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Major Risk Factors Predicting Anemia Development during Pregnancy: Unmatched-Case Control Study

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Abstract

Background: Anemia in pregnancy is associated with increased rates of maternal and perinatal mortality, premature delivery and other adverse outcomes. Hence, identifying anemia predicting risk factors in high-risk groups such as pregnant women is essential for problem based intervention modalities, particularly for developing countries. The aim of this study was to identify the major risk factors predictive of anemia development during pregnancy in Hawassa and Yirgalem cities located in Sidama Zone, Ethiopia.

Methods: Unmatched case-control study, involving 561 pregnant women who initiated antenatal care follow up during their first trimester, was conducted from February to March 2011. Socio-demographic, hemoglobin level, obstetric and medical data of the study participants were collected using pre-tested well-structured questionnaire and reviewing antenatal care follow up record cards of each pregnant woman. Hemoglobin level <11 g/dl was used to define anemia during pregnancy. Bivariate and multivariate analyses were conducted to find predictors of anemia, P-value <0.05 was considered as statistically significant.

Results: The major predicting risk factors for occurrence of anemia among pregnant women were, lower educational level (AOR=3.3, 95% CI: 1.3-8.0, P=0.007), prolonged menstruation period 6-8 days before the index pregnancy (AOR=3.1, 95% CI: 1.6-5.9., P=0.001), intestinal parasitic infection (AOR=2.9, 95% CI: 1.4-8.1, P=0.000), gastritis with duodenal ulcer bleeding (AOR=3.87, 95% CI: 1.8-8.0, P=0.000) and not taking meat/organ meats (AOR=2.8, 95% CI: 1.3-6.1, P=0.008).

Conclusions: Family illiteracy, intestinal parasitic infection, duration of menstrual bleeding, gastritis with duodenal ulcer bleeding, and inadequate intake of organ meats were identified as strong predicting risk factors of anemia among pregnant women. Therefore, to reduce maternal mortality, the overall anemia prevention strategy in pregnant women should promote community-based health education to low educated families, mass de-worming of intestinal parasites and focused counseling for those women who have prolonged menstruation and peptic ulcer diseases.

Keywords: Anemia; Risk factors; Pregnant women; Case control study; Ethiopia

Introduction

Anemia is a common public health problem affecting one-third of the world populations. Pregnant women and young children are at higher risk of mortality and morbidity due to anemia [1]. During pregnancy anemia may lead to haemorrhage, puerperal infection, thromboembolic problems, premature labor, low birth weight and maternal and perinatal mortality [2]. The prevalence of anemia in pregnant women is very high in developing regions (44% to 57%) compared to developed countries (<31%) [3]. In most developing countries anemia is the most frequent maternal complication of pregnancy. According to WHO criteria anemia in pregnant women is defined as a hemoglobin concentration of less than 11 g/dl in the blood. Based on this criterion more than half of pregnant women in the world have hemoglobin levels indicative of anemia and many of these women were anemic at the time of conception [3,4].

In general, the etiologies of anemia are classified into three main causation groups: nutritional, marrow disease and hemolytic anemia. Nutritional anemia is the most common types of anemia throughout the globe that is mainly associated with iron, folate and vitamin B12 deficiencies [5]. From these etiologies, about 50% of anemia cases are linked to iron deficiency. Unless treated, iron deficiency anemia could impel severe consequence in pregnant women such as severe postpartum bleeding that leads to maternal death and neurophysiological impairment in infants [6-8]. Iron deficiency anemia in pregnancy could be more severe in the presence of other

non-nutritional cause of anemia, such as during chronic disease states (cancer, tuberculosis and HIV infection), parasite infections (malaria, hookworms, ascaris, and schistosoma), drug toxicity and other allied haematological consequences of chronic and systemic inflammation [3,7,9,10].

