Factors Associated with Anemia among Lactating Mothers in Subsistence Farming Households from Selected Districts of Jimma Zone, South Western Ethiopia: A Community Based Cross-Sectional Study

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Abstract

Introduction: Anemia is the most common nutritional deficiency disorder affecting one third of the global population. Lactating mothers are more susceptible because of maternal iron depletion during lactation, blood loss during childbirth and inadequate nutrient intake. Morbidity associated with chronic anemia extends to loss of productivity from impaired work capacity, cognitive impairment, and increased susceptibility to infection. Nevertheless, many Ethiopian mothers remained anemic yet the availability of information is limited.

Methods: A community-based cross-sectional study was conducted among 327 randomly selected lactating mothers residing in the two districts. Interviewer administered questionnaire was used to collect demographic characteristics and anemia risk factors. Finger prick blood sample was analyzed by Hemocue device to determine hemoglobin level. Epi-data 1.4.4.0 and SPSS version 20 were used for data entry and analysis. Bivariate and multivariable regressions were used to identify candidate and predictor variables of anemia, respectively. All associations were considered statistically significant at alpha <0.05.

Results: Overall, 28.7% (95% CI: 24.1%, 33.6%) of mothers were anemic with mild and moderate anemia accounting for 25.8% and 2.9%, respectively. Multi-gravidity (AOR=2.32 (95% CI: 1.12, 4.84), lower ante-natal frequency (AOR=2.37 (95% C.I.: 1.20, 4.71)), lower meal frequency/day (AOR=2.28 (95% C.I.: 1.12, 4.63)), food insecurity (AOR=4.19(2.83, 21.13)), mild undernutrition (AOR=0.35 (95% C.I.: 0.10, 0.80)) and lower dietary diversity (AOR=2.32 (95% C.I.: 1.65, 5.72)) were predictors of anemia.

Conclusion: Anemia is public health problem in the study community, where one in every four lactating mothers was anemic. Antenatal follow up should be encouraged in order to reserve and prevent iron depletion during breast-feeding period, while frequent births need to be alleviated through family planning. Multi-sectoral collaboration is needed to improve the feeding practice, dietary diversity, food insecurity and undernutrition of study community in order to prevent anemia.

Keywords: Lactating women; Anemia; Jimma Zone; Hemoglobin concentration; Southwest Ethiopia; Malnutrition

Abbreviations: ANC: Ante-Natal Care; AOR: Adjusted Odds Ratio; CDC: Center for Disease Control; C.I.: Confidence Interval; COR: Crude Odds Ratio; HFP-CCC: Home Based Food Production and Child Centered Counseling; HIV: Human Immunodeficiency Virus; SD: Standard Deviation; SPSS: Statistical Package for Social Science; UNICEF: United Nations International Children's Emergency Fund; WHO: World Health Organization

Introduction

Anemia is the most common nutritional deficiency disorder in the world affecting about one third of the global population [1]. It is the reduction in the hemoglobin concentration of the peripheral blood below the normal range expected for age and sex of an individual. It is manifested by a condition in which the number of red blood cells or their oxygen carrying capacity is insufficient to meet physiologic needs [2].

Anemia is a global health problem in both developing and developed countries with major consequences on human health as well as social and economic development [3]. Worldwide, the World Health Organization (WHO) estimated the number of anemic persons to be about 2 billion and approximately 50% of all cases can be attributed to iron deficiency [4]. It is responsible for about 1 million deaths a year, out of which three-quarters occur in Africa and South-East Asia [5].

Although the prevalence of anemia is estimated at 9% in countries with high development, in countries with low development the prevalence is as high as 43%. The most at risk population groups are Children and women of reproductive age. Africa and Asia accounting for more than 85% of the absolute anemia burden in high-risk groups [6,7].

Lactating mothers are susceptible to anemia because of maternal iron depletion during lactation as well as blood loss during childbirth [8]. Studies have shown that, although breast milk is not a good source of iron, the quality of breast milk is maintained at the expense of maternal stores [9]. Postpartum anemia is highest in mothers who are anemic during pregnancy [10]. Furthermore, lactating mothers are highly susceptible to iron depletion if the energy and nutrient intake in their diets is inadequate. Lactating mothers begin the postnatal period after having iron depleted through the continuum from pregnancy to childbearing [11].

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The outcomes of anemia in women are tremendous as the condition adversely affects both their productive and reproductive capacities. It reduces women's energy and ability for work and can therefore endanger household integrity, food security and income. It is also contributes to poor perinatal outcomes in developing countries since it predisposes to premature delivery, high perinatal mortality and increased risk of death during delivery and postpartum [12].

