Anaemia at antenatal care initiation and associated factors among pregnant women in West Gonja District, Ghana: a cross-sectional study

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Abstract

Introduction: anaemia in pregnancy remains a critical public health concern in many African settings; but its determinants are not clear. The purpose of this study was to assess anaemia at antenatal care initiation and associated factors among pregnant women in a local district of Ghana.

Methods: a facility-based cross-sectional survey was conducted. A total of 378 pregnant women attending antenatal care at two health facilities were surveyed. Data on haemoglobin level, helminths and malaria infection status at first antenatal care registration were extracted from antenatal records booklets of each pregnant woman. Questionnaires were then used to collect data on socio-demographic and dietary variables. Binary and multivariate logistic regression analyses were done to assess factors associated with anaemia. Results: the prevalence of anaemia was 56%, with mild anaemia being the highest form (31.0%). Anaemia prevalence was highest (73.2%) among respondents aged 15-19 years. Factors that significantly independently reduced the odds of anaemia in pregnancy after controlling for potential confounders were early (within first trimester) antenatal care initiation (AOR=5.01; 95% CI =1.41-17.76; p=0.013) and consumption of egg three or more times in a week (AOR=0.30; 95% CI=0.15-0.81; P=0.014). Conclusion: health facility and community-based preconception and conception care interventions must not only aim to educate women and community members about the importance of early ANC initiation, balanced diet, protein and iron-rich foods sources that may reduce anaemia, but must also engage community leaders and men to address food taboos and cultural prohibitions that negatively affect pregnant woman.

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Introduction

Globally, anaemia affects an estimated 43% of children, 38% of pregnant women, and 29% of non-pregnant women of childbearing age [1]. In low-income countries, anaemia affects 40 to 60% of pregnant women [2, 3]. The World Health Organization defines anaemia as decreased concentration of haemoglobin (Hb) level of less than 11g/dL [1]. Anaemia during pregnancy is considered severe when Hb concentration level is less than 7.0g/dL; moderate when haemoglobin level falls between 7.0-9.9g/dL; and mild from 10.0-10.9g/dL [4]. The causes of anaemia during pregnancy are multi-factorial, and includes nutritional deficiencies of iron, folate, and vitamin B12 [1]. Economic and socio-cultural factors such as cultural and religious food taboos also significantly contribute to anaemia among pregnant women [3, 5]. Other causes of anaemia in pregnancy include parasitic infections like helmints and other conditions such as low intake or poor absorption of iron [4]. Iron deficiency is the most common cause of anaemia in pregnancy in many low-income settings [2, 4]. While evidence suggests that most women in low-income countries, including Ghana, enter pregnancy with less than adequate stores of nutrients [6], anaemia in pregnant women could have serious adverse pregnancy outcomes, including high maternal death, impaired mental development in children, increased risk of fetal growth retardation, low birth weight, premature delivery and perinatal mortality [7, 8]. Like many countries in Africa, anaemia remains an important threat to safe motherhood and newborn health in Ghana [9, 10]. Anaemia is the number two cause of all admissions and the number five cause of death among all admitted patients in Ghana [11]. Indeed, health facility level data suggest that the prevalence of anaemia among pregnant women in Ghana is on the rise, from 34% in 2014 to 37% in 2016 [11]. There are however regional disparities. In the Northern region where this study was conducted, 43.2% of pregnant women attending ANC in 2016 were anaemic [11]. The situation in the specific district (West Gonja District) where this study was conducted is worse: anaemia among ANC attendants rose from 23.4% in 2012 to 43.9% in 2016 [12]. While the potential adverse health consequences of anaemia in pregnancy are widely recognised, few empirical studies have been conducted in Ghana to identify key determinants [10]. Indeed, the lack of evidence on anaemia in many low-income countries is acknowledged as one of the reasons why the fight against anaemia in pregnancy still remains a problem [1]. This study aimed to assess anaemia at antenatal care initiation and its determinants among pregnant women in a local district of Ghana.

Methods

**Study design and respondents:** a facility based cross-sectional quantitative survey was conducted at the west Gonja District Hospital and the Damango Health Centre, all in the West Gonja District of the Northern region of Ghana between November 2017 and April 2018. All pregnant women aged 15-49 years who were attending these two health facilities to receive their first ANC between November 2017 and April 2018 were eligible for the study. However, pregnant women who reported a recent history of blood transfusion (within the past three months) before initiation of first ANC were excluded from the study.

