

Original Research Article

Prevalence and Determinants of Anaemia among Reproductive-aged Women in Ethiopia: A Nationally Representative Cross-sectional Study

Abstract

Anaemia in reproductive-aged women is a worldwide health problem. This study was aimed to assess prevalence and determinants of anaemia among reproductive-aged women in Ethiopia. Data for the study were obtained from 2016 Ethiopian demographic and health survey data, which is a national representative cross-sectional data. A Multivariable logistic regression model was applied to identify determinants of anaemia among reproductive-aged women. A total of 14460 women who aged 15 to 49 years were included in the study. Prevalence of anaemia of among reproductive-aged women was 27.08% (95% CI: 22.88, 31.08%). Women living in Afar (AOR=2.439; 95% CI: 2.006, 2.968), Amhara (AOR=1.269; 95% CI: 1.035, 1.556), Somalia (AOR=2.592; 95% CI: 2.142, 3.133), Benshangul-Gumuz (AOR=2.019; 95% CI: 1.666, 2.447), Gambela (AOR=2.465; 95% CI: 2.026, 2.998) were associated with high risk of anaemia. Women with 1 or 2 children (AOR=1.272; 95% CI: 1.103, 1.466), 3 or 4 children (AOR=1.277; 95% CI: 1.059, 1.539) and 5 or more (AOR=1.420; 95% CI: 1.213, 1.662) were associated with high risk of anaemia. Further, pregnant women (AOR=1.408; 95% CI: 1.263, 1.570) were associated with high risk of anaemia. Hence, **concerned bodies** need to pay special attention to women regarding anaemia based on place of residence and the region.

Keywords: Anaemia, **Prevalence**, **Determinants**, Reproductive-aged women, Ethiopia

1. Introduction

Anaemia is defined as a condition in which concentration of red blood cells/hemoglobin is lower than the normal resulting in reduced oxygen-carrying capacity to meet physiologic needs of the body [1]. A non-pregnant and pregnant women are considered as anaemic if hemoglobin levels are lower than 120 gram/liter and lower than 110 gram/liter respectively [2]. Anaemia is one of the global widespread public health and nutritional problems affecting both developing and developed countries and occurs at all stages of life cycle prominently in young, pregnant women and other women in child bearing age [3]. It has significant adverse health consequences such as child mortality, maternal mortality, increased risk of adverse pregnancy outcomes, impaired neuro-cognitive and physical development of children and reduced work capacity, and adverse impacts on socio-economic development [4, 5]. Some of the symptoms that are resulted from impaired tissue oxygen delivery include weakness, fatigue, and difficulty in concentration [6].

Globally, it is thought that most commonly anaemia is caused by deficiency of iron. In addition, deficiencies in nutrition like folate, vitamin B12 and vitamin A, parasitic infections, acute and chronic inflammation and inherited or acquired disorder which affects synthesis of hemoglobin, production of red blood cell or survival of red blood cell can also cause anaemia [2].

The prevalence of anaemia in developed countries is estimated to be 9% and in that of developing countries 43% [7]. It is estimated that 42% of the pregnant women and 30% in non-pregnant women who are 15-49 years old are anaemic globally. It is also estimated that anaemia contributes to more than 115000 maternal deaths and also 591000 prenatal deaths globally annually [8]. Anaemia in reproductive-aged women is a worldwide health problem. The prevalence of anaemia is highest in Low Income countries predominantly in Africa. In Africa 57.1% of the pregnant and 47.5% of non-pregnant women are anaemic [3].

Despite Ethiopian ministry of health and its stakeholders are doing their best to decrease prevalence of anaemia in the country, the recent demographic and health survey report, 2016 EDHS showed an increase in the prevalence of anaemia among women aged 15-49 years as compared to 2011 EDHS report. The prevalence of anaemia among women who aged 15-49 years declined from 27% in 2005 to 17% in 2011[9] but then increased to 24% in 2016 in Ethiopia. Moreover, the prevalence of anaemia is more among women than that of men in Ethiopia. According to 2016 EDHS report the prevalence of anaemia among women was 24% compared to 15% for men in 2016 in Ethiopia [10].