In Ethiopia, anemia during pregnancy is an important public health issue due to its association with increased rates of maternal and perinatal mortality, premature delivery, low birth weight, and other adverse outcomes. Ethiopia is among the poorest countries in Africa with high rates of food insecurity and malnutrition [6,8]. The nutritional status of women in Ethiopia is also low and their daily workload is often enormous because of reproducing and ensuring the survival of their children. Due to these facts, in Ethiopia iron deficiency anemia is the commonest problem affecting pregnant women, women of reproductive age and children [6,8,11,12]. Ethiopian Ministry of Health, tries to intervene malnutrition problem by Essential Nutrition Action (ENA) plan through supplementation of vitamin A, iron, and iodine along with promotion of exclusive breastfeeding, proper complementary feeding, and improved maternal and child nutrition [13]. Besides these efforts, the estimated prevalence of anemia among pregnant women in Ethiopia is high 63% compared to neighboring countries 55% in Kenya, 58% in Sudan and Eritrea 55.3% [3]. Perhaps, this might be one of the main reasons that Ethiopia still has a higher number of maternal deaths than the neighboring countries, according to the 2014 World bank development indicators data report the maternal deaths per 100,000 live births in Ethiopia is 420 while in Sudan and Kenya is 360 and 400, respectively [14].

Despite the above high estimation of anemia and its high impact on maternal mortality rate, few studies reported from urban and rural parts of Ethiopia to show the prevalence of anemia and the related risk factors among pregnant women. Correspondingly, one of the aims of the Millennium Development Goals has been to reduce maternal mortality by 75% by the end of 2015 from the 1990 levels [7,15]. Thus, taking proper intervention measures in anemic pregnant women is indispensable to accomplish this goal and knowing the main risk factors of anemia is fundamental for antenatal caregivers to develop prevention, early detection and prompt management strategies of anemia in pregnancy.

Therefore, the aim of this study was to identify the main predictive risk factors of anemia development during pregnancy among pregnant women who initiated antenatal care follow up in health centers found in Hawassa and Yirgalem cities located in Sidama Zone, Ethiopia.

Methods

Study sites

This study was conducted in Hawassa and Yirgalem cities found in Sidama Zone, Southern Nations Nationalities and Peoples Region (SNNPR), Ethiopia. Hawassa town is the capital city of SNNPR located 272 km south of Addis Ababa, while, Yirgalem city is 45 km far from Hawassa. According to August 2013 report of the Central Statistical Agency (CSA) of Ethiopia, Hawassa and Yirgalem cities have an estimated population density of 399,461 and 54,947, respectively [16]. At present, in Hawassa there are four hospitals (one public and three private), three health centers and twenty private clinics. While, in Yirgalem, one hospital, one health center and eight private clinics are found.

Study design

An unmatched case-control study was conducted from February 7, 2011 to March 20, 2011 among pregnant women who initiated antenatal care follow up in the health facilities during their first trimester. Using the WHO definition for diagnosis of anemia in pregnancy, the participant pregnant women were categorized into the case and control group based on the hemoglobin level test result on their first visit to antenatal care clinics: case group (Hgb level <11 g/dl) and control group (Hgb level between 11 g/dl-15.5 g/dl inclusive) [3]. The inclusion criteria were, pregnant women who came for antenatal care follow up during their first trimester and who are willing to take part in the study after getting informed consent during the study period. Participants were excluded from the study if they are severely ill thus unable to respond to the questionnaire or not willing to take part in the study.

Sample size determination

Sample size calculations were conducted in the StatCalc module of EpiInfo (EpiInfo™ version 3.5.1, U.S. Centers for Disease Control and Prevention, Atlanta, GA, USA). The following assumptions considered to determine the sample size, soil-transmitted helminths as major determinant factors to cause anemia in Ethiopia. Hence, from recently published study in Ethiopia the expected frequency of soil-transmitted helminth infections is 43.5% in those mothers that are exposed but not anemic [17]. The study was powered to detect an odds ratio of 2.0 with 95% significance and 80% power, case to control ratio 1:4 give the largest possible sample size. Thus, considering 10% non-response error, the total number of study participants were 561, of these 112 were cases and 449 controls.

