Anemia among Pregnant Women Attending Ante Natal Care Clinic in Adare General Hospital, Southern Ethiopia: Prevalence and Associated Factors

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ABSTRACT

BACKGROUND: Anemia is a global public health problem affecting both developing and developed countries. It is associated with increased morbidity and mortality in pregnant women and children. Nevertheless, information regarding the prevalence of anemia and associated factors among pregnant in the study area is limited. Therefore, this study was aimed to assess the prevalence of anemia and associated factors among pregnant women attending antenatal care clinic in Adare General Hospital, Southern Ethiopia.

METHOD: A facility-based cross-sectional study was conducted from October 1, 2020, to December 15, 2020, among 340 pregnant women aged 15 to 49 years who came for focused antenatal care follow-up. Trained data collectors administered questionnaires, and collected capillary blood and stool samples. Data were coded and entered into EPI Info 7 and the analysis was done using SPSS version 20.0. Factors associated with anemia were assessed using binary logistic regression. Those variables that had a *P*-value less than .25 on bi-variable regression analysis were considered for multi-variable regression analysis. Statistical significance was declared with $P < .05$.

RESULT: The prevalence of anemia among pregnant women was 24.1% (95% CI: 19.55%-28.69%). The majority of anemia cases were mildly anemic (62.2.0%). Increased odds of anemia was found among pregnant women with household monthly income ⩽2550 Ethiopian Birr (⩽69.67 United States Dollar) (AOR = 2.08; 95% CI: 1.15, 3.76), not attended formal education (AOR = 3.86; 95% CI: 1.42, 10.54), not using iron tablets (AOR = 2.64; 95% CI: 1.33, 5.27) and infected with *Plasmodium vivax* (AOR = 7.58; 95% CI: 3.11, 18.47).

CONCLUSIONS: Anemia had moderate public health significance in the study. Low monthly family income, educational status, iron tablet consumption during pregnancy and *Plasmodium vivax* infection were found to be independent predictors for anemia in pregnancy. The burden of anemia should be alleviated through enhancing maternal socio-economic status, prevention of illnesses targeting pregnant women, and strengthening the expansion of prenatal iron-folate supplementation.

KEYWORDS: Prevalence, anemia, antenatal care, pregnant women, Adare General Hospital

Introduction

Anemia is a condition in which the number of red blood cells (RBCs) is insufficient to meet the body's physiologic needs. Specific physiologic needs vary with a person's age, gender, altitude, smoking behavior, and different stages of pregnancy. Based on the level of hemoglobin (Hg), World Health Organization (WHO) cut-off points for anemia varies by age, sex, and pregnancy status.[1]

Anemia is a global public health problem affecting both developing and developed countries. It occurs at all stages of the life but is more prevalent in pregnant women and young children. Its risk is higher due to an increase in blood volume during pregnancy, and high iron demands of infant growth and pregnancy.[2-5] Based on recommended hemoglobin concentrations thresholds (<10.5 g/dl in second trimester of pregnancy, <11 g/dl in first and third trimester of pregnancy, and under-5 children, <11.5 g/dl in pre-school children, <12 g/dl in adolescents, and non-pregnant women and <13 g/dl in men), the

WHO estimates that 2 billion people are anemic.[2,4,6] The prevalence of anemia was estimated to be 38.2% globally, 22% in high-income regions, 44.6% in Africa, and 36% in East Africa among pregnant women.[7,8] Its prevalence was estimated to be 29.1% in national level[9] and 31.6% in rural Sidama.[10]

Anemia has consequences for human health, social, and economic development.[3,5] It is associated with increased morbidity and mortality in women and children,[11,12] poor birth outcomes such as preterm delivery, low birth weight, and perinatal mortality,[9,13-15] and decreased productivity of workforces in adults.[5,16,17] Severe iron deficiency anemia is causing the deaths of an estimated 50,000 young women per year in pregnancy and childbirth. In Ethiopia, according to WHO estimation, the annual number of maternal deaths from severe anemia is 4390.[17]

