Predictors of Anemia Among Pregnant Women Attending Antenatal Care at Public Hospitals of Sidama Region, Ethiopia, 2021 A Case Control Study Protocol

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Abstract

Background: Anemia is the leading cause of morbidity and mortality in pregnant women in developing countries, with consequences for the mother and fetus resulting in premature birth, low birth weight, cognitive impairment in the fetus and death.

Objective: To determine predictors of anemia among pregnant women attending ANC at public hospitals of Sidama region, Ethiopia, 2021.

Methods and Materials: A facility based unmatched case-control will be conducted from June 25 to July 25 in public hospitals of Sidama region. A total of 6 Midwives, 6 laboratory technician and 6 supervisors will be involved in the data collection process. Cases will be recruited consecutively as they present to the hospitals and immediately four controls will be allocated for each case that came after selection of cases.

The data will be entered into Epidata software and exported to SPSS software for windows version 23 for analysis. Descriptive statistics will be computed and both bivariable and multivariable logistic regression will be employed to identify predictors of anemia among pregnant women. The output will be presented using adjusted odds ratio (AOR) with the respective 95% confidence interval (CI).

Budget and Work Plan: A total of 184,928 Birr will be required to carry out this study. The study will be conducted from June 25 to July 25, 2021.

Keywords: *Anemia; Predictors; Pregnancy*

Introduction

Anemia involves a decreased ability of red blood cells to carry oxygen to tissues as a result of fewer than normal circulating red blood cells or a decrease in hemoglobin levels (Hgb). Anemia during pregnancy is defined as a hemoglobin concentration of less than 11 grams per deciliter (g/dL) and is classified as mild (10.0 - 10.9g/dl), moderate (7.0 - 9.9g/dl) and severe < 7g/dl. Currently the World Health Organization (WHO) has a hemoglobin level of less than 11.0 g/dl at 1st and 3rd trimesters and less than 10.5 g/dl in the 2nd trimester is

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used to define anemia [1]. Anemia is very common in pregnant teens because of the double need for iron for their own growth and the growth of the fetus, and they are less likely to use prenatal care [2].

In the world pregnant women who are affected by anemia are 56 million, out of those 17.2 million pregnant women are from Africa [3]. Globally Iron deficiency anemia (IDA) affecting about 32 million pregnancy women and is the most common cause of anemia among pregnant women [3,4] and 50% of all the pregnant women who develop anemia live in middle and low-income countries [5].

The magnitude of anemia among pregnant women was found to be highest in developing countries, such as sub- Sahara Africa, South-East Asia were 57% and 48% respectively and lowest prevalence which is 24.1% reported among pregnant women in South America [6].

Prevalence of anemia among pregnant women in Africa was nearly half (46.3%) [7], 62.7% pregnant women are anemic in Ethiopia [3].

Pregnant women might be at risk of developing anemia due to low socioeconomic conditions. The poor nutritional intake, repeated infections, poor diet, poor antenatal care service, frequent pregnancies, low health-seeking behaviors and parasitic diseases, such as malaria and hookworm are associated with anemia [8-11]. Inadequate intake and poor bioavailability of iron-rich foods also contribute significantly to the development of anemia during pregnancy [11].

Despite efforts by the government and other stakeholders, anemia during pregnancy remains a public health issue in Ethiopia.

Statement of problem

In 2011, 38% (32.4 million) of pregnant women aged 15 - 49 years were anaemic globally [12]. Africa (61.3%) and Southeast Asia (52.5%) are regions with the highest rate of anemia during pregnancy in the world [13].

Anemia is still a public health problem in Ethiopia. According to the Central Statistical Agency of Ethiopia 2016 report [14], the prevalence of anemia among pregnant women was 29% which decreases with increasing women's education and household wealth.

The most common obstetric problems of anemia during pregnancy include: lower exercise tolerance, puerperium infection, thromboembolic problems, postpartum hemorrhage, pregnancy-induced hypertension, placenta pravia and heart failure, abortion, premature birth, stillbirth, low newborn birth weight, postnatal mortality and morbidity [15-17].

WHO aims to reduce anemia in women of childbearing potential, including pregnant women, by 50% by 2025 [18]. The Ethiopian Ministry of Health also tried to alleviate the problem of anemia and its effects by implementing essential nutritional measures [19].