Sampling technique

Seven public health facilities are found in Hawassa and Yirgalem cities that give antenatal care service to the public. The health facilities are Yirgalem health center, Hawassa health center, Yirgalem Hospital, Millennium health center, Tulla health center, Anamura health center and Hawassa University Referral Hospital. All the health facilities were included in the study, except Hawassa University Referral Hospital. Numbers of study participants were allotted from each health facility antenatal care clinic proportional to their average client size attended per month by referring the registration books of each antenatal care clinic (Table 1). Thus, mathematically, average number of pregnant women who attended antenatal care in each health facilities per month multiplied by the total sample size (N=561), divided by the total sum average number of pregnant women attended in all the antenatal care clinics per month (405).

Health Facilities	AVG no ANC Clients/month	Sample Size	No of Controls	No of Cases
Yirgalem H/center	133	184	147	37

Hawassa H/center	94	130	104	26
Yirgalem Hospital	48	66	53	13
Millennium H/center	52	72	58	14
Tulla H/center	58	81	65	16
Anamura H/center	20	28	22	6
Total	405	561	449	112

Table 1: Shows calculated sample size of pregnant women allocated to each health facility.

Data collection procedure

Data were collected on face-to-face interview bases using well-structured questionnaires and reviewing the antenatal care follow up record cards of each pregnant woman who gave their consent to participate in the study. The questionnaire gathers four groups of participants' characteristics, namely (1) socio-demographic, (2) menstruation and pregnancy, (3) dietary (4) clinical diseases. Following an interview, on the same day the antenatal care cards of each pregnant woman who gave their consent were reviewed to obtain the hemoglobin test result of their first visit to antenatal care clinics and their medical history. Using WHO criteria, pregnant women whose hemoglobin level between 11-15.5 g/dl at their first visit of antenatal care clinics were selected as control (non-anemic) and those with a hemoglobin level below 11 g/dl were selected as case (anemic). In all health facilities, hematological parameters were measured either using Cell Dyn 1800 or Sysmex automated hematology analyzers of different manufacturers. Convenience sampling technique was used to achieve the proportional sample size of study subjects allotted for each health facility with a ratio of four controls per case (4:1). To make sure the quality of data, the questionnaire was translated to Amharic (national language of Ethiopia) from their original source and translated back to English. To further assure the quality of the data obtained from antenatal care follow up record cards and minimize recall bias, participant's clinical status and laboratory results were rechecked and cross-checked from their follow up history cards and laboratory registration book, respectively. The data collectors in all health facilities were nurses and selected based on their interest and experience on data collection. In all health facilities, one day training was provided to the selected nurses.

Data analysis

The collected data were entered into Epi Info version 3.5 software. For analysis, the data were exported to SPSS version 15 and cleaned by sorting and tabulating simple frequency tables. Then outcome variables were dichotomized into 1=cases and 0=controls and two steps (Bivariate and Multivariate) logistic regression analysis was implemented. To investigate the strength of association between dependent and independent variables crude and adjusted odds ratio were computed at 95% confidence interval and p-value <0.05 for statistical significance.

Ethical considerations

This study was ethically cleared and its consent procedure was approved by the Research and Ethical Clearance Committee of Addis Continental Institute of Public Health (ACIPH) and Haramaya University. Formal permission letters were obtained from SNNPR health bureau, Hawassa and Yirgalem town health desk departments and to the respective health facilities. The voluntary nature and purpose of the study was fully explained to each study participant in their local languages. Data collection was begun after written informed consent was obtained from each pregnant woman. To make sure confidentiality of participants information anonymous typing was used instead of their names and any participant identifiers were not written on the questionnaire. To keep the privacy of the study participants all were interviewed alone. The confidentiality of information obtained from the interviewee was securely kept throughout the entire study period. During each data collections process, pregnant women who were found anemic were treated on the spot.

Results

Socio demographic characteristics

Five hundred sixty one pregnant women were recruited for this study with a 100% response rate: 112 cases and 419 controls. The age of study participants ranged from 15-39 years of age, from these majorities of them (80%) were young (<30 years) with an average mean age ± SD=25 ± 4.7 years. Relatively, of the controls 170 (37.9%) were younger (between: 25-29 years) than the cases 38 (33.9%). The level of husband education attended college and above in the control group was nearly twice 123 (29.6%) as that of the case group 17 (17.9%) and the difference was statistically significant (Crude Odds Ratio (COR)=3.3, P<0.05). Most of the case group average monthly family income falls below 500 Birr (44.2%) compared to the control group (21.1%) but the p-value did not show statistical differences (Table 2).