Morbidity associated with chronic anemia extends to loss of productivity from impaired work capacity, cognitive impairment, and increased susceptibility to infection which also exerts a substantial economic burden. Physical and cognitive losses due to iron deficiency anemia cost developing countries up to 4.05% losses in gross domestic product per annum [13], thereby stalling social and economic development. In the World Health Organization (WHO)/World Bank rankings, iron deficiency anemia is the third leading cause of disability-adjusted life years lost for females' aged 15-44 years [14,15].

Anemia is reportedly accounted for about 20% of all maternal deaths in sub-Saharan Africa brought about through three main mechanisms [16]. First, anemia resulting from blood loss during or after childbirth makes women more susceptible to deaths by lowering their hematological reserve. Second, severe anemia is associated with increased susceptibility to infection due to lowered resistance to disease; and third, hemoglobin level of less than 4 g/dl is associated with high risk of cardiac failure and death particularly during delivery or soon after, if prompt intervention is not instituted [17,18].

Although the magnitude of iron deficiency anemia, the most common form of nutritional anemia in Ethiopia has not yet been investigated, limited data is available on the prevalence of anemia among pregnant and lactating women in the rural communities, which showed a prevalence rate of 18.7% [19]. In a study conducted in urban slum communities of Addis Ababa, the capital city of Ethiopia, the prevalence rate was 22.3% among lactating women [20].

Various studies pointed out that the predisposing factors contributing for anemia are multi-factorial. Some of these are grand multi-parity, low socioeconomic status, maternal infection, late prenatal care, HIV infection and inadequate spacing of children [21].

Anemia in Ethiopia contributes to high rates of maternal, infant and child mortality in which 676 maternal deaths per 100 000 live births was reported by the 2011 national survey. Similarly, 59 infants and 88 children die out of 1000 live births as reported by 2011 Ethiopian demographic and health survey [22].

This study aimed at identifying factors associated with anemia among lactating women from subsistent farming households. Since most studies conducted on anemia focused on pregnant mothers, urban areas and health facilities; this study aimed at filling the gap by addressing mothers living in subsistent farming households, the most vulnerable population sub-groups who have limited fortune of health service utilization. The selected districts were purposively selected by HFP-CCC (Home Based Food Production and Child Centered Counseling) project for their high prevalence of malnutrition and subsistent farming households. Therefore, the findings of this study can be utilized by all responsible stake holders of the study community and other similar settings for evidence based planning and intervention.

Methodology

This study was conducted in two districts of Jimma zone, namely Dedo and Seqa Chekorsa districts, from February 3-March 2, 2014.

The study aimed at investigating health problems of 355 purposively selected lactating mothers who fulfilled the selection criteria to be included in the longitudinal study of HFP-CCC project (home-based food production and child-centered counseling) implemented by a collaboration of Jimma University and Nestle Foundation.

Jimma town, the capital of Jimma Zone is located in 346 Km south western direction from Addis Ababa, the capital city of Ethiopia. The zone has a total population of 2.5 million from which 94% are rural inhabitants. Subsistence farming is the dominant form of livelihood in the zone where only 15% of the population is in non-farm related jobs [23]. Dedo and Seka-Chokorsa Woredas are among the 18 administrative districts in Jimma Zone where the eight HFP-CCC project Kebeles are located. This setting was selected to represent subsistent farming households in rural southwestern Ethiopia and additional project implementation criteria.

This study employed community-based cross-sectional design to assess determinants of anemia among study participants. The total sample size of this study was calculated using single population proportion formula based on the following assumptions. Using 95% level of confidence, 26.2% prevalence of anemia among lactating mothers in SNNPR (Southern Nations, Nationalities and People's Regional) state of Ethiopia [24], 5% precision and 10% non response rate, the final sample size was calculated to be 327. As a result, among the total project beneficiary lactating mothers, only 327 mothers were randomly selected to be included in the current study.

Data was collected through a pretested interviewer administered questionnaire prepared in English and translated to local language. The questionnaire included information on socio-demographic characteristics, household wealth indicators and different anemia risk factors including maternal health service utilization, recent illnesses, and diet.

Dietary practice of study participants was assessed using 24 h dietary recall method. Maternal Dietary Diversity Score was analyzed by adding together all the food groups consumed within the past 24 h [25].

