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ACCESS TO ENERGY AND HOUSEHOLD HEALTH OUTCOMES IN NIGERIA

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ABSTRACT
This study examined the effect of access to energy and household health outcomes at the micro-level in Nigeria, using the 2018 Nigerian Demographic Health Survey data. The descriptive statistics results showed that 76.16 percent of the household adopt wood as a means for energy for cooking, demonstrating strong preferences for wood-fuel traditional stoves. The infant mortality rate, low-birth weight, and pre-term births are used to proxy household health outcomes. More so, the empirical findings suggests that there is a positive significant effect of unclean energy access on infant deaths, low birth weights, and pre-term births in Nigeria. The study examined the effect of maternal behaviour such as iron intake, malaria, and adequate antenatal visits on infant deaths. Iron intake has no significant effect on infant deaths, low birth weight, however has a negative effect on pre-term births. Also, a mother that suffers from malaria is likely to have a child that would die before the first birthday, a child that weighs less than 2,500 grams (low birth weight), meanwhile, no significant effect on the risk of preterm babies. Further, sufficient antenatal visits (at least 8 visits) reduces the likelihood that a child will dies before the first birthday, will more likely not weigh 2,500 grams, however, no significant effect on the risk of preterm babies. The study, therefore, recommends that targeted policies that seek to upscale efficient cooking technologies such as improved cooking stoves should be decisively pursued. In addition, improving rural electrification and encouraging in appliances such as electric stoves and refrigerators can minimize exposure to gasses from biomass combustion and reduce the frequency and duration of cooking time; thus, allowing women to reallocate spared time into income-earning engagements.

1. BACKGROUND
Energy access is fundamental to all human activity; it is a basic factor equal to air, water, and the earth (Tripathi et al, 2015). Energy access is inextricably linked to economic growth, human development, and environmental sustainability (International Energy Agency (IEA), 2017). The importance of energy access at the global and regional levels is well known; at the household level, energy is crucial for cooking and food processing (natural gas/coal/biomass), lighting, refrigeration, cooling, communication (electricity), powering household appliances (electricity), heating (biomass, kerosene, electricity), transportation, and small-scale agriculture; mechanized farming (Cooke et al., 2008). Access to clean energy is critical for attaining sustainable development and reducing the disproportionate burden of diseases among women, children, and infants who are the most at risk. Access to clean energy is inextricably linked to access to food and water in reducing poverty, improving health and human life, and raising living standards (International Energy Agency (IEA), 2017). Specifically, access to energy has been conceptualized to mean household access to a minimum level of electricity, household access to safer and more sustainable (i.e., minimum harmful effects on health and the environment as possible) cooking and heating fuels and stoves. Also, access to modern energy for public services, e.g., electricity for health facilities, schools, and street lighting (International Energy Agency (IEA), 2016).

The household plays an important role in the care and rehabilitation of individuals. The function of the household is complex and focuses on the whole system rather than on the individuals, including roles, relationships, well-being, and belonging, and significantly takes place in the context of some public concerns, such as health problems (McGoldrick et al. 2013). The discussion on household health outcomes is mostly on women and child health outcomes (Boateng et al, 2020). For instance, maternal mortality has remained a very important challenge across the globe, specifically for resource-constrained regions of the world. Maternal health is important because it is regarded by the United States Joint Commission on Accreditation of Health Care Organizations as a “sentinel event” as it is a criterion to assess the quality of a healthcare

system (The Joint Commission, 2010). It is also a key indicator of population health, health system development, and social and economic development (World Health Organization, 2010). Similarly, child health is foundational to adult health and well-being. It is a deciding factor in the well-being of a population and often serves as a pointer of the socioeconomic status and health development of a household at a micro-level and nation at large (Wegbom et al. 2019). Nonetheless, a child cannot achieve optimal health alone, there is a need to depend on adults in the family and community to provide an environment in which they can learn and grow successfully.

Despite the growing concern about the importance of providing modern energy for all, the number of households globally depending on traditional solid fuels for cooking is increasing (Dioha and Emodi, 2019). Globally, around 1.06 billion people do not have access to electricity, while around 2.5 billion people do not have access to clean cooking facilities (IEA, 2017), while more than 3 billion people worldwide use biomass in the form of fuelwood, animal dung, agricultural residues, and charcoal to meet their cooking energy needs; of which 2.6 billion of this population is estimated to live in developing countries. About 13% of the world's population lives in sub-Saharan Africa (IEA, 2014). However, the African continent is reported to account for only 4% of world energy consumption; the lowest per capita modern energy consumption in the world although it is richly endowed with various types of energy resources (solar, hydro, wind, and geothermal). The continent also has 1.3 billion of the world's people without access to electricity and one-quarter of the estimated 2.6 billion people in developing countries depend on biomass for cooking and space heating (World Bank, 2012; IEA, 2014). Nigeria is the most populous country (about 200 million persons) and the largest economy in Africa. However, in Nigeria, around 94% and 39% of the population do not have access to clean cooking facilities and electricity, respectively (IEA, 2017). The concern assumes even greater significance in the era of climate change, owing to the low adaptation capacity of Nigeria. Moreover, the health consequences attributed to a lack of access to modern energy services are dire, and it also contributes to the depletion of forests which are meant to be carbon sinks.

In Nigeria, cooking accounts for 91% of total domestic energy consumption (Oyedepo, 2012) and wood is the most widely utilized cooking fuel with 120 million Nigerians estimated to be vulnerable to illness and deaths from exposure to cooking smoke (ICEED, 2019). The impact is particularly severe for women and girls, who are typically responsible for these chores, and for infants whose organs are tender and still growing (Boateng et al, 2020). Intuitively, for the household, access to energy is fundamental to reducing poverty and improving health. Meanwhile, the lack of access to adequate, affordable, reliable, and acceptable energy for a healthy and sustainable livelihood poses a challenge to several households (Boateng et al, 2020).

One of the main development challenges in the developing world is to tackle the energy poverty of a large proportion of the population. There are 1.5 billion people without access to electricity, and 2.8 billion people depend on traditional biomass (fuel wood, crop residues, animal dung, etc.) for cooking in the world (IEA 2016). The worsening energy crisis has badly affected all sectors of the economy. The issue surrounding the lack of access to energy and the implications are enormous, specifically, energy poverty affects health outcomes. Theoretically, the issue of access to energy on general health is both direct and indirect. From the indirect channel, energy poverty affects healthcare providers as it increases transaction costs (Heltberg, 2004) and directly affects vulnerable groups who cannot afford more expensive healthcare (Alem et al., 2015). Lack of energy access has resulted in differential health and economic effects for several populations. The key health conditions that attributes to global mortality due to lack of access to clean energy are pneumonia, stroke, ischemic heart disease, chronic obstructive pulmonary disease, lung cancer, and poor obstetric outcomes (Bruce et al, 2006). Existing literature suggests that the statistics on access to clean fuels for cooking in a given region can be used as a surrogate

indicator of disease risk (Smith, 2000). During pregnancy, maternal exposure to particulate matter and carbon monoxide from unclean cooking fuels such as firewood, straw, dung and kerosene impair neonates' health and survival in two fundamental ways. Firstly, carbon monoxide combines with haemoglobin to enter the placenta, thereby blocking nutrient-delivery tissues to the foetus (Boy, Bruce, 2002). Secondly, particulate matter obstructs the maternal pulmonary tract leading to oxygen shortage as well as damage to foetus cells through oxidative stress (Amegah et al, 2012). Consequently, these processes, coupled with high cell proliferation and volatile metabolic reactions during intrauterine development result in retarded infant growth typical of low birth weights, pre-term births, and infant mortality.

