ISSN: 2572-3278

Eteffa et al. J Nutri Med Diet Care 2022, 8:059
DOI: 10.23937/2572-3278/1510059
Volume 8 | Issue 1
Open Access

Journal of
Nutritional Medicine and Diet Care

REVIEW ARTICLE

Prevalence of Anemia and its Associated Factors among Antenatal Care Attendees in the Public Health Facilities of Pawi District, Northwest, Ethiopia, 2020

Tola Eteffa[1], Azimeraw Arega[2], Bezawit Abejie[2], Wondu Feyisa[2], Fentahun Alemnew[2], Asteray Asme[2], Nigusu Ayalew[2], Alemwork Abie[2], Eden Asmare[2], Tigist Wubet[2] and Kebede Feyisa[3]*

[1]*Department of Midwifery, Pawi Health Science College, Ethiopia*

[2]*Department of Midwifery, Bahir Dar University College of Medicine and Health Sciences, Ethiopia*

[3]*Department of Pharmacy, Bahir Dar University College of Medicine and Health Sciences, Ethiopia*

***Corresponding author:** *Wondu Feyisa, Department of Midwifery, Bahir Dar University College of Medicine and Health Sciences, Bahir Dar, Ethiopia*

Abstract

Introduction: Anemia is a medical disorder and in pregnant women, it is diagnosed when the hemoglobin level of red blood cells less than 11 grams/deciliter, which reduces oxygen-carrying capacity of red blood cells to tissues. It is a major public health problem for pregnant mothers. Anemia is largely preventable and easily treatable, if detected in time, however, it remains one of the causes of maternal and neonatal morbidity and mortality especially in developing countries. Understanding the prevalence of anemia and its associated factors would help in its preventive and therapeutic measures.

Objective: This study aims to assess the prevalence and its associated factors of anemia among antenatal care attendees in the public health facilities of Pawi district, North-west, Ethiopia 2020.

Method: Institutional based cross-sectional study was conducted in the public health facilities of Pawi district from February 1-30/2020 on 420 pregnant mothers. The data were collected by systematic random sampling technique, and entered into a computer using Epi data 3.5, and analyzed using Statistical Package of Social Sciences 25.0 version. The mid-upper arm circumference was measured to assess the nutritional status. Bivariate and multivariable logistic regression analyses were done to estimate the crude and adjusted odds ratio with a confidence interval of 95% and a P value of less than 0.05 considered statistically significant.

Result: In this study, 32.9% of pregnant women were anemic and 50.7% had moderate anemia level. The mean hemoglobin concentration was 11.81 ± 1.57 grams per deciliter. Age [AOR = 3.45, 95% CI = 1.22-9.78], rural residency [AOR = 3.51, 95% CI = 1.92-6.42], low family income [AOR = 3.10, 95% CI = 1.19-8.08], irregular menstruation [AOR = 3.56, 95% CI = 1.87-6.79], antepartum hemorrhage [AOR = 3.13, 95% CI = 1.27-7.74], multi-parity [AOR = 2.91, 95% CI = 1.33-6.38], short inter-pregnancy gap [AOR 3.32, 95% CI = 1.69-6.53], not taking iron and folate [AOR = 4.83, 95% CI = 2.62-9.90], 3rd trimester [AOR = 3.21, 95% CI = 1.25-8.25], coffee consumption [AOR = 3.24, 95% CI = 1.42-7.42], poor minimum dietary diversity score [AOR = 3.54, 95% CI = 1.58-7.95], undernourished [AOR = 4.09, 95% CI = 2.19-7.64], and poor knowledge of anemia [AOR = 3.19, 95% CI = 1.72-5.93] were significantly associated with anemia in pregnant women.

Conclusion: In this present study, anemia in pregnant women is a moderate public health problem. Therefore, it is important to continue taking action to reduce anemia among pregnant women.

Keywords

Anemia, Bahir Dar University, Knowledge, Pawi district

Abbreviations

ANC: Antenatal Care; AOR: Adjusted Odds Ratio; CI: Confidence Interval; COR; Crude Odds Ratio; IDA: Iron Deficiency Anemia; IFA: Iron Folic Acid; MDDS: Minimum Dietary Diversity score; MUAC: Mid Upper Arm Circumference; WHO: World Health Organization

Citation: Eteffa T, Arega A, Abejie B, Feyisa W, Alemnew F, et al. (2022) Prevalence of Anemia and its Associated Factors among Antenatal Care Attendees in the Public Health Facilities of Pawi District, Northwest, Ethiopia, 2020. J Nutri Med Diet Care 8:059. doi.org/10.23937/2572-3278/1510059

Accepted: March 21, 2022: **Published:** March 23, 2022

Background

Anemia is characterized by a decline in the number or size of red blood cells and hemoglobin concentration and its results in impaired capacity to transport oxygen [1]. Globally, the prevalence of anemia in pregnancy is estimated to be approximately 38.2% or, it affects 32 million pregnant women [2]. In South-East Asia, the Eastern Mediterranean and African 38.9% to 48.7% of pregnant women were anemic [2]. In Ethiopia, based on a systematic review and meta-analysis report around 32% of pregnant women were affected by anemia and according to the 2016 Ethiopian Demographic and Health Survey report, 24% of reproductive age women were estimated to be anemic [3,4].

Anemia in pregnancy is identified by the World Health Organization (WHO) as hemoglobin level less than 11 grams per deciliter and is divided into three levels in terms of severity: mild anemia (hemoglobin level, 9-10.9 g/dl), moderate anemia (hemoglobin level, 7-8.9 g/dl), and severe anemia (hemoglobin level 7-4.5 g/dl) [2]. WHO uses hemoglobin a cutoff value at sea level of altitude to define anemia based on gestational age and, based on this Hb value less than 11.0 g/dl at 1st and 3rd trimesters and less than 10.5 g/dl at 2nd trimester was used to define anemia [5]. Hemoglobin levels differ within pregnancy due to physiological hemodilution which is highest during 20 to 24 weeks of gestation [6].

Anemia is estimated to contributed for more than 115,000 or 20% of all maternal deaths and is also responsible for 591,000 prenatal deaths globally per year [1,7]. Pregnant women suffering from anemia and their neonates encounter negative consequences, including experience of general fatigue, fetal anemia, low birth weight, preterm delivery, increase risk of post-partum hemorrhage, intrauterine growth restriction, perinatal mortality stillbirth, reduced work capacity, low tolerance to infections, shortness of breath, reduced physical, and mental performance [8,9].

The WHO categorized public health significance of anemia based on prevalence into: Normal (≤ 4.9%), mild (5.0-19.9%), moderate (20.0-39.9%), and severe (≥ 40%) [10]. Countries with less than 4.9% prevalence have no public health problem, but those with 5%-19.9% of anemia in pregnancy have a mild public health problems and others with 20%-39.9% have a moderate public health problem and those countries with higher than 40% are classified as countries with a severe public health problem [2]. In Ethiopia, the level of public health significance for non-pregnant women was mild 19% (14 to 26%) and for pregnant women were moderate 26% (12-29%) [2].

Iron deficiency anemia (IDA) is the most common nutritional problem in the world today, accounting for approximately 50% of cases worldwide [11], and it is the cause of 75% of anemia cases during pregnancy [12]. In a non-pregnant state an adult woman has about 2000 mg of iron in her body, however, when she becomes pregnant, the demand for iron increases by an additional 1000 mg, this is because of baseline maternal body iron loss of 230 mg, the development of the placenta and fetus requires ~360 mg iron and an additional 450 mg iron is needed to expand maternal RBC mass. Overall normal pregnancy increases iron requirement by 2-3-fold and folate requirement by 10-20-fold and this physiological demand for iron increases from the second trimester and reaches its peak in the third trimester [13-15]. Centers for Disease Control and Prevention recommend screening for anemia in pregnant women and universal iron supplementation to meet the iron requirements of pregnancy [16]. The recommended daily dietary allowance of ferrous during pregnancy is 27 mg [17]. In Ethiopia based on a Mini Ethiopian Demographic and Health Survey 2019 report, among women with a live birth in the past 5 years, 60% took iron and folic acid (IFA) tablets during pregnancy, and only 11% took them for the recommended period of 90 or more days [18].