Body-mass-index of study participants was calculated to determine nutritional status based on their weight and height measurements using calibrated equipments. UNICEF SECA electronic weighing scales and a portable stadiometer were used to measure weight and height of study participants respectively [26].

Anemia status of study participants was determined based on blood hemoglobin concentration result. Finger-prick blood sample was taken and analyzed by HemoCue device (HemoCue Hb 301). Values were adjusted for altitude using the Centre for Disease Control (CDC) Atlanta method [18]. Maternal anemia status was determined using cutoffs used for non-pregnant women [22]. As a result, hemoglobin concentration below 12.0 g/dl was considered as anemic; with its severity of mild, moderate and severe anemia determined using cutoff points of 10.0-11.9 g/dl, 7.0-9.9 g/dl and <7.0 g/dl, respectively.

Data were entered in to computer using Epi-data version 1.4.4.0 and exported to SPSS version 20 for analysis. Proportions and means (SD) were used to describe the study population by explanatory variables and anemia. Bivariate logistic regression was done to identify the candidate variables and finally the predictors of anemia were determined using multivariable logistic regression model. All statistical tests were considered significant at alpha <0.05.

Interviewers were trained prior to data collection and pretest was done among 40 mothers residing in adjacent kebele which is not

included in the actual study. The data collection has been regularly supervised by supervisors and investigators.

Results

Socio-demography of respondents

The response rate of this study was 93.9%. The mean age of study participants was 26.4 years with standard deviation of 5.7 years. Majority of study participants were from Oromo ethnicity, Muslim religion and in a marital union with 276 (93.6%), 266 (88.1%), and 273 (97.2%) respectively. Two hundred twenty five (75.3%) of study participants cannot read and write (Table 1).

Health service utilization of study mothers

One third (110) of study participants had suffered from any type of illness during their breastfeeding period. However, 81 (73.6%) of mothers didn't visit health facility for treatment. Nearly one third (108) of study participants had ever used family planning for birth spacing. Seventy seven (29.1%) mothers had short birth interval (less than two years), whereas less than one tenth (27) of study participants had history of spontaneous abortion. Regarding WHO recommendation of focused antenatal care visit, only 103 (44%) of study participants visited health facility at least four times. However, study participants' home was the major place of child delivery practiced by 248 (82.4%) mothers. 45 (14.7%) of study participants had faced at least one type of delivery related health problems such as hemorrhage, loss of consciousness, severe headache, birth canal laceration, retained placenta, etc. (Table 2).

Dietary practice of study participants

Based on dietary diversity score assessment, Only 98 (31.9%) of study mothers consumed at least 6 food groups, whereas 134 (43.6%) and 75 (24.4%) of study participants consumed 4-5 and less than 4 food groups respectively. The mean and standard deviation of maternal dietary diversity score was 4.9 and 1.9 food groups respectively. The most commonly consumed food group was cereals followed by

Variables		Frequency	Percent
Age of mother	15-24	81	26.6
	25-34	188	61.8
	35-49	35	11.5
Religion of mother	Muslim	266	88.1
	Orthodox	22	7.3
	Protestant	14	4.6
Ethnicity of mother	Oromo	276	93.6
	Amhara	9	3.1
	Others	10	3.4
Marital status	Not in union	8	2.8
	In union	273	97.2
Husband's occupation	Farmer	280	94.3
	Government	5	1.7
	Merchant	8	2.7
	Other	4	1.3
Literacy of mother	Read and write	74	24.7
	Cannot read and write	225	75.3
Distance from health facility (foot walk)	<30 min	175	57.0
	30-60 min	94	30.6
	Above 60 min	38	12.4

Table 1: Socio-demography of study participants, factors associated with anemia among lactating mothers from selected districts of Jimma Zone, 2014.

Variables		Frequency	Percent
Ever been sick during breast feeding period	No	196	64.1%
	Yes	110	35.9%
Ever used family planning	Yes	108	35.6%
	No	195	64.4%
Birth interval	<2 years	77	29.1%
	2-4 years	143	54.0%
	>4 years	45	17.0%
Spontaneous abortion	Yes	268	90.8%
	No	27	9.2%
Frequency of antenatal care visits	<4	131	56.0%
	≥ 4	103	44.0%
Delivery place of index child	Health facility	53	17.6%
	Home	248	82.4%
Health problem during delivery	No	262	85.3%
	Yes	45	14.7%

Table 2: Health service utilization, factors associated with anemia among lactating mothers from selected districts of Jimma Zone, 2014.

legumes and other vegetables consumed by 288 (94.4%), 269 (88.5%) and 233 (76.4%) mothers respectively. The least commonly consumed food groups were fish, organ meat and flesh meat consumed by only 6 (2.0%), 12 (3.9%) and 25 (8.2%) respectively.

