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The Effects of Traditional Energy Consumption and Poverty on the Health Status of Rural Dwellers in Nigeria

Temitope Sade Akintunde[1], Bosede Akanbi[2], Mathew Adagunodo,[3]
Olawale Olufemi Akinrinde[4]

Abstract: This study examines the effects of traditional energy consumption and poverty on the health status of rural dwellers in Nigeria. In an attempt to critically examine the effect of the consumption of traditional energy and poverty on the health status of rural dwellers in Nigeria, this study employs a primary survey and collects data from 1044 respondents in three (3) senatorial districts in Osun State, Nigeria. Initial findings reveal that the socio-economic conditions of households in rural areas in Osun state are significant in explaining traditional energy consumption. Additional findings further reveals that income as a proxy for poverty and energy consumption for cooking and lighting is significant in explaining the health status of rural dwellers in Nigeria. This study recommends that government should endeavour to make clean and modern energy technologies available to rural households in Osun and Nigeria in general as a practical step to addressing the poverty level and health challenges of rural dwellers. This invariably implies that government should also prioritize alleviating the people from their poor economic conditions with a view to enabling them afford clean and modern energy technologies for their energy needs.

Keywords: Energy Consumption; Poverty; Health Status; Nigeria

JEL Classification: D12; D62; H119; K32

1. Introduction

Energy is very essential to human survival and existence. In order to cook, energy has to be provided for, and over the years, people have cultivated different ways of sourcing energy. Energy has evolved over time from the use of conventional energy to modern energy, which could be used for several purposes other than cooking. Energy is also used for lighting. However, modern energy is being used

[1] Associate Professor, PhD, Department of Economics, Osun State University, Nigeria, E-mail: temitope.akintunde@uniosun.edu.ng. https://orcid.org/0000-0002-4713-7560.
[2] Associate Professor, PhD, Department of Economics, Osun State University, Nigeria, E-mail: bosede.akanbi@uniosun.edu.ng.
[3] Lecturer I, PhD, Department of Economics, Osun State University, Nigeria, E-mail: mathew.adagunodo@uniosun.edu.ng.
[4] Postdoctoral Research Fellow, University of Johannesburg, Johannesburg, South Africa, Corresponding author: oakinrinde@uj.ac.za. https://orcid.org/0000-0001-7350-2376

largely in developed countries, while traditional energy is still in use in most developing countries where the level of poverty is high (Ogwumike & Ozughalu, 2012). Traditional energy is also known as biomass energy or fossil fuels, which comprise fuel wood, crop residues, dung coal, oil, and gas. The most commonly used type of biomass is fuel wood, especially in emerging nations, and it is the primary source of energy for domestic use (Bello, 2012). Poverty involves several dimensions of deprivation. Several definitions have been made concerning poverty. For instance, Krugman and Robin (2009) defined poverty as "the lack of basic human needs such as clean water, nutrition, health care, education, clothing, and shelter". Also, poverty is seen as a lack of the necessities of life, voicelessness, powerlessness, and access to productive assets (Magaji, 2005). UNDP (2000) stated that the poor spend more time and money on energy services compared to those who are well situated, and this has a detrimental effect on their health. Widespread poverty, hunger, and high disease-related mortality are problems in many emerging nations. The effects of fast population growth, severe environmental issues like land degradation and resource depletion, and unchecked local chemical pollution, notably through burning, exacerbate this low health state (McMichael, Woodward & Leeuwen, 1994). The problem of poverty and income inequality in Nigeria is high, and this has an effect on people's health because these problems have led to premature deaths due to inability to pay for hospital bills. Also, most of the diseases associated with the burning of fossil fuels are non-communicable. Consequently, it has been stated that the incidence of non-transmissible diseases is enormous and has accounted for a large proportion of morbidity and mortality in low and middle-income countries (Akintunde, Adeomi & Akintunde, 2018). Similarly, Bridge (2017) stated that "the primary health consequence that individuals face as a result of energy poverty is respiratory complications due to indoor air pollution. Air pollution that results from burning biofuels indoors is one of the greatest health concerns facing developing countries". According to WHO (2006), indoor air pollution has a link to tuberculosis, lung cancer, and respiratory infections, which affect 1.5 million people annually. Nigeria has its own challenges with its high incidence of poverty (Akinrinde, Omitola & Tar, 2021; Akinrinde & Tar, 2021). Approximately 61% of Nigerians, or approximately 112 million people, live in poverty, according to the National Bureau of Statistics (2010). Also, Nigeria's poverty level index reached 72% in 2016, according to Fitch assessments. Osun State in Nigeria's south-western region is one of the poorest states in the country, with low federal allocations and low internally generated revenue. The recent dwindling of total revenue as a result of the reduction in prices of crude oil also affected the state negatively. This is because the state government could not meet the basic requirements of its populace, such as free education and health care, to mention a few. Todaro and Smith (2009) stated that one of the features of those in the poverty group is that they are mostly found in rural areas and are predominantly subsistence farmers. This captures why this study focuses on the rural dwellers in Nigeria.