Anemia is an indicator of both poor nutrition and poor health. It is caused by multiple factors.[5,6,18] Approximately 50% of all anemia can be attributed to iron deficiency (ID), with the

rest due to conditions such as deficiencies of other key micronutrients including folate, vitamin B12, or vitamin A deficiency, chronic inflammation, infectious diseases such as malaria, HIV/AIDS, hookworm infections, and urinary schistosomiasis; and inherited disorders that affect RBCs such as thalassemia, where diets are based mostly on staple foods with little meat intake.[4-6]

Despite many efforts to fight anemia over the past 3 decades, little progress has been reported and it is still public health problem.[18] In Ethiopia, anemia prevalence among women aged 15 to 49 was increased from 17% in 2011 to 24% in 2016.[9,19] Only 5% of women took iron tablets for 90 days or more during their most recent pregnancy, while only 6% of women took deworming medication. Another reason could be an underestimation of the role of other causes of anemia other than iron deficiency.[6,9]

In Sidama region, there were a few studies done on anemia in rural areas. There was no study done to assess anemia in urban residents' pregnant women of the region. Therefore, our study was intended to cover this gap by assessing the prevalence of anemia and associated factors among pregnant women in Adare General Hospital (AGH).

Methodology

Study design

An institution-based cross-sectional quantitative study was conducted in Adare General Hospital (AGH), from October 1, 2020, to December 15, 2020, among pregnant women attending antenatal care (ANC) clinic. AGH is one of the 4 general hospitals in Sidama National Regional State and located in Hawassa city which is the capital of the region. Hawassa city is located at south 273 kilometers from Addis Abeba, the capital of Ethiopia. The city is bordered at the North by Oromia regional state, at the West by Hawassa Zuria district, at the Southwest by Boricha district, at the South by Malga district, and at the East by Wondo genet district and the Oromiya region. It is located 1708 meters above sea level. Small scale trade, labor work, and employments are the main source of income for the residents of the city. The city administration has 2 public hospitals and 10 health centers. The physical health service coverage of the city was 100%. All of the public hospitals and health centers provide antenatal care to pregnant women. In a previous year, 1714 pregnant women received antenatal care in AGH. The study populations were pregnant women aged from 15 to 49 years who had ANC follow up. ..\Map.doc

Inclusion and exclusion criteria

All pregnant women who were residents of Hawassa for at least the past 6 months and attended Adare General Hospital for ANC visit, and willing to participate were included. Those who were seriously sick (unable to give response) at time of data collection, mentally unstable, or can't hear were excluded from the study.

Sample size determination and sampling technique

The sample size was computed based on single population proportion formula considering the following assumptions: 95% confidence level, 5% margin of error, 27.9% expected prevalence of anemia,[20] and 10% non-response rate. Thus, the total sample size of 340 was computed. The average number of clients who visited the ANC clinic daily during the data collection period was estimated based on the previous 3 months' daily client flow of the clinic which was obtained by referring client registration book/record before data collection. The lottery method was used to select the first study participant, and a systematic sampling method ($k = N/n = 717/340 = 2.11 = 2$) was used to select the rest of others.

Data collection and quality control

A pre-tested and interviewer-administered questionnaire was used to collect data. The questionnaire was adapted and modified from different related works of literature,[9,21] and prepared in English, and translated into Amarigna language by 2 native speakers who got Masters in language studies. Similarly, back-translation to the English language was done by language experts. Before data collection, 5% of the sample size was pre-tested to check clarity, and local understanding of the questions included in the data collection tool. Two laboratory technologists and 4 midwifery nurses participated in data collection. Two public health officers and a senior laboratory technologist supervised the data collection process. Data collectors and supervisors were trained for 2 days. Every day, the filled questionnaires were reviewed and checked for completeness by the supervisors and principal investigators, and the necessary feedback was offered to data the collectors in a next morning before the actual procedure.