**Study setting:** the West Gonja District has an estimated population of 49,386 [13]. Women form 51% of the district’s population, with about 1,975 women expected to have become pregnant in 2017 [12]. The main occupations of women in the district are farming and retail trade and services, with few engaged in teaching and nursing [12]. Health service delivery in the district is done through a total of thirteen (13) community-based health planning and services (CHPS) compounds, five (5) health centres, and one (1) district hospital. All the 19 facilities provide basic ANC services. However, the West Gonja Hospital (the main referral hospital) provides comprehensive prenatal, delivery and postnatal services. The West Gonja hospital and Damongo Health Centre (the largest first-tier primary public healthcare facility) were purposively selected for this study. These facilities are the largest public health facilities and receive the largest number of ANC registrants on annual basis.

**Sample size:** a total of 433 pregnant women reported for their first ANC in the two facilities (224 in West Gonja hospital and 209 in Damongo health centre) between November 2017 and April 2018. However, 34 women had history of recent blood transfusion and 21 women who met the inclusion criteria declined to participate. They were therefore excluded from the study, leaving a final sample size of 378.

**Recruitment and data collection:** all respondents were recruitment at the ANC clinics of the two health facilities. Two research assistants were trained and stationed at each of the two ANC clinics. Starting from November 1, 2017 to April 30, 2018, the research assistants attended all weekly ANC clinic sessions organised by midwives/nurses. Pregnant women who reported to the clinics for their first ANC were all approached after they (women) had completed all service procedures and were exiting. They were individually told
about the purpose of the study and the study procedures. Those who
could read (in English) were immediately provided with information
leaflets about the study. Those who could not read were asked if they
wanted to receive the information leaflet so that a family member or
friend could later read and explain to them. Nearly all such women
accepted the information leaflets. The research assistants enlisted the
names and contact numbers of all the women approached. Those
without personal telephone numbers were requested to provide the
numbers of their husband/partner, family member or friend.
Following from this, each woman was given two weeks to decide on
their participation. They were each re-contacted via telephone after
the two-week period. Where the decision was in favor of participation,
interview dates were arranged, usually on the next ANC visit.
However, where the decision was against participation (there were
21 such cases), such women were dropped.

In terms of data collection, two methods were employed: data
extraction from ANC booklets of respondents and administration of
structured questionnaires. First, the following information was
extracted from the ANC booklet: timing of ANC initiation, Hb level at
registration, helminths infection, malaria infection, number of times
the woman became pregnant and number of children delivered by the
woman. HB level, helminths infection and malaria infection are routine
blood tests done for all pregnant women at ANC initiation. A simple
tool was designed and used to extract this information from the
maternal and child health record books of each of the 378 women
who agreed to participate in the study. This information was then
subsequently linked to information collected from each woman using
the questionnaires. Second, questionnaires were used to collect data
on other socio-demographic, maternal and dietary characteristics.
The questionnaires were pre-tested at two other smaller health
centres located in the district. All necessary corrections were made
before actual data collection from November 2017 to April 2018.
Actual data collection occurred alongside recruitment: as women
reported to the ANC clinic on weekly basis for the first time, they were
approached, recruited and subsequently interviewed. The two
research assistants conducted all interviews in a designated small
room within the premises of each health facility. Women were
interviewed one at a time. English and Gonja (local dialect) were the
interview languages.

Data entry and processing: completed questionnaires were
manually examined for completeness, then hand-coded and entered
into Epi info version 7. The data were independently entered by the
two research assistants. The first and second authors then
independently compared the two data entries. All errors were
discussed and resolved before data were exported into Stata (version
15.0) for further cleaning and analysis.

Variables: the main outcome variable is anaemia, which we defined
and measured primarily as a binary outcome. We followed the WHO's
definition and categorisation: women whose haemoglobin (Hb)
concentration levels were >11g/dl and <11g/dl were classified as 'not
anaemic' and 'anaemic' respectively [1]. We re-categorized all
anaemic women into mild (10-10.9g/dl), moderate (7-9.9g/dl) and
severe (<7g/dl). Several independent variables were also defined and
measured, including socio-demographic factors such as age, maternal
education, occupation, marital status, religion, husband's occupation,
and place of residence as well as maternal and dietary characteristics.
Timing of ANC initiation was determined by whether the woman came
within the first, second or third trimester. Malaria infection was
determined by whether a woman tested Positive or Negative for the
presence of malaria parasite at the time of ANC initiation. Helminthic
infection was also determined by whether the woman tested Positive
or Negative for any intestinal worm infection during her current
pregnancy at the time of ANC initiation.

