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IMPACT ANALYSIS OF AIR POLLUTION AND UNDER-FIVE MORTALITY, 2010-2021: EVIDENCE FROM LIQUID FUELS ENERGY CONSUMPTION IN NIGERIA

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ABSTRACT

This paper examined the impact of emissions from the use of liquid fuels (kerosene, diesel and natural gas) as sources of energy at homes and industries on the death rate of children below the age of five years in Nigeria. Nigeria as an oil producing country is dependent on the oil for at homes and industries without much consideration for the adverse effect of this practice. Ex-post-facto research design and time series data from 2010-2021 sourced from the World Bank data bank were used in the study. To avoid spurious results, the time series data for the study were subjected to unit root test using Augmented Dickey Fuller. The variables were found to be stationary at levels. Results of the Ordinary Least Square multiple regression analyses reveal positive and significant relationships between kerosene and diesel emissions and infant mortality rate in Nigeria thereby accepting the alternative hypotheses for the variables and rejecting the null. However, the association between natural gas emission and infant mortality is negative and insignificant thereby accepting the null hypothesis and rejecting the alternative. The results indicate that increase in the use of kerosene and diesel as sources of energy will undoubtedly lead to increase in infant mortality while the use of natural gas reduces the death rate of infants in Nigeria. It is therefore recommended among others that government should make natural gas affordable to the public since it is the cleaner energy source.

Keywords: Liquid fuels, Under-five mortality, Air Pollution, Unit Root.

Introduction

Among the challenges to human health and life is air pollution. Yet, improvements on air quality and general environmental conditions seem to have been relegated to the background in some less developed countries in pursuance of economic growth and technological advancement. Air pollution is often attributed to sources of energy among which are: petrol, coal, and natural gas. These fossil fuels are non-renewable sources of energy because they form through natural processes after millions of years. Deposits of fossil fuels are not found in many countries of the world. Nevertheless, petroleum (crude oil) of various sizes are found in some countries such as Kuwait, United States of America, Mexico, Venezuela, Saudi Arabia, Morocco, Libya, Nigeria and others. Other countries depend on the oil production strength of these producing countries.

Following the discovery of crude oil in its commercial quantity in 1959, the refining (to an extent), and high rate of use of such products derived from the crude oil as gasoline, diesel, kerosene, etc., there was a swift shift from the use of coal which used to be the highest source

of fuel energy in the country. This study therefore investigates the impact of air pollution emanating from the use of the liquid fuels in the country particularly on infants in the country.

Statement of the Problem

However important the advent of crude oil is to Nigeria, the negative effects of the burning of the fuels derived from it cannot be evenly tackled. The carbon dioxide, carbon monoxide, lead, nitrogen oxides, particulate matter, polycyclic aromatic hydrocarbons, sulfur dioxide , and volatile organic compounds resulting from the consumption of the petroleum derived products are toxic and hazardous to human health. Washington, DC (2016) reported air pollution as emerging the deadliest form of pollution as well as the fourth highest risk factor for premature deaths causing the world economy about 225 billion US dollars in lost labor income in 2013. World Bank and Institute for Health Metrics and Evaluation ((2016) estimated the number of lives lost in the year 2016 as a result of air pollution as 5.5 million and projected that an average 1.8 million people would die prematurely each year between 2001 and 2020 because of air pollution. For World Health Organization (2016), 92 percent of the world's population is exposed to unsafe levels of air pollution. According to Murray (2016), the burden of disease associated with air pollution is an urgent call for action because, of all the different risk factors for premature deaths, air is one area over which individuals have little control. Consequently there is a growing demand to address the problem of air pollution and the sources particularly in developing countries such as Nigeria.

Objectives of the Study

The major objective of this study is to ascertain the relationship between air pollution from liquid fuels as sources of energy and the rate of death of children below the age of five years in Nigeria. Specifically, the study will reveal:

1. The relationship between air pollution the use of kerosene and Under-5 mortality in Nigeria
2. The extent to which emissions from the use of diesel impacts on infant mortality in Nigeria
3. The association between emissions from use of natural gas as source of energy and infant mortality in Nigeria.

