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Anaemia prevalence and associated factors among lactating mothers in Ethiopia: evidence from the 2005 and 2011 demographic and health surveys

Yihunie Lakew,[1] Sibhatu Biadgilign,[2] Demewoz Haile[3]

[1]Ethiopian Public Health Association, Addis Ababa, Ethiopia
[2]Independent Public Health Consultant, Addis Ababa, Ethiopia
[3]Department of Public Health, College of Medicine and Health Sciences, Madawalabu University, Bale Goba, Ethiopia

Correspondence to
Demewoz Haile;
demewozhaile@yahoo.com

ABSTRACT

Objective: To identify factors associated with anaemia in lactating mothers in Ethiopia.

Design: A cross-sectional secondary analysis of data pooled from two rounds of the 2005 and 2011 Ethiopian Demographic and Health Survey (EDHS) was used. A multivariate logistic regression model was applied to determine the factors associated with anaemia.

Population: A total of 7332 lactating mothers (2285 from EDHS 2005 and 5047 from EDHS 2011) were included from 11 administrative states of Ethiopia.

Main outcome measures: Lactating mothers considered anaemic if haemoglobin level <12 g/dL.

Results: The overall prevalence of anaemia among lactating mothers was 22.1% (95% CI 21.13% to 23.03%). The highest prevalence was 48.7% (95% CI 40.80% to 56.62%) found in the Somali region, followed by 43.8% (95% CI 31.83% to 56.87%) in the Afar region. The multivariate statistical model showed that having a husband who had attended primary education (adjusted OR (AOR) 0.79; 95% CI 0.68 to 0.91), working during the 12 months preceding the survey (AOR 0.71; 95% CI 0.63 to 0.80), having a normal maternal body mass index (18.5–24.99 kg/m^2) (AOR 0.78; 95% CI 0.68 to 0.89), being in the middle wealth quintile (AOR 0.83; 95% CI 0.71 to 0.98) or rich wealth quintile (AOR 0.83; 95% CI 0.70 to 0.98), having ever used family planning (AOR 0.68; 95% CI 0.57 to 0.80), having attended antenatal care (ANC) for the indexed pregnancy four times or more (AOR 0.73; 95% CI 0.59 to 0.91), having experienced time variation between the two surveys (AOR 0.73; 95% CI 0.64 to 0.85), and breastfeeding for 2 years (AOR 0.76; 95% CI 0.66 to 0.87) were factors associated with lower odds of having anaemia in lactating mothers.

Conclusions: Anaemia is highly prevalent among lactating mothers, particularly in the pastoralist communities of Somali and Afar. Promoting partner education, improving maternal nutritional status, and creating behavioural change to use family planning and ANC services at health facilities are recommended interventions to reduce the prevalence of anaemia among lactating mothers in Ethiopia.

Strengths and limitations of this study

- The study aimed to identify factors associated with laboratory-confirmed anaemia among lactating mothers at the national level. The study findings can be used to inform policy and programme actions.
- Some regions from which data were collected had a small sample size, and so findings should be interpreted with caution.
- This study also shares the limitation of a cross-sectional design, which makes it difficult to demonstrate cause-and-effect relationships.

INTRODUCTION

Anaemia is a serious nutrition problem affecting millions in developing countries and remains a major challenge for human health and social and economic development.[1] Lactating mothers are vulnerable to anaemia. During the period of lactation, mothers are susceptible to anaemia because of maternal iron depletion and blood loss during childbirth.[2] Studies have shown that, although breast milk is not a good source of iron, the concentration of iron in breast milk is independent of maternal iron status. This indicates that the quality of breast milk is maintained at the expense of maternal stores.[2 3]

Postpartum anaemia is highest in mothers who are anaemic during pregnancy.[4] 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.[5] A study from South Africa showed that iron status was associated with depression, stress and cognitive functioning in poor African mothers during the postpartum period.[6]

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In a meta-analysis of observational and intervention trials, Ross and Thomas[7] found that ~20% of maternal mortality in sub-Saharan Africa and South Asia was attributable to anaemia that was primarily the result of iron deficiency.