The dietary diversity (DD) was assessed using 24 hours recall method. The level of dietary diversity score (DDS) was computed out of 9, and was classified as high (DDS ≥ 6), optimal (DDS = 4 or 5) and low (DDS ≤ 3) according to the recommendation of the Food and Agriculture Organization (FAO) of the United Nations.[21]

Approximately a drop of capillary blood was collected using capillary tubes. For each participant, a blood sample was obtained by middle finger-prick of non-dominant hand after disinfection with alcohol, drying of the skin, and removal of the first drop of the blood. Hemoglobin analyses were done using an automated hematology machine, CELL DYN 1800 (Abbott Laboratories Diagnostics Division, USA). Regarding the blood film test for malaria, before staining the blood films, the thin blood films were fixed in methanol for 30 seconds. Then smears were stained with 10% Giemsa solution for 10 minutes. The staining techniques and blood film examination were conducted employing WHO guidelines.[22] Quality control of collected blood samples was done according to WHO standard.[23] Microscopic examination of thick films, using high power magnification for the presence of malaria parasites and thin

films, for identification of plasmodium species was carried out under a 100× oil immersion objective.

Stool samples were collected by using a clean and labeled container from the study participants. A portion of the stool was processed with direct microscopic technique to detect intestinal parasites immediately. During the examination, a formal ether concentration technique was applied. The samples were examined microscopically first with 10× and then with 40× objective for detection of helminths eggs, larvae, and cysts of protozoan parasites. Quality control of the collected stool samples was done according to the standards.[24,25]

The human immunodeficiency virus (HIV) status of the respondents was taken from clients' records and history of chronic illness was assessed by asking respondents if they are on medication, advised to use preventive actions, had follow up visits for such diseases.

Operational definitions

Anemia: hemoglobin level of less than 11.0 g/dl during first or third trimester or less than 10.5 g/dl during the second trimester of pregnancy; mild anemia: hemoglobin level 10 to 10.9 g/dl, moderate anemia: hemoglobin level 7 to 9.9 g/dl, and severe anemia: hemoglobin level <7 g/dl.[26,27]

Dietary diversity score (DD): the number/types of different foods or food groups consumed in the previous day (24 hours from the sunrise yesterday to sunrise today).

Low dietary diversity: diet diversity score less than or equal 3; medium dietary diversity: diet diversity score 4 or 5, and high dietary diversity: diet diversity score greater than or equal to 6.[21]

Data management and analysis

The data was reviewed and organized after its collection; then coded and entered into EPI Info 7, and the analysis was done using SPSS version 20 Software. Hemoglobin level was adjusted for altitude, and individual smoking status using the recommendation by WHO.[1] WHO hemoglobin levels were used as cut-off values to classify anemia. Variables in the bi-variable model with a *P*-value less than .25 were taken to multivariable logistic regression to decrease the effect of confounding factors.[28,29] Statistical significance was declared with *P* < .05. Finally, the result was presented using narration, tables and charts.

Ethical consideration

Ethical clearance was obtained from the Institutional Review Board (IRB) of Yirgalem Hospital Medical College. Before administration of questionnaires, and collection of stool and blood samples, consent was obtained from each study participants. Participants were informed about the general purpose, possible risks, and benefits of the study. To ensure confidentiality, participants' data were linked to a code number. Test results

were told to them, and women who were not on iron with folic acid were supplemented with iron with folic acid coordinating with the hospital staff.

Results

Socio-demographic and economic information about study subjects

Of 340 pregnant women recruited for the study, all of them (100%) volunteered to participate. The mean age (±standard deviation) of the respondents was 26.00 (±4.6) years, and slightly more than half of the respondents 194 (57.1%) were in the age interval of 25 to 34 years. Regarding gestational age, slightly greater than two-thirds (70.3%) were in the second trimester. Pertaining to educational status, 71 (20.9%) were not attended formal education. Out of all the study participants, 144 (42.4%, 156 (45.9%) and 193 (56.8%) were housewives, Sidama in ethnicity, and protestant in religion respectively. Almost all of the respondents, 334 (98.2%) were married and the majority of them, 245 (72.1%) have a family size of less than 5 in number. Regarding family monthly income, 159 (46.8%) respondents reported an average monthly family income of ⩽2550 Ethiopian birr or ⩽69.67 $US (Table 1).

