

Correlates of Ghanaian households' use of climate-friendly and health-promoting fuels: insight from the 2014 demographic and health surveys

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Abstract

Background About five of the Sustainable Development Goals (SDGs) directly calls for clean and climate-friendly household cooking fuels to help mitigate Carbon Dioxide (CO₂) and black carbon emissions to ensure that the global mean temperature is kept below 1.5 °C to promote good human health. In developing countries, climate-friendly and health-promoting fuels (CF&HPFs) are generally unaffordable and inaccessible. Studies on the prevalence and the predictors of household use of climate-friendly fuels and health-promoting fuels (CF&HPFs) in Ghana are few and nationally non-representative. To effectively design programs that encourage Ghanaian households to use CF&HPFs, the study estimated the proportion of households currently using CF&HPFs and delineated factors that account for their use.

Methods The study used the data of the cross-sectional demographic and health surveys conducted in 2014. Chi-square test of independence was used to identify the predictors that were statistically significant related to households' use of CF&HPFs for the multivariable model. In the multivariable model, we reported prevalence ratios using the generalized linear model (glm), setting the family to "Poisson" and the link to "log." The estimation adjusted for the study designed and the household sampling weights.

Results The main finding was that rich households were 8.85 times likely to use CF&HPFs compared to poor households. We further found that the following factors were associated with a higher probability of a Ghanaian household to use climate-friendly and health-promoting fuels for cooking: male-headed households, households' headed by persons between 24 years and 55 years, households with heads that were currently married or never married, households with heads that have attained at least a primary level education, households with less than eight members, households with at least two women, and households in Western, Central, Greater Accra, Volta, Eastern, Ashanti, Brong Ahafo, Upper East region.

Conclusion Given that the most important correlate of household's use of CF&HPFs is household wealth, we recommend that significant attention should be given to economic empowerment of citizens in policies and interventions aimed at encouraging Ghanaians to use this type of fuel.

Background

The campaign to curb the devastating effects of global warming on humanity and the ecosystem is yielding positive results, with many state and non-state entities pursuing and adopting environmental and energy policies that promote the health of humans and the planet at large [1, 2]. Greenhouse emission has largely been identified as the prime cause of climate change; however, the negative impact of using certain types of fuels for household needs on climate change and health has also received policy and scholarly attention [3, 4]. About 5 of the Sustainable Development Goals (SDGs) directly calls for clean and affordable household cooking energy to help mitigate CO₂ and black carbon emissions and to ensure the global mean temperature is kept below 1.5°C, promote good health and gender equality [5–7]. The types of fuels used in households across the globe can broadly be categorized into climate-friendly (electricity, liquefied petroleum gas, natural gas) and non-climate-friendly fuels (wood, agricultural/crop residue, animal dung, coal, charcoal, kerosene), with the former also described as human health-promoting fuels [8]. Globally, an estimated 3 billion people rely on non-climate friendly fuels (NCFs) for

cooking and heating purposes and about 97% of the population in Sub-Saharan Africa's depends on these solid and biomass fuels [9, 10]. This figure is expected to remain unchanged until 2030 [10].

The consequences of using NCFs are two folds: environmental degradation and ill-health. Using NCFs for household cooking and heating resulted in the annual emission of a little over one billion tons of carbon dioxide (CO₂) into the atmosphere constituting 3% of global carbon dioxide (CO₂) and 25% of black carbon emissions [3, 11]. Also, an estimated 55% of woods harvested globally are consumed as fuelwoods and for burning charcoal [12], and this has resulted into deforestation and biodiversity loss [13]. Regarding health repercussions, NCFs produces smoke of incomplete combustion, which reduces the ambient air quality of the immediate environment. The smoke also contains harmful pollutants such as carbon monoxide, sulphur dioxide, nitrogen dioxide and particulate matter (PM) such as PM_{2.5} that are harmful to human health [8]. About 4 million premature deaths are directly associated with household air pollution (HAP) resulting from the use of NCFs for cooking [14]. The inhalation of particulate matter from HAP, for instance, accounts for nearly 45% of all pneumonia-related deaths among children under 5 years globally and other deadly respiratory infections and diseases.