Ethiopia is one of the countries in sub-Saharan Africa affected by anaemia, and it contributes to high rates of maternal, infant and child mortality globally.[8] [9] In Ethiopia, the maternal mortality rate is 676 maternal deaths per 100 000 live births,[10] which is one of the highest in the world. The country has very high infant and under-5 mortality rates, which account for 59 and 88 deaths per 1000 live births, respectively.[10]

Anaemia testing was included in the two rounds of the Ethiopian Demographic and Health Survey (EDHS). The prevalence of anaemia among lactating mothers was 29.9% in 2005 and 18.5% in 2011.[10] [11] It was 30.6% in 2005 and 22% in 2011 among pregnant women, and 23.9% in 2005 and 15% in 2011 among women who were neither pregnant nor lactating. This shows that the prevalence of anaemia was higher among pregnant and lactating mothers in Ethiopia. However, little information is available on the socio-demographic factors associated with anaemia in lactating mothers. This study aimed to identify factors associated with anaemia in lactating mothers in Ethiopia using the pooled data of EDHS 2005 and 2011.

METHODS
Data type and study design
This analysis used secondary data from the 2005 and 2011 EDHS to identify factors associated with anaemia in lactating mothers. Both the 2005 and 2011 EDHS samples were selected using a stratified, two-stage cluster sampling design. All women aged 15–49 who were usually resident or who had slept in the selected households on the night before the survey were eligible. The EDHS data include a women's questionnaire that measures socio-demographic characteristics of the mothers, information on reproductive health and service use behaviours, as well as results of HIV and anaemia tests. The tool was pretested and translated into three local languages: Amharic, Oromefa and Tigregna. The EDHS was designed to provide population and health indicators at national and regional levels. The survey is conducted every 5 years. The detailed methodology can be found elsewhere.[10] [11]

Data extraction
Both EDHS 2005 and 2011 data were downloaded, with permission, from the Measure DHS website in SPSS format. After a review of the detailed data coding, further data recoding was completed. A total of 7332 lactating mothers (2285 from EDHS 2005 and 5047 from EDHS 2011) were included in the analysis. Based on published literature, information on a wide range of socio-demographic and economic variables,

health-service-related factors and anaemia level indicators were extracted. The chosen variables were region, residence, wealth index, occupation, body mass index (BMI), duration of breastfeeding, respondent's education, husband's education, family planning use, iron tablet supplementation during pregnancy, time variation between the two surveys, marital status, age, parity and antenatal care (ANC) attendance.

Measurement of variables
In both rounds of the EDHS, haemoglobin analysis was carried out on site using a battery-operated portable HemoCue analyser for all anaemia samples. The raw measured concentrations of haemoglobin were obtained using the HemoCue instrument and adjusted for altitude and smoking status.[10] Lactating mothers were considered to be anaemic if their haemoglobin level was <12 g/dL. Haemoglobin level was measured in g/dL, operationalised as a categorical variable by predefined cut-off points for mild, moderate and severe anaemia recommended by the WHO for women above the age of 15 years. For this analysis, we recategorised anaemia level as anaemic and non-anaemic from prior classifications in levels (no, mild, moderate, severe) because of very small numbers of cases in the categories of severe and mild anaemia in all datasets of pooled and individual surveys.

ANC attendance refers to obtaining services during pregnancy according to the WHO recommendation of at least four ANC visits for low-risk pregnant women. The frequency of ANC visits was measured by asking the respondent to recall how many times she had attended for the indexed child. Occupational status was defined as non-working and working, which comprises professional/technical/managerial, clerical, sales and services, skilled manual, unskilled manual and agriculture classifications. BMI (kg/m^2) was categorised using the standard WHO classification into underweight <18.5 kg/m^2, normal 18.5–24.9 kg/m^2, overweight 25.0 kg/m^2 and above. Parity, defined as the number of children ever born, was categorised as 1–4, 5–9 and 10+. The wealth index, constructed from household assets and characteristics available in both surveys to categorise individuals into wealth quintiles (poorest, poorer, middle, rich and richest), was used. For the present analysis, the wealth index was collapsed into three groups (poor, middle and rich) to give meaningful and practical subpopulation categories for designing programme interventions in the general community.