Concerning the usual feeding practice of study participants, the mean and standard deviation of number of meals was 3 and 0.6 per day respectively. Majority, 243 (80.2%) of study participants eat three times per day, whereas 29 (9.6%) and 31 (10.2%) of study participants usually eat more than three times per day and less than three times per day respectively. In majority of study participants (61.2%), the amount of food intake had no change as compared to the previous non-lactating non-pregnant time, while 37.2% of study participants had an increased amount of food intake. The rest 1.6% had a decline in amount of food intake as compared to their non-lactating non-pregnant time. One hundred and twenty five (41%) of participants were chronically energy deficient as measured by body-mass-index BMI less than 18.5 kg/m². Accordingly, 76 (24.9%), 24 (7.9%) and 25 (8.2%) of study participants were mildly, moderately and severely underweight, respectively.
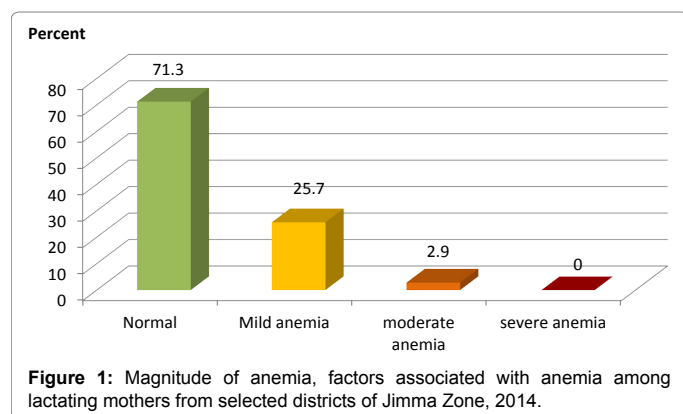
Magnitude of anemia

The mean and standard deviation of hemoglobin concentration for participants were 12.8 and 1.4 g/dl respectively, ranging from 7.0 to 16.6 g/dl. The overall prevalence of anemia among study participants was 28.7%, 95% CI (24.1%, 33.6%) having a hemoglobin concentration below 12.0 g/dl. Mild and moderate anemia accounts 79 (25.8%) and 9 (2.9%) of study participants respectively, whereas none of the study participants were found to be severely anemic (Figure 1).

Predictors of anemia

Based on multivariable logistic regression analysis; multi-gravidity, lower frequency of ANC visits, lower meal frequency per day, lower dietary diversity score, mild undernutrition and food insecurity were identified as independent predictors of anemia.

Multi-gravida mothers had higher chance of being anemic as compared to their counter parts. Accordingly, mothers who had more than three pregnancies were twice more likely to be anemic than their counterparts, AOR=2.32 (95% CI: 1.12, 4.84). Frequency of ANC visit was also associated with anemia. As a result, mothers who didn't attend the all four WHO recommended visits were twice more likely to be anemic than mothers who attended the all recommended ANC visits, AOR=2.37 (95% C.I.: 1.20, 4.71). As shown on Table 3 below, frequency

of meal was also significantly associated with anemia. Accordingly, mothers who eat at most three times per day had a twofold increased chance of being anemic than mothers who eat more than three times per day, AOR=2.28 (95% C.I.: 1.12, 4.63). Similarly, eating variety of food types has a preventive role on exposure to anemia. Accordingly, based on maternal dietary diversity score, mothers who consumed less than 6 food groups were 2 times more likely to be anemic as compared to their counter parts, AOR=2.32 (95% C.I.: 1.65, 5.72). similarly, based on household food insecurity access scale, mothers from food insecure households were four times more likely to be anemic as compared to mothers from food secure households, AOR=4.19 (2.83, 21.13). Nutritional status of mothers had also a significant association with hemoglobin concentration of study participants. Based on body-mass-index of study participants, compared to severely underweight mothers, mildly underweight mothers had 65% less chance of being anemic, AOR=0.35 (95% C.I.: 0.10, 0.80) (Table 3).

Figure 1: Magnitude of anemia, factors associated with anemia among lactating mothers from selected districts of Jimma Zone, 2014.