In pregnant women, anemia remains one of the most intractable major public health problems, especially in developing countries because of various sociocultural problems like shortage of essential nutrients, iron folate, vitamin B12, C, and A, poverty, lack of awareness, poor dietary habits, parasitic infestation, blood loss, Human immunodeficiency virus, tuberculosis, malaria, too early pregnancies, high parity, short inter-pregnancy interval, cultural beliefs and practices, non-usage of insecticide treated bed net and late booking of pregnant women at prenatal care units [9,19-22].

Anemia can be prevented by creating awareness for pregnant mothers during their antenatal visit, iron supplementation, regular deworming, consistent use of insecticide treated bed net, nutritional counseling, food fortification, iron and folic acid supplementations and by treating the underlying causes and complications [23,24]. As well as it can be prevented by encouraging pregnant women to start prenatal visits early and there is supporting information from a study done in Ghana shows that the risk of developing anemia decreased by increasing the number of prenatal visits [25]. Reducing anemia is recognized as an important component of the health of women and children and in 2012 the World Health Assembly planned the second global nutrition target and one of these targets was a 50% reduction of anemia among women of reproductive age by 2025 [26]. Knowing the magnitude of anemia and its associated factors help to prevent its adverse fetal and maternal outcomes. Therefore, the aim of this study was to assess the prevalence of anemia and its associated factors among pregnant women who attendee antenatal care (ANC) in the public health facilities of Pawi district, North-west, Ethiopia.

Methods

Study design and period

An institutional based cross-sectional study design was employed from February 1-30/2020 in the public health facilities of Pawi district.

Study area

The study was conducted in Pawi district North-west Ethiopia. Pawi district is bordered on the south and west by Metekel and on the east and north by the Amhara Region. It`s located about 526 km away from the capital city of Ethiopia, Addis Ababa, and 421 km from Benishangul Gumuz regional state, Assosa city. The most commonly used food habits in the Pawi district population are dagusa, maize, and teff. The district has 20 Kebeles with a total population of 89807 (44960 males and 44847 females) [27]. Regarding to the health facilities, the district has one public hospital, two health centres, three private clinics and six drug shops. The total number of pregnant women who visit Pawi general hospital, Felege Selam and Mender 14 health centre ANC unit per day on average were 30, 4, and 6 respectively.

Source population

The source population for this study was all pregnant women who attended ANC in the public health facilities of Pawi district.

Study population

The study population was all pregnant women who attended ANC in the public health facilities of Pawi district during the study period.

Inclusion criteria

Pregnant women who attended the ANC in the public health facilities of Pawi district.

Exclusion criteria

Pregnant women who revisited the ANC unit during the study period.

Sample size determination

The sample size was calculated using a single population proportion formula by considering the following assumptions: Proportion of anemia among pregnant women in Madda Walabu University Goba Referral Hospital, Bale Zone, Southeast Ethiopia was 46.2% [28], Zα/2 = critical value for normal distribution at 95% confidence level, which is equal to 1.96 (Z value of alpha = 0.05) or 5% level of significance (α = 0.05) and a 5% margin of error (ω = 0.05). The sample size was adjusted by adding a 10% non-response rate and the final total sample size was 420.

Sampling procedure and technique

After considering three of the public health facilities of the district, the total sample size was proportionally allocated for each health facility in the district based on their quarterly ANC flow. The number of pregnant women who have attended the ANC unit quarterly at Pawi hospital, Mender 14 health and Felege Selam health center was 2640, 320, and 480 respectively. The total sample size after proportional allocation was 322, 39, and 59 pregnant women, respectively for Pawi hospital, Mender 14, and Felege Selam health center respectively. Then eligible pregnant women in each facility were selected by using systematic random sampling techniques based on their monthly ANC visits. The numbers of ANC flow monthly in Pawi Hospital, Mender 14 and Felege Selam health center was 660, 80 and 120 respectively. For each facility the sampling interval (K^{th} units = 2) was obtained by dividing the numbers of monthly pregnant women who attended ANC in each facility by the sample size of that facility. The starting unit was selected by using the lottery method among the first k^{th} units in each facility.

Operational definitions

Anemic pregnant women: Pregnant women that have blood hemoglobin concentration below 11 g/dl.

Non-anemic pregnant women: Pregnant women that have blood hemoglobin concentration greater than 11 g/dl [29].

Mild anemia in pregnancy: Blood hemoglobin concentration between 10-10.9 g/dl.

Moderate anemia in pregnancy: Blood hemoglobin concentration between 7-9.9 g/dl.

Severe anemia in pregnancy: Blood hemoglobin concentration less than 7 g/dl [23,30].

Monthly income of the family: < 1000 Ethiopian Birr (low), 1000-2575 Ethiopian Birr (medium), and > 2575 Ethiopian Birr (high) [31].

Data collection tools and procedures

A structured interviewer-administered questionnaire, physical measurement and blood sample was used to collect the data which were adapted from relevant works of literature and modified to the local context. Questionnaires were first prepared in the English language, then it was translated into Amharic by an individual who has good ability of these languages, then retranslated back into English to check the consistency. The questionnaire consisted of Socio-demographic characteristics, Reproductive and obstetric characteristics, medical history, nutritional habits, and knowledge of anemia measuring questions. A pre-tested structured interviewer-administered questionnaire was used for data collection purposes. The data were collected by three diploma midwives, three laboratory technicians, and supervised by one BSc midwife and one laboratory technologist. A venous

blood sample was taken from the study participants by using a heparinized hematocrit tube and labeled with an identification number. The collected sample was transferred to a complete blood count automated hematology analyzer for hemoglobin determination and the capillary tube after being sealed at one end was centrifuged in the microhematocrit centrifuge at 10,000g for 5 minutes. Then, the result was read using a hematocrit reader and pregnant women who have anemia were treated.

The nutritional status of the participants was assessed by measuring the mid-upper arm circumference (MUAC) halfway between the olecranon and acromion process using non-stretchable tape to the nearest 0.1 cm. Undernutrition was defined as MUAC less than < 23 cm while normal nutritional status was considered to be ≥ 23 cm or more [32]. The minimum dietary diversity score (MDDS) of pregnant women was assessed using a 24-hour recall method. The women were asked whether they had taken any food from nine pre-defined groups and it includes; cereals, pulses, dark green leafy vegetables, vitamin A rich fruit, meats and fish, eggs, nuts and seeds, milk and milk products, and oils and fats). A Participant who had consumed (at least once) the food within each subgroup scored 1 unless 0 was given. Finally, the mother's dietary intake was categorized as poor if she consumed ≤ 3 food groups, 4-5 food groups, and ≥ 6 food groups, respectively [33].

Data quality assurance

Data were collected by trained data collectors and pre-testing of the instrument was done before the actual data collection. The questionnaire was pre-tested at 5% [21] pregnant women who attended prenatal in the Gilgelbelles health center. Data collectors and the supervisors were trained for two days by the investigator. After necessary modifications and correction was done to standardize and ensure its reliability and validity additional adjustments were made based on the results of the pre-test and daily supervision was done, a blood sample was collected and placed on proper anticoagulant EDTA and analyzed within an hour.

Data processing and analysis

The data were entered into Epi data 3.5, edited and cleaned for inconsistencies, missing values, and outliers, then exported to the statistical package of social science 23.0 version for analysis. During analysis, all explanatory variables which a have significant association in bivariate analysis with a P-value < 0.20 was entered into a multivariate logistic regression model to get adjusted odds ratio (AOR) and those variables with 95% of confidence intervals (CI) and a P-value of < 0.05 was considered as statistically significance with anemia in pregnant women. The multicollinearity test was done using variance inflation factor and no collinearity exists between the independent variables. The model goodness of the test was checked by Hosmer- Lemeshow goodness of the fit test and the P-value of the model fitness of the test was 0.384. Frequency tables and descriptive summaries were used to describe the study variables.