Our study is important to develop strategies according to local conditions, taking into account the specific determinants of anaemia in the study area and among pregnant women. Furthermore, Most of the previous cross-sectional studies in Ethiopia recommended the implementation of analytical studies as case-control studies [17,20-22].

In Sidama zone, previously one case control study was conducted from February to March 2011 to identify predictors of anemia among pregnant women in Hawassa and Yirgalem cities [23], but our study differs in several ways from the previous study. one we will used women Dietary Diversity Score and MUAC to assess nutritional status of pregnant women so this will help to identify nutritional factors associated with anemia and second we will do laboratory examination on peripheral morphology of red blood cells and this will give information on the type of anemia that a pregnant women developed and third we include water sources and sanitation, this help to test the association between safe water Sippy and anemia among pregnant women and fourth we include all public hospitals in Sidama region.

A lot has been done to minimize the risk of anaemia, but the complication of anaemia is still a problem amongst pregnant women. The true predictors of anaemia were not well addressed in the study area. Therefore, this study will tried to investigate the stated information gaps among pregnant women so as to give evidence based action.

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Significant of the study

Despite efforts by the government and other stakeholders, anemia during pregnancy remains a public health issue in Ethiopia. Research findings have revealed that determinants of anemia vary from place to place. This underscores the importance of determining the problem factors associated with anemia using a robust study design in order to obtain local data in the regions.

In Sidama, to the best of current knowledge, no research exists that has used case control study design to identify predictors of anemia among pregnant woman. The finding of this study would help to guide the antenatal care service providers and other concerned stakeholders to work more towards alleviating the problem. Also it might be used as a base line data for other researchers who are interested on this area.

Literature Review

Factors associated with anemia

Anemia during pregnancy has a variety of causes and factors, including socio-economic conditions, abnormal demands such as multiple pregnancies, teenage pregnancies, malnutrition, maternal illiteracy, unemployment, short gestational intervals, gestational age, primigravida and multigravida, excessive loss of appetite, and vomiting during pregnancy [24].

A study conducted in Canada revealed a strong significant association between intestinal parasitic infection and anemia in pregnant women [25].

A study conducted among Pregnant Women Receiving Antenatal Care (ANC) at Fatima Hospital in Jashore, Bangladesh showed that Monthly family income, family size, gestational age (third trimester), birth spacing < 2 years [AOR (95% CI), Excessive blood loss during previous surgery (Yes), Food group eaten 24 hours (1 - 4 groups), Breakfast regularly were predictors of anemia among pregnant women [26].

An analysis of recent national survey data to identify Determinants of anemia among women and children in Nepal and Pakistan elucidate that anemia was significantly higher among women from the poorest households in Pakistan, women lacking sanitation facilities in Nepal, and among undernourished women (BMI < 18.5 kg/m^2) in both countries (Nepal and Pakistan) [27]. Furthermore, a research findings from study done in Yemen cited that low family monthly income, short pregnancy spacing, never consumed liver, and presence of health problems as a risk factors associated with anemia [28].

Across sectional study which was done at different gestational periods of 320 pregnant woman visiting antenatal care clinic at Kakamega county (Kenya) shows that, anemia was not significantly associated between age and anemia but there was significantly association between anemia and socio-economic status of the expectant mothers [29].

Prior studies in Ethiopia have reported significant associations between anemia in pregnancy and parasitic infections (e.g. schistosomiasis, hookworm infection), Previous use of contraceptives, use of iron supplements, birth interval/intervals, parity and pregnancy, level of education, age, body weight, trimester of pregnancy and financial status [21,30-36].

A cross sectional study which was done to assess prevalence of anemia and associated risk factors among pregnant women attending antenatal care in Azezo Health Center Gondar town, Northwest Ethiopia show that, anemia was significantly associated with age groups ranged from 26 - 34 years old and age groups greater than 34 years old. Rural residence was significantly associated with reduced anemic cases [37].

Institution based cross sectional study which was done to assess Prevalence of Anemia and its associated Factors among all Pregnant Women Attending Antenatal Care (ANC) in Mizan Tepi University Teaching Hospital, South West Ethiopia revealed that, Anemia was sig-

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nificantly associated with history of malaria attack, and infections with hookworm, Ascaris lumbricoids, S. mansoni, Giardia intestinalis, and Entamoeba histolytica/dispar. However, iron supplement was protective of anemia [38].