Statistical analysis: categorical variables were summarised into
frequencies and proportions. Continuous variables were summarised
into means and ranges and continuous variables like age were re-
categorised into age groups. Bivariate analysis was first done using
chi-square test of independence to assess association between
anaemia and categorical independent variables. Binary logistic
regression was used to assess for factors associated with anaemia.
Factors with p-value < 0.05 at 95% confidence level were considered
statistically significant and were therefore included in a multiple
logistic regression model for further analysis. Odd ratios were
estimated.

Ethical considerations: the research was conducted in accord with
prevailing ethical principles. Ethical approval was obtained from the
Ghana Health Service Ethical Review Committee (GHS-ERC Number:
GHS-ERC 20/02/2017). Informed written consent was obtained
(either by signing or thumb printing) from each respondent before
interviewing.
Results

Characteristics of respondents: Table 1 shows the background characteristics of the 378 respondents who took part in the study. The mean age was 26.9, and the majority (29.1%) were aged 25-29 years. Table 2 also shows the maternal characteristics of respondents. Majority (51.9%) initiated ANC in the second trimester (13 to 24 weeks). Some 13.8% of the respondents tested positive for malaria at their first ANC visit, while 31.2% tested positive for helminths infection. Table 3 describes the dietary characteristics of respondents. A combined 55.8% of the respondents took meat (including liver) and fish at least three times a week. Some 51.1% also consumed egg 1-2 times per week. Green leafy vegetable consumption was generally high among respondents: 21.4% and 76.7% consumed green leafy vegetable 1-2 times and 3+ times per week respectively.

Prevalence of anaemia: in terms of prevalence of anaemia, 55.8% of the respondents were anaemic (Hb less than 11g/dl), with the mean Hb level being 10.8g/dl and a range of 6.7g/dl to 14.4g/dl. Among the 55.8% who had anaemia, 0.3% had severe anaemia, 24.5% had moderate anaemia, and 31.0% had mild anaemia.

Predictors of anaemia: to determine factors associated with anaemia in pregnancy, chi-square tests of independence were first performed between a total of 24 independent variables and anaemia in pregnancy. From this initial analysis, 11 factors were statistically associated with anaemia in pregnancy. These 11 factors were then pulled into binary and multiple logistic regression models and odds ratios were estimated. The results are shown in Table 4 and Table 4 (suite). After adjusting for potential confounders, two factors significantly independently predicted anaemia in pregnancy: timing of ANC initiation and egg consumption per week. Women who initiated ANC within the second and third trimesters were, respectively, 2.71 and 5.01 times more likely to be anaemic compared to those who started ANC within the first trimester (AOR=2.71; 95% CI=2.09-5.81; P<0.01) and (AOR=5.01; 95% CI =1.41-17.76; p=0.013). The odds of getting anaemia in pregnancy significantly declined as a pregnant woman consumed eggs more frequently per week. When compared to women who reported not consuming egg at all, the odds of being anaemic in pregnancy were 0.51 lower for women who consumed egg 1-2 times per (AOR=0.51; 95% CI=0.29-1.39; p=0.257), and 0.30 times lower for women who consumed egg 3+ times per week (AOR=0.30; 95% CI=0.15-0.81; P=0.014).

