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Regional Disparities and Socio-demographic Determinants of Clean Cooking Energy Use Among Women in Nigeria

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Abstract

This study examines regional disparities and socio-demographic factors influencing clean cooking energy use among women in Nigeria. Utilizing data from the 2018 Nigeria Demographic and Health Survey, we analyzed a sample of 41,256 women aged 15-49. Our analysis reveals marked regional disparities, with the southwest showing the highest clean cooking energy use at 42.88% and the northeast the lowest at 1.32%. Bivariate analysis indicates that women in the South-South (COR: 2.31, 95% CI: 2.06-2.58, $p < 0.001$) and South-West (COR: 7.21, 95% CI: 6.53-7.97, $p < 0.001$) are significantly more likely to use clean energy compared to those in the North-Central. Multivariable logistic regression identifies wealth (AOR: 234.37, 95% CI: 96.89-566.92, $p < 0.001$), education (AOR: 5.30, 95% CI: 4.25-6.62, $p < 0.001$), and urban residence (AOR: 0.59, 95% CI: 0.53-0.65, $p < 0.001$) as significant determinants of clean cooking energy use. These findings highlight the need for targeted policies to address regional and socio-demographic disparities and promote equitable access to clean cooking energy across Nigeria

Keywords: Clean energy, Cooking fuel, Disparities, NDHS and Women

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INTRODUCTION

Clean cooking energy is essential for improving health, environmental sustainability, and economic development. In many low- and middle-income countries, including Nigeria, the reliance on traditional biomass fuels poses significant health risks and environmental degradation. Household air pollution from unclean cooking fuels is a leading cause of respiratory diseases, particularly among women and children who spend substantial time near cooking areas (World Health Organization [WHO], 2018). Transitioning to clean cooking energy sources, such as electricity, liquefied petroleum gas (LPG), and natural gas, is crucial for mitigating these adverse effects (Bailis et al., 2015).

Nigeria, the most populous country in Africa, exhibits substantial regional and sociodemographic disparities in access to clean cooking energy. The country's six geopolitical regions; North-Central, North-East, North-West, South-East, South-South, and South-West differ markedly in economic development, urbanization, and infrastructure, influencing energy use patterns (National Bureau of Statistics [NBS], 2020). Understanding these regional variations is vital for designing effective interventions to promote clean cooking energy adoption.

Women are disproportionately affected by the use of traditional cooking fuels due to their roles in food preparation and household management. Prolonged exposure to smoke from biomass fuels increases the risk of chronic respiratory diseases, eye problems, and pregnancy complications, including low birth weight and stillbirths (Gordon et al., 2014). Additionally, the time and labour involved in collecting firewood and other traditional fuels limit women's opportunities for education and economic activities, perpetuating cycles of poverty and gender inequality (Clancy et al., 2002). Addressing the energy needs of women by promoting clean cooking fuels can lead to significant improvements in their health, economic status, and overall well-being (Pachauri & Rao, 2013).

Previous studies have identified several factors influencing cooking energy choice, including income, education, urbanization, and cultural practices (Puzzolo et al., 2016; Rehman et al., 2011). Wealthier and more educated households are generally more likely to adopt clean cooking fuels due to better access to financial resources and awareness of health benefits (Malla & Timilsina, 2014). Urban households also tend to use cleaner fuels compared to rural households, reflecting differences in infrastructure and fuel availability (Lam et al., 2012).

Despite these insights, there is limited comprehensive analysis of how these factors interact across Nigeria's diverse regions. This study aims to fill this gap by examining the regional disparities and sociodemographic determinants of clean cooking energy use among Nigerian women. By leveraging data from the 2018 Nigeria Demographic and Health Survey (NDHS), this research provides a nuanced understanding of the factors driving clean cooking energy adoption.

The study's objectives are to (1) describe the sociodemographic characteristics of women in Nigeria, (2) assess regional disparities in clean cooking energy use, (3) examine the bivariate relationship between region and cooking energy type, and (4) identify the sociodemographic factors associated with clean cooking energy use through multivariable analysis. This comprehensive approach allows for targeted policy recommendations to enhance clean cooking energy access, thereby improving health outcomes and environmental sustainability in Nigeria.

METHODS

Study Setting

The study was conducted in Nigeria, encompassing the 6 geo-political regions of the country which comprised North-Central, North-East, North-West, South-East, South-South and South-West.