A study on prevalence of anemia and associated factors among pregnant women in Ethiopia indicated that Undernutrition as seen in mid upper arm circumference (MUAC) being less than 23cm and food consumption score being poor and borderline category, were factors independently associated with anemia [39].

A result of study conducted at Jigjiga revealed that previous chronic diseases with, knowledge about anemia, excessive menstrual bleeding, history of malaria attack and history of abortion had significant association with anemia [40].

A community based cross- sectional study was conducted to assess Prevalence of anemia and associated factors among pregnant women in Southern Ethiopia revealed that household monthly income, level of food security, availability of latrine, frequency of meal per day, eating animal source of food at least once per week, history of malaria infection, and nutritional status; low socio economic class, trimester second and third, gravidity three to five and six and above, iron not supplemented, hookworm infection and low dietary diversity score showed statistically significant association ($p < 0.05$) with anemia[41].

Unmatched-Case Control Study conducted at Hawassa and Yirgalem cities found lower educational level, prolonged menstruation period 6-8 days before the index pregnancy, intestinal parasitic infection, gastritis with duodenal ulcer bleeding and not taking meat/organ meats as major predicting risk factors for occurrence of anemia among pregnant women [23].

A study conducted to Determinants of Anemia among Pregnant Women Attending Antenatal Clinic in Public Health Facilities at Durame Town also identified were parasitic infection, not taking additional diet during pregnancy, consuming tea/coffee immediately after food, not eating meat, previous heavy menstrual blood flow, and being housewife as a major determinant factors of anemia among pregnant women [42].

Figure 1: Conceptual framework showing anemia and associated factors among pregnant women attending ANC in Sidama Region, 2021. Developed from different literatures reviewed [34-42].

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Objective

To identify predictors of anemia among pregnant women attending ANC service at public hospitals of Sidama region, Ethiopia, 2021.

Methodology

Study area

The study will be conducted in public hospitals of Sidama region. It is located about 275 Kilometers away from Addis Ababa. It has 30 Districts, 1 city administration and 6 town administration with a total of 576 kebeles of which 524 of them are rural and 52 are urban. It is one of the highly populated areas in Ethiopia, having a total population of about 4 million people residing on 72100 hectare of land. Out of the total population 5.7% are urban and 94.3% rural residents [49]. Sidama is characterized by three agro-ecological zones: the dry midlands/lowlands (20%), the midlands (48%) and the highlands (32%). In Sidama region mixed agriculture (crop and livestock production) is practiced. Major crops grown include: enset, coffee, maize, wheat, teff, barley, haricot bean and khat. Enset is the main staple crop both in highlands and midlands while maize is so in the lowlands. There are two cropping seasons in Sidama Zone: belg and meher. Belg rains are mainly used for land preparation and planting of long cycle crops such as maize and sorghum and seed bed preparation for meher crops. The meher rains are used for planting of cereal crops like barley, teff, wheat and vegetable crops. Besides, meher rains are also responsible for the growth and development of perennial crops such as enset, coffee and khat. Food security is more precarious in the lowland areas of Aleta Wondo, Borecha, Darra, Bensa, Loka Abaya and Hawassa Zuria woredas mainly due to moisture stress and water logging in some pocket areas hampering agricultural production, less diversification of food sources and minimum use of improved farm inputs due to lack of cash and credit facilities to purchase the inputs. The Sidama region administration has a total of 4063 health professional of different disciplines and 524 Health Posts, 127 Health Centers, 1 general and 12 District hospital owned by government and additionally there are 21 private and 3 NGO clinics, 65 private rural drug venders. The overall potential health service coverage of the Zone by public health facilities are 90.3%.

Study design and period

A facility based unmatched case-control study will be conducted from June 25 to July 25, 2021.

Source population

All pregnant women attending ANC service at public hospitals of Sidama region will be the source population.

Study population

All pregnant women attending ANC at public hospitals during study period and fulfilled the inclusion criteria will be the study population for this study.

Eligibility criteria

Inclusion criteria

- Pregnant woman who attending first ANC visit

- Permanent resident pregnant woman (at least 6 months).

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Exclusion criteria

- Pregnant woman with severe illness and unable to speak and second and third visit.

