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Contributing Factors of Anemia in Pregnancy in the Twifo Atti-Morkwa District in Ghana

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Abstract: The study determined the factors influencing anemia among pregnant women in the Twifo Atti-Morkwa District of Ghana. This study employed a hospital-based cross-sectional study design to assess the risk factors for anemia among pregnant women. About 430 pregnant women attending antenatal care services in all health facilities in the Twifo Atti-Morkwa district were used as respondents for the study. Data were collected quantitatively using a structured questionnaire. The questionnaire was administered using a face-to-face interview process. The data were analyzed using STATA version 15 (StataCorp, College Station, Texas 77845, USA). Pearson's chi-square and binary logistic regression were used to find the variables significantly associated with anemia in pregnancy at a p-value 0.05. The findings showed the respondents were within the age range of 15 to 45 years, with a mean age of 26.36 years. Only 49.07% of them had visited ANC at least 4 times. Additionally, 50.93% of them started ANC attendance in the first trimester of their pregnancy. The majority of them (89.77%) attended ANC regularly. Most of them indicated that they took routine ANC drugs, and amongst them, 91.75% took iron supplements, 87.63% took folic acid, 49.74% took Sulfadoxine-pyrimethamine, and 66.75% took multivitamins. Despite the regular ANC attendance, high intake of iron and folic acid supplements, and high utilization of ITN, the prevalence of anemia in pregnancy at 36 weeks of gestation in the Twifo Atti-Morkwa district was high. Anemia at 36 weeks of gestation was significantly associated with factors such as number of ANC visits, gravidity, and gestational age at start of ANC, malaria infection, and intake of food supplements. To address the burden of anemia in pregnancy in the district, it is vital to note that supplements alone are not adequate. There, therefore, the need for intensive education on other strategies such as deworming, nutrition, and adherence to Sulfadoxine-pyrimethamine to improve general health in women before and during pregnancy.

Keywords: Anemia, pregnancy, pregnant women, Twifo Atti-Morkwa

1. INTRODUCTION

Anemia is a condition characterized by a reduction of the number of red blood cells per unit volume than normal (Shaban et al., 2020). The World Health Organization (WHO) also defines anemia as an Hb concentration below 11.0 gram per deciliter (g/dl) or hematocrit of less than 33%) (WHO, 2015; Koyuncu et al., 2017). In pregnant women anemia ranges from mild (10.0 to 10.9g/dl or hematocrit of 30 to 32.9%), moderate (7 to 9.9g/l or hematocrit of 21 to 29.9%), to severe (less than 7g/l or less than 21%) (Salhan et al., 2012). Anemia is a major public health problem worldwide and generally affects young children and pregnant women (WHO, 2017). Globally, the prevalence of anemia for all women of reproductive age was 32.8%, with 36.5% among pregnant women and 32.5% among non-pregnant women (Hegazy et al., 2010; Shaban et al., 2020). Contributed to the highest prevalence of anemia in pregnancy. In Ghana, recent estimate showed that about 54.3% of pregnant women suffered from anemia in 2016 (WHO, 2020). Anemia can adversely affect the health of individual, result in mortality, and impair work capacity and economic development (Shaban, 2020).

Anemia in pregnancy is multifactorial, with nutritional deficiency being the common cause of this condition. Other causes include infectious disease and genetic factors (Allali et al., 2017). Nutritional anemia is caused by deficiency in hematopoietic materials such as iron, folic acid, Vitamin A and B12, and protein-energy malnutrition, which result from insufficient nutrients that are needed during hemoglobin synthesis and erythropoiesis. Sickle cell anemia and thalassemia are inherited hemoglobin

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diseases responsible for hemoglobinopathies (Hegazy et al., 2010; Shaban et al., 2020). Infectious diseases such as malaria, parasitic infections, tuberculosis, HIV and schistosomiasis are major cause of anemia (Hegazy et al., 2010; WHO, 2021). Also, exposure to toxic heavy metals such as lead and low levels of trace elements such as zinc and copper can contribute to anemia (Nikooyeh et al., 2018).

Anemia in pregnancy is a major public health problem worldwide. According to the WHO (2014) a country with a 40% or higher prevalence of anemia in vulnerable groups has severe public health problem. In Ghana, the prevalence of anemia has remained higher than 40% over the years (GSS, 2015), despite the policies implemented by the Ghana Health Service that is aimed at improving hemoglobin level during pregnancy including the giving of iron and folic acid supplementation, health education on nutrition, ensuring the quality of care, prevention of malaria infection through IPT prophylaxis, helminths infestation through the administration of albendazole to every pregnant woman. Recent estimate showed that anemia in pregnancy in Ghana was 54.3% as at 2016 (WHO, 2021).

In Twifo Atti-Morkwa District, the study area for this study, data from the District Health Information Management System indicated high rate of anemia in pregnancy in recent years. For instance, in 2016, 1294 out of 2965 pregnant women was found to be anemic at ANC registration. In the same year, pregnant women with hemoglobin level <11g/dl at 36 weeks of pregnancy was recorded was 34.9% (i.e. 418 out of 1197). In 2017, about 61.4% (1712 / 2789) of pregnant women were anemic at ANC registration and 57.4% (592 / 1032) of them were anemic at 36 weeks of gestation with an Hb level of <11g/dl. Similarly, in 2018 and 2019, about 60.1% (579 / 963) and 55.3% (625 /1131) of pregnant women were anemic at 36 weeks of gestation with an Hb level of <11g/dl. Also, recently in 2020, about 51.6% of pregnant women who visited ANC were anemic at registration and 50.0% of them were anemic at 36 weeks of gestation (DHIMS report, 2021). Additionally, anemia has caused morbidity and mortality in both mother and child in the Twifo Atti-Morkwa district in Ghana hindering the attainment of Sustainable Development Goals. According to the DHIMS reports, about 3 pregnant women died during pregnancy and childbirth due to complication related to anemia in 2016 and 2017. Also, the district recorded a still birth rate of 16.4% in 2016, 20.7% in 2017, 15.2% in 2018, 19.5 in 2019 and 9% in 2020, as a result of anemia in pregnancy. About 15 pregnant women also experienced postpartum hemorrhage in 2017 and 2018 due to anemia. Furthermore, about 67 and 82 babies were born with low birth weight (less than 2500 g) as a result of anemia in pregnancy in 2019 and 2020 respectively. Available data on risk factors associated with anemia among pregnant women within anemia endemic districts in Ghana like the Twifo Atti-Morkwa district is very limited. Assessing the possible factors may be useful in informing policy and modifying existing interventions to reduce anemia in pregnancy. Thus, the purpose of this current study was to identify the risk factors that are associated with anemia in pregnancy in Twifo Atti-Morkwa district.

2. MATERIALS AND METHODS

Study Design and Type

Study design generally denotes the strategies that allows for a proper structuring of the research to effectively address the research problem or gaps. Also, the type of data analysis that can be done is informed by the research design to adopt (Wallen and Fraenkel, 2001). This study employed a hospital based cross-sectional study design to determine the factors influencing anemia in pregnancy. Cross-sectional design was used for this study because data were collected from a representative subset of a population at a specific point in time. Also, it is less expensive and less time-consuming. The cross-sectional study design enables the comparison of different variables at the same time, measure prevalence and multiple outcomes and exposures.

Study Population

Study population refers to the grand total of what is being measured. Examples include people, organization, industries, firms, departments, etc. (Proctor, 2003). Other researchers also define study population as all members of the target population as defined by the objectives of the study (Nwana, 2008). The population for this study was pregnant women receiving antenatal care services in all health facilities in the Twifo Atti-Morkwa District.

