

Postpartum Anemia and Associated Factors among Lactating Women Visiting Public Health Centers in Odo shakisso District, Oromia Region, South West Ethiopia: A Cross Sectional Study

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ABSTRACT

Background: Anemia is one of the most serious public health problems worldwide. Although anemia during pregnancy has been adequately investigated, very little is known about postpartum anemia in low income countries like Ethiopia.

Objective: To assess the magnitude of anemia and associated factors among lactating women visiting public health centers in the study area.

Methods: Facility-based cross-sectional study design was used among randomly selected 509 lactating women who have given birth in the last 6 months prior to the study period. Data were collected using a pretested structured questionnaire. Blood samples were collected to determine hemoglobin concentration using a battery-operated portable hemo cue analyzer. Hemoglobin (Hgb) level was measured in gram per deciliter (g/dl). The stool examination was performed for ova and parasite using direct wet mount technique. Descriptive statistics was used to describe the data using numerical summary measures, tables, and percentages. Bivariable binary logistic regression analyses were used to see the association between each independent variable and the outcome variable. Multivariable binary logistic regression model was fitted to control for all possible confounders and to identify predictors of anemia. Odds ratio alongside 95% Confidence Intervals (CIs) were estimated to measure the strength of the association between study variables. Level of statistical significance was declared at p value <0.05.

Results: The overall magnitude of postpartum anemia was 30.2%; 95% CI: (26.3%, 34.2%), mild anemia being [22.5%; 95% CI: (18.6%, 26.3%)], moderate anemia [5.7%; (95% CI: (3.8%, 7.7%)] and severe anemia [2%; 95% CI: (0.8%, 3.2%)] respectively. Maternal primary level of education [Adjusted Odds Ratio [(AOR)=2.6, 95% CI: (1.6.0, 6.34)], paternal illiteracy [(AOR)=2.7; (95% CI:1.18, 6.19)], being infected with *Ascaris lumbricoids* [AOR=5.28, 95% CI: (1.81,15.43)] and Hook worm [(AOR)=5.38, 95% CI: (1.05, 27.57)], multiparity [(AOR)=2.5, 95% CI: (1.45, 4.31)], and lack of iron supplementation during pregnancy [(AOR)=2.89; 95%CI: (1.65, 4.65)] were significantly associated with anemia.

Conclusions: The magnitude of postpartum anemia was high. Maternal and paternal education, intestinal parasitic infections, multiparity and lack of iron supplementation during pregnancy were predictors of postpartum anemia. Hence, all concerned bodies should strengthen strategies to contain parasitic infections, improve iron supplementation, birth spacing, and postnatal deworming to prevent postpartum anemia.

Keywords: Ethiopia; Lactating women; Postpartum; Anemia

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Abbreviations: ANC: Antenatal Care, BMI: Body Mass Index, EDHS: Ethiopian Demographic and Health Survey, FAO: Food and Agriculture Organization, FMOH: Federal Ministry of Health, Hgb: Hemoglobin, IDA: Iron Deficiency Anemia, MDG: Millennium Development Goals, MMR: Maternal Mortality Ratio, PPH: Post-Partum Hemorrhage, SBAs: Skill Birth Attendants, SSA: Sub Saharan Africa, WHO: World Health Organization.

INTRODUCTION

Anemia is the second leading cause of disability and most serious public health concerns affecting roughly one third of the world's population. Postpartum anemia is the common public health significance throughout the globe mainly affecting lactating women in low-income countries ending up in significant adverse health and socio-economic challenges due to maternal iron depletion and blood loss during childbirth. Severe anemia is associated with substantially worse mortality and cognitive and functional outcomes. Iron deficiency anemia during the postpartum period may have long-term health implications for the mother and her infant. Women with low iron stores at the time of delivery and later may experience fatigue, altered cognition and depressive symptoms. This cross-sectional study aimed at assessing the magnitude of anemia and associated factors among lactating women visiting public health centers in the study area. The results showed that the overall magnitude of postpartum anemia was 30.2% indicating that anemia is a moderate public health problem of the community based on World Health Organization's (WHO's) recommendations. About 2% of the women were found to be severely anemic. Postpartum anemia was significantly associated with maternal and paternal literacy status, infection with intestinal parasites, multiparity, and lack of iron supplementation during pregnancy period. Thus, all relevant stakeholders should strengthen strategies to contain parasitic infections, improve iron supplementation during pregnancy, birth spacing, and postnatal deworming to prevent postpartum anemia.

