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The Choice of Healthy Source of Energy for Cooking Among Households in Ghana: Does Financial Inclusion Matter?

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ABSTRACT: Air pollution resulting from the use of unhealthy/unclean energy sources for cooking causes illnesses such as lung cancer, stroke, chronic obstructive pulmonary disease and ischaemic heart disease. In Ghana, each year, about 18 000 deaths are recorded due to the use of unhealthy energy sources for cooking. While financial inclusion can influence the adoption of healthy energy sources for cooking, less attention has been paid to it. This study, therefore, investigates the effect of financial inclusion on the choice of healthy source of energy for cooking among households in Ghana. Doing so reveals whether financial inclusion can be employed as a tool to decrease the use of unhealthy sources of energy for cooking in Ghana. We employ the Ghana Living Standards Survey round 7 (GLSS7) as the data source for the study whiles the binary logistic regression is used as the estimation technique. The findings show that, households with financial inclusion (using a single indicator) are more likely to choose healthy sources of energy for cooking relative to those without financial inclusion (OR = 2.52, $P < .01$). Moreover, the effect of financial inclusion (using a single indicator) on choosing a healthy source of energy for cooking is greater among rural households (OR = 3.18, $P < .01$) relative to their urban counterparts (OR = 2.27, $P < .01$). The findings are robust even after using a different estimation technique and a combined index of financial inclusion. Thus, in the quest to improve the use of healthy sources of energy for cooking, enhancing financial inclusion among households, could be a useful strategy.

KEYWORDS: Source of energy/fuel for cooking, air pollution, financial inclusion, Ghana

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Introduction

Estimates show that, each year, nearly 4 million people die prematurely from illnesses (such as lung cancer, stroke, chronic obstructive pulmonary disease and ischaemic heart disease) linked to household air pollution resulting from the use of open fires or stoves that are fuelled by biomass (animal dung, crop waste and wood), coal and kerosene for cooking. Moreover, nearly 50% of deaths attributable to pneumonia among children under-five is as a result of household air pollution.[1] Thus, the combustion of biomass, coal and kerosene releases huge amounts of toxic gases into the atmosphere,[2] that are detrimental to human health.

Nonetheless, nearly 3 billion people globally (mostly the poor in low-and middle-income countries), use such unhealthy sources of energy for cooking.[1] Unhealthy sources of energy therefore refer to fuels for cooking that are harmful to human health (eg, wood, charcoal, coal, kerosene, crop residue, sawdust and animal waste) whiles healthy sources of energy refer to fuels for cooking that are not harmful to human health (eg, gas and electricity).

The use of unhealthy sources of energy costs the world over US$2.4 trillion every year due to negative effects on the climate and health as well as productivity losses among women. In sub-Saharan Africa (SSA), the rate of access to healthy sources of energy for cooking such as gas and electricity is only 10%, compared with 56% and 36% in the Caribbean and Latin America, and East Asia respectively.[3]

The situation in Ghana is not different. This is because, more than 65% of households in Ghana use unhealthy sources of energy for cooking.[4] For instance, charcoal consumption increased from 1563 kilotonnes in 2000 to 2275 kilotonnes in 2011 whiles firewood consumption increased from 7100 kilotonnes to 11355 kilotonnes during the same period.[5] It is therefore not surprising that 18 000 people in Ghana die each

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year due to exposure to smoke from such unhealthy energy sources.[6]

To ensure universal access to healthy sources of energy for cooking by 2030, it has been estimated that, US$150 billion is needed each year, including US$103 billion purchases of clean stoves or fuels by households.[7] This therefore clearly shows that, financial inclusion (the ability of individuals/businesses to meet their needs by having access to inexpensive financial services/products[8]) could be a major tool towards enhancing access to healthy sources of energy for cooking among households. This is because, financial inclusion has been found to play major roles in poverty alleviation, reducing income inequality as well as ensuring higher income (economic growth),[9-12] which would result in an improvement in welfare. Therefore, based on the energy ladder hypothesis, as household welfare increases, there will be a transition from the use of unhealthy energy sources to healthy ones.[13]