52 Some of the documented factors associated with anaemia among women include place of residence,
53 geographic region, maternal age, maternal education level, marital status, wealth index, meal
54 frequency per day, smoking cigarette, body mass index, nutrition education, contraceptive methods,
55 intestinal parasitic infection, gravidity, pregnancy status, hookworm infection, chronic illness, parity,
56 iron supplementation, and currently breast feeding, birth interval [11-29].

57 Anaemia in pregnant women causes increased risk of premature delivery and low birth weight [9]. So,
58 it is essential to identify factors associated with anaemia among women in reproductive age to inform
59 the planners of strategies to deal with the identified factors to reduce the chances of adverse maternal
60 and fetal outcomes associated with anaemia, and to make the women healthy and give healthy births
61 so that they can freely participate and contribute their contributions in socio-economic activities for
62 the development of the country. This study, therefore, aimed to assess the prevalence and
63 determinants of anaemia among reproductive-aged women in Ethiopia.

64 **2. Methods**

65 **2.1 Source of data**

66 This study was based on a nationally representative cross-sectional survey, 2016 EDHS (2016
67 Ethiopian demographic and health survey) which was implemented by the Central Statistical Agency
68 (CSA) from January 18 to June 27, 2016 in Ethiopia.

69 **2.2 Study Area**

70 This study was conducted in Ethiopia. Ethiopia is one of the countries in Africa continent and located
71 in the Horn of Africa. It is bordered by six African countries: to the north and northeast by Eritrea, to
72 the east by Djibouti and Somalia, to the west by Sudan and by South Sudan, and to the south by
73 Kenya. And, it is the second most populous nation in African continent.

74 **2.3 Sample Size**

75 In this study, we used a sample of 14460 women aged 15 to 49 years.

76 **2.4 Variables of the study**

77 **2.4.1 Dependent Variable**

78 Dependent variable was anaemic status of women at a time survey.

79 **2.4.2 Independent Variables**

80 Independent variables included in this study were region, place of residence, marital status, level of
81 education, wealth index, smoking cigarette, age, body mass index, parity, pregnancy status, and
82 contraceptive methods.

83 **2.5 Data Analysis**

84 Data analysis was done using SPSS version 25. Multivariable logistic regression model was
85 employed to identify the determinants of anaemia among women. [REDACTED].

86 **3. Results**

87 **3.1 Descriptive Statistics Results**

88 **3.1.1 Prevalence of anaemia among women**

89 A total of 14460 women of which 3916 (27.08%) anaemic were included in this study (Table 1).

90 **Table 1. Prevalence of anaemia among women in Ethiopia**

		Counts	Percent
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Anaemic	Yes	3916	27.08	91
	No	10544	72.92	
Total		14460	100	92

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94 3.1.2 Background characteristics of women

95 Of total of 14460 women included, about two-third (67.52%) of the women were living in rural while
 96 remaining 32.48% of them were living in urban at a time of the survey. Regarding geographic region,
 97 10.89% of them were living in Tigray region while remaining 7.05%, 11.65%, 12.46%, 8.70%, 7.07%,
 98 12.15%, 6.80%, 5.17%, 11.13% and 6.58% of them were living respectively in Affar region, Amhara
 99 region, Oromia region, Somalia region, Somalia region, Benshangul-Gumuz region, SNNPR,
 100 Gambela region, Harari region, Addis Ababa, and Dire Dawa at time of survey (Table 2).

101 Regarding age, more than one-fifth (21.89%) of the women were in the age group of 15-19 years,
 102 about one-sixth (18.16%) of the them were in the age group of 20-24 years, about one-sixth (18.06%)
 103 of them were in the age group of 25-29 years, about one-seventh (14.29%) of them were in the age
 104 group of 30-34 years, about one-eighth (13.07%) of them were in the age group of 35-39 years,
 105 8.25% of them were in the age group of 40-44 years and remaining 6.28% of them were in age group
 106 of 45-49 years at a time of the survey. Regarding marital status, majority (63.64%) of them were
 107 married or living together, about one-fourth (26.29%) of them were single, 2.88% of them were
 108 widowed while the remaining 7.19% of them were divorced/no longer living together/separated at a
 109 time of the survey. Regarding parity, majority (33.29%) of the women had no child, about one-
 110 fourth(25.66) of them had 5 or more children, 23.62% of the them had 1 or 2 children while the
 111 remaining 17.43% of them had 3 or 4 children at a time of the survey (Table 2).