The Union of Concerned Scientists (2017) stressed that the use of coal could lead to serious cardiovascular and respiratory risks, especially through coal dust. Fossil fuel combustion releases some airborne pollutants that are detrimental to the environment and to people's health. For instance, sulfur dioxide (SO2) emissions, which mostly stem from burning coal, may make respiratory conditions including asthma, stuffy noses, and pulmonary inflammation worse. In addition, nitrogen oxides (NOX), a consequence of all fossil fuel combustion, can contribute to acid rain and ground-level ozone, which can damage lung tissue and raise a person's chance of developing chronic respiratory disorders including asthma, bronchitis, and heart attacks that can be fatal. (EPA, 2016). Also, Akintunde and Adagunodo (2018) asserted the fact that uncontrolled human activities, especially at the energy generation stage, lead to carbon dioxide emissions, and these emissions have had devastating impacts on both the environment and human beings.

At this juncture, it is pertinent to raise the following questions for the study: What type of traditional energy is common among people living in Osun State? What are these forms of energy used for? Is there any influence of biomass energy and poverty on the health status of the people? Is the influence positive or negative? To offer solutions to the posed questions, this research seeks to identify the most common source of energy. and what the energy is mostly used for in both the rural and urban centers of Osun State. Also, this research seeks to investigate the effects of biomass energy and poverty on the health status of people living in Osun State.

2. Literature Review

In the realm of understanding energy consumption patterns in emerging nations like Nigeria, the concept of fuel substitution, often dubbed the energy ladder theory, serves as a cornerstone. This theory posits that as household socioeconomic status improves, there is a corresponding abandonment of lower-level energy sources in favor of more modern alternatives (Leach, 1992; Hosier & Kipondya, 1993; Chaudhuri & Pfaff, 2003; Davis, 1998). Complementing this theory is the environmental Kuznets curve (EKC) or the Inverted-U hypothesis, suggesting that household energy consumption correlates positively with per capita income up to a certain threshold, beyond which it declines (Foster, Tre & Wodon, 2000). Another significant hypothesis, the poverty-environment hypothesis, underscores the imperative of addressing poverty to facilitate the transition to greener energy sources and mitigate health risks associated with reliance on biomass fuels.

Various researchers have delved into the dynamics of household energy consumption, highlighting factors such as disposable income, household size, fuel accessibility, and climatic conditions (Wood & Baldwin, 1985; Christopher & Adrian, 2000; Jamal, 2005; Abban, Hongxing, Nuta, Dankyi, Ofori & Cobbinah, 2022). Bridge’s study in Nicaragua shed light on the individual and household-level impacts of energy poverty on human development, particularly health outcomes, while Omar and Hasamujzaman’s research in Bangladesh further underscored the detrimental effects of energy poverty on health and education (Bridge, 2017; Omar & Hasamujzaman, 2021). Tekin in Turkey and Oliveras in Barcelona similarly unearthed negative correlations between energy poverty and health outcomes, amplifying the urgency of addressing this multifaceted issue (Tekin, 2019; Oliveras et. al, 2020). Similarly, Nuţă et. al. (2021), in their study, explored the complex interplay among urbanization, economic growth, renewable energy consumption, and environmental degradation, providing a comparative analysis of European and Asian emerging economies. Through robust empirical analysis and statistical modeling, their research uncovered nuanced insights into the relationship dynamics shaping environmental outcomes in these regions. By examining the impact of urbanization, economic development, and renewable energy adoption on environmental degradation, their study offered valuable implications for sustainable policy formulation and intervention strategies. The findings of their study underscored the importance of integrated approaches to addressing environmental challenges while fostering economic growth and renewable energy transition in rapidly evolving economies.

