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PUBLIC HEALTH EXPENDITURE, ENVIROMENTAL POLLUTION AND HEALTH OUTCOMES IN NIGERIA

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ABSTRACT

The study examines public health expenditure, environmental pollution and health outcomes- using infant mortality rate as proxy. Data was sourced from Central Bank of Nigeria and National Bureau of statistics from the period 1981 to 2021. A test of stationarity of the variables using- Unit Root Tests (ADF and P-P Tests) were examined coupled with a test of the existence of a long-run equilibrium relationship using the Johansen Co-integration Test. Afterward, an Error Correction Model (ECM) technique were applied in the study. Other diagnostic tests such as Residual Diagnostic Test, Serial Correlation LM Test and Histogram Normality Test were conducted to further validate the credibility of the model. The findings from the results showed that carbon (iv) oxide and gas flaring do not have significant effect on infant mortality rate as they were not statistically significant at 5% level. HIV showed negative impact on infant mortality which means the variables do not have direct effect on infant mortality. On the other hand, public health expenditure showed positive impact on infant mortality rate due to corrupt practices in the health sector. The study recommends that, expenditure on healthcare should be efficient and accountable. Also, government should create more or intensify public awareness program on pollution and HIV. Overall, the study identified a significant connections between health expenditure and health outcomes, and a weak relationships between environmental pollution and health outcomes in Nigeria.

Keywords: *Public health expenditure, Environmental pollution, Carbon di Oxide, Infant mortality*
JEL Classification Codes: *C52, L12, Q56*

1. INTRODUCTION

Health is a crucial component of a country`s welfare. Access to health care might be seen as one of the necessities for attaining sustainable long-term economic development. The general physical condition, or the state of the body or mind, specifically in terms of the presence or absence of illness, injuries, or limitations, can be referred to as being in good health (World Health Organisation). Without a good health condition, it is almost impossible to carry out any economic activity and if at all there is any, it will certainly not be efficient, hence, health of everyone needs to be taken seriously (Cremieux et al., 1999). The provision of health is seen as a key element of a policy to promote broad based economic growth. The level of government expenditure on health determines the ultimate level of human capital development which eventually leads to better, more skilful, efficient and productive investment in other sector of the economy (Khan, 2007). However, recent and past pandemics and epidemics have justified the need to re-think many health issues around the world. The world is now experiencing a backlog on good health and life due to the ignorance and lack of proper consideration of various health related factors

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like energy, environment, public and private health expenditures, hygiene, and sanitation. In many areas, health amenities have been found to be lacking, thereby exacerbating those health-related issues. Therefore, ensuring better health facilities for all people to build a safer world has now become a prime policy goal across the globe.

According to the World Health Organization (2005), about 50% of economic growth gap between developed and developing countries is due to poor health, and short life expectancy. This is because developed countries spend a large percentage of their gross domestic products (GDP) on health care for their citizens, while some developing countries have high volatility in health care spending. The report also reveals wide variability in health system performance at each income level, and in each country. A close look at Nigeria mortality rate from 2000 to 2010 shows an increase from 26.40 to 30.48 and reaching 31.83 in 2015 and further reached 34.25 in 2020 (CBN,2017 and NBS, 2021). These observed upward trends in recent times according to Nwani et al. (2018) can be attributed to the problem of insecurity, illiteracy, poverty and high cost of health care. Lives in Nigeria have remained miserable and short with communicable and non-communicable diseases.

As a determinant of health, environmental pollution are now at the center of national and international academic discourse and other public forums. Documented evidence shows that environment refers to a wide range of external conditions, situations and things that affect the survival and development of people, organisms, groups and/or societies. In Nigeria, for example, environmental concerns only came to public attention in 1988 during Koko toxic waste disposal saga. The incident highlighted the urgent need to mobilize the Federal Environment Protection Agency of Nigeria (FEPA), and other relevant agencies to solve environmental related problems in the country.