Statistical analysis
For this study, the 2005 and 2011 EDHS data were pooled to achieve high power for detecting the associated factors. Sample weights were applied to compensate for the unequal probability of selection between the strata, which has also been geographically defined for non-responses. A detailed explanation of the weighting procedure can be found in the EDHS methodology

report.[10] We used 'svy' in Stata V.11 to weight the survey data and perform the analyses.

Descriptive statistics were used to show the prevalence of anaemia among lactating mothers varying by background characteristics. Bivariate and multivariate logistic regression statistical analysis was carried out to determine the factors associated with anaemia in lactating mothers. Variables found statistically significant at p<0.25 during bivariate analysis were analysed in the multivariate logistic regression model.[12] This p value cut-off point prevented removal of variables that would potentially have an effect during multivariate analysis. Both crude and adjusted ORs were reported with 95% CI. Variables with p<0.05 were considered significant in the multivariate logistic regression model.

Ethics statements

The data were downloaded and used after communicating the purpose of the analysis and receiving permission from the Measure DHS Organisation. The original EDHS data were collected in accordance with international and national ethical guidelines.

RESULTS

Most respondents (86%) were from rural areas. Nearly 60% of lactating mothers were Christians and 38% were Muslims. The mean age of the respondents was 28.4 (SD 6.8) years. The overall prevalence of anaemia among lactating mothers during 2005–2011 was 22.1% (95% CI 21.13% to 23.03%). The prevalence of anaemia for the years 2005 and 2011 was 29.9% (95% CI 28.04% to 31.79%) and 18.5% (95% CI 17.45% to 19.60%), respectively. The prevalence was 13.8% (95% CI 11.44% to 16.41%) in urban areas and 23% (95% CI 21.99% to 24.03%) in rural areas. In the period 2005–2011, the highest prevalence of anaemia among lactating mothers was 48.7% (95% CI 40.80% to 56.62%) found in the Somali region, while the lowest prevalence was 9.0% (95% CI 4.07% to 15.47%) reported in Addis Ababa. In the period 2005–2011, the prevalence of anaemia among lactating mothers was consistently higher in those in the poor wealth index group, not currently working, with BMI ≥25 kg/m^2, with 1 year duration of breastfeeding, never educated, never used ANC, never used family planning services, no iron tablet supplement during pregnancy, and with higher parity. A significant reduction in the prevalence of anaemia among lactating mothers was observed in all background variables from 2005 to 2011 (table 1). Figure 1 shows the classification of anaemia in terms of its detailed variables.

In the bivariate step of our analysis, age and marital status were not statistically significant in the data from both individual surveys and pooled data with the cut-off point p<0.25. The variable associated with anaemia for the 2005 data was BMI, whereas for the 2011 data associated variables were working status, wealth index, ever use of family planning, ANC attendance four times or more for indexed pregnancy, husband's education, maternal BMI and duration of breastfeeding.

In the final multivariate model using pooled data, the independent predictors of anaemia for Ethiopian lactating mothers were currently working, wealth index, ever use of family planning, ANC attendance four times or more for indexed pregnancy, husband's education, maternal BMI, time variation in the two surveys, and duration of breastfeeding.

Paternal educational status was found to be a predictor of anaemia in lactating mothers. Lactating mothers with husbands who had attended primary education were 21% less likely to have anaemia than those who had husbands with no education (adjusted OR (AOR) 0.79; 95% CI 0.68 to 0.91). The odds of working lactating mothers being anaemic was 29% less than their counterparts (AOR 0.71; 95% CI 0.63 to 0.80). Lactating mothers with a normal maternal BMI (18.5–24.99 kg/m^2) were 22% less likely to be anaemic than lactating mothers with low BMI (<18.5 kg/m^2) (AOR 0.78; 95% CI 0.68 to 0.89). Similarly, lactating women categorised in the middle (AOR 0.83; 95% CI 0.71 to 0.98) and rich (AOR 0.83; 95% CI 0.70 to 0.98) wealth quintiles were each 17% less likely to have anaemia than lactating women in poorer wealth quintiles.