However, while a number of studies have been conducted on the factors that determine the choice of source of energy for cooking among households in other countries[14-16] and Ghana,[17-26] among the studies devoted to Ghana, only Twumasi et al[25,26] focused on financial inclusion. Notwithstanding, the study by Twumasi et al[25,26] focused on only rural households in 4 regions. Meanwhile, the use of only rural households in some few regions makes the findings less applicable to urban households as well as households in other regions of Ghana. For instance, Kumasi and Accra, which are the most densely populated urban areas in Ghana,[27] account for 57% of the total charcoal consumption in the country.[28]

This study, therefore, investigates the effect of financial inclusion on the choice of healthy source of energy for cooking among rural and urban households in all the regions of Ghana (At the time the data used for this study were collected, there were only ten regions in Ghana). Doing so helps in arriving at findings that are more useful in designing policies for the entire country as well as subgroups: regions, rural and urban households. This would help in achieving the Sustainable Development Goals (SDGs) 3.9.1 (reduce the rate of mortality due to ambient air pollution) and 7.1.2 (enhance the percentage of the population who primarily rely on clean fuels and technology).[29]

Methods

Data and variables

The source of data for the study is the Ghana Living Standards Survey round 7 (GLSS7), collected in 2016 to 2017. The data were collected throughout Ghana employing a 2-stage stratified sampling approach. Out of the 15 000 households systematically selected, 14 009 were finally interviewed.[4] Details of the sampling and data collection methods of the GLSS7 can be found elsewhere.[4]

With regard to the variables, the source of energy normally used by the household for cooking is employed as the dependent variable. After dropping non-cooking households and those who use other (unknown) energy sources for cooking as well as recoding options, the dependent variable is turned into a binary outcome; healthy source (gas/electricity (1)) and unhealthy source (wood, charcoal, kerosene, crop residue, sawdust and animal waste (0)). We add kerosene to the unhealthy energy sources because its usage has been found to be associated with cardiovascular mortality and respiratory diseases among others.[30]

The independent variable of interest is financial inclusion; measured as the ownership of bank account or contribution to a loan or saving scheme by the household head (single indicator). The variable has a response of either 'yes' or 'no'. This measure included the ownership of mobile money account, participation in a traditional savings and loans scheme called 'susu' among others. Thus, the financial inclusion measure used in this study captures the access and usage aspects of financial inclusion, directly or indirectly (see GLSS7 data and questionnaire).

The remaining independent variables used are household head's educational qualification, age (in years), sex, religion, region, total expenditure per day per adult (in Ghana Cedis (GHS)), residence (urban/rural) and rent agreement as well as household size. Variables including rent agreement, religion and educational qualification are recoded (For rent agreement, perching and squatting are put together. Concerning religion, all Christian denominations are put together while traditionalist and other religion categories are merged. Similarly, for education, all forms of formal educational qualifications are put together). Aside from household size, total expenditure per day per adult and age that are continuous, all the remaining independent variables are categorical, so they are treated as dummy variables.

Statistical Analyses

Descriptive statistics (percentages and frequencies) are used to present the demographic characteristics of the respondents. Bivariate analysis is conducted to find out the extent of association between the choice of healthy source of energy for cooking and the categorical independent variables using the Pearson's Chi square.

Given that bivariate analysis is restricted to only 2 variables at a time, we employ the binary logistic regression as the baseline multivariate estimation technique. The binary logistic regression is chosen because the dependent variable is binary.[31] The regression results are presented using Odds Ratios (ORs) in order to quantify the association between the choice of healthy source of energy for cooking and the independent variables.[32]

For our baseline analysis, we run 3 estimation results; first, with the overall sample, second, with only urban households and third, with only rural households. To check the robustness of our estimates, we use (i) the binary probit regression as an estimation technique (Table 4) given the binary nature of the dependent variable[31] and (ii) a combined index of financial inclusion (FI index: generated from participation in an informal savings and loan scheme (susu), ownership of accounts in

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commercial banks, rural banks, formal savings and loans institutions, credit unions, mobile money and mortgage as well as using a cheque book, Automated Teller Machine (ATM), Ezwich (a financial transaction card in Ghana) and electronic banking) created using Principal Component Analysis (PCA) (Table 5). Employing such an index helps in capturing the various dimensions of financial inclusion.[33-35]

Given the complex nature of the design used in collecting the data employed by this study, all the analyses are weighted in order to make the estimations regionally and nationally representative.[36] All data analyses are conducted using STATA 14.0.