Data Source and Study Sample

This study utilised secondary data from the 2018 Nigeria Demographic and Health Survey (NDHS), a nationally representative household survey that employs a stratified multi-stage cluster sampling method. Access to the NDHS dataset was secured through an online application and approval process, which included a detailed description of the study's objectives. The analysis concentrated on the Individual Record (IR) file, which contains demographic, socioeconomic, and health information for women aged 15-49. Only those women who reported their type of cooking fuel were included in the analysis. After performing data cleaning and consistency checks, the final sample consisted of 41,256 women who met the inclusion criteria.

Study Variables

Dependent Variable: A binary dependent variable indicating cooking energy type was created (0 = unclean, 1 = clean). This variable was derived from the original 11-category fuel types variable in the NDHS dataset. Cooking energy sources such as electricity, LPG, natural gas, and biogas were classified as clean due to lower emissions, while kerosene, coal, charcoal, wood, biomass fuels, and animal dung were categorized as unclean based on higher emission profiles (Puzzolo et al., 2016; Rehman et al., 2011). This categorization enabled the analysis of factors influencing the choice between clean and unclean cooking energy among Nigerian women.

Independent Variables: The study primarily focused on sociodemographic characteristics as independent variables. These included age, education level, wealth index, residence, head of household's sex, employment status, and region.

Data Analysis

Descriptive statistics and cross-tabulations were employed to characterize the study population and examine disparities in clean cooking energy use across Nigeria's six geopolitical regions. Bar charts visualized these regional disparities. The sociodemographic characteristics of the women were summarized using frequencies and proportions.
Bivariate logistic regression assessed the association between region and cooking energy use. Multivariable logistic regression identified sociodemographic factors influencing cooking energy choice among women. Odds ratios, confidence intervals, and p-values determined the magnitude and statistical significance of these factors and regional differences.
Data analysis was conducted using STATA version 15, incorporating sampling weights to account for the complex survey design.

RESULTS

Socio-demographic Description

Table 1 outlines the sociodemographic characteristics of the 41,256 women included in the study. The age distribution shows that 20.24% of the women are in the 15-19 age group, followed by 17.32% in the 25-29 age group. Most women (39.51%) have secondary education, while 35.1% have no education. The majority reside in urban areas (54.27%), with the remaining 45.73% in rural areas. Regarding the wealth index, 22.33% of the women are in the

richest quintile, whereas 17.35% are in the poorest. A significant portion of the households (83.52%) are headed by males. In terms of employment status, 65% of the women are currently working. Regionally, the North-West has the highest representation with 29.43% of the sample, followed by the South-West with 17.36%.

Table 1: Sociodemographic Characteristics of Women N = 41,256

Variable	Weighted Frequency	%
Age Group		
15-19	8,349	20.24
20-24	6,709	16.26
25-29	7,144	17.32
30-34	6,090	14.76
35-39	5,393	13.07
40-44	3,898	9.45
45-49	3,674	8.9
Education		
No Formal Education	14,480	35.1
Primary	5,978	14.49
Secondary	16,300	39.51
Tertiary	4,498	10.9
Residence		
Rural	18,868	45.73
Urban	22,388	54.27
Wealth Index		
Poorest	7,159	17.35
Poorer	7,950	19.27
Middle	8,097	19.63
Richer	8,840	21.43
Richest	9,211	22.33
Sex of Household Head		
Male	34,457	83.52
Female	6,799	16.48
Currently Working		
Yes	14,439	35.00
No	26,817	65.00
Region		
North-Central	5,824	14.12
North-East	6,555	15.89
North-West	12,140	29.43
South-East	4,800	11.64
South-South	4,772	11.57
South-West	7,164	17.36

Source: Nigeria Demographic and Health Survey (NDHS), 2018

Regional Disparities in Clean Cooking Energy Use

Figure 1 illustrates the disparities in clean cooking energy use across the six geopolitical regions of Nigeria. The South-West region has the highest percentage of clean cooking energy use at 42.88%, while the North-East has the lowest at 1.32%. The South-South (18.62%) and South-East (9.04%) regions also exhibit relatively higher usage of clean cooking energy compared to the North-Central (6.63%) and North-West (4.38%). This is summarized on Figure 2.