Of the reproductive characteristics, family planning use and ANC were significant factors associated with anaemia in lactating mothers. Lactating mothers who had ever used family planning were 32% less likely to have anaemia than lactating mothers who had never used family planning (AOR 0.68; 95% CI 0.57 to 0.80). Lactating mothers who reported ANC attendance four times or more for indexed pregnancy were 27% less likely to have anaemia than mothers who never attended ANC (AOR 0.73; 95% CI 0.59 to 0.91). Lactating mothers who fed breast milk for 2 years were 24% less likely to have anaemia than lactating women who fed breast milk for 1 year (AOR 0.76; 95% CI 0.66 to 0.87) (table 2).

DISCUSSION

Over one-fifth of lactating mothers were anaemic in Ethiopia, which is lower than in other developing countries. For example, 66.0% of lactating mothers have been reported as having anaemia in India,[13] and 43.8% of lactating mothers in Kenya had a haemoglobin level <12 g/dL.[14] Another study from Myanmar reported an anaemia prevalence rate of 60.3% in lactating women, with 20.3% of lactating mothers having severe anaemia.[15] Although the prevalence of anaemia among lactating mothers in Ethiopia was relatively low compared with these studies, it remains a public health problem according to WHO classification.[16] The lower prevalence of anaemia in Ethiopia among lactating mothers may be due to the cultural norms of providing nutritional care to lactating mothers during the postpartum period. Lactating mothers are encouraged to rest for 3–6 months and to eat a variety of foods

Table 1 Prevalence of anaemia among lactating mothers by background characteristics in Ethiopia using pooled data from the EDHS 2005 and 2011

