Anemia and Associated Factors among Iron-Folic Acid Supplements User and Non-user Pregnant Women at Debark General Hospital, Northwest Ethiopia

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Abstract

Background: Anemia is one of the most serious medical disorders that can affect pregnant women and raises the risk of preterm birth, low birth weight, and fetal abnormalities. Currently, most women visiting antenatal care clinics are receiving iron-folic acid supplements. However, a significant number of pregnant women may not receive it due to several factors. Therefore, this study aimed to assess the magnitude of anemia and its associated factors in iron-folic acid supplements user and non-user pregnant women in Debark General Hospital, Northwest Ethiopia.

Methods: An institutional-based cross-sectional study was conducted among randomly selected 391 pregnant women who visited Debark General Hospital, Northwest Ethiopia from March to April 2022. Data were collected through face-to-face interviews, assessment of food consumption score, nutritional status, and hemoglobin determinations using a structured questionnaire. Data were analyzed using Statistical Package for Social Sciences 23 statistical software for statistical analysis. The factors related to anemia were identified using multivariable logistic regression models.

Results: The magnitude of anemia was 20.8 % (95% CI; 15.8, 26.2) among iron-folic acid supplement users, and 46.6% (95% CI; 38.2- 55.0) among iron-folic acid supplement non-users who were anemic. Pregnant women who had no iron-folic acid supplements (IFAS) adherence with antenatal care follow-up (AOR=3.85, 95% CI: 1.29-11.43), meal frequency ≤ 2 times per day (AOR= 3.55, 95% CI: 1.64, 7.71) and mid-upper arm circumference (MUAC) of mothers of < 23 centimeters (AOR=4.19, 95% CI: 2.0, 8.78) were factors associated with anemia among iron-folic acid supplement users. On the other hand, pregnant women with low dietary diversity (AOR=3.47, 95% CI: 1.46-8.21), Middle upper arm circumstance of mothers of < 23 centimeters (AOR=3.65, 95% CI: 1.12, 11.9) were significantly associated with anemia among IFAS non-users.

Conclusions: Anemia was a major health problem among both iron-folic acid supplement users and non-user pregnant women in the study area. Therefore, there should be routine screening for anemia for all iron-folic acid supplement users and non-user pregnant women by considering meal frequency, iron-folic acid supplement adherence, and food consumption for early diagnosis and management.

Keywords: Anemia, Associated factors, Folate, Iron, Pregnant women

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Introduction

Anemia is a condition in which the number of red blood cells or hemoglobin (Hgb), concentration within them is lower than normal (WHO, 2017). It is a significant issue for public health that is linked to a higher risk of morbidity and mortality, particularly in women and young children. Worldwide, it has been reported that nearly 510,000 maternal deaths occur per year associated with childbirth or early postpartum. Approximately 20% of maternal death is caused by anemia; with the majority of deaths occurring in low-income countries (Crawley, 2004). Maternal anemia accounts for 18% of perinatal deaths, 19% of premature births, and 12% of low-birth-weight infants in low- and middle-income countries (Rahman *et al.,* 2016).

Globally, the prevalence of anemia among pregnant women is 36.8% (Karami *et al*., 2022). The highest prevalence was observed in West Africa (56%), South Asia (52%), and East Africa (36%) (Stevens *et al.,* 2013). The pooled prevalence of anemia among pregnant women in Ethiopia and the Amhara region

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was estimated to account for 31.7% and 15.89%, respectively (Kassa *et al.,* 2017).Nutritional deficiency (iron, vitamin, and folate deficiencies), infectious diseases such as malaria, and untreated genetic hemoglobin disorders are among the significant factors contributing to maternal anemia (Baloch *et al*., 2022; Black *et al*., 2013).

According to the world health organization (WHO), Iron-Folic-Acid Supplements (IFAS) during pregnancy decreased the risk of all types of maternal anemia at term by 70% (WHO, 2012). However, Poor adherence to supplement, side effects on the gastrointestinal tract, inadequate supply of tablets, lack of health care provider consultation for pregnant women, poor use of antenatal care services, ANC visits, nutrition counseling, and lack of awareness about IFAS hinder the intake of folate iron during pregnancy (Assefa *et al*., 2019; Birhanu *et al*., 2018; Jikamo & Samuel, 2018; Juma *et al*., 2015).