Pregnancy and health service related factors of pregnant women attending ANC clinic

About two-thirds of the respondents, 224 (65.9%) were of gravida ⩽2, and 119 (35%) had visited ANC clinic 2 times. From those who are eligible for iron, 116 (37.4%) pregnant women reported that they were not taking iron tablets, and the rest do. Only 44 (12.9%) had taken de-worming drugs during this pregnancy. Eight in ten women, 267 (78.5%), had used any kind of modern contraceptive method prior to this pregnancy. One in ten women, 37 (10.9%), reported heavy menstrual flow. Ninety-eight (28.8%) respondents had less than 2 years interval between previous and current pregnancy. More than two-thirds of women, 239 (70.3%) were in their second trimesters of pregnancy. Of those who had given birth previously, 16 (4.7%) had reported a history of heavy blood loss in last delivery (Table 2).

Dietary diversity, medical illness, and related factors of pregnant women

Regarding dietary diversity, one in four women, 84 (24.7%) were grouped under low score (DD ⩽ 3). Concerning coffee drinking habits, about half, 155 (45.6%) reported they drank coffee 1 to 6 cups of coffee per week during or immediately after a meal.

Of 340 pregnant women, 51 (15%) were identified from their record review that they were infected with HIV. Nine (2.65%), and 22 (6.5%) of pregnant women reported that they had diagnosed chronic disease, and a history of surgery respectively.

Table 1. Socio-demographic factors of pregnant women attending ANC clinic in Adare General Hospital, Southern Ethiopia.

VARIABLE (N=340)	CATEGORY	FREQUENCY	PERCENT (%)
Age in years	15-24 years	125	36.8
	25-34 years	194	57.1
	35-49 years	21	6.2
Gestational age	First trimester	30	8.8
	Second trimester	239	70.3
	Third trimester	71	20.9
Educational Status	Not attended formal education	71	20.9
	Elementary	129	37.9
	Secondary school and above	140	41.2
Occupation	Maid	25	7.3
	Merchant	92	27.1
	House wife	144	42.4
	Government Employee	79	23.2
Ethnicity	Sidama	156	45.9
	Amhara	37	10.9
	Wolayita	38	11.2
	Oromo	43	12.6
	Tigrai	20	5.9
	Gurage	46	13.5
Religion	Protestant	193	56.8
	Orthodox	113	33.2
	Catholic	10	2.9
	Muslim	24	7.1
Marital Status	Married	334	98.2
	Single	6	1.8
Family size	Family size <5	245	72.1
	Family size ≥5	95	27.9
Monthly family income	≤2550 ETB (≤69.67 $US)	159	46.8
	>2550 ETB (>69.67 $US)	181	53.2

Abbreviations: ETB, Ethiopian Birr; n, sample size; $US, United States Dollar.

Table 2. Pregnancy and health service related factors of pregnant women in Adare General Hospital, Southern Ethiopia.

VARIABLE (N=340)	CATEGORY	FREQUENCY	PERCENT (%)
Gravidity	Gravida 1 & 2	224	65.9
	Gravida 3 & 4	99	29.1
	Gravida ≥5	17	5.0

(Continued)

Table 2. (Continued)

VARIABLE (N=340)	CATEGORY	FREQUENCY	PERCENT (%)
ANC visit	Once	89	26.2
	2 times	119	35.0
	3 times	77	22.6
	⩾ 4 times	55	16.2
Iron tablets taken	Yes	194	62.6
	No	116	37.4
De-wormed during this pregnancy	Yes	44	12.9
	No	296	87.1
Taken contraceptive	Yes	267	78.5
	No	73	21.5
History of heavy menstrual cycle (⩾5 days)	Yes	37	10.9
	No	303	89.1
Birth interval	Primi-gravida	77	22.6
	<2 years	98	28.8
	⩾2 years	165	48.5
Trimester of pregnancy	First trimester	30	8.8
	Second trimester	239	70.3
	Third trimester	71	20.9
History of heavy blood loss in last delivery	Yes	16	4.7
	No	324	95.3

Abbreviations: ANC, antenatal care; n, sample size.

