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# Anemia and Its Determinants Among Apparently Healthy Women from Pastoralist Communities of Ethiopia: A Community Based Cross Sectional Study

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**Abstract:** This study examined the magnitude of anemia and its determinants among 468 apparently healthy women randomly selected from the pastoralist communities of Somali region, Ethiopia. The overall prevalence of anemia was 39.98%, of which mild, moderate and severe anemia were 108(25.17%), 57(13.29%) and 6(1.40%), respectively. Most (65%) of the anemic women are from rural settings. The mean Hgb level (adjusted for altitude) was 12.01(±2.1SD) gm/dl and ranged from 7-16gm/dl. As expected, anemia was significantly lower among contraceptive users (p=0.005), got iron supplementation (p=0.104), had no malaria (p=0.901) and counseled on anemia (p=0.375). Low consumption of meat (p=0.001) and fruits (p=0.029) were the significant factors associated with Anemia. To improve anemia in the community, a concerted effort comprising of public health measures and nutrition counseling in addition to the ongoing weekly iron folic acid supplementation is recommended.

**Keywords:** Anemia, Pastoralists, Inadequate Nutrient Intake, Women, Ethiopia

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## 1. Introduction

Anemia is an important global public health problem, affecting the lives of more than two billion people globally, accounting for about 30% of the world's population, and is the most common public health problem in developing countries occurring at all stages of life with sub Saharan Africa and Southeast Asia being the most hit regions [1]. The groups most affected are pregnant women, children under the age of five years, adolescents and to a lesser extent, school-age children [2].

The cause of anemia varies though usually attributed to nutritional deficiencies that include inadequate intake of iron and other micronutrient deficiencies like folate, vitamin B12 and vitamin A and hemoglobinopathies. Other than these, parasitic infestations, malaria, HIV/AIDS, cancers and chronic illnesses, poor sanitary and health conditions and poor socioeconomic condition are among other causes of anemia particularly in poor countries [3-5], suggesting that

socioeconomic factors are the major determinants factors for anemia. It is a major concern for healthcare policies because of its association with impaired reproduction, low work performance and educability, and with diminished response from the immunological system, with major social and economic implications [5]. Mildly anemic subjects with borderline hemoglobin levels are reported to be quite common among apparently healthy general population globally while moderate and severe anemia gets immediate attention due to their functional consequences. Failure to identify and investigate mild anemia in such population could lead grave conditions which could be averted.

In Ethiopia, the prevalence of anemia at national level is 23% in women of reproductive age and the problem in Somali region exceeds the national figure by three folds, which is 58% based on the 2016 Ethiopian demographic health survey [6].

The main risk factors for iron deficiency anemia in Ethiopia include a low intake of iron, consuming diets high in phytate

or phenolic compounds which are inhibitors of iron absorption and periods when iron demand is high during pregnancy and adolescent's period [7]. Although the 2016-EDHS report demonstrated that anemia is a serious public health problem in the pastoralist community, its attributes are not well studied signifying a gap to be addressed. Therefore we examined the extent of the problem and its attributes contextually to reinforce the current intervention strategies towards the pastoralist community of reproductive age groups.

## 2. Materials and Methods

### 2.1. Study Setting and Study Period

The study was conducted from February 2017-April 2017 in Gashamo district, Jarar zone of the Somali Regional State, located 628 Km east of the capital of Addis Ababa, Ethiopia among apparently health women. The study site was conveniently chosen because of conflicting reports documented for the area by few investigators.

### 2.2. Study Design and Sampling Procedures

A community based cross sectional study design was employed to sample the eligible women. The sample size was estimated using double population proportions formula assuming a proportion of 9% among non-exposed and 19% among exposed with a ratio of 1:3 in the exposed and non-exposed, respectively including non-response rate of 5% and a design effect of 1.5 [7]. A total of 468 participants were estimated and enrolled in the study after their informed verbal consent was obtained. All women in apparent health, aged 15-49 years available in the households at the time of the study were considered eligible and were included. Those women who refused to participate and were pregnant or lactating and those who had chronic illnesses were excluded.