In their study published in 2024, Dilanchiev et al. delve into a fascinating exploration of the connections between remittance, foreign direct investment (FDI), renewable energy, and environmental quality across major remittance-receiving countries (Dilanchiev et. al, 2024). Using panel data analysis, their study uncovers the intricate interplay among these factors and their impact on environmental sustainability. Their findings provide meaningful insights into how economic activities, energy choices, and environmental conditions intersect, shedding light on pathways for sustainable development in economies reliant on remittance inflows. This study further underscores the importance of considering multiple factors in shaping environmental outcomes and offers valuable guidance for policymakers and stakeholders striving for a greener future.

In the Nigerian context, Adagunodo's analysis utilizing the Almost Ideal Demand Systems (AIDS) model revealed the intricate socio-economic determinants influencing petroleum product demand, with petroleum prices exerting a significant impact on consumer behavior (Adagunodo, 2018). Additionally, Ogunleye and Adagunodo's study in Osun State delved into the repercussions of petroleum price hikes on household energy use patterns and environmental sustainability, elucidating the shift in energy sources following subsidy terminations (Ogunleye & Adagunodo, 2018).

Amidst the existing literature, a notable gap exists in the examination of the health implications of traditional energy usage, particularly at the micro-level in developing nations. Thus, this study endeavors to bridge this void by scrutinizing the nexus between fossil fuel usage, poverty, and human health, leveraging primary data to unravel critical insights and pave the way for informed policy interventions.

3. Methodology

This study was based on the poverty-environment hypothesis. According to the poverty-environment hypothesis, households are compelled by poverty to rely on resources from environmental common property in order to survive. This hypothesis implied that in order to reduce environmental degradation, there is a need to reduce poverty (Baland et. al, 2003). For the purpose of gathering the required data, structured questionnaires were used. Households from three senatorial districts in Osun State: Osun West, Osun East, and Osun Central, were used for this study. From each senatorial district, two local governments were chosen. Odo-Otin and Osogbo from Osun Central, Oriade and Ife North from Osun East, and Ejigbo and Irewole from Osun West are the local governments that were chosen. These local governments were selected because they capture rural and urban poverty and their impact on energy consumption patterns, which has implications for their health status. It uses multi-stage sampling techniques to capture the diverse nature of the population. 200 questionnaires were administered in each of the six local governments; however, only 1044 questionnaires were duly filled out and returned. The developed questionnaire contained background, conceptualization, format, and data analysis, establishing validity and reliability. Formulae 1 and 2, as recommended by Bartlett et. al. (2001), were used to compute the sample size of the study:

$$n = \left(\frac{n_o}{1+n_0/N}\right) \quad (1)$$

According to Bartlett et. al. (2001), the computation of sample size for categorical data was carried out in the same manner as for continuous data, with the exception of the computation of n o, which is as follows:

$$n_0 = \left(\frac{t^2 \times pq}{d^2}\right) \quad (2)$$

Where p is the percentage of respondents who will provide information that is of interest to you (the percentage confirming), q viz (1-p) is the percentage of respondents who won't provide information that is of interest to you (the percentage defective), and p*q is the estimate of variance (which is maximum when p and q are both equal to 0.50).

A stratified random selection strategy (using a random number table) was used to select the respondents for the survey after selecting the sample size from each target population. When a household was chosen to participate in the survey, either the husband or wife (in the case of a married pair) was in charge of responding to the questionnaire. If both the husband and wife were present when the interview was conducted, it was decided who should be the respondent using a random sample procedure. The questionnaire was given to either single household heads or one member of a couple who was present during the visit.

4. Data Collection and Analysis

The general logistic regression model equation is given by:

$$\text{Logit (Y)} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n \quad (3)$$

Where: logit = ln $\left(\frac{p}{1-p}\right)$ and p is the probability of the study event; α is the Y intercept, β_i are regression coefficients, and X_i are a set of predictors. Empirically, equation (4) becomes;

$$\text{Logit(Y)} = \ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n + \epsilon_i \quad (4)$$

Where π is the probability of event, α is the intercept, β_i are regression coefficients and X_i are set of predictors (i.e. socioeconomic and demographic factors).