Discussion

This study is one of the few to assess anaemia prevalence and associated factors among pregnant women attending ANC services in Ghana. Results suggest that the prevalence of anaemia among pregnant women in the study is quite high (56%), with mild anaemia being the highest (31.0%) form. Two factors significantly independently predicted anaemia in pregnancy after adjusting for other factors, namely timing of ANC initiation and egg consumption per week. Several aspects of these results deserve further reflection on. The prevalence of anaemia in this study is highest (73.2%) among respondents aged between 15-19 years. This is consistent with findings from Mangla & Singla's study [6]. A number of factors could contribute to high anaemia in this age group. One of the important causes of anaemia is iron deficiency, and studies suggest that the 15-19 year age band is a period of intense physical and mental growth, with a higher demand for iron and other nutrients [4, 10]. Pregnancy and childbirth during this age group could place further demands on the already inadequate iron stores in teenage mothers. This could easily predispose pregnant teenagers to anaemia. Apart from the fact that young girls may be unprepared biologically, they may also be unprepared emotionally and economically to deal with pregnancy. This is particularly likely because in many contexts in Ghana, sexual and reproductive health topics remain taboo subjects for most parents to discuss with their adolescent children, and teen pregnancy is often not welcome [14]. This could easily undermine social and economic support for teenage mothers, which could in turn affect their nutritional status. This would suggest a need to intensify early sexual and contraception education and counselling for female adolescents at home and in school as well as self-efficacy training and skills acquisition to help them negotiate peer-pressures to initiate sex early and to protect themselves during sexual intercourse. The role of parents and guardians in providing sexual and reproductive health education needs to be encouraged given that early sexual debut and childbearing among female adolescents is a widely reported phenomena in Africa [15-17]. Apart from interventions to stop or reduce early sexual debut and childbearing, interventions to encourage teen mothers to seek early ANC together with targeted nutritional counselling and support services, would also be essential.

The timing of ANC initiation emerged as an important predictor of anaemia among first time registrants. Compared to women who initiated ANC in the first trimester, the odds of having anaemia in pregnancy were still significantly higher among pregnant women who
initiated ANC in the second trimester (AOR=2.71; 95% CI=2.09-5.81; P<0.01) and third trimester (AOR=5.01; 95% CI=1.41-17.76; p<0.013). This is also consistent with what has been reported in Bangladesh [18], and in a regional health facility study in South Africa [8], where anaemia in pregnancy was higher among women who registered in the second and third trimesters compared to those who registered within the first trimester. That late ANC initiation is associated with anaemia in pregnancy is however not surprising. This is not only because majority of women in our study initiated ANC either in the second or third trimester, but also because late ANC initiation means that many of the interventions and services routinely offered to pregnant women at ANC clinics to prevent anaemia in pregnancy such as IFA supplementation, provision of LLINs, and IPT dosing, as well as laboratory investigations (e.g. Hb check and stool tests) to diagnose early anaemia in pregnancy and offer early treatment, are delayed for such women. This would suggest a need for both health facility and community-based preconception and conception care interventions to educate women and community members on the importance of early antenatal care initiation and the need to seek ANC services early. In doing this, efforts must be made to address health system barriers such as long distances to service centres as well as engage community members (men and mothers-in-law in particular) to address socio-cultural barriers such as the need to perform traditional pregnancy-related rituals before permission is granted for pregnant women to access services as shown in previous research in northern Ghana [19, 20].

Some aspects of dietary characteristics were also significantly associated with anaemia in pregnancy. While meat/fish and green leafy vegetable consumption did not surprisingly show significant statistical association with anaemia in pregnancy as we expected, frequency of egg consumption did show strong statistical association with anaemia such that women who consumed eggs three or more times in a week were less likely to be anaemic in pregnancy compared to those who did not consume eggs at all. This is similar to findings by Gebre & Mulugeta in northern Ethiopian where frequency of egg consumption did show strong statistical association with anaemia in pregnancy as we expected, leafy vegetable consumption did not surprisingl.. Some aspects of dietary characteristics were also significantly associated with anaemia in pregnancy. While meat/fish and green leafy vegetable consumption did not surprisingly show significant statistical association with anaemia in pregnancy as we expected, frequency of egg consumption did show strong statistical association with anaemia such that women who consumed eggs three or more times in a week were less likely to be anaemic in pregnancy compared to those who did not consume eggs at all. This is similar to findings by Gebre & Mulugeta in northern Ethiopian where frequency of egg consumption did show strong statistical association with anaemia in pregnancy as we expected, leafy vegetable consumption did not surprisingl

be essential. Taken together, this study has provided important insights into the anaemia and dietary situation among pregnant women who started ANC between November 2017 and April 2018 in the west Gonja District. The findings give an indication of the factors that may be contributing to anaemia in pregnancy. This could potentially afford policy makers and healthcare workers an opportunity to plan and implement contextually relevant interventions to reduce anaemia and its associated adverse consequences. The findings also provide a basis for large-scale further quantitative and qualitative studies in different contexts in Ghana to estimate anaemia prevalence, identify important determinants and explore detailed contextual, structural and personal level explanatory factors. The study however has some limitations. First, the study only assessed anaemia at registration and did not examine anaemia at various stages of pregnancy (e.g. anaemia at 28 weeks and at 36 weeks). Such an analysis could provide better understanding on the prevalence at each stage. Second, data on Hb level, malaria and helminths infection were extracted from maternal and child health records of each woman. Any original data errors resulting from inaccurate test results or improper data capture could not have been addressed. Finally, there could be recall bias since respondents were asked about dietary and other behaviours that might have taken place long before this study.