A multi stage sampling was employed to sample the participants. In the first stage, Jarar zone was purposively selected, from this zone; Gashamo district was included because the area was solely pastoralist. Subsequently all available kebeles/villages found in the district were then stratified into rural and urban settings. After the stratification took place, a total of 4 kebeles (two kebeles from each settings) were selected randomly through lottery method initially which was then followed by registering of household by settings (urban and rural) to constitute the sampling frame. After stratification of the settings was completed, participants were selected systematically from the registration list with a random start until the required sample size was reached.

### 2.3. Data Collection

A pre-tested structured tool translated into the local language (Somali) was used to collect the data. Two trained female midwives and one male with BSc in public health, with previous relevant experience were recruited in the district and collected the data through face to face interview. The training covered basic interviewing skills, and how to measure hemoglobin. The tools consisted of socio-demographic,

dietary, obstetric history and laboratory test for hemoglobin measurements.

Dietary data were collected using food frequency questionnaire (FFQ) modified from the Helen Keller International FFQ that was used previously in Ethiopia, to estimate meat and vegetable consumption in addition to the staple food intake (3).

Twenty four common foods, irrespective of the staple food, were included on the FFQ

(Plant sources: banana, beans, bread, wheat, barley, sorghum, ground nuts, oranges,

Fruits and vegetables, peanuts, potato, rice, spinach, meat sources: beef meat, goatmeat, eggs, liver, milk, poultry; and an "other" option). Responses were grouped as once/ twice per week or once per month.

The presence of anemia was assessed through measuring hemoglobin (Hgb) levels in the blood, using a portable hemoglobin meter (HemoCue, Angelholm, Sweden), in order to make direct readings on blood samples obtained via finger prick using a disposable lancet by the midwives. The finger prick site was cleaned using antiseptic and dried, before withdrawing the blood. Women with hemoglobin concentrations less than 12 g/dL were considered to be anemic, in accordance with the WHO classification [1]. To avoid the contribution of intestinal worms to anemia, all participants were dewormed with 400 mg Albendazole tablet prior to data collection.

### 2.4. Data Quality Management

To maintain the quality of the data, two days training was given to data collectors on the objective of the study, hemoglobin measurement procedures and ethical issues. The questionnaires were developed in English and then translated into Somali language and back translation was done. Pretest and demonstration of instrument was performed on 5% of the sample in similar communities that were not included in the sample. The collected data were checked for completeness and consistencies by the supervisors and the investigator. The HemoCue was regularly checked against the standards provided by the company.

### 2.5. Data Analysis

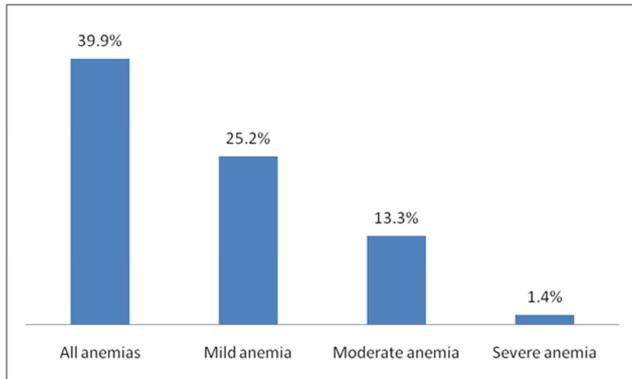
The data were entered and cleaned by using EPI data version 3.1 and was analyzed by Stata version 14. Data were summarized as frequencies and percentages in tables. Bivariate and multivariate logistic regression analyses were used to identify the independent predictor of anemia with an estimation of odds ratios (OR) and 95% confidence intervals (95% CI). All significant variables in the bivariate analysis with p value  $\leq 0.2$  were fit into the multivariate logistic regression model. A  $P < 0.05$  was declared statistically significant.

## 3. Result

Altogether 429 women participated with 91.60% response rate. The mean (SD) age was 25.67 years ranging from 15 to

45 years and no significant differences among anemic and their counterparts.

**3.1. Prevalence of Anemia**



**Figure 1.** Magnitude and categories of anemia among respondents (n=429) in gashamo district, Ethiopian Somali regional state, April 2017.