A number of studies investigated factors that account for households' continuous reliance on NCFs in developing countries. Some of these factors include poverty, large household sizes, lack of formal education, and dwelling in a rural area [15, 16]. In developing countries, climate-friendly fuels (CFFs) are generally unaffordable and inaccessible in many parts. Studies on the prevalence and the predictors of household use of CFFs and health-promoting fuels (HPFs) in Ghana are few and nationally non-representative. To effectively design programs that encourage Ghanaian households to use CF&HPFs, it is important to estimate the proportion of households currently using CF&HPFs and delineate factors that account for their use. We fill this gap in the literature by employing a complex survey design analysis and developing prevalence ratio model of socioeconomic and demographic predictors of household use of CF&HPFs by using the nationally representative 2014 Ghana Demographic and Health Survey (GDHS) dataset.

Methods

Design

The 2014 Ghana Demographic and Health Surveys (GDHS) data was collected in line with a cross-sectional survey design [17]. The survey employed two-stage probability sampling, stratified by urban and rural areas of the ten administrative regions of Ghana [17]. The sampling frame for the survey was based on the updated sampling frame from the 2010 Ghana Population and Housing Census [17]. The first stage of the probability sampling involved the selection of enumeration areas (EAs), which was stratified by place of residence [17]. A total of 427 EAs were selected, 216 in urban areas and 211 in rural areas [17]. The second stage of the probability sampling involved the systematic sampling of households [17]. The implementers of the survey undertook a household-listing operation in all the selected EAs from January through March 2014, and households to be included in the survey were systematically selected

from the list [17]. Approximately 30 households were selected from each EA to constitute the total sample size of 12,831 households [17].

Data collection

Trained enumerators collected the data from early September to mid-December 2014 using paper-based questionnaires [17]. The selected sample size for the 2014 GDHS was 12,831 households, of which 12,010 were occupied [17]. Out of the occupied households, 11,835 were successfully reached, resulting in a 99% response rate [17]. In the GDHS, household heads provided information on their demographic characteristics and household characteristics such as household population and composition, housing structure, household assets, access to basic utilities, sources of drinking water, water treatment practices, access to sanitation facilities, and type of fuel used for cooking [17].

Study sample

The unit of analysis is households, and the dataset contains 11,835 households. The data were weighted using the household weight variable in the dataset. A sample of 513 households indicated that they cooked no food in the house, so they were excluded from further analyses. Therefore, the analytic weighted sample is 11,322.

Variables

Outcome variable:

In the dataset, the household head was asked to select the main source of fuel for cooking in the household from the following categories: electricity, LPG, natural gas, kerosene, coal, lignite, charcoal, wood, straw/shrubs/grass, and agricultural crop. Electricity, LPG, and natural gas was defined in our study as CF&HPFs and all other sources of fuels as non-climate friendly and health promoting.

Predictor variables:

Ten sociodemographic characteristics variables were selected as potential predictors in the study. Marital status was recoded as follows: never in union (as never married), married and living with partner (as currently married), widowed, divorced, and no longer living together/separated (as formally married). For the multivariate model, household wealth was dichotomized as follows: poorest, poorer, and middle (as poor) and richer and richest (as rich).

Data analysis

We used STATA version 14 for the data analyses. Summary statistics, chi-square test of independence, and complex sample prevalence ratio modelling were performed. The analysis accounted for sampling design (cluster, strata) and household weights. The complex sample analysis eliminates the underestimation of the Standard Errors (SE) associated with the confidence intervals of the regression coefficients. We chose to report prevalence ratios using the generalized linear model (glm) in STATA,

setting the family to “Poisson” and the link to “log,” to avoid the potential overestimation of effects from reporting odds ratios when the prevalence of the outcome of interest is above 10%.

Results

Sample Characteristics

In the dataset, 3040 (26.9%) households were using CFFs and HPFs for cooking. Majority of the households were headed by males (64.9%). Most of the household heads were currently married (62.9%). The summary statistics for the remaining study variables are reported in Table 1.