112 About 45.50% of the women did not attain formal education, about one-third (33.58%) of them
 113 attained primary education, 13.82% of them attained secondary education while the remaining only
 114 7.10% of them attained higher than secondary education at a time of the survey. Regarding wealth
 115 index, majority (34.72%) of women were richest, one-fourth (25.17%) of them were poorest, 13.51%
 116 of them were poorer, 13.15% of them were Medium while 13.46% of them were richer at a time of the
 117 survey. Only 123 (0.85%) of the women were smoking cigarette while the remaining majority
 118 (99.15%) of them were not smoking at a time of the survey (Table 2).

119 Majority (65.15%) of the women had body mass index between 18.5 and 24.9, 23.45% of them had
 120 body mass index less than 18.5 and the remaining only 11.40% of them had body mass index of 25
 121 and above. Regarding pregnancy statuses, about nine-tenth (92.73%) of the women were not
 122 pregnant while the remaining only 7.27% of them were pregnant at a time of the survey. Regarding
 123 contraceptive methods, more than three-fourth (78.35%) of the them were not using contraceptive
 124 methods while the remaining 21.65% of the women were using it at a time of the survey (Table 2).

125 3.1.3 Bivariate analysis result

126 The prevalence of anaemia among women was highest in Somalia region (58.35%) followed by Affar
 127 region (45.65%) and it was lowest in Addis Ababa city administrative (15.79%) followed by Amhara
 128 region (17.58%) (Table 2).

129 Regarding place of residence, prevalence of anaemia among women in rural area (30.61%) was
 130 higher than in urban (19.76%). The prevalence of anaemia among women was highest for those who
 131 aged 30-34 years (29.93%) followed by age group 35-39 years (28.83%) and it was lowest in those
 132 women who aged 15-19 years (23.73%) followed by age group 45-49 years (24.35%) (Table2).

133 The prevalence of anaemia among women decreased with increased level of education. It was
 134 highest among those women who were not educated (33.94%) and it was lowest among those
 135 women whose level of education was higher than the secondary education (15.19%). Likewise, it
 136 decreased with increased body mass index. It was highest among those women whose body mass
 137 index was less than 18.5 (32.11%) and lowest for those women whose body mass index was 25.0
 138 and above (21.35%) (Table 2).

139 The prevalence of anaemia among women was highest for those women whose total number of
 140 children ever born were 5 or more (34.36%) followed by those women whose total number of children
 141 ever born were 3 or 4 (29.29%) and lowest for those women who had no child (12.75%). Similarly, it
 142 was higher for those women who were pregnant (37.58%) than those who were not pregnant
 143 (26.26%) (Table 2).

144 The prevalence of anaemia among women was also higher for women who were not using
 145 contraceptive methods (29.36%) than those who were using contraceptive methods (18.79%).
 146 Similarly, it was higher for those women who were smoking cigarette (29.27%) than those who were
 147 not smoking (27.06%) (Table 2).

148 All independent variables except smoking cigarette were significant in bivariate analysis. Those
 149 significant independent variables (with p-value < 0.25) in bivariate analysis were included in the
 150 multivariable logistic regression analysis.

151 **Table 2. Bivariate analysis of anaemia by background characteristics of women in Ethiopia**
 152 **(n=14460)**

