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ANEMIA STATUS AND ASSOCIATED FACTORS AMONG PREGNANT WOMEN ATTENDING ANTENATAL CARE IN A HEALTH FACILITY IN ADDIS ABABA, ETHIOPIA

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ABSTRACT: Anemia remains a major maternal and infant health problem particularly in sub-Saharan Africa. Contemporary understanding of the magnitude of anemia and related socio-demographic variables in a specific setting would help scale-up preventive and therapeutic measures in a locality. This study was, therefore, aimed at estimating anemia prevalence among pregnant women attending antenatal clinic at Selam Health Center in northwest Addis Ababa. The study was undertaken between December 2015 and February 2016. The sample size was calculated using the general formula for single population proportion sampling. A questionnaire or face-to-face interview and medical records were used to gather pertinent data on socio-demography, clinical history, and maternal characteristics of the participants. Venous blood was drawn to measure hemoglobin (Hb) using BC-3000Plus Auto Hematology Analyzer and define anemia (Hb<11.0g/dl). The overall prevalence of anemia was 16.3% (n=480). The majority of the participants (52.0%) had mild anemia (Hb=10.0-10.9g/dl). Significant predictors of anemia were being positive for HIV (odds ratio (OR) 3.67, 95% confidence interval (CI)=1.70-7.90, p=0.001, intestinal parasitic infection positive (OR 3.46, 95% CI 1.67-7.20, p=0.001), and having lower inter-pregnancy gap (OR 7.312, 95% CI 3.041-17.587, p=0.001). Although anemia prevalence was lower than reports from some other parts of Ethiopia, the figure is sizeable and in need of attention.

Key words/phrases: Anemia, antenatal, hemoglobin, pregnancy, prevalence

INTRODUCTION

Anemia is characterized by an undesired change in the number or size of red blood cells (RBC) and subsequent drop in hemoglobin (Hb) concentration below the normal resulting in the impaired capacity to transport oxygen (WHO, 2001). The World Health Organization (WHO) defines anemia based on age, sex, and pregnancy status with separate cutoff values for each. There are various types of anemia based on different classification systems. Most of the literature shows that anemia could be grouped into three major classes based on the specific cause. These are anemia caused because of blood loss, decreased or faulty RBC, and direct destruction of RBC. Blood loss can be acute or chronic. Acute blood loss may be due to surgery, childbirth, ruptured blood vessels, etc. Several factors such as cancer, gastrointestinal, and/or heavy menstrual bleeding as well as infections can initiate chronic blood loss.

Anemia is a major global public health concern. The highest proportions of individuals affected are from sub-Saharan Africa and Southeast Asia (WHO, 2015). Anemia in pregnancy is a key health complication that affects the health of both the mother and her baby. It is an important contributor to maternal mortality or morbidity as well as to preterm delivery, stillbirth, and low birth weight, which in turn contribute to increased risk of infant mortality (Institute of Medicine, 2003). By the end of 2015, roughly 303,000 women died during and following pregnancy and childbirth (WHO, 2015). According to this same WHO source, almost all of these deaths occurred in low-resource settings.

Pregnancy-related anemia is variable based on pregnancy trimester. Hb level below 11g/dl is considered anemic for first and third trimesters, the level is <10.5g/dl for the second trimester (CDC and WFP, 2005). During pregnancy, there are normal physiological and anatomical changes (Mims, 2015) including an expansion of blood volume and related hemodynamic changes to

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allow increased uterine and placental blood flow to adequately transport essentials for fetus growth and development. Consequently, levels of Hb and hematocrit, and RBC count decline during pregnancy ending up in anemia.

Moreover, micronutrient deficiencies in pregnant women continue to be a significant health challenge in low-income countries for a variety of reasons. These include poor access to nutrient-adequate diet due to low income, bioavailability, and seasonality; increases in metabolic and physiologic demands of pregnancy; cultural practices; and infections. Therefore, anemia is one type of undernutrition, results in weak work performance, delays in the cognitive development of the baby, and increased susceptibility to infections (Darnton-Hill and Mkparu, 2015). Iron-deficiency affects immune status (Ekiz, 2005) and thus increases the risk of infections. Deficiency of other micronutrients such as folate in pregnancy is also associated with health problems like stillbirth, premature birth, low birth weight, and neural tube defects (WHO, 2015).

