no statistical significance established in this study with regards to iron and folic acid supplementation, the results showed pregnant women who took the iron and folate supplements had a decreased odds of 60% in becoming anaemic as compared to those who did not take the supplement. Several studies have all confirmed these findings [32],[33]. Contrary though, a research done in Northwest Ethiopia by Melku *et al.*, (2014) proved otherwise as the supplements did not reduce the prevalence of anaemia as compared to those who did not take it [34]. Pregnancy is associated with an increase in blood volume of about 50% and there is a grave requirement of iron to the growing fetus and placenta hence taking the iron tablets during pregnancy can help increase haemoglobin level and prevent anaemia.

Sickle cell disease by itself makes sufferers prone to anaemia. Without statistical significant evidence, the study still showed after adjusting for all other covariates that the odds of becoming anaemic was about 3 times higher for those with sickle cell and for pregnant women who did not know their sickle cell status, it was as much as 6 times higher. This shows the importance of pregnant women being aware of their sickle cell status to help reduce the risk of anaemia and its implications on pregnancy and the health of the woman.

5. CONCLUSIONS

Anaemia has very unfavourable effects on both mother and foetus hence its prevention is critical and cannot be overemphasized enough. The prevalence of anaemia among pregnant women in Tema General Hospital remains a public health problem though there are ongoing modalities in places such as administration of iron and folate supplementation, giving of anti-malarial prophylaxis and anti-helminths. The study established that younger women were at increased risk of getting anaemia. It also found that being married had a slightly greater chance of being anaemic while those who were widowed /divorced /separated had a decreased risk of being anaemic as compared to single pregnant women. Pregnant women who were in government or private employment were less likely to be anaemic compared to those unemployed. The research also disclosed that a higher family income was associated with a decreased likelihood of being anaemic. Source of anaemia information either from a health worker or media were all statistically significant in this study. There is, therefore, the need to economically empower women and also offer them health education to both curb unplanned pregnancies and reinforce the need to attend antenatal care clinics during their pregnancies.

6. LIMITATIONS

The study relied on self-report and information from respondents' antenatal records, therefore, the information given by self could not be verified and this may have led to information bias.

The study also excluded pregnant women who were reporting to the clinic for the first time and had no haemoglobin records, though their participation could have further corroborated the results obtained.

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between all authors. RT and SM participated in conceiving the study and in the development of data collection tools. RT carried out data collection. SM and RT participated in the data analysis and drafting of the manuscript. All authors have read and approved the content of the final manuscript.

CONFLICT OF INTEREST

All authors have declared no conflict of interest.

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