**Conclusion**

The main objective of this study was to assess anaemia prevalence and associated factors among pregnant women attending ANC services in the West Gonja District. The study revealed a relatively high (56%) anaemia prevalence among the study respondents. Timing of ANC and regular egg consumption were the strongest predictors of anaemia in pregnancy. These findings and discussion together suggest that awareness and knowledge about anaemia among pregnant women attending ANC alone may not even be sufficient to bring about reduced prevalence. Therefore, interventions need to go beyond awareness and knowledge creation through information provision to focusing on other important dietary, economic and cultural factors that may impact negatively on the possibility of getting anaemia in pregnancy. In this regard, health facility and community-based preconception and conception care interventions must not only aim to educate women and community members on the importance of early ANC initiation, balanced diet and sources of iron rich foods that may reduce anaemia, but must also
engage community leaders to address issues related to food taboos and prohibitions during pregnancy that could expose pregnant women to adverse health outcomes, including anaemia.

What is known about this topic

- Anaemia affects 40-60% of pregnant women in low-income countries;
- Anaemia is a significant contributory factor to adverse pregnancy outcomes, including high maternal death, impaired mental development in children, increased risk of fetal growth retardation, low birth weight, premature delivery and perinatal mortality;
- But its determinants are not exactly clear.

What this study adds

- Early (within first trimester) antenatal care initiation and consumption of egg three or more times in a week significantly independently reduced the odds of being anaemic in pregnancy;
- Preconception and conception care interventions must stress the importance of early antenatal care initiation, consumption of balanced diet and protein and iron-rich foods;
- Community-based engagement and interventions to address food taboos and cultural prohibitions that negatively affect pregnant women are needed.

Competing interests

The authors declare no competing interests.

Authors’ contributions

Basil Addayire Tibambuya conceived the study with John Kuumuori Ganle. John Kuumuori Ganle and Muslim Ibrahim contributed to the study design. Basil Addayire Tibambuya collected the data, entered and performed data analysis. John Kuumuori Ganle and Muslim Ibrahim interpreted the data. John Kuumuori Ganle drafted the manuscript. All authors read and contributed to the revision. All authors also read and approved the final draft of the manuscript for submission for publication.

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Tables

Table 1: demographic and economic characteristics
Table 2: maternal characteristics
Table 3: dietary and cultural characteristics
Table 4: predictors of anaemia in pregnancy (multivariable logistic regression analysis)
Table 4 (suite): predictors of anaemia in pregnancy (multivariable logistic regression analysis)