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Sampling Method and Sample Size
Sampling Size

In a study where the entire population cannot be considered due to their larger size, sampling is best used for the purpose of collecting data from a cohort of such population (Saunders et al., 2009). This study employed Cochran's formula (1977) formula in calculating the sample size. This calculation was done based on the proportion of anemia among pregnancy women at 36 weeks of gestation in the Twifo Atti-Morkwa District in 2020 (DHIMS2 report, 2020). Details of the sample size calculation are shown below:

$n=z^2pq/d^2$ (Cochran, 1977), where n=desired sample size
Z= Z score (reliability coefficient) of 1.96 at 95% CI
p= proportion of pregnant women who developed anemia at 36 weeks of gestation in 2020 = (50.0%).
q= 1-p (proportion of pregnant women who did not develop anemia at 36 weeks of gestation = 1-0.50 = 0.50
d= degree of accuracy required usually set at 0.05
Substituting the figures above gives:
$n=z^2pq/d^2$
$n= (1.96^2*0.50*0.50) / 0.05*0.05$
n=3.8416*0.25 / 0.0025
n=0.9604 / 0.0025 = 384.16
Considering a non-response rate of 10%, the final sample size =384.16 + (384.16*0.10)
= 384.16 + 38.416 = 429.576
Thus, final sample size = 430 (nearest whole number).

Sampling Method
This study adopted the probability sampling, particularly simple random sampling method to select 423 pregnant women who were within the inclusion criteria of the study at the ANC services at health facilities in the Twifo Atti-Morkwa District. By so doing, first five folded papers with number inscribed in them (1, 2, 3, 4, and 5) were given to an anonymous person to randomly select a number. The number selected (for example, 2) was used as the random. Secondly, papers with written numbers 1, 2 and 3 were folded and each pregnant woman was allowed to choose one. All pregnant women who chose the number 2 were included in the study. Prior to the selection, their ANC booklets were consulted to choose those who met the inclusion criteria. These participants were made to respond to the questionnaires after receiving their ANC services.

Data Collection Tool and Technique
A structured questionnaire was administered to receive responses from pregnant women at the ANC clinics during the data collection period. Based on the study objectives, the questionnaire was categorised into four sections. The first section entails the measure of demographic, economic, obstetric, nutritional, behavioural characteristics of the respondents and behavioural factors. Content of the questionnaire were driven from existing literature. Aside the principal investigator, two research assistants were trained to assist in the collection of data at the health facilities. The questionnaires were designed in English; however, the questions were interpreted in the local dialects for respondents who did not understand English, and were assisted to fill it. The interviews lasted for approximately 15 minutes for each respondent, and were conducted at the time (s) convenient to the respondents: either before consultation or after consultation with the ANC physician.

Data Analysis
The data were entered into Epi-Info database and exported to STATA version 15.0 (StataCorp, College Station, Texas 77845 USA) for analysis. For the purpose of data quality, the data were cleaned before the analysis was conducted. Descriptive statistics was run to determine the respondent's characteristics and proportion of anemia in pregnancy. The outcomes of the descriptive statistics were presented in the form of tables and figures detailing frequencies, percentages, mean and standard deviation of the variables. Pearson's chi-square test was used to determine the significant relations between the independent variables (sociodemographic and economic characteristics, obstetric factors, behavioural characteristics, behavioural factors, and nutritional factors) and dependent variables (anemia in pregnancy). The statistically significant variables in the binary analyses were further analysed using binary logistic regression to get the adjusted estimates and associations between anemia in pregnancy and the exposure variables. P-values ≤ 0.05 were considered statistically significant at 95% Confidence Interval (CI).

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3. RESULTS

Table 1: Socio-demographic characteristics of respondents

Variables	Frequency (n=430)	Percentage
Age (years)		
< 20	56	13.02
20 to 30	260	60.47
>30	114	26.51
	Mean = 26.36	Std. Dev = 6.28
Marital status		
Married	228	53.02
Single	101	23.72
Divorced / Separated	10	2.33
Co-habiting	90	20.93
Religion		
Christian	347	80.70
Islam	74	17.21
Others	9	2.09
Ethnicity		
Akan	262	60.93
Dangme / Ga	34	7.91
Ewe	71	16.51
Northern tribes	63	14.65
Level of education		
No formal education	57	13.26
Primary school	88	20.47
Junior high school	178	41.40
Senior high school	71	16.51
Tertiary	36	8.37
If married, level of education of spouse (n=228)		
No formal education	18	7.89
Primary school	19	8.33
Junior high school	88	38.60
Senior high school	50	21.93
Tertiary	53	23.25
Occupation		
Unemployed	95	22.09
Government worker	38	8.84
Farmer	106	24.65
House wife	22	5.12
Trader	103	23.95
Self employed	66	15.35

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Monthly income		
None	78	18.14
< GH₵500	260	60.47
GH₵500 to 1000	46	10.70
> GH₵1000	46	10.70
Partner's monthly income		
None	185	43.02
> GH₵500	142	33.02
GH₵500 to 1000	52	12.09
> GH₵1000	51	11.86

Others = Neither Christian nor Islam
Northern tribes = Frafra, Krobo, Mosi

The study respondents have ages ranging from 15 to 45 years with a mean age of 26.36 years. The majority of them were within the ages of 20 to 30 years (60.47%) followed by ages greater than 30 years (26.51%). Most of the respondents (53.02%) were married and 80.70% were of Christian religion. Also, majority of them (60.93%) were of Akan tribe. Comparatively, most of respondents (41.40%) and their spouse (38.68%) had completed junior high school; only a few no formal education. Most of the respondents were farmers (24.65%) and traders (23.95%), and only a few (8.84%) were government employees. Amongst the working group, the majority (60.74%) earn less than GH₵500 every month (Table 1).

Table 2: Obstetric characteristics of the respondents

Variables	Frequency (n=430)	Percentage
Parity		
<3	268	62.33
3 to 4	117	27.21
>4	45	10.47
Gravida		
<3	186	43.26
3 to 4	156	36.28
>4	88	20.47
Number of children		
None	125	29.07
One	84	19.53
Two	77	17.91
Three	70	16.28
Four and more	74	17.21
If more than one, what are their birth interval (n=221)		
One year	20	9.05
Between one and two years	99	44.80
Two years	43	19.46
More than two years	59	26.70
Number of ANC visits (for current pregnancy)		
< 4	219	50.93

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≥ 4	211	49.07
At what gestational age did you begin ANC visit (for current pregnancy)		
First trimester	219	50.93
Second trimester	151	35.12
Third trimester	60	13.95
Do you attend ANC regularly?		
Yes	386	89.77
No	44	10.23
If yes how often? (n=386)		
Monthly	377	97.67
Every 3 months	9	2.33

As shown in Table 2, 43.26% of the respondents had been pregnant less than three times. Similarly, most of them (62.33%) had ever given birth less than three times. Also, 29.07 of them had no children whilst 19.53% had only one child. Amongst those with more than a child, most of them (44.80%) indicated practicing birth interval between one and two years for their children. Moreover, 50.93% of them had attended ANC for less than 4 times whilst 49.07% of them had visited ANC for at most 4 times. Additionally, most of them (50.93%) began ANC attendance at first trimester of their pregnancy. Majority of respondents (89.77%) attend ANC regularly, and amongst these, most of them (97.67%) attend ANC every month.