Result

Socio-demographic characteristics of the mothers

A total of 420 pregnant women participated in the study with a response rate of 100%. The mean age of the study participant was 25.43 years with a standard deviation of ± 5 and ranging from 15-42 years. Of the mothers, 155 (36.9% found in the age group of 25-29 years and 231 (55.0%) lived in urban. Four hundred nine (97.4%) of the mothers married and 264 (62.9%) were Orthodox Christian religion followers. Of the mothers, 184 (44.3%) were attended primary education and 265 (63.1%) are a housewife. Regarding to their partner, 128 (31.3%) had attended primary education and 197 (50.2%) are farmers. In this study, 218 (51.9%) of the mothers had a family size of 2-4 and 203 (48.3%) had a low monthly family income (Table 1).

Reproductive and obstetric characteristics of the mothers

Among the total mothers, 294 (70.0%) were multigravida and 179 (42.6%) had a history of childbirth two times and above. In this study, 352 (83.8%) of the mothers had no history of abortion, 223 (75.8%) had a history of ANC visits in their previous pregnancy and 246 (84.7%) gave childbirth through spontaneous vaginal delivery. Three hundred fourteen (74.8%) of the women had regular menstrual cycles and 189 (64.3%) had greater than or equal to two years interpregnancy intervals. From the total mothers, 233 (55.0%) were interviewed in their 2nd trimester of pregnancy, and 45 (10.7%) had a history of antepartum hemorrhage. Of the mothers, 261 (62.2%) had a history of contraceptive utilization and 173 (66.3%) were utilized Depo Provera (Table 2).

Medical history of the mothers

Of the mothers, 71 (14.6%) had a history of medical illness and among them, 37 (52.1%) had a history of malarial attack. Twenty-three (5.5%) had history of malarial attack within the last 12 months and 25 (5.9%) where using medication currently. In this study, 287 (68.3%) were supplemented with iron folate, 167 (39.8%) dewormed regularly and 187 (44.5%) were used insecticide treated bed net regularly (Table 3).

Knowledge of anemia

Of the total ANC attendees, 292 (69.5%) had heard about anemia, and the majority of them, 187 (64.0%) heard from health professionals. Among women who had heard of anemia 217 (74.3%) were defined anemia

Table 1: Socio-demographic characteristics of the mothers who attended ANC in the public health facilities of Pawi district, Northwest Ethiopia, 2020, (n = 420).

Variable	No. (%)
Age, y	
15-19	44 (10.5)
20-24	132 (31.4)
25-29	155 (36.9)
30-34	89 (21.2)
Residence	
Urban	231 (55.0)
Rural	189 (45.0)
Marital status	
Married	409 (97.4)
Others*	11 (2.6)
Religion	
Orthodox	264 (62.9)
Muslim	95 (22.6)
Protestant	56 (13.3)
Catholic	5 (1.2)
Educational status	
Had no formal education	124 (29.5)
Primary education	184 (44.3)
Secondary	67 (16.0)
Diploma and above	43 (10.2)
Occupation	
Housewife	265 (63.1)
Merchant/self-employee	119 (28.3)
Government employed	36 (8.6)
Educational status of partner (n = 409)	
Had no formal education	74 (18.1)
Primary education	128 (31.3)
Secondary	120 (29.3)
Diploma and above	87 (21.3)
Occupation of the partner (n = 409)	
Farmer	197 (50.2)
Merchants/self-employee	131 (32.0)
Government employee	81 (19.8)
Family size	
≤ 2	84 (20.0)
2-4	218 (51.9)
≥ 5	118 (28.1)
Monthly income of the family	
High (≥ 2575)	57 (13.6)
Medium 1000-2575	160 (38.1)
Low ≤ 1000	203 (48.3)

*Indicates (single and divorced)

as a decrease in the concentration of RBC or Hb level in the blood. The majority, 77.8% of the women mentioned blood loss as a cause of anemia, and physical weakness/ fatigue was mentioned as a symptom of anemia by 136 (46.6%) the mothers. Two hundred fourteen (73.3%) of the mothers believed that anemia can be treated and

Table 2: Reproductive and obstetric characteristics of the mothers who attended ANC in the public health facilities of Pawi district, Northwest Ethiopia, 2020, (n = 420).

Variable	No. (%)
Gravida	
Primigravida	126 (30.0)
Multigravida	294 (70.0)
Parity	
Nullipara	125 (29.8)
Primipara	116 (27.6)
Multipara	150 (35.7)
Grand multipara	29 (6.9)
History of abortion	
Yes	68 (16.2)
No	352 (83.8)
History of prenatal visits in a previous pregnancy	223 (75.8)
Yes	71 (24.2)
No	
Mode of delivery in recent childbirth	
Spontaneous vaginal delivery	246 (84.7)
Vacuum/forceps delivery	39 (13.3)
Cesarean section	9 (3.0)
Pregnancy interval	
< Two years	105 (35.7)
≥ Two years	189 (64.3)
Menstrual character	
Irregular	106 (25.2)
Regular	314 (74.8)
Gestational age in trimester	
1st	61 (14.5)
2nd	233 (55.5)
3rd	126 (30.0)
History of antepartum hemorrhage	
Yes	45 (10.7)
No	375 (89.3)
History of modern contraceptive utilization	
Yes	261 (62.2)
No	159 (37.8)
Type of contraceptive utilized (n = 261)	
Depo Provera	173 (66.3)
Implants	52 (19.9)
Others*	36 (13.8)

*Indicates (COC/POP and IUCD)

201 (68.8%) were known that pregnant women are at risk for anemia. Of the mothers, 185 (63.4%) were knew that anemia can cause serious problems in the health of pregnant women and for the expected baby. Majority, 89.4% of them were believed that anemia can be prevented by taking iron supplementation and 103 (35.3%) were identified that drinking tea, coffee, or milk after a meal reduces iron absorption in the body. Overall, based on the above-predetermined criteria 185 (63.4%) of the mothers had good knowledge of anemia (Table 4).

Nutritional related characteristics of the mothers

In this study, 179 (42.6%) of the mothers` main stable diet was teff, and 220 (52.4%) got their food source by purchasing. Of the mothers, 293 (69.8%) of them ate greater than or equal to three meals per day and, 297 (70.0%) counseled about nutrition. About, 262

Table 3: Medical history of the women who attended ANC in the public health facilities of Pawi district, Northwest Ethiopia, 2020, (n = 420).

Variable	No. (%)
History of medical illness	
Yes	71 (16.9)
No	349 (83.1)
Diagnosed medical illness (n = 71)	
Gastritis/PUD	8 (11.3)
Malaria	37 (52,1)
Anemia	9 (12.7)
UTI	7 (9.8)
Others*	10 (14.1)
Malarial attack within last 12 month	
No	397 (94.5)
Yes	23 (5.5)
Did you take medication currently?	
Yes	25 (5.9)
No	395 (94.1)
Iron supplementation	
Yes	287 (68.3)
No	133 (31.7)
Regular deworming	
Yes	167 (39.8)
No	253 (60.2)
Regular utilization of insecticide treated bed net	187 (44.5)
Yes	233 (55.5)
No	

*Indicates (HIV, Hypertension, Pneumonia)

Table 4: Knowledge about anemia among women who attended ANC in the public health facilities of Pawi district, Northwest Ethiopia, 2020, (n = 420).