Variables		Case: n=112 (%)	Control: n=449 (%)	COR (95% CI)
Age group	15-19	12(10.7)	61(13.6)	0.2(0.01, 4.3)

	20-24	21(18.8)	147(32.7)	0.3(0.04, 2.4)
	25-29	38(33.9)	170(37.9)	0.7(0.1, 3.9)
	30-34	32(28.6)	54(12)	0.3(0.01, 3.9)
	35-39	9(8)	17(3.8)	1
Marital status	Never married	6(5.4)	12(2.7)	0.8(0.02, 2.6)
	Married	98(87.5)	431(96.0)	0.1(0.1, 1.4)
	Separated/Widowed	8(7.1)	6(1.3)	1
Religion	Orthodox	43(88.4)	147(32.7)	0.1(0.02 ,0.6)
	Catholic	8(7.1)	14(8.1)	0.7(0.1, 1.4)
	Protestant	50(44.6)	258(57.5)	0.1(0.01, 0.4)
	Muslim	11(9.8)	30(6.7)	1
Read/Write	No	3(4.1)	10(2.8)	1.5(0.4, 5.8)
n=426	Read	13(17.6)	42(11.9)	1.6(0.8, 3.2)
	Read and Write	58(78.4)	300(85.2)	1
Women income	<500	25(65.8)	86(50.3)	1.4(0.3, 5.7)
n=209	>500	13(34.2)	85(49.7)	1
Husband Educational level		26(27.3)	56(13.5)	3.3(1.6, 6.7)*
n=510	07-12-2015	52(54.7)	236(56.9)	1.5 (0.9, 2.8)
	College and above	17(17.9)	123(29.6)	1
Family income	<500	46(44.2)	86(21.1)	1.02(0.1, 5.7)
n=513	500-1499	47(45.2)	233(56.9)	0.5(0.1, 4.9)
	1500-2499	7(6.7)	53(12.9)	1.6(0.2,1 2.4)
	2500-3499	1(1.1)	19(4.6)	0.2(0.01, 3.9)
	>2500	4(3.7)	37(9.0)	1
Mean age of cases ± SD=26 ± 5.1 years; mean age of controls ± SD=24 ± 5.2 years; *P<0.05; COR (Crude Odds Ratio).				

Table 2: Socio-demographic characteristics of pregnant women aged 15-39 years in Hawassa and Yirgalem health facilities (N=561).

Menstruation and pregnancy related characteristics

During the menstruation period, about 43 (38%) of cases and 131 (29.2%) of controls had irregularities of menstruation flow but no statistical difference seen between the groups. Very heavy menstrual bleeding was more common among cases than controls (12.5% vs. 4.0%; COR=4.51, P<0.05). Moreover, a significantly higher number cases were more likely to have a prolonged menstruation period (6-8 days) than the control group (25% vs. 9.1%; COR=3.3, P<0.05). Likewise, a significant proportion of anemic cases have more than three prior pregnancies than the control group (60.7% vs. 35.9%; COR=3.3, P<0.05) (Table 3).

Variables		Case: n=112 (%)	Control: n=449 (%)	COR (95% CI)
Menstrual cycle	Regular	69(61.6)	318(70.8)	1
	Irregular	43(38.4)	131(29.2)	1.5(0.9, 2.33)
Menstruation by no of pads	Very heavy	14(12.5)	18(4.0)	4.5(1.7, 11.9)
	Heavy	27(24.1)	63(14.0)	2.4(1.1, 5.6)