Table 3: Precipitants of anemia in pregnancy

Variables	Frequency (n=430)	Percentage
Have you experienced blood loss from your body in the past 2 months?		
Yes	46	10.70
No	384	89.30
If yes, which of these?		
Injury that result in heavy bleeding	32	69.57
Blood loss in urine	1	2.17
Blood in stool	3	6.52
Antepartum hemorrhage	1	2.17
Uterine bleeding	5	10.87
Vaginal bleeding	4	8.70
Do you take your routine ANC drugs?		
Yes	388	90.23
No	42	9.77
Hemoglobin level at registration (n=430)		
< 11.0 grams	240	55.81
≥ 11.0 grams	190	44.19
Hemoglobin level at 36 weeks (n=390)		

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< 11.0 grams	246	63.08
≥ 11.0 grams	144	36.92

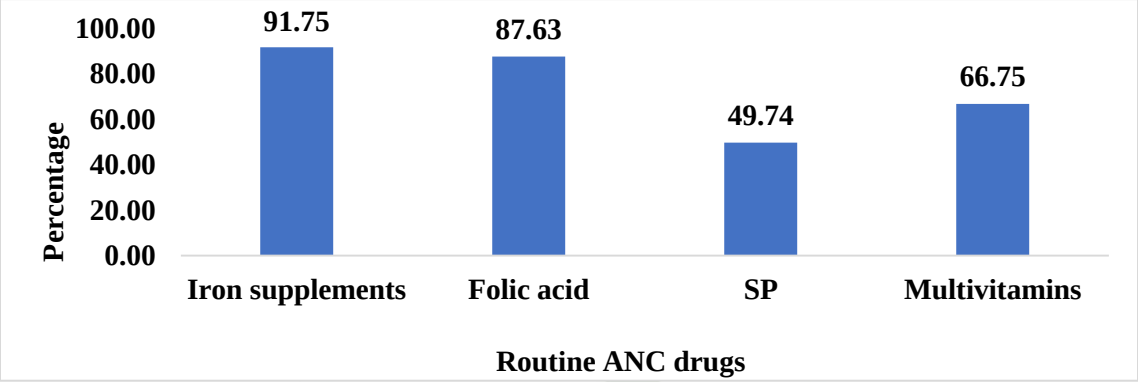

Figure 1: Proportion of pregnant women who take any of the routine ANC drugs

As shown in Table 1, only a few (10.70%) of the respondents indicated having experienced blood loss in their body in the last 2 months prior to data collection period. Amongst them, majority experience injury that resulted in heavy bleeding (69.57%) followed by uterine bleeding (10.87%) and vaginal bleeding (8.70%). Majority of the respondents indicated that they take routine ANC drugs. Amongst them, 91.75% took iron supplements, 87.63% took folic acid, 49.74% took Sulfadoxine-pyrimethamine (SP), and 66.75% took multivitamin (Figure 1). Furthermore, out of 430 respondents surveyed, 390 (90.70%) of them were at 36 weeks of pregnancy. The proportion of respondents' anemic at ANC registration was 55.81% and those anemic at 36 weeks of gestation were 63.08%.

Table 4: Knowledge about anemia in pregnancy

Variables	**Frequency (n=430)**	**Percentage**
Have you ever heard of anemia?		
Yes	372	86.51
No	58	13.49
If yes, where did you hear of anemia (N=372)		
Health facility	258	69.35
Friend	57	15.32
Media	57	15.32
Can Anemia spread from one person to another? (n=372)		
Yes	60	16.13
No	312	83.87
What are the symptoms of Anemia? (only yes responses) (n=372)		
Dizziness		
Yes	271	72.85
Easy fatigability		
Yes	73	19.62
Weakness		
Yes	149	40.05

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Fever		
Yes	32	8.60
What are the causes of Anemia during pregnancy? (only yes responses) (n=372)		
Malaria		
Yes	113	30.38
No eating well		
Yes	285	76.61
Bleeding		
Yes	132	35.48
Genetic disease		
Yes	37	9.95
What are the effects of Anemia in pregnancy on the unborn child? (only yes responses) (n=372)		
Low birth weight		
Yes	284	76.34
Congenital anomalies		
Yes	55	14.78
Intra-uterine death		
Yes	99	26.61
What are the effects of Anemia in pregnancy on the mother? (only yes responses) (n=372)		
Body weakness		
Yes	178	47.85
Maternal death		
Yes	310	83.33
Don't know		
Yes	23	6.18
Can Anemia be treated? (n=372)		
Yes	330	88.71
No	42	11.29
Level of knowledge (n=372)		
Good knowledge	168	45.16
Poor knowledge	204	54.84

As shown in Table 4, 86.51% of the respondents have ever heard of anemia. Amongst these, most of them (69.35%) heard about anemia at the health facility. The majority (83.87%) indicated that anemia cannot spread from one person to another. Additionally, most of them indicated dizziness (72.85%) and weakness (40.05%) as symptoms of anemia whilst only a few indicated easy fatiguability (19.62%) and fever (8.60%) as symptoms. Similarly, regarding the causes of anemia in pregnancy, most of them indicated "not eating" (76.61%) well and "bleeding" (35.48%) whilst a few (9.95%) indicated anemia as a genetic disease. Also, 30.38% of respondents indicated malaria as a cause of anemia in pregnancy. Regarding the effect of anemia in pregnancy on the unborn child, 76.34% indicated low birth weight, 26.61% indicated intra-uterine death, and 14.78% indicated congenital anomalies. Also, majority of them indicated maternal death (83.33%) and body weakness (47.85%) as the effect

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of anemia in pregnancy on the pregnant mother. More so, 88.71% of them indicated that anemia can be treated.

In estimating the overall level of knowledge, 12 questions were assessed under the following "Can anemia be spread from one person to another?", "What are the symptoms of anemia?", "What are the causes of anemia during pregnancy?", "What are the effect of anemia in pregnancy on the unborn child?", "What are the effect of anemia in pregnancy on the pregnant mother?", and "Can anemia be treated?". Respondents who responded correctly to each of the knowledge questions were given a score of "1" whilst those who responded wrongly were given a score of "0", making a total score of 12 points if a respondent had all questions correct. Using a mean cut of point estimation, the level of knowledge was categorized into two; good knowledge and poor knowledge. The mean knowledge score after computation was 7.51. Thus, all respondents who had a score below the mean score were categorized as having "poor knowledge" whilst those scored 7.51 and above were categorized as having "good knowledge". Generally, 54.84% of the respondents had poor knowledge about anemia in pregnancy whilst 45.16% had good knowledge about the condition.

Table 5: Respondents' behavioural characteristics

Variables	Frequency (n=430)	Percentage
Have you had malaria in the past month?		
Yes	160	37.21
No	270	62.79
If yes, how do you often get malaria? (n=160)		
Once a month	109	68.13
Twice a month	20	12.50
Thrice a month	31	19.38
Do you own ITN?		
Yes	363	84.42
No	67	15.58
If yes, do you use the ITN? (n=363)		
Yes	289	79.61
No	74	20.39
If yes, did you sleep under the net last night? (n=289)		
Yes	228	78.89
No	61	21.11
How often were you deworming before pregnancy? (n=430)		
Every one month	10	2.33
Every three months	145	33.72
Every six months	109	25.35
Not at all	166	38.60

As shown in Table 5, majority of the respondents (68.13%) indicated that they often had malaria once a month. However, only a few (37.12%) indicated they had malaria in the past month prior to the data collection period. Also, most of the respondents (84.42%) owned an insecticide treated bed net (ITN). Amongst these, 79.61% indicated they use the ITN. Among those who use the ITN, 78.89% slept under it the last night prior to the survey. Furthermore, 38.60% of the respondents did not deworm at all prior to pregnancy; 33.72% dewormed every three months prior to their pregnancy; and

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25.35% dewormed every six months prior to their pregnancy. Only a few (2.33%) practiced deworming every month prior to their pregnancy.

Table 6: Respondents' feeding habit and pattern

Variables	Frequency (n=430)	Percentage
How many times do you eat in a day before pregnancy excluding snacks?		
One time	13	3.02
Two times	97	22.56
Three times	269	62.56
Four and more times	51	11.86
Has your previous eating habit changed since you became pregnant?		
Yes	291	67.67
No	139	32.33
If yes, how many times now?		
One time	15	5.15
Two times	78	26.80
Three times	59	20.27
Four and more times	111	38.14
Find it difficult to eating	28	9.62
Do you practice any form of pica?		
Yes	160	37.21
No	270	62.79
If yes, what do you eat?		
Chewing stick / wooden sponge		
Yes	81	34.62
Chalk		
Yes	27	11.64
Uncooked maize dough / starch		
Yes	5	2.16
Cola nuts		
Yes	20	8.62
Clay		
Yes	101	43.72
What stage of your pregnancy did you start this pica practice? (n=160)		
1 to 3 months	79	49.38
4 to 6 months	60	37.50
7 to 9 months	15	9.38
Not sure	6	3.75
Do you avoid taken certain foods?		