Variable	No. (%)
Have you heard of anemia in pregnancy?	
Yes	292 (69.5)
No	128 (30.5)
Source of information	
Health professionals	187 (64.0)
Mass media	84 (28.8)
Others*	38 (13.0)
Not applicable	128 (30.5)
What does anemia mean?	
A decrease in the concentration of RBC or Hb level in the blood	217 (74.3)
I don't know	75 (25.7)
Not applicable	128 (30.5)
Causes/risk of anemia in pregnancy (more than one answer is possible)	195 (66.8)
Malnutrition	123 (42.1)
Parasitic infestations	97 (33.2)
Malaria	227 (77.8)
Acute/chronic blood loss	136 (46.6)
Chronic medical illness	114 (39.1)
High parity	121 (41.4)
Short interpregnancy interval	24 (8.2)
I don`t know	128 (30.5)
Not applicable	
How can one know that she is suffering from anemia? (more than one answer is possible)	
Paleness of the skin	81 (27.8)
Shortness of breathing	28 (9.6)
Physical weakness/fatigue	136 (46.6)
Poor appetite	57 (19.5)
Fainting	118 (40.4)
Headaches	106 (36.3)
I don't know	49 (14.7)
Not applicable	128 (30.5)
Can anemia be treated	
Yes	214 (73.3)
I don't know	78 (26.7)
Not applicable	128 (30.5)
Does pregnant woman's are at risk for anemia?	201 (68.8)
Yes	91 (31.2)
No	128 (30.5)
Not applicable	
Can anemia cause a serious problem in your health and for the expected baby?	
Yes	185 (63.4)
No	107 (36.6)
Not applicable	128 (30.5)
How can one protect herself from getting anemia? (more than one answer is possible)	
Eating food enriched with iron sources	144 (46.3)
Taking iron supplementation	261 (89.4)
Drinking or eating fruits	105 (36.0)
Spacing childbirth	130 (44.5)
Deworming	87 (29.8)
Sleeping under ITNs	66 (22.6)
I don't know	37 (12.7)
Not applicable	128 (30.5)
Do you know that drinking tea, coffee, and milk after meal reduce iron absorption in the body?	
Yes	103 (35.3)
No	189 (64.7)
Not applicable	128 (30.5)
Knowledge of anemia	
Good	185 (63.4)
Poor	107 (36.6)
Not applicable	128 (30.5)

*Indicates (family, friend, and neighborhood)

Table 5: Nutritional related characteristics of the women who attended ANC the public health facilities of Pawi district, Northwest Ethiopia, 2020, (n = 420).

Variable	No. (%)
Main stable diet	
Teff	179 (42.6)
Maize	107 (25.5)
Dagusa	134 (31.9)
Frequency of meals consumed per day	
Three times or above	293 (69.8)
Less than two times	127 (30.2)
Family food source	
Grow their own	200 (47.6)
Buy/purchase	220 (52.4)
Counseled about nutrition	
Yes	297 (70.0)
No	123 (29.3)
Meat consumption at least once per week	
At least once per week	158 (37.6)
Less than once per week	262 (62.4)
Fruit and vegetable consumption at least once per day	187 (44.5)
Yes	233 (55.5)
No	
Coffee consumption after a meal	
Always after every a meal	249 (59.3)
Sometimes	86 (20.5)
Not at all	85 (20.2)
Tea consumption after a meal	
Always after every meal	119 (28.3)
Sometimes	185 (44.0)
Not at all	116 (27.65)
Minimum Dietary Diversity Score food groups	324 (77.1)
Cereal/starchy staples	276 (65.7)
Pulses (beans, peas, and lentils)	183 (43.6)
Dark green leafy vegetables	127 (30.2)
Vitamin A rich fruit	57 (13.6)
Egg	64 (15.3)
Meat and fish	138 (32.9)
Nuts and seeds	108 (25.7)
Milk and milk product	389 (92.6)
Oils and fats	
Minimum Dietary Diversity Score	
Poor	123 (29.3)
Medium	191 (45.5)
High	106 (25.2)
MUAC	
Undernourished (< 23 cm)	119 (28.3)
Normal (≥ 23 cm)	301 (71.7)

(62.4%), consumed meat at least once per week and 233 (55.5%) of them consumed fruit and vegetables at least once per day. Of the mothers, 59.3% consumed coffee always after the meal, and 185 (44.0%) consumed tea sometimes after a meal. One hundred ninety-one (45.5%) of the women had medium MDDS and 301 (71.7%) were having a normal MUAC level (Table 5).

Prevalence of anemia in pregnant women

In this study, 138 (32.9%) of the pregnant women were anemic, and among these women; 65 (47.1%), 70 (50.7%), and 3 (2.2%) of the women were mild, moderate, and severe anemic respectively. The mean hemoglobin concentration was 11.81 ± 1.57 g/dl.

Factors associated with anemia in pregnant women

In bivariate analysis, variables that have a significant association with a P-value < 0.20 were age, residence, educational status, monthly family income, history of abortion, history of irregular menstruation, birth interval, parity, family size, history of antepartum hemorrhage, trimester of pregnancy, iron supplementation, history of medical illness, malarial attack within the last 12 months, frequency of meal per day, meat consumption per weeks at least once, fruit and vegetable consumption at least once per day, coffee consumption always after meal per day, tea consumption always after meal per day, undernutrition, poor MDDS, and knowledge of anemia.

In a multivariate logistic regression analysis; age, residency, monthly family income, history of irregular menstruation, birth interval, parity, history of antepartum hemorrhage, trimester of pregnancy, iron supplementation, coffee consumption always after meal per day, poor MDDS, undernutrition, and knowledge of anemia remained significantly associated with anemia.

Pregnant women who are found in the age group of greater than 30 years were 3.45 times more likely anemic [AOR = 3.45, 95% CI = 1.22-9.78] relative to women who were found in the age group of 15-19 years. Women who are living in rural were 3.51 times more likely anemic [AOR = 3.51, 95% CI = 1.92-6.42] relative to those who are living in urban and the likelihood of developing anemia was 3.10 times higher among women who have low monthly family income compared to women who have high family monthly income [AOR = 3.10, 95% CI = 1.19-8.08]. Having a history of irregular menstruation were increased the odds of being anemic by 3.56 times [AOR = 3.56, 95% CI = 1.87-6.79] relative to women who had regular menstrual cycles, and the odds of being anemic increased by being multiparous 2.91 times [AOR = 2.91, 95% CI = 1.33-6.38] relative to being nullipara. Women who had a short interpregnancy gap were 3.32 times more likely anemic [AOR 3.32, 95% CI = 1.69-6.53] relative to women who had greater than two years inter

pregnancy interval and women who had a history of antepartum hemorrhage were 3.13 times more likely anemic [AOR = 3.13, 95% CI = 1.27-7.74] relative women who had no history of antepartum hemorrhage.

Women who are not taking iron folate were 4.83 times more likely anemic [AOR = 4.83, 95% CI = 2.62-9.90] than those who are taking iron folate and pregnant mothers who are found in their 3rd trimester were 3.21 times more likely anemic [AOR = 3.21, 95% CI = 1.25-8.25] when compared to women who are found in their 1st trimester of pregnancy. The odds of being anemic were 3.54 times higher among women who had poor MDDS [AOR = 3.54, 95% CI = 1.58-7.95] than those who had high MDDS, and women who are undernourished were 4.09 times anemic [AOR = 4.09, 95% CI = 2.19-7.64] relative to women who are not undernourished. Women who consumed coffee always after the meal were 3.24 times more likely anemic [AOR = 3.24, 95% CI = 1.42-7.42] relative to those not consumed coffee at all and women who had poor knowledge of anemia 3.19 times anemic [AOR = 3.19, 95% CI = 1.72-5.93] relative to women who had good knowledge of anemia (Table 6).

Table 6: Logistic regression analysis for anemia among women who attended ANC in the public health facilities of Pawi district, Northwest Ethiopia, 2020, (n = 420).