In terms of the effect of energy access on maternal health, WHO (2006) explains three channels through which energy practices can reduce infant mortality and adverse pregnant outcomes. Foremost, reducing indoor air pollution prevents child morbidity and mortality from acute lower respiratory infections. Secondly, protecting the developing embryo from indoor pollution can help avert stillbirth, perinatal mortality, and low birth weight. Thirdly, getting rid of open fires and kerosene wick lamps in the household can prevent infants and toddlers from being burned and scalded. Similarly, refrigerator permits medicines conservation and better conservation of food; thus, several diseases can be avoided. In Nigeria, access to energy remains a serious problem. The World Bank reports (2021) that only 4.91% of Nigerians have access to clean fuels and technologies for cooking in 2017. Although, the nation has the largest natural gas reserves in Africa and remains a major crude oil exporter in the continent, yet, between 2000 and 2017, the country's population with access to clean cooking fuels and technologies consistently stood below 5% compared to its regional peers recording double-digit figures. For instance, a higher percentage of the population in Egypt (97.6%) and South Africa (84.8%) have access to clean fuels and modern technologies for cooking compared to Nigeria's 4.91% in 2017. Despite its abundant energy resources, the widespread lack of energy access remains rife as the country struggles with significant health challenges. The World Health Organization (WHO) ranked Nigeria third on the list of top 10 countries using polluting fuels as the primary energy source for cooking. Further, despite Nigeria's position as the sixth largest petroleum oil exporting nation, endowed with gas hydro, and solar resources; according to World Bank (2021), 85 million Nigerians do not have access to grid electricity. This represents 43% percent of the country's population and makes Nigeria the country with the largest energy access deficit in the world. Globally, there are approximately 7,000 newborn deaths every day, amounting to 47% of all child deaths under the age of 5 years, up from 40% in 1990 (WHO, 2020). It is worthy of note that, five nations (India, Pakistan, Nigeria, the Democratic Republic of Congo, and Ethiopia) alone accounted for half of the global infant deaths in 2018. In Nigeria, 9% of global infant deaths are contributed to the nation annually (WHO, 2019). This makes the country the third largest contributor to new-born mortalities in the world. Compared to Ghana and South Africa's indices of 34 and 41 deaths in every 1,000 infants in 2018, respectively, the infant mortality rate is still relatively higher in Nigeria with 67 deaths per 1,000 infants (World Bank, 2021). Nigeria experienced a very high maternal mortality ratio (814 per 100, 000 live births in 2015 with uncertainty interval ranging from 596 to 1180 maternal deaths per 100,000 live births) which is higher than the average for sub-Saharan Africa (765 per 100,000 live births) (WHO, 2015). Nigeria is one of the countries in Sub-Saharan Africa where maternal mortality has remained a problem. The country's progress toward cutting the number of maternal deaths has been largely insufficient (Alkema et al. 2016). Also, Nigeria is among the top six countries in the world that contribute to more than 50% of all global maternal deaths (Hogan et al. 2010).

The rationale behind the choice to investigate the impact of energy access on household health outcomes is predicated on the understanding that access to energy can be regarded as one of such environmental factors determined by socioeconomic characteristics and implies the health outcomes of the household (Olisakee, 2014). Further, the global energy access problem is

increasingly concentrated in sub-Saharan Africa, which by 2030 will account for nearly 90% of the world's population without electricity access and 40% without clean cooking (IEA, 2018). Therefore, the challenges of access to energy continued to worsen. Despite the importance placed on improvement in health outcomes, Nigeria continues to struggle, specifically for child and women's health outcomes.

There is a large and growing body of empirical studies investigating the energy access health link with an interesting focus on the effect on maternal and infant health outcomes (Ezeh et al. 2014; Ibrahim et al. 2022; Olugbemisola et al. 2018; Sana et al. 2018; Roberman et al. 2021; Olugbemisola et al. 2016). This study contributes to the growing literature on the impact of access to energy on household health outcomes by looking at infant mortality, low birth weights, and pre-term births in Nigeria. Specifically, the objectives of this study are to (i) examine the effect of access to energy on infant mortality (ii) investigate the effect of access to energy on low birth weight; and (iii) highlight the effect of access to energy on pre-term births.

This study is organized into six sections, section one is the background, section two contains the stylized facts on energy access and health outcomes. Section 3 is the literature review while section 4 and 5 contains the methodology and discussion of results, section six is the conclusion and policy recommendations.

2. Stylized facts on Health Outcomes and Energy Access in Nigeria

2.1 Overview of the Health System in Nigeria.

The Nigeria national health system is decentralized into a three-tier structure with responsibilities at the federal, state, and local government levels. All three tiers of government are concerned with the health system's functions and activities. At the federal level, the Federal Ministry of Health (FMOH) is in charge of policy formulations and technical support to the overall health system, representing the country on health matters, national health management information system, and provision of health services through the tertiary and teaching hospitals and national laboratories. The state-level ministries of health (SMOH) are responsible for the secondary hospitals and the regulation and technical support for primary health care services while the local-level ministries of health take care of the primary health services. Health is one of the indicators to measure the well-being of humans; the positive and negative outcomes of health can be employed to rank or rate the welfare of an individual. According to the World Health Organization (WHO), the health indicators for Nigeria are among the worst globally; the country shoulders 10 percent of the world's disease burden. Furthermore, the Nigerian health sector is facing a major human resources health crisis with the mal-distribution of the available workforce and the increasing brain drain resulting in a shortage of critically needed health professionals.

2.1.1 Child Health Outcomes in Nigeria

Neonatal mortality rate (NMR) is described as the number of children that died during the first 28 days of life (i.e. 0-27). The Measure Evaluation team states that NMR is the main outcome pointer for newborn care and directly mirrors prenatal, intrapartum, and neonatal care. This factor is different from the perinatal mortality rate because it focuses only on deaths among live births and covers a longer period after birth. WHO (2019) states that reducing the neonatal mortality rate is becoming essential not only because the proportions of under-five deaths that occur during the neonatal period are increasing as under-five mortality declines but also because the health involvements required to tackle the chief cause of neonatal deaths generally differ from those needed to address other under-five deaths. There is an adverse relationship between infant/ child mortality and neonatal mortality rate; as the infant mortality rate declines, the proportion of infant/ child deaths that occur in the neonatal period typically increases.