In Ethiopia; while the prevalence of anemia is highest (40.0-59.9%) in infants and children aged 6-59 months, for pregnant women it is around 20.0-39.9% (WHO, 2008). The public health significance of anemia among the former group is considered severe and the latter moderate. Both should gain increased program emphasis. The Millennium Development Goal (MDG) number 5 recognized to reduce child mortality and improving maternal health. Although Ethiopia has made good progress towards reaching the MDGs and met the goal of reducing child mortality (Goal 4), the goal for improving maternal health (Goal 5) was not achieved (UNDP, 2015). In 2012, the World Health Assembly endorsed nutrition targets developed by the WHO with one of the targets being a 50% reduction of anemia among women of reproductive age by 2025 (https://www.who.int/nutrition/global-target-2025/en/). Ethiopia, by formulating its health policy tried to give priority for diseases caused by malnutrition in general and maternal anemia in particular to achieve this goal (Saldanha *et al.,* 2012). Furthermore, the government is striving to achieve Sustainable Development Goal (SDG) 2 (https://www.sightsavers.org/policy-and-advocacy/global-goals/).

The 2011 Ethiopian Demographic and Health Survey - EDHS (CSA and ICF, 2012) reported the prevalence of anemia, in the general population, highest in Somali (44.16%) for females, 7.5% for males) followed by Afar (34.48%) for females, 6.8% for males), and lowest in Addis Ababa (9.37%) for females, 1.3% for males). Similarly, the 2016 survey (CSA and ICF, 2017) reported the overall prevalence of anemia among pregnant women 41% of which 20% were moderately anemic, 18%, mildly anemic, and 3%, severely anemic. Anemia prevalence in Addis Ababa remained the lowest (11.9%) and Somali highest. However, a systematic review and meta-analysis that depended on a single report from Addis Ababa (Alemayehu Hailu and Tewabech Zewde, 2014) indicated that Addis Ababa was not the least for anemia prevalence; it was the Amhara Region (Getachew Mullu *et al.,* 2017).

Apart from the broad EDHS data, limited peer-reviewed reports exist on pregnant anemia in Addis Ababa and that is perhaps why the above meta-analysis article could depend on the single publication on women attending antenatal care (ANC) in Tikur Anbessa Specialized Hospital reported anemia prevalence of 21.3% (Alemayehu Hailu and Tewabech Zewde, 2014). A study on pregnant women attending antenatal clinic at St. Paul's Hospital Millennium Medical College, Addis Ababa, documented the prevalence of anemia 11.6% (Angesom Gebreweld and Aster Tsegaye, 2018). A more recent report from Tikur Anbessa Specialized Hospital recorded a more reduced prevalence of anemia (4.8%), although only half of the study participant pregnant women were knowledgeable about anemia (Beshir Bedru *et al.,* 2020).

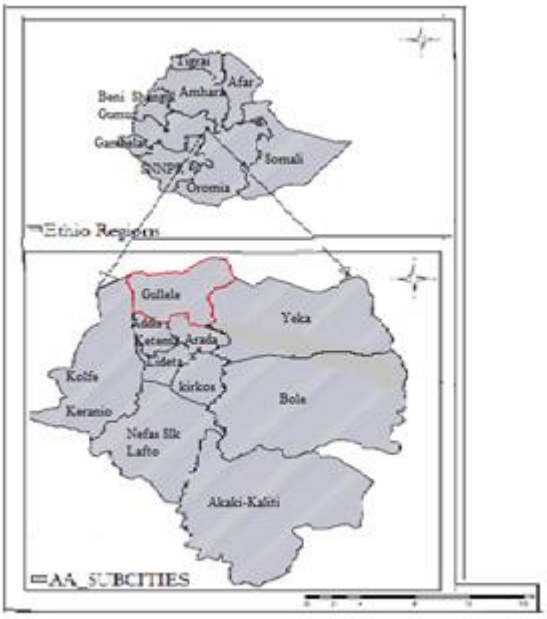
Government provision of iron and folic acid supplementations aiming mitigating anemia and achieving the SDG might have contributed towards apparently declining anemia in Addis Ababa. Nonetheless, the problem particularly among pregnant women is prevailing throughout Ethiopia. Nationwide studies like the EHDSs with broader objectives often miss dynamisms at the micro-ecological levels necessitating small-scale locality-specific studies to enforce targeted interventions. It requires closer attention in a setting-specific fashion. Such a study is lacking in the current study area, which is among the poorer sections of Addis, and this is to fill in the gap and help in evidence-based decision-making. To better orient and guide women, up-to-date information,