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| Characteristic                        | Frequency (n=387) | Percent | Characteristic                        | Frequency (n=387) | Percent |
|--------------------------------------|-------------------|---------|--------------------------------------|-------------------|---------|
| **Mother's Age**                     |                   |         |                                      |                   |         |
| Mean age (SD)                        | 26.9±10.1         |         |                                      |                   |         |
| 15-19                                | 41                | 10.9    | <200                                 | 257               | 68.0    |
| 20-24                                | 104               | 27.5    | 200-500                              | 98                | 25.9    |
| 25-29                                | 110               | 29.1    | 600-1,000                            | 16                | 4.2     |
| 30-34                                | 75                | 19.8    | 1,100+                               | 7                 | 1.9     |
| 35+                                  | 48                | 12.7    |                                      |                   |         |
| **Mother's Education**               |                   |         |                                      |                   |         |
| None                                 | 131               | 34.7    | None                                 | 132               | 34.9    |
| Primary                              | 57                | 15.1    | Primary                              | 37                | 9.8     |
| Junior High School (JHS)             | 85                | 22.5    | Secondary                             | 80                | 21.2    |
| Secondary                            | 65                | 17.2    | Tertiary                              | 77                | 20.4    |
| **Partner's Education Level**        |                   |         |                                      |                   |         |
| **Partner's Occupation**             |                   |         |                                      |                   |         |
| Self-employed                        | 195               | 51.6    | unemployed                            | 233               | 61.6    |
| Tertiary                             | 40                | 10.6    | Government worker                    | 73                | 19.3    |
| Divorced                             | 1                 | 0.3     |                                      |                   |         |
| Married                              | 315               | 83.3    |                                      |                   |         |
| Single                               | 51                | 13.5    |                                      |                   |         |
| **Religious Affiliation**            |                   |         |                                      |                   |         |
| Christianity                         | 91                | 24.1    |                                      |                   |         |
| Islam                                | 285               | 75.4    |                                      |                   |         |
| Traditional                          | 2                 | 0.5     |                                      |                   |         |
| **Place of Residence**               |                   |         |                                      |                   |         |
| Rural                                | 163               | 43.1    |                                      |                   |         |
| Urban                                | 215               | 56.9    |                                      |                   |         |
| **Mother's Occupation**              |                   |         |                                      |                   |         |
| Government worker                    | 28                | 7.4     |                                      |                   |         |
| Self-employed                        | 195               | 51.6    |                                      |                   |         |
| Unemployed                           | 155               | 41.0    |                                      |                   |         |
| **Distance to Facility for ANC (km)**|                   |         |                                      |                   |         |
| <1                                   | 139               | 36.8    |                                      |                   |         |
| 2-4                                  | 142               | 37.6    |                                      |                   |         |
| 5-7                                  | 79                | 20.9    |                                      |                   |         |
| 8-10                                 | 18                | 4.8     |                                      |                   |         |
| **Monthly Expenditure (GHC)**        |                   |         |                                      |                   |         |
| <200                                 | 278               | 73.5    |                                      |                   |         |
| 200-500                              | 89                | 23.5    |                                      |                   |         |
| 600-1,000                            | 9                 | 2.4     |                                      |                   |         |
| 1,100+                               | 2                 | 0.5     |                                      |                   |  |
### Table 2: maternal characteristics

| Characteristic                        | Frequency (n=387) | Percent |
|---------------------------------------|-------------------|---------|
| **Timing of ANC Initiation**          |                   |         |
| First trimester                       | 161               | 42.6    |
| Second trimester                      | 196               | 51.9    |
| Third trimester                       | 21                | 5.6     |
| **Parity**                            |                   |         |
| 0-4                                   | 341               | 90.7    |
| S+                                    | 35                | 9.3     |
| **Gravidity**                         |                   |         |
| 1-4                                   | 337               | 89.2    |
| S+                                    | 41                | 10.9    |
| **Birth Spacing (years)**             |                   |         |
| 1                                     | 15                | 4.0     |
| 2+                                    | 272               | 72.0    |
| **Primigravida**                      |                   |         |
| Ownership of Treated Bed Net          |                   |         |
| Yes                                   | 360               | 95.2    |
| No                                    | 18                | 4.8     |
| Sleep Under Treated Bed Net Everyday  |                   |         |
| Yes                                   | 331               | 87.6    |
| No                                    | 47                | 12.4    |
| **Malaria Infection at ANC Initiation** |               |         |
| Yes                                   | 81                | 21.5    |
| No                                    | 297               | 78.5    |
| **Helminths Infection at ANC Initiation** |             |         |
| Yes                                   | 118               | 31.2    |
| No                                    | 260               | 68.8    |

### Table 3: dietary and cultural characteristics

| Characteristic                                | Frequency (n=387) | Percent |
|-----------------------------------------------|-------------------|---------|
| **Lipton/Coffee Tea Consumption (at least once a week)** |                   |         |
| Yes                                           | 176               | 46.6    |
| No                                            | 202               | 53.4    |
| **Meat/Fish Consumption Per Week**            |                   |         |
| None                                          | 15                | 4.0     |
| 1-2 times                                     | 152               | 40.2    |
| 3+ times                                      | 211               | 55.8    |
| **Egg Consumption Per Week**                  |                   |         |
| None                                          | 56                | 14.8    |
| 1-2 times                                     | 193               | 51.8    |
| 3+ times                                      | 129               | 34.1    |
| **Green leafy Vegetable Consumption Per Week** |                   |         |
| None                                          | 7                 | 1.9     |
| 1-2 times                                     | 81                | 21.4    |
| 3+ times                                      | 290               | 76.7    |
| **Food Prohibited during Pregnancy**          |                   |         |
| Egg                                           | 15                | 4.0     |
| Meat                                          | 11                | 2.9     |
| None                                          | 352               | 93.1    |