This study employed chi-square to analyze the socioeconomic and demographic characteristics in order to determine the effect of biomass consumption on health status in Osun State. Also, Ordinary Least Square and Binary logistic regression approach were used. The model is stated below:

$$w_{i=} \rho + \mu_i \alpha_{1i} + \mu_{2i} \alpha_{2i} + \epsilon_i \quad (5)$$

$w_{=}$ Heath status (Asthma, Chronic Obstructive Pulmonary, Allergic Rhinitis, visits to the hospital) ρ is the intercept, $\mu_i$are regression coefficients, $\alpha_i$are set of biomass consumption.

5. Results and Discussion

In order to determine the effects of traditional energy and poverty on health status in Osun State, the demographic and social features using chi-square were presented in Table 1. It can be gathered from Table 1 that the use of traditional energy (57.6%) was higher than the use of modern energy (42.4%) among the respondents. Females made more use of traditional energy (60.6%) than males (39.4%). African women engaged more in domestic chores at home than men; this is because of the culture, and in most cases, women were involved in cooking with fossil fuels. Furthermore, it was observed that older people were seen to be using traditional energy. For instance, from age 41 and above, the percentage of people using traditional energy was 63.96% and 82.53%, respectively. This implied that most of the old people still preferred to use traditional energy, and they may not be aware of modern energy, which the young people are likely to be aware of because of the use of social media among this young cohort.

Table 1. Demographic and Social Parameters among Study Participants

Variables	Traditional energy	Non-traditional energy	P value
N	601(57.6%)	443(42.4%)	
Females	327(60.6%)	213(39.4%)	0.043
Age range			
>60 yrs	98(82.35%)	21(17.65%)	0.000
41-60	252(63.96%)	142(36.04%)	
25-40	196(47.46%)	217(52.54%)	
18-24	55(46.61%)	63(53.39%)	
Level of education			
Nil	235(83.63%)	46(16.37%)	0.000
School cert	217(76.14%)	68(23.86%)	
Tech Sch/Grade II	75(64.66%)	41(35.34%)	
NCE	15(25.42%)	44(74.58%)	
OND	40(33.61%)	79(66.39%)	
First degree	16(11.11%)	128(88.89%)	
Postgraduate	3(7.5%)	37(92.5%	
Type of Marriage			
Polygamous	340(76.23%)	106(23.77%)	0.000
Monogamous	214(46.52%)	246(53.48%)	
How large are your dependents?			
1-2	85(50.90%)	82(49.10%)	0.000
3-5	239(51.07%)	229(48.93%)	
6-10	215(75.70%)	69(24.30%)	
>10	39(67.24%)	19(32.76%)	
Occupation			
Unemployed	202(88.99%)	25(11.01%)	0.000
Self employed	531(72.15%)	205(27.85%)	
Paid employee	50(19.01%)	213(80.99%)	
Type of occupation			
Petty trader	187(70.30%)	79(29.70%)	0.000
Public servant	24(32.06%)	107(67.94%)	
Private worker	36(43.37%)	47(56.63%)	
Farmer	306(86.69%)	47(13.31%)	
Employer of labour	11(35.48%)	20(64.52%)	
Others	25(40.32%)	37(59.68%)	
Rural-urban status			
Rural	385(64.06%)	216(35.94%)	0.016
Urban	254(57.34%)	189(42.66%)	

Source: Authors' Computation, 2024

Disparity can also be seen among the educated and uneducated people among the respondents in the type of energy used. It was observed that most educated people used modern energy, while the less educated or uneducated used traditional energy. This implied that education is very important when it comes to the use of energy. This is similar to the findings by Adagunodo (2018), wherein he argued that the education level of households was an important variable in explaining energy consumption. It also conformed to the study of Omar and Hasamujzaman (2021). It was revealed from Table 1 that families with large dependents use more traditional energy. Most of the unemployed and self-employed respondents used traditional energy. Most of these people are in the poor or low-income group. Studies have also confirmed the association between income and traditional energy. This agrees with the result of Barnes and Samad (2012), which showed that most of the poor people were also energy poor in India. Lastly, it was also observed that most people living in rural areas use more traditional energy than those living in urban areas. This could be a result of the accessibility of traditional energy in rural areas. This confirms the finding of Ashagidigbi et. al. (2020), which revealed that energy poverty is more prevalent in rural areas than urban areas.