Out of all pregnant women who were tested, 24 (7.1%) confirmed that they were infected with *Plasmodium vivax (P.vivax)*, and 9 (2.65%) were infected with intestine parasites. Out of the 9 intestinal parasites infested pregnant women; 5 (1.47%), 2 (0.59%), and 2 (0.57%) were infected with *Ascaris lumbricoides, Entamoeba histolytica*, and *Giardia lamblia*, respectively (Table 3).

Hemoglobin concentration and prevalence of anemia

The mean hemoglobin concentration (±SD) was 12.17 (±1.57) g/dl with 95% confidence interval (CI) of 11.99 to 12.34 g/dl. The concentrations for the first, second, and third trimesters were 11.86 (±1.72), 12.34 (±1.52), and 11.72 (±1.61) g/dl, respectively. The overall prevalence of anemia was 24.1% (95% CI: 19.55-28.69). Out of all respondents, the prevalence of mild, moderate, and severe anemia was 51 (15.0%), 31 (9.1%), and 0%, respectively (Figure 1). Of anemic pregnant women, 10 (2.94%), 46 (13.53%), and 26 (7.65%) were in first, second, and third trimesters of pregnancy.

Factors associated with anemia

Those variables that had a *P*-value less than .25 on bi-variable logistic regression analysis were considered for multivariable logistic regression analysis to identify the independent predictors of anemia among pregnant women. Variables that qualified for multivariate regression analysis were; average monthly family income, gravidity, educational status of respondents, ANC visits, coffee consumption habit immediately after a meal, history of diagnosed chronic disease, iron tablet consumed during this pregnancy, malaria-infected, de-worming drug has been taken during this pregnancy, contraceptive has been taken prior to this pregnancy, DDS, HIV sero-status of respondent and history of the heavy cycle prior to this pregnancy.

The multivariable logistic regression analysis outputs confirmed that average monthly family income (*P*=.016), not attended formal education (*P*=.008), not consumed iron tablets during pregnancy (*P*=.006), and malaria infection (*P*=.0001) were independent predictors of anemia.

Table 3. Dietary diversity level, disease status, and related factors of pregnant women in AGH, Southern Ethiopia.

VARIABLE (N=340)	CATEGORY	FREQUENCY	PERCENT (%)
DD	Low	84	24.7
	Medium (Optimal)	134	39.4
	High	122	35.9
Coffee consumption	No cup of coffee	64	18.8
	1-6 cups of coffee per week	155	45.6
	1-2 cups of coffee per day	102	30.0
	⩾3 cups of coffee per day	19	5.6
HIV status	Sero-positive	51	15.0
	Sero-negative	289	85.0
P. vivax infected	Yes	24	7.1
	No	316	92.9
History of chronic diseases	Yes	9	2.6
	No	331	97.4
Intestine parasite infection	Yes	9	2.6
	No	331	97.4
History of surgery	Yes	22	6.5
	No	318	93.5

Abbreviations: DD, dietary diversity score; HIV, human immuno-deficiency virus; n, sample size; P. vivax, plasmodium vivax.
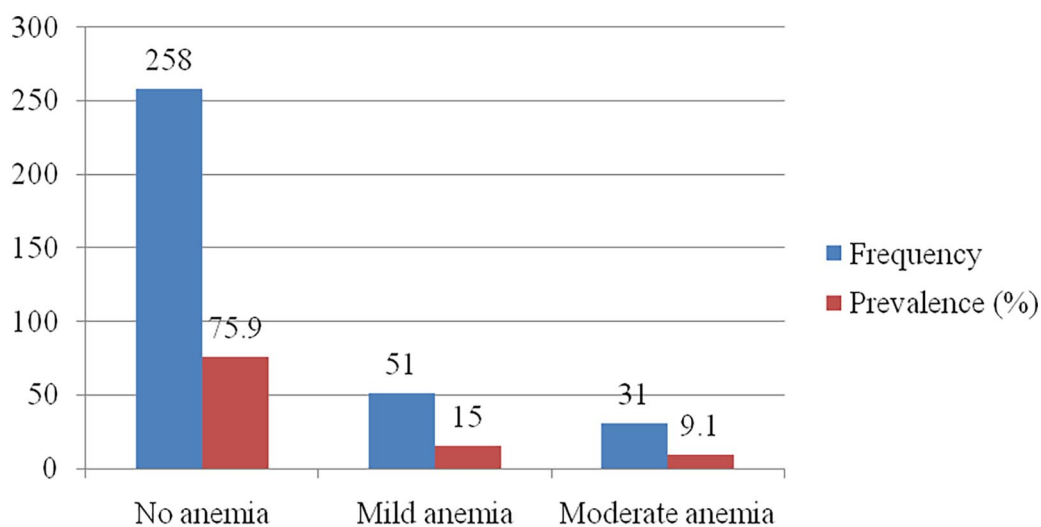
Figure 1. Anemia status and severity among pregnant women attending ANC clinic in Adare General Hospital, Sidama National Regional State, Ethiopia, 2020.