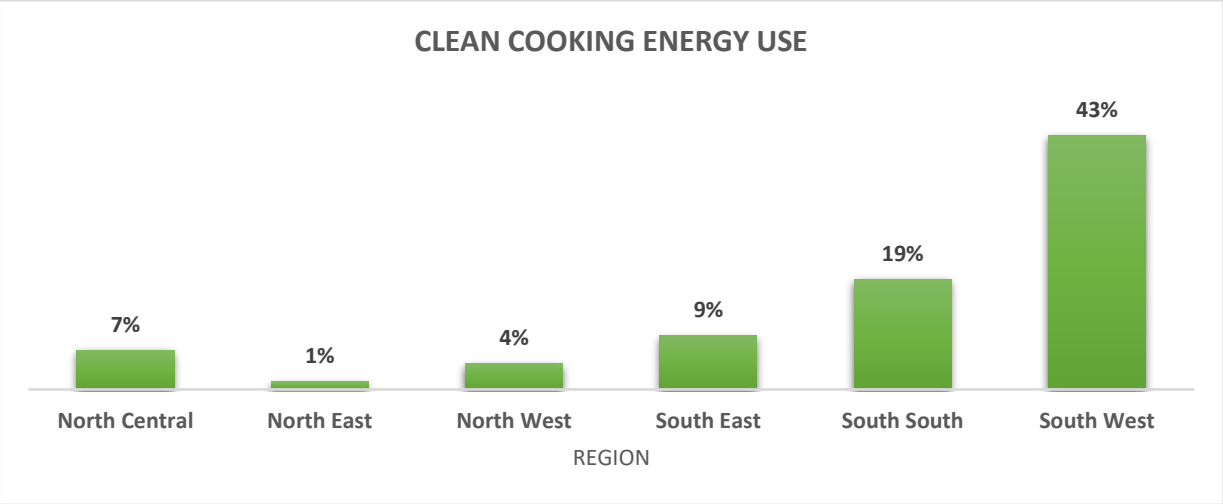

Figure 1: Disparities in clean cooking energy use across regions
Source: Nigeria Demographic and Health Survey (NDHS), 2018