Results

This section is devoted to the presentation of the empirical results and it is divided into 3 sub-sections. The first sub-section presents the descriptive statistics and bivariate analysis results, the second sub-section is devoted to the baseline regression results and the third sub-section covers results of robustness checks.

Descriptive statistics and bivariate analysis

In this sub-section, the summary statistics and bivariate analysis results of variables are presented (Tables 1 and 2).

From Table 1, it is observed that as regards the choice of source of energy for cooking, 73.56% of the households use unhealthy sources of energy for cooking whiles only 26.44% use healthy sources of energy for cooking.

With regard to the baseline financial inclusion indicator, the results show that 56.15% of the household heads have access to useful financial products and services (financial inclusion) whiles 43.85% of them do not have any form of financial inclusion. Also, regarding educational qualification of household heads, it can be seen that, 69.17% of them have some level of educational qualification, whiles 30.83% of them have no educational qualification. Summary statistics of the rest of the variables used by the study can be found in Table 1.

For the bivariate analysis (Table 2), the Pearson's Chi^2 results reveal that there are statistically significant associations between all the categorical independent variables namely: financial inclusion, sex of household head, educational qualification of household head, religion, region, residence and rent agreement, and the choice of healthy source of energy for cooking. The relationships among these variables are all statistically significant at the 1% level. The results above necessitate the use of a multivariate technique to find out the effect of financial inclusion on the choice of healthy energy source for cooking. To do so, the study controls for other factors since the bivariate analysis considers only 2 variables at a time.

Baseline regression results

This sub-section of the study presents the baseline multivariate analysis results and these are reported in Table 3. It is worth noting that 3 estimation results are presented, distinguished by,

Table 1. Socio-demographic characteristics of respondents.

VARIABLE	%		
Energy for cooking			
Unhealthy energy for cooking	73.56		
Healthy energy for cooking	26.44		
Financial inclusion			
Yes	56.15		
No	43.85		
Sex			
Male	64.78		
Female	35.22		
Educational qualification			
None	30.83		
Yes	69.17		
Religion			
No religion	5.81		
Christian	74.66		
Traditionalist/other	3.95		
Islam	15.58		
Region			
Western	10.68		
Central	8.60		
Greater Accra	18.32		
Volta	7.89		
Eastern	12.02		
Ashanti	21.19		
Brong-Ahafo	9.16		
Northern	6.55		
Upper East	3.26		
Upper West	2.32		
Residence			
Urban	55.03		
Rural	44.97		
Rent agreement			
Owning	43.78		
Renting	27.49		
Rent free	28.25		
Perching/squatting	0.48		
	MEAN	*MIN*	*MAX*
Total expenditure per day per adult (in GHS)	11.99	0.11	546.97
Age (in years)	46.69	15	99
Household size	4.37	1	28
FI index	0	−0.99	6.92

Source: Authors' computation from GLSS7.
Zero mean of FI index is due to rounding.

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Table 2. Bivariate analysis of source of energy for cooking and categorical independent variables.

VARIABLE	UNHEALTHY ENERGY FOR COOKING (%)	HEALTHY ENERGY FOR COOKING (%)	SIG
Financial inclusion			
Yes	59.81	40.19	***
No	91.15	8.85	
Sex			
Male	71.68	28.32	***
Female	76.99	23.01	
Educational qualification			
None	88.86	11.14	***
Yes	58.09	41.91	
Religion			
No religion	88.37	11.63	***
Christian	68.87	31.13	
Traditionalist/other	95.45	4.55	
Islam	84.85	15.15	
Region			
Western	74.92	25.08	***
Central	75.73	24.27	
Greater Accra	42.06	57.94	
Volta	82.50	17.50	
Eastern	81.94	18.06	
Ashanti	72.50	27.50	
Brong-Ahafo	87.37	12.63	
Northern	96.38	3.62	
Upper East	93.29	6.71	
Upper West	93.74	6.26	
Residence			
Urban	59.32	40.68	***
Rural	90.81	9.19	
Rent agreement			
Owning	84.35	15.65	***
Renting	54.62	45.38	
Rent free	75.19	24.81	
Perching/squatting	78.18	21.82	

Source: Authors' computation from GLSS7.
Sig, significance.
***$P < .01$.

first, where the overall sample is used for estimation, second, where only urban households are used and third, estimates involving only rural households.

