

# The link between indoor air pollution from cooking fuels and anemia status among non-pregnant women of reproductive age in Ethiopia

SAGE Open Medicine

Volume 10: 1–9

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DOI: 10.1177/20503121221107466

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## Abstract

**Objective:** The effect of indoor air pollution from different fuel types on the anemia status among non-pregnant women is rarely studied. This study aimed to assess the link between indoor air pollution from different fuel types and anemia among non-pregnant women of reproductive ages in Ethiopia.

**Method:** The secondary data from the 2016 Ethiopian Demographic and Health Survey data have been employed for this study. The anemia status of women in reproductive age was the outcome variable with multiple outcomes as (moderate to severe, mild, and no anemia) and households using biomass fuel and clean fuel were selected for this study. Multinomial logistic regression was employed to estimate the association of biomass fuel use with the anemia status controlling for the predictor variables. Relative risk ratio was calculated at 95% confidence interval. An independent-sample t-test was used to assess the mean difference in blood hemoglobin level (g/dL) between the two fuel users. A p value < 0.05 was considered significant.

**Result:** From the total of 10,961 participants included in this study, the proportion of anemia in women of non-reproductive age was 41.8% and 19.4% among biomass fuel and clean fuel users, respectively, with a mean blood hemoglobin level of 12.71 ( $\pm 1.81$ ) g/dL. In the final model, women using biomass fuel for cooking were 47% more likely to have mild anemia than households who use cleaner fuels, whereas the association was insignificant for moderate to severe anemia. Biomass fuel users were also found to have 5.8 g/dL lower blood hemoglobin level than the clean fuel user ( $p < 0.001$ ).

**Conclusion:** The use of biomass fuel was associated with reduced blood hemoglobin levels and significantly associated with mild anemia levels in women of reproductive age in Ethiopia. National efforts should be in place to reduce indoor air pollution from biomass fuels.

## Keywords

Anemia, Demographic and Health Survey, fuel type, non-pregnant women, Ethiopia

Date received: 3 October 2021; accepted: 30 May 2022

## Introduction

Anemia is an adverse public health condition characterized by reduced oxygen-carrying capacity by the red blood cells or low blood hemoglobin concentration (120 g/L for non-pregnant women), which is inadequate to meet the physiologic needs of the body.<sup>1–3</sup> It is one of the most important public health challenges to women, where it affects more than 500 million women in the reproductive age group and more than 32 million pregnant women globally.<sup>1,3,4</sup> Preschool-aged children (47.4%) are the most affected segment of the population by anemia followed by

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pregnant women (41.8%) and women of reproductive age (30.2%) globally.<sup>5</sup>

According to the World Health Organization (WHO), anemia is almost three times higher in women from developing countries (50%) compared to counterparts in developed nations (18%). Africa and Asia are the worst affected continents with 60% and 52% of their women estimated to be anemic, respectively.<sup>6</sup>

The problem in Ethiopia is more severe when compared to other developing countries where more than 62.7% of pregnant and 52.3% non-pregnant women are affected by anemia.<sup>7</sup> Anemia during the reproductive years specifically among non-pregnant women is highly important because of its impact on the woman's nutritional status during early pregnancy, and a significant proportion of women enter pregnancy with anemia in many developing countries.<sup>8</sup>

Even if the majority (75%) of anemia occurrences are attributed to iron deficiency,<sup>9</sup> nutritional deficiencies (including folate, vitamin B12, and vitamin A), parasitic infections, infectious diseases such as TB and HIV, and maternal blood loss through menstruation are common causes of anemia in developing countries.<sup>1,10–12</sup>

Indoor air pollution from the use of high-polluting fuels for cooking was found to increase the risk of many adverse health effects including acute respiratory infections (ARI), low birth weight (LBW), cesarean delivery, and pregnancy complication.<sup>8</sup> One of the least studied causes of anemia in non-pregnant women is an inflammation that resulted from exposure to indoor air pollution from either tobacco smoking or the use of biomass fuels. Findings from developing countries using national data indicated that exposure to biomass fuel smoke was linked with anemia in children and pregnant women.<sup>13–15</sup> But little is known about the effect of these biomass fuels on the anemia status of non-pregnant women of reproductive age in Ethiopia.