Background characteristic	2005		2011		2005–2011	
	Total lactating women†	Prevalence of anaemia (95% CI)	Total lactating women†	Prevalence of anaemia (95% CI)	Total lactating women†	Prevalence of anaemia (95% CI)
Region						
Tigray	142	35.4 (27.69 to 43.33)	281	13.4 (9.89 to 17.90)	422	20.8 (17.18 to 24.93)
Afar	22	46.2 (25.88 to 66.16)	38	42.4 (27.27 to 58.10)	59	43.8 (31.83 to 56.87)
Amhara	591	32.2 (28.47 to 36.00)	1352	18.9 (16.91 to 21.09)	1943	22.9 (21.12 to 24.86)
Oromia	826	28.5 (25.45 to 31.60)	2041	20.1 (18.39 to 21.87)	2867	22.5 (21.00 to 24.05)
Somali	60	49.2 (37.50 to 62.50)	92	48.3 (37.76 to 58.02)	152	48.7 (40.80 to 56.62)
Benshangul-gumz	24	26.8 (10.81 to 44.92)	59	20.5 (11.51 to 32.02)	83	22.9 (14.81 to 32.83)
SNNPR	578	26.2 (22.66 to 29.82)	1059	13.5 (11.54 to 15.66)	1637	18.0 (16.16 to 19.88)
Gambella	6	46.5 (14.66 to 85.34)	18	23.2 (7.49 to 45.31)	25	28.0 (13.15 to 47.7)
Harari	3	27.1 (1.67 to 86.80)	10	23.4 (3.50 to 51.95)	15	20.0 (5.35 to 45.35)
Addis Ababa	27	14.4 (4.89 to 31.97)	83	7.3 (2.98 to 14.43)	111	9.0 (4.07 to 15.47)
Dire Dawa	5	33.0 (7.35 to 81.76)	13	35.8 (15.68 to 65.91)	18	33.3 (14.77 to 56.9)
Residence						
Urban	145	19.4 (13.49 to 26.34)	595	12.4 (9.96 to 15.27)	740	13.8 (11.44 to 16.41)
Rural	2140	30.6 (28.68 to 32.59)	4452	19.4 (18.27 to 20.59)	6592	23.0 (21.99 to 24.03)
Wealth index						
Poor	986	32.2 (29.29 to 35.12)	2306	21.4 (19.74 to 23.09)	3293	24.6 (23.15 to 26.09)
Middle	517	29.9 (26.15 to 34.04)	1102	17.0 (14.84 to 19.27)	1619	21.1 (19.19 to 23.16)
Rich	782	27.0 (23.96 to 30.18)	1639	15.6 (13.86 to 17.37)	2420	19.3 (17.76 to 20.91)
Current occupational status						
Not working	1568	31.8 (29.55 to 34.16)	2325	21.0 (19.37 to 22.68)	3893	25.4 (24.06 to 26.29)
Working*	712	25.5 (22.46 to 28.86)	2722	16.4 (15.03 to 17.81)	3434	18.3 (17.02 to 19.61)
BMI						
<18.5	481	33.9 (29.76 to 38.21)	1138	19.3 (17.12 to 21.70)	1619	23.6 (21.57 to 25.71)
18.5–24.99	1729	28.3 (26.20 to 30.44)	3723	18.1 (16.89 to 19.37)	5453	21.3 (20.22 to 22.39)
25+	65	42.1 (30.05 to 53.76)	175	20.4 (15.07 to 27.04)	240	26.3 (20.98 to 32.09)
Duration of breastfeeding (years)						
1	1072	30.7 (27.98 to 33.50)	2461	20.6 (19.04 to 22.23)	3533	23.7 (22.31 to 25.11)
2	728	26.6 (23.53 to 29.95)	1490	15.4 (13.61 to 17.27)	2218	19.1 (17.52 to 20.79)
3+	478	32.5 (28.34 to 36 to 72)	1096	18.2 (15.96 to 20.52)	1575	22.6 (20.59 to 24.72)
Mother's education						
None	1804	31.8 (29.70 to 34.00)	3486	19.2 (17.91 to 20.52)	5291	23.5 (22.36 to 24.65)
Primary	394	24.3 (20.32 to 28.79)	1377	18.3 (16.32 to 20.41)	1770	19.6 (17.80 to 21.50)
Secondary	79	17.3 (10.46 to 27.31)	126	8.3 (4.10 to 13.69)	205	11.8 (7.83 to 16.67)
Higher	8	1.1 (0.63 to 48.03)	58	9.7 (4.30 to 20.28)	66	8.7 (3.77 to 17.95)
Husband's education						
None	1333	33.9 (31.40 to 36.48)	2531	20.3 (18.77 to 21.91)	3864	25.0 (23.65 to 26.38)
Primary	701	26.2 (23.09 to 29.60)	2048	17.2 (15.60 to 18.87)	2749	19.5 (18.05 to 21.01)
Secondary	199	20.7 (15.41 to 26.64)	238	14.3 (10.26 to 19.17)	437	17.2 (13.84 to 20.92)
Higher	23	14.8 (3.43 to 31.53)	147	13.7 (8.75 to 19.88)	170	13.8 (8.99 to 19.30)
Family planning						
Never used	1775	32.1 (29.97 to 34.31)	2889	21.2 (19.72 to 22.70)	4663	25.4 (24.16 to 26.66)
Ever used	15	16.4 (2.30 to 37.52)	2158	14.9 (13.46 to 16.47)	2173	14.9 (13.46.16.45)
ANC use						
Never	1636	32.0 (29.80 to 34.32)	2977	20.4 (18.97 to 21.87)	4613	24.5 (23.27 to 25.75)
1–3 times	386	27.7 (23.43 to 32.35)	1208	18.4 (16.27 to 20.64)	1594	20.6 (18.65 to 22.62)
4+ times	260	18.9 (14.44 to 23.95)	845	12.6 (10.44 to 14.91)	1105	14.1 (12.16 to 16.27)
Iron supplementation during pregnancy						
No	2046	30.1 (28.15 to 32.12)	4196	18.8 (17.64 to 20.01)	6242	22.5 (21.47 to 23.54)
Yes	236	27.1 (21.74 to 33.06)	840	16.9 (14.48 to 19.55)	1076	19.2 (16.97 to 21.68)
Parity						
1–4	1293	28.9 (26.50 to 31.44)	3111	18.1 (16.77 to 19.48)	4404	21.3 (20.11 to 22.53)
5–9	903	30.5 (27.52 to 33.52)	1739	19.6 (17.79 to 21.53)	2642	23.3 (21.73 to 24.96)
10+	89	37.1 (27.53 to 47.46)	197	17.0 (12.02 to 12.46)	287	23.2 (18.72 to 28.50)
Total	2285	29.9 (28.04 to 31.79)	5047	18.5 (17.45 to 19.60)	7332	22.1 (21.13 to 23.03)