Sample size determination

Epinfo version 7 software will be applied to compute the sample size for cases and controls with an assumption of 95% confidence level, 80% power of the study, 4:1 (r = 4) ratio of non-anemic over anemic, the odds ratio = 2.5 from factors that has association with anemia from recent study conducted in Durame and proportion of controls exposed 9.0% [42], the maximum sample size after adding the potential none response rate of 10% the total sample size became 576 (115 cases and 461 controls). The computation is depicted in the following table (Table 1).

Factors	AOR	% of Controls Exposed	Power	Ratio of Controls To Cases	CI	Anemic	Non Anemic	Final Sample Size	Source
Intestinal Parasite (Yes/No)	2.9	11.6	80	1:4	95	62	248	310	(23)
Previous heavy menstrual flow (Yes/No)	2.62	12.2	80	1:4	95	75	300	375	(42)
Meat (Yes/No)	2.8	18.7	80	1:4	95	51	201	252	(23)
Additional food (Yes/No)	2.5	9	80	1:4	95	105	419	524	(42)

Table 1: Sample size calculation for the study.

Sampling techniques

From 18 public hospitals found in the region we randomly selected 6 hospitals. Enumeration of prior three month's ANC register was conducted in order to know monthly flow of each hospital. Then, based on the number of ANC register, the sample size will be allocated proportionally for all selected public hospitals in the region (Figure 2). Cases will be recruited consecutively as they present to the hospitals and immediately four controls will be allocated for each case that came after selection of cases.
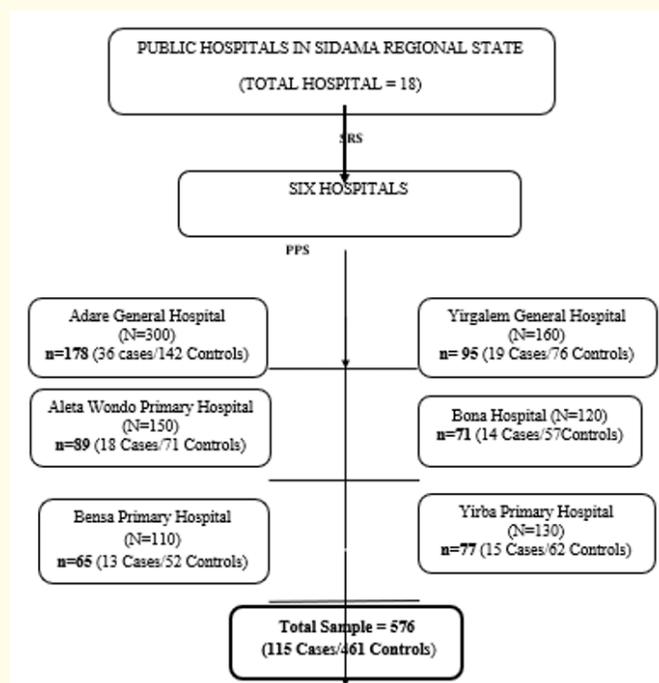

Figure 2: Schematic representation of sampling procedure.

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Study variables

Dependent variable for Objective one

Anemia.

Independent variables

- Sociodemographic; clinical and reproductive; nutrition and lifestyle; and knowledge and health service related factors are independent variables.

Operational definitions

Anemia

Any hemoglobin level below 11g/dl in first and third trimesters and below 10.5 gm/dl in the second trimester of gestation is considered as anemia [1].

Nutritional assessment

Nutritional assessment of woman will be done using anthropometry and dietary methods.

- A Mid-upper arm circumference (MUAC) measurement of < 23 cm and ≥ 23 cm will be classified as malnutrition and normal nutritional status, respectively [43].

- Dietary Diversity (DD) will be categorized as adequate (consumption of at least five of the ten food groups) and inadequate (consumption of less than five food groups) [44].

Knowledge about anemia

We will used eight items composite score to measure the knowledge level of respondents regarding anemia which includes: general signs of anaemia, Iron-rich foods, foods that increase iron absorption, foods that decrease iron absorption, causes of anaemia, consequences of anaemia for pregnant women and infants and young children, and prevention of anaemia. The cumulative mean score of knowledge of participants about anemia will be estimated using mean score. Based on this, those who had scored less than the mean will be considered to have poor knowledge and those who had scored greater than or equal to the mean value will be considered as having good knowledge.

Data collection procedure

Data will be collected using a structured and pre-tested questionnaire, anthropometry and laboratory analysis of stool specimens.

