Exploration of iron deficiency anemia and its associated factors among pregnant women seeking antenatal care in public health facilities of southwestern Ethiopia. A mixed study

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BACKGROUND: Anemia is a major problem in Ethiopia, affecting a large part of the population. Despite the importance of the problem, the causes of anemia, especially iron deficiency anemia, among pregnant women attending antenatal care (ANC) in the study area have been little studied. Therefore, the aim of this study was to investigate iron deficiency anemia and its associated factors in pregnant women seeking antenatal care in public health facilities in Southwest Ethiopia in 2023.

METHODS AND MATERIALS: A mixed facility-based cross-sectional study was conducted involving 364 pregnant women from selected health facilities in Ilubabor and Buno Bedele zones. Backward multiple logistic regression was used to analyze the relationship between dependent and independent variables, with statistical significance set at a *P* value less than .05.

RESULTS: In this study, the prevalence of iron deficiency anemia was found to be 21.4%. Several factors have been significantly associated with iron deficiency anemia including; presence of malaria parasite [AOR=15.8, CI=5.1−48.4], presence of Helminthes [AOR=8.1, CI=2.8−23.9], consumption of leafy vegetables less than once a day [AOR=3.4, CI = 1.5−13.3] and not taking iron supplements/consumption [AOR=2.2, CI=1.1−4.4].

CONCLUSION AND RECOMMENDATIONS: The overall prevalence of iron deficiency anemia in the study area suggests that, it is a moderate public health problem. In order to improve the nutritional status of women, routine and consistent nutritional advice, the establishment of regular preventive systems and the implementation of feedback mechanisms are recommended.

Key words: Buno Bedele zone, ilubabor zone, iron deficiency anemia, pregnant women, southwest Ethiopia

Introduction

According to the World Health Organization (WHO), anemia during pregnancy is defined as a hemoglobin (Hb) concentration below 11 g/dL.[1] It is characterized by a decrease in hemoglobin concentration (HBC), red blood cell count (RBC), packed cell volume (PCV) and subsequent decrease in tissue oxygen demand.[2] The definition of anemia in pregnancy is based on either hemoglobin or hematocrit concentration and can vary according to factors such as age, gender, height, smoking status, and pregnancy status.[3,4] The increased need for iron is related to increased requirement for iron in fetal growth and development as well as the increasing

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Why was this study conducted?
Previous studies in this area have not included enough variables to facilitate generalization. Additionally, southwest Ethiopia is currently experiencing a malaria epidemic in 2024. Therefore, the aim of this study is to determine the prevalence and associated factors of anemia among ANCs seeking women in health facilities in Southwest Ethiopia.

Key findings
The prevalence of anemia in southwest Ethiopia was 21.4%. The study identified factors like being infected with malaria and helminthes, inadequate consumption of vegetables, and inadequate consumption of iron supplementation were significantly associated with iron deficiency anemia among pregnant women.

What does this add to what is known?
This used qualitative study design in addition to quantitative one, which was not included in previous study.

maternal blood volume during pregnancy, which leads to a decrease in hemoglobin.[5]

Although anemia can have several causes, it is widely recognized that iron deficiency is the most important factor, accounting for approximately half of all cases of anemia during pregnancy.[6] The prevalence of iron deficiency anemia (IDA) is an indicator of the nutritional status of a community. Due to its impact on maternal and fetal mortality, physical activity and child growth and development, IDA is considered a key health indicator.[7] Recent studies on the economic costs of anemia have highlighted the significant burden of this disease and the cost-effectiveness of reducing iron deficiency anemia in children and pregnant women. These studies consider factors such as reduced productivity, health care costs, and lifetime costs associated with impaired cognitive development in infants who develop iron deficiency anemia during pregnancy. In a global burden of disease analysis, iron deficiency anemia was the third most common cause of disability-adjusted life years (DALYs) in women aged 15–49 years.[8]

According to the World Health Organization (WHO), in 2005, 1.62 billion people worldwide (24.8% of the world's population) suffered from anemia. Preschool children were the social group with the highest prevalence of anemia at 47.4%, followed by pregnant women at 41.8%. The prevalence of anemia in pregnant women is 68 percent worldwide. In Africa, its prevalence is estimated at 66.8%.[1,5] In Ethiopia, anemia is a major problem, affecting more pregnant women (22%) than lactating women (19%) and non-pregnant and non-lactating women (15%). Based on EDHS 2011 data, the prevalence of anemia in pregnant women in Oromia is 16%, which corresponds to the national prevalence.[9-12] The causes of anemia during pregnancy in sub-Saharan Africa are diverse and multifactorial. These include infections such as malaria (especially falciparum species), hookworm infection, and iron and folate deficiencies. Maternal and reproductive factors, health care factors and chronic diseases such as chronic kidney disease also contribute to anemia.[13]

