Original Research Article

Awareness of the health implications of use of biomass energy sources among women in rural households of Jigawa State, Nigeria

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Abstract

Various health challenges and fatalities in rural communities of most developing countries of the world have been traceable to the unabated use of biomass energy sources. We therefore assessed the awareness of the health implications of the use of biomass energy sources among women in rural households of Jigawa State. Multistage sampling procedure was used to collect data from 120 respondents using structured questionnaires. Data were collected on respondents' socioeconomic characteristics, types of biomass used, information sources on the health implications from use of biomass energy sources, awareness of the health implications and constraints to the use of alternatives to biomass. Data were summarised using frequencies, percentages, means, Chi-square and Pearson Product Moment Correlation. Majority of the respondents (78.3%) were below 40 years of age with a mean age of 30 ± 2.02 years. Majority were married (90.8%), Muslims (100%), involved in agro-processing (65.8%), had no formal education (73.3%), and earned not more than ₦10,000 (90.8%) with mean household size of 9 members. Wood (100%) and charcoal (100%) were the dominant biomass energy sources used. Respondents' main source of information on the health implications of the use of biomass were radio (64.2%) and extension agents (54.2%). Awareness level of the health implications from the use of biomass energy sources was fairly high (51.7%). High cost of the alternatives, scarcity of refilling points and alternatives and lack of capital were the main hindrances to the use of the alternatives to biomass energy sources. The result on the inferential statistics revealed that a significant association existed between education ($\chi^2 = 6.08$; $P < 0.05$) and awareness of health implications from the use of biomass. Efforts should be made to sensitize women on the health implications resulting from the use of biomass. Alternatives should be made available and affordable to encourage a switch from biomass energy sources thereby reducing the fatalities that may result from its continual use.

Keywords: Biomass energy sources; indoor air pollution; health implications; non-solid fuel.

INTRODUCTION

Energy is an integral part of human survival, access to clean safe and affordable energy for cooking is becoming more challenging particularly in developing nations of the world. Cooking in a household involve the use of solid and non-solid fuel. The solid fuel consists of coal which is a fossil fuel and biomass fuel (BMF) like wood, charcoal, dung and crop residues. The non-solid fuel consists of kerosene, Liquefied Petroleum Gas (LPG), gas and electricity (Desalu et al., 2012; Emagbetere et al., 2016; Hameed et al., 2016)

According to UNDP and WHO (2009), about 3 billion people in developing countries rely on solid fuels (wood, charcoal, agricultural waste, and animal dung) to

meet their cooking needs, out of this number, around 2.6 billion rely on traditional biomass, while 400 million use coal as their primary cooking fuel. The author further posit that over 700 million people without access to modern fuels for cooking live in the Least Developed Countries (LDCs) and over 600 million in sub-Saharan Africa. The International Energy Agency (IEA) (2007) reported that the proportion of the population relying on biomass is highest in sub-Saharan Africa. Furthermore, it stated that in many parts of this region, more than 90% of the rural population rely on fuel wood and charcoal. In Nigeria, it is estimated that about 91% of the household energy needs are met by biomass (Babalola, 2010;

Vivan et al., 2012; Emagbetere et al., 2016). These statistics and assertions highlighted above by the aforementioned authors suggest that Africa and indeed Nigeria is the hub for the massive use of biomass fuel, a situation that is further compounded by the slow pace of development of other energy options, lack of proper policy on energy usage, preference for use of biomass energy and challenges bothering around availability and affordability of cleaner options.

The dependence on biomass is not without its challenges. According to IEA (2007), concern is heightened when resources are harvested unsustainably and energy conversion technologies are inefficient, this it argued portends serious adverse consequences for health, the environment and economic development. Duflo et al. (2008) posited that cooking and heating with solid fuels generates high levels of health-damaging pollutants, such as particulates and carbon monoxide which is one of the causes of local and regional air pollution that could result in morbidity and mortality. Burning of solid fuels for household cooking, heating and lighting is a major cause of household, or indoor, air pollution (UNICEF, 2016). UNEP (2006) reports that about 36% of lower respiratory infections and 22% of chronic respiratory infections are caused by indoor air pollution as a result of biomass utilization.