A total of 6 Midwives, 6 laboratory technician and 6 supervisors will be involved in the data collection process.

Questionnaires

The questionnaire included information on sociodemographic; clinical and reproductive; nutrition and lifestyle; and knowledge and health service related factors will be collected using a structured and pre-tested questionnaire, anthropometry and laboratory analysis of stool and blood sample. The part of the questionnaire on Dietary Diversity (DD) was adopted from a standard tool [44].

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Anthropometric assessment

Anthropometric assessment of nutritional status

Nutritional status of pregnant mother is measured using MUAC which is the only anthropometric measure for assessing nutritional status among pregnant women [43]. Mid-upper arm circumference (MUAC) of the mother will be measured using flexible non-stretchable standard tape measure as measure of nutritional status.

Dietary methods of assessing nutritional status

The DD was assessed using 24 hours recall method. Respondents will be asked whether they had taken any food from predefined 10 food groups on the preceding day. Accordingly, the level of Dietary Diversity Score (DDS) will be computed out of 10 [44].

Fecal sample collection and laboratory analysis

Fecal sample collection

Following the completion of questionnaire, a wide screw capped containers pre-labeled with names will be distributed to each respondent. Participant who will not able to provide sample on the first day were asked again on the following day.

Fecal sample laboratory analysis

Initially, an adhesive cellophane tape with a glass slide and a fecal specimen container will be distributed to the pregnant women. Approximately 2mg fecal specimen in labeled plastic vials containing 10% formaldehyde for the preservation of helminth eggs, protozoan cysts, and trophozoites in the fecal specimens will be collected. The stool specimens will be examined for the presence of parasites, helminth eggs, and larvae and protozoan trophozoites or cysts using direct wet mount.

Blood sample collection and laboratory analysis

Labeled venous or heparinized blood samples giving sequential numbers of the study participants will be used. Blood samples will be used for Hemoglobin determination (by using Hemo Cue) and RBCs morphology identification. Hemoglobin determination venous blood sample will be taken, filled to micro cuvette, wipe of excess blood from the outside of the micro cuvette tip, and then placed in the cuvette holder of the device for measuring hemoglobin concentration [45]. This Hgb determination will be done by selected hospitals as parts of routine ANC service.

Annex I: Information sheet

Good morning/good afternoon.

My name is _____I am here on the behalf of research team of Hawassa Health Science College. The team is conducting research on 'Predictors of Anemia Among Pregnant Women Attending Antenatal Care at Public Hospitals of Sidama Region, Ethiopia, 2021'.

You are selected by random sampling technique to participate in this study because you are currently taking ANC service at this hospital. Your participation will only be based on your willingness .You have the right to choose not to take part in this study. If you choose to take part, you have the right to stop at any time. If you are willing to participate or refuse or decide to withdraw later, you will not be subjected to any ill-treatment.

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If you agree to participate in the study, you will be interviewed about socio-demographic characteristics, knowledge and health service related factors, clinical and reproductive factors, and nutrition and lifestyle related factors.

Your name will not be written on the questionnaire. No one will have access to the non-coded data except the principal investigator and the data will only be used for this study. Your willingness and honest answers are very important for the success of this study.

We would like to appreciate your help in responding to these questions, and it will not take more than 30 minutes.

Annex II. Informed written consent form

I (the respondent), the undersigned, am told that the researchers are going to conduct study in Sidama region governmental hospitals to assess the risk factors of anemia and its effect on birth weight and s/he acquainted with me the first time s/he meets. I also informed that both the government and the Woreda health office to commence appropriate strategies to battle this problem would use the result of the study. I am, too, told that the research will benefit the community in general including me, the respondent, and that the research will not inflict any harm to me. Besides, I briefed that I will be interviewed for not more than 20 to 30 minutes. In addition, I let know that the investigators selected me randomly. Moreover, I am notified that my participation in the study is entirely voluntarily, and that I can quit from the study any time I want. Likewise, I am enlightened that I will not be subjected to any form of punishment following my failure to participate in the study. In the same way, I am explained that the information collected from me will not by any means be disclosed to any people other than those participating in the study unless obtained permission from me. Equally, I told that I could ask them questions I found difficult or any type otherwise.