From Table 3, it is observed that the results of the urban- and rural samples are not qualitatively different from that of the overall sample, especially with regard to the effect of financial inclusion. For this reason, the focus of the interpretation of the results is on the overall sample.

Beginning with the variable of interest; financial inclusion, the results suggest that households whose heads are financially included are more likely to choose a healthy energy source for cooking (OR = 2.52, $P < .01$) relative to households whose heads don't have any form of financial inclusion. Specifically, households whose heads have financial inclusion have 2.52 times greater odds of using healthy energy source for cooking relative to those whose heads don't have any form of financial inclusion. Moreover, the effect of financial inclusion on using healthy source of energy for cooking is greater among rural households (OR = 3.18, $P < .01$) relative to urban households (OR = 2.27, $P < .01$).

We also find that expenditure per adult is associated with 1.06 times higher odds of a household using healthy energy source for cooking (OR = 1.06, $P < .01$). Regarding the sex of household head, from Table 3, it can be seen that being a male-headed household increases the likelihood of choosing healthy source of energy for cooking (OR = 1.28, $P < .01$) relative to households whose heads are females.

The study also finds that households whose heads have obtained some levels of formal educational qualification are more likely to choose a healthy energy source for cooking (OR = 3.0, $P < .01$) relative to households whose heads do not have any educational qualification. Specifically, households with formally educated heads have 3 times higher odds of using a healthy energy source for cooking relative to those without formally educated heads.

As regards religion, having a Christian as the head of a household increases the odds of choosing a healthy source of energy for cooking by 1.89 times (OR = 1.89, $P < .01$), relative to households whose heads do not belong to any religion.

Turning to region and the choice of healthy energy source for cooking, the results obtained indicate that relative to households in the Western Region, households in the Greater Accra Region are more likely to choose a healthy source of energy for cooking (OR = 1.63, $P < .05$). Specifically, households in the Greater Accra Region have 1.63 times greater odds of using a healthy energy source for cooking relative to those in the Western Region. Notwithstanding, households in the Eastern (OR = 0.52, $P < .01$), Ashanti (OR = 0.68, $P < .05$), Brong Ahafo (OR = 0.38, $P < .01$), Northern (OR = 0.22, $P < .01$) and Upper East (OR = 0.56, $P < .05$) Regions are found to have lesser odds of using a healthy energy source for cooking compared with those in the Western Region.

Concerning residence, rural households are found to have 0.32 times lesser odds (OR = 0.32, $P < .01$) of using healthy

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Table 3. Logistic regressions: Effect of financial inclusion on healthy source of energy for cooking.