5.1. The Linear Regression

The model summary in Table 2 shows the coefficient of determination (R-value) which explains the correlation between the dependent and the explanatory variables. The value is 0.889 which is greater than the 0.4. This implies that the model is good and be used for further analysis. Coefficient of determination adjusted R^2 is 0.790. The R-square implies that 89% variation in the dependent variable is explained by the explanatory variable. This shows that the model can adequately account for the relationship between the variables. The Durbin-Watson is 1.853 and it indicates that zero evidence of serial correlation as the value was tending to 2. Therefore, the model is accepted.

Table 2. Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.889[a]	.790	.789	.99069	1.853

a. Predictors: (Constant), Cooking. Traditional Energy, Lightening. Traditional Energy, Average Monthly Income, Age, Household Size, Level of education

b. Dependent Variable: Asthma_ill.

Table 3. ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	24.081	8	3.010	19.720	.000[b]
Residual	134.936	884	.153		
Total	159.017	892			

a. Dependent Variable: Asthma_ill.

b. Predictors: (Constant), Cooking. Traditional Energy, Lightening. Traditional Energy, Average Monthly Income, Age range, Household Size Level of education.

Table 4. Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	2.330	0.099		23.545	0.000*		
Cooking. Traditional Energy	0.068	0.030	0.072	2.227	0.026*	.935	1.069
Lightening. Traditional Energy	0.069	0.019	0.122	3.591	0.000*	.899	1.112
Average Monthly Income	-0.015	0.007	-0.076	-1.967	0.050*	.694	1.441
Age	0.047	0.017	0.098	2.833	0.005*	.868	1.151
Household Size	0.008	0.036	0.008	0.214	0.831	.780	1.282
Level of Education	-0.076	0.021	-0.122	-3.650	0.000*	.868	1.151
a. Dependent Variable: Asthma_ill.							

*Source: Authors' Computation, 2024 * Significant with p-value < 0.05*

Table 3 shows that F = 19.72 and significant level of P = 0.000 indicates that the overall model is significant at 5%. Thus, traditional energy used for cooking, traditional energy used for lightning, people who cook with firewood and average monthly income, age, household size and education are good predictors of health status which has been complemented by the illness of asthma.

Table 4 showed the unstandardized beta value for the traditional energy for cooking to be0.068, the beta value for traditional energy for lightening is 0.069, beta value for average monthly income is -0.015, beta value for age is 0.047, beta value for house hold size is 0.008 while beta value for education is -0.076. However, t-value and the corresponding p-value (Sig.) which are less than preset level of significant (0.05) indicates that individual contribution of the explanatory variables are statistically significant except for household size. The result in Table 4 indicates that cooking with traditional energy, lightening with traditional energy, age and household size had positive signs and they are significant at 5% with the exception of household size that is not significant. The average monthly income and level of education had negative significant effect on the asthma illness. This is similar to the findings of Omar and Hasamujzaman (2021).

Table 5 presents the binary logistic regression result to ascertain robustness of the model. This Omnibus test of model coefficient in table 5 indicated that the overall model is statistically significant with chi-square = 51.720 and p = 0.000. In the summary of the model presented in Table 6, Cox & Snel R-square Nagelkerke R-square suggests that the model account for 65.6% and 79.9% of variability in health status respectively by the explanatory variables. Therefore, the explained variation in health status based on our model ranges from 65.6% to 79.9%. The result from the Hosmer and Lemeshow test in Table 7 revealed that the model is fit. This is evidenced by the chi- square of p- value of 0 .600 which is not significant.