Research Questions

This study will answer questions such as:

1. To what extent has emission from the use of kerosene affected the rate of infant mortality in Nigeria?
2. What is the relationship between air pollution from the use of diesel and infant mortality in Nigeria?
3. How has the air pollution from natural gas impacted on Under-5 mortality in Nigeria?

Hypothesis

To be tested in the study are:

Ho1: There is no significant relationship between air emission from use of kerosene and Under-five mortality in Nigeria.

Ho2: The association between air emission from diesel and infant mortality is not significant.

H03: Air emission from the use of natural gas as source of energy is not significantly linked to infant mortality in Nigeria.

Significance of the study

The study is important and relevant because:

1. the knowledge from it will make developing countries committed to legal environmental obligations as well as set emissions targets.
2. the knowledge of the dangers of air pollution from liquid fuels consumption will reveal to economic agents the need for cleaner energy use.

Scope of the Study

In this study, Nigeria will be used as a case study for the years 2010-2021. Time series secondary data will be use. The scope of the study is informed by increase in the number of pollution control measures adopted in the country within the period without a corresponding decrease in the under-five mortality rate. The study will be limited by scarcity of quality data for the variables.

Review of related literature

Liquid fuels are sources of energy for heating, lighting and locomotion. They are particularly, the most convenient fuels for internal combustion engine and cooking at homes. These uses have increased rapidly in importance with the coming of the motor car and a wide range of other appliances (Robert and Ralph, 2017). Liquid fuels are those combustible or energy-generating molecules that can be harnessed to create mechanical energy. Liquid fuels in widespread use include natural gas, diesel, and kerosene (Domenic, 2012). Carl, Jevons, and Leon (1870) propounded the theory of marginality. Marginality is one of the fundamental economic theories that seek a level of operation of an economic activity that will give an optimum net gain. The net gain is the difference between the benefits and costs of an economic activity. The cost and benefit derivable from any economic activity (production or consumption) increases simultaneously. However, cost will rise faster than benefit because of diminishing returns from each of the further units employed or consumed. When the benefit derived from increasing the activity equals the cost of increasing the activity, that activity is said to be maximized. Increasing the activity after the maximum level is reached will cost more than the benefit derived. This theory can be applied to the use of liquid fuels and the costs from them. Empirical literature is replete with the harmful role of petroleum derived air pollution in humans and climate. Naz, Page and Agho (2017) study reveals that household air pollution mainly from cooking fuel is one of the major causes of respiratory illness and deaths among young children in low and middle-income countries like Pakistan. Multi-level logistic regression models were used to examine the association between household air pollution and under-five mortality in a total of 11,507 living children across four age-groups (neonatal aged 0–28 days, post-neonatal aged 1–11 months, child aged 12–59 months and under-five aged 0–59 months). The result shows a weak association of using cooking fuel with total under-five mortality. However, there was stronger association evident for sub-group analyses of children aged 12–59 months. In the study to ascertain whether the effect of pollution on infant mortality differ between developing countries with evidence from Mexico City, Eva, Rema, and Paulina (2012) estimated the relationship between pollution and infant mortality using data from Mexico and the finding was that an increase of 1 part per billion in carbon monoxide over the previous week results in 0.0032 deaths per 100,000 births

while a 1 μg/m^3 increase in particulate matter (pm_{10}) results in 0.24 infant deaths per 100,000 births. According to Resul, Erdal, and Aydogan (2016), in the same study with evidence from the expansion of natural gas infrastructure, the result of the analysis which used variation across provinces in Turkey and over time in the intensity of natural gas utilization revealed that the expansion of natural gas infrastructure yielded a significant decrease in the rate of infant mortality therefore advocating natural gas as a cleaner energy. Luechinger (2014) is not left out in the search for the association between infant mortality and air pollution. The natural experiment from power plant desulfurization was used to estimate the effect of SO_2 pollution on infant mortality in Germany, 1985-2003. The study exploited the natural experiment created by the mandated desulfurization at power plants and power plants' location and prevailing wind directions, to determine the treatment intensity for countries. The result of the estimate shows elasticity of 0.07 – 0.13 and the indicated decrease in pollution suggests an annual increase of 826 – 1460 infant lives.