Are you willing to participate in the study? Yes _____ No____ Signature _____

Study area: - **Sidama region**   Health Facility_____

Name of the interviewer_____ Sig. ____ Date _____

Name of supervisor _____Sign _____ Date_____

Questionnaire code _____

For further explanation use the Principal Investigator's Address

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Annex III: Questionnaires

I. Socio-demographic characteristics of pregnant women

Code	Variables	Coding categories	Skip
100	Age of respondent	_____	
101	Residence	1. Rural 2. Urban	

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102	Marital status	1. Never married 2. Married 3. Separated 4. Widowed	
103	Religion	1. Protestant 2. Orthodox 3. Muslim 4. Other	
104	Mothers Educational level	1. No formal education 2. Primary (1-8) 3. Secondary (8-12) 4. College and above	
105	Husband Educational level	1. No formal education 2. Primary (1-8) 3. Secondary (8-12) 4. College and above	
106	Occupation status	1. Government employee 2. Self employed 3. Housewife 4. Farmer 5. Other (Specify)_____	
107	What is the source of the food for the family?	1. Buying from market 2. Farming(crops, animals) 3. Food aid/donation 4. other(specify)	
108	Who has the primary responsibility of providing food for the house hold?	1. Father 2. Mother 3. Grandmother 4. Relatives 5. Other(specify)	
109	Do you have a bank saving account?	1.Yes 2. No	
110	Average monthly income of the family	In birr_____	
111	Family Size	-	
112	What is the main source of drinking water for members of your house hold?	1. Purified water 2. Tap water 3. public tab/stand pipe 4. protected well 5. unprotected well 6. other specify	
113	Did you take any action to make the water safer to drink?	1.Yes 2. No	If no, skip to Q115

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| 114 | If yes, what do you usually do to make the water safer to drink? | 1. Boiling
2. Chlorine-water
3. Sand
4. Guard/bishangari/aqua tab
5. Other(specify) | |
| 115 | What kind of toilet your family members usually used? | 1. flush to piped sewer system
2. flush to septic tank
3. ventilated improved pit latrine
4. pit latrine with slab
5. pit latrine without slab
6. no facility/ bush/field
7. other(specify) | |

II. Clinical and reproductive related factors of pregnant women

Code	Variable	Coding categories	Skip
200	When did you see your last menstrual period? (enter date, month & year)	1. ___/___/___E.C 2. I don't know	
201	Have you ever given a birth?	1. Yes 2. No	
202	Parity	1. Para one 2. Para two 3. Para three or more	
203	Gravidity	_____	
204	Gestational age	1. 1st trimester 2. 2nd trimester 3. 3rd trimester	
205	What is the interval between current and previous pregnancy?	1. < 2 years 2. ≥ 2 years	
206	Age at first pregnancy(years)		
207	Age at first marriage (years)		
208	Menstrual cycle	1. Regular 2. Irregular	
209	Menstruation by no of pads		
210	Duration of menstruation in days	_____	
211	Number of miscarriages (spontaneous abortion)	_____	

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212	Number of stillbirths	_____	
213	Children <5 yrs death		
215			
216	Gastritis	1. Yes 2. No	
217	Duodenal bleeding(presence of hematemesis)	1. Yes 2. No	
218	History of medication (Quinine, cephalosporin, penicillin, methyldopa, NSAIDs(Aspirin, Ibuprofen))	1. Yes 2. No	
219	History of induced abortion	1. Yes 2. No	
220	Contraceptives use	1. Yes 2. No	If no skip to 222
221	Types of contraceptive methods	1. Pills 2. Injectable 3. Implant 4. IUCD 5. Other	
222	Intestinal parasite	1. Yes 2. No	If no skip to224
223	List types of I/P		
224	Do you have any diagnosed chronic disease previously?	1. Yes 2. No	
224	If yes, specify the name of diagnosed chronic disease?	-----------------	
225	Did you infected with malaria in the last 3 months?	1. Yes 2. No	
226	Diarrhea illness in past two week	1. Yes 2. No	
227	Hemorrhoids	1. Yes 2. No	
228	Gum bleeding	1. Yes 2. No	
229	Presence of current blood loss	1. Yes 2. No	
	STIs	1.Yes 2. No	
	HIV status (by review records)	1.Positive 2. Negative	

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III. Nutrition and lifestyle related factors of pregnant women