The utilization of IFAS in pregnant women ranged from 18% to -83.8 % in Ethiopia (Haile *et al*., 2017; Liyew & Teshale, 2020; Ridwan & Shafi, 2021; Tamirat *et al*., 2022). However, there is a paucity of timely evidence on the magnitude of anemia and its associated factors among IFAS user and non-user pregnant women in Ethiopia, particularly in the study area. Therefore, this study aimed to assess the magnitude of anemia and associated factors among iron-folic acid supplements user and non-user pregnant women at Debark General Hospital, Northwest Ethiopia.

Materials and Methods

Study Setting, Design, and Period

An institutional-based cross-sectional study was conducted in Debark town, Amhara Regional State, in northwest Ethiopia from March to April 2022.The town is 828 kilometers from Addis Ababa, the capital of Ethiopia, and about 260 kilometers from Bahir Dar city, the capital of Amhara regional state. It has a latitude and longitude of 13°08′ N and 37°54′ E and an elevation of 2850 meters above sea level. The town had three Kebeles and a total population of 25,350. According to the zonal health office, among all women residing in the town, 20.96% (17, 968) of them were of reproductive age, and 5604 were estimated to be pregnant. The town contained one hospital, two health centers, six pharmacies, and two health posts. The majority of maternal health services, such as antenatal care, labor delivery, postnatal care, and vaccination services are offered free of charge in the health institutions (Zeleke & Bayeh, 2022).

Population, Inclusion/ Exclusion Criteria

The source populations were all pregnant women attending ANC services at Debark General Hospital during the study period. All pregnant women in 2nd and 3rd trimesters were included in the study. On the other hand, pregnant women who were severely ill unable to respond to the questionnaire were excluded.

Sample Size and Sampling Technique

The sample size was calculated using Open Epi Info 7.2.5 statistical software assuming the following assumptions: 95% confidence level, 80% power, equal unexposed to the exposed ratio (1:1), the proportion of anemia among non-users (36.3 %) and users (15.9 %) (Tang *et al*., 2016) and 10% non-response rate. Final sample size of 391, prior to the data collection period, 831 pregnant women (624 users and 207 non-users) had been registered in the Debark General Hospital's prenatal registry within the previous six months. Sampling frames were created and the number of study participants to be included in the study was determined for each of user and non-user by probability proportion allocation to size sampling, followed by simple random sampling (Fig 1).

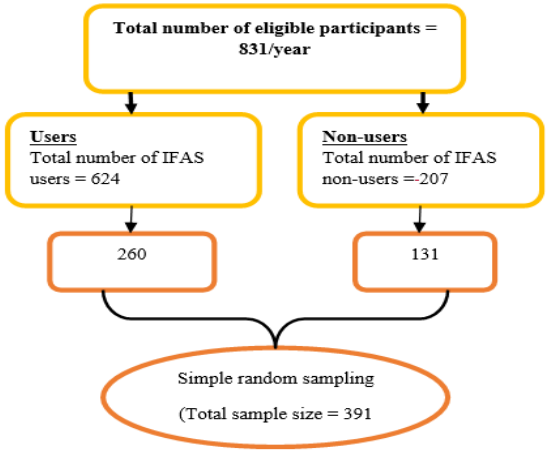

Figure-1; Schematic representation of sampling procedure.

Data Collection Techniques

Data were collected by the following method;

Face-to-face interview: was conducted by two experienced midwives using structured questionnaires developed by reviewing the literature (Gebremariam *et al*., 2019; Juma *et al*., 2015; Nasir *et al*., 2020; Tamirat *et al*., 2022; Tang *et al*., 2016). The questioner used to obtain socio-demographic characteristics, maternal obstetric history, dietary intake, maternal habits, and the history of chronic illness.