Table 1: Summary statistics of study variables

Variables	n(%)
CF&HPFs	
Using	3040 (26.9)
Not using	8282 (73.1)
Sex of HH	
Male	7347 (64.9)
Female	3975 (35.1)
Age of HH	
15-24	772 (6.8)
25-34	2707 (23.9)
35-44	2721 (24.0)
45-54	2165 (19.1)
55+	2954 (26.1)
Missing	3
Marital status of HH	
Never married	1618 (14.3)
Currently married	7123 (62.9)
Formally married	2576 (22.8)
Missing	5
The education level of HH	
None	2540 (22.4)
Primary	1547 (13.7)
Middle/JSS/JHS	4416 (39.0)
Secondary and above	2818 (24.9)
Missing	2
Size of HH	
1	2528 (22.3)
2	1828 (16.1)
3	1721 (15.2)
4-5	2976 (26.3)
6-7	1574 (13.9)
8+	694 (6.1)
Number of women (15-49) in HH	
0	3852 (34.0)
1	5862 (51.8)
2+	1609 (14.2)
Number of men (15-49) in HH	
0	7815 (69.0)
1	2868 (25.3)
2+	639 (5.6)
Household wealth	
Poorest	1585 (14.0)
Poorer	2149 (19.0)
Middle	2494 (22.0)
Richer	2503 (22.1)
Richest	2590 (22.9)
Urban/rural residence	
Urban	6161 (54.4)
Rural	5161 (45.6)
Region	
Western	1229 (10.9)

Central	1150 (10.2)
Greater Accra	2343 (20.7)
Volta	991 (8.8)
Eastern	1230 (10.9)
Ashanti	2049 (18.1)
Brong Ahafo	979 (8.6)
Northern	721 (6.4)
Upper East	372 (3.3)
Upper West	259 (2.3)
HH: Household Head	

Chi-square test of independence between the outcome variable and potential predictors

Results from the chi-square test of independence revealed that sex, age, marital status, and education of HH, size of household, number of women or men in the household, household wealth, locality of residence, and region of residence were statistically significantly associated with the use of CF&HPFs for cooking.

Table 2: Chi-square test of independence between the outcome variable and potential predictors

Variables	CF&HPFs	
	Not using n(%)	Using n(%)
Sex of HH		
Male	5211 (70.9)	2135 (29.1)
Female	3070 (77.2)	905 (22.8)
$\chi^2 = 51.74$; Phi = -0.07; p-value = 0.000		
Age of HH		
15-24	519 (67.2)	253 (32.8)
25-34	1664 (61.4)	1044 (38.6)
35-44	1902 (69.9)	819 (30.1)
45-54	1680 (77.6)	485 (22.4)
55+	2514 (85.1)	439 (14.9)
$\chi^2 = 454.88$; Cramer's V = 0.20; p-value = 0.000		
Marital status of HH		
Never married	809 (50.0)	809 (50.0)
Currently married	5296 (74.4)	1827 (25.6)
Formally married	2171 (84.3)	405 (15.7)
$\chi^2 = 608.83$; Cramer's V = 0.23; p-value = 0.000		
The education level of HH		
None	2444 (96.2)	96 (3.8)
Primary	1392 (90.0)	154 (10.0)
Middle/JSS/JHS	3316 (75.1)	1100 (24.9)
Secondary and above	1128 (40.0)	1689 (60.0)
$\chi^2 = 2493.47$; Cramer's V = 0.469; p-value = 0.000		
Size of HH		
1	1537 (60.8)	991 (39.2)
2	1260 (68.9)	568 (31.1)
3	1222 (71.0)	499 (29.0)
4-5	2297 (77.2)	679 (22.8)
6-7	1329 (84.4)	245 (15.6)
8+	636 (91.6)	58 (8.4)
$\chi^2 = 464.48$; Cramer's V = 0.20; p-value = 0.000		
Number of women (15-49) in HH		
0	2782 (72.2)	1070 (27.8)
1	4243 (72.4)	1619 (27.6)
2+	1257 (78.2)	351 (21.8)
$\chi^2 = 24.10$; Cramer's V = 0.05; p-value = 0.000		
Number of men (15-49) in HH		
0	5782 (74.0)	2033 (26.0)
1	1990 (69.8)	878 (30.6)
2+	509 (79.7)	130 (20.3)
$\chi^2 = 37.23$; Cramer's V = 0.06; p-value = 0.000		
Household wealth		
Poorest	1582 (99.8)	3 (0.2)
Poorer	2135 (99.3)	14 (0.7)
Middle	2296 (92.1)	198 (7.9)
Richer	1737 (69.4)	766 (30.6)