World Health Organization (2018) also established that close to 4 million people die prematurely from illness attributable to household air pollution from inefficient cooking practices using polluting stoves paired with solid fuels and kerosene. They further claim that those more vulnerable to these prevalent circumstances were women who are faced with primary duties of cooking (IEA, 2007). Young children are also disproportionately affected, because they often spend time near the traditional open fires while their mothers are engaged in cooking, thus, increasing their exposure to indoor air pollution (Duflo et al., 2008). Biomass fuel is rated second most important environmental cause of disease after contaminated waterborne diseases and the fourth most important cause of overall excess mortality in developing countries after malnutrition, unsafe sex, and waterborne diseases (Bruce, 2006).

Findings from Ndwiga et al. (2014) revealed that the greatest health impacts as a result of the biomass fuel chain have been documented to occur among the poorest population who rely on biomass as their main energy source. According to statistical figures presented by NBS (2017), for 2009–2010, Jigawa state has the highest poverty head count (88.5%). This statistical figure underscores her vulnerability and her choice of energy sources. Audu et al. (2013) reportedly confirmed in their research that Nigeria is losing an estimated land of 351,000 sq.km to desert, representing 38% of its total landmass, which corresponds to the landmass of the desert-threatened frontline states (Bauchi, Gombe, Borno, Yobe, Jigawa, Kano, Katsina,

Zamfara, Sokoto and Kebbi) of the country. Due to both natural and human factors, forest cover is being depleted, making northern part of the State highly vulnerable to desert encroachment (Jigawa State Government (JSG) and Education Sector Support Programme in Nigeria (ESSPIN), (2014). The continual and unsustainable harvest and use of forest resources for fuel wood is not without grave consequences for the environment and human health. UNDP and WHO (2009) reported that worldwide, about two million deaths annually from pneumonia, chronic lung disease, and lung cancer are associated with exposure to indoor air pollution resulting from cooking with biomass; 99 percent of these deaths occur in developing countries. The bodies also posited that some 44 percent of these deaths occur in children; of the adult deaths, 60 percent occur in women in developing countries and that in less developing countries and Sub-Saharan Africa, more than 50 percent of all deaths from these three diseases can be attributed to solid fuel use. A study by Bruce et al. (2002) reported that there is consistent evidence that biomass smoke exposure increases the risk of childhood acute respiratory infections, particularly pneumonia, and probably otitis media. The study further established an association between smoke exposure with chronic bronchitis, chronic obstructive pulmonary disease (in particular among women), asthma, and increased risk of cataract.

Despite the challenges and assertions concerning the use of biomass energy sources particularly with references to its health implications, the dependence on traditional biomass is still on the increase. A recent survey by the National Bureau of Statistics (NBS) (2012) revealed that in 2010, 95% of the energy sources used for cooking in households in Jigawa State was fuel wood (a major component of biomass energy source). Statistical projections by IEA (2006), also indicates that people relying on biomass will increase from 2.6 billion in 2015 to 2.7 billion by 2030 if mitigating policies are not considered. Putting all of these in perspective, it is pertinent to ask if the rural households in Nigeria have understanding of the health implications of the use of biomass or not? Do they deploy any measures to reduce the negative impact of exposure to biomass use? Other key question that comes to mind includes what are the compelling factors that encourage the use of this form of energy among the people in the area? Against this backdrop, it is imperative to assess the awareness of the health implications of the use of biomass fuel for cooking among rural households in Jigawa State.