Food consumption score assessment; eight dietary groups were included: cereals/grains/tubers (2), pulses (3), vegetables (1), fruits (1), meat/fish/egg (4), milk/milk products (4), sugar/honey (0.5), and fat/oil/butter (0.5) with their corresponding proportionate weights (based on relative nutritional value) were used to assess household frequency of consumption of various food groups during the seven days prior the interview.

Nutritional status assessment: was made by measuring middle upper arm circumference (MUAC) using measuring tape (ShorrTape© Measuring Tape). It was measured in duplicate to 0.1- cm precision. A third measurement was performed, and the mean of the two closest measurements was calculated when the first two measurements were > 0.5 cm apart.

Hemoglobin level measurement: of the participants were measured by two experienced laboratory professionals using the HemoCue HB-301 system (HemoCue HB-301 analyzer, Sweden). One µl of capillary blood was collected from all participants, filled into a microcuvette, wiped off excess blood from the outside of the micro cuvette tip, and then placed in the cuvette holder of the device for measuring hemoglobin concentration in g/dl.

Blood film examination: Six and two µl of capillary blood were taken from all participants for thick and thin blood film preparation, respectively (WHO, 2010). The thin films were fixed with absolute methanol, and both thick and thin smears were stained using the 10 % Giemsa stain for 10 minutes. After the slides were dried, the examination was conducted microscopically (100x objectives) to investigate plasmodium species.

Operational Definition

Adherence: Pregnant mothers who consumed at least one tablet daily for four days in the week consecutively or consumed 20 tablets of the prescribed doses daily in a month (Boti *et al*., 2018).

Minimum dietary diversity score: was defined as the number of food groups consumed by the pregnant mother (FAO, 2016).

Data Quality Control

A questionnaire was first prepared in English language and translated into the local language (Amharic) and then back to the English language. Training was given to data collectors and supervisors on methods of obtaining consent, study objectives, contents of the questionnaire, interviewing technique, and MUAC measurement procedures. A week before the actual data collection, 5% of the questionnaires were pre-tested among pregnant women at the Dabat Primary Hospital, which is about 27.2 kilometers from the study area. The questionnaire was checked for completeness and consistency at the end of each data collection date. Standard operating procedure (SOP) was strictly followed for all laboratory activities. The sensitivity and specificity of the HemoCue machine were checked by a complete blood count machine (Coulter DxH 800 analyzer). Positive malaria slides were stained with Giemsa to ensure the Giemsa's quality. Two experienced laboratory professionals examined the blood films and stool specimens. An experienced third laboratory professional double-checked any result that might be arguable to identify the malaria species in the blood film examination.

Data Processing and Analysis

Data were entered into Epi data version 3.1, cleaned, and exported to Statistical Package for Social Sciences (SPSS) 23 software for analysis. Descriptive analysis was conducted to describe the percentages and number distributions of the respondents. The households' food consumption score was divided into three categories: poor (0–21), borderline (21.0–34.99), and acceptable (≥35) (CSA & WFP, 2019). Pregnant women having MUAC< 23 cm were considered undernourished and ≥ 23 cm were non-malnourished (Tang *et al*., 2016).

Hemoglobin values were adjusted for altitude as proposed by the WHO. Adjusted Hgb concentration was calculated as Hgb = -0.032∗ (altitude in meters ∗ 0.0033) + 0.022 ∗ (altitude in meters ∗ 0.0033)2 for an average altitude of the Debark town (2850 m)

above sea level. Then finally, 1.6 g/ dl was subtracted from an individual-measured Hgb to obtain adjusted Hgb concentration values. Anemia was defined as a hemoglobin level of less than 11 g/dl based on WHO criteria (WHO, 2018). Bivariable and multivariable logistic regression analysis was used to identify factors associated with anemia. Variables with p-value < 0.25 in the bivariable analysis were included in the multivariable logistic regression analysis. Finally, a variable P-value of < 0.05 at a 95% confidence interval was a statistical significance factor associated with anemia.