There are several measures to prevent and treat iron deficiency anemia. These interventions include improving nutrition, iron fortification, iron supplementation and other public health measures such as control of helminthes infections and malaria. In addition, the expansion of health services is crucial.[14] The Centers for Disease Control and Prevention (CDC) recommends anemia screening for pregnant women and universal iron supplementation, which has been shown to be an effective public health intervention to meet iron needs during pregnancy, except in certain genetic disorders such as hemochromatosis.[15]

Despite the prevalence of the problem, there is insufficient research data on the factors associated with anemia among ANC mothers in southwestern Ethiopia. Previous studies in this area have not included enough variables to facilitate generalization. Additionally, southwest Ethiopia is currently experiencing a malaria epidemic in 2024. Therefore, the aim of this study is to determine the prevalence and associated factors of anemia among ANCs seeking women in health facilities in Southwest Ethiopia. This study included additional variables that were not considered in the previous study. This study can also provide necessary statistics to regional or regional health authorities and other stakeholders involved in maternal and reproductive services. These statistics can be used to design parasite control programs aimed at reducing the prevalence of anemia during pregnancy. This finding may also be valuable for the ANC program and services, which include routine screening of every pregnant woman for malaria and helminth infection in addition to hemoglobin measurement.

Methods and materials
Study area and period
The study conducted between May 2 and June 2, 2023, in public health facilities located in the Illubabor and Buno Bedele zones in southwestern Ethiopia. Illubabor is one of the 20 zonal administrations in the Oromia Regional State, approximately 600 km west of Addis Ababa, the capital city of Ethiopia. The total population of the zonal administration was recorded as 968,303 as of 2020, and it includes 14 rural woredas, 1 town administration, 23 urban kebeles, and 263 rural kebeles. The zone also has an adequate healthcare infrastructure, including 2 hospitals, 29 health centers, and 263 health posts, with a total of 1114 health workers across various professional categories, along with 606 supportive staff members.

On the contrary, Buno Bedele is a recently formed administrative division situated at a distance of about 480 kilometers from the Ethiopian capital, Addis Ababa. It consists of a municipal administration and nine rural districts,

and is expected to have a combined population of 815,437. The area is furnished with 3 functioning hospitals, one of which is currently being built, as well as 22 health centers and 246 health posts. Buno Bedele Zone, with an expanse of 5,856.5030 square kilometers, contains 1,126.64 square kilometers of forested terrain.

Study design and population

A mixed facility based cross sectional study was conducted. The Source populations were all pregnant mothers attending ANC in public health facilities of Ilubabor and Buno Bedele zones and the Study population were all pregnant mothers who came for ANC service in selected public health facilities of Ilubabor and Buno Bedele zones during the study period.

Sample size determination

The required sample size (n) was determined using single population proportion formula at a confidence level of 95%, value of a standard normal distribution score using 0.05 level of significance; expected prevalence of anemia in pregnant women was 31.5% in Ilu Aba Bor zone,[16] at d = 0.05, degree of precision desired. By applying this formula,

N $= \frac{z\alpha/2^2 p(1-p)}{d2}$ Where n= total sample size, Z= confidence interval, P= prevalence of anemia, d= margin of error. Sample size=332. By adding non response rate of 10%, a total sample size became **366.** For the qualitative part of the study, focused group discussion (FGD) and in depth interview (IDI) with 18 mothers in all health facilities were involved depending on idea saturation.

Sampling technique and procedures

We used a multistage sampling approach to select health facilities and study participants. Two hospitals and 7 health centers were initially randomly selected in the first phase. In the second phase, a systematic sampling technique was used to determine the evaluated units of study. The K-value was calculated using the mean of case flow among service personnel on the ANC registers in the selected health facilities during

the previous 3 months, resulting in N/n 1120/366=3. To select the first mother, the second mother was randomly selected, bypassing all 3 mothers, and all eligible participants who met the inclusion criteria were included until the final minimum sample size was reached (Figure 1).