In most developing countries such as Ethiopia, the disproportionate access to clean energy (electricity was 93% in urban areas and 8% in rural areas) the main reason that made inhabitants to be dependent on high-polluting energy sources for cooking and other purposes.<sup>7</sup> So many noxious gases such as carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), and nitrogen dioxide (NO<sub>2</sub>) are emitted when biomass fuels are utilized for cooking, heating, and lighting in the indoor environment in most developing countries, where most of the population is dependent on biomass fuels for cooking and the most vulnerable groups for the pollution are mainly women.<sup>14,16,17</sup> Therefore, this research aimed to assess the link between exposure to indoor air pollution from different fuel types and the anemia status among non-pregnant women of reproductive age in Ethiopia.

## Methods

### *Study area and period*

The 2016 Ethiopian Demographic and Health Survey data were employed for this study. It was a nationwide survey

intended to provide up-to-date estimates of key demographic and health indicators. Ethiopia, with a projected total population of 118,218,249 by 2021 according to World population review,<sup>18</sup> is the most populous country in East Africa, and the second-most populous country in Africa where the majority (93%) of households use some type of solid fuel for cooking mainly would for domestic energy needs.<sup>7</sup> The country is divided into nine regions (Oromiya, Amhara, Southern Nations and Nationalities and Peoples Region (SNNPR), Benishangul-Gumuz, Tigray, Afar, Somali, Gambela, and Harari) with two city administrations (Addis Ababa and Dire Dawa), which are further sub-divided into zonal administration then into Woreda for administrative purpose. The Woreda is also divided into kebele which is the smallest administrative unit.

### *Study design, sampling technique, and data collection*

We have conducted a cross-sectional study using the survey of the 2016 Ethiopian Demographic and Health Survey data. This survey was carried out by the Ethiopian Central Statistics Agency (CSA) with the Ministry of Health (MoH) under the ICF technical assistance using a census frame of a complete list of 84,915 enumeration areas (EAs) created for 2007. The survey employed a two-stage stratified sampling to select eligible residential households across 645 EAs. Each region was stratified into urban and rural areas, giving 21 sampling strata. Samples of EAs were selected independently in each stratum in two stages. A total of 18,008 households were selected for the sample, of which 17,067 were occupied. Of the occupied households, 15,683 women were successfully interviewed.<sup>7</sup>

### *Dependent variable*

The data collected regarding blood hemoglobin level was used as a base for categorizing the anemia status of non-pregnant women of reproductive age. The blood samples for anemia testing were taken from voluntarily consented non-pregnant women by capturing a drop of blood from their finger prick and collected in a microcuvette. The analysis to determine the blood hemoglobin level was conducted on-site using a battery-operated portable HemoCue analyzer. After the on-site analysis, the concentration of blood hemoglobin from each sample was measured in g/dL. The Global Burden of Disease (GBD) 2010 criteria were used to categorize the non-pregnant women's anemia status using their hemoglobin (Hb) level. Hence, the non-pregnant women were categorized as not anemic (Hb  $\geq$  12.0 g/dL), mildly anemic (11.0–11.9 g/dL), moderately anemic (8.0–10.9 g/dL), or severely anemic (Hb < 8.0/dL).<sup>19</sup> Afterward, the non-pregnant women were further categorized as not anemic and anemic. In order to ensure the quality of the data, 72 individuals were recruited and trained on how to collect bio-marker data (testing for anemia by measuring hemoglobin levels) and demonstrations of bio-marker measurement or testing procedures were carried out.<sup>7</sup>

### Exposure variable

The fuel type for household energy demand was the main exposure variable. The non-pregnant women were asked during the survey “What type of fuel does your household mainly use for cooking?” to assess the main fuel types used in the household, and there were 11 fuel types (namely, electricity, liquefied petroleum gas (LPG), natural gas, biogas, kerosene, coal/lignite, charcoal, wood, straw/shrubs/grass, agricultural crop, animal dung) as a response. Therefore, these were further re-categorized into biomass fuels (wood, straw, animal dung, and crop residues) and clean fuels (electricity, LPG, and natural gas).<sup>20</sup> For this analysis, medium-polluting fuels were removed from the analysis, and only biomass fuel users and clean fuel users were assessed for anemia status and other predictor variables. Because of the small number, moderate anemia and severe anemia are categorized into one variable, as “moderate to severe anemia.” Therefore, the above-mentioned different fuel types were further classified by considering the type of indoor air pollution they produced as described in, as high-pollution fuels (wood, straw, animal dung, and crop residues), medium-polluting fuel types (kerosene and charcoal), and low-pollution fuels (electricity, LPG, and natural gas).<sup>21</sup> But since our objective was to compare the high-polluting fuels with low-polluting fuel types, we removed the medium-polluting fuel user types from the analysis.