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Yes	183	42.56
No	247	57.44
If yes, what food do you avoid? (n=183)		
Meat / fish	35	19.13
Milk	42	22.95
Eggs	37	20.22
Fruits	23	12.57
Cereals	6	3.28
Food from roots and tubers	19	10.38
Legumes	2	1.09
Miscellaneous	3	1.64
Oily foods	6	3.28
Sugary foods	1	0.55
Vegetables	9	4.92
At what time of pregnancy did you avoid these foods? (n=183)		
1 to 2 weeks	97	53.01
13 to 24 weeks	71	38.80
25 to 40 weeks	15	8.20
Why do you avoid these foods? (n=183)		
Taste of food	23	12.57
Poor appetite	31	16.94
Smell / aroma	97	53.01
Don't know	32	17.49
Do you take any alcoholic beverage?		
Yes	53	12.33
No	377	87.67
What type of alcohol beverage do you take?		
Pitoo	41	77.36
Beer	5	9.43
Local distilled alcohol	7	13.21
Do you take any form of food supplement? (n=430)		
Yes	270	62.79
No	160	37.21
If yes, which of these?		
Folic acid	78	29.10
Multivitamin	76	28.36
Iron	65	24.25
Herbal medicine	173	64.07

The majority of the respondents (62.56%) noted that they ate three times in a day prior to their pregnancy. Only a few (3.02%) ate once in a day prior to their pregnancy (Table 6). Also, most of them (67.67%) indicated that

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their previous eating habit changed when they became pregnant. Amongst them, 38.14% ate four and more times, 26.80% of them ate two times and 20.27% rate three times in a day. More so, 37.21% of the respondents practiced at least one form of pica. Amongst them, 43.72% ate clay, 34.62% chewed stick or wooden sponge, 11.64% chewed chalk, 2.16% ate uncooked maize dough, and 8.62% ate cola nuts. Most of those who practiced pica (49.38%) started within the first trimester (1 to 3 months) of pregnancy. Also, 42.56% of the respondents indicated that they avoid taken certain food whilst pregnant. Amongst them, the majority avoided taken milk (22.95%), eggs (20.22%), meat or fish (19.13%) and fruits (12.57%). Most of them (53.01%) avoided taken in foods within 1 to 2 weeks of gestation. Additionally, majority (53.01%) of those who avoid taken certain foods indicated smell or aroma as their reason. Also, 12.33% of the respondents indicated that they drink alcoholic beverages. Amongst them 77.36% drink pitoo, 13.21% drink locally distilled alcohol, and 9.43% drink beer. Furthermore, most of the respondents (62.79%) took a form of food supplement whilst pregnant. Amongst these, the majority (64.07%) indicated taking herbal medicine as a food supplements whilst pregnant (Table 6).

Table 7: Association between socio-demographic characteristics and anemia in pregnancy at 36 weeks gestation

Variables	Anemia at 36 weeks (%)		Chi-square (X^2)	p-value
	< 11.0gram	≥ 11.0gram		
Age (years)			2.759	0.252
< 20	34 (73.91)	12 (26.09)		
20 to 30	150 (62.24)	91 (37.76)		
>39	62 (60.19)	41 (39.81)		
Marital status			6.772	0.080
Married	121 (58.17)	87 (41.83)		
Single	59 (66.29)	30 (33.71)		
Divorced / Separated	9 (90.00)	1 (10.00)		
Co-habiting	57 (68.67)	26 (31.33)		
Religion			1.626	0.444
Christian	194 (62.38)	117 (37.62)		
Islam	46 (63.89)	26 (36.11)		
Others	6 (85.71)	1 (14.29)		
Ethnicity			1.088	0.780
Akan	146 (63.20)	85 (36.80)		
Dangme / Ga	22 (70.97)	9 (29.03)		
Ewe	40 (60.61)	26 (39.39)		
Northern tribes [β]	38 (61.29)	24 (38.71)		
Level of education			19.547	**0.001****
No formal education	36 (65.45)	19 (34.55)		
Primary school	54 (67.50)	26 (32.50)		
Junior high school	109 (68.13)	51 (31.87)		
Senior high school	38 (60.32)	25 (36.68)		
Tertiary	9 (28.13)	23 (71.88)		
If married, level of education of spouse (n=228)			5.781	0.216
No formal education	11 (61.11)	7 (38.89)		
Primary school	10 (55.56)	8 (44.44)		

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Junior high school	49 (63.64)	28 (36.36)		
Senior high school	30 (63.83)	17 (36.17)		
Tertiary	21 (43.75)	27 (56.25)		
Occupation			18.879	**0.002****
Unemployed	54 (65.85)	28 (34.15)		
Government worker	11 (32.35)	23 (67.65)		
Farmer	68 (68.69)	31 (31.31)		
House wife	10 (47.62)	11 (52.38)		
Trader	64 (68.93)	29 (31.18)		
Self employed	39 (63.93)	22 (36.07)		
Monthly income			14.271	**0.003****
> GH₵500	154 (64.98)	83 (35.02)		
GH₵500 to 1000	31 (68.89)	14 (31.11)		
> GH₵1000	15 (36.59)	26 (63.41)		
None	46 (68.66)	21 (31.34)		
Partner's monthly income			21.260	**<0.001*****
> GH₵500	80 (62.50)	48 (37.50)		
GH₵500 to 1000	33 (71.74)	13 (28.26)		
> GH₵1000	16 (34.04)	31 (65.96)		
None	117 (69.23)	52 (30.77)		

Dummy variables: <11.0grams=1; ≥11.0grams=0
*p-value≤0.05; **p-value≤0.01; ***p-value<0.001

In order to ascertain the association between sociodemographic characteristics and anemia in pregnancy at 36 weeks of gestation, Chi-squared test was used. A probability value less than 0.05 were considered significant. As shown in the Table 7, majority of the respondents (73.91%) within the age group less than 20 years were anemic compared to the other age groups. However, there was no significant association between respondents' age and anemia at 36 weeks of gestation (χ^2=2.759; p=0.252). Also, 58.17% of respondents who were married were anemic whilst 41.83% of those unmarried (including those single, divorced, and cohabiting) were anemic. Marital status however did not have significant association with anemia at 36 weeks of gestation (χ^2=6.772; p=0.080). Additionally, majority of the respondents from the Islamic religion (63.89%) were anemic compared to those from Christian religion (62.38%). Religion showed no significant association with anemia at 36 weeks of gestation. More so, amongst the ethnic groups, most of the respondents (70.97%) from Dangme / Ga ethnic group were anemic compared to others (χ^2=1.088; p=0.780). Furthermore, anemia in pregnancy was higher among respondents who had junior high school (68.13%) level of education compared to the others. Respondents' level of education was significantly associated with anemia at 36 weeks (χ^2=19.547; p=0.001). Also, anemia was highest among traders (68.93%), farmers (68.69%), unemployed (65.85%) and self-employed respondents (63.93%). Occupation was found to have significant association with anemia at 36 weeks of gestation (χ^2=18.879; p=0.002). Respondents' who receives monthly income ranging from GH₵500 to 1000 (68.89%), and those whose partners' do not receive monthly income (69.23%) were anemic compared to others. Respondents' monthly income (χ^2=14.271; p=0.003) and partners' monthly income (χ^2=21.260; p<0.001) were found to have significant association with anemia at 36 weeks of gestation.