education, and communication are imperative to deal with socio-cultural practices.

MATERIALS AND METHODS

Study area

The study was undertaken at Selam Health Center (SHC), which is situated in Gullele Sub-City. Gullele Sub-City is one of 10 Sub-cities of *Addis Ababa City Government* located in the northwestern part of the City. In the south Addis Ketema and Arada, north the Oromia Region, west Kolfe-K'eraniyo and east Yeka sub-cities border Gullele Sub-City (Fig. 1). The Sub-City's altitude ranges from 2449-3016 meters above sea level. At the time of this study, the Sub-City covered 3,273 hectares and divided into 10 *woredas* (the lowest administrative division in present Ethiopian city administration) containing 284,582 people. *Woreda* 9 having an area of 197.41 hectares was where SHC is based. The *woreda* had an estimated population of 32,693 people of whom 15,476 were males and 17,217 females (AACA, 2014). SHC is the only health center in the *woreda* serving an average of 75 patients per day according to the health center's official record.



Study design and population

The study was a health facility-based cross-sectional survey. All pregnant women visiting the ANC of SHC between December 2015 and February 2016 formed the source population. Among these, those who were not on iron supplement intake and willing to take part in the study were recruited. Mothers who were not permanent attendants of the ANC of SHC, who started iron supplement and those who were not willing to take part in the study were excluded. Gullele Sub-City was selected, on purpose, from the 10 sub-cities in Addis Ababa and SHC because it had more ANC attendees compared with any other health center within the sub-city.

Sample size

The sample size was calculated using the general formula for single population proportion sampling (Lwanga and Lemeshow, 1991), where 'Z' (= 1.96) is standard normal distribution curve value for the 95% confidence interval (CI), 'p' prevalence estimate and 'm' 5% margin of error (0.05). Since there was no specific previous anemia prevalence (p) report for the study *woreda*, it was fixed at 30.0% taking into account the national anemia prevalence estimate of 22.0% for pregnant women (CSA and ICF, 2012). Pregnant women were consecutively recruited during the defined study period as they turned up for ANC.

Hb measurement and anemia determination

A structured questionnaire (see Appendix) was used to capture data on socio-demography, and personal behaviors like smoking and alcohol intake, and health status. For clinical and obstetric conditions, the medical records of the participating women were referred to additionally. The questionnaire was distributed and filled by participants themselves, for those who were unable face-to-face interview was administered.

Weight and height were measured to calculate the body mass index (BMI). Venous blood samples (4ml from each participant) were collected by laboratory technicians into vacutainer tubes (BD, USA) containing an anticoagulant (EDTA (ethylenediaminetetraacetic acid). Hb was measured using the BC-3000Plus Auto Hematology Analyzer (Mindray; Nansha, Shenzhen 518057, China). The raw Hb values were adjusted for the stage of pregnancy and altitude (INACG, 2016).

Data quality assurance

The questionnaire was first tested on colleagues to assure the data quality. Moreover, three midwife nurses were trained to administer the questionnaire and collect the data to reduce possible observer bias. Certified and experienced laboratory technicians or technologists took the measurement. A standardized procedure, chemicals, and a pre-calibrated instrument designed for the measurement of Hb concentration were used. Data accuracy was assured by daily on-site crosschecks.