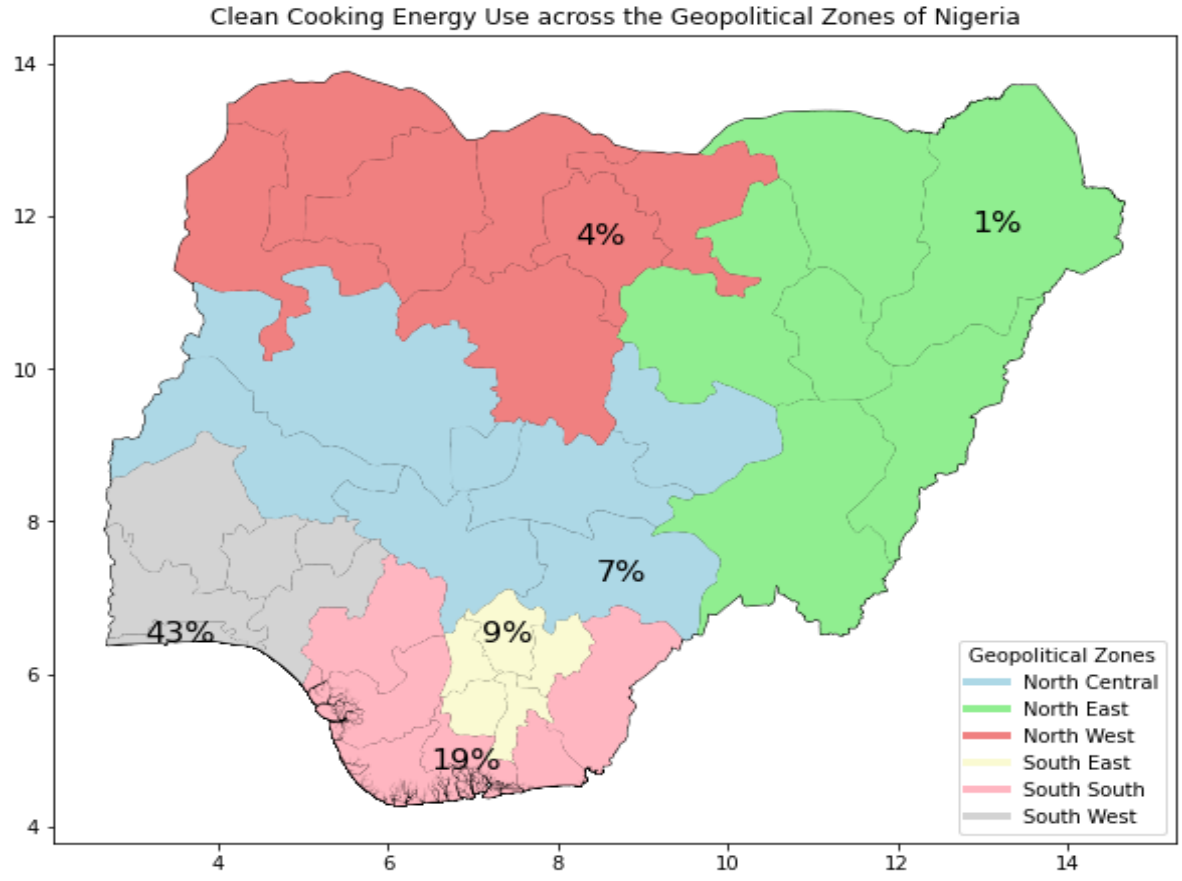

Figure 2: Map of Nigeria Showing the Proportion of Clean Energy Use across the Geopolitical Zones
Source: Adapted from Administrative Map of Nigeria

Bivariate Association of Clean Cooking Energy and Region

Table 2 presents the bivariate logistic regression analysis between cooking energy type and region. The North-Central region serves as the reference category. Women in the North-East are significantly less likely to use clean cooking energy (COR: 0.13, 95% CI: 0.11-0.17, p < 0.001). The odds of using clean cooking energy are also lower in the North-West (COR: 0.45, 95% CI: 0.40-0.52, p < 0.001). Conversely, women in the South-South (COR: 2.31, 95% CI: 2.06-2.58, p < 0.001) and South-West (COR: 7.21, 95% CI: 6.53-7.97, p < 0.001) are significantly more likely to use clean cooking energy compared to the North-Central region.

Table 2: Bivariate Logistic Regression Analysis of Cooking Energy and Region

Region	Unclean Energy	Clean Energy	COR (95% C.I)	p-value
	Freq. (%)	Freq. (%)		
North-Central	5,438 (93.37)	386 (6.63)	R.C	
North-East	6,469 (98.68)	86 (1.32)	0.13 (0.11 , 0.17)	**0.00**
North-Eest	11,608 (95.62)	532 (4.38)	0.45 (0.40 , 0.52)	**0.00**
South-East	4,366 (90.96)	434 (9.04)	0.91 (0.80 , 1.04)	**0.15**
South-South	3,884 (81.38)	889 (18.62)	2.31 (2.06 , 2.58)	**0.00**
South-West	4,092 (57.12)	3072 (42.88)	7.21 (6.53 , 7.97)	**0.00**

Source: Nigeria Demographic and Health Survey (NDHS), 2018

Multivariable Analysis of Sociodemographic Factors Associated with Clean Cooking Energy

Multivariable logistic regression analysis identified sociodemographic factors associated with clean cooking energy use. Age, residence, wealth index, education, household head's sex, employment status, and region significantly influenced cooking energy choice (Table 2).

Younger women aged 25-29 were more likely to use clean cooking energy compared to those aged 15-19 (AOR: 1.20, 95% CI: 1.03-1.39, p=0.02). While not statistically significant, women aged 45-49 showed a lower likelihood of using clean energy.

Urban women were less likely to use clean cooking energy than rural counterparts (AOR: 0.59, 95% CI: 0.53-0.65, p<0.001). Higher wealth was associated with increased clean cooking energy use, with the richest quintile exhibiting the highest likelihood (AOR: 234.37, 95% CI: 96.89-566.92, p<0.001).

Education level positively correlated with clean cooking energy adoption, with higher education linked to significantly increased likelihood (AOR: 5.30, 95% CI: 4.25-6.62, p<0.001). Women in female-headed households were more likely to use clean cooking energy (AOR: 1.61, 95% CI: 1.45-1.78, p<0.001). Employed women showed a slightly higher likelihood of using clean energy (AOR: 0.86, 95% CI: 0.78-0.95, p=0.01).