The main objective of this study is to assess the awareness of the health implications of the use of biomass energy sources among women in rural households of Jigawa State. Specifically, the study:

1. described socio-economic characteristic of the respondents,

2. identified the type of biomass energy used by respondents,
3. identified the source of information on the health implication of the use of biomass,
4. determined the level of awareness of the health implications of the use of biomass fuel for cooking among respondents; and
5. investigate respondents' constraints to the use of non-solid energy source.

MATERIALS AND METHODS

Description of study area

Jigawa State is one of thirty-six states that constitute Federal Republic of Nigeria, it is situated in the north-western part of the country between latitudes 11.00°N to 13.00°N and longitudes 8.00°E to 10.15°E, it is border to the west by Kano and Katsina States, Bauchi State to the east, Yobe State to the northeast and to the north, Jigawa shares an international border with Zinder Region in The Republic of Niger, which offers a unique opportunity for cross-border trading activities (JSG and ESSPIN, 2014).

According to the 2006 census, the State had a total population of over 4.3 million inhabitants. The population growth of the state is estimated at 3.5% with about 48 % of the population falling under the age of fifteen. Out of the estimation about 2.9 million are considered to be productive adults. Eighty per cent (80%) of the population is found in the rural areas and is made up of mostly Hausa, Fulani and Manga (a Kanuri dialect) (Jigawa State Government, 2016).

The state is situated within the Sudan savannah vegetation zone, but there are traces of Guinea savannah in the southern part of the state. Its total forest covers about 5% due to rainfall characteristics and deforestation due primarily to use of wood for cooking, making northern part of the State highly vulnerable to desert encroachment (Jigawa State Government, 2016). Jigawa state is predominantly an agrarian state with over 80% of the population involved in agriculture. The major rain fed crops grown in the state includes millet, sorghum, cowpea, maize, rice, groundnut, cocoyam, soya beans, sesame, cotton and watermelon. Irrigation fed crops includes sugarcane, Hot pepper, okra, tomatoes, onions and spinach. The major livestock kept in the state includes, small ruminants (sheep and goat), poultry, cattle etc. The main rivers are Hadejia-Kafin Hausa and Iggi Rivers with a number of tributaries feeding extensive marshlands in north-eastern part of the State. Hadejia – Kafin Hausa River traverses the State from west to east through the Hadejia-Nguru wetlands and empties into the Lake Chad Basin. Popular rain-fed season crops include; millet, sorghum, maize, cowpea, rice, groundnut, sesame, cotton and watermelon.

Sampling procedure

A multi-stage sampling procedure was adopted for this study. The first stage involved the purposive selection of all the nine identified Local Government Areas in the northern fringes of the state. The northern fringes represent the area of intense deforestation both by natural and human activity. The second stage involved the random sampling of three (3) Local Government Areas (Biriniwa, Suletankarkar, and Babura) out of the nine Local Government Areas identified. Subsequently, two communities from each Local Government Areas (Birniwa: kukawa and Yusufari. Sule-Tankarkar: Jeke and Suletankarkar. Babura: Kanyababba and Dorawa) were randomly selected to give a total of six (6) communities. The third stage involved the use of snowball sampling to generate a list of all households that uses biomass energy sources. From the list generated, a total of 120 households were randomly selected proportionately and used for the study. Due to prominent roles played by women in household cooking, one woman mostly responsible for household cooking, were purposively selected from the sampled households for the study.

Data collection

Primary data were used for the study. Structured questionnaire was used to collect information on the respondents' socioeconomic characteristics, the type of biomass energy used, awareness of the health implications of the use of biomass fuel for cooking, sources of information on the health implication of the use of biomass and constraints to the use of non-solid energy source.

Awareness of the health implication of the use of biomass energy sources was measured on a two point scale of 'aware and not aware' with a score of 2 and 1, respectively. An index was generated and used to re-categorise respondents into high and low levels of awareness. Constraints to the use of non-solid energy was measured on a three point scale of severe, mild and not a constraint, scores of 2,1 and 0 were awarded to the response options accordingly. Mean scores were computed and used to rank the constraints.