Richest	531 (20.5)	2059 (79.5)
$\chi^2 = 5451.46$; Cramer's V = 0.694; p-value = 0.000		
Urban/rural		
Urban	3616 (58.7)	2544 (41.3)
Rural	4665 (90.4)	496 (9.6)
$\chi^2 = 1434.00$; Phi = -0.356; p-value = 0.000		
Region		
Western	906 (73.7)	323 (26.3)
Central	889 (77.3)	261 (22.7)
Greater Accra	1060 (45.2)	1283 (54.8)
Volta	834 (84.2)	157 (15.8)
Eastern	1027 (83.5)	203 (16.5)
Ashanti	1431 (69.8)	619 (30.2)
Brong Ahafo	847 (86.6)	131 (13.4)
Northern	696 (96.7)	24 (3.3)
Upper East	348 (93.8)	23 (6.2)
Upper West	243 (93.8)	16 (6.2)
$\chi^2 = 1509.46$; Cramer's V = 0.365; p-value = 0.000		

Predictors of climate-friendly and health-promoting cooking fuels

We built a prevalence ratio model of predictors of climate-friendly and health-promoting cooking fuels with variables that were statistically significantly related to the outcome variable in the bivariate analysis. The following factors were associated with a higher probability of a Ghanaian household to use CF&HPFs for cooking: male-headed households, households' headed by persons between 24 years and 55 years, households with heads that were currently married or never married, households with heads that have attained at least a primary level education, households with less than eight members, households with at least two women, rich households, and households in Western, Central, Greater Accra, Volta, Eastern, Ashanti, Brong Ahafo, Upper East region. Details of the prevalence ratio estimates of each predictor in the model with its corresponding 95% confidence intervals are reported in Table 3.

Table 3: Prevalence Ratio model of Predictors of CF&HPFs for cooking

	PR [95% CI for PR]	SE	P>t
Sex of HH (Ref: Female)			
Male	1.12 [1.02, 1.23]	0.05	0.02
Age of HH (Ref: 55+)			
15-24	1.08 [0.91, 1.29]	0.10	0.37
25-34	1.24 [1.10, 1.40]	0.08	0.00
35-44	1.20 [1.07, 1.34]	0.07	0.00
45-54	1.16 [1.03, 1.30]	0.07	0.02
Marital status of HH (Ref: Formally married)			
Currently married	1.22 [1.07, 1.38]	0.08	0.00
Never married / never lived together	1.20 [1.04, 1.39]	0.09	0.02
Education of HH (ref: No education)			
Primary	1.54 [1.17, 2.02]	0.21	0.00
Middle/JHS/JSS	2.18 [1.73, 2.76]	0.26	0.00
Secondary/SSS/SHS/Higher	3.24 [2.56, 4.10]	0.39	0.00
Size of HH (ref: 8+ members)			
1 member	2.10 [1.52, 2.88]	0.34	0.00
2 members	1.79 [1.31, 2.44]	0.28	0.00
3 members	1.72 [1.28, 2.32]	0.26	0.00
4-5 members	1.37 [1.00, 1.88]	0.22	0.05
6-7 members	1.18 [0.85, 1.63]	0.20	0.33
Number of women in HH (ref: None)			
1 woman	1.06 [0.96, 1.16]	0.05	0.25
2+ women	1.22 [1.03, 1.44]	0.10	0.02
Number of men in HH (ref: none)			
1 man	0.98 [0.91, 1.05]	0.04	0.57
2+ men	1.05 [0.88, 1.24]	0.09	0.58
Wealth status of HH (Ref: Poor)			
Rich	8.85 [6.91, 11.33]	1.11	0.00
The locality of residence (ref: Rural)			
Urban	1.02 [0.91, 1.15]	0.06	0.73
Region (ref: Northern)			
Western	2.27 [1.49, 3.46]	0.49	0.00
Central	2.25 [1.46, 3.46]	0.49	0.00
Greater Accra	2.66 [1.78, 3.97]	0.54	0.00
Volta	2.31 [1.51, 3.53]	0.50	0.00
Eastern	1.79 [1.16, 2.77]	0.40	0.01
Ashanti	2.18 [1.45, 3.27]	0.45	0.00
Brong Ahafo	1.95 [1.25, 3.05]	0.44	0.00
Upper East	1.87 [1.19, 2.94]	0.43	0.01
Upper West	1.48 [0.76, 2.89]	0.50	0.24
_constant	0.00 [0.00, 0.01]	0.00	0.00

Discussion

The study sets out to estimate the proportion of Ghanaian households currently using CF&HPFs and delineate factors that account for their use. The findings reveal that less than a third of Ghanaian households were using CF&HPFs for cooking. The households' use of CF&HPFs were also found to be positively associated with certain household head demographic factors, household characteristics, and place and region of residence.