Data collection procedures

The quantitative part of this study used a semi-structured questionnaire conducted through face-to-face interviews. The questionnaire was developed based on a review of relevant literature.[1,9,36] The questionnaire was originally written in English and then translated into the local language, Afan Oromo, and then translated back into English to ensure consistency. The data collection included nine bachelor's degrees in midwifery as data collectors and 4 master's degree holders as supervisors. To ensure consistency of variables, the questionnaire was pretested on 19 women (5% of the sample size) at Shenen Gibe General Hospital, located outside the study area. Make necessary adjustments or modifications based on pre-test results. The internal reliability of the questionnaire was evaluated using Cronbach's alpha and gave a value of 0.87, indicating validity and consistency.

Both data collectors and supervisors received training for 2 consecutive days before data collection began. The training included research objectives, the importance of confidentiality, and proper procedures for data collection. Completed questionnaires were collected daily during the data collection period, with supervisors providing timely feedback after checking the data for completeness and consistency. Monitor regularly to ensure the quality of the data collection process.

In the qualitative phase of the study, there were 2 components, separate focus group discussions (FGD) and in-depth interviews (IDI) with women and their husbands, both of which were conducted through the development of separate guidelines that were developed with the help of experts on literature search and qualitative research. Before the study itself, the interview guide was

pre-tested to reveal any errors in the research design. The guide contains open-ended semi-structured questions as well as surveys to explore a deeper understanding of anemia. A total of 18 pregnant women divided into 3 groups [6 members per group] participated in focus groups and 9 individual in-depth interviews (IDI) were conducted (one woman per institution) lasting an average of 30 minutes. The interview guide was originally written in English and later translated into the local language, Afan Oromo. The data was collected by trained qualitative researchers.
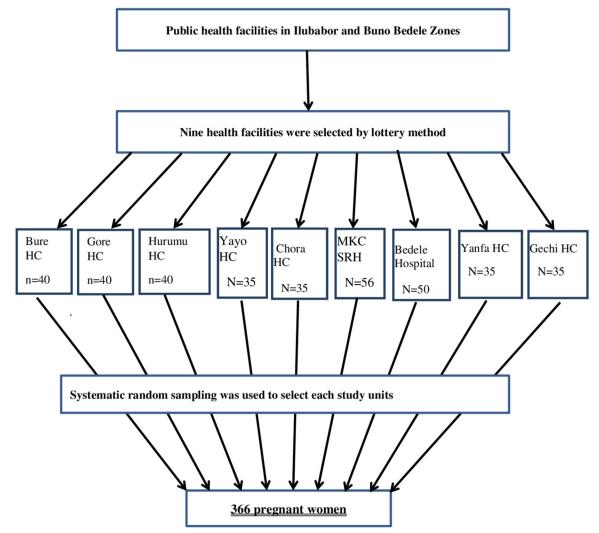
The collected data was analyzed using the software tool Atlas.ti.7.1. The audio recordings were transcribed verbatim and then translated into English to speed up the analysis process. The transcriptions were thoroughly read and reviewed multiple times to ensure a comprehensive understanding of the data. Following data collection, a debriefing session was conducted. Verbatim transcriptions of audio recordings were prepared and translated into English to aid in the analysis. The transcriptions were carefully reviewed multiple times to ensure a comprehensive understanding of the data. Once the line-by-line coding process was completed by principal investigators and the research assistant, the focus shifted to transcriptions containing the most extensive data relevant to the research questions. After establishing consistency among the coders, a codebook manual was developed. The principal investigator then meticulously coded all of the data. Through the process of clustering codes and categories, potential categories and themes were identified to address the study's subject matter. The codebook manual, along with the categories and topics, underwent refinement through 4 iterations of coding. Finally, the study's main themes, categories, and quotations extracted from the data were presented alongside the findings.

Data processing and analysis

The quantitative part of the study involved an in-depth examination of the data. Data were carefully checked for completeness and consistency before

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being cleaned, coded and entered into SPSS software for analysis. Afterwards, descriptive statistics such as frequencies and cross-tabulations were performed for further analysis. The results of the study were presented in various graphical representations such as pie charts as well as texts and tables. Multivariate logistic regression analysis considered all variables that were significant at the *p*-value of less than = .25 in bivariate logistic regression. Overall model fit was assessed using the Hosmer-Lemeshow test, which determined model fit. To test the presence or absence of collinearity

between them, a multicollinearity test was performed using the variance inflation factor (VIF), and the result showed no multicollinearity (mean VIF=2.59, minimum VIF=1.16, maximum VIF=5.22). The strength of the association between anemia and its explanatory variables was reported by adjusted odds ratios (AORs) with 95% confidence intervals (CIs) using backward logistic regression. In this study, a *P* value of less than .05 was considered to indicate a statistically significant association.