*Professional/technical/managerial, clerical, sales and services, skilled manual, unskilled manual and agriculture.
†The numbers are weighted.
ANC, antenatal care; BMI, body mass index; EDHS, Ethiopian Demographic and Health Survey.

Figure 1 Prevalence of anaemia among lactating mothers in Ethiopia, 2005–2011.
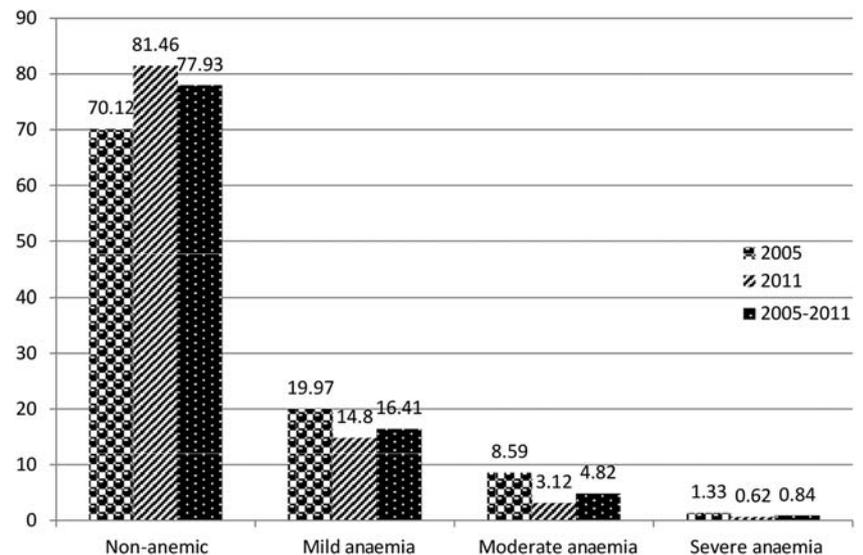
including animal sources, even during religious fasting periods. Iron supplementation in pregnant mothers remains low in Ethiopia[10] despite its known contribution to reducing the risk of postpartum haemorrhage[17] Postpartum haemorrhage was also found to be one of the risk factors for anaemia during the period of lactation.[17]

This study shows that anaemia is a widespread problem in the pastoralist communities of Somali and Afar. The prevalence of anaemia in lactating mothers was found to be higher in the pastoralist regions and showed slow decline in these regions from 2005 to 2011. This may be because pastoralist communities are heavily dependent on animal milk, which has low iron bioavailability, as a source of daily food.[18 19] The other reason may be low utilisation of family planning and ANC services in pastoralist areas.[10]

One of the factors found to be associated with anaemia was paternal education. Having a husband with a higher level of education was found to be associated with lower odds of a lactating mother having anaemia. This may be because educated husbands might support their wives in the use of modern health services such as family planning, ANC and postnatal care, which in turn reduce the odds of having anaemia, as well advising them to eat a diverse diet.