To begin with, male-headed households were more likely to use CF&HPFs for cooking compared to female-headed households. Men have more economic advantage in most Ghanaian communities. This advantage position of men enables them to purchase CF&HPFs that are generally considered expensive in Ghana. Even though some studies present similar results, others present contrary findings. For example, one study conducted in South Asia found that female-headed households were more likely to use CF&HPFs fuels [18, 19]. The authors mentioned the ability of CF&HPFs to reduce the drudgery associated with cooking as a major influential factor for its adoption and use by female-head households.

Again, households headed by persons between 24 years and 55 years were observed to more likely to use CF&HPFs. Conventionally, persons within this age group belong to the active working-age population, granting them easier access to economic opportunities. Therefore, these individuals are more likely to afford the usage of CF&HPFs. Additionally, persons above 55 years may find it difficult and inconvenient to adopt CF&HPFs for cooking because they perhaps belonged to a generation that predominantly relied on solid fuels for cooking [20]. Other scholars also explain that the tendency to experiment and to adopt efficient modern technologies and behaviour may be a contributing factor for the adoptions and use of CF&HPFs among the younger generation [21].

Furthermore, we found that households with currently married or never-married individuals were more likely to use CF&HPFs. In today's Ghana, it is trendy for couples to rely on LPG and electricity for cooking. Also, anecdotal evidence suggests that couples may be more likely to use CF&HPFs because of its convenience. Even though undocumented in the literature, it is prudent to argue that households with never-married heads were more likely to use CF&HPFs due to its convenience and the high tendency of reducing exertion often associated with traditional cooking methods.

Moreover, we found education as another key contributing factor influencing for adoption and use of CF&HPFs among households. This is because the educated household head is more informed on the environmental and health benefits of cleaner cooking fuels hence its choice and usage. One scholar in a similar study opined that educated household heads in urban communities are more inclined to use CF&HPFs [22]. In addition, it is instructive to reason that educated household heads may have more access to economically viable opportunities than their uneducated counterparts. This economic advantage provides educated households with high-income levels hence their ability to purchase CF&HPFs which are relatively expensive but convenient to use.

Besides, the study revealed that household's with less than eight members have a higher likelihood of using CF&HPFs. We attribute this phenomenon to the reduction in the financial burden in smaller

households than larger households. Large households in Ghana are most often dominated by dependent individuals. The high demand for cooking energy uses due to the family size and the challenge of limited resources create the situation of treating the adoption and use of CF&HPFs which are most often expensive as a periphery or less of a household need due to prevailing household welfare status. Other studies confirms this finding [16, 23, 24].

We also found that households with at least two women had a higher likelihood of using CF&HPFs. In Ghana, cooking activities are mostly a preserve of adult female household members. This exposes them, (especially women without clean cooking methods) to chronic obstructive pulmonary diseases (COPD) such as bronchitis, lung cancer, asthma etc than their counterparts who adopt and use CF&HPFs. We argue that in an attempt to avert the physical drain and negative health implications associated with the burning of solid biomass for cooking, households with 2 or more adult females are more likely to combine financial resources to adopt CF&HPFs which is more convenient, timesaving and healthy. Findings from a study conducted by some authors concur with this observation [16].

The adoption and use of cooking fuels like other graded commodities are highly influenced by the purchasing power of the household. Our study revealed that rich households were 8.85 times likely to use CF&HPFs compared to poor households. The finding agrees with the Energy Ladder Theory that explains the direct relationship between the rise in household income and the adoption of clean cooking energy sources [25]. Again, apart from the ability to purchase CF&HPFs which are most often expensive, there appears to be some luxurious prestige attached with the adoption and use of CF&HPFs which rich households want to be associated with [24].

We investigated whether regional variations influenced the likelihood of a Ghanaian household to use climate-friendly and health-promoting fuels for cooking. The study observed that households within some political administrations in Ghana had a higher probability of using improved cooking methods than others. For example, we observed that households in the Greater Accra, Ashanti, Brong Ahafo, Central, Western and Eastern regions were more likely to use CF&HPFs than traditional biomass such as animal dung, fuelwood and biochar. One possible explanation for this observation can be attributed to the urbanized nature of these regions [26]. The Greater Accra region, for example, is the political head and administrative region of Ghana. It is the most urbanized region with about 87.4% of its population living in urban centres with access to viable economic and political resources for an improved standard of living [27]. This implies that households within these regions are more likely to utilize the available economic and political advantage to adopt or adapt climate-friendly and health-promoting fuels for cooking than their counterparts in the other regions of the country. These finding shares some similarities with findings of one other study [28].