Analytical methods

Data were analysed using descriptive statistics such as frequencies, percentages, means, and ranks. Furthermore, Chi square (χ^2) and Pearson Product Moment Correlation (r) were used.

RESULTS AND DISCUSSION

Socioeconomic characteristics of respondents

Table 1 shows that majority of the respondents (78.3%) were not older than 40 years of age with a mean age of 30.4 ± 2.02 years. This suggests that

Table 1. Socioeconomic characteristics of respondents

Variables	Frequency	Percentage	Mean ± S.D
Age (Years)			
≤20	12	10.0	30.4 ±2.02
21–30	45	37.5	
31–40	49	40.8	
41–50	10	8.3	
≥51	4	3.3	
Marital Status			
Single	1	0.8	90.8
Married	109	90.8	
Divorce	6	5.0	
Widow	4	3.3	
Religion			
Muslim	120	100	65.8
Occupation			
civil servant	8	6.7	
Agro–processor	79	65.8	
Trading	19	15.8	
Farming	11	9.2	2.5
Others	3	2.5	
Educational Qualification			
Non–formal	88	73.3	0.0
Primary	22	18.3	
Secondary	10	8.3	
Tertiary	0	0.0	
Average Monthly Income (N)			
≤10,000	107	89.2	₦9,075 ± 5,845.78
11,000–20,000	5	4.20	
21,000–30,000	2	1.70	
31,000–40,000	4	3.3	
41,000–50,000	1	0.8	
≥ 51,000	1	0.8	
Household Size (Person)			
1–5	16	13.3	9 ± 2.9
6–10	65	54.2	
11–15	29	24.2	
≥16	10	8.3	

Source: Field survey, 2017

*Note: exchange rate of US dollar (\$) to Nigeria Naira (₦) is \$1 = ₦306

respondents were very much in their active years. This is similar to the findings of Bello et al. (2016) who observed the average age of women involved in groundnut processing in Jigawa State to be 32 years. An overwhelming proportion of the respondents were married (90.8%) and belonged to the Islamic faith (100%). The result on marital status suggests that they get involved in household activities, particularly cooking. This is in line with the submission of Akinbile (2007) who posited that marriage confers responsibility. Most of the respondents (65.8%) were involved in agro-processing, suggesting that women

embrace agro-processing more in the study area. This may not be unconnected with traditional and religious belief in the study area which restricts women to certain roles. Table 1 further reveals that Majority of the respondents (73.3%) had non-formal education, a situation that may impact on the level of awareness of the health implications from the persistent use of biomass energy sources. This assertion is in line with the position of Fabiyi and Akande (2015) who posited that there is the need for a type of education which must equip the receiver with necessary skills to face challenging situations which could be economic,

Table 2. Respondents' source(s) of information on health implications of the use of biomass energy sources

Variables	Yes		Ranking
	F	%	
Radio	77	64.2	1 st
Television	16	13.3	4 th
Newspapers	2	1.7	6 th
Extension agents	65	54.2	2 nd
Cooperative society	7	5.8	5 th
Non-Governmental Organization (NGO)	1	0.1	7 th
Religious houses	0	0.0	8 th
Friends/neighbor	30	25.0	3 rd

Source: Field survey, 2017

Table 3. Types of biomass energy sources used by respondents

Variables	Yes		Ranking
	F	%	
Fire wood	120	100	1 st
Charcoal	120	100	1 st
Animal dung	17	14.2	4 th
Saw dust	10	8.3	5 th
Coal	0	0.0	6 th
Plant residue	64	53.3	3 rd

Source: Field survey, 2017

social, political and cultural in nature. The finding is also consistent with the position of Oniye (2009) who noted that Nigerian women are disadvantaged in terms of accessibility to formal education. A large proportion of the respondents (90.8%) earned on the average, not more than ₦10, 000 monthly. More than half (54.2%) of the respondents had a household size of between 5–10 members with an average of nine (9) persons per household.