Code	Variable	Coding categories	Skip
300	MUAC in cm	_____	
301	What is your staple diet?	1. Teff 2. Enset based 3. Maize based 4. Roots 5. Others(specify)	
302	Main meal frequency in a day	1.One times 2.Two times 3. Three times	
303	Additional meal during pregnancy	1. Yes 2. No	
304	Eat foods made from teff	1. Yes 2. No	
305	Average weekly consumption of animal source foods like meat, chicken, milk, egg, cheese, fish?	1. 1-2 times 2. ≥3 times 3. I have not eaten	
306	Eating condition during pregnancy	1. Increased 2. No change 3. Decreased	
307	Substance use (Cigarate, alcohol, khat)	1. Yes 2. No	
308	Drinking tea immediately after meal	1. Yes 2. No	
310	Drinking coffee immediately after meal	1. Yes 2. No	
312	Consistent use of bed net	1. Yes 2. No	
313	Wearing shoes consistently	1. Yes 2. No	

IV. 24 hour Food Frequency Questionnaire

Code	Food groups	Coding categories	Consumed Yes = 1 No = 0
400	Grains, white roots and tubers, and plantains	Maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, porridge).	

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401	Pulses	Mature beans or peas (fresh or dried seed), lentils or bean/pea products.	
402	Nuts and seeds	Beans, peas, lentils, nuts, seeds or foods made from these	
403	Dairy	Milk, cheese, yoghurt or other milk products	
404	Meat, poultry and fish	Fresh or dried fish, Beef, goat, chicken	
405	Eggs	Eggs from poultry	
406	Dark green leafy vegetables	Cassava leaves, kale, spinach etc.	
407	Other vitamin A-rich fruits and vegetables	Mangos, apricots	
408	Other vegetables	Tomato, onion etc.	
409	Other fruits	Other fruits, including wild fruits	

V.   Knowledge and health service related factors

Code	Variable	Coding categories	Skip
500	Have you heard about anaemia?	1.Yes 2. No	
501	If Yes: Can you tell me how you can recognize someone who has anaemia? **(at least two)** - Less energy/weakness - Paleness/pallor - Spoon nails/bent nails (koilonychia) - More likely to become sick (less immunity to infections) - Other - Don't know	1.Yes 2. No	
502	What are the health risks for infants and young children of a lack of iron in the diet? **(at least one)** - Delay of mental and physical development - Other - Don't know	1.Yes 2. No	
503	What are the health risks for pregnant women of a lack of iron in the diet? **(at least one)** - Risk of dying during or after pregnancy - Difficult delivery - Other - Don't know	1.Yes 2. No	

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504	What causes anaemia? **(at least two)** - Lack of iron in the diet/eat too little, not much - Sickness/infection (malaria, hookworm infection, other infection such as HIV/AIDS) - Heavy bleeding during menstruation - Other - Don't know		
505	How can anaemia be prevented? **(at least two)** - Eat/feed iron-rich foods/having a diet rich in iron - Eat/give vitamin-C-rich foods during or right after meals - Take/give iron supplements if prescribed - Treat other causes of anaemia (diseases and infections) - seek health-care assistance - Other - Don't know		
506	Can you list examples of foods rich in iron? **(at least two)** - Organ meat (Liver, Kidney, Heart etc.) - Flesh meat (Beef, Pork, Lamb, Goat, Rabbit, Dog, Chicken, Duck, etc.) - Fish and seafood (fresh fish, Dried fish, Canned fish etc.)		
506	When taken during meals, certain foods help the body absorb and use iron. What are those foods? **(at least one)** - Vitamin-C-rich foods, such as fresh citrus fruits (orange, lemons, etc.) - Other - Don't know		
507	Some drinks decrease iron absorption when taken with meals. Which ones? **(at least one)** - Coffee - Tea - Other - Don't know		
508	Nutrition education in pregnancy	1. Yes 2. No	
509	One-way walking distance from nearby health facility	1. 0-30 minutes 2. 0-30 minutes	

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510	At what gestational age did you start your first ANC visit	1. Weeks_____ 2. I don't know	
511	Did you get any iron supplement in this pregnancy?	1. Yes 2. No	
512	If yes, how many days did you take?	1. No. Of days_____ 2. I don't know	
513	Did you take any anti helminthic drugs previously?	1. Yes 2. No	
513	Home delivery (previous)	1.Yes 2. No	