Ethical Consideration

Ethical clearance was obtained from Haramaya University College of Health and Medical Sciences Institutional Health Research Ethical Review Committee, with reference number (IHRERC-039-2022).

An informed written and signed consent/assent was obtained from all study participants. All standard infection prevention control measures were used during the data collection process to protect data collectors and participants from COVID-19. Personal identifiers were excluded during the data collection to assure confidentiality. Obstetric and maternal health information obtained from the study participants was kept strictly confidential. Anemic pregnant women were instantaneously linked to the physicians for appropriate treatment and follow-up.

Results

Socio-Demographic Characteristics of Participants

A total of 391 pregnant women (260 IFAS users and 131 non-users) participated in this study, with a response rate of 100%. The mean age of IFAS users and non-users was 26.0 years (Standard Deviation (SD) = ±4.9) and 25.05 years (SD= ±5.1), respectively which ranges between 25-35 years. The mean family size of IFAS users and non-users was 4.4 (SD = ± 0.079) and 4.6 (SD = ± 0.122), respectively. The majority of IFAS users (64.6%) and non-users (72.5%) were urban dwellers. Regarding their educational status, 72.3% of IFAS users and 74.8% of non-users were educated. About 58.1% of IFAS users and 59.5% of non-users were unemployed (Table 1).

Table 1: Socio-demographic characteristics of study participants at Debark General Hospital, Ethiopia, 2022 (n= 391).

Variable	Categories	Users (n = 260) N (%)	Non-users (n=131) N (%)
Age (in years)	15-24	106(40.8)	56(42.8)
	25-35	142(54.6)	73(55.7)
	36-49	12(4.6)	2(1.5)
Family size	≤5	216(83.1)	109(83.2)
	>5	44(16.9)	22(16.8)
Residence	Urban	168(64.6)	95(72.5)
	Rural	92(35.4)	36(27.5)
Educational status	Uneducated	72(27.7)	33(25.2)
	Educated	188(72.3)	98(74.8)
Occupational status	Employed	109(41.9)	53(40.5)
	Unemployed	151(58.1)	78(59.5)

Maternal Obstetric Characteristics

Nearly two-thirds (62.3%) of IFAS users were in the third trimester, while more than half (59.5%) of IFAS non-users were in the second.

The majority (81.9%) of IFAS users and 70.2% of non-users had no excess menstrual bleeding (p = 0.008) (Table 2).

Table 2: Maternal obstetric characteristics of study participants in Debark General Hospital, Ethiopia, 2022 (n=391)

Variable	Categories	User (n= 260) N (%)	Non-users (n= 131) N (%)
Gestational age of the mother	2nd Trimester	98(37.7)	78(59.5)
	3rd Trimester	162(62.3)	53(40.5)
Gravidity	Less than two times	90(34.6)	50(38.2)
	Two and above times	170(65.4)	81(61.8)
Parity	None	92(35.3)	54(41.2)
	Primipara	55(21.2)	29(22.2)
	Multi-para	113(43.5)	48(36.6)
	primigravida	88(33.8)	51(38.9)
Pregnancy Gap in years	< 2	40(15.4)	20(15.3)
	≥ 2	132(50.8)	60(45.8)
Excess menstrual bleeding	Yes	47(18.1)	39(29.8)
	No	213(81.9)	92(70.2)
History of abortion	Yes	44(16.9)	28(21.4)
	No	216(83.1)	103(78.6)

Dietary and Maternal Health Characteristics

The majority of (70.8%) IFAS users and 70.2% of non-user pregnant women had three or more meals per day. Above half (60%) of IFAS users and 58.8% of non-users had adequate dietary diversity during pregnancy. About 85.4% of IFAS users and 90.1% of non- were used tea or coffee. The majority of (79.2%) IFAS users and 81.7% of non-user had MUAC measurements ≥ 23 cm (Table 3). Consumption of meat, eggs, and milk products was higher in IFAS non-user than users, while intake of grains was relatively higher in the IFAS users (Figure 2).There were significant differences in the intake of meat (p = 0.04), (p = 0.01), milk and milk products (p < 0.001), (p = 0.04), (p = 0.01), milk and milk products (p < 0.001), and grains (p = 0.04) between IFS users and non-users.