Background

Anemia is defined as having low blood Hemoglobin (Hgb) concentration which could end up in significant adverse health and socio-economic challenges among population of the globe. It is estimated that nearly half of the cases of anemia is due to iron deficiency though it could be due to other causes [1,2]. Postpartum anemia is the common public health significance throughout the globe mainly affecting women in low-income countries [3,4]. Lactating women are susceptible to anemia because of maternal iron depletion and blood loss during childbirth [5]. Postpartum anemia can be defined as a hemoglobin level of <110 g/l at 1 week postpartum and <120 g/l at 8 weeks postpartum [3,6].

Anemia is the second leading cause of disability and most serious public health concerns affecting roughly one third of the world's population [1,7,8]. Globally, in 2011 it is estimated that anemia affects around 800 million children and women. The

highest prevalence of anemia was observed in children (42.6%) while it is lowest among non-pregnant women (29.0%). The global prevalence of anemia for all women of reproductive age was 29.4% [1]. In particular, the prevalence of postpartum anemia ranges from 16% to 60.3% [5,9,10]. It was proved that there are no countries for which country-level estimates were generated where anemia is not at least a mild public health problem with at least prevalence of 5% in children and women, few studies from Ethiopia reported that the prevalence of postpartum anemia ranged from 22.1% to 28.3%. [5,11,12]. Few studies have highlighted that postpartum anemia is associated with some maternal socio-demographic and economic characteristics such as maternal age [7,8,10], literacy and occupational status, and socio-economic position [9,12-16], maternal body mass index and, paternal education [5], and obstetric factors such as narrower birth interval [7,17], delivery complications, preexisting anemia during prepartum, lack of consumption of iron rich foods and iron folic acid supplementation during pregnancy [11,12] superimposed with perceived blood loss during delivery, ever use of family planning [12] and ANC attendance for the indexed pregnancy [5,11,12,14,15].

Severe anemia is associated with substantially worse mortality and cognitive and functional outcomes [1]. Iron deficiency anemia during the postpartum period may have long-term health implications for the mother and her infant [18]. Women with low iron stores at the time of delivery and later may experience fatigue, altered cognition and depressive symptoms [19]. One study from South Africa also reported that iron status was associated with depression, stress and cognitive functioning in poor African women during the postpartum period [5]. In cognizant of adverse consequences of anemia among vulnerable segments of its population such as children and women of reproductive age group, the government of Ethiopia has strengthened its maternal and child health service packages at different levels of the health care system to respond to the health care needs of these needs groups through provision of primary health care services such as immunization for children antenatal and postnatal care services for women [20]. There is paucity of evidence with regards to postpartum anemia in low-income countries like Ethiopia including the study setting [5,11,12,21] although evidence on anemia during pregnancy has been exhausted to design appropriate interventions towards the containment of postpartum anemia and its resultant outcomes. Therefore, this study aimed to assess the magnitude of postpartum anemia and its predictors among lactating women visiting health centers in Odo Shakisso District, Oromia Region, South west Ethiopia.

MATERIALS AND METHODS

Study setting and period

The study was conducted in Odo Shakisso district, which is found in Guji Zone, Oromia Regional State. Shakisso is the capital town of Shakisso district which is located 497 km away from Addis Ababa, the capital of Ethiopia and 140 km from the capital of Guji Zone, Negele Borena, from May 10 to 25, 2017. The district is organized into 20 rural and 2 urban kebeles (smaller administrative unit in Ethiopia). Based on 2007 census the district has a total of 123,593 (60,561 male and 63,032 female) population. Out of this female in reproductive age groups (15-49 years) is 27,190 [22]. Regarding health institutions, the district has 4 health centers and 28 health posts which are governmental, and 27 private medium clinics and 2 pharmacies. Concerning human resource for health, the woreda has a total of 129 health professionals with different background and 56 health extension workers, two for each rural kebeles [23].