*The purpose for measuring meat(liver) and fish together was to assess meat-based sources of iron
Table 4: predictors of anaemia in pregnancy (multivariable logistic regression analysis)

| Characteristic         | Anaemic, n (%) | Not Anaemic, n (%) | Unadjusted OR (95%CI) | P-value | Adjusted OR (95%CI) | P-value |
|------------------------|----------------|--------------------|-----------------------|---------|---------------------|---------|
| **Mother’s age**       |                |                    |                       |         |                     |         |
| 15-19 (ref)            | 30(73.2)       | 11(26.8)           | 1                     |         | 1                   |         |
| 20-24                  | 64(61.5)       | 40(38.5)           | 0.59(0.26-1.30)       | 0.189   | 0.99(0.37-2.70)     | 0.992   |
| 25-29                  | 60(54.6)       | 50(45.5)           | 0.44(0.20-0.97)       | 0.041*  | 1.02(0.35-2.97)     | 0.971   |
| 30-34                  | 37(49.3)       | 38(50.7)           | 0.36(0.16-0.82)       | 0.015*  | 0.69(0.22-2.17)     | 0.522   |
| 35+                    | 20(41.7)       | 28(58.3)           | 0.26(0.11-0.64)       | 0.003*  | 0.37(0.11-1.22)     | 0.102   |
| **Mother’s Education** |                |                    |                       |         |                     |         |
| Tertiary (ref)         | 13(32.5)       | 27(67.5)           | 1                     |         | 1                   |         |
| Secondary              | 34(52.3)       | 31(47.7)           | 2.28(1.00-5.18)       | 0.049*  | 0.44(0.12-1.61)     | 0.216   |
| JHS                    | 48(56.5)       | 37(43.5)           | 2.69(1.23-5.93)       | 0.014*  | 0.40(0.10-1.57)     | 0.187   |
| Primary                | 36(56.5)       | 21(43.5)           | 3.56(1.52-8.35)       | 0.004*  | 0.68(0.16-2.78)     | 0.586   |
| None                   | 80(61.1)       | 51(38.9)           | 3.26(1.54-6.89)       | 0.002*  | 0.80(0.20-3.29)     | 0.762   |
| **Marital Status**     |                |                    |                       |         |                     |         |
| Single (ref)           | 38(74.5)       | 13(25.5)           | 1                     |         | 1                   |         |
| Married                | 165(52.4)      | 150(47.6)          | 0.38(0.19-0.73)       | 0.004*  | 0.50(0.21-1.20)     | 0.122   |
| Cohabitation           | 796(36.4)      | 4(36.4)            | 0.60(0.15-2.38)       | 0.466   | 0.52(0.11-2.59)     | 0.427   |
| Divorced               | 1(100.0)       | 0(0.0)             |                       |         |                     |         |
| **Mother’s Occupation**|                |                    |                       |         |                     |         |
| Unemployed (ref)       | 101(65.2)      | 54(34.8)           | 1                     |         | 1                   |         |
| Self-employed          | 103(52.8)      | 92(47.2)           | 0.60(0.39-0.92)       | 0.020*  | 0.89(0.50-1.59)     | 0.700   |
| Government worker      | 7(25.0)        | 21(75.0)           | 0.18(0.07-0.45)       | 0.000*  | 0.36(0.08-1.77)     | 0.210   |
| **Monthly Earnings**   |                |                    |                       |         |                     |         |
| <200                   | 171(61.5)      | 107(38.5)          | 1                     |         | 1                   |         |
| 200-500                | 38(42.7)       | 51(57.3)           | 0.47(0.29-0.76)       | 0.002*  | 1.27(0.53-3.03)     | 0.588   |
| 600-1,000              | 2(22.2)        | 7(77.8)            | 0.18(0.04-0.88)       | 0.034*  | 1.45(0.16-3.52)     | 0.744   |
| 1,100+                 | 0(0.0)         | 2(100.0)**         |                       |         |                     |         |
| **Monthly Expenditure**|                |                    |                       |         |                     |         |
| <200                   | 162(63.0)      | 95(37.0)           | 1                     |         | 1                   |         |
| 200-500                | 3(18.8)        | 13(81.2)           | 0.48(0.30-0.77)       | 0.002*  | 0.65(0.29-1.44)     | 0.288   |
| 600-1,000              | 44(44.9)       | 54(55.1)           | 0.14(0.04-0.49)       | 0.002*  | 0.21(0.04-1.16)     | 0.074   |
| 1,100+                 | 2(28.6)        | 5(71.4)            | 0.23(0.05-1.23)       | 0.087   | 1.69(0.12-2.93)     | 0.693   |