Variables	Anemia in Pregnancy		COR (95%-CI)	AOR (95%-CI)	P-value
	Anemic	Non-anemic			
Age, y					
15-19	12	32	1	1	
20-24	35	97	0.96 (0.45-2.01)	0.83 (0.30-2.30)	0.715
25-29	38	117	0.87 (0.41-1.85)	0.66 (0.24-1.84)	0.427
≥ 30	53	36	3.93 (1.79-8.62)	3.45 (1.22-9.78)	0.020*
Residence					
Urban	53	178	1	1	
Rural	85	104	2.75 (1.80-4.18)	3.51 (1.92-6.42)	0.001*
Educational status					
No formal education	26	84	1		
Primary	62	24	1.62 (0.95-2.76)	1.58 (0.74-3.37)	0.242
Secondary and above	50	74	2.18 (1.24-3.85)	2.33 (1.00-5.43)	0.049
Monthly family income					
High	13	44	1	1	
Medium	43	117	1.24 (0.61-2.53)	2.41 (0.90-6.47)	0.080
Low	82	121	2.29 (1.16-4.52)	3.10 (1.19-8.08)	0.020*
History of abortion					
No	108	246	1	1	
Yes	30	28	1.78 (1.05-3.03)	1.03 (0.45-2.35)	0.945
Irregular menstruation					
No	79	235	1	1	
Yes	59	47	3.73 (2.36-5.92)	3.56 (1.87-6.79)	0.001*
Parity					
Nullipara	22	103	1	1	
Primipara	43	73	2.76 (1.52-4.50)	1.47 (0.63-3.42)	0.372
Multipara	73	106	3.22 (1.86-5.58)	2.91 (1.33-6.38)	0.008*
Pregnancy interval					
Greater than two	56	133	1	1	
Less than two	59	46	3.05 (1.86-5.01)	3.32 (1.69-6.53)	0.001*
Family size					
< 2	15	69	1		
2-4	69	149	2.13 (1.14-3.98)	0.89 (0.33-2.42)	0.819
≥ 5	54	64	3.88 (1.99-7.55)	1.21 (0.39-3.74)	0.738
Trimester of pregnancy					
1st	16	45	1	1	
2nd	72	161	1.26 (0.67-2.37)	1.70 (0.71-4.08)	0.236
3rd	50	76	1.85 (0.94-3.63)	3.21 (1.25-8.25)	0.016*

Antepartum hemorrhage					
No	118	257	1	1	
Yes	20	25	1.74 (0.93-3.26)	3.13 (1.27-7.74)	0.013*
Iron supplementation					
Yes	66	221	1	1	
No	72	61	3.95 (2.55-6.13)	4.83 (2.62-9.90)	0.001*
Frequency of meal per day					
≥ Three times	91	202	1	1	
< Three times	47	80	1.30 (0.84-2.02)	1.64 (0.86-3.14)	0.136
Coffee consumption after a meal					
Not at all	19	67	1	1	
Once or less per day	21	64	1.16 (0.57-2.35)	1.84 (0.68-4.97)	0.226
Always	98	151	2.29 (1.29-4.01)	3.24 (1.42-7.42)	0.001*
Tea consumption after a meal					
Not at all	32	84	1	1	
Once or less per day	67	118	1.49 (0.90-2.47)	1.62 (0.79-3.32)	0.186
Always	39	80	1.28 (0.73-2.24)	1.45 (0.63-3.36)	0.384
Fruit and vegetable consumption at least once per day					
Yes	52	135	1	1	
No	86	147	1.52 (1.01-2.30)	1.78 (0.97-3.27)	0.062
Meat consumption at least once per week					
Yes	45	113	1	1	
No	93	169	1.38 (0.90-2.12)	1.77 (0.94-3.32)	0.077
History of medical illness					
No	107	242	1	1	
Yes	31	40	1.75 (1.04-2.95)	1.73 (0.78-3.84)	0.175
Malaria attack within the last 12 months					
No	127	270	1	1	
Yes	11	12	1.95 (0.84-4.54)	1.09 (0.23-5.09)	0.913
MDDS					
High	25	81	1		
Medium	59	132	1.45 (0.84-2.49)	1.55 (0.74-3.25)	0.243
Poor	54	69	2.54 (1.43-4.50)	3.54 (1.58-7.95)	0.002*
MUAC					
Normal (> 23 cm)	77	224	1	1	
Undernourished (≤ 22 cm)	61	58	3.06 (1.97-4.77)	4.09 (2.19-7.64)	0.001*
Knowledge of anemia					
Good knowledge	43	142	1	1	
Poor knowledge	39	68	1.89 (1.13-3.19)	3.19 (1.72-5.93)	0.001*

*Indicates (Significant at a P-value of < 0.05)

Discussion

The current study shows, 32.9% [95% CI: 28.6-37.4] of pregnant women were anemic. The finding of this study was in line with studies conducted in different parts of Ethiopia: Arba Minch public hospital 28.8% [29], Northwestern zone of Tigray 36.1% [34], Assosa zone public health institutions 31.8% [35], rural Sidama 31.6% [36], Harar town 32% [37], Najo general hospital 37.8% [38], Arba Minch town 32.8% [31], Shalla woreda 36.6% [39], Dilla University referral hospital 28.7% [40], Wolayita Sodo town 39.9% [41], Jimma University hospital 38.2% [42], Ilu Abba Bora zone 31.5% [43], Southeast Ethiopia 27.9% [44], Tikure Anbessa specialized hospital 33% [45], Mizan Tepi University teaching hospital 23.5% [46], Nekemte referral hospital 29% [47], Aymiba health center 25.2% [48] and Woldia hospital 39.1% [49]. This finding was also in line with the studies done in Sagamu Southwest Nigeria (32.5%) and public health facilities in Ghana (33%) [50,51].

In this study, the prevalence of anemia is higher

than studies conducted in different parts of Ethiopia: St. Paul`s hospital 11.6% [52], Adama medical college hospital 14.9% [53], Shire town 16.3% [54], Bahir Dar city administration 18.3% [55], Azezo health center 21.6% [56], Sidama zone 21.3% [57], Debre Markos referral hospital 11.5% [58], Mekelle town 19.7% [32], Lemo district 23.2% [59], Adigrat general hospital 7.9% [60], Wollega University referral hospital 17.8% [61], and Gondar University teaching hospital 16.6% [62]. The possible reason for this discrepancy in the prevalence of anemia in pregnant women might be the setting of the study area as the majority of these studies was conducted in town sitting and pregnant women from town sitting might be had adequate information about anemia and because of this, they might be less likely anemic than pregnant women who are found in a rural setting.

The prevalence of anemia in pregnant women was also lower than studies conducted in Northeast India 89.6% [63], Fatima hospital Bangladesh 58.9% [64], selected hospital in Accra, Ghana 51.0% [25], Pumwani maternity hospital, Kenya 57% [65], Ondo specialist hospital Nigeria 47.3% [66] and Tanzania 46.3% of pregnant women were anemic [67]. The possible reason for the lower prevalence of anemia in our study might be due to the time gap.

However, it was lower than studies done in different parts of Ethiopia; Goba Referral Hospital 46.2% [28], Bahir Dar town health facility 45.4% [68], Gode town 56.8% [69], Gilgel Gibe 53.9%, [70] and Jigjiga city 63.8% [71]. The possible reason for the lower prevalence of anemia in the current study might be due to the time gap and increasing the numbers of women who utilized maternity services from time to time. Because of this they may get adequate information about anemia in the form of counseling or education and supplemented with folic acid. The finding is also found to be lower than studies conducted in Uganda, 22.1% [72], Nigeria 23.2% [73], and Northern Tanzania 18.0% [74].

In this study, socio-demographic characteristics, reproductive, nutritional related factors, and knowledge levels of the mothers on anemia were significantly associated with anemia in pregnant women. Pregnant women who are found in the age group of ≥ 30 years were more likely anemic than those who are found in the age group of 15-19 years old. This finding supported by studies conducted in Azezo Health Center, Jigjiga city, and Pumwani Maternity Hospital shows that the prevalence of is anemia associated with the increasing age of the mothers [56,65,71]. The possible reason might be due to that majority of pregnant women who are found in the age group of ≥ 30 were multiparous and they are more anemic than the others because of the increased number of pregnancies and delivery.

Pregnant women who are lived in rural areas were more anemic. This finding agrees with studies done in Azezo Health [56], Adigrat General Hospital [60], Aymiba Health Center [48], Northwestern zone of Tigray [34], and Ilu Abba Bora Zone [43]. This could be due to the reason that pregnant women from rural areas might be had no adequate information about nutrition during pregnancy as well as the educational status of study participants, economic factors, and inaccessibility of health care facilities.