In the qualitative phase of the study, an inductive thematic approach was

used to analyze the data. Data were analyzed using Atlas.ti.7.1 software, which facilitated the creation of codes, groups, and themes.

Results
Quantitative analysis

Socio demographic characteristics of study participants. Three hundred sixty-six pregnant women were interviewed in this study, resulting in a 94.5% response rate. The mean age of the study participants was 24 years and SD 4.6. The average income of the

TABLE 1
Socio-demographic characteristics of pregnant women attending antenatal care at Ilubabor and Buno Bedele Zones, southwest Ethiopia, 2023 (n=346)

Characteristics	Frequency	Valid percent (%)
Age of participants in years		
15-24	55	15.9
25-34	237	68.5
35-45	54	15.6
Marital status		
Married	340	98.3
Single	6	1.7
Residence		
Urban resident	310	89.6
Rural resident	36	10.4
Educational status		
Unable to read and write	41	11.8
Primary school	103	29.8
Secondary school	127	36.7
Greater than secondary school	75	21.7
Occupation of the women		
Housewife	136	39.3
Merchant	44	12.7
Governmental employee	99	28.6
Students	56	16.2
Daily laborers	11	3.2
Monthly income (in ETB)		
<732 (under poverty)	49	14.2
732-2000 (low income)	129	37.3
>2000 (medium and high income)	168	48.6

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participants was 2000 ETB, of which the majority of 168 (48.6%) had an income of more than 2000 ETB (Table 1).

Obstetric and reproductive history. Among all participants, 163 (47.1%) of them where primigravida and average gestational age of the participants was 28 weeks, with a minimum of 9 weeks and a maximum of 38 weeks. Among the participants, 35 (10.1%) had a miscarriage or termination at least once in their life, and 92 (26.6%) of them experienced menstrual disturbances before the current pregnancy (Table 2).

Parasitic infections and chronic medical illness. Laboratory results showed that 25 (7.2%) of the participants had malaria infection and 28 (8.1%) had helminthic infection. Among these participants, there were 128 (37%) and 41 (11.8%) participants with malaria and helminthes infection in the past 3 months respectively. About 38 (11%) of those who participated in the study responded as they had chronic kidney disease (Table 3).

Nutrition and dietary behavior. Among the study participants, 250 (72.3%) of them ate meat or fish at least once per week, 90 (26%) of them less than once per week and 6 (1.7%) did not eat all. Among these, 149 (43.8%) were consumed and 191 (56.2%) of them have not consumed meat or fish during the last 24 hours. Similarly, 146 (42.2%), 114 (32.9%) and 86 (24.9%) of them were eating an egg at-least once per week, less than week and not at all respectively. Among this, 53 (15.3%) of were consumed and 293 (84.7%) of them were not consumed an egg during the last 24 hours. Regarding vegetable consumption, 85 (24.6%) of them consume green leafy vegetables at least once per day, 251 (72.5%) of them consume green leafy vegetables less than once per day and 10 (2.9%) of them were not consume green leafy vegetables at all. Among this, 212 (61.2%) of were consumed and 134 (39.8%) of them were not consumed the green leafy vegetables during the last 24 hours. Concerning fruits, 82 (23.7%) of the participants eats fruits at least once per day, 261 (75.1%) o them eats fruits less than once per day and 3 (1.2%) of them were not eats fruits at all. Among 346 participants, 194 (56%), 110 (31.8%), 25 (7.2%) and 17 (5%) of them consumes Injera with "wot" (cereals), porridge, porridge with fish and Injera with "wot & porridge" respectively. Regarding hot drinks 114 (32.9%) and 139 (40.2%) have habit of drinking tea and coffee after meal at least once per day respectively. Additionally, around 47 (13.6%) have 17−20.9 cm and 299 (86.4) have greater than 23 cm MUAC measurements respectively. Finally, around 89 [25.7%], 212 [61.3%] and 45 [13%] of them have BMI measurements of less than 18.5, 18.5−24.9, and greater than 25 respectively.