VARIABLE	FULL SAMPLE	URBAN SAMPLE	RURAL SAMPLE
Financial inclusion (Ref: No)			
Yes	2.522*** (0.273)	2.269*** (0.286)	3.177*** (0.736)
Total expenditure per day per adult (in GHS)	1.064*** (0.00629)	1.053*** (0.00666)	1.097*** (0.0131)
Sex (Ref: Female)			
Male	1.279*** (0.122)	1.326*** (0.140)	1.192 (0.267)
Educational qualification (Ref: None)			
Yes	3.000*** (0.342)	2.964*** (0.383)	3.423*** (0.772)
Religion (Ref: No religion)			
Christian	1.893*** (0.410)	2.106*** (0.510)	1.050 (0.441)
Traditionalist/other	1.537 (0.516)	2.170* (0.874)	0.675 (0.401)
Islam	1.246 (0.343)	1.258 (0.379)	1.030 (0.539)
Region (Ref: Western)			
Central	0.784 (0.154)	0.680 (0.175)	1.015 (0.325)
Greater Accra	1.627** (0.335)	1.363 (0.312)	5.685*** (3.495)
Volta	0.984 (0.195)	1.106 (0.296)	0.822 (0.294)
Eastern	0.522*** (0.0985)	0.452*** (0.109)	0.670 (0.228)
Ashanti	0.683** (0.129)	0.710 (0.171)	0.514* (0.184)
Brong Ahafo	0.382*** (0.0828)	0.336*** (0.0851)	0.464* (0.188)
Northern	0.223*** (0.0676)	0.168*** (0.0552)	0.598 (0.295)
Upper East	0.555** (0.139)	0.613 (0.183)	0.617 (0.318)
Upper West	0.686 (0.157)	0.644 (0.205)	0.747 (0.270)
Residence (Ref: Urban)			
Rural	0.320*** (0.0431)		
Age (in years)	0.980*** (0.00352)	0.982*** (0.00409)	0.975*** (0.00654)
Household size	0.957** (0.0203)	0.969 (0.0244)	0.926** (0.0346)
Rent agreement (Ref: Owning)			
Renting	1.455*** (0.158)	1.228 (0.154)	2.138*** (0.433)
Rent free	0.941 (0.105)	0.867 (0.117)	1.020 (0.206)
Perching/squatting	0.654 (0.411)	0.539 (0.379)	1.342 (1.182)
Observations	9081	4579	4502

Source: Authors' computation from GLSS7.
Odds Ratios are used; Standard errors in parentheses.
*P <0.1. ** P <.05. *** P <.01.

energy source for cooking relative to urban households. Also, a rise in the age of the household head decreases the likelihood of choosing healthy energy source for cooking (OR = 0.98, P <.01). Specifically, a 1-year increase in the age of the household head is found to be associated with 0.98 times lesser odds of using healthy energy source for cooking. Similarly, an increase in household size is associated with a lesser likelihood of using healthy energy source for cooking (OR = 0.96, P <.05).

Turning to rent agreement, the results show that households who rent are more likely to choose a healthy energy source for cooking (OR = 1.46, P <.01), compared with their counterparts who own their dwellings.

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Table 4. Probit regressions: Effect of financial inclusion on healthy source of energy for cooking.

VARIABLE	FULL SAMPLE	URBAN SAMPLE	RURAL SAMPLE
Financial inclusion (Ref: No)			
Yes	0.529*** (0.0598)	0.490*** (0.0734)	0.577*** (0.112)
Total expenditure per day per adult (in GHS)	0.0333*** (0.00342)	0.0282*** (0.00360)	0.0512*** (0.00599)
Sex (Ref: Female)			
Male	0.144*** (0.0538)	0.170*** (0.0623)	0.0859 (0.117)
Educational qualification (Ref: None)			
Yes	0.617*** (0.0611)	0.636*** (0.0736)	0.635*** (0.108)
Religion (Ref: No religion)			
Christian	0.352*** (0.115)	0.439*** (0.139)	0.0269 (0.194)
Traditionalist/other	0.230 (0.184)	0.432* (0.243)	−0.139 (0.297)
Islam	0.119 (0.149)	0.139 (0.173)	0.0228 (0.247)
Region (Ref: Western)			
Central	−0.122 (0.115)	−0.210 (0.158)	0.00528 (0.170)
Greater Accra	0.315*** (0.120)	0.216 (0.139)	0.952*** (0.343)
Volta	−0.00855 (0.116)	0.0689 (0.163)	−0.112 (0.183)
Eastern	−0.366*** (0.110)	−0.457*** (0.146)	−0.250 (0.179)
Ashanti	−0.210* (0.110)	−0.186 (0.147)	−0.395** (0.184)
Brong Ahafo	−0.542*** (0.125)	−0.636*** (0.154)	−0.435** (0.205)
Northern	−0.844*** (0.172)	−1.044*** (0.192)	−0.292 (0.258)
Upper East	−0.314** (0.144)	−0.263 (0.181)	−0.257 (0.261)
Upper West	−0.233* (0.132)	−0.270 (0.190)	−0.172 (0.193)
Residence (Ref: Urban)			
Rural	−0.663*** (0.0752)		
Age (in years)	−0.0114*** (0.00202)	−0.0109*** (0.00246)	−0.0129*** (0.00330)
Household size	−0.0312** (0.0124)	−0.0238 (0.0152)	−0.0437** (0.0190)
Rent agreement (Ref: Owning)			
Renting	0.229*** (0.0628)	0.131* (0.0757)	0.407*** (0.108)
Rent free	−0.0285 (0.0632)	−0.0758 (0.0800)	0.00778 (0.104)
Perching/squatting	−0.305 (0.350)	−0.414 (0.392)	0.128 (0.467)
Constant	−1.441*** (0.188)	−1.372*** (0.234)	−2.106*** (0.316)
Observations	9081	4579	4502