The overall prevalence of anemia is 39.86% [95%CI=0.35-0.45]. The mean Hgb level (adjusted for altitude) was 12.01 ( $\pm$ 2.1SD) g/dl and ranged from 7-16gm/dl. The prevalence rate of mild, moderate and severe Anemia was 108(25.17%), 57(13.29%) and 6(1.40%), respectively (Figure 1).

Table 1 demonstrates the various characteristics associated with anemia. Anemia was significantly higher among rural 110(64.32%) than urban 61(35.67%) dwellers. The majority (86.55%) of anemic women were married and most (81.87%) of them live with their husbands. The proportion of anemia was significantly higher among farmers (56.14%), those who had more than two children (83.63%), had no education (84.21%), whose water source is tanker (72.51%), wash hands without soap (21.64%), whose spouse was farmer (43.27%) and had no education (59.6%). Unexpectedly, anemia was lower among those who had treated their water probably indicating that the causes were nutritional.

**Table 1.** Socio-demographic characteristics of respondents by anemia in Gashamo district, jarar zone, Somali regional state of Ethiopia, October 2017.

Characteristics	Categories	Anemic	Normal	X <sup>2</sup> -value	P-value
Settings	Rural	110(64.32)	102(39.53)	47.6829	0.001
	Urban	61(35.67)	156(60.46)		
Age	Mean (SD)	25.76(SD $\pm$ 6.05)	27.82(SD $\pm$ 6.08)		
Marital status	Single	15(8.77)	55(21.32)	17.1146	0.001
	Married	148(86.55)	179(69.38)		
	Divorced	8(4.68)	24(9.30)		
Women lived with	Husband	140(81.87)	165(63.95)	18.4306	0.001
	Father & mother	27(15.78)	78(30.23)		
	Relatives	4(2.34)	15(5.81)		
Women's occupation	Daily laborer	19(11.11)	36(13.95)	37.8918	0.001
	House wife	48(28.07)	97(37.57)		
	Farmer	96(56.14)	104(40.31)		
	Government	8(4.68)	21(8.13)		
Had children	Yes	143(83.63)	181(70.16)	10.0953	0.001
	No	28(16.37)	77(29.84)		
Women's education	Literate	27(15.79)	79(30.62)	39.3875	0.001
	Illiterate/none	144(84.21)	179(69.37)		
Source of drinking water	Piped into dwelling	4(13.45)	7(2.71)	63.5318	0.001
	public tape	49(27.49)	63(24.42)		
	Tanker truck	87(59.06)	96(37.20)		
	Rain water	31(18.12)	92(35.65)		
	Daily laborer	39(22.80)	27(10.46)		
Husband's occupation	Merchant	24(14.03)	49(18.99)	87.7460	0.001
	Farmer	74(43.27)	73(28.19)		
	Government	9(5.26)	45(17.44)		
	Others	25(14.61)	64(24.80)		
	Yes	47(27.48)	108(41.86)		
Make water safer to drink	No	124(72.51)	150(58.14)	18.8054	0.001
	Always with soap	16(9.35)	20(7.75)		
Washed hands with soap	Sometimes with soap	20(11.69)	31(12.01)	46.9277	0.001
	Without soap	37(21.64)	46(17.83)		
	Do not wash at all	98(57.31)	161(62.40)		
	Illiterate/none	102(59.65)	169(65.50)		
Husband's education	literate	69(40.35)	89(34.50)	61.8633	0.001

Figures are numbers (percentages) of respondents unless stated otherwise.

**3.2. Obstetric Related Characteristics**

Table 2 displays the obstetric related history of the respondents by magnitude of anemia. The proportion of anemia was higher among women who did not use

contraceptives (91.23%), received no iron supplementation during ANC (85.96%), had malaria (80%) and are counselled during ANC visit and the difference noted was significant only for contraceptive use (p=0.005). On the other hand, among contraceptive users, those who consumed pills 10(66.67%) of

them had anemia.

**Table 2.** Obstetric related characteristics of respondents by anemia in Gashamo district, jarar zone, Somali regional state of Ethiopia, October 2017.