This study revealed that as the household income increased, the chances of being not anemic are also increased. Pregnant women with household monthly income less than or equal to 2550 ETB (⩽69.67 $US) (Adjusted odds ratio (AOR)=2.08; 95% CI: 1.15, 3.76) were 2 times more likely to be anemic as compared to those who had a monthly income of greater than 2550 ETB (>69.67 $US). Regarding the educational study, not attended formal education (AOR=3.86; 95% CI: 1.42, 10.54) were 3.8 times more anemic as compared to respondents who were educated high school and above. Compared to their counterparts, the odds of anemia were higher among pregnant women who not using iron tablets during pregnancy

Table 4. A bivariate and multivariate binary regression analysis output of the factors associated with anemia among pregnant women attending ANC in Adare General Hospital, Southern Ethiopia, 2020.

VARIABLE (N=340)	CATEGORY	ANEMIC STATUS		COR (95% CI)	AOR (95% CI)	*P*-VALUE
		NO (%)	YES (%)			
Monthly family income	≤2550 ETB (≤69.67 $US)	109 (42.2)	50 (61)	2.14 (1.29-3.55)	2.08 (1.15-3.76)	.016*
	>2550 ETB (>69.67 $US)	149 (57.8)	32 (39)	1	1	
Gravidity	Gravida 1 and 2	174 (67.4)	50 (61)	1	1	
	Gravida 3 and 4	74 (28.7)	25 (30.5)	1.18 (.68-2.04)	1.01 (.49-2.06)	.982
	Gravida 5 and above	10 (3.9)	7 (8.5)	2.44 (.88-6.73)	1.29 (.35-4.74)	.703
Educational status	Not attended formal education	43 (16.7)	28 (34.1)	3.91 (1.99-7.65)	3.86 (1.42-10.54)	.008*
	Elementary school	95 (36.8)	34 (41.5)	2.15 (1.16-3.97)	1.54 (.66-3.61)	.324
	Secondary school and above	120 (46.5)	20 (24.4)	1	1	
ANC visits	Once	56 (21.7)	33 (40.2)	3.46 (1.46-8.22)	2.11 (.72-6.18)	.173
	Two times	93 (36)	26 (31.7)	1.64 (.69-3.91)	1.44 (.53-3.93)	.473
	Three times	62 (24)	15 (18.3)	1.42 (.56-3.63)	1.37 (.46-4.09)	.578
	Four or more times	47 (18.3)	8 (9.8)	1	1	
Coffee consumption habit immediately after meal	No cup of Coffee	51 (19.7)	13 (15.8)	1	1	
	1-6 cups of coffee per week	121 (47)	34 (41.5)	1.10 (.54-2.26)	1.13 (.48-2.62)	.783
	1-2 cups of coffee	75 (29)	27 (33)	1.41 (.67-2.99)	1.60 (.67-3.85)	.294
	≥3 cups of Coffee	11 (4.3)	8 (9.7)	2.85 (.95-8.53)	1.88 (.46-7.64)	.378
Diagnosed chronic disease	Yes	5 (2)	4 (4.9)	2.59 (.68-9.90)	3.41 (.59-19.69)	.170
	No	253 (98)	78 (95.1)	1	1	
Used iron tablet	Yes	185 (71.7)	35 (42.7)	1	1	
	No	73 (29.3)	47 (57.3)	3.40 (2.03-5.69)	2.64 (1.33-5.27)	.006*
P. vivax infected	Yes	8 (3.1)	16 (19.5)	7.58 (3.11-18.47)	7.58 (3.11-18.47)	.0001*
	No	250 (96.9)	66 (80.5)	1	1	
De-wormed	Yes	37 (14.3)	7 (8.5)	1	1	
	No	221(85.7)	75 (91.5)	1.79 (.77-4.19)	1.55 (.56-4.26)	.395
Used contraceptive	Yes	198 (76.7)	69 (84.2)	1.61 (.83-3.11)	1.55 (.56-4.26)	.395
	No	60 (23.3)	13 (15.8)	1	1	
DDS	Low	55 (21.3)	29 (35.4)	3.01 (1.56-5.78)	1.24 (.46-3.29)	.673
	Medium	89 (34.5)	33 (40.2)	2.11 (1.14-3.93)	1.70 (.72-4.03)	.227
	High	114 (44.2)	20 (24.4)	1	1	
HIV sero-status	Positive	31 (12)	20 (24.4)	2.36 (1.26-4.43)	2.20 (.93-5.20)	.072
	Negative	227 (88)	62 (75.6)	1	1	
History of heavy menstrual cycle	Yes	24 (9.3)	13 (15.8)	1.84 (.89-3.80)	2.05 (.85-4.92)	.108
	No	234 (90.7)	69 (84.2)	1	1	