Study design, participants, and sample selection

Facility based cross-sectional study design was used among all randomly selected 509 lactating women visiting Health centers in Odo Shakiso District during data collection. We excluded all lactating women who were unable to respond to the interview during data collection. The sample size was computed both for point estimate and factors associated with postpartum anemia. The sample size to determine prevalence of anemia among lactating women was computed using a single population proportion formula with the following assumptions: 95% confidence level, 5% margin of error, prevalence of anemia to be 18.5% [5], 10% for non-response which gave rise to 509 samples. We used this sample size as it was greater than the sample size computed for different factors associated with postpartum anemia in previous studies. The study samples were selected from four health centers after proportionally allocating the sample size to each health center based on the flow of postnatal women to the health centers from the past records. The samples were selected by simple random sampling using the registry of the health center as a sampling frame.

Measurements

Data were collected by face to face interview using a structured and pretested questionnaire which was initially prepared in English and translated to regional language, Afan Oromo, and then back translated to English by different language experts to maintain consistency. Two diploma nurses collected the socio-demographic data while four diploma laboratory technicians collected 2 milliliter blood samples for Hgb test. Finger-prick blood sample was taken and analyzed by HemoCue device (HemoCue Hgb 301). Values were adjusted for altitude using the Centre for Disease Control (CDC) Atlanta method by subtracting 1.9 g/dl for an altitude of 2840 meters above sea level [2]. The stool examination was performed for ova and parasite using direct wet mount technique.

Postpartum maternal anemia status was an outcome variable in this study and was determined using cut-offs used for non-

pregnant women. As a result, overall hemoglobin concentration below 12.0 g/dl was considered as anemia while mild, moderate and severe levels of anemia were determined using cutoff points of 10.0-11.9 g/dl, 7.0-9.9 g/dl and <7.0 g/dl, respectively. Blood taken from lactating women to measure Hgb was decontaminated and damped in the safety box by precaution as per Ethiopian standardized biological waste disposal guideline.

The independent variables for this study included, women's and paternal education, presence of parasitic infection, average monthly income, number of live births, iron supplementation during pregnancy, breastfeeding practice, and family planning utilization. The data collection process was supervised by one BSc nurse from nearby hospital. The data collectors and supervisors were deployed to the field after getting two days proper training on the aim of study and data collection procedures, such as techniques of interview and blood samples collection.

Data quality control

Questionnaire was tested prior to the actual task data collection period among 5% of the study samples from health center outside the study area. The questionnaire was assessed for its face validity such as clarity and wording and the optimal time for completing the interview. Modifications were done based on the result of the pretest before the final task of data collection training was given to data collectors and supervisors and close supervision was made during data collection. Every day after data collection, questionnaire was reviewed and checked for completeness by the supervisors and the necessary feedback was offered to data collectors for the consecutive day.

The standardization procedure was followed to ensure reliability and validity of anthropometric measurements by computing relative Technical Error of Measurement (TEM) using Emergency Nutrition Assessment Standardized Monitoring and Assessment of Relief and Transitions (ENA SMART) software to compare measurements done by each data collector with selected criterion anthropometrist before deploying the data collectors to the field to minimize both random and systematic errors attributed to inaccurate anthropometric measurement. Accordingly, the relative TEM for inter-observer (validity) and intra-observer (reliability) for weight and height measurement was within the normal cut-off points [24]. Hgb data were also carefully handled while following the standard procedures by the laboratory technicians. Data were also double entered by different data clerks to validate the responses.

Statistical analysis

All collected data were checked for completeness visually, coded and entered onto EPI Data version 3.1 and exported to SPSS version 20 computer software for data cleaning and analysis. Descriptive summary statistics such as mean, standard deviation and percentage were computed to describe the study population in relation to relevant variables. Hgb values were categorized as anemic and coded "1" and non-anemic and coded as "0" for further analysis. Bi-variable binary logistic regression analyses were used to see the association between dependent variable and

each independent variable. All variables with p value <0.25 were included into final multivariable binary logistic regression model to control for confounders and identify factors associated with postpartum anemia. Hosmer and Lemshow goodness of fit test was used to test model fitness to the data. Multicollinearity between independent variables was tested using standard error and all independent variables with standard error greater than 2 were dropped from the final model. Odds ratio alongside 95%CI were estimated to measure the strength of the association between the study variables. Level of statistical significance was declared at p-value ≤ 0.05 . The results were presented using text, frequency tables.