Healthcare service and medication history. In their current pregnancy, 247 (71.4%) of them took iron supplementation and 99 (28.6%) of them didn't take it. Similarly, 86(24.9%) of them were

TABLE 2

Obstetric and reproductive history of pregnant women attending antenatal care at Ilubabor and Buno Bedele Zones, southwest Ethiopia, 2023 (n=346)

Characteristics	Frequency	Valid percent (%)
Gestational age		
Less than 12 wk	22	6.4
13—27 wk	234	67.6
Greater than 28 wk	90	26
Bleeding during present pregnancy		
Yes	26	7.5
No	320	92.5
Parity		
0	163	47.1
1	80	23.1
2	58	16.8
3 up to 4	40	11.6
>=5	5	1.4
ANC follow up during last pregnancy		
No	187	54.04
Yes	159	45.96
Place for the previous delivery		
Health institution	161	46.5
At home	179	51.7
Other places*	6	1.8
Birth interval		
NA or not known	163	47.1
Less than 2 y	37	10.7
2—4 y	104	12.1
Greater than 4 y	42	12.1
Frequency of abortion		
Never aborted	311	89.9
One abortion	33	9.5
Two or more abortion	2	0.6
Contraceptive using		
Yes	236	68.2
No	110	31.8
Irregularity of menstrual cycle		
Yes	92	26.58
No	254	73.42

* Other places of delivery: indicates for the births happened simply on the roads NA: not addressed.

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dewormed and 260 (75.1%) of the women were not dewormed. Additionally, none of them were supplemented with Calcium.

Hemoglobin concentration of study participants [prevalence of iron deficiency anemia]

The prevalence of iron deficiency anemia during the current pregnancy was found to be 21.4%. Mean HBC values for pregnant women were 12.11 g/dL and SD + 1.36 with a maximum value of 14.5 g/dL and a minimum of 7.40 g/dL. Most of the participants 272 (78.6%) had normal HBC levels, 67 (19.4%) had mild anemia and the remaining 7 (2%) had moderate anemia.

Factors associated with iron deficiency anemia

Bivariate logistic regression analysis showed that various factors such as residence, average monthly income, gestational age, lack of ANC monitoring during the last pregnancy, menstrual irregularity before pregnancy, presence of malaria parasite, presence of egg parasite, history of malaria infection, consumption of fish or meat, egg, fruit, vegetable, coffee consumption, BMI, MUAC and iron supplementation were statistically associated with iron deficiency anemia during pregnancy with a p-value below 0.25. On the other hand, multivariate logistic regression analysis showed that factors such as presence of malaria and oocysts, vegetable and iron intake were significantly associated with iron deficiency anemia during pregnancy.

Women with malaria parasite infection were 15.8 times more likely to develop iron deficiency anemia during pregnancy than their counterparts (AOR=15.8, 95%, CI=5.1—48.4). The results of this study also showed that pregnant women with eggs (helminthic infection) were 8.1 times more likely to be anemic than those without helminthes infection (AOR=8.1, 95% CI=2.8—23.9).

This study also showed that pregnant women who ate vegetables less than once a day were 3 times more likely to develop anemia than those who ate

TABLE 3
Parasitic infection and chronic illness history of pregnant women attending antenatal care at Ilubabor and Buno Bedele Zones, southwest Ethiopia, 2023 (n=346)

Characteristics	Frequency	Valid percent (%)
Presence of malaria		
No	321	92.8
Yes	25	7.2
Types of malaria species		
Plasmodium Vivax	2	8
Plasmodium Falciparum	23	92
Presence of ova parasite (Helminthes)		
No	318	91.9
Yes	28	8.1
Types of ova parasites		
Hook worm	8	28.6
Ascaris lumbricoid	14	50
Trichuriasis	4	14.2
Ameobiasis and giardiasis	2	8.2
History of malaria infection during the last 3 mo		
No	218	63
Yes	128	37
Bed nets availability		
No	46	13.3
Yes	300	86.7
Bed nets utilization		
No	137	39.6
Yes	209	60.4
History of helminthes infection during past 3 mo		
Yes	41	11.85
No	305	88.15
History of chronic kidney disease		
Yes	38	10.98
No	308	89.02
Principal drinking water source		
Pipe to dwelling/premise	173	50
Stand pipe	159	45.9
Protected well or spring	5	1.4
Unprotected source	9	2.6

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vegetables at least once a day (AOR=3.4, 95% CI=1.5−13.3). In addition, this study showed that pregnant women who did not receive iron supplements during the current pregnancy were 2.2 times more likely to be anemic than their counterparts (AOR=2.2, 95% CI=1.1−4.4) (Table 4).

Qualitative analysis
The participants provided qualitative data by means of comprehensive in-depth interviews and focused group discussions. The analysis of the data resulted in the identification of 3 main themes through qualitative analysis. The factors discovered were classified into 3 main thematic categories in this study specifically; the presence of infection, inadequate vegetable consumption, and lack of iron supplementation/intake during pregnancy. Within the first theme, there were 2 sub-themes: the presence of malaria parasite and the presence of helminthes. Although the themes were considered distinct, there was a significant amount of overlap between them. Furthermore, the participants' responses to the interview questions often explored multiple aspects or topics. In such cases, the interview data were elaborated upon in a manner that corresponds to their most relevant context.