Regional disparities were evident, with the South-West region demonstrating the highest odds of clean cooking energy use (AOR: 4.70, 95% CI: 4.14-5.34, p<0.001), while the North-East region exhibited the lowest odds (AOR: 0.30, 95% CI: 0.23-0.39, p<0.001).

These findings underscore significant regional disparities and the influence of sociodemographic factors on clean cooking energy adoption among Nigerian women. Targeted interventions are crucial to promote clean cooking, especially in regions with low adoption rates and among disadvantaged groups.

Table 2: Multivariable Logistic Regression of Cooking Energy and Sociodemographic Factors

Variable	Cooking Energy		AOR (95% C.I)	p-value
	unclean Freq. (%)	Clean Freq. (%)		
Age Group				
15-19	7463 (89.4)	885 (10.6)	R.C	
20-24	5937 (88.5)	771 (11.5)	1.00 (0.86 , 1.16)	0.99
25-29	6081 (85.1)	1062 (14.9)	1.20 (1.03 , 1.39)	0.02
30-34	5088 (83.6)	1000 (16.4)	1.09 (0.93 , 1.27)	0.31
35-39	4567 (84.7)	825 (15.3)	1.07 (0.91 , 1.26)	0.44
40-44	3392 (87.1)	504 (13.0)	0.96 (0.80 , 1.16)	0.69
45-49	3324 (90.5)	349 (9.5)	0.85 (0.69 , 1.03)	0.10
Residence			R.C	
Rural	14205 (75.3)	4661 (24.7)	0.00 (0.00 , 0.00)	
Urban	21650 (96.7)	737 (3.3)	0.59 (0.53 , 0.65)	0.00
Wealth Index			R.C	
Poorest	7155 (100.0)	3 (0.1)	0.00 (0.00 , 0.00)	
Poorer	7937 (99.9)	11 (0.2)	1.31 (0.45 , 3.81)	0.62
Middle	8017 (99.0)	79 (1.0)	5.82 (2.36 , 14.36)	0.00
Richer	8114 (91.8)	724 (8.2)	28.62 (11.83 , 69.26)	0.00
Richest	4631 (50.3)	4580 (49.7)	234.37 (96.89 , 566.92)	0.00
Education			R.C	
No Formal Education	14335 (99.0)	144 (1.0)	0.00 (0.00 , 0.00)	
Primary	5626 (94.1)	351 (5.9)	1.23 (0.96 , 1.59)	0.10
Secondary	13587 (83.4)	2712 (16.6)	1.88 (1.51 , 2.33)	0.00
Tertiary	2307 (51.3)	2190 (48.7)	5.30 (4.25 , 6.62)	0.00
Sex of Household Head			R.C	
Male	30323 (88.0)	4134 (12.0)	0.00 (0.00 , 0.00)	
Female	5533 (81.4)	1264 (18.6)	1.61 (1.45 , 1.78)	0.00
Currently Working			0.00 (0.00 , 0.00)	
No	12871 (89.1)	1567 (10.9)	R.C (0.00 , 0.00)	
Yes	22985 (85.7)	3831 (14.3)	0.86 (0.78 , 0.95)	0.01
Region			R.C	
North-Central	5437 (93.4)	386 (6.6)	0.00 (0.00 , 0.00)	
North-East	6468 (98.7)	86 (1.3)	0.30 (0.23 , 0.39)	0.00
North-West	11608 (95.6)	532 (4.4)	0.90 (0.77 , 1.06)	0.21
South-South	4366 (91.0)	433 (9.0)	0.52 (0.45 , 0.61)	0.00
South-East	3883 (81.4)	888 (18.6)	1.68 (1.46 , 1.93)	0.00
South-West	4091 (57.1)	3072 (42.9)	4.70 (4.14 , 5.34)	0.00

Source: Nigeria Demographic and Health Survey (NDHS), 2018

DISCUSSION

The findings of this study highlight significant regional and sociodemographic disparities in clean cooking energy use among Nigerian women, with important implications for policy and intervention strategies. The South-West region leads in clean cooking energy adoption, while the North-East lags considerably. These disparities can be attributed to differences in economic development, urbanization, and access to clean energy infrastructure across regions (NBS, 2020). This is consistent with findings from other countries where regional development significantly influences energy choices (Duarte et al., 2018).