Infant mortality is the demise of young children under the age of one. Death is measured by the infant mortality rate indicated the number of deaths of children less than one year of age per 1000 births. Genowska et al. (2015) assert that many factors contribute to infant mortality which includes; the mother's educational attainment, environment quality, and political and medical infrastructure. They explained that improving sanitation, access to clean drinking water, and immunization against infectious diseases can help reduce high rates of infant mortality. According to UNICEF (2018), child mortality is defined as the deaths of children under the age of 14 and includes national mortality under-5 mortality and mortality of children aged 5-14. Since time immemorial, child mortality has been at the Centre of health discourse; government, health professionals, and policymakers have a unique stake in decreasing the incidence of childhood death rate globally (Adeyele and Ofoegbu, 2015).

The United Nations (UN) organization recommended that countries should base the measurement of their human development/welfare on health status i.e. child/infant/neonatal mortality rate. Adeyele and Ofoegbu (2015) assert that child deaths in Nigeria commonly emanate from several risk factors and avoidable diseases and mortality among children. Also, deaths during the 28 days of life (neonatal) are linked to the endogenous status of a child, quality of antenatal care, and whether aid was given during delivery and post-partum care. Furthermore, the infant mortality rate is mainly related to the wealth status of the households, environmental indicators, health behavior, and nutritional practices. Also, other features have been related to infant and child deaths, indicating, they include maternal education, early marriage, place of residence, regional variations, fertility behavior, breastfeeding practices, use of health services by mother and or child, ethnicity and religion.

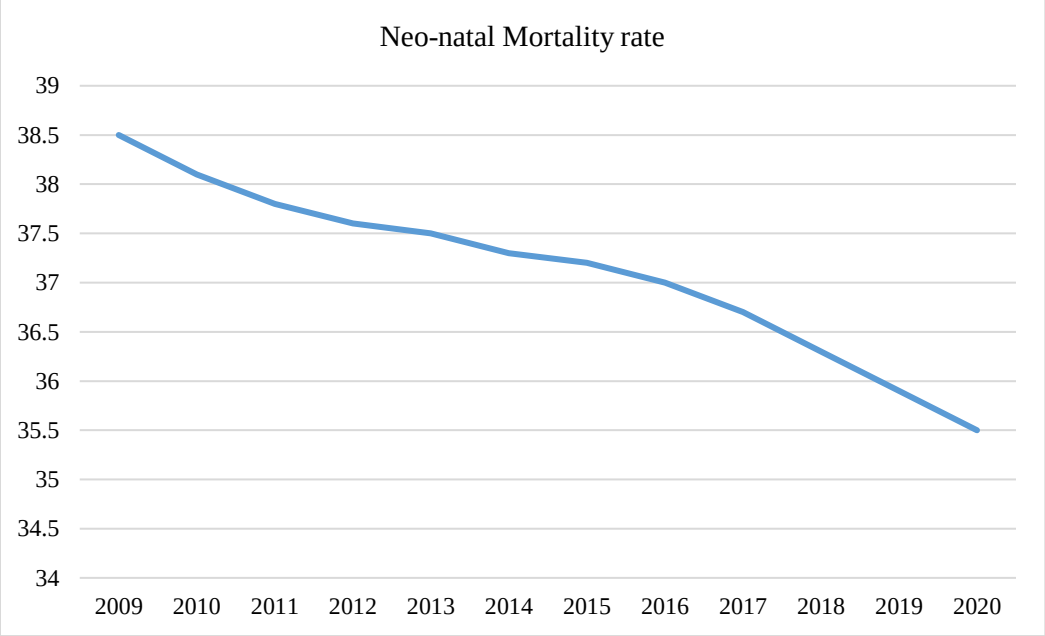

Fig 2.1 Trend Analysis of Neonatal mortality in Nigeria (per 1000 live births)
Source: *Author's representation, Knoema database*

The neonatal mortality rate is the number of neonates dying before reaching 28 days of age, per 1,000 live births in a given year. The neonatal mortality rate in Nigeria started on the high side; the death of babies during the first 28 days in the country was 38.5 deaths per 1000 live births in 2009 and it dropped to 38.1 deaths per 1000 live in 2010. In 2020, the neonatal mortality rate for

Nigeria was 35.5 deaths per 1,000 live births. The neonatal mortality rate in Nigeria fell gradually from 65 deaths per 1,000 live births in 1971 to 35.5 deaths per 1,000 live births in 2020.

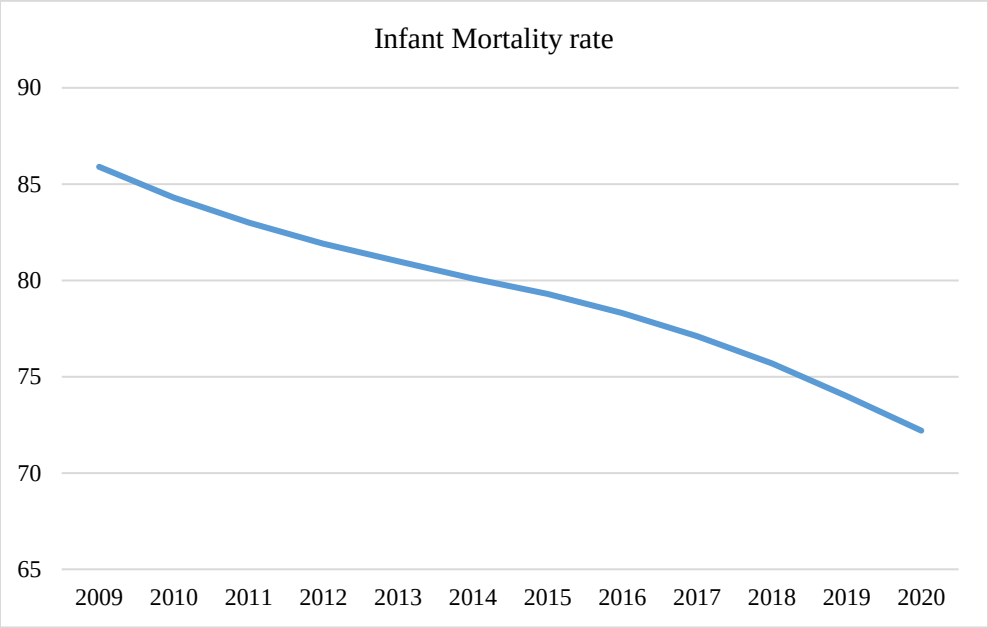

Fig 2.2 Trend Analysis of Infant mortality rate in Nigeria
Source: Author's representation, Knoema database

The infant mortality rate is the number of infants dying before reaching one year of age per 1,000 live births in a given year. The infant mortality in Nigeria was 85.9 deaths per 1000 live births in 2009, it decreased to 85.9 deaths per 1000 live births in 2010 and continued to be on decrease from 2009 until 2020. The infant mortality rate in the country gained an audience and attention was paid to it, thereby, the number of babies that dies before the age of one drastically and steadily reduced from the period it started dropping to date. In 2020, the infant mortality rate for Nigeria was 72.2 deaths per 1,000 live births. The infant mortality rate in Nigeria fell gradually from 163.8 deaths per 1,000 live births in 1971 to 72.2 deaths per 1,000 live births in 2020.