However, maternal educational status was not statistically associated with anaemia, which is in contradiction to many other studies from Ethiopia and abroad.[15 20–22] This might be an important motivator to involve husbands in anaemia-prevention efforts.

Lactating mothers who had been working in the 12 months preceding the survey had lower odds of having anaemia than their counterparts. This may be because working mothers were earning money as compared with non-working mothers and the extra income enabled them to access and purchase more food items, including animal sources (meat, poultry, fish), and increase dietary diversity. Studies have shown that income growth improves diet diversity, which in turn improves intake of micronutrients, including iron.[23 24]

Similarly, lactating mothers in the lower wealth quintiles had greater odds of having anaemia than those in the higher wealth quintiles. In many other studies of anaemia in reproductive-age women, the wealth index was found to be a statistically significant factor.[15 20] Further studies have also shown that women of low socio-demographic status are at risk of iron deficiency anaemia in late pregnancy and in the postpartum period.[25 26] Therefore, women's empowerment through economic interventions and working status may provide a positive contribution to preventing anaemia.

This study also supports the importance of family planning for reducing the risk of anaemia. Lactating mothers who have ever used family planning (modern or traditional) had lower odds of having anaemia than those who had never used family planning. This finding is consistent with studies from Ethiopia and Timor-Leste which showed that use of family planning was associated with lower odds of having anaemia.[20 27]

Maternal nutritional status (as measured by BMI) was found to be significantly associated with anaemia. As compared with undernourished lactating mothers (BMI $<18.5\ kg/m^2$), being in the normal BMI category (18.5–24.9 kg/m^2) was associated with lower odds of having anaemia. This finding is consistent with studies from Ethiopia and Thailand.[20 28] When a mother is at risk of deficiency of macronutrients, she is most likely also at risk of other micronutrient deficiencies such as iron.[29]

ANC attendance was found to be associated with lower odds of lactating mothers having anaemia. This is most likely because mothers are advised during ANC attendance to take iron supplements according to the Ethiopian micronutrient guidelines and instructed to consume different sources of iron-rich food items.[30] Therefore, improving iron status during pregnancy also helps to prevent anaemia during the lactation period.

Lactating mothers who fed breast milk for 2 years had lower odds of having anaemia than those who fed breast milk for 1 year. This may be due to the effect of breastfeeding on maternal depletion. Those mothers who breastfeed

Table 2 Factors associated with anaemia in lactating mothers in Ethiopia using pooled data from the EDHS 2005 and 2011