Sources of information on health implications of the use of biomass energy sources

Table 2 shows that the major sources of information on the health implications from the use of biomass were radio (64.2%), and extension agents (54.2%). The result is consistent with the position of Olajide (2012) who averred that radio is the most potent source of information dissemination to farmers and it is also referred to as farmers' companion. However, religious houses (0.0%), NGOs (0.1%), newspapers (1.7%) and television (13.3%) were recorded as the least sources from which information on the health implications on the use of biomass were accessed by the respondents. It was interesting to note that religious centres were not drafted as a medium of information dissemination in the study area, particularly when the respondents' religious affiliation is put in perspective. This calls for concerted efforts to explore this avenue in the future.

Types of biomass energy sources used by respondents

Table 3 shows that the dominant biomass energy sources used by respondents were fire wood (100%), charcoal (100%) and plant residues (53.3%). This is in line with the position of Vivan et al. (2012) who in a related study found out that fire wood and charcoal were the dominant biomass sources of energy used in Kaduna State, northern Nigerian. The result corroborates the position of NBS (2012) that 95% of the energy sources used for cooking in Jigawa State was fuel wood. The extent of usage suggests that a lot needs to be done to checkmate this trend in the area. Obayelu et al. (2017) in related study also found out that firewood was the dominant source of biomass energy used in rural areas of south-western Nigeria. These findings thus presuppose that across Nigeria, rural people are under immense life threatening challenges from the persistent use of this energy source.

Level of awareness of the health implications from the use of biomass energy sources

Table 4 shows that a few were aware that "Prolong exposure to fume from biomass energy sources can result to pneumonia" (27.5%), "Prolong absorption of smoke fumes into the lens of the eye can cause cataract" (21.7%). However, majority (90.8%) were aware that "long exposure to fumes from biomass energy sources is a major cause of adult and children mortality". While

Table 4. Respondents' level of awareness of the health implications from the use of biomass energy sources

Health implications	Awareness
Prolong exposure to fume from biomass energy source can result to pneumonia	33 (27.5)
Tuberculosis is associated with exposure to fumes from biomass energy sources	4 (3.3)
Chronic obstructive pulmonary disease is caused by exposure to fumes from biomass energy sources	0 (0.0)
Long exposure to fumes from biomass energy sources is a major cause of adult and children mortality	109 (90.8)
Lung cancer is associated with prolonged exposure to fumes from biomass energy sources	8 (6.7)
Prolong absorption of smoke fumes into the lens of the eye can cause cataract	26 (21.7)
Acute exposure to fumes from biomass energy source is associated with wheezing and exacerbation asthma	9 (7.5)
Low birth weight is associated with acute exposure to fumes from biomass energy sources	2 (1.7)

Source: Field survey, 2017

Table 5. Categorization of respondents' level of awareness of the health implications from the use of biomass energy sources

Level of awareness	scores	Frequency	Percentage	Mean
High	10–12	62	51.7	9.59 ± 0.81
Low	8–9	58	48.3	

Source: Field survey, 2017

Table 6. Respondents' constraints to the use alternatives to biomass

Variables	Mean	Ranking
High cost of cleaner alternatives	2.92	1 st
Lack of capital	2.52	4 th
Scarcity of the alternatives	2.77	3 rd
High risk involved in the usage of the alternatives	1.57	6 th
Scarcity of refilling station	2.84	2 nd
Distance to refilling / selling points	2.20	5 th
Lack of technical knowhow on the use of the alternatives	1.05	7 th
Lack of preference for the alternatives	1.02	8 th

Source: Field survey, 2017

the result in Table 4 is unimpressive, the result on the categorisation of respondents' level of awareness in Table 5 shows that respondents' level of awareness is fairly high (51.7%). Nonetheless, the result suggests that a lot needs to be done with respect to creating awareness on the health implications resulting from the use of biomass as energy sources particularly for cooking. The result is consistent with the findings of Edelstein et al. (2008) that the vast majority of women across social groups in a study conducted in Ethiopia were aware that cooking fumes could cause ill health.