Presence of malaria parasite
In the study area there are malaria epidemics. Based on the results of the malaria screening, the mother was indeed suffering from malaria.

A mother who is 40 years old shared as, "I was expecting my fifth child, and my fourth child was lost due to a miscarriage at 4 months of pregnancy. The doctor diagnosed me with severe malaria. Throughout my pregnancy, I have been dealing with symptoms such as fever, chills, weakness, and dizziness. Even before becoming pregnant, I frequently suffered from sudden headaches. The doctor informed me that I currently have malaria."

Wezero kidist was 20 years old primigravida lady came for her first antenatal contacts. She said that "I do not know that I am pregnant now lacking energy because, I felt this symptom as soon as I got pregnant and I was healthier before marriage. Before pregnancy as a family we often use bed nets (Agobar). The midwife told me weakness is common for pregnant women. Now, after laboratory checkup they informed me that I have malaria and gave me some drugs. The

TABLE 4
Bi-variable and multivariable logistic regression analysis of association between factors associated iron deficiency anemia among pregnant women attending antenatal care at Ilubabor and Buno Bedele Zones, southwest Ethiopia, 2023 (n=346)

Characteristics	Presence of iron deficiency anemia (n=346)			
	Yes n (%)	No n (%)	COR (95%CI)	AOR (95% CI)
Place of residence				
Urban	62 (17.9%)	248 (71.7%)	1	1
Rural	12 (3.5%)	24 (6.9%)	2.0 (1.3−4.2)	1.6 (0.5−4.6)
ANC follow up during last pregnancy				
Yes	31 (8.96%)	128 (36.9%)	1	1
No	43 (12.43%)	144 (41.62%)	1.2 (1.1−4.6)	1.35 (0.42−4.32)
Irregularity of menstrual period				
Yes	27 (7.8%)	63 (18.2%)	1.91 (1.1−3.33)	1.661 (0.78−3.5)
No	47 (13.6%)	209 (60.4%)	1	1
Presence of malaria parasite				
Yes	**17 (4.9%)**	**8 (2.3%)**	**9.8 (4.1−23.9)**	**15.8 (5.1−48.4)***
No	57 (16.5%)	264 (76.3%)	1	1
Presence of ova parasite				
Yes	**16 (3.5%)**	**12 (8.1%)**	**10.7 (4.33−26.23)**	**8.1 (2.8−23.9)***
No	58 (16.8%)	260 (75.1%)	1	1
History of malaria infection				
Yes	37 (10.7%)	91 (26.3%)	1.9 (1.2−3.35)	1.7 (0.82−3.6)
No	37 (10.7%)	181 (52.3%)	1	1
Frequency of vegetable consumption				
At least once per day	6 (1.73%)	79 (22.83%)	1	1
Less than once per day	**68 (19.65%)**	**193 (55.78%)**	**4.6 (1.93−11.1)**	**3.4 (1.5-13.3)***
Frequency of coffee drinking				
At least once per day	44 (12.7%)	95 (27.5%)	4.2 (1.94-9.2)	1.7 (0.82−3.45)
Less than one per day	30 (8.7%)	177 (51.2%)	1	1
Iron supplementation/intake				
Yes	36 (10.4%)	211 (61%)	1	1
No	**38 (11%)**	**61 (17.6%)**	**3.2 (1.86-5.57)**	**2.2 (1.1-4.4)***

1 = reference group.

* Significant association at *P*-value <.05.

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mother said that in her family 2 persons were sufferings from malaria."

Presence of helminthes parasite

The anemia experienced by the study participants at this time was probably related to previous medical condition like intestinal worms or helminthes. From the interviews, it was also found that the informants had helminthes.

A 22 years old informant stated that "When I was a teenager, I often got severe abdominal pain. I got tired easily and I had bloody diarrhea. I went to the doctor and the doctor said I had giardia and anemia."

Wezero Bikiltu stated that "I was healthy before pregnancy. After I got pregnant, starting from 9 weeks of gestation I was experiencing fatigue, abdominal pain and occasional diarrhea and

when I went to toilet I was seeing some white worms in my stool. My father gave me some herbal drugs and the symptoms were disappeared for some weeks. However at 20 weeks I developed severe diarrhea and that is why I ame today. The midwife send me to laboratory wards, they took my stool and checked. After I came back to maternity ward, the midwife informed that I have intestinal parasite and anemia. They gave me this drug and instructed me to eat fruits and vegetables."