Variable	2005		2011		2005–2011	
	COR (95% CI)	AOR (95% CI)	COR (95% CI)	AOR (95% CI)	COR (95% CI)	AOR (95% CI)
Occupation						
Not working	1.00	1.00	1.00	1.00	1.00	1.00
Working	0.82 (0.66 to 1.00)	0.83 (0.64 to 1.06)	0.62 (0.54 to 0.71)	0.68 (0.58 to 0.78)	0.64 (0.57 to 0.72)	0.71 (0.63 to 0.80)
Wealth index						
Poor	1.00	1.00	1.00	1.00	1.00	1.00
Middle	0.71 (0.54 to 0.92)	0.82 (0.61 to 1.10)	0.74 (0.61 to 0.89)	0.85 (0.69 to 1.04)	0.74 (0.64 to 0.87)	0.83 (0.71 to 0.98)
Rich	0.66 (0.53 to 0.82)	0.91 (0.68 to 1.22)	0.62 (0.52 to 0.72)	0.80 (0.65 to 0.97)	0.65 (0.57 to 0.73)	0.83 (0.70 to 0.98)
Family planning use						
Never used	1.00	1.00	1.00	1.00	1.00	1.00
Ever used	0.37 (0.11 to 1.28)	0.51 (0.14 to 1.91)	0.54 (0.46 to 0.63)	0.69 (0.58 to 0.82)	0.48 (0.41 to 0.55)	0.68 (0.57 to 0.80)
ANC attended						
Never	1.00	1.00	1.00	1.00	1.00	1.00
1–3	0.78 (0.59 to 1.03)	0.94 (0.66 to 1.33)	0.78 (0.59 to 1.00)	1.00 (0.83 to 1.2)	0.81 (0.71 to 0.94)	0.99 (0.84 to 1.16)
4+	0.55 (0.41 to 0.74)	0.82 (0.53 to 1.28)	0.55 (0.41 to 0.74)	0.71 (0.55 to 0.92)	0.52 (0.44 to 0.61)	0.73 (0.59 to 0.91)
Husband's education						
None	1.00	1.00	1.00	1.00	1.00	1.00
Primary	0.77 (0.61 to 0.96)	0.77 (0.58 to 1.01)	0.69 (0.59 to 0.80)	0.80 (0.67 to 0.94)	0.69 (0.61 to 0.78)	0.79 (0.68 to 0.91)
Secondary	0.55 (0.39 to 0.77)	0.83 (0.50 to 1.38)	0.64 (0.48 to 0.87)	0.81 (0.58 to 1.14)	0.62 (0.49 to 0.77)	0.83 (0.62 to 1.09)
Higher	0.58 (0.26 to 1.30)	0.50 (0.73 to 3.40)	0.72 (0.49 to 1.0)	0.96 (0.61 to 1.52)	0.64 (0.46 to 0.90)	0.94 (0.61 to 1.45)
Maternal BMI						
<18.5	1.00	1.00	1.00	1.00	1.00	1.00
18.5–24.99	0.74 (0.59 to 0.92)	0.76 (0.59 to 0.99)	0.74 (0.64 to 0.86)	0.79 (0.68 to 0.93)	0.76 (0.67 to 0.86)	0.78 (0.68 to 0.89)
25+	1.1 (0.62 to 1.90)	1.66 (0.79 to 3.48)	0.82 (0.58 to 1.2)	1.12 (0.77 to 1.62)	0.85 (0.64 to 1.12)	1.21 (0.87 to 1.68)
Duration of breastfeeding (years)						
1	1.00	1.00	1.00	1.00	1.00	1.00
2	0.79 (0.64 to 0.99)	0.79 (0.62 to 1.03)	0.71 (0.60 to 0.83)	0.75 (0.63 to 0.88)	0.75 (0.66 to 0.85)	0.76 (0.66 to 0.87)
3+	0.99 (0.77 to 1.27)	1.10 (0.82 to 1.49)	0.71 (0.59 to 0.86)	0.82 (0.67 to 0.99)	0.81 (0.70 to 0.94)	0.89 (0.76 to 1.05)
Time laps						
2005					1.00	1.00
2011					0.65 (0.58 to 0.73)	0.73 (0.64 to 0.85)

1.00 is the reference category.
ANC, antenatal care; AOR, adjusted OR; BMI, body mass index; COR, crude OR; EDHS, Ethiopian Demographic and Health Survey.

younger children might have a higher burden of breast-feeding than mothers who fed the older children. A study by Gebremedhin *et al*[20] also found that breastfeeding increases the risk of anaemia significantly.

One of the strengths of this study is the use of laboratory-confirmed anaemia data at the national level. Therefore, the study findings can be used to inform policy and programme actions. However, there is the caveat that some regions had a small sample size, which questions the accuracy of prevalence estimates per region, so findings should be interpreted with caution. The study did not determine the presence of soil-transmitted helminth infection, which is associated with anaemia. This study also has the limitation of a cross-sectional study design, which makes it difficult to demonstrate cause-and-effect relationships.

CONCLUSION

Anaemia is a public health problem in lactating mothers in Ethiopia. There are regional disparities regarding the prevalence of anaemia, with the highest found in the pastoralist regions of Somali and Afar. Promoting partner education, improving maternal nutritional status, and creating behavioural change to use family planning and attend ANC services at health facilities are recommended interventions to reduce the prevalence of anaemia among lactating women in Ethiopia.

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