VI. Data related with laboratory analysis

Type of investigation	Result	
Stool examination		
HGB determination		
Perpheral morphology		

Data quality control

Three day intensive training will be given on how to perform MUAC measurement and on interviewing techniques using standard checklist and structured questionnaire. The checklist and questionnaires will be translated into a regional working language (Sidaamu Afoo). Supervision will be conducted. Double data eatery will be done and the questionnaire will be pretested on 5% of total sample size at Leku Primary Hospital. During data collection, continuous supervision will be done by the supervisors and principal investigator

Data processing and analysis

The data will be entered into Epidata software and exported to SPSS software for windows version 23 for analysis. Descriptive statistics will be computed and both bivariable and multivariable logistic regression will be employed to identify predictors of anemia among pregnant women (Table 2 to 7).

Activity	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Research proposal Preparation									
Final proposal submission and Defense									
Obtaining ethical Clearance									
Giving training									
Data collection and processing									
Result Writing									
Final paper Submission									
Defense and dissemination of result									

Table 2: *Showing the work plan of the study in Sidama Region, 2021.*

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No	Items	Source of Budget	Unit	Amount	Unit Price (Birr)	Total Price (Birr)
1	Pen	HCHS	Pieces	30	6	180
2	Pencils	>>	Pieces	50	3	150
3	Paper for Duplication	>>	Packet	30	300	9,000
4	Pencil sharpener	>>	Pieces	18	5	90
5	Pencil eraser	>>	Pieces	18	5	90
6	Notebook	>>	Pieces	22	20	440
Sub Total						**9,950**

Table 3: Showing the stationary cost for the study in Sidama region, 2021.

No	Items	Source of Budget	Unit	Amount	Unit Price (Birr)	Total Price (Birr)
1	Photo copying (including the pre-test)	>>	Pieces	634	8	5,072
2	Lab investigation for stool specimen		specimen	10	10*634	6,340
Sub Total						**11,412**

Table 4: Showing the services cost for the study in Sidama region, 2021.

No	Items	Source of Budget	Unit	Unit Price (Birr)	Total Price (Birr)
1	12 Data collectors	HCHS	12	339*12*1	4,068
2	6 Supervisors	>>	6	6*339*1	2,034
3	Trainer(PIs)		4	4*339*1	1,356
Sub total					**7,446**

Table 5: Showing the training cost for the study in Sidama region, 2021.

No	Items	Source of Budget	Unit	Unit Price (Birr)	Total Price (Birr)
1	Data collector	HCHS	Per questionnaire	100*634	63,400
2	Supervisor	>>	339 per day	339*6*30	61,020
Sub total					**124,420**

Table 6: Showing the Perdiem payment for the study in Sidama region, 2021.

No	Items/Activities	Source of Budget	Unit	Total Price (Birr)
1	Stationary	HCHS	Birr	9,950
2	Service (transportation etc)	>>	>>	11,412
3	Training	>>	>>	7,446
4	Perdiem for data collection and supervisors	>>	>>	124,420
Grand total				**153,228**

Table 7: Showing the total cost of the study in Sidama region, 2021.

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Ethical Consideration

Prior to data collection appropriate ethical clearance and supportive letter will be obtained from the Ethical Review Committee of Hawassa College of Health Science. Written permission will be obtained to undertake the study from the selected hospitals. Participation in the study will be based on voluntary base and the participants will be informed about the right to withdraw at any time from the study. Confidentiality will be assured by using anonymity. Pregnant women who had anemia (Hb < 11 g/dl) will be provided with Iron-folate tablets and those who were in the third trimester and infected with intestinal parasites will be dewormed. Written consent will be requested from every study participant included in the study during data collection time after explaining the objectives of the study. For this purpose, a one page consent letter was attached to the cover page of each questionnaire stating about the general objective of the study and issues of confidentiality which was discussed by the data collectors before proceeding with the interview.

Dissemination of Results

The findings will be presented to the Hawassa College of Health Science community and submitted to Hawassa College of Health Science research and publication core process owner. The findings will also be communicated to local health planners and other relevant stake holders in the area to enable them take recommendations into consideration during their planning process.

Conclusion

It can also be communicated to health planners and managers at regional level through Hawassa College of Health Science website and library. Efforts will be made to publish in peer reviewed national and international journals.

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