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Table 8: Association between respondents' obstetric factors and anemia at 36 weeks of gestation

Variables	Anemia at 36 weeks		Chi-square (X^2)	X^2 p-value
	< 11.0gram	≥ 11.0gram		
Parity			0.017	0.992
<3	149 (63.14)	87 (36.86)		
3 to 4	69 (63.30)	40 (36.70)		
>4	28 (62.22)	17 (37.78)		
Gravida			5.673	**0.050***
<3	109 (68.99)	49 (31.01)		
3 to 4	81 (55.86)	64 (44.14)		
>4	56 (64.37)	31 (35.63)		
Number of children			6.590	0.159
None	74 (71.84)	29 (28.16)		
One	42 (53.85)	36 (46.15)		
Two	44 (60.27)	29 (39.73)		
Three	39 (61.27)	24 (38.10)		
Four and more	47 (64.38)	26 (35.62)		
If more than one, what are their birth interval			6.128	0.106
One year	14 (73.68)	5 (26.32)		
Between one and two years	65 (67.71)	31 (32.29)		
Two years	26 (60.47)	17 (39.53)		
More than two years	25 (49.02)	26 (50.98)		
Number of ANC visits (for current pregnancy)			5.383	**0.020***
< 4	129 (68.98)	58 (31.02)		
≥ 4	117 (57.64)	86 (42.36)		
At what gestational age did you begin ANC visit (for current pregnancy)			5.553	**0.050***
First trimester	109 (57.37)	81 (42.63)		
Second trimester	94 (67.14)	46 (32.86)		
Third trimester	43 (71.67)	17 (28.33)		
Do you attend ANC regularly?			6.188	**0.013***
Yes	215 (61.08)	137 (38.92)		
No	31 (81.58)	7 (18.92)		
Do you take your routine ANC drugs?			5.203	**0.023***
Yes	217 (61.30)	137 (38.70)		
No	29 (80.56)	7 (19.44)		

Dummy variables: <11.0grams=1; ≥11.0grams=0
*p-value≤0.05; **p-value≤0.01; ***p-value<0.001

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Anemia was highest among respondents who have experienced 3 to 4 birth (63.30%) compared to the others (Table 8). However, there was no significant association between parity and anemia at 36 weeks of gestation (χ^2=0.0169; *p*=0.992). Also, majority of respondents (68.99%) who have experienced less than 3 pregnancies were anemic compared to the others. The findings revealed a significant association between gravidity and anemia at 36 weeks of gestation (χ^2=5.673; *p*=0.050). Additionally, anemia was highest among respondents who have no children (71.84%) compared to those with one and more children. However, there was no significant association between number of children and anemia at 36 weeks of gestation (χ^2=6.590; *p*=0.159). Similarly, anemia was highest among respondents who practiced birth interval of one year (73.68%) compared to the birth intervals. Birth interval however had no significant association with anemia at 36 weeks of gestation (χ^2=6.128; *p*=0.106). More so, respondents' who visited ANC less than 4 times for current pregnancy were anemic compared those who visited ANC 4 and more times. The findings showed statistically significant association between number of ANC visits and anemia at 36 weeks of gestation (χ^2=5.383; *p*=0.020). Also, anemia was higher among respondents who started ANC at third trimester of gestation (71.67%) compared to those who stated at second and first trimester. The result showed a significant association between start of ANC visit and anemia at 36 weeks of gestation (χ^2=5.553; *p*=0.050). Similarly, anemia at 36 weeks of gestation was highest among respondents who did not attended ANC regularly (81.58%) compared to those who did (χ^2=6.188; *p*=0.013). Also, anemia was highest among those who did not take their routine ANC drugs (80.56%) compared to those who took their routine ANC drugs (χ^2=5.203; *p*=0.023).

Table 9: Association between respondent's level of knowledge about anemia and behavioral characteristics, and anemia at 36 weeks of gestation

Variables	**Anemia at 36 weeks**		**Chi-square (X^2)**	**X^2 p-value**
	< 11.0gram	**≥ 11.0gram**		
Knowledge about anemia				
Have you ever heard of anemia?			0.021	0.885
Yes	214 (62.94)	126 (37.06)		
No	32 (64.00)	18 (36.00)		
If yes, where did you hear of anemia (N=372)			1.769	0.413
Health facility	154 (63.90)	87 (36.10)		
Friend	35 (66.04)	18 (33.96)		
Media	25 (54.35)	21 (45.65)		
Level of knowledge			0.907	0.341
Good knowledge	91 (59.87)	61 (40.13)		
Poor knowledge	122 (64.89)	66 (35.11)		
Behavioural characteristics				
Have you had malaria in the past month?			5.174	**0.023***
No	146 (58.87)	102 (41.13)		
Yes	100 (70.42)	42 (29.58)		
If yes, how do you often get malaria? (n=160)			5.554	0.062
Once a month	63 (64.95)	34 (35.05)		
Twice a month	14 (73.68)	5 (26.32)		
Thrice a month	23 (88.46)	3 (11.54)		

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Do you own ITN?			3.964	**0.046***
Yes	215 (65.15)	115 (34.85)		
No	31 (51.67)	29 (48.33)		
If yes, do you use the ITN? (n=363)			3.733	0.053
Yes	166 (62.64)	99 (37.36)		
No	49 (75.38)	16 (24.62)		
If yes, did you sleep under the net last night? (n=289)			1.047	0.306
Yes	133 (64.25)	74 (35.75)		
No	33 (56.90)	25 (43.10)		
How often were you deworming before pregnancy? (n=430)			13.123	**0.004****
Every one month	4 (66.67)	2 (33.33)		
Every three months	72 (54.55)	60 (45.45)		
Every six months	55 (57.29)	41 (42.71)		
Not at all	115 (73.72)	41 (26.28)		

Dummy variables: <11.0grams=1; ≥11.0grams=0
*p-value≤0.05; **p-value≤0.01; ***p-value<0.001

Anemia was higher among respondents who have not heard about anemia (64.00%) compared to those who have heard about the condition (Table 9). However, having heard about anemia or not did not show statistical significance with anemia at 36 weeks of gestation (χ^2=0.0210; p=0.885). Also, anemia was highest among those whose source of knowledge about anemia was friends (66.04%), compared health facility (63.90%), and media (54.35%) (Table 9). Notwithstanding, source of information about anemia was not statistically significant with anemia at 36 weeks of gestation (χ^2=1.769; p=0.413). Generally, anemia was higher among respondents with poor knowledge (64.89%) about anemia in pregnancy compared with those with good knowledge. However, there was no significant association between respondents' level of knowledge and anemia at 36 weeks of gestation (χ^2=0.907; p=0.341).

Considering respondents behavioral characteristics, anemia was higher among those who had malaria in the last month prior to the survey (70.42%) compared with those who did not have malaria (Table 9). The result showed a statistically significant association between malaria and anemia at 36 weeks of gestation (χ^2=5.174; p=0.023). Interestingly, anemia was highest among those who are often infected with malaria thrice a month (88.46%) compared to those who are infected twice (73.68%) and once (64.95%) a month. However, frequency of malaria infection was not significantly associated with anemia at 36 weeks of gestation (χ^2=5.554; p=0.062). Similarly, anemia was higher among respondents who owned ITN (65.15%) compared to those who did not own an ITN. Owning an ITN was significantly associated with anemia at 36 weeks of gestation (χ^2=3.964; p=0.046). Also, majority of respondents who did not use ITN (75.38%) were anemic at 36 weeks of gestation compared to those who used ITN. However, there was no significant association between ITN usage and anemia at 36 weeks of gestation (χ^2=3.733; p=0.053). Furthermore, anemia was highest among respondents who did not deworm at all prior to their current pregnancy (73.72%) compared to those who dewormed. The result showed statistically significant association between frequency of deworming and anemia at 36 weeks of gestation (χ^2=13.123; p=0.004).