### Other predictor variables

The predictor variables included in this study were women-related factors (the age of the women, body mass index (BMI), education level, *Khat* chewing, and parity) and socio-demographic factors (sex of head of the household, residency, and wealth index). Maternal age and BMI of the non-pregnant women in reproductive age were used as a continuous variable for the analysis, and the highest education level achieved by the non-pregnant women in reproductive age was categorized as no formal schooling, primary school, secondary, and higher (university/college and above). The tobacco smoking status was labeled as “yes” or “no.” The residency was grouped into urban and rural while the wealth index was a five-category variable as poorest, poorer, medium, richer, and the richest.

### Inclusion and exclusion criteria

Pregnant women were excluded from this study. Non-pregnant women who are not currently resident in the area, and without information such as blood hemoglobin, BMI, fuel type, water source, and latrine facility were excluded from the study.

### Statistical analysis

We have used SPSS analysis software version 25 for the analysis. Multinomial logistic regression was employed to determine whether there was an association between the use of different fuel types and the anemia status of the non-pregnant women in reproductive age in Ethiopia. Relative risk ratio

(RRR) was used to measure the association and their 95% confidence interval was calculated. A p-value of less than 0.05 was considered for statistical significance. An independent-sample t-test was used to assess the mean difference in blood hemoglobin level (g/dL) between biomass and clean fuel users.

### Ethical approval

The 2016 bio-marker (anemia testing) was collected in all households and the data collection procedures for the household and individual interviews, bio-marker data were initially recorded on the paper-based Bio-marker Questionnaire and subsequently entered into interviewers’ tablet computers. Blood samples for anemia testing were collected from women age 15–49 after they voluntarily consented to be tested. The data collection regarding the bio-marker collection (anemia testing) was reviewed and approved by the Federal Democratic Republic of Ethiopia Ministry of Science and Technology and the Institutional Review Board of ICF International. Since this study used secondary data, all the personal identification of the respondents are removed and are anonymous.

## Result

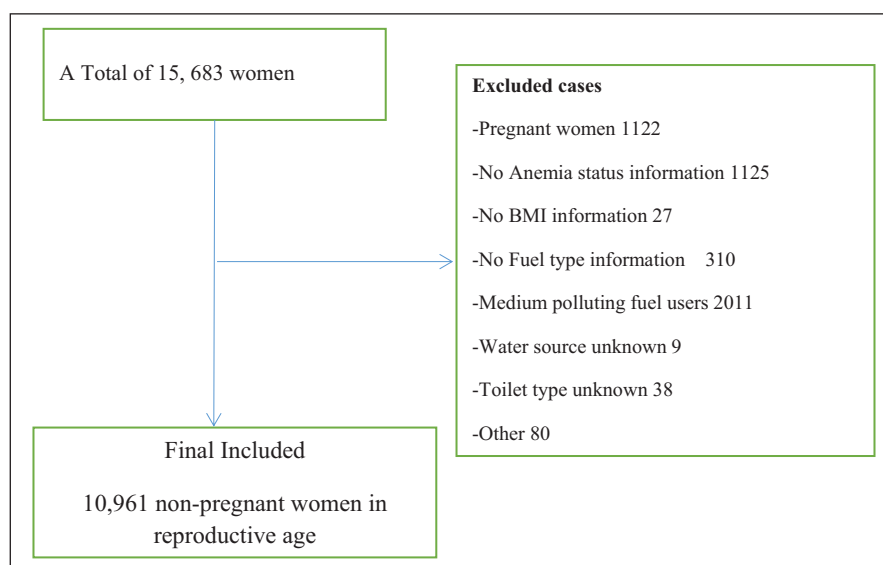
### Characteristics of the study participants

The model fitting information, using the likelihood ratio chi-square test, indicated that the final model has a significant improvement, in fit over a null model,  $\chi^2(63)=722.22$ ,  $p<0.001$ . Pearson chi-square test result showed that  $\chi^2(32805)=32,756.695$ ,  $p=0.574$ , and deviance chi-square test showed that  $\chi^2(32805)=16,315.545$ ,  $p=1.00$ , which indicated in both cases that the model fit the data well. Of the total of 15,683 women, 4722 were excluded because they did not fulfill the inclusion criteria for this study (as shown in Figure 1), and a total of 10,961 women were enrolled for the final analysis in this study.