Data analysis

Data entered into IBM SPSS statistics version 23 (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.). Univariate and multivariate logistic regression models were used to test the association between dependent and independent variables. The dependent variable is anemia status and the independent are socio-demographic characters, infections, chronic illness, smoking and alcohol intake, age of the pregnancy, and inter-pregnancy gap (IPG) or the number of pregnancies. A p-value of less than 0.05 was considered statistically significant.

Ethics statement

Ethical approval was granted from Addis Ababa University College of Natural and Computational Sciences Institutional Review Board (Ref: CNSDO/288/08/2016). Permission was obtained from the SHC administration before the kickoff of the project. The objectives, benefits, and risks of the study were explained to the participants, and written informed consent was obtained from each. The information about the study participants was kept confidential and anemic cases and those with self-reported health problems were referred to concerned health personnel for appropriate intervention.

RESULTS

Study population

Totally 480 pregnant women aged 18-38 years (mean age 28.2) were examined. Most of the participants (73.3%) were 25-31 years old. Except for a few individuals (11.0%), the participants were married. More than half of the participants (52.2%) were unemployed. The medical history of the participants showed that 35(7.3%) had clinical malaria in the last 1 year, 35(7.3%) intestinal parasitic infections (IPIs), and 31(6.5%) reactive to HIV antibody test (Table 1). Although the majority of the participants (71.5%) had normal BMI, there were 71(14.8%) underweight and 66(13.8%) overweight cases. While 25(5.2%) of the participants were self-reported alcoholic drink consumers, slightly more (31(6.5%) were smokers all reporting a daily cigarette number below 10 (Table 2). All of the women reported that they had no recent history of bloody diarrhea or bleeding, chronic kidney or other infectious or non-infectious diseases. Further, the women declared that they had no known clinically overt genetic disorders such as sickle cell anemia, hemophilia, hemolytic anemia, and the like.

Table 1 Anemia of pregnant women at Selam Health Center, Addis Ababa, December 2015-February 2016 (N =480).

Variable	Anemic, no.(%)	Non-anemic, no.(%)	Total, no.(%)
Age (year)			
18-24	6(22.2)	21(77.7)	27(5.6)
25-31	57(16.1)	295(83.3)	352(73.3)
32-38	15(14.9)	86(85.1)	101(21.0)
Marital status			
Single	6(11.3)	47(88.7)	53(11.0)
Married	72(16.9)	355(83.1)	427(89.0)
Residence			
Addis Ababa	68(15.1)	381(84.9)	449(93.5)
Other	10(32.3)	21(67.7)	31(6.4)
Employed			
Yes	30(13.2)	198(86.8)	228(47.5)
No	48(19.1)	204(80.9)	252(52.5)
Malaria			
Yes	11(31.4)	24(68.6)	35(7.3)
No	67(15.1)	378(84.9)	445(92.7)
Bloody diarrhea			
Yes	0(0.0)	0(0.0)	0(0.0)
No	78(16.3)	402(83.7)	480(100)
Chronic kidney disease			
Yes	0(0.0)	0(0.0)	0(0.0)
No	78(16.2)	402(83.8)	480(100)
Intestinal parasites			
Yes	13(37.1)	22(62.9)	35(7.3)
No	65(14.6)	380(85.4)	445(92.7)
HIV			
Yes	12(38.7)	19(61.3)	31(6.5)
No	66(14.7)	383(85.3)	449(93.5)

Table 2. Smoking and alcohol-drinking habits of anemic and non-anemic pregnant women at Selam Health Center, Addis Ababa, December 2015-February 2016 (N = 480).