Discussion

The prevalence of anemia among study participants was 28.7% (hemoglobin level below 12 g/dl), which is slightly higher than national survey, Addis Ababa slum areas, and eastern Ethiopia, in which 18.5% [22], 22.3% [27] and 10.9% [28] lactating mothers were found to be anemic. The mean hemoglobin concentration (12.8 g/dl) was also higher than a study conducted in Addis Ababa slum areas (11.4 g/dl) [27]. However, the prevalence was quite lower than findings from Middle East and India where 66% of study participants in Dehradun district–India [29], and nearly half of study participants in Qashqa'I Iran were anemic [30]. This might be due to social and cultural factors of Ethiopians; as mostly mothers take longer maternity leave after child delivery and kept nourished with variety of foods. In addition, majority of Ethiopians consume"Injera" (one of the staple foods in Ethiopia), which is rich in dietary iron. In the current study, 95 % study participants consumed cereals food group (which contain "teff") within the past 24 h preceding the survey. Regarding the severity of anemia, none of the participants were severely anemic (Hemoglobin concentration less than 7 g/dl), while 25.8% and 2.9% of study participants were mildly and moderately anemic, respectively. Eventhough the prevalence of anemia among current study participants was relatively low compared to most studies; it is considered as a public health problem according to WHO classification [31].

Based on multivariable logistic regression analysis; multi-gravidity, lower frequency of ANC visits, lower meal frequency per day, lower dietary diversity score, mild undernutrition and food insecurity were identified as independent predictors of anemia. Multi-gravida mothers had higher chance of being anemic than their counter parts. The mothers who had more than three pregnancies were twice more likely to be anemic than their counterparts, AOR=2.32 (95% CI: 1.12,

Variables		Anemic	Normal	COR (95% CI)	AOR (95% CI)
Literacy	Read and write	19	55	1	1
	Can't read and write	67	158	1.228 (0.68, 2.23)	0.93 (0.43, 2.04)
Marital status	Not in union	2	6	1	1
	In union	79	194	1.22 (0.24, 6.18)	1.72 (0.15, 20.22)
Place of delivery	Health facility	12	41	1	1
	Home	74	174	1.45 (0.72, 2.92)	1.96 (0.79, 4.86)
Gravidity	≤4	31	95	1	1
	above 4	57	124	1.41 (0.84, 2.35)	2.32 (1.12, 4.84)*
frequency of ANC visits	≥4	25	78	1	1
	<4	48	83	1.80 (1.02, 3.20)*	2.37 (1.20, 4.71)*
Delivery related problems	No	74	188	1	1
	Yes	14	31	1.15 (0.58, 2.28)	1.31 (0.47, 3.65)
Age of mother	15-24	26	55	1	1
	25-34	51	137	0.79 (0.45, 1.39)	0.93 (0.42, 2.06)
	35-49	11	24	0.97 (0.41, 2.27)	1.75 (0.55, 5.554)
Meal frequency/per day	≤3	29	58	1.36 (0.80, 2.33)	2.28 (1.12, 4.63)*
	>3	59	161	1	1
Maternal DDS	< 6 food groups	63	142	1.73 (1.23, 3.83)*	2.32 (1.65, 5.72)*
	≥6 food groups	20	78	1	1
Nutritional status	Normal	49	131	0.56 (0.24, 1.33)	0.38 (0.13, 1.15)
	Mild underweight	20	56	0.54 (0.21, 1.38)	0.35 (0.10, 0.80)*
	Moderate underweight	9	15	0.90 (0.29, 2.84)	0.89 (0.23, 3.55)
	Severe underweight	10	15	1	1
Food insecurity	Secure	83	191	1	1
	Insecure	4	17	0.54 (0.18, 1.66)	4.19 (2.83, 21.13)*

*Significant at p<0.05

Table 3: Predictors of anemia, factors associated with anemia among lactating mothers from selected districts of Jimma Zone, 2014.

4.84). This is in line with a study conducted in Sidama zone, southern Ethiopia in which women with parity of 1-2, 3-4 and 5 or more had 2.17, 2.26 and 2.83 times increased odds of anemia compared to nulliparous mothers [32]; and Wolaita Sodo, southern Ethiopia in which multi-gravida mothers had higher odds of anemia [33]. This may be due to the reason that repeated and frequent births may not provide sufficient time period to replenish lost nutrient stores before another child birth [34]. The risk will be substantially aggravated among mothers whose feeding practice is poor [35].