From the total of 15,683 women, 10,961 non-pregnant women of reproductive age have fulfilled the inclusion criteria. The blood level ranges between 3.4 and 19.4 g/dL with a mean blood hemoglobin level of 12.72 ( $\pm 1.81$ ) g/dL. As indicated in Table 1, the majority of 9505 (86.7%) of the women live in households that use biomass fuels such as wood, belong to the poorest (3177, 29%) or poorer category (1703, 15.3%), and have no education (5473, 50%). Rural residence (8425, 76.8%) and male-headed households (7904, 72.1%) were dominant among the study participants.

### Types of cooking fuel types

Wood was the major (8887, 80.7%) type of fuel used in households, where the women of reproductive age reside followed by electricity (1351, 10.3%) and animal dung (497, 4.5%). Based on the level of their pollution-emitting capacity, the fuel types were further categorized, and the result indicated that high-polluting fuel types (biomass fuels) account for more than two-thirds of fuel types with 9505 (86.7%) (Figure 2).



**Figure 1.** Included and excluded cases for the study.

**Table 1.** Characteristics of the study participants in Ethiopia.

Variables	Category	Anemia status				Total
		No anemia (n = 7924)	Mild (n = 2236)	Moderate (n = 700)	Severe (n = 101)	
Fuel type	Biomass fuel	6704	2049	653	99	9505 (86.7%)
	Clean	1220	187	47	2	1456 (13.3%)
Residence	Urban	2048	385	88	5	2536 (23.2%)
	Rural	5876	1851	602	96	8425 (76.8%)
Sex of head of the household	Male	5737	1590	501	76	7904 (72.1%)
	Female	2187	646	199	25	3057 (27.9%)
Wealth index	Poorest	1889	861	367	60	3177 (29%)
	Poorer	1235	360	90	18	1703 (15.5%)
	Middle	1254	331	82	10	1677 (15.3%)
	Richer	1301	274	68	8	1651 (15.1%)
	Richest	2245	410	93	5	2753 (25.1%)
Education	No education	3625	1294	471	83	5473 (50%)
	Primary	2793	663	165	9	3630 (33.1%)
	Secondary	1006	205	42	8	1261 (11.5%)
	Higher	500	74	22	1	597 (5.4%)
Water source	Improved	5493	1397	385	40	7315 (66.8%)
	Unimproved	2431	839	315	61	3646 (33.2%)
Toilet facility	Improved	1707	381	115	13	2216 (20.2%)
	Unimproved	3611	815	205	23	4654 (42.5%)
	No facility/field/bush	2606	1040	380	65	4091 (37.3%)

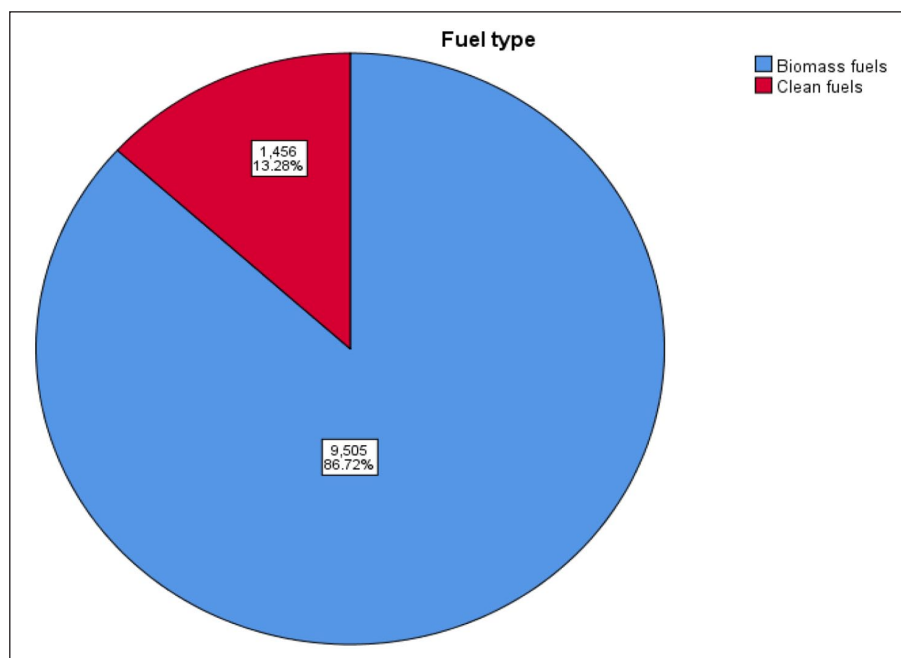
### *Anemia status among reproductive-age women in Ethiopia*