The under-five mortality rate is the probability per 1,000 live births that a newborn baby will die before reaching age five, if subject to current age-specific mortality rates. The under-five mortality rate likewise declined drastically in Nigeria, in 2009, the rate of under-five morality was 138.3 deaths per 1,000 live births, and this reduced to 135.5 deaths per 1,000 live births and continued to decline till 2020. In 2020, the child or under-five mortality rate was 113.8 deaths per 1,000 live births. The child mortality rate fell gradually from 278.6 deaths per 1,000 live births in 1971 to 113.8 deaths per 1,000 live births in 2020.

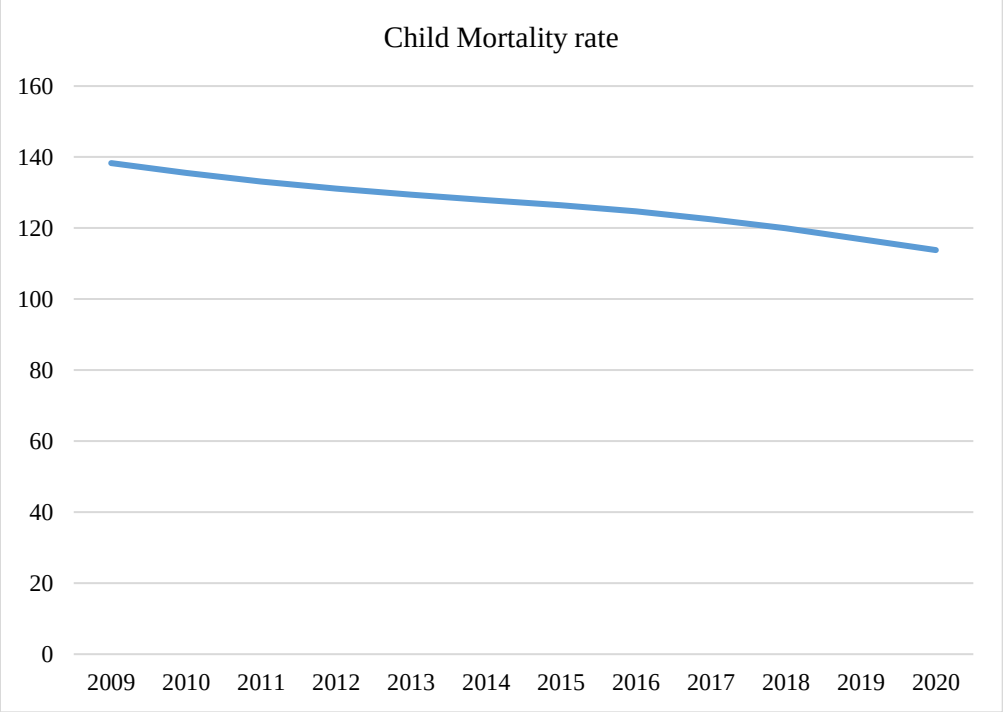

Fig 2.3 Trend analysis of Child Mortality rate in Nigeria

Source: Author's representation, kneoma database

Overview of Access to Energy in Nigeria

It is envisaged that by the year 2050, the world population would have risen by 70%, with cities attaining sizes not experienced before (United Nations (UN) 2017; Food Agriculture Organisation (FAO, 2009). This implies that the global energy demand will continue to increase since man's daily activity depends on energy. Energy is seen as an essential component of development that affects the peace, security, well-being, physical environment, and socio-economic growth of a nation (Jatau et al. 2006; Urban 2009; Ajah 2013). In terms of access to electricity, the share of the world's population having access to electricity grew from 83 percent in 2010 to 90 percent in 2018, an increase of more than a billion people. During this period, the number of people without access to electricity fell from about 1.2 billion to 789 million, outpacing the overall increase in population.

3. LITERATURE REVIEW

The neoclassical discourse on health broadly defined it to include longevity and illness-free days each year, which is both demanded and produced by consumers (Grossman, 1972). Since human beings are nothing but individualistic utility maximizers, then, it logically follows that health is desired by human beings because it generates utilities. Utility is generated from health in two ways. First, ill-health is painful, which is a source of disutility. Therefore, health enters the individual utility function directly with a positive influence on welfare. Second, health is viewed as a special kind of human capital, therefore, better health means more sick-free days available for an individual. With these sick-free days, people can go to the market and produce income (which ultimately turns into commodities), and leisure that ultimately generates utility. Therefore, health is not only a consumer good, but also it is a human capital, an investment good for the household production function. In the neoclassical framework, health care, age, income and education, environmental and lifestyle factors, and genetic factors are viewed as the determinants of health (Henderson, 2005).

Energy access is defined as a household having reliable and affordable access to both clean cooking facilities and to electricity which is enough to supply a basic bundle of energy services. It posits that modern energy is a fundamental prerequisite for overcoming poverty, improving health and enabling education. This definition serves as a benchmark to measure progress towards the attainment of sustainable development goal 7.1 which is to ensure affordable, reliable, sustainable modern energy for all by 2030.

The energy access framework revolves around the foundational concepts of the energy ladder theory. The theory is predicated on the economic theory of consumer behavior (Hosier and Kipondya, 1993), meaning that when income increases, households not only consume more of the same good they also shift to more sophisticated goods with higher quality. The main reason for the movement is that households preferred clean fuels, ease of use, and efficiency, modern fuels have these qualities unlike traditional fuels such as fuelwood, crop residues, and dung (Darazo and Babayo, 2016). The energy ladder theory expounds a strong correlation between income and household fuel choice, it portrays fuelwood as an inferior good and modern energy as superior good. However, re (Masera and Navia 1996) showed the deficiency of the energy ladder theory and argued that households tended to stack fuel rather that completely switch from one to the other.

Empirical literature has shown the factors affecting household health outcomes and especially under five to be the mother's educational level, wealth index, marital status, place of residence, sex of the child, region, maternal age at childbirth, number of children ever born, birth interval, and child-size at birth. Therefore, child health outcomes can be linked to social, economic, environmental, and demographic factors other than health-related factors (Wegbom et al. 2019). To examine whether health has yielded significant gains in child health in Nigeria, Jemiluyi et al. (2021) showed that there exists a long-run relationship between health aid and child health indicators, with aid having a reducing impact on the mortality indicators and a positive correlation with child immunization coverage. Also, public health expenditure, literacy rate, and urbanization rate are negatively correlated with measures of child mortality and positively correlated with the measures of immunization coverage. Except for infant mortality, the GDP growth rate has an insignificant effect on child health. In terms of maternal mortality in women of child bearing age (15-49), Meh et al. (2019) finds that there are variations in the levels of maternal mortality across the different regions in Nigeria, it was more pronounced in the northern region compared to other regions, however age and community wealth were significantly associated with maternal mortality in all regions.