Variable	Anemic, no.(%)	Non-anemic, no.(%)	Total, no.(%)
Smoking			
yes	9(29.0)	22(71.0)	31(6.5)
No	69(15.4)	380(84.6)	449(93.5)
Cigarette no,/day			
<10	9(29.0)	22(71.0)	31(100)
10-20	0(0.0)	0(0.0)	0
Alcohol-intake			
Yes	10(40.0)	15(60.0)	25(5.5)
No	68(14.9)	387(85.1)	455(94.5)
Alcohol-intake frequency			
Daily	5(83.3)	1(16.7)	6(24)
3-4 days/week	2(28.4)	5(71.4)	7(28)
Occasional	3(25.0)	9(75.0)	12(48)

For most participants (41.3%) the current pregnancy was their first (primigravidae) and for 155(32.3%) it was their fourth or above (multigravidae); 127 (26.5%) were experiencing their second or third pregnancy (Table 3). Most of the participants (39.9%) were in their first trimester followed by those in their third (34.8%) and second (25.8%). Regarding the IPG for those having more than one pregnancy, 32 (12.1%) had below 2, 143 (50.7%) 2-3, and 105 (37.2%) had more than 3 years gaps between their successive pregnancies.

Table 3 Maternal characteristics of anemic and non-anemic pregnant women at Selam Health Center, Addis Ababa, December 2015-February 2016 (N = 480).

Variable	Anemic, no.(%)	Non-anemic, no.(%)	Total, no.(%)
Trimester			
First	30(15.9)	159(84.1)	189(39.4)
Second	22(17.7)	102(82.3)	124(25.8)
Third	26(15.6)	141(84.4)	167(34.8)
Number of pregnancy			
1(the current)	24(12.1)	174(87.9)	198(41.3)
2 or 3	18(14.2)	109(85.8)	127(26.5)
≥4	36(23.2)	119(76.8)	155(32.3)
IPG in years (n=282)			
<2	6(14.7)	29(84.2)	34(12.1)
2-3	22(15.4)	121(84.6)	143(50.7)
>3	14(13.3)	91(86.7)	105(37.2)
BMI			
Underweight	14(19.7)	57(80.3)	71(14.8)
Normal	50(14.6)	293(85.4)	343(71.5)
Overweight	14(21.2)	52(78.8)	66(13.8)

BMI: body mass index, IPG: inter-pregnancy gap

Anemia and related variables

The overall prevalence of anemia (Hb<11.0g/dl) among the women was 16.3% with 48% moderate and 52% mild cases none being severe. The mean Hb was 12.0g/dl with the lowest and highest values 7.8 and 13.8g/dl, respectively. A high prevalence of anemia was observed among women who have had IPIs (37.1%), HIV-seropositive (38.7%), and mothers with more than three pregnancies (32.3%). The prevalence of anemia increased as the number of pregnancies increased.

In univariate analysis, participants belonging to the age group (years) 18-24 were at significantly increased risk of being anemic than those who were 25-31 (odds ratio (OR) 3.24, 95% CI: 1.47-7.13, p=0.040). IPI-positive participants were 3.46 times more likely to have anemia than those who were not (OR 3.46, 95% CI: 1.67-7.20, p=0.001). Similarly, HIV-seropositivity was found to be a statistically significant predictor of anemia (OR 3.67, 95% CI: 1.70-7.90, p=0.001). Individuals who had less than 2 years of IPG were also at significantly higher risk of having anemia than those who had 2-3 years gaps (OR 7.312, 95% CI: 3.041-17.587, p=0.001). Finally, all of the above three variables (IPI, HIV, and IPG) were found to be independently associated with the occurrence of anemia in the multivariate model (Table 4).

Table 4. Univariate and multivariate logistic regression analysis results of socio-demographic and other variables in relation to anemia among pregnant women in Selam Health Center, Addis Ababa, December 2015 to February 2016 (N = 480).