According to our finding, the proportion of anemia in non-pregnant women of reproductive age in Ethiopia was 29.4% and 16.2% among biomass fuel and clean fuel users, respectively. Among the participants selected for this study, moderate to severe, and mild anemia accounts for 7.3% and 20.4%,

respectively (Table 2). The overall prevalence of anemia among the study participants was 27.7%.

### *Bivariate analysis*

As indicated in Table 3, non-pregnant women with biomass fuel use were 2.8 (95% CI, 2.1–3.8) times more likely to be moderate to severe anemic (adjusted odds ratio (AOR), 2.0;



**Figure 2.** Fuel type categories utilized by the non-pregnant women in Ethiopia.

**Table 2.** The proportion of anemia levels among different fuel type users among non-pregnant women of reproductive age in Ethiopia.

Anemia status	Fuel types		
	Biomass fuels	Clean fuels	Total
Severe	99	2	101 (0.92%)
Moderate	653	47	700 (6.4%)
Mild	2049	187	2236 (20.4%)
Not anemic	6704	1220	7924 (72.3%)
Total	9505 (86.7%)	1456 (13.3%)	10,961 (100%)

95% CI, 1.7–2.3) and more mildly anemic than those women who use clean fuel types. Women who were having no education were three times more anemic than women with higher education whereas, when compared with higher educated women having no education, primary and secondary education were found to have more chance of being mildly anemic in decreasing order. All the participants in different wealth index categories were found to be moderate to severely and mildly anemic when compared with the richest. But the strength of the association has seen decrements from the poorest to the richer.

### Multivariable analysis of risk factors

For every 1 kg/m<sup>2</sup> increase in BMI, the odds of the non-pregnant women to be moderate to severe anemic decreased by 0.86 ( $b = -0.001$ ,  $SE = 0.000$ ,  $p = 0.005$ ). The multivariable analysis also indicated that the use of biomass fuel was 1.4

times more moderate to severe anemic than clean fuel type users, but the association was not statistically significant. Whereas, biomass fuel user women of reproductive age were 47% more likely to develop mild anemia than those women who use clean fuel at the household level. As indicated in Table 4, BMI, age of the women and the household head in years, the total number of household members > 3, the total number of children born > 5, using an unimproved water source, having no toilet, and being the poorest in wealth index matrix were factors associated with severe anemia status whereas the age of household head, BMI, education, the total residents > 3, the total children ever born > 5, having no toilet, and being the poorest in a wealth index matrix

The mean difference in blood hemoglobin level adjusted for altitude and smoking (g/dL) was assessed for biomass fuel and clean fuel users using an independent sample t-test, and the result indicated that there was a significant mean blood hemoglobin level (5.8 g/dL) reduction ( $p < 0.001$ ) between the two groups. Non-pregnant women of reproductive age living in households that utilize biomass fuel for cooking were found to have a blood hemoglobin level of 5.8 g/dL lower than those women who reside in households with clean fuels such as electricity.

### Discussion

To the researchers' knowledge, this research is the first to assess the link between indoor air pollution arising from cooking fuels and the anemia status among non-pregnant women in Ethiopia using nationwide data. In this finding, the proportion of anemia was found to be higher among biomass

**Table 3.** Bivariate analysis of factors associated with the anemia status among women of reproductive age in Ethiopia.