	Moderate	61(54.5)	310(69.0)	1.1(0.6, 2.4)
	Low	10(8.9)	58(12.9)	1
Duration of menstruation in days	03-May	84(75)	408(90.9)	1
	06-Aug	28(25)	41(9.1)	3.3(1.9, 5.6)*
Number of pregnancy	01-Feb	44(39.3)	288(64.1)	1
	3 and above	68(60.7)	161(35.9)	2.7(1.8, 4.2)*
Number of miscarriages	0	100(89.3)	427(95.1)	1
	01-Apr	12(10.7)	22(4.9)	0.4(0.9, 0.9)
Stillbirth	0	111(99.1)	440(97.9)	1
	01-Apr	1(0.9)	9(2.1)	0.4(0.05, 3.5)
Children <5 yrs death	0	69(61.6)	157(34.9)	1
	01-Feb	43(38.4)	292(65.0)	0.3(0.2, 0.5)
Household size	01-Mar	44(39.3)	277(61.7)	1
	04-Jun	52(46.4)	142(31.6)	2.3(1.4, 3.6)*
	07-Sep	16(14.3)	30(6.7)	3.3(1.6, 6.6)*
COR (Crude Odds Ratio); *P<0.05				

Table 3: Menstruation and pregnancy related characteristic of pregnant women aged 15-39 years in Hawassa and Yirgalem health facilities (N=561).

Dietary related characteristics

An important association was seen between anemia and those who have not eaten dark green leafy vegetables and meat or organ meat. The majority of the cases (46.4%) who did not eat meat or organ meat such as liver, kidney were likely to develop anemia five times more than the controls (18.7%) and the difference was statistically significant (COR=5.4, P<0.05). Likewise, the eating condition after pregnancy compared to before pregnancy, both groups shown to decrease in food intake during pregnancy; however, a significantly higher number of cases reduced their food intake compared to the control group (37.5% vs. 25.8% COR=3. 47, P<0.05) (Table 4).

Factors		Case: n=112 (%)	Control: n=449 (%)	COR (95% CI)
Main meal frequency in a day	One time	2(1.8)	13(2.9)	0.6(0.1, 2.8)
	Two times	13(11.6)	34(7.6)	1.5(0.8, 3.1)
	Three times	97(86.6)	402(89.5)	1
Food made from teff	Don't take	22(19.6)	35(7.8)	1.9(0.9, 4.2)
	Daily	50(44.6)	257(57.2)	0.0(0.0, 0.0)
	1-2 times in a week	25(22.3)	111(24.7)	0.6(0.3, 1.2)
	Once in two weeks	15(13.4)	46(10.2)	1
Dark green leafs vegetables	Don't take	14(12.5)	19(4.23)	2.5(2.8, 10.7)*
	Daily	21(18.8)	106(23.6)	0.6(0.3, 1.4)
	1-2 times in a week	61(54.5)	270(60.1)	0.8(0.4, 1.4)
	Once in two weeks	16(14.3)	54(12.1)	1
Meat/Organ meat Liver, Kidney	Don't take	52(46.4)	84(18.7)	5.4(2.8, 10.7)*

	Daily	32(28.6)	143(31.8)	1.9(0.9, 3.9)
	1-2 times in a week	15(13.4)	107(23.8)	1.2(0.5, 2.7)
	Once in two weeks	13(11.6)	115(25.61)	1
Eating condition during pregnancy	Decreased	42(37.5)	116(25.8)	3.4(1.7,6.5)
	No change	56(50)	202(44.9)	2.6(1.3,4.8)
	Increased	14(12.5)	131(29.2)	1
COR (Crude Odds Ratio); *P<0.05				

Table 4: Dietary and related characteristics of pregnant women aged 15-39 years in Hawassa and Yirgalem health facilities (N=561).

Health related characteristics

In this comparison study majority of the well-known anemia associated factors such as gastritis, duodenal ulcer with internal bleeding, intestinal parasites and chronic kidney disease were more common (2 to 3 times) among cases compared to the control group and the difference was statistically significant (P<0.05) (Table 5).