The likelihood of developing anemia was higher among the study participants who have low monthly family income. This finding was supported by studies done in Arba Minch public hospital [29], Wolayita sodo town [41], Lemo district [59], Nekemte Referral Hospital [47], Arba Minch town [31], and Bangladesh [64]. This might be due to the reason that having a low monthly family income disturbs the household food purchasing capacity which affects the family food security. Hence, pregnant women with low-income groups could not get adequate nutrition and they are at risk for anemia.

In our study finding, the odds of being anemic were higher among pregnant women who had a history of irregular menstruation. This result agrees with the studies done in Wolayita sodo town [41] and Mizan Tepi University Teaching Hospital [46]. Having a history of antepartum hemorrhage was also increased the risk of being anemic. This result agrees with the studies done in Arba Minch Public hospitals [29], Bahir Dar city administration [55], West Shewa [75], Adigrat General Hospital [60] and, Bangladesh [64]. Our study finding also supported by a study in Mekelle city public hospitals shows that those women who had an antepartum hemorrhage in pregnancy had 6.6 odds of severe anemia [76]. The possible reason might be due to increased loss of the blood, which decreases stored iron that leads to extra-requirement of iron. This study revealed that, the women who gave two or more childbirth were more anemic than the others. This finding is supported by studies done in Bahir Dar city administration [55], Wolayita sodo town [41], Gode town [69], Mekelle town [32], and Lemo district [59]. This might be at each delivery there is a loss of blood and which may lead to a decreased in iron reservation.

The odds of being anemic were higher in women who had a short interpregnancy interval. This finding supported by studies done in Shire town [54], West Shewa [75], Arba Minch town [31], Assosa Zone Public Health Institutions [35], Wollega University referral hospital [61], Dilla University referral hospital [40] and Bangladesh [64]. This might be due to inadequate time for restoration of nutritional status because of closed and repeated pregnancies. Mothers attain good nutritional status, including iron, when there is a gap of at least 2 years between consecutive pregnancies [77]. Mothers need adequate time to restore nutritional reserve until the next pregnancy.

Women who are not taking iron and folic acid

were 4.83 times more likely anemic. This finding was consistent with the studies conducted in Goba Referral Hospital [28], Dilla University referral hospital [40], Azezo Health Center [56], Gode town [69], Lemo district [59], Pumwani Maternity Hospital Kenya [65], Northwestern zone of Tigray [34], St. Paul`s Hospital [52] and Pumwani Maternity Hospital Kenya [65]. Since the requirement for iron increases for pregnant women as compared to non-pregnant women; this is associated with the reality that blood volume increases by 50% during pregnancy and the requirement of iron to growing fetus and placenta. Available meta-analyses suggest that iron supplementation would increase the mean blood hemoglobin concentration by 10.2 g/L (gram per liter) in pregnant women and 8.6 g/L in non-pregnant women and about 50% of anemia in women could be eliminated by iron supplementation [11].

Having poor MDDS were increase the odds of anemia by 3.54 times. This finding is supported by studies done in Mekelle town [32], Lemo district [59], Nekemte Referral Hospital [47], and Bangladesh [64]. This might be due to the reason that women who had high MDDS may get adequate nutrients in their diet. The odds of being anemic were 4.09 times higher among undernourished women. This finding is in line with studies conducted in Gode town [69], Jigjiga city [71], Assosa Zone Public Health Institutions [35] Dilla University referral hospital [40] and Pumwani Maternity Hospital Kenya [65] shows that a decreased odds of anemia were found in women with good nutritional status.

The chance of getting anemia was 3.24 times higher among respondents who consumed coffee always after meals per day. This result was supported by the study conducted in Debre Markos Referral hospital [58]. This might be due to that coffee consumption affects iron bioavailability and due to its potency as an inhibitor of absorption, it is likely to aggravate anemia at a time of increased physiological need during pregnancy. Pregnant mothers who are found in their 3rd trimester were 3.21 times more likely anemic. This finding supported by studies done in Shalla woreda [39], Bahir Dar city administration [55], Dessie town health facilities [78], Wolayita sodo town [41], Gode town [69], Adigrat General Hospital [60], Lemo district [59], Nekemte Referral Hospital [47], St. Paul`s Hospital [52] Jigjiga city, a tertiary referral hospital in Northern Ghana [79], Kenya [80] and Fatima hospital Bangladesh [64] shows that the prevalence of anemia increases as gestational age increases [71]. The possible reason might be as pregnancy progresses, the increase in oxygen consumption by both the mother and fetus is associated with major hematologic changes. Iron requirements for fetal growth rise steadily in proportion to the weight of the fetus, with most of the iron accumulating during the third trimester [13]. WHO report states that anemia in pregnancy peaks in the third trimester [81].

Women who had poor knowledge of anemia were 3.19 times anemic. This is supported by studies conducted in Mizan Tepi University Teaching Hospital [46], tertiary referral hospital of Northern Ghana [79], and Tanzania [67]. The possible reason might be their educational status and residency. As we have seen in our study, pregnant women who are live in rural and had no formal educational level had poor knowledge of anemia. They may also not get adequate information about anemia compared to women who are lives in the urban area. Because of this, they may have poor knowledge of anemia and this in turn, may increase the risk of getting anemia during their pregnancy.

Limitation of the Study

There was recall bias regarding to requesting the daily meal frequency and MDDS. To avoid this recall bias, we tried to remind them to remember their eating habits by comparing before the pregnancy and during this pregnancy.

Conclusion and Recommendations

In our study, anemia in pregnant women was a moderate public health problem. Among the predictors, age, rural residence, low monthly income, high parity, short interpregnancy interval, having a history of irregular menstruation, antepartum hemorrhage, 3rd trimester of pregnancy, not supplemented with iron folate, poor MDDS, undernourished, coffee consumption always after the meal and poor knowledge of anemia was significantly associated with anemia during pregnancy. Therefore, nutritional counseling on the consumption of iron-rich foods and iron/folate supplementation, promoting postnatal family planning method utilization, birth spacing, and awareness creation on the effects of taking coffee immediately after meals are highly recommended.

Key Points

- In this study, one third (32.9%) of the pregnant women were anemic, and among these women 50.7% had moderate anemia.
- The mean hemoglobin concentration was 11.81 ± 1.57 g/dl.
- In Pawi district anemia in pregnant women was a moderate public health problem.
- Socio-demographic characteristics, reproductive, nutritional related factors, and knowledge levels of the mothers on anemia were significantly associated with anemia in pregnant women.

Declarations

Ethical approval and consent to participate

Ethical clearance was obtained from the Institutional Review Board of BDU, College of Medicine and Health Sciences. A formal letter was also obtained from Pawi

woreda health office, Pawi general hospital chief executive office, Felege Selam health center, and mender 14 health center head office. The purpose of the study was explained for each pregnant mother. At the time of data collection, written consent was obtained from each study participant for those ages greater than 16 years and from parents/guardians for those ages less than 16 years. All respondents assured that the data would not have any negative consequences on any aspects of their life.

Competing interests

The author declares that they have no conflict of interest regarding this work or the publication of this paper.

Authors' contribution

All authors contributed to the conception of the research idea, study design, data collection and supervision, analysis and interpretation of the result, and manuscript write-up. All authors have read and approved the final manuscript.

Funding

This study was financially supported by Bahir Dar University College of Medicine. The funder has no role in study design, data collection, analysis, interpretation, the decision to publish, or preparation of the manuscript.

Acknowledgments

Firstly, we would like to thank Bahir Dar University, College of Medicine and Health Sciences, Department of Midwifery. Secondly, we would like to thank Pawi district health office and health facilities staff for giving the necessary information. Finally, we would like to acknowledge, the data collectors, supervisors, and study participants for their participation in this study.