Characters	Level	Anemic	Normal	X <sup>2</sup> -value	P-Value
Used contraceptives	Yes	15(8.77)	48(18.60)	7.9360	0.005
	No	156(91.23)	210(81.31)		
CM used	Injections	4(26.67)	4(8.33)	9.6390	0.086
	Pills	10(66.67)	40(83.33)		
	Natural methods	1(6.67)	4(8.33)		
Received iron supp.	Yes	13(7.60)	26(10.08)	2.6423	0.104
	No	158(92.40)	232(89.92)		
Had malaria	Yes	16(9.35)	9(3.49)	0.0128	0.910
	No	155(90.64)	249(96.51)		
Counseled on anemia	Yes	3(4.61)	8(7.40)	0.7880	0.375
	No	62(95.38)	100(92.59)		

CM=contraceptive methods; Supp=supplementation; Figures are numbers (percentages) of respondents unless stated otherwise.

### 3.3. Nutrient Consumption

Table 3 indicates nutrient and diet characteristics of respondents by prevalence of anemia. As shown, out of 171 anemic women, 106(61.98%) had a meal patterns of two times

per day and the difference was significant (p=0.001). The proportion of anemia was significantly higher among women who didn't consume meat (75.44%), green leafy vegetables (88.89%) and fruit (95.90%).

**Table 3.** Nutrient and diet characteristics of respondents by anemia in Gashamo district, jarar zone, Somali regional state of Ethiopia, October 2017.

Characters	Level	Anemic	Normal	X <sup>2</sup> -value	P-Value
Meals per day	Two times	106(61.98)	158(61.24)	29.3602	0.001
	Three times	62(36.25)	93(36.04)		
	Four and above	3(1.75)	7(2.71)		
Consumed meat	Yes	42(24.46)	123(47.67)	29.9342	0.001
	No	129(75.44)	135(52.32)		
Consumed GLV	Yes	19(11.11)	67(25.67)	46.8715	0.000
	No	152(88.89)	191(74.03)		
Consumption of GLV	Daily	1(5.26)	4(5.97)	9.8444	0.020
	Twice a week	3(15.78)	7(10.44)		
	Twice a month	4(21.05)	18(26.86)		
	Once a month	11 (57.89)	38(6.71)		
Consumedfruits	Yes	7(4.1)	18(6.97)	4.7889	0.029
	No	164(95.90)	240(93.02)		

GLV=Green leafy vegetables; Figures are numbers (percentages) of respondents unless stated otherwise.

### 3.4. Results of Bivariate and Multivariate Analyses

Even though anemia was significantly higher among rural dwellers (p=0.001), married (p=0.001), farmers (p=0.001), live with their husbands (p=0.001), those who had more than two children (p=0.001), had no education (p=0.001), whose water source is tanker (p=0.001), wash hands without soap (p=0.001), whose spouse was farmer (p=0.001), had no education (p=0.001), had a meal patterns of two times per day

(p=0.001), did not consume meat (p=0.001) vegetables (p=0.001) and fruit (p=0.001), the association remained significantly only for low consumption of meat and fruits in the multivariate analysis (Table 4). The odds of developing anemia was nearly 10 times more likely among non-meat consumers (AOR=9.87; 95% CI=1.28-76.16) and 5 times more likely among non-fruit consumers (AOR=5.46; 95%CI=1.48-20.15) suggesting that the causes of anemia are nutritional in origin (Table 4).

**Table 4.** Results of bivariate and multivariate analyses of respondents by anemia in Gashamo district, Jarar zone, Somali regional state of Ethiopia, October 2017.

Characters	Level	Anemic	Normal	AOR (95%CI)
Residence area	Rura	110(64.32)	102(39.53)	0.54 (0.01-40.33)
	Urban	61(35.67)	156(60.46)	1
Marital status	Married	148(86.55)	179(69.38)	4.44(0.14-14)
	Unmarried	23(13.45)	79(30.62)	1
Women lived with	Husband	140(81.87)	165(63.95)	15.23(0.35-657.2)
	Father& mother	31(18.12)	93(36.04)	1
Women's occupation	Daily laborer	19(11.11)	36(13.95)	0.25(0.02-3.34)
	House wife	48(28.07)	97(37.57)	0.47(0 .06- 3.70)
	Farmer	96(56.14)	104(40.31)	0.2(0.02-2.49)
	government	8(4.68)	21(8.13)	1