Variables	Categories	Frequency	Anaemic		P-value
		n(%)	Yes, n(%)	No, n(%)	
Region	Tigray	1597 (10.89)	330 (20.66%)	1267 (79.34%)	0.000
	Affar	1034 (7.05)	472 (45.65%)	562 (54.35%)	
	Amhara	1684 (11.65)	296 (17.58%)	1388 (82.42%)	
	Oromia	1801 (12.46)	482 (26.76%)	1319 (73.24%)	
	Somalia	1258 (8.70)	734 (58.35%)	524 (41.65%)	
	Benishangul-Gumuz	1037 (7.07)	202 (19.48%)	835 (80.52%)	
	SNNPR	1757 (12.15)	378 (21.51%)	1379 (78.49%)	
	Gambela	983 (6.80)	276 (28.08%)	707 (71.92%)	
	Harari	748 (5.17)	204 (27.27%)	544 (72.73%)	
	Addis Ababa	1609 (11.13)	254 (15.79%)	1355(84.21%)	
Dire Dawa	952 (6.58)	288 (30.25%)	664 (69.75%)		
Place of residence	Rural	9763 (67.52)	2988 (30.61%)	6775(69.39%)	0.000
	Urban	4697 (32.48)	928 (19.76%)	3769(80.24)	
Level of education	No education	6580 (45.50)	2233 (33.94%)	4347(66.06)	0.000
	Primary	4855 (33.78)	1139 (23.46%)	3716(76.54)	
	Secondary	1998 (13.82)	388 (19.42%)	1610(80.58)	
	Higher	1027 (7.10)	156 (15.19%)	871(84.81)	
Age	15-19	3165 (21.89%)	751 (23.73%)	2414(76.27)	0.000
	20-24	2662 (18.16)	713 (26.78%)	1949(73.22)	
	25-29	2647 (18.06)	760 (28.71%)	1887(71.29)	
	30-34	2088 (14.29)	625 (29.93%)	1463(70.07)	
	35-39	1769 (13.07)	510 (28.83%)	1259(71.17)	
	40-44	1209 (8.25)	333 (27.54%)	879(72.46)	
	45-49	920 (6.28)	224 (24.35%)	696(75.65)	
Marital status	Single	3801 (26.29)	763 (20.07%)	3038(79.93%)	0.000
	Married/living together	9203 (63.64)	2800 (30.42%)	6403(69.58%)	
	Widowed	416 (2.88)	110 (26.44%)	306(26.44%)	
	Divorced/no longer	1040 (7.19)	243 (23.37%)	797(76.63%)	

	living together/separated				
Wealth index	Poorest	3639 (25.17)	1511 (41.52%)	2128(58.48%)	0.000
	Poorer	1953 (13.51)	546 (28.00%)	1407(72.00%)	
	Middle	1901 (13.15)	483 (25.41%)	1418(74.59%)	
	Richer	1946 (13.46)	421 (21.63%)	1525(78.37%)	
	Richest	5021 (34.72)	955 (19.00%)	4066(81.00%)	
Smoking Cigarette	No	14337 (99.15)	3880 (27.06%)	10457(72.94%)	0.584
	Yes	123 (0.85)	36 (29.27%)	87(70.73%)	
Body mass index	Less than 18.5	3391 (23.45)	1089 (32.11%)	2302(67.89%)	0.000
	18.5-24.9	9420 (65.15)	2475 (26.27%)	6945(73.73%)	
	25.0 and above	1649 (11.40)	352 (21.35%)	1297(78.65%)	
Parity	No child	4814 (33.29)	996 (12.75%)	3818(87.25%)	0.000
	1 or 2	3415 (23.62)	907 (26.56%)	2508(73.44%)	
	3 or 4	2520 (17.43)	738 (29.29%)	1782(70.71%)	
	5 or more	3711 (25.66)	1275 (34.36%)	2436(65.64%)	
Pregnancy status	No	13409 (92.73)	3521 (26.26%)	9888(73.74%)	0.000
	Yes	1051 (7.27)	395 (37.58%)	656(62.42%)	
Contraceptive usage status	No	11330 (78.35)	3328 (29.36)	8002 (70.64%)	0.000
	Yes	3130 (21.65)	586 (18.72)	2544(81.28%)	

153 3.2 Inferential Statistics Results

154 The multivariable logistic regression analysis result revealed that region, place of residence, age,
155 wealth index, body mass index, parity, and pregnancy status were significantly associated with
156 anaemia among women (Table 3).

157 The odds of being anaemic for women from Afar region was 2.439 (AOR: 2.439, 95% CI for AOR:
158 2.006, 2.968) times higher than for those from Tigray region. Similarly, the odds of being anaemic for
159 women from Amhara region, Somalia region, Benshangul-Gumuz region and Gambela region were
160 1.269 (AOR: 1.269, 95% CI for AOR: 1.035, 1.556), 2.592 (AOR: 2.592, 95% CI for AOR: 2.142,
161 3.133), 2.019 (AOR: 2.019, 95% CI for AOR: 1.666, 2.447) and 2.465 (AOR: 2.465, 95% CI for AOR:
162 2.026, 2.998) times respectively higher than for those from Tigray region. On the other hand, the odds
163 of being anaemic for women from Oromia region, SNNPR region, Harari region, Addis Ababa and
164 Dire Dawa were 0.374 (AOR: 0.374, 95% CI for AOR: 0.305, 0.458), 0.372 (AOR: 0.372, 95% CI for
165 AOR: 0.299, 0.465), 0.641 (AOR: 0.641, 95% CI for AOR: 0.521, 0.789), 0.794 (AOR: 0.794, 95% CI
166 for AOR:0.638, 0.989) and 0.613 (AOR: 0.613, 95% CI for AOR:0.501, 0.749) times respectively less
167 than for those from Tigray region (Table 3).