Lack of vegetables consumption

From interviews with informants, we found that the pattern of consumption illustrates the lack of intake of iron from the daily menu for pregnant women. The consumption of green vegetables as a source of iron was also low.

Wezero Temima stated that "I usually eat small portions. As a woman, I am lazy to eat vegetables. Eating vegetables cannot be right during pregnancy. My mother forbade me to eat vegetables, especially when I was young and pregnant. Because it tastes sweetly, so that it can result in vomiting and heartburn during pregnancy. Vegetable that can be eaten during pregnancy is just cabbage alone".

An 18 years old primigravida lady said that "In the family we live together and we are many in number. Generally I eat food after everyone eats in the family, sometime there will be no vegetables leftover; similarly weekly once we used to cook vegetables, in the end only I eat the morsel.

"As it was my second pregnancy nobody bothered about me whether I eat or not, even for vaccination I used to go on my own; To decrease the family burden I got married very early at 17 years and I was not well prepared for marriage and I got pregnant very soon I didn't know the importance of nutrition".

Iron supplementation during pregnancy

The informant lacked knowledge about the significance or advantages of consuming an iron supplement. A few individuals recognized the iron tablet provided by the midwife monthly as a means to boost blood levels. They shared a mutual understanding of the connection between blood levels and the monthly blood pressure readings. According to the participants, if their blood pressure is normal, they assume they are not anemic and therefore do not require the iron tablet distributed by the midwife. The informant further mentioned that they were never informed or educated by the midwife regarding the purpose of the iron pills during antenatal care.

A 32 weeks gravid uterus lady said that "Every month I do a pregnancy check-up with the midwife. The midwife gave me 90 tablets. The midwife said the drug was given for a blood booster. But I don't take the drugs because my blood pressure is normal, so why should I take the drug?"

Wezero Chaltu stated that "Iron tablets are medicine. I have heard information on television that states pregnant women should not take much drugs. If a pregnant woman eats a lot of drugs while pregnant, it can cause her child to have a disability. That's why I never ate the Iron tablets given by the midwife. I am afraid my fetus may be deformed. "

Also another 38 years old pregnant mother stated that" I am pregnant with my fourth child. However, the midwife never told me about the iron tablets. In the previous pregnancy I took few of the tablets and I felt severe vomiting, heart burn and indigestion. The midwife only gives tablets which in my opinion are medicines for pregnant women. The midwife just reminded me not to forget to take the medicine. So I don't want to take this red colored drug generally."

Finally wezero Tsehay stated that "Every month I check with the midwife, the midwife will measure my blood pressure and listen to my baby's heartbeat. There is a device stuck in my stomach. The midwife declared my child healthy. However, every checkup the midwife gave me medicine. I didn't know what medicine it was, the midwife never explained it. The midwife said, don't forget to take medicine so that the baby is healthier. I just want to know it's a blood booster, right? My friend said it was a blood booster, even though I didn't take it because my baby is healthy."

Discussion

We found that the prevalence of iron deficiency anemia during pregnancy was 21.4% (CI=19.26−23.54). This finding is lower than the results of 26.8% in European communities,[17] 38.6% in the United States,[18] 74.8% in India [19] and 32.8% in southern Ethiopia.[20] The observed differences can be attributed to differences in socio-demographic factors, socio-cultural practices during pregnancy, regional differences, misconceptions about nutrition during pregnancy, time differences between study periods, age differences between participants, differences in health care facilities, and the prevalence of other diseases that can cause anemia in different circumstances. The decrease in the incidence of anemia in this study could be explained by the consumption of foods containing fish and porridge (mainly from sprouted corn). This diet increases iron bioavailability and may affect anemia during pregnancy.

However, this study is consistent with studies conducted in northern Ethiopia (21.6%)[21] and the 2019 EDHS report on the prevalence of anemia among pregnant women in the Oromia region of Ethiopia [20%].[9] The observed consistency can be attributed to the closeness of the study periods, the similarity of the study settings, and the study design used. In this study, 90.5% and 9.5% of women with anemia were mild and moderate, respectively, which is similar to studies conducted in India [22] and eastern Ethiopia [23] where most pregnant women had mild anemia. A possible explanation is that iron deficiency often develops gradually, may not be easily detected in the early stages, and only becomes clinically apparent after the anemia becomes severe, despite the presence of functional impairment.