However, none of the scholars in the reviewed literature has been able to dichotomize the level of the effects of the different liquid fuels effects on infant mortality in Nigeria within the time frame of this study. This is precisely what this paper wishes to achieve.

Research Methodology

Ex-post-facto research design was used in the study to establish the relationship between liquid fuels emissions and infant mortality in Nigeria. To eliminate spurious regression results emanating from non-stationarity of time series data, this study has subjected the data for the variables under study to unit root test using Augmented Dickey Fuller test. The afore-stated hypotheses were tested using Least Square technique. The study is modeled after that of Naz, Page and Agho (2017) that studied the association between household air pollution and under-five mortality in a total of 11,507 living children across four age-groups (neonatal aged 0–28 days, post-neonatal aged 1–11 months, child aged 12–59 months and under-five aged 0–59 months). However, this study is specific in stating the sources of the air pollution and regressing same on the mortality rate of infants only and in Nigeria specifically. The relationship therefore is thus specified:

$U5 = a_0 + a_1K + a_2D + a3G + u$…….. (1)

Where:

U5 = Under-5 mortality rate

K = emissions from kerosene

D = emissions from diesel

G = emissions from natural gas

a_0 = intercept (constant) of the model

a_1, a_2, and a_3 = unknown coefficients of the model to be estimated

u = Stochastic error term.

It a priori expected that the association between the independent variables (kerosene, diesel and natural gas emissions) have positive impacts on infant mortality in Nigeria.

Data Presentation, Analysis and Interpretation of Results

Time series data from 2010-2021 sourced from the World Bank data bank is used in the analysis of the relationship that obtains between the emissions from three liquid fuels often used in Nigeria as sources of energy and infant mortality rate.

Below are the results of the Augmented Dickey Fuller Unit Root Test:

Table 4.1: Unit Root Test (Augmented Dickey Fuller)

Variables	t-statistic @ I(0)	Order of Integration
U5	-4.658427	1(0)
K	-5.503165	1(0)
D	-4.135859	1(0)
G	-6.435094	1(0)
Test Critical values:		
1% Level	-4.297073	
5% Level	-3.212696	
10 Level	-2.747676	

Source: Extracted from Eviews8 output

Information from the table above shows that all the variables are stationary at levels. The study therefore used the OLS technique to estimate the link between the independent variables and the Under-5 mortality rate in the country within the time frame.

Table 4.2: Summary of the Ordinary Least Square Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	85.21966	6.134426	13.89203	0.000
K	2.68525	1.309397	2.96720	0.006
D	4.68447	0.859878	3.12423	0.004
G	-0.03619	0.144374	0.25069	0.114

R- Squared = 0.889
Adjusted R-Squared = 0.810
Source: Extract from Eviews8 Computer Software Output

From the above table, it can be deduced that apart from natural gas that has negative and insignificant link with infant mortality, emissions from kerosene and diesel have positive and significant impacts on infant mortality. One percent increase in the use of kerosene will increase the death rate of infants in Nigeria by about 2.69 percent. There will be 4.68 percent increase in infant mortality rate due to one percent increase in the use of diesel as source of energy. Consequently the study accepted the alternative hypotheses for kerosene and diesel relationships with infant mortality rejecting the null while in the association between natural gas emission and infant mortality, the null is accepted.

Summary and Conclusion

This study examined the impact of kerosene, diesel and natural gas emissions on infant mortality rate in Nigeria. The study is pertinent for the fact that future productivity and national income of a country is also a function of the future work force. The OLS multiple regression results unraveled positive and significant relationship between emissions from kerosene and diesel and infant mortality rate in Nigeria. However, natural gas emission shows itself as a cleaner energy by its negative though inconsequential link with infant mortality within the study time frame.

Recommendations

Given the major findings, the study thus recommends for policy implications:

1. the use of kerosene and diesel as energy sources at homes and industries be discouraged in the country
2. Natural gas as a cleaner energy be made affordable to the public.

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