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; DDS, dietary diversity score; HIV, human immuno-deficiency virus; n, sample size; P. vivax, plasmodium vivax.

(AOR=2.64; 95% CI: 1.33, 5.27). Furthermore, this study reported also that those pregnant women who had been infected with malaria were 7 times more likely to be anemic (AOR=7.58; 95% CI: 3.11, 18.47). But the rest of the observed predictors were not significantly associated with the anemia in the multivariate regression analysis (Table 4).

Discussion

In the present study, the overall prevalence of anemia among pregnant women was 24.1% (95% CI: 19.55%-28.69%). According to the WHO classification of the public health importance of anemia,[8] it is a moderate public health problem. The findings of this study were in line with the WHO Ethiopia report of 2015 which states 23% of pregnant women in Ethiopia were anemic.[8] This study was also comparable with the studies done in Southeast Ethiopia 27.9%,[20] Mekele 19.7%,[30] North East Ethiopia 24.2%,[31] Gondar town 21.6%,[32] Southern Ethiopia 23.2%,[33] and Tikur Anbessa Specialized Hospital of Addis Ababa 21.3%.[34] The finding was higher than the studies done in Adigirat General Hospital of Ethiopia, 7.9%[35] and Saint Paul's Hospital Millennium Medical College of Addis Ababa, 11.6%.[36] But it is lower than the studies done in Shala woreda, Oromia National Regional State, Ethiopia 36.6%,[37] Wolaita Sodo, Southern Nations, Nationalities and Peoples Region (SNNPR), Ethiopia 39.94%,[38] Illu abbabori, Oromia National Regional State, Ethiopia 31.5%,[39] South Sudanese refugees 36.1%,[40] Arba Minch town, SNNPR, Ethiopia 32.8%,[41] North West Tigrai 36.1%,[42] South Eastern Nigeria 49.3%,[43] South West Ethiopia 53.9%,[44] Ethiopia Demographic and Health Survey 29.1%,[9] and Sidama National Regional State, Ethiopia 31.6%.[10,45] The Lower prevalence of anemia among pregnant women in this study is likely related to access to information about adequate nutrition during pregnancy, socio-economic factors, and accessibility of health care services as it was conducted in an urban area. This discrepancy could also result from the geographical variation of factors and differences in the study period and study design.