Characters	Level	Anemic	Normal	AOR (95%CI)
Husband's occupation	Daily laborer	39(22.80)	27(10.46)	1.51(0.07-32.1)
	Merchant	24(14.03)	49(18.99)	0.54(0.07-4.21)
	Farmer	99(57.89)	137(53.1)	0.044(0.002-11.167)
	Government	9(5.26)	45(17.44)	1
Had children	Yes	143(83.63)	181(70.16)	1
	No	28(16.37)	77(29.84)	1.58(0.27-9.19)
Women's education	literate	27(15.79)	79(30.62)	1
	Illiterate	144(84.21)	179(69.37)	0.59(0.14-2.46)
Husband's education	Illiterate	102(59.65)	169(65.50)	1.18(0.04-32.09)
	literate	69(40.35)	89(34.50)	1
Source of drinking water	Piped into dwelling	4(13.45)	7(2.71)	1
	public tape	49(27.49)	63(24.42)	0.88(0.47-1.65)
	Tanker truck	87(59.06)	96(37.20)	0.43 (0.25-8.38)
Making water safe	Rain water	31(18.12)	92(35.65)	0.18(0.11-25.24)
	Yes	47(27.48)	108(41.86)	1
Washed hands with soap	No	124(72.51)	150(58.14)	0.42(2.2-18.24)
	Always with soap	16(9.35)	20(7.75)	1
	Sometimes with soap	20(11.69)	31(12.01)	15.87(1.44-144.4)
	Without soap	37(21.64)	46(17.83)	0.913(0.2-4.2)
Meals per day	Do not wash at all	98(57.31)	161(62.40)	0.09(0.01-1.22)
	Two times	106(61.98)	158(61.24)	1.52(0.07-33.31)
	Three times	62(36.25)	93(36.04)	1.58(0.22-11.15)
Consumed meat	Four and above	3(1.75)	7(2.71)	1
	Yes	42(24.46)	123(47.67)	1
consumed GLV	No	129(75.44)	135(52.32)	9.87(1.28-76.16)**
	Yes	19(11.11)	67(25.67)	1
consumed GLV	No	152(88.89)	191(74.03)	6(0.28-14.25)
	Daily	1(16.33)	4(5.97)	1
	Twice a week	3(42.86)	7(10.44)	1.99(0.45-8.68)
	Twice a month	4(18.37)	18(26.86)	1.69(0.29 -9.94)
Consumedfruits	Once a month	11 (22.45)	38(6.71)	0.35 (0.05-2.77)
	Yes	7(4.1)	18(6.97)	1
Used contraceptives	No	164(95.90)	240(93.02)	5.46 (1.84-20.15)**
	Yes	15(8.77)	48(18.60)	0.62(0.13 -2.95)
Methods (type ) used	No	156(91.23)	210(81.31)	1
	Injectable	4(26.67)	4(8.33)	1
	Pills	10(66.67)	40(83.33)	4(4.08-18.83)
Supplemented with iron	Natural methods	1(6.67)	4(8.33)	4(0.29-53.47)
	Yes	13(7.60)	26(10.08)	1
	No	158(92.40)	232(89.92)	0.29(0.75-1.2)

1=reference\*= Significant at p-value of  $\leq 0.2$  & \*\* Significant at p-value of  $\leq 0.05$ ; others= government /students; Figures are numbers (percentages) of respondents unless stated otherwise

## 4. Discussion

The present study assessed the prevalence and determinant of anemia contextually among apparently healthy reproductive aged women from pastoralist communities. The overall magnitude of anemia in the studied community falls in the category of serious public health problem when the WHO threshold criteria of 40% is considered [8-9]. The current figure however, when compared with the national figure reported by Ethiopian demographic health survey for the country, it is nearly two-folds (40% vs 23%) [6]. Nonetheless when compared with the regional figure reported in the same national survey, it is lower (40% vs 58%) probably due to the variation in the type of study participants as well as seasonal variations [6] in addition to lack of sufficient micronutrients in food as is the case in most developing countries.