Of particular interest in the above finding was the higher probability of households in the Upper East region to use climate and health-promoting fuels for cooking. This is quite revealing because households in the Northern regions of Ghana are the poorest across the country. However, the likelihood of households in the Upper East regions identified in this study to use CF&HPFs suggests some qualitative

explanations. It is therefore prudent to argue that the exposure of the Upper East region over the years to some major improved stove interventions such as the Research of Emission, Air Quality, Climate and Cooking Technologies in Northern Ghana Project (REACTING) as well as the presence of the Navrongo Health Research Center might have influenced this observation. The REACTING project was aimed at testing the adoption, acceptance, and impact of two improved cookstoves: a locally designed rocket stove (Gypa) and a Philips HD4012 LS gasifier stove. The implementation of this project might have had some over-spill effect on some households in the region. Again, the presence of the Navrongo Health Research Center through their education and other micro-interventions might have influenced the above observation in this study.

The has certain strength and limitations that are worth mentioning. The study employed the cross-sectional analysis which did not permit the researchers to derive causal relationships between predictors and the outcome variable. It is also worth mentioning that few households were excluded from the analysis because they did not cook at home and therefore did not use any domestic cooking energy. Close to four decades, the GDHS program has been conducting its survey every five years, and this has improved the quality of the sampling methodologies, data collection procedures, and the development of the questionnaires. Given that the study used the GDHS dataset that is nationally representative and large, the estimates from the analyses can be generalized for the entire Ghanaian population.

Conclusions

The adoption and sustained use of CF&HPFs are important in enhancing good health for nearly half of the world's population, mostly women and children in developing countries and to help protect the global environment. Our study finds household characteristics and region of residence as influential factors in the adoption of CF&HPFs in Ghana. The level of education, wealth status, age and marital status of household heads positively influenced the use of CF&HPFs. It became evident in this study that male-headed households were more likely than female-headed households to adopt CF&HPFs even though it dissented to most literature. Additionally, having two or more adult females in a household positively influences the chances of using clean cooking energy. Large family size (above 8 individuals) and residence in the Upper West region of Ghana were found to negatively influence the adoption of clean cooking fuels.

To increase the adoption and use of CF&HPFs to advance Ghana's cause towards achieving the SDGs, we recommend: a national effort to improve the economic standards of the poor majority to switch to clean cooking fuel use; education on efficient and sustainable consumption must be intensified and incorporated in the basic school's curriculum to ensure the future generation are more environmental sustainability and health-conscious.

Abbreviations

CFFs: climate-friendly fuels

HPFs: health promoting fuels

CF&HPFs: Climate-friendly and health promoting fuels

NCFFs: non-climate friendly fuels

GDHS: Ghana Demographic and Health Surveys

COPD: chronic obstructive pulmonary diseases

REACTING: Research of Emission, Air Quality, Climate and Cooking Technologies in Northern Ghana Project

HH: Households

HAP: household air pollution

SDG: Sustainable Development Goals.

Declarations

Ethics approval and consent to participate

The Ghana Health Service Ethical Review Committee and the Institutional Review Board of ICF International reviewed and approved the 2014 GDHS protocol. Enumerators obtained informed consent from mothers between 15-49 years with children under-five years before interviewing them [17]. The GDHS did not obtain assent from parents or guardians of childbearing women who were either 15 or 16 years because they already had children and were independent of their guardians or parents. The GDHS is publicly available upon a simple, registration-access request, so no further ethical clearance was sought

Consent for publication

Not Applicable

Availability of data and materials

The 2014 Ghana DHS dataset supporting the analysis of this study is available in the DHS repository. The DHS datasets are available for free after a simple registration process.

Competing Interests

The authors declare no competing interests.

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Authors did not receive any funding.

Authors' contributions

DSS, AP and PLK conceptualized the study. AP and DOH performed data analysis. NKE validated the analysis. DSS, PLK, NKE, DMV, ANKH, DOH and AP wrote the paper. AP supervised the study. All authors have read and approved the manuscript.

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