Factors		Case: n=112 (%)	Control: n=449 (%)	COR (95% CI)
Gastritis	Yes	26(23.2)	40(8.9)	3.1(1.7, 5.3)*
	No	86(76.8)	409(91.1)	1
Duodenal bleeding	Yes	5(4.5)	9(2.0)	2.3(1.8,6.9)*
	No	107(95.5)	440(97.9)	1
Medication drugs	Yes	20(17.8)	39(8.7)	2.3(1.2,4.1)*
	No	92(82.1)	410(91.3)	1
Diarrheas episode	Yes	5(4.5)	8(1.7)	2.5(0.8,8.0)
	No	107(95.5)	441(98.2)	1
Intestinal parasite	Yes	35(31.3)	52(11.6)	3.4(2.1,5.7)*
	No	77(68.8)	397(88.4)	1
Malaria Infection	Yes	17(15.7)	37(8.2)	1.9(1.1,3.6)*
	No	95(84.8)	412(91.8)	1
Chronic kidney disease	Yes	31(27.6)	59(13.1)	2.5(1.5,4.2)*
	No	81(72.2)	390(86.9)	1
Chronic disease♠	Yes	7(6.3)	22(4.9)	1.5(0.5,3.1)
	No	105(93.8)	427(95.1)	1
Hemorrhoids	Yes	5(4.5)	10(2.2)	2.1(0.6,6.1)
	No	107(95)	439(97.2)	1
Gum bleeding	Yes	10(8.9)	19(4.2)	2.2(1.0,4.9)*
	No	102(91.0)	430(95.8)	1
Know about anemia	Yes	28(25)	142(31.6)	0.7(0.4,1.1)
	No	84(75)	307(68.4)	1

COR (Crude Odds Ratio); *Chronic diseases includes: Hypertension, Diabetics, Hepatitis, Skin disease, Asthmatic and Epileptic; *P<0.05.

Table 5: Health and medication characteristics of pregnant women aged 15-39 years in Hawassa and Yirgalem health facilities (N=561).

Multivariate analysis: Predicting risk factors of anemia

To find out independent predictors of anemia, multiple logistic regression analysis was done, adjusting potential confounders. Pregnant women whose husbands had inadequate knowledge and lower educational level were more likely to develop anemia than whose husbands had a higher educational level (Adjusted Odds Ratio (AOR)=3.3, 95% CI: 1.3-8.0, P=0.007). Likewise, we also observed a strong statistical significant association between occurrence of anemia and prolonged menstruation period 6-8 days before the index pregnancy (AOR=3.1, 95% CI: 1.6-5.9, P=0.001), intestinal parasites infection (AOR=2.9, 95% CI: 1.4-8.1, P=0.000), gastritis or other duodenal ulcer with internal bleeding (AOR=3.87, 95% CI: 1.8-8.0, P=0.000) and not taking meat or organ meats (AOR=2.8, 95% CI: 1.3-6.1, P=0.008). However, none of the following factors: not eating dark green vegetables, gum bleeding, chronic kidney disease and malaria infection were statistically associated with the occurrence of anemia in this study. The results of the analysis are shown in Table 6.

Factors		Case: n=112 (%)	Control: n=449 (%)	COR (95% CI)	AOR (95% CI)
Education	Yes	74(66.1)	352(78.4)	1	1
	No	38(33.9)	97(21.6)	1.8(1.1, 2.9)	1.4(0.5, 2.2)
Husband educational level	01-Jun	26(27.3)	56(13.5)	3.4(1.4, 6.7)*	3.3(1.3, 8.0)**
	07-Dec	52(54.7)	236(56.9)	1.5(0.8, 2.9)	1.5(0.7, 3.1)
	College and above	17(17.9)	123(29.6)	1	1
Duration of menstruation days	3-5	84(75)	408(90.9)	1	1
	6-8	28(25)	41(9.1)	3.3(1.9, 5.6)*	3.1(1.6, 5.9)***
Dark green vegetables	Don't take	14(12.5)	19(4.23)	2.5(2.8, 10.7)	1.3(0.4, 3.9)
	Daily	21(18.8)	106(23.6)	0.6(0.3, 1.4)	1.1(0.2, 0.9)
	1-2 times in a week	61(54.5)	270(60.1)	0.8(0.4, 1.4)	0.6(0.3, 1.3)
	Once in two weeks	16(14.3)	54(12.1)	1	1
Meat/Organ meat	Don't take	52(46.4)	84(18.7)	5.4(2.8, 10.7)*	2.8(1.3, 6.1)**
	Daily	32(28.6)	143(31.8)	1.9(0.9, 3.9)	1.1(0.5,2.6)
	1-2 times in a week	15(13.4)	107(23.8)	1.2(0.5, 2.7)	0.8(0.3, 2.0)
	Once in two weeks	13(11.6)	115(25.61)	1	1
Gastritis/duodenal bleeding	Yes	26(23.2)	40(8.9)	3.1(1.7, 5.3)*	3.8(1.8, 8.0)***
	No	86(76.8)	409(91.1)	1	1
Intestinal parasite	Yes	35(31.3)	52(11.6)	3.4(2.1, 5.7)*	2.9(1.4, 8.1)***
	No	77(68.8)	397(88.4)	1	1
Malaria	Yes	17(15.7)	37(8.2)	1.9(1.1, 3.6)	0.8(0.4, 1.8)
	No	95(84.8)	412(91.8)	1	1
Kidney disease	Yes	31(27.6)	59(13.1)	2.5(1.5, 4.2)	1.7(0.9,3.4)
	No	81(72.2)	390(86.9)	1	1
Gum bleeding	Yes	10(8.9)	19(4.2)	2.2(1.0, 4.9)	1.0(0.3,2.9)
	No	102(91.0)	430(95.8)	1	1