Constraints to use of non-solid alternatives to biomass energy sources

Table 6 indicates that the major constraints hampering the use of non-solid alternatives energy sources were high cost of the alternatives ($\bar{x} = 2.92$), scarcity of refilling points ($\bar{x} = 2.84$), scarcity of the alternatives ($\bar{x} = 2.77$) and lack of capital ($\bar{x} = 2.52$) among others. However,

lack of preference for the alternatives ($\bar{x} = 1.02$) and lack of technical knowhow on the use of the alternatives ($\bar{x} = 1.05$) were the least constraints of the respondents to use of non-solid alternatives to biomass energy sources. The findings suggests that awareness of the health implication from the use of biomass energy sources on the one hand, though a necessary condition is not a sufficient condition to dissuade respondents from using biomass energy sources, other variables come into play. The results are consistent with the findings of Hammeed et al. (2016) who in a related study found that lack of funds to purchase gas, scarcity of gas at skid plants, and high cost of refilling LPG cylinder were major challenges hampering the use of LPG. The results also corroborates the position of Udofia (2015) who asserted that price, availability and affordability of a particular cooking fuel, as well as the ease in getting these fuels, are key in the choice of energy in Nigerian homes.

Table 7. Chi square (χ^2) and Pearson Product Moment Correlation (r) analysis showing relationship between respondents' socio-economic characteristics and their level of awareness of the health implications from the use of biomass energy sources

Variables	χ^2 -value	df	r-value	p-value
Age			0.114	0.216
Level of education	6.08*	2		0.049
Marital status	2.55	3		0.467
Household size			0.040	0.662
Occupation	1.35	3		0.718
Average monthly income			0.004	0.964

$P \leq 0.05$ = significant

Test of relationship between selected socio-economic characteristics of respondents and level of awareness of the health implications associated with the use of biomass energy sources

Table 7 represents the test of relationship between respondents' selected socio-economic characteristics and their level of awareness of the health implications associated with the use of biomass energy sources. The result revealed that age marital status, household size, occupation and average monthly income were not significantly related to the level awareness of the health implications associated with the use of biomass energy sources, however, only respondents' level of education ($\chi^2 = 6.08$; $P < 0.05$) was significantly related to level of awareness of the health implications associated with the use of biomass energy sources. This implies that respondents' awareness of the health implications associated with the use of biomass energy is associated with education. This result is in line with the findings of Nwankwo et al. (2018), who also found level of education among other variables that were related to awareness and knowledge of the harmful effect of use of biomass energy to health. This suggests that efforts should be made to educate the populace on the health effect of the use of biomass energy sources, considering that it is the most available form of energy in the study area. This assertion agrees with the position of Ozoh et al. (2018), who found that people who are more educated are aware of the health implication of the use of biomass energy sources, and thus, favours a switch to cleaner options.

CONCLUSION AND RECOMMENDATIONS

The study concludes that respondents were indulged in the use of biomass despite a generally fairly high awareness level. High cost of the alternatives, scarcity of refilling points and alternatives and lack of capital were the main hindrances to the use of the alternatives to biomass. The result on the inferential statistics revealed that a significant association existed between education ($\chi^2 = 6.08$; $p < 0.05$) and awareness of health implications from the use of biomass. Efforts should

be made by the Ministry of Information, National Orientation Agency, extension delivery services, religious organisations and aid donor agencies to further sensitize women on the enormity of the health implications resulting from the sustained use of biomass through radio jingles, distribution of well-designed information leaflets, education of children in schools, and stakeholder-community meetings. Government should implement policies that favour the availability, affordability and accessibility of the alternatives as well as providing information on where and how to access these alternatives to encourage a switch from biomass energy sources thereby reducing the fatalities that may result from its continual use.

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