Magnitude of Anemia in IFAS Users and Non-users

The overall magnitude of anemia among IFAS users and non-users of pregnant women was 29.4% (95% CI=24.8-34.0). The proportion of anemia was 20.8% (95% CI=15.8, 26.2) and 46.6% (95% CI=38.2, 55.0) among IFAS users and non-users, respectively.

The adjusted mean Hgb level of IFAS users and non-users was 11.6 g/dl (SD = ± 0.91) and 11.13 g/dl (SD = ± 1.29), respectively.

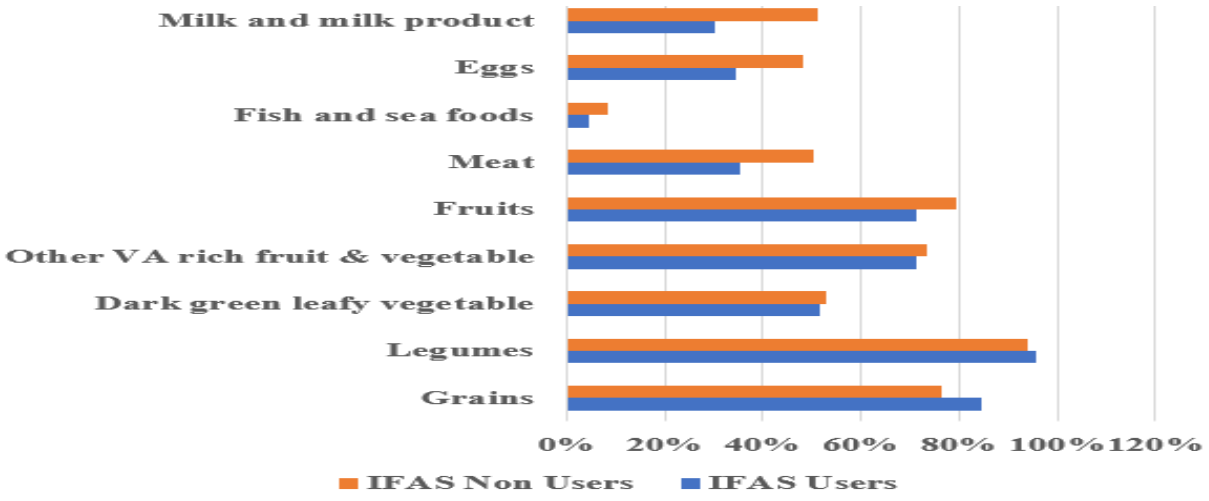

Figure 2: Percentage of food groups consumed in the past 24 hours in iron-folic acid supplement user and non-user pregnant women in Debark General Hospital, Northwest Ethiopia, 2022 (n= 391).

Table 3: Dietary habit and maternal health characteristics of study participants in Debark General Hospital, Ethiopia, 2022 (n= 391)

Variables	Categories	Users (n= 260) N (%)	Non-users (n= 131) N (%)
Meal frequency per day	Three times and above	184 (70.8)	92 (70.2)
	Two times and less	76 (29.2)	39 (29.8)
Dietary diversity	Yes	156(60)	77(58.8)
	No	104(40)	54(41.2)
Intake of tea and coffee	Yes	222(85.4)	118(90.1)
	No	38(14.6)	13(9.9)
Presence of chronic disease	Yes	20(7.7)	12(9.2)
	No	240(92.3)	119(90.8)
Current malaria illness	Presence	13(5)	4(3.1)
	Absence	247(95)	127(96.9)
Current hookworm infection	Presence	9(3.5)	6(4.6)
	Absence	251(96.5)	125(95.4)
MUAC (cm)*	< 23	54(20.8)	24(18.3)
	≥ 23	206(79.2)	107(81.7)

MUAC: Middle Upper Arm Circumference

Factors Associated with Anemia in IFAS Users

In bivariable analysis; family size, residence, educational status, occupation, gravidity, ANC follow-up with no IFAS adherence, meal frequency per day, dietary diversity, history of abortion, and MUAC measurement were considered as candidates for multivariable logistic regression analysis. In multivariate logistic regression, ANC follow-up with no IFAS adherence, meal frequency per day, and MUAC measurement were associated with anemia ($p < 0.05$).