The type of cooking fuel and appliance used is also said to contribute to health outcomes of women and children, therefore, understanding the determinants and usage of energy is important as well the accessibility to clean energy. Jewitta et al, (2020) explored how and why cooking system use and priorities vary over time and space in Nigeria. Cooking system choices were constrained by economic and access considerations linked to spatial-temporal variations in fuel cost, availability, and service quality coupled with socio-cultural and utilitarian influences on cooking practices. Fuel cost has been shown to be a critical obstacle in the adoption of clean cooking fuel, given this many households do not completely switch from the use of traditional fuel to clean fuels. Rather fuel stacking is the prevailing norm as only few households stop using firewood when adopting LPG, and both users and non-users have highly positive views of LPG as convenient and clean cooking fuel (Ajayi, 2018; Paudel et al, 2018). In Nigeria access to clean energy use includes residence area, household size, per capita expenditure, gender of household head, household ownership of housing unit, parents' educational levels, and poverty status of a household (Ogwumike et al, 2004; Ajayi, 2018; Onyekuru et al, 2020). In assessing the dimensions and consequences of household energy insecurity for women, infants, and children in low- and middle-income countries, three levels were found. Boateng et al, (2020) found three

dimensions of energy insecurity – physical, behavioral, and economic – and adverse consequences – psychosocial, disease, and nutrition as a suitable rubric for examining energy insecurity in low and middle-income countries. Likewise, Imran and Ozcatalbas (2020) examine the determinants of household cooking fuels and their impact on women's health in rural Pakistan. The results of the study show that 75.5% of the households in the study area use fuelwood, 44.4% use LPG, and 27.9% use crop residues for cooking. Health expenditures of households using biomass are almost 25% higher than those using LPG. The use of traditional biomass with traditional devices was found to be having negative impacts on rural women's life. For many African countries Owili et al, (2017), established that the use of solid cooking fuel increased the risk of under-five death in SSA. However, the use of cooking fuel and death of the under-five children varied between and within countries implying a lack of a single generalized result. Rehfuess et al, (2011) assessed the health effect of solid fuel use and found that a majority of the estimated 1.6 million annual premature deaths attributable to this risk factor occurred among children under five years of age. Roberman et al (2021), explored the adverse birth outcomes due to exposure to household air pollution from unclean cooking fuel among women of reproductive age in Nigeria and found that the risk of stillbirth is significantly higher for mothers using unclean cooking fuel. Oluwole et al, (2013) investigated the effect of stove intervention on household air pollution and the respiratory health of women and children in rural Nigeria. The study revealed that household biomass fuel use causes significant household air pollution, which increases the likelihood of respiratory symptoms and/or obstruction in those exposed to regular cooking with firewood causing household air pollution and compromised lung health.

These and many more studies employed the Nigerian Demographic and Health Survey (NDHS) 2013–2018 data set to analyze the effect of using unclean energy in the household on children and women. Their results showed that there was a highly significant relationship between the type of cooking fuel and under-five mortality in Nigeria (Ezeh et al, 2014; Olugbemisola et al, 2016, 2018; Ibrahim et al, 2022).

Inconclusion, while previous studies on this discourse appear to be increasing, the low number of studies focusing on access to energy and its impact on household health outcomes remain understudied. This study therefore, examined the effect of household cooking fuels on household health outcomes in Nigeria.

4. METHODOLOGY

This study adopts the model specified by Ibrahim et al, (2022), and is given as:

$$z_{it} = \beta_0 + \beta_1 EnergyAccess_{it} + \beta_2 X_{ivt} + \varepsilon_{it} \qquad (1)$$

Where, z_{it} denotes the health outcomes of a household i in time t; the health outcomes are proxy as infant deaths, pre-term births, and low birth weight. $EnergyAccess$ represents the access to energy for cooking in the household, it is generally classified into clean and unclean energy types. X denotes the control variables such as the maternal health behavior and demographic characteristics of the household. While ε_{it} represents the error term or disturbance term.

The Nigeria Demographic Health Survey (NDHS) 2018 dataset was used The NDHS is a nationally representative cross-sectional household survey that gives information on the population and health of Nigerian households. Women between the ages of 15 and 49 were interviewed about sexual and reproductive health, nutrition, family, and other demographic factors. The survey instrument also includes several additional items such as ethnicity, education, and household assets. The survey classically covered several thousand respondents nationally, representing urban and rural areas and provinces/states. The survey is conducted every four to

five years, with the same questions asked in each survey to simplify comparisons across time and space. Using the three-stage stratified and multistage cluster sample designs; 33,924 mothers were interviewed.

Table 4.1: Data Description and Measures

Measures	Description
Child age	In months
Number of Households	In figure
Infant Deaths	Dummy (= 1 if a child dies before 24 months, 0 otherwise)
Low Birth Weight	Dummy (= 1 if child has a weight >2,500 grams, 0 otherwise)
Pre-Birth Term	Dummy (= 1 if a pregnant woman gives birth before 9 months, 0 otherwise)
Access to Energy	Dummy (= 1 if access is an unclean energy source, 0 otherwise)
Iron intake	Dummy (= 1 if a pregnant woman received iron vitamins, 0 otherwise)
Malaria	Dummy (= 1 if a pregnant woman suffers malaria, 0 otherwise)
Sufficient antenatal visit	Dummy (= 1 if a pregnant woman has at least eight antenatal visits, 0 otherwise)
Higher Education	Dummy (1=Higher education, 0= others)
Secondary	Dummy (1= secondary education, 0= others)
Primary	Dummy (1= primary qualification, 0==others)
No education	Dummy (1=No education, 0=others)
Child gender	Dummy (1=Male, 0=Female)
Christianity	Dummy (1=Christianity, 0=Others)
Islam	Dummy (1=Islam, 0= otherwise)
Wealth Index	Dummy (1=Middle and Rich households, 0=poor, poorer, and poorest households)
Residence Area	Dummy (1= rural, 0=urban area)

Estimation Technique

The logistic regression model is adopted due to the dichotomous nature of the two dependent variables. A dichotomous dependent variable violates the linear regression model's homoscedasticity and normalcy requirements, as Allison (1999) shows. Additionally, using the ordinary least squares method to estimate a linear probability model will result in predicted values that are outside the probability's range of probable values (0,1). These factors lead to the use of the logistic regression model when the dependent variable is binary. This model converts probability to odds before taking the odds' logarithm. By doing this, the probability's lower and upper bounds are eliminated (Niu, 2018).

The logistic regression model is specified as:

$$logit\ Z_{it} = \left[{}^{Z_{it}}/_{1 - Z_{it}}\right] = \beta_0 + \beta_1 EnergyAccess_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (2)$$

Where z_{it} denotes the proportion of mothers in a household who have experienced infant deaths, pre-term births, and low birth weight. $EnergyAccess$ represents the access to energy for cooking in the household, it is generally classified into clean and unclean energy types. X denotes the control variables such as the maternal health behavior and demographic characteristics of the household. While β_0 and β_1 are the regression parameters and ε_{it} represents the error term or disturbance term.