Table 5. Omnibus Tests of Model Coefficients

		Chi-square	Df	Sig.
Step 1	Step	51.720	7	.000
	Block	51.720	7	.000
	Model	51.720	7	.000

Source: Authors' Computation, 2024

Table 6. Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	703.412[a]	.656	.799

Source: Authors' Computation, 2024[a] Estimation terminated at iteration number 5 because parameter estimates changed by less than .001

Table 7. Hosmer and Lemeshow Test

Step	Chi-square	Df	Sig.
1	9.288	8	.600

Source: Authors' Computation, 2024

Table 8. Regression Results for Variables in the Equation: Dependent Variable – Asthma illness

Variables	**B**	**S.E**	**Wald**	**Sig.**	**95% CI for EXP (B)**	
					Lower	**Upper**
Cooking with Traditional Energy	0.68	0.14	23.35	0.000*	0.39	0.67
Lightening with Traditional Energy	0.55	0.14	14.83	0.000*	0.44	0.76
Average Monthly Income	-0.92	0.03	0.13	-0.001*	1.39	0.09
Age	-0.17	0.11	2.14	0.14	0.68	1.06
Household Size	0.13	0.23	0.30	0.58	0.72	1.80
Level of Education	0.12	0.13	0.82	0.37	0.87	1.46

*Source: Authors' Computation, 2024 * Statistically significant at 5%*

From Table 8, the dependent variable is the asthma illness. Cooking with traditional energy and lighting with traditional energy had a positive and significant effect on asthma illness, which implies that traditional energy consumption reduces households' health status. This finding agrees with the previous results of Bridge (2017), Omar and Hasamujzaman (2021), Tekin (2019), and Oliveras et. al. (2020). The average monthly income had a negative and significant effect on the asthma illness. The above result confirms the findings of Akpan and Riman (2010), which revealed that income is a productive tool in addressing health problems. This is because low-income earners most of the time make use of traditional energy sources that are harmful to their health. Age also had a negative but not significant effect on the asthma illness. Lastly, both household size and the level of education had a positive but not significant effect on the asthma illness.

6. Conclusion

The issue of energy consumption is of global concern due to its socio-economic importance. Traditional energy consumption and poverty are subjects that are worthy of examination due to their impact on health status, in particular cardio-respiratory illness. Given this circumstance, this study assessed the determinants of traditional energy consumption, investigated the effect of traditional energy consumption on asthma illness, and examined the effect of income on asthma illness. These were with a view to examining the implications of traditional energy and poverty on health status. We employed logistic and simple linear regression to examine the impact of traditional energy consumption and poverty on health status in Osun State, Nigeria. We employed a primary survey and collected data from 1044 respondents in three senatorial districts in Osun State (East, West and Central). We found that people in the study area, mostly women, who were uneducated and aged, made more use of traditional energy than modern energy. Our results also showed that usage of traditional energy for cooking and lighting, age, and household size had a positive influence on health status within the study period. However, household size's influence on health status was not significant. In addition, average monthly income and level of education had a negative and significant effect on health status (asthma illness). The implication of our results is that using traditional energy for cooking and lighting, low income, and household size all have tendencies to lower health status in Osun State. As a result, we recommend policies that could mitigate poverty and enhance the use of modern energy among households. Therefore, the government should make cleaner energy sources such as solar lamps and gas available to the populace at a highly subsidized rate.

7. Policy Recommendations

Subsidized Access to Cleaner Energy Sources

Government should prioritize the implementation policies aimed at providing cleaner energy sources, such as solar lamps and gas, at highly subsidized rates to households. This initiative would incentivize the transition from traditional energy sources to cleaner alternatives, thereby reducing respiratory health risks associated with indoor air pollution.

Promotion of Modern Energy Technologies

Efforts should also be made to raise awareness and promote the adoption of modern energy technologies among households, especially those in rural and low-income areas. This can be achieved through educational campaigns highlighting the benefits of cleaner energy sources for both health and environmental sustainability.

Income Support Programs

To address the negative impact of low income on health status, the government should also prioritize the implementation of income support programs targeted at vulnerable populations in Osun state, and Nigeria, in general. These programs could include cash transfers, vocational training, and job creation initiatives aimed at lifting households out of poverty and improving their access to essential services, including modern energy sources.

Educational Initiatives

Investing in education, particularly for women and marginalized communities, can empower individuals to make informed decisions regarding energy use and health behaviors. Educational initiatives that create awareness about the health risks associated with traditional energy consumption and promote the adoption of cleaner alternatives for improved respiratory health outcomes should be prioritized.

By giving adequate consideration to these policy recommendations, government and other relevant stakeholders can mitigate poverty, promote sustainable development, and improve health outcomes by addressing the socio-economic determinants of energy consumption and health status in Nigeria.

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