COR (Crude Odds Ratio); AOR (Adjusted Odds Ratio); *Significant (P<0.05); **Strongly significant (P<0.01); ***Very strongly significant (P ≤ 0.001) in multivariate analysis

Table 6: Multivariate analysis of selected predictors of anemia among pregnant women aged 15-39 years in Hawassa and Yirgalem health facilities (N=561).

Discussion

The aim of this study was to identify main predicting risk factors of anemia using data gained from antenatal care clinics of health facilities found in Hawassa and Yirgalem cities, SNNPR Ethiopia. Thus, among the main predicting risk factors identified in this study, the husband's educational level was appeared as one important predicting risk factor of anemia among pregnant women. Those pregnant women whose husbands had a lower educational level were three times more likely to have anemia than whose husbands had high educational level. This finding is consistent with previous reports from Ethiopia, Tanzania, Indonesia, Korea, which showed no or low level of formal education among women and their partners can increase the risk of anemia occurrence among family members [10,18-20]. Another report also indicated the health status of Ethiopians, both women and men, were affected by low education level [21].

In our study, we found prolonged menstrual bleeding (6-8 days) before the index pregnancy was considerably contributed and significantly associated with the occurrence of anemia during pregnancy. The adjusted odds ratio result showed women who had prolonged menstrual period before the index pregnancy are three times more likely to be anemic during pregnancy than who had less duration of menstruation (3-5 days). This could be due to heavy blood loss during prolonged menstrual bleeding, which could lead to iron deficiency anemia. This finding is in agreement with a study done in Jimma, Ethiopia and elsewhere in the world [22-24].

Regarding family income, anemia is likely to be more frequent among case group families who had less than 500 Birr per month income than control group families. Similarly, other studies in Ethiopia and elsewhere in the world also reported an inverse relation between level of income and anemia [22,25-27]. In fact, Ethiopia is among the poorest countries in Africa and since low family income leads to food uncertainty and susceptible to malnutrition, one may assume the problem of iron deficiency anemia [8,28]. However, in this study, the p-value did not show any statically significant association.

Dietary factors were also found to play major driving role in the incident of anemia among pregnant women. Those pregnant women who have not eaten meat or organ meat (such as liver and kidney) were nearly three times more likely to be anemic compared to those pregnant women who ate meat or organ meat. The multiple logistic regression analysis result showed a strong significant association between anemia and not eating meat or organ meat. Likewise, other reports showed lower consumption of meat is significantly associated with a higher rate of anemia [29-32]. This might be because organ meats are a rich source of iron with an absorption range from 1-10%, which possibly will reduce the occurrence of iron deficiency anemia [33]. Moreover, according to the WHO report, anemia in pregnant women generally assumed due to inadequate dietary iron intake in developing countries [3]. Others dietary factors such as food made from Teff (injera, kita, or porridge) either separately or in combination with other foods did not reveal notable significant differences between the case and control group.