5. Presentation and Discussion of Findings

Descriptive Statistics of the Data

Child age in months and the size of the household stood at 28.37 and 7.08, respectively. This implied that the average age of a child in the survey is 28 months which is roughly two years and four months and the average number of households in the survey is seven. Only 6.68 percent of children died before the age of one; this implied that for every 100 live births, roughly 7 children died before they reach one year. While 3.09 percent of the children a low birth weight. According to World Health Organization (WHO), low birth weight is calculated as the weight of a new birth lower than or equal to 2,500 grams. This implied that only 3.09 percent of the children born weighed less than 2,500 grams and 1.05 percent of the children were pre-term birth.

For the energy type used for cooking, the table showed that only 7.33 percent of the respondents have access to electricity and gas as primary cooking fuel, 7.88 percent use kerosene for cooking, 5.26 percent used charcoal while 76.16 percent used firewood as a means of energy for cooking. This showed that most of the respondents rely on unclean energy sources to cook their daily meals despite the growing concerns about how unclean energy access affects the health outcomes of households. Maternal behaviour showed that 44.65 percent of the women confirmed iron intake during pregnancy which has been confirmed by WHO to be essential to meet the new demand for extra blood volume. Also, 40.40 percent of the women suffered malaria during pregnancy. Meanwhile, only 48.8 percent of the women had sufficient antenatal visits during pregnancy. 34.49 percent lived in rural areas while 65.51 percent lived in urban areas. Only 21.54 percent of the children are vaccinated while 78.46 percent are not vaccinated.

Table 5.1: Descriptive Statistics

Variables	Observations	Mean	Std. Dev
Child Age (in months)	11,704	28.37	17.28
Number of Household	33,924	7.08	3.77
	Observations	**Frequency**	**Percentage**
		Child Health Outcomes	
Infant Deaths	33,924	2,266	6.68
Low Birth Weight	33,924	1,049	3.09
Pre-Birth Term	33,924	356	1.05
		Energy Type	
Electricity and Gas	33,924	2,487	7.33
Kerosene	33,924	2,674	7.88
Charcoal	33,924	1,785	5.26
Wood	33,924	25,835	76.16
		Maternal Behaviour	
Iron Intake	33,924	15,147	44.65
Malaria Parasite	33,924	13,705	40.40
Sufficient Antenatal visits	33,924	16,556	48.80
		Demographic Characteristics	
Child Gender	33,924	16,667	49.13
Wealth Index	33,924	15,809	46.60
Mother's Employment	33,924	22,837	67.32
Residence Area	33,924	11,699	34.49
Hospital Visit	33,924	18,361	54.12
Child Vaccination	33,924	7,307	21.54
Maternal Education			
No Education	33,924	15,391	45.37
Primary	33,924	5,274	15.55
Secondary	33,924	10,623	31.31
Higher Education	33,924	2,636	7,77
Religion			
Christianity	33,924	13,239	39.03
Islam	33,924	20,412	60.17
Others	33,924	273	0.80

Table 5.2 presents the result of the logistic regression estimation approach. The first model assesses the probability of children dying or not before age one. The second model examined the probability of a child having low birth weight, while the third model explains the probability of a mother going through a pre-birth term. For all three models, the effect of unclean energy access and other variables are investigated to achieve the stated objectives of the study.

The results indicate that access to unclean energy increased the likelihood that a child will die before his/her first birthday by 75.8 percent and the effect as shown is statistically significant at a 1% level. This implies that a child exposed to unclean energy types such as wood, charcoal, grass, etc. used for cooking in the household will likely die before the first birthday as compared to a child not exposed to unclean source of energy. The result corroborates the findings of Owili et al, (2017), Rehfuess et al, (2011), and Olugbemisola et al, (2016) that the use of unclean energy sources is detrimental to the health outcomes of a child. Especially, Rehfuess et al, (2011) explain that solid fuel use is attributable to 1.6 million annual premature deaths of children. More so, Olugbemisola et al, (2016) find that fewer cases of child deaths were reported in households where electricity or gas was used as the source of cooking fuels as opposed to wood, charcoal, or grass.

In terms of the effect of maternal behaviour such as iron intake, malaria, and adequate antenatal visits on infant deaths. The result reports that iron intake has no statistically significant effect on infant deaths; this could be explained that the iron intake does not affect the post-birth health of a child. On the other hand, a mother that suffered from malaria during pregnancy is likely to have a child that would die before the first birthday. Meanwhile, adequate antenatal visits (at least 8 visits) reduce the likelihood that a child will die before clocking age one. The result shows that a child whose mother has sufficient antenatal visits will be less likely not to die by 33 percent compared to a child the mother did not go through sufficient antenatal care.

Table 5.2: The Logistic Regression Model Result

Variables	Infant Deaths	Low-term Weight	Pre-birth term
Unclean Energy	0.758***	0.405***	0.457***
	(0.280)	(0.085)	(0.165)
Iron Intake	0.018	0.029	-0.560***
	(0.143)	(0.091)	(0.157)
Malaria	0.346**	0.331***	-0.039
	(0.150)	(0.090)	(0.158)
Sufficient antenatal	-0.326***	0.758***	0.031
	(0.102)	(0.107)	(0.134)
Male child	-0.132*	0.198***	-0.151
	(0.079)	(0.064)	(0.107)
Mother's education	-0.056	0.039	-0.017
	(0.112)	(0.091)	(0.150)
Rich household	-0.451***	-1.156***	-0.370***
	(0.092)	(0.098)	(0.134)
Residence Area	0.083	0.430***	0.307**
	(0.104)	(0.072)	(0.125)
Household size	-0.007	-0.071***	-0.045***
	(0.010)	(0.011)	(0.017)
_cons	1.451***	-3.845***	-3.970***
	(0.176)	(0.164)	(0.237)
Observations	3,211	33,924	33,924
LR chi2(9)	89.97	787.17	78.30
Prob > chi2	0.000	0.000	0.000

*** p>0.001, ** p>0.05, and * p>0.1 Data source: Nigerian Demographic Health Survey, 2018.

Likewise, the results present that there is no statistically significant effect of a mother's educational qualification on infant deaths. This shows that whether a mother is educated or not educated has no significant effect on the probability that a child died before the first birthday. Additionally, the residence area (rural area) and the household size were shown to have no statistically significant impact on infant deaths.

For objective 2, the table indicates that access to unclean energy increased the likelihood that a child will have low weight (i.e < 2,500 grams) at birth by 40.5 percent and the effect is shown as statistically significant at a 1% level. This implied that pregnant women exposed to unclean energy type used for cooking in the household will likely have a child with low birth weight compared to pregnant women not exposed to these unclean sources of energy for cooking. The finding aligns with the study of Ibrahim et al, (2022) that household use of unclean source of energy such as charcoal significantly increased the risk of low birth weight. However, it contradicts the study of Roberman et al (2021) that exposure to unclean fuel was not significantly associated with low birth weight. This study however established that exposure to unclean energy increased the risk of stillbirths in Nigeria but not low birth weight as explained in the study of Ibrahim et al, (2022).