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Table 10: Association between respondent's nutrition and anemia at 36 weeks of gestation

Variables	Anemia at 36 weeks		Chi-square (X^2)	X^2 p-value
	< 11.0gram	≥ 11.0gram		
How many times do you eat in a day before pregnancy excluding snacks?			2.044	0.563
One time	9 (69.23)	4 (30.77)		
Two times	51 (57.95)	37 (42.05)		
Three times	154 (63.37)	89 (36.63)		
Four and more times	32 (69.57)	14 (30.43)		
Has your previous eating habit changed since you became pregnant?			1.658	0.198
Yes	164 (60.97)	105 (39.03)		
No	82 (67.77)	39 (32.23)		
Do you practice any form of pica?			2.117	0.146
Yes	102 (67.55)	49 (32.45)		
No	144 (60.25)	95 (39.75)		
What stage of your pregnancy did you start this pica practice?			2.865	0.413
1 to 3 months	45 (64.29)	25 (35.71)		
4 to 6 months	40 (66.67)	20 (33.33)		
7 to 9 months	13 (86.67)	2 (13.33)		
Not sure	4 (66.67)	2 (33.33)		
Do you avoid taken certain foods?			0.571	0.450
Yes	107 (65.24)	57 (34.76)		
No	139 (61.50)	87 (38.50)		
At what time of pregnancy did you avoid these foods?			1.058	0.589
1 to 2 weeks	54 (62.79)	32 (37.21)		
13 to 24 weeks	46 (69.70)	20 (30.30)		
25 to 40 weeks	7 (58.33)	5 (41.67)		
What type of alcohol beverage do you take?			7.577	**0.023***
Pitoo	23 (57.50)	17 (42.50)		
Beer	5 (100.00)	0 (0.00)		
Local distilled alcohol	7 (100.00)	0 (0.00)		
Do you take any form of food supplement?			6.601	**0.010***
Yes	144 (58.30)	103 (41.70)		
No	102 (71.33)	41 (28.67)		

Dummy variables: <11.0grams=1; ≥11.0grams=0
*p-value≤0.05; **p-value≤0.01; ***p-value<0.001

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As shown in Table 10, anemia was highest among respondent who ate four and more times before pregnancy (69.57%), followed by those who ate one time (69.23%), and two times (57.95%). Respondents' frequency of food consumption before pregnancy was not significantly associated with anemia at 36 weeks of gestation (χ^2=2.044; p=0.563). Also, those whose eating habit did not change since becoming pregnant (67.77%) were anemic compared to those whose eating habit changed. Change of eating habit was not significantly associated with anemia at 36 weeks of gestation (χ^2=1.658; p=0.198). Additionally, anemia was higher among respondents who practiced pica (67.55%) compared to those who did not. Practicing pica however was not statistically significant associated with anemia at 36 weeks of gestation (χ^2=2.117; p=0.146). Amongst those who practiced pica, anemia was highest among those who started the practice within 7 to 9 months of pregnancy (86.67%). However, there was no statistical significance between respondents' start of pica practice and anemia at 36 weeks of gestation (χ^2=2.865; p=0.413). More so, though statistically insignificant (χ^2=0.571; p=0.450), anemia was higher among respondents who avoided taken certain foods (65.24%) compared to those who did not. Also, all respondents who took alcohol beverage like beer and local distilled alcohol were anemic at 36 weeks of gestation. Consumption of alcohol beverage was statistically significant with anemia at 36 weeks of gestation (χ^2=7.577; p=0.023). Furthermore, anemia was higher among respondents who did not take any form of food supplement during current pregnancy (71.33%) compared to those who did not. There was statistical significant differences between intake herbal preparation and anemia at 36 weeks of gestation (χ^2=6.601; p=0.010).

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Table 11: Univariate and multivariate analysis of factors influencing anemia in pregnancy

Variables	Anemia at 36 weeks		COR (95% C.I)	p-value	AOR (95% C.I)	p-value
	< 11.0gram	≥ 11.0gram				
Level of education						
No formal education	36 (65.45)	19 (34.55)	1		1	
Primary school	54 (67.50)	26 (32.50)	1.096 (0.530-2.267)	0.804	0.979 (0.466-2.058)	0.956
Junior high school	109 (68.13)	51 (31.87)	1.128 (0.590-2.156)	0.715	1.031 (0.524-2.028)	0.930
Senior high school	38 (60.32)	25 (36.68)	0.802 (0.379-1.699)	0.565	0.817 (0.366-1.825)	0.622
Tertiary	9 (28.13)	23 (71.88)	0.207 (0.079-0.534)	**0.001****	0.394 (0.109-1.415)	0.154
Occupation						
Unemployed	54 (65.85)	28 (34.15)	1		1	
Government worker	11 (32.35)	23 (67.65)	0.248 (0.106-0.581)	**0.001****	0.987 (0.242-4.031)	0.986
Farmer	68 (68.69)	31 (31.31)	1.137 (0.601-2.122)	0.686	1.578 (0.713-3.491)	0.260
House wife	10 (47.62)	11 (52.38)	0.471 (0.179-1.244)	0.129	0.670 (0.713-1.919)	0.456
Trader	64 (68.93)	29 (31.18)	1.144 (0.608-2.155)	0.676	1.585 (0.683-3.677)	0.284
Self employed	39 (63.93)	22 (36.07)	0.919 (0.459-1.840)	0.812	1.495 (0.614-3.644)	0.376
Monthly income						
> GH₵500	154 (64.98)	83 (35.02)	1		1	
GH₵500 to 1000	31 (68.89)	14 (31.11)	1.193 (0.601-2.368)	0.613	1.342 (0.650-2.770)	0.426
> GH₵1000	15 (36.59)	26 (63.41)	0.311 (0.156-0.619)	**0.001****	1.089 (0.368-3.226)	0.878
None	46 (68.66)	21 (31.34)	1.181 (0.660-2.111)	0.576	1.735 (0.764-3.939)	0.188
Partner's monthly income						
> GH₵500	80 (62.50)	48 (37.50)	1		1	
GH₵500 to 1000	33 (71.74)	13 (28.26)	1.523 (0.730-3.176)	0.262	1.639 (0.758-3.549)	0.209
> GH₵1000	16 (34.04)	31 (65.96)	0.309 (0.154-0.625)	**0.001****	0.517 (0.218-1.229)	0.136
None	117 (69.23)	52 (30.77)	1.350 (0.832-2.192)	0.225	1.389 (0.829-2.328)	0.211

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Table 12: Univariate and multivariate analysis of factors influencing anemia in pregnancy (Continues)

Variables	Anemia at 36 weeks		COR (95% C.I)	p-value	AOR (95% C.I)	p-value
	< 11.0gram	≥ 11.0gram				
Gravida						
<3	109 (68.99)	49 (31.01)	1		1	
3 to 4	81 (55.86)	64 (44.14)	0.569 (0.356-0.910)	**0.019***	0.485 (0.297-0.793)	**0.004****
>4	56 (64.37)	31 (35.63)	0.812 (0.466-1.412)	0.461	0.728 (0.404-1.270)	0.254
Number of ANC visits (for current pregnancy)						
< 4	129 (68.98)	58 (31.02)	1		1	
≥ 4	117 (57.64)	86 (42.36)	0.612 (0.403-0.927)	**0.021***	0.559 (0.357-0.876)	**0.011****
At what gestational age did you begin ANC visit (for current pregnancy)						
First trimester	109 (57.37)	81 (42.63)	1		1	
Second trimester	94 (67.14)	46 (32.86)	1.519 (0.963-2.393)	0.072	1.373 (0.844-2.235)	0.201
Third trimester	43 (71.67)	17 (28.33)	1.879 (1.000-3.532)	**0.050***	2.371 (1.204-4.671)	**0.013****
Do you attend ANC regularly?						
Yes	215 (61.08)	137 (38.92)	1		1	
No	31 (81.58)	7 (18.92)	2.821 (1.209-6.587)	**0.016***	2.149 (0.527-8.747)	0.286
Do you take your routine ANC drugs?						
Yes	217 (61.30)	137 (38.70)	1		1	
No	29 (80.56)	7 (19.44)	2.616 (1.114-6.136)	**0.027***	1.091 (0.263-4.514)	0.905