Another interesting finding of this study is that a strong positive significant association was observed between intestinal parasitic infection and anemic pregnant women compared to non-anemic pregnant women. The chance of being anemic is approximately three times higher among pregnant women who had intestinal parasitic infection than who did not have the infection. This possibly happen because most anemic pregnant women who are living around Yirgalem and Hawassa cities were farmers, since bare foot walking is common among Ethiopian farmers, the chance to be exposed for soil transmitted parasite is very high. Besides this, the low environmental sanitation status may also aggravate the chance of intestinal parasite infection. In general, parasitic diseases were known to play as a major contributing factor to anemia in pregnancy. For example, blood loss caused by hookworm puts mothers at high risk of iron deficiency anemia [34,35]. Similarly, many previous studies conducted in Ethiopia and other developing countries have shown the strong association of intestinal helminthiasis with overall anemia and severe anemia in pregnant women [24,34-39].

Gastritis with duodenal ulcer bleeding was another key clinical predicting factor associated with anemia in this study. Notable statistically significant associations were observed among those women who were anemic and had gastritis with duodenal ulcer bleeding compared to non-anemic. This finding indicated gastrointestinal bleeding increase the risk to become anemic by four fold during pregnancy. Reasonably, other studies showed following an episode of acute gastrointestinal bleeding, peptic ulcer disease patients faced iron deficiency anemia [40-42]. As far as we know, our study is the first to indicate such a significant association between anemia and gastritis with duodenal ulcer bleeding from Ethiopia. In this study, we have also seen chronic kidney disease seems more frequent in anemic pregnant women; however, the percentage of chronic kidney disease is remarkably high in both groups. This might be due to recurrent urinary tract infections, uncontrolled hypertension and heavy proteinuria that have an independent and cumulative effect on the outcome of chronic kidney disease. Especially as it has been described in many studies women are more vulnerable to urinary tract infection, hence, women who have recurrent urinary tract infections are at highest risk of complications during pregnancy and of an accelerated decline in renal function [43,44]. In fact, this notion might hold true since the prevalence of UTI infection among pregnant women is very high in Ethiopia and one study indicted UTI infection is significantly higher among anemic pregnant women [45-47].

Regarding other correlated variables of anemia: age, marital status, number of abortion and stillbirth, eating green leafy vegetables, diarrheal episode, drinking tea and coffee this study did not reveal statistically significant supporting evidence between cases and controls.

Limitations

The first limitation of this research was the study design, using unmatched-case control study and the retrospective nature of case

control studies, together makes it difficult to make an exact cause and effect relationship between risk factors and anemia. The other limitation was, due to time constraint and taking long time to get ethical clearance, Hawassa University Referral Hospital was not included in this study. Recall bias with religion or cultural taboo, such as getting the frequency of food intake, was also seen as a limitation during data collection.

Conclusion

Anemia in pregnancy is a significant cause of mortality and morbidity and it is among the major cause of obstetrics complication and maternal death in Ethiopia. In this study, among the most important risk factors associated with anemia, prolonged menstrual bleeding before the index pregnancy, intestinal parasitic infection, gastritis with duodenal ulcer bleeding and family illiteracy took the leading role regarding the occurrence of anemia. Moreover, our finding evidenced intakes of organ meats are good food diet to prevent anemia during pregnancy. Therefore, to reduce obstetrics complication and maternal death due to anemia, the overall anemia prevention strategy in pregnant women should promote community-based health education and mass de-worming of intestinal parasites to increase awareness of anemia among low educated families and prevent intestinal parasite infections among pregnant women. Moreover, a focused counselling is needed at the community level to delay or space births for those women who have prolonged menstruation and peptic ulcer disease to lessen maternal iron depletion during pregnancy. Finally, we recommend further community-based studies to identify other risk factors of anemia associated with pregnant women to address those women that are unable to attend the antenatal care clinic follow up in health facilities.

Authors' Contributions

BA, AAD: participated in the design of the study, performed the data collection and statistical analysis, and drafted the manuscript. BT: participated in coordination and helped to draft the manuscript. Alemayehu Worku, Amare Worku: participated in the design of the study, statistical analysis and drafting the manuscript. All authors read and approved the final manuscript.

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