The effect of iron intake, malaria, and adequate antenatal visits on low birth weight showed that iron intake has no statistically significant effect on low birth weight. Whereas, the result showed that a mother that suffered from malaria during pregnancy is likely to have a child that weigh less than 2,500 grams (low birth weight) compared to women who do not suffer from serious malaria. Surprisingly, sufficient antenatal visits increase the likelihood that a child will have a low birth weight. The result shows that a child whose mother has sufficient antenatal visits will more likely not weigh 2,500 grams by 75 percent compared to a child the mother did not go through sufficient antenatal care.

The third objective which is on the effect of energy access on pre-term birth. The results show that access to unclean energy increased the risk of pre-term births (pre-mature babies; before 9 months) for women by 45.7 percent. This implied that exposure to unclean energy types used for cooking in the household increased the risk of pre-term births. The finding aligns with the study of Ibrahim et al, (2022) that household use of the unclean source of energy such as charcoal significantly increased the risk of pregnant women having pre-term babies. However, it contradicts the study of Roberman et al (2021) that exposure to unclean fuel is not significantly associated with pre-term birth. This study however established that exposure to unclean energy increased the risk of stillbirths in Nigeria.

Household use of biomass fuel has long been attributed to adverse pregnancy outcomes among women and child health outcomes in especially developing countries. The dominant use of cooking fuels such as firewood, charcoal, coal, lignite, and kerosene are major emitters of toxic gasses such as particulate matter, carbon monoxide, formaldehyde, nitrogen dioxide, ozone, and polycyclic aromatic hydrocarbons (PAH) (Fatmi et al, 2010). These energy types have unfortunately been found to increase the risk of perinatal mortality, low birth weight, miscarriage, pre-term births, hemorrhage, small for gestational age, and hypertensive disorder in especially expecting women. Sadly, in Nigeria, only less than 5% of households have access to clean cooking fuels compared to Egypt (97.6%) and South Africa (84.8%). The study concluded that unclean energy has an accelerating effect on infant deaths, low birth weight, and pre-term births for households in Nigeria. The findings of the study align with those of Owili et al, (2017), Rehfuess et al, (2011), Olugbemisola et al, (2016), and Ibrahim et al, (2022).

6. Policy Recommendations

Inconclusion, The dominant use of cooking fuels such as wood strews, charcoal, coal, lignite, and kerosene are major emitters of toxic gasses such as particulate matter, carbon monoxide, formaldehyde, nitrogen dioxide, ozone, and polycyclic aromatic hydrocarbons (PAH) (Fatmi et al, 2010). These energy types have unfortunately been found to increase the risk of perinatal mortality, low birth weight, miscarriage, pre-term births, hemorrhage, small for gestational age, and hypertensive disorder in especially expecting women.

It is recommended that targeted policies that seek to upscale efficient cooking technologies such as improved cooking stoves should be decisively pursued. In addition, improving rural electrification and encouraging investment in appliances such as electric stoves and refrigerators can minimize exposure to gasses from biomass combustion and reduce the frequency and duration of cooking time; thus, allowing women to reallocate spared time into income-earning engagements. There should be access to good health care facilities, improved earning ability, water, and sanitation as they are indispensable parts of household health outcomes and are the ultimate in the development process.

REFERENCES

Adeyele I.T. and ofoegbu D.I. (2013). Infant and Child Mortality in Nigeria: An Impact Analysis. IJEPT, 3(2):122-132.

Ajah J (2013) Households' access and preference to cooking fuels in Abuja, Nigeria. J Environ Sci Technology 6(2):91–98.

Ajayi, P.I (2018), Urban Household Energy Demand in Southwest Nigeria. African Development Review. Vol. 30 No. 4 pp 410-422.

Alem, Y., Beyene, A. D., Kohlin, G., & Mekonnen, A. (2015). Household fuel choice in urban Ethiopia: A Random Effects Multinomial Logit Analysis. Environment for development Discussion Paper 13–12.

Alkema, L., D. Chou, D. Hogan, S. Zhang, A. Moller, A. Gemmill, D. Ma Fat, T. Boerma, M. Termmerman, C, Mathers and L. Say (2016), PubMed DOI: 10.16/50140-6736(15)00838-7

Amegah, K.A., Jaakkola, J.K.J., Quansah, R., Norgbe, K.G., & Dzodzomenyo, M. (2012). Cooking fuel choices and garbage burning practices as determinants of birth weight: A cross-sectional study in Accra, Ghana. Environmental Health 2012, 11:78. http://www.ehjournal.net/content/11/1/78

Boateng, G. O., Balogun, M. R., Dada, F. O., & Armah, F. A. (2020). Household energy insecurity: dimensions and consequences for women, infants and children in low- and middle-income countries. *Social Science and Medicine*, *258*, 113068. https://doi.org/10.1016/j.socscimed.2020.113068

Boy E, Bruce N. (2002). Birth weight and exposure to kitchen wood smoke during pregnancy in Guatemala. Environ Health Perspect 110(1):109–114.

Bruce N, Rehfuess E, Mehta S, Hutton G, Smith K, Asia S. (2006). Indoor Air Pollution. Washington: World Bank.

Cooke P, Kohlin G, Hyde W. (2008). Fuelwood, forests, and community management: evidence from household studies. Environ Dev Econ, 13(1):103–135.

Dioha, M. O., & Emodi, N. V. (2019). Investigating the impacts of energy access scenarios in the Nigerian household sector by 2030. *Resources*, *8*(3). https://doi.org/10.3390/resources8030127

Dioha, M.O. (2018). Nigeria's Renewable Energy Policy: A Fantasy or Reality? Renew Energy World. https://www.renewableenergyworld.com/ugc/articles/2018/11/29/nigerias-renewable-energy-policy-a-fantasy-or-reality.html

Emodi, N.V.; Emodi, C.C.; Murthy, G.P.; Emodi, A.S. (2017). Energy policy for low carbon development in Nigeria: A LEAP model application. Renew. Sustain. Energy Rev, 68, 247–261.

Ezeh, O. K., Agho, K. E., Dibley, M. J., Hall, J. J., & Page, A. N. (2014). The effect of solid fuel use on childhood mortality in Nigeria: Evidence from the 2013 cross-sectional household survey. *Environmental Health: A Global Access Science Source*, *13*(1), 1–10. https://doi.org/10.1186/1476-069X-13-113

Genowska A., Jamiolkowski, J., Szafraniec, K., Stephaniak, U., Szpak, A., and Pajak, A. (2015). Environmental and Socio-economic determinants of infant mortality in Poland: An Ecological Study. Environmental Health, 14(1), 61.

Grossman, M. (1972). On the concept of health capital and the demand for health. Journal of Political Economy 80:223-55

Heltberg R (2004) Fuel switching: evidence from eight developing countries. Energy Econ 26:869–887.