References

1. Organization WH (2015) Serum and red blood cell folate concentrations for assessing folate status in populations. World Health Organization.
2. WHO (2015) The global prevalence of anaemia in 2011. Geneva: World Health Organization.
3. EDHS E (2016) Demographic and health survey 2016: key indicators report. The DHS Program ICF. 363-364.
4. Kassa GM, Muche AA, Berhe AK, Fekadu GA (2017) Prevalence and determinants of anemia among pregnant women in Ethiopia; a systematic review and meta-analysis. BMC Hematology 17: 1-9.
5. Vitamin W (2011) Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity Geneva: World Health Organization. Mineral Nutrition Information System.
6. Goonewardene M, Shehata M, Hamad A (2012) Anaemia in pregnancy. Best Pract Res Clin Obstet Gynaecol 26: 3-24.
7. Salhan S, Tripathi V, Singh R, Gaikwad HS (2012) Evaluation of hematological parameters in partial exchange and packed cell transfusion in treatment of severe anemia in pregnancy. Anemia 2012: 608658.
8. Vanamala V, Rachel A, Pakyanadhan S (2018) Incidence and outcome of anemia in pregnant women: A study in a tertiary care centre. International Journal of Reproduction, Contraception, Obstetrics and Gynecology 7: 462-466.
9. Frayne J, Pinchon D (2019) Anaemia in pregnancy. Aust J Gen Pract 48: 125-129.
10. Organization WH (2011) Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. World Health Organization.
11. Organization WH (2011) The global prevalence of anaemia in 2011. Geneva: WHO 2015. 2016.
12. Organization WH (2011) Vitamin and mineral nutrition information system. WHO global database on vitamin a deficiency.
13. Bothwell TH (2000) Iron requirements in pregnancy and strategies to meet them. Am J Clin Nutr 72: 257S-264S.
14. Hallberg L, Rossander-Hulten L (1991) Iron requirements in menstruating women. Am J Clin Nutr 54: 1047-1058.
15. Committee SWRT (2014) Regional template/guideline for the management of anemia in pregnancy and postnatally. South West RTC Management of Anemia in Pregnancy.
16. (1998) Recommendations to prevent and control iron deficiency in the United States. Centers for Disease Control and Prevention. MMWR Recomm Rep 47: 1-29.
17. Milman N, Bergholt T, Eriksen L, Byg K-E, Graudal N, et al. (2005) Iron prophylaxis during pregnancy-how much iron is needed? A randomized dose-response study of 20-80 mg ferrous iron daily in pregnant women. Acta Obstetricia et Gynecologica Scandinavica 84: 238-247.
18. EPHI I (2019) Ethiopia mini demographic and health survey 2019: Key indicators. Rockville, Maryland, USA: EPHI and ICF.
19. Adam I, Ibrahim Y, Elhardello O (2018) Prevalence, types and determinants of anemia among pregnant women in Sudan: A systematic review and meta-analysis. BMC Hematol 18: 1-8.
20. Kimiywe J, Ahoya B, Kavle J, Nyaku A (2017) Barriers to maternal Iron-Folic acid supplementation & compliance in Kisumu and Migori, Kenya. Nairobi, Kenya: USAID Maternal and Child Survival Program.
21. Aderoba AK, Iribhogbe OI, Olagbuji BN, Olokor OE, Ojide CK, et al. (2015) Prevalence of helminth infestation during pregnancy and its association with maternal anemia and low birth weight. Int J Gynecol Obstet 129: 199-202.
22. Balarajan Y, Ramakrishnan U, Özaltin E, Shankar AH, Subramanian S (2011) Anaemia in low-income and middle-income countries. The Lancet 378: 2123-2135.
23. Morey SS (1998) CDC issues guidelines for prevention, detection and treatment of iron deficiency. Am Fam Physician 58: 1475.
24. Organization WH (2016) Strategies to prevent anaemia: Recommendations from an expert group consultation, New Delhi, India, 5-6 December 2016.
25. Acheampong K, Appiah S, Baffour-Awuah D, Arhin YS (2018) Prevalence of anemia among pregnant women attending antenatal clinic of a selected hospital in Accra, Ghana. Int J Health Sci Res 8: 186-193.
26. Organization WH (2014) Global nutrition targets 2025:

Anaemia policy brief. Geneva: World Health Organization, 2014. WHO/NMH/NHD/14.4).

27. (2007) Centeral stastical agency.

28. Girma S, Teshome T, Worku M, Solomon T, Kehulu S, et al. (2020) Anemia and associated factors among pregnant women attending antenatal care at madda walabu university goba referral hospital, Bale Zone, Southeast Ethiopia. J Blood Med 11: 479.

29. Waye BG, Gurara AM, Awoke KS (2020) Prevalence of anemia and associated factor among pregnant women attending ante natal care in arba minch public health institutions, South Ethiopia. World 5: 76-83.

30. Organization WH (2008) Worldwide prevalence of anaemia 1993-2005: WHO global database on anaemia.

31. Bekele A, Tilahun M, Mekuria A (2016) Prevalence of anemia and Its associated factors among pregnant women attending antenatal care in health institutions of Arba Minch town, Gamo Gofa Zone, Ethiopia: A Cross-sectional study. Anemia 16: 1073192.

32. Abriha A, Yesuf ME, Wassie MM (2014) Prevalence and associated factors of anemia among pregnant women of Mekelle town: A cross sectional study. BMC Research Notes 7: 1-6.

33. FAO F (2016) Minimum dietary diversity for women: A guide for measurement Rome: FAO.

34. Gebre A, Mulugeta A (2015) Prevalence of anemia and associated factors among pregnant women in North Western zone of Tigray, Northern Ethiopia: A cross-sectional study. J Nutr Metab 2015: 165430.

35. Abay A, Yalew HW, Tariku A, Gebeye E (2017) Determinants of prenatal anemia in Ethiopia. Arch Public Health 75: 51.

36. Gebremedhin S, Enquselassie F, Umeta M (2014) Prevalence and correlates of maternal anemia in rural Sidama, Southern Ethiopia. African Journal of Reproductive Health 18: 44-53.

37. Serbesa ML, Iffa MT (2018) Pregnant women's knowledge, attitude, and practice regarding the prevention of iron deficiency anemia among Ethiopian pregnant women. Caspian Journal of Reproductive Medicine 4: 1-7.

38. Gari W, Tsegaye A, Ketema T (2020) Magnitude of anemia and its associated factors among pregnant women attending antenatal care at najo general hospital, Northwest Ethiopia. Anemia.

39. Obse N, Mossie A, Gobena T (2013) Magnitude of anemia and associated risk factors among pregnant women attending antenatal care in Shalla Woreda, West Arsi Zone, Oromia Region, Ethiopia. Ethiopian Journal of Health Sciences 23: 165-173.

40. Argaw D, Kabthymer RH, Birhane M (2020) Magnitude of Anemia and Its Associated Factors Among Pregnant Women Attending Antenatal Care in Southern Ethiopia: A Cross-Sectional Study. J Blood Med 11: 335-334.

41. Gedefaw L, Ayele A, Asres Y, Mossie A (2015) Anaemia and associated factors among pregnant women attending antenatal care clinic in Walayita Sodo town, Southern Ethiopia. Ethiop J Health Sci 25: 155-162.

42. Belachew T, Legesse Y (2006) Risk factors for anemia among pregnant women attending antenatal clinic at Jimma University Hospital, southwest Ethiopia. Ethiop Med J 44: 211-220.

43. Kenea A, Negash E, Bacha L, Wakgari N (2018) Magnitude of anemia and associated factors among pregnant women attending antenatal care in public hospitals of ilu Abba Bora zone, southwest Ethiopia: A cross-sectional study. Anemia 2018.

44. Kefiyalew F, Zemene E, Asres Y, Gedefaw L (2014) Anemia among pregnant women in Southeast Ethiopia: prevalence, severity and associated risk factors. BMC Research Notes 7: 1-8.

45. Jufar AH, Zewde T (2014) Prevalence of anemia among pregnant women attending antenatal care at tikur anbessa specialized hospital, Addis Ababa Ethiopia. Journal of Hematology & Thromboembolic Diseases.

46. Zekarias B, Meleko A, Hayder A, Nigatu A, Yetagessu T (2017) Prevalence of anemia and its associated factors among pregnant women attending antenatal care (ANC) in Mizan Tepi University Teaching Hospital, South West Ethiopia. Health Science Journal 11: 1-8.