The odds of anemia were more than three times higher among ANC follow-ups with no IFAS adherence than those who had adherence to IFAS (AOR=3.85; 95% CI=1.29, 11.43). Pregnant women who had meal frequency ≤ 2 times per day were more than 3 times more likely to develop anemia than those who had meal frequency ≥ 3 times per day (AOR= 3.55; 95% CI=1.64, 7.71). Furthermore, pregnant women with MUAC < 23 cm were four more likely to develop anemia than counterparts (AOR=4.19; 95% CI=2.0, 8.78) (Table 4).

Table 4: Factors associated with anemia in iron and folic acid supplement user pregnant women in Debark General Hospital, Ethiopia, 2022

Variables	Categories	Anemia (n= 260)		COR (95% CI)	P-value	AOR (95% CI)
		Yes n (%)	No n (%)			
Family size	≤ 5	40(18.5)	176(81.5)	1		1
	> 5	14(31.8)	30(68.2)	2.05(0.99, 4.22)	0.050	1.88 (0.78, 4.54)
Residence	Urban	29(17.3)	139(82.7)	1		1
	Rural	25(27.2)	67(72.8)	1.78 (0.97, 3.29)	0.060	0.86 (0.35, 2.09)
Educational status	Educated	35(18.6)	153(81.4)	1		1
	Uneducated	19(26.4)	53 (73.6)	1.57 (0.83, 2.97)	0.170	0.54 (0.22, 1.3)
Occupational status	Employed	14(12.8)	95 (87.2)	1		1
	Unemployed	40(26.5)	111(73.5)	2.44 (1.25, 4.76)	0.009	1.87 (0.78, 4.47)
Gravidity	< 2	13(14.4)	77(85.6)	1		1
	> 2	41(24.1)	129(75.9)	1.88 (0.95, 3.73)	0.070	1.58 (0.71, 3.52)
IFAS adherence	Yes	45 (18.8)	195(81.3)	1		1
	No	9(45)	11(55)	3.54 (1.39, 9.06)	0.008	3.85 (1.29, 11.43)
History of abortion	Yes	12(27.3)	32(72.7)	1.55 (0.74, 3.27)	0.240	0.91 (0.37, 2.20)
	No	42 (19.4)	174(80.6)	1		1
Meal frequency per day	≥ 3	24(13)	160(87)	1		1
	≤ 2	30(39.5)	46(60.5)	4.35 (2.32, 8.15)	<0.001	3.55 (1.64, 7.71)
Dietary diversity	Yes	23(14.7)	133(85.3)	1		1
	No	31(29.8)	73(70.2)	2.45 (1.33, 4.52)	0.004	1.24 (0.58, 2.63)
MUAC (cm	< 23	24(44.4)	30(55.6)	4.69 (2.42, 9.09)	<0.001	4.19(2.0, 8.78)
	≥ 23	30(14.6)	176(85.4)	1		1

IFAS; iron-Folic Acid Supplement, MUAC; Middle Upper Arm Circumference, COR; Crud, Odds Ratio, AOR; Adjusted odds Ratio

Factors Associated with Anemia in IFAS non-Users

In the bi-variable logistic regression analysis, family size, residence, educational status, occupation, household monthly income, gravidity, care follow-up, meal frequency per day, dietary diversity, and MUAC was a candidate for multivariable logistic regression analysis. In multivariable logistic regression, dietary diversity during this pregnancy, and MUAC measurement had a significant association with anemia. Pregnant women who did not use dietary diversity during this pregnancy were more than three times more likely (AOR=3.47, 95% CI=1.46, 8.21), to develop anemia than those who use dietary diversity during pregnancy. Pregnant women with MUAC of < 23 centimeters were more than three times higher odds (AOR=3.65, 95% CI=1.12, 11.9) to develop anemia than those who had MUAC of ≥ 23 centimeters (Table 5).