Variable		N	Anemic no.(%)	Non-anemic no.(%)	COR (95% CI)	p-value	AOR (95% CI)	p-value
Age (year)	18-24	27	6(22.2)	21(77.7)	3.240(1.470-7.133)	0.040		
	25-31	362	57(13.9)	295(86.1)	2.270(0.931-5.536)	0.720		
	32-38	91	15(16.4)	76(83.5)	1.000			
Residence	AA	449	68(15.1)	381(84.9)	1.000			
	Other	31	10(32.3)	21(67.7)	2.668(1.204-5.914)	0.160		
Employed	Yes	228	30(13.2)	198(86.8)	1.000			
	No	252	48(19.1)	204(80.9)	1.553(0.945-2.551)	0.820		
Malaria	Yes	35	11(31.4)	24(68.6)	2.586(1.210-5.526)	0.140		
	No	445	67(15.1)	378(84.9)	1.000			
IPI	no	445	65(14.6)	380(85.4)	1.000		1.000	
	yes	35	13(37.1)	22(62.9)	3.460(1.670-7.200)	0.001	3.340(1.49-7.48)	0.003
HIV	no	449	66(14.7)	383(85.3)	1.000		1.000	
	yes	31	12(38.7)	19(61.3)	3.670(1.700-7.904)	0.001	2.802(1.174-6.635)	0.020
Smoking	no	449	69(15.4)	380(84.6)	1.000			
	yes	31	9(29.0)	22(71.0)	2.253(0.995-5.090)	0.051		
Alcohol	Yes	25	10(40)	15(60)	3.794(1.637-8.794)	0.002		
	No	455	68(14.9)	387(85.1)	1.000			
Trimester	first	189	30(15.8)	159(84.1)	1.023(.577-1.813)	0.937		
	second	124	22(17.7)	102(82.2)	1.170(.0628-2.174)	0.622		
	third	167	26(15.5)	141(84.4)	1.000			
Number of pregnancy	first	198	24(12.1)	174(87.9)	0.835(.433-1.610)	0.591		
	2 or 3	127	18(14.2)	109(85.8)	0.456(0.259-0.804)	0.007		
	>3	155	36(23.2)	119(76.8)	1.000			
IPG (year)	<2	34	18(52.9)	16(28.5)	7.312(3.041-17.587)	0.001	0.202(0.078-0.520)	0.001
	2-3	143	22(15.4)	121(84.6)	1.182(.573-2.436)	0.651		
	>3	105	14(13.3)	91(86.7)	1.000			
BMI	under	71	14(19.7)	57(80.3)	0.912(.398-2.094)	0.829		
	normal	343	50(14.5)	293(85.5)	0.634(0.327-1.229)	0.177		
	over	66	14(21.2)	52(78.8)	1.000			

AA: Addis Ababa, AOR: adjusted odds ratio, BMI: body mass index, CI: confidence interval, COR: crude odds ratio, HIV: human immunodeficiency virus, IPG: inter-pregnancy gap, IPI: intestinal parasitic infection, no.: number, %: percent

DISCUSSION

The overall anemia prevalence among the study participants was 16.3%. Compared to previous studies in various settings in Ethiopia this figure is much lower. For instance, a prevalence of 53.9% was reported from Gilgel Ghibe dam area, southwest Ethiopia (Million Getachew *et al.*, 2012), 56% from Gode, southeast Ethiopia (Filagot Kefiyalew *et al.*, 2014) and 39.9% from Wolaita Sodo, southwest Ethiopia (Gedefaw Lealem *et al.*, 2015). On the other hand, the current finding is comparable with a 16.6% report from Gondar, northwest Ethiopia (Meseret Alem *et al.*, 2013), 19.3% from Mekelle, northern Ethiopia (Abrehet Abriha *et al.*, 2014). Outside Ethiopia, for instance, the prevalence of anemia was much lower (4.7%) among pregnant women in Iran (Mirzaie *et al.*, 2010).

Factors such as malaria endemicity particularly in Ghibe and Gode, study design and sample size, socio-economic, and other baseline characteristics of the study populations may explain the apparent variations. Moreover, better healthcare awareness and associated early ANC follow-up among the participants might have

contributed towards the observed differences in anemia prevalence. In Iran, iron and folate supplements are routinely prescribed for pregnant women and that might be among the reasons for the apparent very low prevalence rate in the country.