Henderson, J. 2005. Health Economics & Policy. New York: Thomson

Hogan, M.C., K.J. Foreman, M. Naghavi (2010), Maternal mortality for 181 countries 1980-2008: A Systematic analysis of progress towards the millennium development goals. Lancet, 375, 1609-1623. doi:10.1016/S0140-6736(10)60518-1

IEA (2016) World energy outlook 2016. Pari, France, International Energy Agency, p 2016
IEA (2017). World energy outlook 2018. Pari, France, International Energy Agency, p 2018

Imran, M., & Ozcatalbas, O. (2020). Determinants of household cooking fuels and their impact on women's health in rural Pakistan. *Environmental Science and Pollution Research*, *27*(19), 23849–23861. https://doi.org/10.1007/s11356-020-08701-8

International Centre for Energy Environment and Development. (ICEED, 2019). 120 million Nigerians especially women, vulnerable to dangers of firewood smoke. http://iceednigeria.org/ic/120-million-nigerian-women-vulnerable-to-dangers-of-firewood-smoke-expert/

International Energy Agency's (IEA). (2014). Africa energy outlook e A Special report in the 2014 world energy outlook series. Paris: OECD/IEA.

Jatau D, Dishan E, Bonkary H (2006) Domestic energy consumption pattern in Zinder State, Niger Republic. In: Proceedings of the 31st annual conference of the Forestry Association of Nigeria, 351–358.

Jewitt, S., Atagher, P., & Clifford, M. (2020). "We cannot stop cooking": Stove stacking, seasonality and the risky practices of household cookstove transitions in Nigeria. *Energy Research and Social Science*, *61*(May 2019), 101340. https://doi.org/10.1016/j.erss.2019.101340

Liu, Z., Li, J., Rommel, J., & Feng, S. (2020). Health impacts of cooking fuel choice in rural China. *Energy Economics*, *89*, 104811. https://doi.org/10.1016/j.eneco.2020.104811

Masera, O. and Navia, J. (1997), Fuel Switching or Multiple Cooking Fuels? Understanding inter-fuel substitution patterns in rural Mexican households'', *Biomass and Bioenergy,* 12(5), pp. 347-361.

Meh, C., A. Thind, B. Riyan and A. Terry (2019), Levels and Determinants of Maternal Mortality in Northern and Southern Nigeria. BMC Pregnancy and Childbirth 19: 417 pp 1-13

Niu, L. (2018). A review of the adoption of logistic regression in educational research: Common issues, implications, and suggestions. Educational Review. Advance online publication.

Ogwumike, F. O., Ozughalu, U. M., & Abiona, G. A. (2014). Household energy use and determinants: Evidence from Nigeria. *International Journal of Energy Economics and Policy*, *4*(2), 248–262.

Olisakee, G. O. (2014), Energy Poverty and under five mortality in Nigeria: Is there a link? Retrieved from http://www.consultancyafrica.com/index.php?option=com_content

Oluwagbemisola Samuel W, A. (2016). Levels and Trends in Household Source of Cooking Fuel in Nigeria: Implications on Under-Five Mortality. *Health Science Journal*, *10*(4), 1–5. https://www.hsj.gr/medicine/levels-and-trends-in-household-source-of-cooking-fuel-in-

Oluwole, O., Ana, G. R., Arinola, G. O., Wiskel, T., Falusi, A. G., Huo, D., Olopade, O. I., & Olopade, C. O. (2013). Effect of stove intervention on household air pollution and the respiratory health of women and children in rural Nigeria. *Air Quality, Atmosphere and Health*, *6*(3), 553–561. https://doi.org/10.1007/s11869-013-0196-9

Onyekuru, N. A., Ifejirika, C. A., Onuigbo, D. M., Mebo, R. A., & Eboh, E. C. (2020). Factors affecting households' choice of cooking energy in Enugu State, Nigeria. *Agro-Science*, *19*(4), 6–13. https://doi.org/10.4314/as.v19i4.2

Owili, P. O., Muga, M. A., Pan, W. C., & Kuo, H. W. (2017). Cooking fuel and risk of under-five mortality in 23 Sub-Saharan African countries: a population-based study. *International Journal of Environmental Health Research*, *27*(3), 191–204. https://doi.org/10.1080/09603123.2017.1332347

Oyedepo, S.O. (2012). On energy for sustainable development in Nigeria, Renew. Sustain. Energy Rev. 16, 2583–2598.

Paudel, U., Khatri, U., & Pant, K. P. (2018). Understanding the determinants of household cooking fuel choice in Afghanistan: A multinomial logit estimation. *Energy*, *156*, 55–62. https://doi.org/10.1016/j.energy.2018.05.085

Rehfuess, E. A., Bruce, N. G., & Smith, K. R. (2011). Solid Fuel Use: Health Effect. *Encyclopedia of Environmental Health*, 150–161. https://doi.org/10.1016/B978-0-444-52272-6.00716-9

Roberman, J., Emeto, T. I., & Adegboye, O. A. (2021). Adverse birth outcomes due to exposure to household air pollution from unclean cooking fuel among women of reproductive age in Nigeria. *International Journal of Environmental Research and Public Health*, *18*(2), 1–15. https://doi.org/10.3390/ijerph18020634

Sana, A., Meda, N., Badoum, G., Kafando, B., & Bouland, C. (2019). Primary cooking fuel choice and respiratory

health outcomes among women in charge of household cooking in ouagadougou, Burkina faso: Cross-sectional study. *International Journal of Environmental Research and Public Health*, *16*(6). https://doi.org/10.3390/ijerph16061040

Shittu, I. (2022a). *Effect of Households' Primary Cooking Fuel on Infant ' s Acute Respiratory Effect of Households ' Primary Cooking Fuel on Infant ' s Acute Respiratory Infection in Nigeria*. *January*, 0–14.

Shittu, I. (2022b). *Impact of Households' Primary Cooking Fuel on Low-Birth Weight and Pre term Birth in Nigeria*. *January*, 0–16.

Tripathi, Alok, Sagar, Ambuj D., Smith, Kirk R. (2015). Promoting clean and affordable cooking: smarter subsidies for LPG. Econ. Political Wkly. 50(48), 81.

UNICEF (2018). 2018 Annual Report: For every Child in West and Central Africa.

Urban F (2009). Sustainable energy for developing countries: modelling transitions to renewal clean energy in rapidly developing countries. http://www.rug.nl/research/portal.

WHO (2002). World Health Organisation. The health effects of indoor air pollution exposure in developing country. http://apps.who.int/iris/bitstream/handle/10665/67496/WHO_SDE_OEH_02.05.pdf;jsessionid=416F3548094ED48008583F32EFEDDAB4?sequence=1

WHO (2006). World Health Organisation. Evaluating household energy and health interventions: a catalog of methods. World Health Organization, Geneva.

World Bank (2021). World Development Indicators. World Bank.

World Bank. (2012). Fuel Price subsidies in sub-Saharan Africa, Africa's pulse. Washington, DC:

World Health Organization, United Nations Environment Programme (2010). Healthy environments for healthy children: key messages for action. Geneva: World Health Organization.

World Health Organization. (2015). Burden of disease from Household Air Pollution for 2012. Geneva.http://www.who.int/phe/health_topics/outdoorair/databases/HAP_BoD_results_March2014.pdf

World Health Organization. (2019). Global Health Observatory Data: Causes of Child Mortality; World Health Organization: Geneva, Switzerland.