47. Ejeta E, Alemnew B, Fikadu A, Fikadu M, Tesfaye L, et al. (2014) Prevalence of anaemia in pregnant womens and associated risk factors in Western Ethiopia. Food Sci Qual Manag 31.

48. Asrie F (2017) Prevalence of anemia and its associated factors among pregnant women receiving antenatal care at Aymiba Health Center, northwest Ethiopia. J Blood Med 8: 35-40.

49. Brhanie T, Sisay H (2016) Prevalence of iron deficiency anemia and determinants among pregnant women attending antenatal Care at Woldia Hospital, Ethiopia. J Nutr Dis Ther 6: 201.

50. Kofie P, Tarkang EE, Manu E, Amu H, Ayanore MA, et al. (2019) Prevalence and associated risk factors of anaemia among women attending antenatal and post-natal clinics at a public health facility in Ghana. BMC Nutr 5: 1-9.

51. Sholeye OO, Animasahun VJ, Shorunmu TO (2017) Anemia in pregnancy and its associated factors among primary care clients in Sagamu, Southwest, Nigeria: A facility-based study. J Family Med Prim Care 6: 323.

52. Gebreweld A, Tsegaye A (2018) Prevalence and factors associated with anemia among pregnant women attending antenatal clinic at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia. Adv Hematol 2018: 3942301.

53. Ayano B, Amentie B (2017) Assessment of prevalence and risk factors for anemia among pregnant mothers attending ANC clinic at Adama Hospital Medical Collage, Adama, Ethiopia, 2017. Journal of Gynecology and Obstetrics 6: 31-39.

54. Kebede A, Gerensea H, Amare F, Tesfay Y, Teklay G (2018) The magnitude of anemia and associated factors among pregnant women attending public institutions of Shire Town, Shire, Tigray, Northern Ethiopia, 2018. BMC Research Notes 11: 595.

55. Getaneh D, Bayeh A, Belay B, Tsehaye T, Mekonnen Z (2018) Assessment of the prevalence of anemia and its associated factors among pregnant women in Bahir dar city administration, north-west Ethiopia. Journal of Pregnancy and Child Health 5: 2.

56. Alem M, Enawgaw B, Gelaw A, Kena T, Seid M, Olkeba Y (2013) Prevalence of anemia and associated risk factors among pregnant women attending antenatal care in Azezo Health Center Gondar town, Northwest Ethiopia.

57. Gebreegziabher T, Stoecker BJ (2017) Iron deficiency was not the major cause of anemia in rural women of

reproductive age in Sidama zone, southern Ethiopia: A cross-sectional study. PLoS One 12: e0184742.

58. Kumera G, Haile K, Abebe N, Marie T, Eshete T (2018) Anemia and its association with coffee consumption and hookworm infection among pregnant women attending antenatal care at Debre Markos Referral Hospital, Northwest Ethiopia. PLoS One 13: e0206880.

59. Lebso M, Anato A, Loha E (2017) Prevalence of anemia and associated factors among pregnant women in Southern Ethiopia: A community based cross-sectional study. PLoS One 12: e0188783.

60. Berhe B, Mardu F, Legese H, Gebrewahd A, Gebremariam G, et al. (2018) Prevalence of anemia and associated factors among pregnant women in Adigrat General Hospital, Tigrai, northern Ethiopia, 2018. BMC Research Notes 12: 1-6.

61. Kejela G, Wakgari A, Tesfaye T, Turi E, Adugna M, et al. (2020) Prevalence of anemia and its associated factors among pregnant women attending antenatal care follow up at Wollega University referral hospital, Western Ethiopia. Contracept Reprod Med 5: 1-8.

62. Melku M, Addis Z, Alem M, Enawgaw B (2014) Prevalence and predictors of maternal anemia during pregnancy in Gondar, Northwest Ethiopia: An institutional based cross-sectional study. Anemia 2014.

63. Bora R, Sable C, Wolfson J, Boro K, Rao R (2014) Prevalence of anemia in pregnant women and its effect on neonatal outcomes in Northeast India. J Matern Fetal Neonatal Med 27: 887-891.

64. Ahmed S, Al Mamun MA, Mahmud N, Farzana N, Sathi MSA, et al. (2019) Prevalence and associated factors of Anemia among pregnant women receiving antenatal care (ANC) at Fatima Hospital in Jashore, Bangladesh: a cross-sectional study. Food and Nutrition Sciences 10: 1056-1071.

65. Okube OT, Mirie W, Odhiambo E, Sabina W, Habtu M (2016) Prevalence and factors associated with anaemia among pregnant women attending antenatal clinic in the second and third trimesters at pumwani maternity hospital, Kenya.

66. Oluwafemi FS, Fasoro CO, Oni IO, Akingbade AM, Faeji CO, et al. (2019) Prevalence of Anemia among Pregnant Women Registered at Antennal Clinic of Ondo Specialist Hospital, Ondo State, Nigeria. Asian Hematology Research Journal 2: 1-7.

67. Margwe JA, Lupindu AM (2018) Knowledge and attitude of pregnant women in rural Tanzania on prevention of Anaemia. Afr j reprod health 22: 71-79.

68. Melku M, Agmas A (2015) Maternal anemia during pregnancy in Bahirdar Town, Northwestern Ethiopia: A facility-based retrospective study 2015.

69. Addis Alene K, Mohamed Dohe A (2014) Prevalence of anemia and associated factors among pregnant women in an urban area of Eastern Ethiopia. Anemia 2014.

70. Getachew M, Yewhalaw D, Tafess K, Getachew Y, Zeynudin A (2012) Anaemia and associated risk factors among pregnant women in Gilgel Gibe dam area, Southwest Ethiopia. Parasites & Vectors 5: 1-8.

71. Bereka S, Gudeta A, Reta M, Ayana L (2017) Prevalence and associated risk factors of anemia among pregnant women in rural part of JigJiga City, Eastern Ethiopia: A cross sectional study. J Preg Child Health 4: 2.

72. Obai G, Odongo P, Wanyama R (2016) Prevalence of anaemia and associated risk factors among pregnant women attending antenatal care in Gulu and Hoima Regional Hospitals in Uganda: A cross sectional study. BMC pregnancy and childbirth 16: 76.

73. Buseri F, Uko E, Jeremiah Z, Usanga E (2008) Prevalence and risk factors of anaemia among pregnant women in Nigeria. The Open Hematology Journal 7.

74. Stephen G, Mgongo M, Hussein Hashim T, Katanga J, Stray-Pedersen B, et al. (2018) Anaemia in pregnancy: Prevalence, risk factors, and adverse perinatal outcomes in Northern Tanzania. Anemia.

75. Deriba BS, Bala ET, Bulto GA, Geleta TA, Ayalew AF, et al. (2020) Determinants of Anemia among Pregnant Women at Public Hospitals in West Shewa, Central Ethiopia: A Case-Control Study. Anemia.

76. Ebuy Y, Alemayehu M, Mitiku M, Goba GK (2017) Determinants of severe anemia among laboring mothers in Mekelle city public hospitals, Tigray region, Ethiopia. PLoS One 12: e0186724.

77. Dewey KG, Cohen RJ (2007) Does birth spacing affect maternal or child nutritional status? A systematic literature review. Matern Child Nutr 3: 151-173.

78. Tadesse SE, Seid O, G/Mariam Y, Fekadu A, Wasihun Y, et al. (2017) Determinants of anemia among pregnant mothers attending antenatal care in Dessie town health facilities, northern central Ethiopia, unmatched case-control study. PLoS One 12: e0173173.

79. Wemakor A (2019) Prevalence and determinants of anaemia in pregnant women receiving antenatal care at a tertiary referral hospital in Northern Ghana. BMC Pregnancy and Childbirth 19: 1-11.

80. Siteti MC, Namasaka SD, Ariya OP, Injete SD, Wanyonyi WA (2014) Anaemia in pregnancy: Prevalence and possible risk factors in Kakamega County, Kenya. Science Journal of Public Health 2: 216-222.

81. Organization WH (1992) The prevalence of anaemia in women: A tabulation of available information. Geneva, WHO 1992.