The result shows that anemia is a 'mild' public health problem among women as there were no severe cases. It is nearly in line with the reports by Meseret Alem *et al.,* (2013) from Gondar and Abrehet Abriha *et al.,* (2014) from Mekelle. However, the result is markedly different from the report by Filagot Kefiyalew *et al.,* (2014) from southeast Ethiopia where the prevalence of severe anemia was 12.5%. This might be due to differences in socio-economic and level of health awareness differences. The absence of severe cases and overall lower anemia status in this study is a good indication that the disorder could be further reduced if control efforts are scaled-up.

Although the univariate analysis indicated that individuals aged 18-24 years are 3.24 times more likely to have anemia than 25-31 years old, in the multivariate model no association was detected. In contrast, other reports from Ethiopia (Gedefaw Lealem, *et al.,* 2015, Meseret Alem *et al.,* 2013).

Women from Addis had a relatively lower prevalence of anemia than those residing outside Addis perhaps due to relatively better health education and living standard, and other related factors. Similarly, 19.1% of non-employed participants were anemic. This might be due to lower incomes to buy foods that could supply sufficient micronutrients to the body. Hence, they face nutritional deficiencies. Nevertheless, none of the socio-demographic or -economic characteristics of the participants was significantly associated with anemia in the multivariate analysis.

Positivity for IPIs was significantly associated with anemia. This is expected as IPIs, apart from their competition for nutrients, are known to cause blood loss, loss of appetite, reduced motility of food through the intestine, and damage to the wall of the intestine leading to malabsorption of nutrients. The result of the study is consistent with possible factors of anemia in pregnancy (WHO, 2011).

This study also found a significant association between anemia and HIV. Pregnant women with HIV were more likely to have anemia than those without HIV. The relatively higher anemia prevalence among HIV-positive women might be due to the characteristics of the virus, which results in increased metabolic and nutritional needs; poor intake of iron and other nutrients due to reduced appetite, nutrient malabsorption; co-morbidities/infections, and direct suppression of RBC production in the body (Antelman *et al.,* 2000).

In this study, smoking and drinking habits of the pregnant women were assessed and 29.0% of the smokers were anemic. Smoking is associated with anemia in the bivariate analysis but in the multivariate model, there was no association between drinking and smoking with anemia. Probably the degree of smoking matters more than mere smoking. Since the number of smokers was few compared to the non-smokers and all of the smokers declared that they smoke lower than 10 cigarettes (less than half packet) daily, smoking per se could not be a significant predictor of anemia.

The majority of the participants were in their first trimester. This might be because of the gradual improvement in the health-seeking behavior of the women so that they could attend ANC early. The women were residing in the capital and believed to have better knowledge and attitude, and thus a concern for their pregnancies. Whatever the explanation might be the observation is encouraging. On the other hand, there is a different picture nationwide. In a systematic review and meta-analysis, it was shown that ANC utilization is generally low, and delayed initiation of care is very common in Ethiopia (Gezahegn Tesfaye *et al.*, 2017). The analysis identified that the pooled magnitude of delayed ANC in Ethiopia was very high (64.0%) and significant major contributors were maternal age, place of residence, maternal education, husband's education, maternal occupation, monthly income, pregnancy intention, parity, knowledge of ANC, women's autonomy, partner involvement, pregnancy complications, and means of identifying pregnancy. Elsewhere in sub-Saharan Africa, although several women had reported that they wanted to start ANC in the early days of their pregnancies, similar impediments are leading to delayed turning-up such as cultural beliefs, socio-economic factors, and service delivery barriers (Chimatiro *et al.,* 2018).

The result showed the prevalence of anemia increased as the number of pregnancies increased. However, multivariate analysis did not reveal a statistically significant association between anemia

and the number of pregnancies. This is in contrast with other studies in Ethiopia (Filagot Kefiyalew *et al.*, 2014, Gedefaw Lealem *et al.*, 2015, Abrehet Abriha *et al.,* 2014, Niguse Obse *et al.,* 2013) as well as outside (Gautam *et al.,* 2002) where several pregnancies had a statistically significant association with anemia. The present study has also identified that pregnant women who had <2 years IPG (or birth interval) were more likely to have anemia than those who had a 2-3 year gap. The observations may be explained by differences in health awareness of the women, the use of contraceptives to have planned pregnancies thus, the body will have enough time to recover from nutrient loss resulted from the previous pregnancy.