Source: Authors' computation from GLSS7.
Coefficients are used. Standard errors in parentheses.
*P <0.1. ** P <.05. *** P <.01.

Robustness checks

Robustness check using the binary probit regression shows positive significant association between financial inclusion and using healthy source of energy for cooking among households in Ghana (Full sample: coefficient = 0.53, P <.01; Urban sample: coefficient = 0.49, P <.01; Rural sample: coefficient = 0.58, P <.01) (Table 4). This therefore confirms the baseline logistic regression estimates.

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Table 5. Logistic regressions: Effect of a combined index of financial inclusion on healthy source of energy for cooking.

VARIABLE	FULL SAMPLE	URBAN SAMPLE	RURAL SAMPLE
FI index	1.893*** (0.224)	1.749*** (0.241)	2.123*** (0.393)
Total expenditure per day per adult (in GHS)	1.061*** (0.00630)	1.050*** (0.00670)	1.097*** (0.0132)
Sex (Ref: Female)			
Male	1.294*** (0.127)	1.330*** (0.145)	1.290 (0.289)
Educational qualification (Ref: None)			
Yes	3.056*** (0.360)	3.022*** (0.405)	3.392*** (0.739)
Religion (Ref: No religion)			
Christian	1.924*** (0.395)	2.093*** (0.484)	1.221 (0.503)
Traditionalist/other	1.419 (0.453)	2.043** (0.742)	0.646 (0.410)
Islam	1.285 (0.342)	1.280 (0.373)	1.102 (0.566)
Region (Ref: Western)			
Central	0.703* (0.148)	0.594* (0.165)	0.964 (0.311)
Greater Accra	1.687** (0.347)	1.454* (0.329)	5.021** (3.285)
Volta	1.012 (0.196)	1.177 (0.309)	0.793 (0.277)
Eastern	0.512*** (0.0939)	0.446*** (0.104)	0.662 (0.222)
Ashanti	0.708* (0.133)	0.747 (0.179)	0.521* (0.183)
Brong Ahafo	0.423*** (0.0887)	0.377*** (0.0916)	0.496* (0.206)
Northern	0.190*** (0.0593)	0.146*** (0.0489)	0.560 (0.273)
Upper East	0.537** (0.135)	0.608* (0.179)	0.576 (0.311)
Upper West	0.651* (0.161)	0.636 (0.218)	0.674 (0.257)
Residence (Ref: Urban)			
Rural	0.319*** (0.0440)		
Age (in years)	0.981*** (0.00354)	0.982*** (0.00414)	0.976*** (0.00635)
Household size	0.955** (0.0215)	0.963 (0.0261)	0.933* (0.0350)
Rent agreement (Ref: Owning)			
Renting	1.495*** (0.159)	1.248* (0.155)	2.272*** (0.445)
Rent free	0.973 (0.107)	0.889 (0.120)	1.078 (0.216)
Perching/squatting	0.574 (0.377)	0.461 (0.329)	1.564 (1.290)
Observations	9083	4580	4503

Source: Authors' computation from GLSS7.
Odds Ratios are used; Standard errors in parentheses.
*$P < .1$. **$P < .05$. ***$P < .01$.

Similarly, in Table 5, using the combined index of financial inclusion (FI index), we find the results not to be qualitatively different from the logistic regression estimates in Table 3 and the binary probit regression estimates in Table 4. Specifically, the combined index of financial inclusion is found to be associated with greater odds (Full sample: OR = 1.89, $P < .01$; Urban sample: OR = 1.75, $P < .01$; Rural sample: OR = 2.12, $P < .01$) of using healthy source of energy for cooking among households in Ghana.