Table 5: Factors associated with anemia in iron-folic acid supplement non-user pregnant women in Debark General Hospital, Ethiopia, 2022.

Variables	Categories	Anemia (n= 131)		COR (95% CI)	P-value	AOR (95% CI)
		Yes n (%)	No n (%)			
Family size	≤ 5	47 (43.1)	62 (56.9)	1		1
	> 5	14 (63.6)	8 (36.4)	2.31 (0.89, 5.96)	0.080	1.53 (0.46, 5.07)
Residence	Urban	36 (37.9)	59 (62.1)	1		1
	Rural	25 (69.4)	11(30.6)	3.72 (1.64, 8.47)	0.002	1.56 (0.45, 5.35)
Educational status	Uneducated	21(63.6)	12 (36.4)	2.54 (1.12, 5.74)	0.025	1.03 (0.3, 3.52)
	Educated	40 (40.8)	58 (59.2)	1		1
Occupational status	Employed	21(39.6)	32 (60.4)	1		1
	Unemployed	40 (51.3)	38 (48.7)	1.6 (0.79, 3.25)	0.190	0.98(0.34, 2.78)
Monthly Income (ETB)	≤ 2900	37 (51.4)	35 (48.6)	1.54 (0.77, 3.09)	0.220	1.01 (0.38, 2.66)
	>2900	24 (40.7)	35 (59.3)	1		1
Gravidity	< 2	20 (40.0)	30 (60.0)	1		1
	> 2	41(50.6)	40 (49.4)	1.53(0.75, 3.14)	0.230	1.0 (0.42, 2.42)
ANC follow-up	Yes	38 (42.2)	52 (57.8)	1		1
	No	23 (56.1)	18 (43.9)	1.75 (0.83, 3.68)	0.140	1.07 (0.43, 2.66)
Meal frequency per day	≥ 3	35 (38.0)	57(62.0)	3.26(1.48, 7.16)	0.003	1.32(0.46, 3.83)
	≤ 2	26 (66.6)	13(33.4)	1		1
Dietary diversity	Yes	24 (31.2)	53 (68.8)	1		1
	No	37(68.5)	17(31.5)	4.8 (2.27, 10.17)	<0.001	3.47 (1.46, 8.21)
MUAC (cm)	< 23	19 (79.2)	5 (20.8)	5.8 (2.04, 16.9)	0.001	3.65 (1.12, 11.9)
	≥ 23	42 (39.3)	65 (60.7)	1		1

ETB; Ethiopian Birr, ANC; Antenatal Care, MUAC; Middle Upper Arm Circumference, COR; Crud, Odds Ratio, AOR; Adjusted odds Ratio

Discussion

The overall magnitude of anemia among pregnant women was 29.4% which is 20.8% and 46.6% among IFAS users and non-users, respectively. Meal frequency ≤ 2 times per day, no IFAS adherence with ANC follow-up, and undernourished women were identified as associated factors of anemia among IFAS user pregnant women. Low dietary diversity, and undernourished women were identified as associated factors of anemia among IFAS non-user pregnant women.

In this study, the overall magnitude of anemia among pregnant women was 29.4%. It was a moderate public health problem according WHO classification (WHO, 2011). The current findings were concordant with the study conducted in Southeast, Ethiopia (27.9%) (Kefiyalew *et al*., 2014), India (34.0%) (Vindhya *et al.,* 2019), and China (32.6%) (Zhang *et al*., 2009). However, it was lower than the previous studies conducted in eastern Ethiopia (56.7%) (Addis Alene & Mohamed Dohe, 2014), southern Ethiopia (61.6%) Lelissa *et al*., 2015), Nigeria (40.4%) (Dim & Onah, 2007), Ghana (51%) (Acheampong *et al.,* 2018), Kenya 40% (Siteti *et al*., 2014), and higher than other similar studies conducted in different parts of Ethiopia which ranges from 22.2% to 28.7% (Argaw *et al.,* 2020; Worku Takele *et al*., 2018). This inconsistency is due to differences in laboratory methods, the nutritional status of mother, dietary consumption, and awareness of pregnant mother about anemia and prevention practice, accessibility to quality health services, the availability of IFAS, and maternal adherence to IFAS.