A possible limitation of the study could emanate from the questionnaire data that might have some deficiency. Self-reported data are subject to social desirability and recall biases. Social desirability commonly influences behavioral variables such as cigarette smoking and alcohol-consumption. Capturing historical self-report retrospective information involves a potential for recall bias among the respondents which being greatest in case-control or cross-sectional studies like the current one (Raphael 1987, Yu and Tse 2012). This may explain, for instance, the observed absence of statistically significant association between smoking, alcohol drink, or malaria, etc. and anemia among the respondents. Thus, one needs to be cautious in interpreting and drawing conclusions based on such information.

CONCLUSION

This study demonstrated the occurrence of anemia and factors that could increase its occurrence. Accordingly, the anemia in the study population was categorized as a 'mild' type and HIV, IPIs, and IPG were variables significantly associated. Although the condition appears mild as per the WHO criterion; awareness creation on prevention of HIV, personal hygiene and environmental sanitation to control IPIs, and use of measures to widen the IPG is important to further prevent pregnancy-related anemia.

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Appendix A structured questionnaire used to capture data on socio-demography and personal behaviors

Addis Ababa University
College of Natural Sciences
Department of Zoological Sciences
A Questionnaire
Prepared for Studying Anemia among Pregnant Women Attending Antennal Clinic of Selam Health Center, Gullele Subcity, Addis Ababa, Ethiopia

This questionnaire is crafted to collect relevant socio-demographic, clinical and related information on pregnant women attending the antennal clinic of Selam Health Center and who are willing to participate in a survey on anemia.

Dear Madam,
I would like to thank you for giving your informed consent to participate in a study entitled ***Anemia status and associated factors among pregnant women attending antenatal care in a health facility in Addis Ababa, Ethiopia***. Your response to the study items will highly contribute towards the success of the study. Therefore, you are kindly requested to give candid response to each of the items. **It is not necessary** to write your name on this paper. Put √ mark on your answer or sometimes fill in the indicated blanks in front of the question.

1. Personal information of respondents

1.1 Age _____
1.2 Marital status married ☐ single ☐ other ☐
1.3 Residence Addis Ababa ☐ other ☐
1.4 Occupation governmental ☐ private ☐ other ☐

2. Clinical history of the respondents

Have you ever faced the following health problems in the last two weeks and/or having them now?
2.1 Malaria Yes ☐ No ☐
2.2 Bloody diarrhea Yes ☐ No ☐
2.3 Chronic kidney disease Yes ☐ No ☐
2.4 Intestinal parasites Yes ☐ No ☐
2.5 HIV/AIDS Yes ☐ No ☐
2.6 Any other chronic disease (please specify.) _____

3. Smoking, alcohol intake and other habits

3.1 Do you smoke? Yes ☐ No ☐
3.2 If yes, to **3.1**, how many cigarettes per day on average? <1 packet ☐ 1-2 packets ☐ >2 packets ☐
3.3 Do you drink alcohol? Yes ☐ No ☐
3.4 If yes to **3.3**, what is the frequency? Daily ☐ 3-4 days/week ☐ Occasional ☐

4. Maternal characteristics

4.1 Trimester first ☐ second ☐ third ☐
4.2 Number of pregnancies ___
4.3 Gaps between successive pregnancies _____

5. Awareness about anemia

5.1 Do you know what anemia is? Yes ☐ No ☐
5.2 Do you know the causes of anemia? Yes ☐ No ☐

5.3 Do you know the prevention methods of anemia? Yes ☐ No ☐

Validation of the questionnaire

Colleagues working on similar topics read the questionnaire and evaluated whether the questions effectively capture the topic under investigation. Common errors and confusing questions were reviewed before administration.