168 It was also revealed that the odds of being anaemic for women who live in urban was 0.496 (AOR:
169 0.496, 95% CI for AOR: 0.420, 0.586) times less than for those who live in rural areas. The odds of
170 being anaemic for women aged 20-24 years was 1.687 (AOR: 1.687, 95% CI for AOR: 1.341, 2.123)
171 times higher than for those who aged 15-19 years. Similarly, the odds of being anaemic for women
172 aged 25-29 years, 30-34 years, 35-39 years and 40-44 years, 45-49 years were 1.707 (AOR: 1.707,
173 95% CI for AOR: 1.381, 2.109), 1.601 (AOR: 1.601, 95% CI for AOR: 1.317, 1.946), 1.544 (AOR:
174 1.544, 95% CI for AOR: 1.277, 1.867), 1.391 (AOR: 1.391, 95% CI for AOR: 1.148, 1.686), 1.231
175 (AOR: 1.231, 95% CI for AOR: 1.001, 1.513) times respectively higher than for those aged 15-19
176 years (Table 3).

177 Furthermore, the odds of being anaemic for the richer women was 0.277 (AOR: 0.277, 95% CI for
178 AOR: 0.172, 0.447) times less than for the poorest women. The odds of being anaemic for the richest
179 women was 0.158 (AOR: 0.158, 95% CI for AOR: 0.073, 0.343) times less than for the poorest
180 women. Likewise, the odds of being anaemic for the women whose body mass index is between 18.5

181 and 24.5 was 0.272 (AOR: 0.272, 95% CI for AOR: 0.144, 0.512) times less than for those whose
 182 body mass index is less than 18.5. Similarly, the odds of being anaemic for the women whose body
 183 mass index is 25.0 and above was 0.420 (AOR: 0.420, 95% CI for AOR: 0.294, 0.600) times less than
 184 for those whose body mass index was lower than 18.5 (Table 3).

185 Also, pregnancy status was found to be predictor factor of anaemia among women. The odds of being
 186 anaemic for the pregnant women is 1.408 (AOR: 1.408, 95% CI for AOR: 1.263, 1.570) times higher
 187 than for non- pregnant women. The odds of being anaemic for women who ever bore 1 or 2 children
 188 was 1.272 (AOR: 1.272, 95% CI for AOR: 1.103, 1.466) times higher than for those who had no child.
 189 The odds of being anaemic for women who ever bore 3 or 4 children was 1.277 (AOR: 1.277, 95% CI
 190 for AOR: 1.059, 1.539) times higher than for those who had no child. Similarly, the odds of being
 191 anaemic for women who ever bore 5 or more children was 1.420 (AOR: 1.420, 95% CI for AOR:
 192 1.213, 1.662) times higher than for those who had no child (Table 3).

193 **Table 3. Multivariable logistic regressions analysis of factors associated with Anaemia**
 194 **among women in Ethiopia**