Discussion

The results indicate that financial inclusion is a major determinant of choosing a healthy energy source for cooking. Precisely, financial inclusion increases the likelihood of choosing a

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healthy source of energy for cooking; gas/electricity, and this result is qualitatively the same among rural and urban residents. This outcome is not farfetched because, although healthy sources of energy such as gas and electricity are relatively expensive, financial inclusion makes financial resources easily available to households which enhances their ability to afford such energy sources. It is therefore not surprising that the World Bank[37] recognises financial inclusion as an enabler of a number of the SDGs. Moreover, our findings show that, although rural households are less likely to choose healthy sources of energy for cooking relative to urban households, when rural households become financially included, their likelihood of choosing a healthy source of energy for cooking is greater than that of urban households. The implication is that, since rural households are mostly those who use unhealthy sources of energy, providing them with financial inclusion can greatly move them towards affording healthy energy sources. Our findings therefore confirm the energy ladder hypothesis,[13] in that, financial inclusion is capable of enhancing the welfare of households which would boost their ability to afford healthy energy sources for cooking. The outcome of financial inclusion in general, is in tandem with Twumasi et al[25] who found access to credit to enhance the use of clean energy among rural households in 4 regions of Ghana. Similar finding was reported by Edwards and Langpap[38] in Guatemala. Beyond choosing healthy energy sources, financial inclusion has been found to be associated with an enhancement in healthy solid waste disposal,[39] and a reduction in open defecation in Ghana[40] as well as an enhancement in access to basic drinking water in Africa.[34] The implication is that, financial inclusion enhances access to health inputs (such as healthy energy, and basic drinking water and sanitation), hence, it is not surprising that financial inclusion has been found to be associated with an improvement in population health in 33 African countries.[35]

The more likelihood of rural households to choose unhealthy energy sources for cooking (relative to urban households) is not surprising as rural residents generally have low income and hence may not be in the position to afford healthy energy sources. Also, healthy energy sources such as electricity and gas are more likely to be readily available in urban settings as compared with rural settings. Hence, since wood and other less healthy sources of energy for cooking are easily available in rural areas, these households may resort to them. Indeed Karakara and Osabuohien[19] found rural households in Ghana to be less likely to have access to modern energy relative to their urban counterparts. Further, rural folks are less likely to be educated on the health implications of burning solid fuels for cooking relative to urban dwellers who may have access to several sources of information. Our result is in line with Karimu[21] who found residence type to be a significant determinant of the choice of energy among households in Ghana.

The finding on male-headed households being more likely to choose a healthy source of energy for cooking could be linked to the higher likelihood of males to be gainfully employed, hence, more capable of affording healthy energy sources for cooking, relative to females. Moreover, since females are traditionally in charge of food preparation in most households in Ghana, using traditional sources of energy for cooking (such as charcoal) among female-headed households would be seen as normal and hence, they may not view them as less healthy. The finding on sex of household head is in line with the study by Buba et al[15] in Nigeria but contrary to Pangaribowo and Iskandar[14] who found male-headed households in Eastern Indonesia to be more likely to use firewood for cooking. Also, the finding on households headed by formally educated individuals being more likely to use healthy energy sources for cooking is not surprising since those with formal education are more likely to be aware of the negative effects of using unhealthy fuels. Further, people with formal education are more likely to be gainfully employed,[41] which would bolster their ability to afford healthy sources of energy for cooking. The outcome regarding the role of education is consistent with Abebaw,[42] Karakara and Osabuohien[19] and Maina et al.[16] Moreover, in Ghana, education has been found to have positive association with the utilisation of other health inputs.[43-47]Religion is also found to play a role. The more likelihood of Christians to choose a healthy energy source for cooking could be linked to their probability of getting education on using healthy sources of energy for cooking in churches (which are normally visited by policy makers and other stakeholders in disseminating information).