RESULTS

Socio-demographic characteristics of the study participants a

total of 494 lactating women were included in the study yielding a response rate of 97%. About 432 (87%) of them were married and 140 (28%) of them attended formal education. Majority, 336 (68%), of the women were house wives and 265 (54%) were protestant by religion. The majority of the respondents 403 (81.6%) were Oromo followed by Amhara ethnic group 49 (10%). Two hundred ninety two (59.1%) of the respondents had monthly income less than (<500 birr per month) while only 202 (40.9%) reported >500 birr per month. Forty six percent of the participants were in the age group of 25-34 years. Out of 432 married women, 257 (52%) and 267 (54%) of their husbands had formal education and were farmers respectively. Two hundred and thirteen (43%) of the women had no any means of media communication and nearly half of the women, 222 (44.9%), were unable to read and write (Table 1).

Variables	Category	Number	%
Marital status	Married	432	87.4
	Divorced	47	9.6
	Widowed	15	3
Religion	Muslim	164	33.2
	Orthodox	65	13.2
	Protestant	265	53.6
Residence	Urban	1	0.2
	Rural	493	99.8
Ethnicity	Oromo	403	81.6
	Amhara	49	9.9
	Gurage	11	2.2
	others	31	6.4
Occupation of the women	House wife	336	68
	Gov't employee	4	0.8
	Farmer	31	6.3
	Merchant	120	24.3
	Daily laborer	3	0.6
Educational Status of the mother	Unable to read and write	222	44.9
	Read and write	132	26.7
	Primary education(1-8)	78	15.8

Husbands educational Status	Unable to read and write	103	20.9
	Read & write	134	27.1
	Primary education(1-8)	144	29.1
	Secondary and above	113	22.9
Husbands occupation	Farmer	267	54
	Gov't employee	78	15.8
	Merchant	110	22.3
	Daily laborer	39	7.9
Own mass media	Radio	148	30
	Tv	133	26.9
	None	213	43.1
Average monthly income	<500	292	59.1
	500-1000	202	40.9
Family size	=2	16	3.2
	03-04	258	52.2
	≥ 5	220	44.5
Age of the participants	15-24	222	44.9
	25-34	227	46
	35-49	45	9.1

Table 1: Socio-demographic characteristics of the lactating women visiting health centers in Odo Shakisso district, Oromia region, Ethiopia, May 2017 (n=494).

Obstetric characteristics of the women

Teen age pregnancy was found to be 378 (76.5%) of the respondents. Nearly half of the women and almost 100% had parity of less than two and reported history of ≤ 2 abortions

respectively. More than half of the women had history of ANC attendance and nearly three-fourth of the women had got information about anemia during their last pregnancy. Only 36% had got iron supplements during pregnancy and slightly more than half (53%) had history of family planning use (Table 2).

Variables	Category	Number	Percentage
Age at first marriage	<20	378	76.5
	20-34	116	23.5
Age at first pregnancy	<20	378	76.5
	20-34	116	23.5
Parity	<2	244	49.4

	03-04	130	26.3
	≥ 5	120	24.3
Number of abortion	≤ 2	493	99.8
	03-04	1	0.2
Number of still births	≤ 2	484	98
	03-04	10	2
Number of abortions ever had before the last birth	0	374	75.7
	≤ 2	74	15
	03-04	45	9.1
	≥ 5	1	0.2
Visited health facility during last pregnancy	Yes	304	61.5
	No	190	38.5
Reasons to visit health facility during last pregnancy	ANC	263	86.2
	Delivery	12	3.9
	Pregnancy related problem	20	6.6
	Problems not related to pregnancy	10	3.3
If visit was for ANC, number of visits	1	49	16.3
	2	76	25.3
	3	99	33
	4	63	21
	5	13	4.3
Where did you attend ANC follow up	Health center	230	76.4
	Health post	31	10.3
	Hospital	40	13.3
Information about pregnancy received during ANC follow up.	Yes	226	75.6
	No	69	23.1
	Don't know	4	1.3
If Yes, types of information provided during pregnancy	Vaginal bleeding	48	21.1
	Severe headache	2	0.9
	Anemia	160	70.5
	Prolonged labor	17	7.5