The magnitude of anemia was significantly higher among IFAS non-user (46.6%) than among users (20.8%). This report is supported by previous studies from Ethiopia (Alem *et al.,* 2013; Gebremariam *et al*., 2019; Melku *et al*., 2014; Nasir *et al.,* 2020). It has been reported that the intake of supplements containing iron or a combination of iron and folate by pregnant women improves maternal anemia and pregnancy outcomes (Peña-Rosas & Viteri, 2009)

In the present study, IFAS users who had meal frequency ≤ 2 times per day were more likely to develop anemia. This is supported by reports from northern Ethiopia which found meal frequency was directly

associated with anemia during pregnancy (Yesuf & Agegniche, 2021). This might be because pregnancy is a critical period with increased energy and a nutritionally demanding period in a woman's life and can be fulfilled with increased meal frequency per day (Abriha *et al*., 2014; Gebremedhin & Enquselassie, 2011).

Pregnant women who had no IFAS adherence with ANC follow-up were more likely to develop anemia. It was reported in previous studies that the impact of ANC follow-up, and good maternal nutritional status prevent anemia (Shitie *et al*., 2018; Worku Takele *et al*., 2018). For instance, women who began receiving ANC services may have more contact with medical professionals and may learn more about the perceived risks and benefits of IFAS to avoid anemia during pregnancy (Nasir *et al*., 2020).

In the present study, IFAS users and non-user pregnant women with MUAC< 23 cm were more likely to develop anemia. This finding was in line with previous studies (Argaw *et al.,* 2020; Deriba *et al*., 2020; Ghosh et al., 2019; Gibore *et al*., 2021). This could be because malnourished pregnant women are affected by micronutrient deficiency with household food insecurity, increasing trimester of pregnancy (Ghosh *et al*., 2019). Since consumption of low dietary diversity leads to malnourished (Torlesse *et al*., 2003).

The study's strength includes hemoglobin measurements, blood film, dietary diversity and other assessment. However, since it is a cross-sectional study, it cannot show the temporal relation between identified associated factors and anemia. Additionally, this hospital-based study cannot be generalized to the community. Recall bias might have been introduced in the assessment of some factors. The assessment of anima through biochemical tests like serum ferritin was not used.

Conclusion

Anemia was found in approximately one out of every five IFAS users and nearly half of IFAS non-users in this study, indicating that it is a moderate public health problem. Anemia was more prevalent in IFAS non-user pregnant women. Meal frequency ≤ 2 times per day, no IFAS adherence with ANC follow-up, and MUAC< 23 cm were associated with anemia among IFAS users. Likewise, not consuming additional meals during pregnancy, and MUAC of mothers < 23 cm were independently associated with anemia among non-user of IFAS. Therefore, there should be routine screening for anemia for all IFAS users and non-user pregnant women considering the factors like, meal frequency, IFAS adherence, food consumption, which help in early diagnosis, management and improving women's quality of life. For the future perspective, a cohort study with hemoglobin measurement and serum ferritin should be done to screen for anemia.

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Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

AA contributed towards conceiving and designing the study, acquisition of the data, analysis, interpretation, drafting and critical revision, and final approval of the manuscript. FW, MA and HA and contributed towards conceiving and designing the study, analysis and interpretation and final approval of the manuscript. KT contributed towards designing the study, acquisition of the data, analysis and interpretation of the data and final approval of the manuscript.

List of abbreviations

ANC: Antenatal Care, AOR: Adjusted Odds Ratio, CI: Confidence Interval, COR: Crude Odds Ratio, CSA: Central Statistical Agency, Hgb: Hemoglobin, IFAS: Iron- Folic acid supplements, MUAC: Mid - Upper Arm Circumference, WHO: World Health Organization.

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