Variables	$\hat{\beta}$	S.E. ($\hat{\beta}$)	Wald	Df	Sig.	AOR	95.0% CI for AOR)	
							Lower	Upper
Region (Tigray:Rf)			617.024	10	0.000*			
Affar	0.892	0.100	79.649	1	0.000*	2.439	2.006	2.968
Amhara	0.238	0.104	5.182	1	0.026*	1.269	1.035	1.556
Oromia	-0.984	0.104	89.637	1	0.000*	0.374	0.305	0.458
Somaila	0.952	0.097	96.410	1	0.000*	2.592	2.142	3.133
Benshangul-Gumuz	0.703	0.098	51.416	1	0.000*	2.019	1.666	2.447
SNNPR	-0.988	0.113	76.627	1	0.000*	0.372	0.299	0.465
Gambela	0.902	0.100	81.395	1	0.000*	2.465	2.026	2.998
Harari	-0.444	0.106	17.723	1	0.000*	0.641	0.521	0.789
Addis Ababa	-0.230	0.112	4.249	1	0.039*	0.794	0.638	0.989
Dire Dawa	-0.490	0.102	22.966	1	0.000*	0.613	0.501	0.749
place of residence (Rural: Rf)			7.858	1	0.004*			
Urban	-0.701	0.085	69.143	1	0.004*	0.496	0.420	0.586
Age (15-19: Rf)			31.685	6	0.000*			
20-24	0.523	0.117	19.947	1	0.000*	1.687	1.341	2.123
25-29	0.535	0.108	24.495	1	0.000*	1.707	1.381	2.109
30-34	0.471	0.099	22.368	1	0.000*	1.601	1.317	1.946
35-39	0.434	0.097	20.069	1	0.000*	1.544	1.277	1.867
40-44	0.330	0.098	11.324	1	0.001*	1.391	1.148	1.686
45-49	0.207	0.105	3.874	1	0.042*	1.231	1.001	1.513
Wealth index (Poorest: Rf)			68.013	4	0.000*			
Poorer	-1.097	0.584	3.528	1	0.061	0.334	0.106	1.049
Middle	-0.728	0.394	3.412	1	0.059	0.483	0.223	1.046
Richer	-1.284	0.244	27.680	1	0.002*	0.277	0.172	0.447
Richest	-1.845	0.396	21.711	1	0.000*	0.158	0.073	0.343
Body mass index (Less than 18.5: Rf)			39.201	2	0.000*			
18.5-24.5	-1.302	0.323	16.247	1	0.000*	0.272	0.144	0.512
25.0 and above	-0.868	0.182	22.719	1	0.001*	0.420	0.294	0.600
Parity (No child: Rf)			38.279	3	0.000*			
1 or 2	0.241	0.073	10.991	1	0.001*	1.272	1.103	1.466
3 or 4	0.244	0.095	6.539	1	0.011*	1.277	1.059	1.539
5 or more	0.351	0.080	18.967	1	0.000*	1.420	1.213	1.662

Pregnancy status (No: Rf)			37.924	1	0.000*			
Yes	0.342	0.055	38.014	1	0.000*	1.408	1.263	1.570
Constant	-1.543	0.131	137.622	1	0.000*	0.214		

195 Rf = Reference category,
196 $\hat{\beta}$ = Regression coefficient estimate, Sig.=Significance, AOR= Adjusted odds ratio, *= significant at
197 5% level of significance, Df=Degree freedom, S.E.($\hat{\beta}$)= Standard error of estimated parameter, CI=
198 Confidence interval

199 3.3. Goodness of fit of the model

200 The model goodness of fit was checked using Hosmer and Lemeshow test. The Hosmer and
201 Lemeshow test result showed p-value = 0.120, which implies good fit for the model.

202 4. Discussion

203 This study was aimed to assess prevalence and determinants of anaemia among women of
204 reproductive in Ethiopia. A total of 14,460 women of which 3,916 (27.08%) were anaemic were
205 included in this study.

206 In this study, the prevalence of anaemia among reproductive-aged women in Ethiopia was 27.08%
207 (95% CI: 22.88, 31.08%) which is almost similar with earlier study conducted in Turkey [12].
208 Prevalence of anaemia in our study was higher than the studies conducted in Iran [13], Ethiopia [14,
209 15], Vietnam [16], while it was lower than the other studies conducted in Lao PDR [17], India [18],
210 Nepal [19], Cambodia [20], and Bangladesh [21]. The reason for the variation in prevalence of
211 anaemia in this study from those mentioned studies might be because of the differences in
212 socioeconomic status, geographical location of the study area above sea level, and study period.

213 Furthermore, region, place of residence, age, wealth index, body mass index, parity and pregnancy
214 status were significant determinants of anaemia among women.