The multivariable analysis reveals that wealth is a critical determinant of clean cooking energy use. Women from the richest quintile are overwhelmingly more likely to use clean cooking energy compared to those from the poorest quintile (AOR: 234.37, 95% CI: 96.89-566.92, $p < 0.001$). This finding aligns with previous research indicating that higher-income households have better access to clean energy sources due to their ability to afford the initial costs and ongoing expenses associated with clean fuels (Puzzolo et al., 2016). Therefore, policies aimed at subsidizing the cost of clean cooking fuels and equipment for low-income households could significantly enhance adoption rates (Jeuland & Pattanayak, 2012).

Education also plays a significant role in clean cooking energy use. Women with higher education levels are more likely to use clean cooking energy (AOR: 5.30, 95% CI: 4.25-6.62, $p < 0.001$). This correlation underscores the importance of education in raising awareness about the health benefits of clean cooking and the environmental impacts of traditional biomass fuels (Malla & Timilsina, 2014). Educational campaigns focusing on the advantages of clean cooking energy and training programs on efficient cooking practices could be effective in increasing adoption rates, particularly in regions with lower education levels (Lewis & Pattanayak, 2012).

Urban residence is another significant factor influencing clean cooking energy use. Urban women are more likely to use clean cooking energy compared to their rural counterparts (AOR: 0.59, 95% CI: 0.53-0.65, $p < 0.001$). This urban-rural disparity can be explained by better access to clean energy infrastructure, such as electricity and LPG distribution networks, in urban areas (NBS, 2020). To address this gap, investments in rural energy infrastructure are essential. Expanding the distribution networks for electricity and LPG in rural areas can facilitate the transition to clean cooking energy and reduce the reliance on traditional biomass fuels (Bailis et al., 2015).

Regional disparities in clean cooking energy use are pronounced, with the South-West region exhibiting the highest adoption rates and the North-East the lowest. The South-West's higher adoption rates can be attributed to its more developed economy, higher urbanization rate, and better infrastructure (NBS, 2020). In contrast, the North-East's low adoption rates are likely due to lower economic development and infrastructure challenges, exacerbated by ongoing security issues in the region(Conceição, 2019). Targeted interventions addressing these specific regional challenges are crucial. For example, in the North-East, efforts could focus on improving security, economic development, and infrastructure to facilitate the adoption of clean cooking energy (UNDP, 2019).

The bivariate analysis further underscores the importance of regional differences. Women in the South-South (COR: 2.31, 95% CI: 2.06-2.58, $p < 0.001$) and South-West (COR: 7.21, 95% CI: 6.53-7.97, $p < 0.001$) regions are significantly more likely to use clean cooking energy

compared to those in the North-Central region. This finding highlights the need for region-specific policies and interventions. In regions with low adoption rates, such as the North-East and North-West, targeted subsidies, infrastructure improvements, and educational campaigns are necessary to promote clean cooking energy use (Jeuland & Pattanayak, 2012). This study's findings align with the broader literature on energy access and use in low- and middle-income countries. The significant impact of wealth, education, and urbanization on clean cooking energy adoption is consistent with global patterns observed in other countries (Puzzolo et al., 2016; Rehman et al., 2011). These results highlight the multifaceted nature of energy access, where economic, educational, and infrastructural factors interplay to influence household energy choices (Gould & Urpelainen, 2018).

The study underscores the need for a multifaceted approach to promoting clean cooking energy use in Nigeria. Addressing the identified regional and sociodemographic disparities requires targeted policies that consider the unique challenges and opportunities within each region. Subsidies for low-income households, investments in rural energy infrastructure, educational campaigns, and region-specific interventions are essential components of a comprehensive strategy to enhance clean cooking energy access and improve health outcomes for Nigerian women.

CONCLUSION

This study reveals significant regional and sociodemographic disparities in clean cooking energy use among women in Nigeria. Wealth, education, and urbanization are key determinants of clean energy adoption. The findings underscore the need for targeted policies to address these disparities, promoting equitable access to clean cooking energy across Nigeria. Focused interventions on subsidizing clean fuels, improving rural infrastructure, and enhancing educational outreach are crucial for mitigating health risks and promoting environmental sustainability. A multifaceted approach tailored to regional and sociodemographic contexts can significantly improve clean cooking energy use among Nigerian women.

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