On the other hand, when compared with some previous studies conducted in the country by haidar et al in which he documented 79.4% of anemia for Afar region which is semi

pastoralist community, and 55.7% for Dire-Dawa administrative region the present figure is low [10] and concurs with Alene et al report of 40% for Godey, which is a pastoralist community [11]. Compared with some previous elsewhere studies done by Kumar Verma et al in India who reported 49.82% [12], Meda et al of 53.% in Tamil Nadu [13], Abdullahi et al of 56.8% in Godey, eastern part of Ethiopia [11] and Patavegar et al (51.92%) in rural areas of Maharashtra [14], the current finding is lower than what has been reported. Such wide variations could be attributed due to the differences in the methodology employed as well as the differences in the ecology. For instance, Abdullahi et al, assessed the magnitude of anemia among all women of various physiological status in malaria endemic areas which consequently inflated the prevalence of anemia than the present study findings. Whereas when compared with local studies done by Gebremedhin et al findings of 27.5% [5], Asres et al of 16.1% [15] and Kefiyalew et al of 27.9% in south east Ethiopia [16], the present finding is higher than what has been reported by all aforementioned authors. This could be explained by the fact that the study

participants included in his study are purely pastoralists recently affected by severe drought at the time of the study.

As anticipated, when the types of anemia were disaggregated by severity, most (63%) had mild types followed by moderate (33%) and only 4% had severe types of anemia and this finding is consistent with Haidar et al findings [15].

In this study, several socio-demographic factors such as being rural dweller, married, farmers, live with their husbands, had no education and had more than two children, poor hygienic practices of the women and spouse illiteracy was associated with the magnitude of anemia though the observed associations were lost after adjusting for the potential confounding effect of other variables. This suggests that the etiology is due to inadequate food consumption or nutritional in origin. This assertion is substantiated by the fact that those who had a meal patterns of two times per day, did not consume plant (fruits) and animal sources of food (meat) had significantly higher proportion of anemia as evidenced in the multivariate results. The odds of developing anemia were more likely among those who did not consume meat and fruit than their referent groups again suggesting that the causes of anemia are inadequate intake of iron rich foods. Similar findings have been reported previously in the country [20] as well as elsewhere [17-18] by different authors.

The strength of the present study is that the challenge of underestimation or overestimation of food intake, which is associated with dietary assessment methods, was minimized by using food models to help participants to estimate portion sizes. In addition hemoglobin was measured using a HemoCue which is an appropriate test in field setting and HGB value was adjusted for altitude and all participants were solely representing the pastoralist community.

#### *Limitations*

The study however had some drawbacks due to the nature of the study design and thus it was not possible to tell whether anemia preceded the predisposing factors or vice versa.

## **5. Conclusions**

The prevalence of anemia appears to be of serious public health problem of pastoralist community and the finding is concordant with the household food in-secured women of Mexico [19]. Most of the anemias are of mild to moderate degrees. Inadequate intake of animal and plant sources of food was significantly associated with the magnitude of anemia suggesting that the causes of anemia in the pastoralist community appears to be nutritional in origin. Therefore, a concerted effort comprising of public health measures with focused nutrition counseling, on iron rich food consumption, subsidy of food in addition to the ongoing weekly iron folic acid supplementation is essential to reduce the burden of anemia.

## **Abbreviations**

ANC: Antenatal Care  
AOR: Adjusted Odds Ratio  
CM: Contraceptive Methods  
CI: Confidence Interval  
COR: Crude Odds Ratio  
CSA: Central Statistically Agency  
EDHS: Ethiopian Demographic Health Survey  
EPI: Extended Program of Immunization  
FFQ: food frequency questionnaire  
Hgb: Hemoglobin

## **Declaration**

Ethics approval and consent to participate

Somali regional health bureau ethics review committee approved the study under protocol number 028/10/SRHB. In addition the study was cleared at the regional health bureaus, as well as the zonal and district health offices. Data were collected from all women who had given their verbal consent to participate in the study at their residence after the nature of the study was explained to them in their local language. All anemic participants were linked to the close health centers with appropriate advises.

## **Consent for Publication**

“Not applicable”.

## **Availability of Data and Material**

The institutional review board of Addis Ababa University does not allow to share original data unless indicated in the approval process.

## **Competing Interests**

The authors declare that they have no competing interests.

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## **Authors' Contributions**

SA and JH conceptualized the study, wrote the manuscript, and approved the final version.

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