ANC follow up is one of the schemes to prevent and treat anemia among pregnant mothers. Based on the guidelines of micronutrient deficiency prevention and control, all ANC attending mothers are counseled for the benefit of adequate nutrition. In addition, they are also screened for presence of absence of some diseases including anemia [36]. In the current study, mothers who didn't fully attend the four WHO recommended visits were twice more likely to be anemic than mothers who fully attended all the recommended ANC visits, AOR=2.37 (95% C.I.: 1.20, 4.71). This is supported by Ethiopian demographic and health survey report in which lactating mothers who reported four ANC visits or more were 27% less likely to have anemia than mothers who never attended ANC [24]. Meal frequency was also significantly associated with anemia. Accordingly, mothers who ate less than or equal to three times per day had a twofold increased chance of being anemic than mothers who ate more than three times per day, AOR=2.28 (95% C.I.: 1.12, 4.63). This is in line with a study done in northern Ethiopia in which mothers who had meal frequency less than two times per day were four times more likely to be anemic than those whose meal frequency was more than three times per day [37].

Similarly, eating variety of food types has a preventive role on exposure to anemia. Accordingly, based on maternal dietary diversity score (DDS), mothers who consumed less than 6 food groups were twice more likely to be anemic than their counter parts, AOR=2.32 (95% C.I.: 1.65, 5.72). This is consistent with the findings of a study done in southern Ethiopia in which the odds of anemia were two times elevated in the low dietary diversity score [32]; and a study conducted in Northern Ethiopia which showed a 13 fold increased odds of anemia among pregnant mothers of lower dietary diversity [37]. This is due to the reason that poor feeding practice (i.e., low dietary diversity leads to deficiency of minerals and vitamins), decreases bio-availability of iron [38]. This is supported by another finding of current study in which mothers from food insecure households were four times more likely to be anemic than those mothers from food secure households, AOR=4.19 (2.83, 21.13).

Nutritional status of mothers had also a significant association with hemoglobin concentration of study participants. Based on body-mass-index analysis, mildly underweight mothers had 65% less chance of being anemic than severely underweight mothers, AOR=0.35 (95% C.I.: 0.10, 0.80). This finding is in line with a study done in Ethiopia in which lactating mothers with a normal body mass index were less likely to be anemic as compared to their counterparts [24]. Similarly, a study from Thailand revealed lower odds of having anemia among well-nourished mothers.

Eventhough most of the variables have shown statistically significant association on multivariable regression, the odds of anemia were not statistically significant across variables like maternal education, age, sickness during breast feeding period, marital status, place of child delivery, distance from the nearby health facility, abortion history, delivery related problems and family planning utilization.

One of the strengths of current study is the use of laboratory diagnosis and altitude adjustment for verification of anemia. However, dietary assessment and food security findings should be interpreted with caution that seasonal variation could exist so that the finding is limited to the specific season of the year. The study did not assess soil transmitted helminthic infection, which might be associated with anemia.

Conclusion and Recommendation

Anemia is a public health problem (concern) in the study community, where nearly one in every four lactating mothers was anemic having hemoglobin concentration below 12 g/dl. Multi-gravidity, lower frequency of ANC visits, lower meal frequency per day, lower dietary diversity score, severe malnutrition and food insecurity were identified as independent predictors of anemia.

ANC follow up during pregnancy should be encouraged since improving iron status during pregnancy helps to reserve and prevent depletion of iron store so that it helps to prevent anemia during lactation period. Multi-sectoral approach (agriculture, education, and health sector) is needed to improve the feeding practice, dietary diversity, food insecurity and chronic energy deficiency of study community in order to prevent and control anemia. Since high fertility rate is also one of the predictors of anemia, multi-gravidity and frequent birth has to be alleviated through encouraging mothers to use family planning service. Therefore, both governmental and non-governmental organizations including the respective district administrations, health offices and other stake holders has to give due attention to improve the current situation.

Availability of Data and Material

The dataset supporting the current study is available from the corresponding author on reasonable request.

Author's Contribution

Mihiretu A: Conceived the study, participated in the design of the study, obtained ethical clearance and permission for the study, interpreted data, involved in drafting article, involved in analysis of the study. The author read and approved the final manuscript.

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Competing Interests

The author and the funding organization declared that we have no competing interests.

Ethics Approval and Consent to Participate

Ethical clearance was received from Jimma University College of health and medical science ethical review committee. Local administrative bodies were also communicated and permission was obtained from the respective administrative bodies. Finally informed written consent was obtained from the participants before the actual data collection begun. Participants were informed that they have full rights to participate or not, as well as their responses will be kept confidential. Mothers whose hemoglobin concentration below 9.0 g/dl was referred to health facility for further treatment and follow up.

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