215 Place of residence was found to be significant determinant of anaemia among women of reproductive
216 age in Ethiopia. It was revealed that women who live in rural areas were more likely to be anaemic
217 than those who live in urban areas. This result agrees with findings of the study done previously in
218 Ethiopia [22], and Lao PDR [17]. The possible reason could be that those women who live in rural
219 area may not have adequate health services and access for information on factors that influence
220 anaemia due to lack of facilities and services like education. The study also showed that region had
221 association with anaemia among women of Ethiopia. In support to our study, earlier studies in
222 Uganda [23], Myanmar [24], Rwanda [25], Pakistan [26], and Lao PDR [17] also showed that
223 geographic location had significant association with anaemia among women of reproductive age.
224 Women from poorest families are more likely to be anaemic as compared to those from richest
225 families. This result is consistent with the result of the previously conducted studies in in Uganda [23],
226 Ethiopia [27], Meghalaya [28], Rwanda [25], and Sudan [29] which revealed that women from poorest
227 families were more likely to be anaemic than those from the richest families. The reason might be that
228 the poorest households cannot afford good diet, and may not have good sanitation.

229 In this study, it was also found that age was significantly associated with anaemia among women in
230 Ethiopia. Previously conducted study in Uganda [23] showed that age had significant associated with
231 anaemia among women of reproductive age. Our study revealed that women aged between 20 and
232 39 years are more likely to be anaemic than those who were in other age groups, which is almost
233 similar to the results obtained from studies conducted in Uganda [23], and Ethiopia [30]. The possible
234 explanation might be that woman could have more of her lifetime births by this age group.

235 In line with previously conducted studies in Ethiopia [31-33], India [34], and Pakistan [26] our study
236 also revealed that women with higher body mass index were less likely to be anaemic than those with
237 lower body index. Therefore, it is recommended to give particular attention to include micronutrients
238 initiatives as a prioritized program for those who with lower body mass. Pregnant women were more
239 likely to be anaemic than non-pregnant ones. This result agrees with the result obtained from the
240 study done in Uganda [23], Mynmar [24], and Ethiopia [30], Tanzania [35] which revealed that

241 pregnant women were at higher risk of anaemia compared to non-pregnant women. This could be
242 explained by the fact that in pregnancy period nutritional demand of woman is highest in a woman's
243 life and pregnant women are advised to eat more diversified diets than usual and they might not get
244 diversified enough diets.

245 In this study, it was also found that women with higher number of ever born children were more likely
246 to be anaemic than those with lower number of ever born children. This result is supported by the
247 results revealed from the earlier studies [36-38] which revealed that women with parity of two or more
248 were at higher risk of anaemia compared with those with lower parity. This might be due to the fact
249 that in pregnancy there is blood volume expansion that increases iron demand and for this more
250 blood is produced to support the growth of the baby. When the woman's dietary needs are not met
251 during the pregnancy, she would be at risk of anaemia, and the more a woman gets pregnant, the
252 higher risk she will be anaemic.

253 **5. Conclusions**

254 The result of this study demonstrated that about one-fourth of women had anaemia. In the study,
255 region, place of residence, age, wealth index, body mass index, parity, and pregnancy status were
256 identified as significant determinants of anaemia among reproductive-aged women. Women living in
257 Gambela, Somali, Affar, and Benshangul-Gumuz region were associated with higher risk of being
258 anaemic. Similarly, women aged 20-39 years, women with lager number of ever born children, and
259 pregnant women were associated with higher risk of being anaemic. On the other hand, women living
260 in urban areas, women with higher economic status, and women with higher body mass index were
261 associated with reduced risk of being anaemic. Hence, **concerned** bodies need to pay special
262 attention to women regarding anaemia based on place of residence and region.

263 **6. Limitations**

264 Some important determinant factors were not incorporated in the analysis due to high missing values
265 in the data used. Furthermore, because of cross-sectional nature of the data used for the study, it was
266 not possible to determine the cause-effect relationship between anaemia and its predictors.

267 **Abbreviations**

268	CSA	Central Statistical Agency
269	DHS	Demographic and Health Survey
270	EDHS	Ethiopian Demographic and Health Survey
271	SNNPR	Southern Nations, Nationalities and People's Region
272	WHO	World Health Organization

273 **Ethics Approval**

274 Ethical approval was not necessary as this study used the 2016 EDHS publicly available secondary
275 data which is available on the DHS website (<http://dhsprogram.com>).

276 **Consent to participate**

277 Not applicable

278 **Availability of Data**

279 The data used for the final analysis in this study is available from corresponding author upon
280 reasonable request.

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