Got information about Anemia during pregnancy	Yes	162	74
	No	57	26
Duration of breast feeding	One year	92	18.6
	Two year	367	74.3
	Greater or equal to three years	35	7.1
Family planning use	Yes	262	53
	No	232	47
Iron supplementation during pregnancy	Yes	175	35.5
	No	318	64.5

Table 2: Obstetric factors information of the lactating women visiting health centers in Odo Shakiso district, Oromia region, Ethiopia, May 2017(n=494).

Magnitude of anemia among lactating women

The magnitude of postnatal anemia was 30.2%; 95% CI: (26.3%, 34.2%). With regard to the severity of anemia, mild anemia was 22.5%; 95% CI: (18.6%, 26.3%), moderate was 5.7%; 95%CI: (3.8%, 7.7%) and severe anemia was 2%; 95% CI: (0.8%, 3.2%) respectively.

Factors associated with postnatal anemia among lactating women

In multivariable logistic regression analysis, maternal primary education, lack of paternal education, presence *Ascaris* and hook worm in stool, having number of live birth three to four, and lack of iron supplementation during pregnancy were significantly associated with anemia.

The odds of postnatal anemia were 2.6 times higher among women who attended primary education [(AOR=2.6, 95% CI: (1.06, 6.34)] compared with women who attended secondary and above education. Similarly, the odds of anemia were 2.7

times higher among women whose husbands have no formal education [(AOR= 2.7, 95% CI: (1.18, 6.19)] compared with women whose husbands attended secondary and above level of education.

Postnatal anemia was more common among women who were infected with *Ascaris lumbricoids* [(AOR=5.28, 95% CI: (1.81, 15.43)] compared with their counter parts. Moreover, the odds of postpartum anemia were also 5.4 times higher among women who were infected with hook worm [(AOR=5.4, 95% CI: (1.05, 27.57)] compared to women with negative results for hook worm parasite.

Women who had 3 to 4 live births were 2.5 times [(AOR=2.5, 95% CI: (1.14, 4.31)] more likely to develop postpartum anemia compared with those women who gave birth to fewer live births. The odds of postpartum anemia were also nearly 3 times higher among women who were not supplemented with iron tablets during pregnancy [(AOR=2.8, 95% CI: (1.65, 4.66)] compared with their counterparts (Table 3).

Variables	Category	Postpartum anemia		COR (95% CI)	AOR (95% CI)
		Yes	No		
Women's education	No formal education	65 (43.6%)	157 (45.5%)	2.2 (1.20, 3.94)*	0.798 (0.31, 2.09)
	Read and write only	41 (27.3%)	91 (26.4%)	2.2 (1.15, 4.07)*	1.5 (.62, 3.65)
	Primary education(1-8)	32 (21.5%)	46 (13.3%)	2.3 (1.16, 4.66)*	2.6 (1.06, 6.34)**
	Secondary and above	11 (7.4%)	51 (14.8%)	01:00	01:00
Husband's education	No formal education	36 (24.2%)	179 (19.4%)	1.7 (0.99, 2.95)	2.7 (1.18, 6.19)**
	Read and write only	37 (24.8%)	97 (28.1%)	0.55 (0.33, 0.91)*	1.4(.65, 2.90)
	Primary education(1-8)	50 (33.6%)	94 (27.2%)	0.75 (0.46, 1.23)	1.65 (0.84, 3.24)