Dummy variables: <11.0grams=1; ≥11.0grams=0.
COR=Crude Odds Ratio; AOR=Adjusted Odds Ratio
*p-value≤0.05; **p-value≤0.01; ***p-value<0.001

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Table 13: Univariate and multivariate analysis of factors influencing anemia in pregnancy (Continues)

Variables	Anemia at 36 weeks		COR (95% C.I)	p-value	AOR (95% C.I)	p-value
	< 11.0gram	≥ 11.0gram				
Have you had malaria in the past month?						
No	146 (58.87)	102 (41.13)	1		1	
Yes	100 (70.42)	42 (29.58)	1.663 (1.071-2.584)	**0.023***	1.596 (1.024-2.488)	**0.039***
Do you own ITN?						
Yes	215 (65.15)	115 (34.85)	1		1	
No	31 (51.67)	29 (48.33)	0.572 (0.328-0.996)	**0.048***	0.610 (0.349-1.069)	0.084
How often were you deworming before pregnancy? (n=430)						
Every one month	4 (66.67)	2 (33.33)	1			
Every three months	72 (54.55)	60 (45.45)	0.600 (0.106-3.389)	0.563		
Every six months	55 (57.29)	41 (42.71)	0.671 (0.117-3.840)	0.654		
Not at all	115 (73.72)	41 (26.28)	1.402 (0.248-7.945)	0.702		
What type of alcohol beverage do you take?						
Pitoo	23 (57.50)	17 (42.50)	1			
Beer	5 (100.00)	0 (0.00)	1.00			
Local distilled alcohol	7 (100.00)	0 (0.00)	1.00			
Do you take any food supplement?						
Yes	144 (58.30)	103 (41.70)	1		1	
No	102 (71.33)	41 (28.67)	1.779 (1.143-2.768)	**0.011***	1.779 (1.143-2.768)	**0.011***

Dummy variables: <11.0grams=1; ≥11.0grams=0.
COR=Crude Odds Ratio; AOR=Adjusted Odds Ratio
*p-value≤0.05; **p-value≤0.01; ***p-value<0.001

Binary and multiple regression analysis was conducted on the variable significant at Chi-square to assess the likelihood of the predictor variable on anemia at 36 weeks of gestation, and these are presented in Table 11, 12, and 13 above.

Results from the binary regression shows that respondents who had tertiary level education were less likely to have anemia at 36 weeks of gestation compared to the others (COR=0.207 [95% CI (0.079-0.534)], *p*=0.001). Similarly, those working in the government institutions were less likely to have anemia at 36 weeks of gestation compared with those with different working background (COR=0.248 [95% CI (0.106-0.581)], *p*=0.001). Also, those who receive monthly income more than GH₵1000 were less likely to have anemia at 36 weeks of gestation (COR=0.311 [95% CI (0.156-0.619)], *p*=0.001). Likewise, those whose partner receive monthly income more than GH₵1000 were less likely to have anemia at 36 weeks of gestation (COR=0.309 [95% CI (0.154-0.625)], *p*=0.001). Additionally, respondents who have experienced 3 to 4 pregnancies were less likely to have anemia at 36 weeks of gestation (COR=0.569 [95% CI (0.356-0.910)], *p*=0.019). Respondents who attended ANC 4 and more times were less likely to have anemia at 36 weeks of gestation compared with those who attended ANC less than 4 times (COR=0.610 [95% CI (0.403-0.927)], *p*=0.021). More so, respondents who started ANC visit at the third trimester of pregnancy were 1.879 times more like to be anemic at 36 weeks of gestation compared with those who started at first and second trimester of pregnancy (95% CI (1.000-3.532), *p*=0.050). Furthermore, respondents who did not attend ANC regularly were 2.821 more likely to have anemia at 36 weeks of gestation compared with who attend ANC regularly (95% CI (1.209-6.587), *p*=0.016). Also, respondents who did not take routine ANC drugs were 2.616 times more likely to have anemia at 36 weeks of gestation compared to those who took the drugs (95% CI (1.114-6.136), *p*=0.021). Respondents who did not own ITN were less likely to have anemia at 36 weeks of gestation compared to those who have (COR=0.572 [95% CI (0.328-0.996)], *p*=0.048). However, respondents who had malaria in the last month prior to the survey were 1.663 times more likely to have anemia in pregnancy compared to those who did not (95% CI (1.071-2.584), *p*=0.023). Similarly, respondents who took a food supplement were 1.779 times more likely to have anemia at 36 weeks of gestation than those who did not (95% CI (1.143-2.768), *p*=0.011).

After adjusting the significant variables on anemia at 36 weeks of gestation, respondents' gravidity (AOR=0.485, [95%CI (0.297-0.7930)], *p*=0.004), number of ANC visits (AOR=0.559, [95%CI (0.357-0.876)], *p*=0.011), gestational age at start of ANC (AOR=2.371, [95%CI (1.204-4.671)], *p*=0.013), malaria infection (AOR=1.596, [95%CI (1.024-2.488)], *p*=0.039), and intake of food supplement (AOR=1.779, [95%CI (1.143-2.768)], *p*=0.013) remained significantly associated with anemia at 36 weeks of gestation.

4. DISCUSSION

The findings of the present study showed that the respondents were within age range of 15 to 45 years with a mean age of 26.36 years. Most of them were married and belonged to the Christian religion. The study showed that 7.89% of the respondents had never been schooled while 22.09% of them were unemployed. This finding is lower than what was reported in the Ghana demographic and health survey (GSS, 2015). The unemployed status reported in this study is higher than what was reported in studies in Ghana (Dako-Gyeke & Kofie, 2015; Appiah et al., 2020), Kenya (Ikamari et al., 2013), and South Africa (Muzigaba et al., 2014). Several studies have found significant association between socio-demographic characteristics and development of anemia among pregnant women including education (Okunade et al., 2014), age (Chowdhury et al., 2015; Gaillard et al., 2014), marital status (Marchant et al., 2012), family per capital income (Li et al., 2018), and religion (Rai et al., 2015). However, in this current study no such association was found. The finding of this current study is consistent with that of a study in Northern Ghana (Wemakor, 2019). Although insignificant, the findings of this present study showed that 73.91% of respondents within the age group less than 20 years were anemic compared to the other age groups. This agrees with that of the study in Nigeria by Omo et al. (2020). The difference in significance of socio-demographic characteristics on anemia in pregnancy across studies could be due to difference in study setting and characteristics of study participants.