In our study, we identified 4 factors that were significantly associated with iron deficiency anemia. The top 2 factors found to be statistically significantly associated with a higher risk of iron deficiency anemia were malaria parasites and helminthes eggs. This finding was also observed in other studies.[24-26] Therefore, greater efforts are needed in areas where malaria is endemic to

prevent malaria during pregnancy. Consistent with other studies in sub-Saharan Africa [Burkina Faso], P. falciparum malaria is one of the main factors associated with anemia.[27,28] This finding is also similar to studies conducted in Mali [29] and Addis Ababa University.[30] Therefore, detection and treatment of malaria is essential to treat anemia and use insecticide-treated bed nets and other malaria control mechanisms to reduce the incidence of anemia in pregnant women.

In addition, the results of this study showed that pregnant women infected with worms were more anemic than non-infected women. This is consistent with studies conducted in SSA,[31] Rwanda,[32] Bushalo Health Center,[4] Azezo Health Center,[21] East Wollega[33] and Northern Ethiopia.[34,35] Considering the severity of these infections during pregnancy, provision of anti-helminthic starting in the second trimester should become a routine ANC service and part of public health intervention programs to prevent anemia during pregnancy. However, this study shows that the coverage of the proportion of pregnant women taking deworming is low. Co-infection with helminthes can lead to severe anemia, especially in pregnant women, with serious consequences for health outcomes in women and children, and therefore requires additional public health. Therefore, it can be said that if deworming measures are not improved and helminthes control is not implemented, anemia among pregnant women in the study area may not decrease.

According to many studies, the diet of pregnant women can affect anemia during pregnancy. This study shows a significant association between daily intake of green leafy vegetables and anemia status in pregnant women. This is consistent with research conducted in Westmoreland, Jamaica[11] and elsewhere, which showed that women who consumed green leafy vegetables one or more times per week had a reduced risk of anemia compared to women who did not consume green vegetables.[36-40] This suggests that regular consumption of green leafy vegetables can increase HBC levels and thus reduce the likelihood of anemia. Pregnant women should continue to be educated about the importance of eating more iron-rich foods and avoiding or reducing foods that inhibit iron absorption.

This study found a significant association between iron during pregnancy and anemia. Ten percent of all anemia's are due to insufficient iron intake during pregnancy. Pregnant women who do not take iron tablets are 2.5 times more likely to be anemic than their peers. This is consistent with studies conducted at Azezo Health Center in Gondar [18] and Bushalo Health Center in southern Ethiopia.[21] This may be due to the increased need for iron during pregnancy to supply the mother's increasing blood volume and the rapidly growing fetus and placenta, so iron deficiency may occur. We found that although the majority of pregnant women, 71%, received iron supplementation, it is unlikely that iron therapy alone is an effective strategy for treating anemia. Iron supplementation during pregnancy has been used to prevent anemia in pregnant women, but the results have been unsatisfactory, and iron supplementation is so ineffective that it cannot be replaced by a daily iron-rich diet. Results of in-depth interviews revealed that people get minimal amounts of iron from food every day. In addition, the participants did not take iron supplements from their midwives. Inadequate iron intake is one of the causes of anemia in pregnant women. Participants were not aware of the benefits of taking iron supplements, the recommended dosage during pregnancy, and the possible side effects of taking iron supplements.

This study has several limitations. First, it focuses only on anemia caused by iron deficiency and does not consider other causes of anemia. Also, ferritin level was not measured. In addition, women can suffer from anemia due to various factors, such as hemoglobinopathies or lack of other elements such as folate. Conclusions are based only on information from interviewees and may have limitations. In addition, the qualitative nature of the analyzes conducted in the study may provide incomplete information and other limitations.

Conclusion

Based on the data presented in this study, the overall prevalence of anemia in the study area showed that anemia is an average public health problem compared to the 2019 EDHS and we believe that it is a major health problem for pregnant women in Ilubabor and Buno Bedele zones of southwestern Ethiopia. Parasitic infections such as malaria and helminthes, daily consumption of green leafy vegetables and use of iron tablets were significantly associated with anemia in pregnant women.

To improve the nutritional status of women, routine and consistent nutritional advice, regular monitoring and creation of a feedback mechanism are recommended. Since the Ilubabor and Buno Bedele zones are endemic for malaria and helminthes infection, the infections significantly affected the anemia status of the study participants. Therefore, anti-helminthic and antimalarial drugs should be given along with insecticides depending on current federal ministry of health ANC guidelines. According to current ANC WHO guidelines, pregnant women should receive iron supplements routinely in almost all situations. Additional parasite control methods are provided along with the Iron Supplement Guide as needed. ∎

CRediT authorship contribution statement

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.xagr.2024.100417.

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