*p<0.05; OR= odds ratio; CI=confidence interval; ref=reference categories

**Marital Status! =0 predicts success perfectly, hence marital status was dropped and 1 observation not used. Also, monthly expenditure! =0 predicts failure perfectly, hence monthly expenditure was dropped and 2 observations not used

**Marital Status! =0 predicts success perfectly, hence marital status was dropped and 1 observation not used. Also, monthly expenditure! =0 predicts failure perfectly, hence monthly expenditure was dropped and 2 observations not used.
| Characteristic                  | Anaemic, n (%) | Not Anaemic, n (%) | Unadjusted OR (95%CI) | P-value  | Adjusted OR (95%CI) | P-value  |
|--------------------------------|----------------|--------------------|-----------------------|----------|---------------------|----------|
| **Partner's Education**        |                |                    |                       |          |                     |          |
| Tertiary (ref)                 | 29(37.7)       | 48(62.3)           | 1                     |          |                     |          |
| Secondary                      | 43(53.8)       | 37(46.2)           | 1.92(1.02-3.64)       | 0.044*   | 1.85(0.55-6.51)     | 0.339    |
| JHS                            | 39(75.0)       | 13(25.0)           | 4.97(2.28-10.82)      | 0.000*   | 3.89(0.89-17.07)    | 0.072    |
| Primary                        | 26(70.3)       | 11(29.7)           | 3.91(1.69-9.08)       | 0.002*   | 3.59(0.76-16.89)    | 0.106    |
| None                           | 74(56.1)       | 58(43.9)           | 2.11(1.19-3.75)       | 0.011*   | 1.48(0.36-6.11)     | 0.590    |
| **Partner's Occupation**       |                |                    |                       |          |                     |          |
| Unemployed (ref)               | 44(61.1)       | 28(38.9)           | 1                     |          |                     |          |
| Self-employed                  | 137(58.8)      | 96(41.2)           | 0.91(0.53-1.56)       | 0.727    | 0.69(0.35-1.38)     | 0.293    |
| Government worker              | 30(41.1)       | 43(58.9)           | 0.44(0.23-0.86)       | 0.017*   | 1.48(0.40-5.47)     | 0.557    |
| **Timing of ANC Initiation**   |                |                    |                       |          |                     |          |
| First trimester (ref)          | 66(41.0)       | 95(59.0)           | 1                     |          |                     |          |
| Second trimester               | 128(65.3)      | 68(34.7)           | 2.71(1.76-4.17)       | 0.000*   | 3.49(2.09-5.81)     | 0.000*   |
| Third trimester                | 17(81.0)       | 4(19.0)            | 6.12(1.97-19.01)      | 0.002*   | 5.01(1.41-17.76)    | 0.013*   |
| **Birth Spacing (yrs)**        |                |                    |                       |          |                     |          |
| 1 (ref)                        | 11(73.3)       | 4(26.7)            | 1                     |          |                     |          |
| 2+                             | 139(51.1)      | 133(48.9)          | 0.38(0.12-1.22)       | 0.105    | 0.53(0.14-2.08)     | 0.368    |
| Primigravida                   | 61(67.0)       | 30(33.0)           | 0.74(0.22-2.52)       | 0.629    | 0.84(0.20-3.42)     | 0.804    |
| **Egg Consumption per Week**   |                |                    |                       |          |                     |          |
| Never (ref)                    | 41(73.2)       | 15(26.8)           | 1                     |          |                     |          |
| 1-2 times                      | 112(58.0)      | 81(42.0)           | 0.51(0.26-0.96)       | 0.042*   | 0.63(0.29-1.39)     | 0.257    |
| 3+ times                       | 58(45.0)       | 71(55.0)           | 0.30(0.15-0.59)       | 0.001*   | 0.35(0.15-0.81)     | 0.014    |

*p<0.05; OR= odds ratio; CI= confidence interval; ref= reference categories