In this current study, 43.26% of the respondents had experienced pregnancy less than 3 times. This is higher than that of the study in Yemen (Alflah et al., 2017). There was significant association between gravidity and anemia at 36 weeks of gestation. These findings are consistent with that of the study in India (Mangla et al., 2016), Tanzania (Gibore et al., 2020), and in Ethiopia (Bereka et al., 2017). Some studies have explained a change in physiology during recurrent pregnancies and denoted that frequent number of pregnancies causes hormonal changes which lead to an increase plasma volume and subsequently decreases hemoglobin concentration, thus causing anemia in pregnancy (Mirzaie et al., 2010). However, the findings of the present study showed that respondents who have experienced 3 or more pregnancies were less likely to be anemic at 36 weeks of gestation, thus lending no support to this notion. This

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finding is inconsistent with that of the study in Yemen (Alflah et al., 2017), and in Tanzania (Gibore et al., 2020). Also, 50.93% of the respondents in this study started ANC in the first trimester of pregnancy. This is lower than that of the study in Ghana by Wemakor (2019). There was significant association between gestational age at start of ANC and anemia at 36 weeks of gestation which is consistent with that of the study by Omo et al. (2020). There was higher prevalence of anemia among respondents who started ANC in the third trimester of gestation. Also, this study showed significant association between number of ANC visits and anemia at 36 weeks of gestation, and lower likelihood of anemia at 36 weeks of gestation among the respondents who attended ANC 4 and more times compared with those who attended ANC less than 4 times. These findings are consistent with that of the study in Nepal (Ghosh et al., 2017; Yadav et al., 2021) and Jamaica (Charles et al., 2010) which indicated increased chances of anemia in pregnancy among those who had fewer ANC visits. Reasons could be that infrequent ANC visits deny or delay pregnant women from receiving routine ANC drugs, deworming medication, and counseling on healthy dietary practices, and malaria prophylaxis. Furthermore, anemia was higher among the respondents who did not take any routine ANC drugs were anemic at 36 weeks of gestation. This could be as a result of iron deficiencies developed during pregnancy due to an increased iron requirement to supply the expanding blood volume of the pregnant women and rapidly growing fetus and placenta. This is consistent with that of the study in India (Alene & Dohe, 2014), Uganda (Viveki et al., 2012), and Ethiopia (Gebreweld & Tsegaye, 2018).

In this current study, 86.51% of the respondents had heard of anemia which is lower than that of the finding of the study in Ghana (Asare & Kwapong, 2013) and Pakistan (Ayesha et al. 2012), but higher than the study in India by Nivedita et al. (2016). The source of awareness of majority of the respondents was from health facilities. This is consistent with the study by Nivedita et al. (2016) in India, but inconsistent with the study in Saudi Arabia by Aboud et al. (2019) who noted the media as the most sourced awareness regarding anemia in pregnancy. Thus, the role of the media towards awareness creation and /or imparting knowledge regarding anemia in pregnancy is very poor in Twifo Atti-Morkwa district. Additionally, awareness about the cause of anemia in pregnancy was quite high, and the most identified cause was poor eating habit, followed by bleeding, and malaria infection. This is in line with that of the study in Ghana by Asare et al. (2013) who noted poor diet as the most identified cause of anemia in pregnancy. Additionally, maternal death and low birth weight were commonly identified by the respondents in this study as an effect of anemia in pregnancy to a mother and an unborn child, respectively. Similar results had been reported in the literature (Mbule et al., 2013; Rai et al., 2015; Gebre & Mulugeta et al., 2015; Vanamala et al., 2018;). The high level of awareness of anemia in pregnancy in this study suggests that antenatal caregivers in the district constantly educate pregnant women on anemia during ANC services, since most of the respondents indicated attending ANC regularly. Generally, 54.84% of the respondents had poor knowledge about anemia in pregnancy despite being aware of the condition. Inconsistent with this finding is that of the study in India (Nivedita et al., 2016). It is, however, consistent with that of the study in Ghana (Appiah et al., 2020), in Nepal (Ghimire & Pandey, 2013) and in Nigeria (Ademuyiwa, 2020). Although insignificant, anemia was high among respondents with poor knowledge about the condition compared to those with good knowledge. This suggests that pregnant women with poor or inadequate knowledge about anemia are unlikely to adhere to anemia preventive strategies (Appiah et al., 2020).

Dietary habits and patterns play a significant role in preventing anemia in pregnancy. It has been shown in studies that change in dietary patterns among women is higher during pregnancy than at any other stage in life (; Salih et al., 2015; Nana & Zema, 2018). In this current study, 67.67% of the respondents indicated a change in eating habits when they became pregnant. Majority of them indicated an increase in the number of times they ate compared with their previous eating pattern before pregnancy. Meanwhile, 42.56% of the respondents avoided consuming certain food whilst pregnant, and the most restricted foods were protein including milk, eggs and meat or fish. In support of this findings, some studies have found that majority of women in developing countries restrict their food intake during pregnancy for fear of having a large-for-gestational-age baby and or cultural reasons (Kuche et al., 2015; Rai et al., 2015). The common reasons accrued to food restriction in this study included smell or aroma. Also, 37.21% of the respondents practiced pica during pregnancy. This is higher than that of the study in Kumasi Metropolis, Ghana (Mensah et al.,

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2010) and in Iran (Khoushabi et al., 2014), but lower than that of the study in Ho teaching hospital (Konlan et al., 2020) in Ghana. Additionally, consistent with the study by Khoushabi et al. (2014), the finding of this current study showed a decrease in prevalence of pica practice with increase of each trimester of pregnancy. The practice of pica among the respondents could be due to a common belief that pica items serve as a form of spiritual protection and cures ailment; as a result the negative effect of the practice is overlooked by a lot of women (Mensah et al., 2010). Other reasons could be to prevent salivation, nausea, and vomiting (Khoushabi et al., 2014). Furthermore, in this current study anemia in pregnancy was significantly associated with intake of food supplements, and showed that the respondents who took any form of food supplement were 1.78 more likely to develop anemia in pregnancy.

Malaria prevention using ITNs has been recommended as part of maternal and child health policies in sub-Saharan Africa where the burden of malaria is high and causes severe anemia in pregnancy (Singh et al., 2013, WHO, 2014). In this current study, 84.42% of the respondents own ITN, however, 78.89% slept under them the night before the survey. This suggests that ITN use among pregnant women in Twifo Atti-Morkwa was high which could be related to the high level of education by health care providers including nurses, midwifes and public health nurses. This is congruent with Darko et al. (2017) and Kanmiki et al. (2019), and in Nigeria by Aluko and Oluwatosin (2012), Ukibe et al. (2013) and Onyeneho et al. (2015). The high utilization of ITN among pregnant women could be due to the increased sensitization of ITN and its importance to malaria prevention by health professionals in the district. This current study also showed that 37.21% of the respondents had malaria in the last month before the survey, indicating a relatively low prevalence of malaria among them. This is consistent with that of a cross-sectional study in sub-Saharan Africa (Ssentongo et al., 2020), however higher than the findings of the survey in Ghana by the National Malaria Control Programme (GHS, 2017). The prevalence of malaria among the respondents could be due to low adherence to Sulfadoxine-pyrimethamine as evident in the findings of this study. Also anemia was higher among the respondents who had malaria in the last month prior to the survey compared with those who did not have malaria. This is consistent with that of the studies in Nigeria (Oladeinde et al., 2012), and in sub-Saharan Africa by Ssentongo et al. (2020). There was significant association between malaria and anemia in pregnancy, and showed that the respondents with malaria infection were 1.59 times more likely to develop anemia in pregnancy. This supports the findings of the by Ssentongo et al. (2020) who indicated 27% likelihood of malaria influencing anemia in pregnancy among their respondents in sub-Saharan Africa.

5. CONCLUSION

The majority of individuals took ANC medicines, with SP and multivitamins being the least common. The study found that pregnant women often utilized ITNs. Prior to the survey, several study participants had malaria. Some women did not deworm before becoming pregnant. Anemia was more prevalent in respondents who had not dewormed before their current pregnancy. Although the majority of participants had a poor grasp of anemia in pregnancy, there was no link with anemia at 36 weeks. The research indicated that pregnant women's dietary habits change. Some people also had pica and ate clay, sticks, and wooden sponges. Herbal supplements were the most commonly used. Changes in eating habits and pica had no effect on anemia at 36 weeks of pregnancy, although dietary supplements did. Anemia in pregnancy at 36 weeks is common in Twifo Atti-Morkwa, despite regular ANC attendance, high iron and folic acid supplement usage, and high ITN use. Anemia at 36 weeks was linked to ANC visits, being pregnant, how far along the pregnancy was when ANC began, having malaria, and taking dietary supplements.

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