The finding on households in the Greater Accra Region being more likely to opt for healthy sources of energy for cooking (relative to those in the Western Region) could be due to the region's highly urbanised nature. Moreover, according to the Ghana Statistical Service,[48] the Greater Accra Region has lower poverty incidence relative to the Western Region, hence, it is not surprising that households in the region (Greater Accra Region) are more likely to opt for healthy sources of energy for cooking. Similarly, the outcome of the more likelihood of residents in the Western Region to use a healthy source of energy for cooking relative to households in the Upper East Region could be due to the higher poverty incidence in the Upper East Region.[48]

The outcome of total expenditure (per adult) being associated with healthy source of energy for cooking is not surprising. This is because, higher spending means higher ability to afford healthy sources of energy for cooking such as gas and electricity. This outcome is similar to those of Amoah[18] and Karimu in the case of income.[21]

Rising age of the household head being associated with the less likelihood of using a healthy source of energy for cooking can be linked to the attachment of old people to traditional sources of energy for cooking such as wood and charcoal. Moreover, some might say their grandparents used these sources of energy for cooking and they lived long, hence, there

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is no need to abandon such sources of energy for cooking. The result of age is in tandem with Karimu[21] but conflicts those of Pangaribowo and Iskandar.[14] Moreover, the implication of the household size result could be attributed to the fact that an increase in household size increases the financial burden on households. This therefore, may prevent households with higher members from adopting cleaner and efficient energy sources, which are relatively expensive. Studies by Twumasi et al,[25] Kwakwa et al[23] and Kuunibe et al[22] found household or family size to be a significant determinant of the choice of energy. Similarly, rising household size has been found to be associated with rising expenditure on unhealthy (dirty) fuels among households in Nigeria.[16]

Last but not the least, the more likelihood of using a healthy source of energy for cooking by households who rent could be due to stringent rules by owners of dwellings on air pollution that results from burning of unhealthy fuels as it creates inconveniences for other tenants.

Conclusion and Policy Implication

Using unclean/unhealthy sources of energy for cooking among households produces several pollutants that are detrimental to human health. Efforts are therefore being made in Ghana to ensure that households' resort to healthier/cleaner sources of energy such as gas and electricity. To this end, some empirical studies on the determinants of choice of source of energy for cooking have been conducted. Nonetheless, while financial inclusion could play a role in enhancing the choice of healthy sources of energy, less attention has been paid to it. This study, therefore, offers the foremost empirical analysis of the effect of financial inclusion on the choice of healthy source of energy for cooking among both rural and urban households in all the regions of Ghana. We find that financial inclusion is associated with the use of healthy sources of energy for cooking (gas and electricity) relative to unhealthy ones such as charcoal, wood, animal waste among others. The effect of financial inclusion on using healthy sources of energy for cooking is even greater among rural households.

This study therefore recommends that policy makers pay attention to enhancing financial inclusion in the quest to increase the use of healthy sources of energy for cooking among households in Ghana. In particular, since rural dwellers are mostly those who use unhealthy energy sources for cooking, a deliberate attempt should be channelled towards providing them access to useful financial products and services. Doing so would enhance their ability to afford healthy sources of energy for cooking, which can lead to enhanced health outcomes in the long-run.

Notwithstanding the above, whiles this study uses a general form of financial inclusion, disaggregating financial inclusion into formal and informal can help in finding out which form of financial inclusion is most useful in using/acquiring healthy sources of energy for cooking. We therefore suggest that future research looks into this direction.

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Authors' Contributions

All the authors; MI, KGK, EKA, AM, YMZ, TJMKK, MKB and BOH were involved in the conception, design, data acquisition, analysis and interpretation as well as drafting of the manuscript. All the authors read and approved the final version of the manuscript.

Availability of Data and Materials

The data used for the study is available for free from the website of the Ghana Statistical Service (https://www2.statsghana.gov.gh/nada/index.php/catalog/97/get_microdata) after creating an account.

Consent for Publication

Not applicable.

Ethical Approval and Consent to Participate

The study uses secondary data collected by the Ghana Statistical Service using questionnaires. The Ghana Statistical Service did not require any ethical approval to collect the data used by this study because it is mandated by law (the Statistical Service Act, 2019 (Act 1003), which replaced the Statistical Service Law, 1985) to serve as the major statistics generating and co-ordinating entity for the Ghana National Statistical System. However, all respondents consented before partaking in the survey.

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