	Secondary education and above	26 (17.4%)	87 (25.2%)	01:00	01:00
Stool examination for ova and parasites	None	216 (89.6%)	245 (96.8%)	01:00	01:00
	<i>Ascaris</i>	18 (7.5%)	5 (2.0%)	4.1(1.49, 11.18)*	5.3(1.81, 15.43)**
	Hook worm	6 (2.5%)	2 (0.8%)	3.4 (0.680-17.036)	5.4 (1.05, 27.57)**
	Mixed	1 (0.4%)	1 (0.4%)	1.1 (0.071-18.244)	2.2 (0.13, 36.86)
Number of live births	<2	106 (44.0%)	138 (54.5%)	01:00	01:00
	03-04	73 (30.3%)	57 (22.5%)	1.67 (1.09, 2.56)*	2.5 (1.45, 4.31)**
	≥5	62 (25.7%)	58 (22.9%)	1.4 (0.898-2.158)	1.29 (0.69, 2.40)
Average monthly income	<500	88 (59.1%)	204 (59.1%)	0.997 (0.675-0.474)	1.25 (0.81, 1.95)
	500-1000	61 (40.9%)	141 (40.9%)	01:00	01:00
Iron supplementation during Pregnancy	Yes	42 (28.2%)	133 (38.7%)	01:00	01:00
	No	107 (71.8%)	211 (61.3%)	1.20 (0.83, 1.74)	2.77 (1.65, 4.65)
Duration of breastfeeding	One year	27 (18.1%)	65 (18.8%)	01:00	01:00
	Two year	112 (75.2%)	255 (73.9%)	1.35 (0.85, 2.14)	1.12 (0.65, 1.94)
	Two or more year	10 (6.7%)	25 (7.2%)	0.867 (0.393-1.913)	0.92 (0.36, 2.33)
Family planning	Yes	83 (55.7%)	179 (51.9%)	01:00	01:00
	No	66 (44.3%)	166 (48.1%)	1.25 (0.88, 1.78)	0.76 (0.47, 1.22)

Note: *Statically significant at P <0.05, ** statically significant at p<0.01, CI=Confidence Interval, COR=Crude Odds Ratio, AOR=Adjusted Odds Ratio

Table 3 : Predictors of anemia among women Lactating women visiting health centers in Odo shakiso district, Guji zone, Oromia, Ethiopia, May 2017 (n=494).

DISCUSSION

This study aimed at assessing the magnitude of postnatal anemia and associated factors among postnatal women attending health centers in Odo Shakisso District, Oromia national regional state, south west Ethiopia. In this study, the overall magnitude of postpartum anemia was 30.2%, (95% CI: (26.3%, 34.2%). Lack of maternal and paternal education, infection with *Ascaris lumbricoids* and Hook worm, having number of live births 3 to 4, and lack of iron tablets supplementation during pregnancy were significantly associated with postpartum anemia. Nearly one-third of lactating women were anemic in this study, which is consistent with study result from mothers in coastal Karnataka, India (26.5%) [7], China (32.7%) [25], Tanzania (34.2%) [17], Uganda (29.9%) [26], pooled evidence from Ethiopian demographic and health survey, 2016 which reported pooled prevalence of 28.3% among lactating women [12] but lower than study conducted in southern India (47.3%) [8], Myanmar (60.3%) [9], Ghana (46.7%) [27], and North West Ethiopia

(47.2%) [21]. On the contrary, this finding is greater than evidence from Ghana (16%) [10], pooled prevalence from 2005 and 2011 Ethiopian demographic and health surveys which reported 22.1% [5], and postpartum anemia reported from among postnatal women in Northwest Ethiopia (24.3%) [5,11].

The odds of postpartum anemia were 5.3 times higher among women who had *Ascaris lumbricoids* intestinal parasite compared with their counter parts. Likewise, the odds postpartum anemia were 5.4 times higher among women whose stool results revealed hook worm infection compared with those women who had no positive results of any intestinal parasites in their stool. Similar studies also revealed that parasitic infection are among leading causes of anemia, including blood loss, iron deficiency and other micronutrient deficiencies (e.g., vitamin A, folate, vitamin B12 and riboflavin), inherited hemoglobin disorders (e.g., sickle-cell disease and thalassemia), and other acute and chronic infections that cause inflammation [17,26,28].