Risk factors	Category	Mild anemia		p value	Moderate to severe anemia		p value
		RRR	95% CI		RRR	95% CI	
		Fuel type	Biomass fuel Low-polluting fuels	2	1.7–2.3	<0.001	2.8
Age of household head		0.99	0.99–0.999	0.009	0.986	0.98–0.99	0.000
Age of the women in years	–	1.01	1.001–1.01	0.021	1.0	0.99–1.01	0.952
BMI in kg/m <sup>2</sup>	–	1.0	0.999–1.0	<0.001	0.999	0.999–0.999	<0.001
Sex of head of the household	Male	0.244	0.8–1.04	0.94	0.99	0.8–1.2	0.926
	Female						
Education	No education	2.4	1.9–3.1	<0.001	3.2	2.1–4.9	<0.001
	Primary	1.6	1.2–2.1	<0.001	1.3	0.8–2.0	0.237
	Secondary	1.4	1.0–1.8	0.027	1.03	0.6–1.7	0.909
	Higher						
Type of place of residence	Urban	0.6	0.5–0.7	<0.001	0.4	0.3–0.5	<0.001
	Rural						
Wealth index	Poorest	2.5	2.2–2.8	0.000	5.2	4.1–6.5	.000
	Poorer	1.6	1.4–1.9	0.000	2.0	1.5–2.6	.000
	Middle	1.4	1.2–1.7	0.000	1.7	1.3–2.3	.000
	Richer	1.1	0.97–1.4	0.113	1.3	0.99–1.8	.059
	Richest						
Cigarette smoking	No	0.8	0.5–1.2	.261	1.3	0.5–3.2	0.616
	Yes						
Chewing Khat	No	1.1	0.9–1.2	0.528	0.9	0.7–1.1	0.203
	Yes						
Total number of household members	≤ 3	0.7	0.6–0.8	0.000	0.7	0.6–0.8	0.000
	> 3						
Number of under five children	≤ 5	0.7	0.6–0.8	0.000	0.7	0.6–0.8	0.000
	> 5						
Toilet type	Improved	0.56	0.5–0.6	0.000	0.4	0.35–0.5	0.000
	Unimproved	0.57	0.5–0.6	0.000	0.37	0.3–0.4	0.000
	No toilet facility/field/bush						
Ever had terminated pregnancy	Yes	1.01	0.8–1.2	0.971	1.1	0.8–1.4	0.540
	No						
Water source	Improved	0.7	0.67–0.8	0.000	0.50	0.4–0.6	0.000
	Unimproved						

BMI: body mass index; RRR: relative risk ratio.

fuel users than the clean fuel users where anemia status was observed in 29.4% of the biomass fuel users and only in 16.2% of lean fuel users. This finding was similar to a finding done in Ghana where women who were using biomass fuels were 36.4% more anemic than women who were using cleaner fuels 20.5%.<sup>21</sup> The result also showed a 5.8 g/dL lower blood hemoglobin of level in the biomass fuel users when compared with the clean fuel users. This finding was in line with the finding reported by Padhy and Padhi,<sup>22</sup> where participants who live in households that cook with traditional biomass fuels had low hemoglobin values.

The finding indicated that high-polluting fuel use was not associated with moderate to severe anemia in logistic regression, whereas the use of biomass fuel was linked with reduced blood hemoglobin level in non-pregnant women in Ethiopia and also linked with an increased odds of mild

anemia. This was in agreement with a finding done in Ghana where women who smoke fish as their primary livelihood using biomass fuel were at an increased risk of being anemic considering other dietary factors into consideration.<sup>21</sup>

The link between the cooking fuel use and the anemia status can be explained by the role of the indoor air pollutants arising from biomass fuel in triggering systemic inflammation, which could finally lead to iron homeostasis, impaired erythropoietin response to reduced hemoglobin levels, and impaired marrow response to erythropoietin.<sup>23</sup>

Our finding also indicated that lower BMI was associated with both moderate to severe and mild anemia in non-pregnant women in Ethiopia. This is consistent with a recent study finding among younger adults in Ethiopia,<sup>24</sup> where a lower BMI was associated with higher anemic status. This shall not be interpreted as a higher BMI is linked with better

**Table 4.** Multivariable analysis of factors associated with the anemia status among women of reproductive age in Ethiopia.