Environmental pollution occurs when the environment is unable to process and neutralize the harmful by products of human activities in a timely manner without causing structural or functional damage to the system. Despite many effort to clean up the environment in recent years, pollution remains a major problem and an ongoing threat to health. According to Hagget (1975), the problem is arguably greater in developing countries with traditional sources of pollution such as industrial emissions, poor sanitation, poor waste management, polluted water resources and the effect of indoor air pollution from biomass fuels. Man-made air pollution is one of the greatest threats to public health worldwide, killing about 9 million people annually (Inyang, 1978).

Carbon(iv)oxide emission per capita (in metric ton) as a measure of environmental pollution rose from 0.62 in 2000 to 0.76 in 2005 and stood at 0.44 in 2017 and at 0.6 in 2021 (World Bank, 2022). This is relatively high and poses a threat to good health. This unfortunate circumstance is mostly hit by the poor masses in Nigeria due to lack of access to quality health care as a result of high cost and low earnings (Nwani et al.,2018). Public health expenditure and environmental pollution in any nation are some of the functions of the health status of the nation.

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The current state of health in Nigeria has attracted the attention of many international organisations. This is also reflected in the United Nation SDGs, where three of the goals relate to health (reducing infant mortality rate, improving maternal health and HIV/AIDS, malaria and other diseases).

The objective of this study is to determine the impact of public health expenditure and environmental pollution on health outcomes in Nigeria. The research questions to be answered from which the hypothesis were drawn are: what is the effect of public health expenditure on health outcome? Does environmental pollution have a significant impact on health? The rest of the study is organized into 5 sections including the introduction. Next is literature review in section two, followed by methodology in section three. Section four focuses on data analysis and discussion of empirical results while section five summarizes the study.

2. LITERATURE REVIEW

The study of the relationship between public health expenditure, environmental pollution and health outcomes is rather a new phenomenon in economic literature and so far it has received a lot of attention in recent times. Several studies (for instance, Nwani et al., 2018; Byaro et al., 2018; Damilola et al., 2022; Ely et al., 2017; Edeme & Olisakwe, 2019; Khan et al., 2020; Udeorah et al., 2018; Oluwatoyin et al. (2015), Omitogun, 2014 and Olarinde & Bello, 2014) have found a significant relationships between health expenditure, environmental pollution and health outcomes. Nwani et al. (2018) in their work on the effect of public health expenditure, environmental pollution and health outcomes concluded that public expenditures on health have a positive and significant impact on health outcomes in Nigeria while environmental pollution have a negative effect on health. In another study, Eneji et al. (2013), examined the causal relationship between health expenditure, health status and productivity in Nigeria, the study report a weak causality between health expenditure and health status in the country. Similar findings were obtained in Ghana, where public health expenditure was observed to improve health status through the reduction in infant mortality rate (Boachie & Ramu, 2015). Edeme et al. (2017), in their study of health expenditure and health outcomes in Nigeria, found that health expenditure and health outcomes has a long run equilibrium relationship. They also found that improvement in health expenditure also improves life expectancy and reduces infant mortality rate in Nigeria.

Filmer and Pritchett (1999), in their own work found that public spending and health outcome are tenuously related. According to them doubling public spending from 3 to 6 percent of GDP would improve child mortality by only 9 to 13 percent. Surveying the literature on the link between public expenditure and health outcomes, Pritchett (1996), notes that all of the negative or ambivalent findings on the effect of public spending on health outcomes could potentially be a reflection of differences in the efficacy of spending which could arise due to a variety of reasons including corruption and patronage. Besides, it is also noted that the link between public spending and health outcomes could be broken by the

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displacement of private sector effort by public spending. This argument is eloquently made in Filmer et al. (2000) while commenting on the weak links that several studies have found between public spending on health and health status. Although in most of the studies where public spending is found to have low or negligible impact, it is argued that public provision could lead to a "crowding out" of private sector provision, and they have failed to question the efficacy of public spending.