Maternal and paternal illiteracy is associated with postpartum

anemia in this study. Level of maternal education is found to be significantly associated with postpartum anemia in this study. Accordingly, women who attended primary education were 2.6 times more likely to develop anemia compared with those who attended secondary and above level of education. This finding is in accordance with the studies conducted in Myanmar and Coastal Karnataka where lack of primary education positively influenced the development of postpartum anemia [7,9]. Similarly, other studies done in Tanzania and Ethiopia also identified lack of education among factors contributing to anemia [12]. This may be due to the fact that as education level increases the awareness to consume iron rich food sources and seeking health services increases leading to prevention of anemia. The odds of postpartum anemia were also 2.7 times higher among women whose husbands' had no formal education compared with their counterparts. This finding is in congruence with one former study conducted in Ethiopia [5]. This implies that husbands who had formal education are very much concerned about feeding of breastfeeding women and ANC follow up during pregnancy which may contribute to decrease postpartum anemia.

The chance of postpartum anemia was found to be 2.5 times more common among women whose parity was greater or equal to five compared with those whose parity was less than two. This finding is in agreement with evidence from other studies conducted in Ethiopia [12,17,26]. This may be attributed to the fact that as parity increases the chance of blood loss during delivery increases causing anemia. Moreover, the odds of postpartum anemia were 2.8 times higher among women who didn't take iron supplements during pregnancy compared with their counter parts. This result is consistent with similar studies results in the past [12,21]. This may be attributed to physiological change during pregnancy that requires higher amount of iron to satisfy different body needs. Unlike former studies, other maternal socio-demographic characteristics such maternal age [7,8,10], income/wealth index [5,9,12] and obstetric factors like antenatal care attendance [5,11], contraceptive use [5,12], and birth interval [7,17] were not significantly associated postpartum anemia in this study.

This study could have some limitations. Firstly, recall bias can be introduced during recall of some obstetric phenomena by the women. Secondly, social desirability bias could misclassify the respondents' monthly income due to fear of disclosing the actual estimate upon interview. Thirdly, anthropometric measurements may be affected by Technical Error of Measurement (TEM) by data collectors leading to misclassification of body mass index based nutritional status of women. Lastly but not least, Hgb measurements might have been affected by the effect of an altitude and techniques during laboratory sessions. Nevertheless, all necessary precautions have been made to minimize all forms of biases that could have been introduced otherwise by intensive training before the actual task of data collection and through close supervision of the data enumerators during data collection.

CONCLUSION

Nearly about one-third of the lactating women were anemic. Lack of maternal and paternal education, intestinal parasitic

infections such as *Ascaris lumbricoids* and Hook worm, multiparity, and lack of iron tablets supplementation during pregnancy were significantly associated with postpartum anemia. Hence, all concerned bodies should strengthen strategies to contain parasitic infections, improve iron supplementation, birth spacing, and postnatal deworming to prevent postpartum anemia.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Before the Commencement of data collection, Haramaya University Institutional Health Research Ethics Review Committee (IHRERC) has reviewed and approved the study. Informed written consent was obtained from each participant after explaining the purpose and benefits of the study. It was explained to every study participants that the risk of being participated in this study is minimal. Confidentiality of the study participants' information was ensured throughout the study and beyond. Those lactating women who had severe anemia were referred to Maternal and Child Health (MCH) department to obtain iron and folic acid tablets. All lactating women who were found to be positive for intestinal parasites were treated with appropriate anthelmintics.

CONSENT FOR PUBLICATION

Not applicable

AVAILABILITY OF DATA AND MATERIALS

The datasets generated and/or analyzed during the current study are not publicly available due to privacy but are available from the corresponding author on reasonable request.

COMPETING INTERESTS

The authors declare that they have no any competing interests.

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AUTHORS' CONTRIBUTIONS

TS: conceived the idea of this study, prepared data collection questionnaires, conducted data collection, data entry, analyses, and interpretation and critically reviewed the manuscript, GE: assisted with conceptualizing the design of the study as well as data analysis, data interpretation and write up and critical review of the manuscript, YD: assisted with conceptualizing the design of the study as well as data analysis, data interpretation, HM: assisted with conceptualizing the design of the study as well as data collection, data interpretation. All authors read and approved the final version of the manuscript.

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