Risk factors	Category	Mild anemia		p value	Moderate to severe anemia		p value
		RRR	95% CI		RRR	95% CI	
		Fuel type	Biomass fuel Clean fuels	1.47	1.2–1.9	0.001	1.4
Age of household head		0.996	0.99–1.0	0.055	0.991	0.985–0.997	0.003
Age of the women in years	–	1.0	0.995–1.01	0.745	0.987	0.978–0.997	0.010
BMI in kg/m <sup>2</sup>	–	1.0	1.0–1.0	0.044	1.000	0.999–1.000	0.005
Sex of head of the household	Male Female	0.9	0.8–1.01	0.069	0.998	0.8–1.2	0.983
Education	No education Primary Secondary Higher	1.5 1.2 1.2	1.1–1.9 0.9–1.6 0.9–1.6	0.012 0.237 0.263	1.6 0.8 0.9	0.99–2.7 0.5–1.4 0.5–1.5	0.052 0.494 0.647
Type of place of residence	Urban Rural	0.9	0.8–1.2	0.563	1.01	0.7–1.5	0.943
Wealth index	Poorest Poorer Middle Richer Richest	1.6 1.2 1.1 0.9	1.2–2.0 0.9–1.5 0.9–1.4 0.7–1.2	0.000 0.226 0.338 0.562	3.1 1.5 1.4 1.2	2.03–4.7 0.95–2.3 0.9–2.1 0.8–1.4	0.000 0.086 0.135 0.347
Cigarette smoking	No Yes	0.9	0.6–1.6	0.810	1.85	0.7–5.2	0.239
Chewing Khat	No Yes	1.1	0.9–1.2	0.515	0.8	0.6–1.1	0.124
Total number of household members	≤3 >3	0.7	0.6–0.8	0.000	0.73	0.6–0.9	0.005
Number of under five children	≤5 >5	0.7	0.6–0.9	0.000	0.6	0.48–0.8	0.000
Toilet type	Improved Unimproved No toilet facility/field/bush	1.2 0.8	0.96–1.4 0.7–0.9	0.123 0.000	1.625 0.8	1.2–2.2 0.6–0.9	0.001 0.008
Ever had terminated pregnancy	Yes No	1.01	0.8–1.2	0.926	1.1	0.8–1.4	0.648
Water source	Improved Unimproved	0.99	0.9–1.1	0.905	0.8	0.7–0.97	0.023

BMI: body mass index; RRR: relative risk ratio.

anemic status because it may not necessarily mean that all the necessary micro-nutrient demands are met in obese women, but the lower BMI is the main risk factor for many adverse health outcomes among non-pregnant women of reproductive age including anemia.<sup>25</sup>

Indoor air pollution from biomass fuel is associated with many adverse health outcomes in developing countries. These adverse health outcomes such as anemia, arising from the use of biomass fuels for cooking, could be reduced through different interventions such as the provision of improved cookstove at the household level.<sup>26</sup>

### Strength and limitation of this study

The main strength of this finding is the use of a large representative sample size which can be generalized at the national

level. But the variation in the type of fuel types used, the duration of exposure to indoor air pollution, and feeding habits were not taken into consideration during this analysis. The use of improved biomass cook stoves and presence of chimney in households will also influence exposure to pollution and hence the results. But because of the lack of these information in the data sets, their effect was not assessed in this study, which, the researchers believe, is the main limitation of this study. Therefore, care should be taken during the interpretation of the result.

### Conclusion

The finding indicated that the use of biomass fuel was associated with reduced blood hemoglobin levels and significantly associated with mild anemia levels in women of

reproductive age in Ethiopia. National efforts should be in place to reduce indoor air pollution from biomass fuels.

### Acknowledgements

We are very much thankful to DHS ICF, USA, for providing us the permission as well as the national data set. Our special thanks go to Wellington Bridgette, for her unreserved support in the entire process. We also would like to acknowledge that the pre-print version of this research paper is uploaded on “Research Square” under the following link <https://doi.org/10.21203/rs.3.rs-909454/v1>.

### Author contributions

**Girum Gebremeskel Kanno and Robel Hussen:** conceptualization, investigation, project administration, methodology, formal analysis, writing the original draft.

**Temesgen Geremew and Tesfaye Diro:** methodology, data curation, analysis, editing, and writing.

**Binyam Tariku Seboka and Awash Alembo:** methodology, data curation, analysis, editing, writing, and manuscript preparation.

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### Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

### Ethical approval

Because this study used a secondary data and the personal information of the respondents was removed, Ethical clearance was not mandatory for this research because we have used secondary data for the analysis. However, a request was made to DHS and a permission letter was granted to utilize the data set.


### Informed consent

The primary survey has been carried out by the Ethiopian Central Statistics Agency (CSA) every 5 years with the major aim of gathering timely estimates of key demographic and health indicators with the Ministry of Health’s (MoH) request, and this is the fourth round, and the necessary informed concept has been taken. But this research is based on a secondary data; therefore, the informed consent is not applicable. However, a request was made to DHS and a permission letter was granted to utilize the data set.

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### Data availability statement

The survey data we used for this research can be accessed online from the Demographic and Health Survey program website through the following link: <http://dhsprogram.com/data/available-datasets.cfm>

### Supplemental material

Supplemental material for this article is available online.

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