This study has assessed socio-economic variables associated with anemia but only family income (AOR = 2.08; CI: 1.15-3.76) and not attended formal education (AOR = 3.86; CI: 1.42-10.54) had shown statistically significant association with anemia which indicates the higher prevalence of anemia in pregnant women with low monthly family income and not attended formal education. Regarding family income, the current study showed increased odds of anemia was observed in pregnant women who have a lower monthly income. This finding is consistent with studies done in Wolaita Sodo, SNNPR, Ethiopia[38] and Arba Minch town, SNNPR, Ethiopia.[41] This implies that empowering women in income and decision-making power are essential strategies to decrease anemia risk and betterment of health status of pregnant women and the community as a whole. Regarding educational status, this study comes up with similar findings done in North East Ethiopia,[31] North West Tigrai of Ethiopia,[42] Tikur Anbessa Specialized Hospital of Addis Ababa,[34] and Sidama National Regional State, Ethiopia.[10] This high prevalence of anemia in pregnant women not attended formal education might be due to inadequate knowledge on factors causing anemia and on how to prevent the risk factors.

The current finding showed that malaria infection was significantly associated to anemia. The association is supported by systematic review.[46,47] The study conducted in the Gilgel Gibe dam area of Southwest Ethiopia[44] supports the current study. Another studies which were done in Azezo health center, Amhara National Regional State, Ethiopia[32] and Illu abbabori, Oromia National Regional State, Ethiopia[39] also support the current finding. This is due to the fact that failure to seek health care early, early diagnosis and treatment of malaria, and malaria infection itself might lead to increased red blood cell destruction and consequently, end up in anemia. Major transmission of malaria occurs in Ethiopia from September to December, following the major rains, and the data collection was done during this period (October 1-December 15) by laboratory-confirmed malaria test. Therefore this might contribute to the association of malaria with anemia.

In the present study, pregnant women who did not take iron supplementation were at a 2.6 times higher risk to be anemic as compared to pregnant women who took their iron supplementation (AOR = 2.64; 95% CI: 1.33-5.27). This result was consistent with other studies conducted in Arba Minch town, SNNPR, Ethiopia,[41] Saint Paul's Hospital, Addis Ababa,[36] North West Tigrai of Ethiopia,[42] Azezo health center, Amhara National Regional State, Ethiopia,[32] and Sidama National Regional State, Ethiopia.[10] The reason for this might be taking iron tablets can help pregnant women to increase their hemoglobin level, and as result helped them to prevent anemia.

Limitation of the Study

This study was aimed at assessing the prevalence of anemia and its determinants among pregnant women. However, the study was not free from some limitations. It was facility based and therefore, might not be possible to generalize the current findings to the entire pregnant women of Hawassa City. It lacks the qualitative part which in-depth explores women's perception about causes of anemia, and its prevention in pregnancy. In addition to that, possible reasons for the high point prevalence of HIV among the pregnant women in the study area was not assessed.

Conclusion and Recommendations

Almost one-fourth of pregnant women had anemia in this study. Anemia had moderate public health significance in the study area. Low monthly family income, educational status, use of iron tablet during pregnancy, and malaria infection were found to be predictors for anemia in pregnancy in our study. Therefore, the burden of anemia should be alleviated through enhancing maternal socio-economic status, prevention of illnesses like malaria targeting pregnant women, nutrition/diet counseling, and strengthening the expansion of prenatal iron-folate supplementation. Researchers should conduct further community based studies on assessing the factors affecting the prevalence of anemia and pregnancy related illness. Researchers should also include in-depth or focus group interviews of care providers and mothers to enhance understanding of women's perception on prevention mechanism of pregnancy related illness/anemia. Furthermore, we recommend researchers investigate why prevalence of HIV is greater than expected among pregnant women in this area.

Author Contributions

Study conceptualization, AP; data curation, AB and AP; methodology AB and AP; formal analysis, AB and AP; funding acquisition, AB; investigation, AB and AP, software, AB and AP; supervision, AB and AP; validation, AB; visualization, AB and AP; writing original manuscript, AP; review and editing, AB, and AP.

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