Rajkuman and Swaroop (2007) examined data from 1990, 1997, and 2003 for effects of public health spending on the mortality of children (under five), using corruption and bureaucratic quality as indicators of governance level. In countries with good governance, increasing public health spending by 1 percentage, increases the under-5 mortality rate by 0.32%. This effect decreases to 0.20% in countries with average governance and has no effect in countries with weak governance. Akinci et al. (2015) obtained similar findings in their study of Middle East and North Africa region. They observed that a percentage rise in per capita government expenditure reduces the infant mortality rate by 7.5 – 8.1 %.

In a discordant finding, Berger and Messer (2002) considered health care inputs, health behaviors, age, education, health care expenditures, Gini coefficient, public share of health expenditures, and population covered by public sources for inpatient and outpatient services in OECD (Organisation for Economic Co-operation and Development) countries. They found that "increases in the share of health expenditures that are publicly financed are significantly associated with higher mortality rates (Berger & Messer, 2002, p. 5)." This may be because of a less productive mix of services or less efficient service provision. Increases in insurance coverage are correlated with lower mortality rates.

Riman and Akpan (2012), investigated the causal direction and long-run relationship between government health expenditure, poverty, and health status, in Nigeria. They employed the granger causality test and vector error correction model (VECM) in establishing a strong causal bi-directional relationship running between life expectancy and poverty in Nigeria. Their study also reported the existence of a long-run relationship between poverty and health status. However, they found a non-significant long-run relationship between health status and government health expenditure. They concluded that policies that would improve health status should be such as would promote adult literacy level, reduce the poverty and income disparity since, increasing budgetary allocation to funding the health sector alone without reducing the poverty level, would not be sufficient to improve the health status of the country.

In examining the implication of government health expenditure, environmental pollution and health outcome, the environmental Wagner's Law and Kuznets curve was adopted. Wagner's Law is named after the German political economist (1835-1917), who developed a "law of increasing state activity" using empirical analysis on Western Europe at the end of the 19th century. He

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argued that government expenditure is a function of increased industrialization and economic development. Wagner stated that during the industrialization process, as the real income per capita of a nation increases, the share of public expenditures in total expenditures increases. The law cited that "the advent of modern industrial society will result in increasing political pressure for social progress and increased allowance for social consideration by industry" (Nwani et al., 2018).

Wagner (2002) designed three focal bases for the increased in state expenditure. Firstly, during industrialization process, public sector activity will replace private sector activity. State functions like administrative and protective functions will increase. Secondly, governments needed to provide cultural and welfare services like education, public health, old age retirement insurance, food subsidy, natural disaster aid, environmental protection programs and other welfare functions. Thirdly, increased industrialization will bring out technological change and large firms that tend to govern will have to offset these effects by providing social and merit goods through budgetary means. The second reason forms the fulcrum of this study. Several studies have showed evidences of the application of Wagner theory. These include Tsaurai (2014), Olayiwola et al. (2021), Babatunde (2011), Aggreh and Kasimu (2014) and Serena and Andrea (2011).

3. RESEARCH METHODOLOGY

The study adopts the health production function (HPF) as the baseline model. The model (HPF) has been widely used by researchers to show the relationships between health outcomes and health inputs or determinants. The extant literature is replete with studies which have employed the health production function model (Nixon & Ulman, 2008; Anyawu & Erihijakpor, 2007; Filmer & Pritchett, 1999). In these studies, the model considered socio-economic factors or health resources as the inputs and health outcomes as a measure of outputs from the health system. In studies where health production function have been used to analyse health outcomes, the production function is specified in the form of Cobb Douglas function. In the Cobb Douglas production function, the output elasticity of an input is defined by the constant representing the exponent of the input in the production function. In relation to health production function, the appropriate socio-economic inputs are identified which tend to influence the well-being of the population/health system or otherwise improvement in the health outcomes. In studies that have used health production function (for instance, Filmer & Prichett, 1999; Anyawu & Erhijakpor; 2007, Osemwengie, 2020), mortality (maternal and infants mortality) and life expectancy have been generally used to measure improvement in wellbeing of society or health outcomes. For example, Filmer and Prichett (1999) in their study explicitly presented a final form of a health production equation which is reported as:

$$\text{Ln (HS)} = \beta_1 \text{ Ln } (^{GDPi}/_{Ni}) + \beta_2 \text{ Ln } (^{Hi}/_{GDPi}) + \beta_3 (X_i) + \varepsilon_I \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

According to them, equation (1) specifies the natural log of health outcomes which they use

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infant mortality as a proxy. Where the log of mean of per capita income is represented by (GNP_i/N_i), the log of public health expenditure as a share of GDP was represented by (H_i/GDP_i) and socio-economic factors were represented by a vector X_i. They considered female education, access to safe water, religion, ethno linguistic fractionalization and urban population as socio-economic factors. This relates to the basic model of the health production function in the health literature.

3.1 Model Specification

Following the health production function model above, the model for this study is specified thus:

IMR = F(GASF, CO2M, PHIV, GEXP) ……..…… 2

The econometric form therefore becomes:

$IMR = \beta_0 + \beta_1 GASF + \beta_2 CO2M + \beta_3 PHIV + \beta_4 GEXP + \varepsilon_t$……....3

Where,

IMR = infant mortality rate

PHIV = the prevalence of HIV/AIDS

GASF = Gas faring

CO2M = CO2 emission

GHEXP = Government Health expenditure

ε_t= error term

β_0 -β_4= coefficients

3.2 Apriori Expectation and Justification of Variables

The apriori expectation of the econometric model is given thus: $\beta_1, \beta_2, \beta_3 > 0$, $\beta_4 < 0$. This means that Gas faring, CO2 emission are expected to have an increase on infant mortality rate which is a proxy for health outcome. The federal government use revenue from oil production to bring about development in terms of good healthcare system, provision of social amenities, infrastructure and industrialization and ensure their sustainability through regular maintenance. However, oil production activities bring about gas flaring and CO2 emissions leads to environmental degradation. Thus, the volume of gas flaring which is the burning of natural gas into the air, most times as a result of scarcity of domestic market and because of the high cost associated with gas development, is expected to increase infant mortality rate which is a proxy for health outcome and it was included in the model because it's a variable that can influence health outcome. Furthermore, the emission of carbon dioxide which increases the concentration of green-house gases (GHG) in the atmosphere, and in turn contributes to global warming was included in the model. Therefore, CO2 emission is expected to increase infant mortality rate. Lastly, government expenditure which is both recurrent and capital expenditure was included in the model because of its capacity to bring about improved health outcome.

. 3.3 Unit Root Test and Co-integration Test

The estimation of variable-series that are non-stationary will thus lead to estimates that are spurious and thus render the coefficients unreliable for policy direction. The stationarity test will be carried out with the application of Augmented-Dickey Fuller Statistic. The test involves the estimation of the following regression equation.

$^a xt = a + bt \times dxt\text{-}1 + \Sigma t$…… …… (4)

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Where x is the variable under consideration. Thus the ADF unit root test states that Ho: b = 0 and Hi: b<0, where the ADF statistic was compared with the observed Mackinnon critical values. A series that exhibits a stochastic trend will not be stationary and cannot be forecast far in the future. Stationary series will constantly return to a given value and no matter the starting point, in the long-run, it is expected to attain the value.

Given an auto-regressive AR (I) process as follows: Yt = m + PYt-1 + Σt, where m and P are parameters and Σt, is the white noise assumption. Y is a stationary series if -1<P<1. However, the above description is valid only if the series is an AR (1) process. (Dickey and Fuller, 1981). A non-stationary series could be made stationary by differencing once or twice. For robustness, the Phillip Perron unit root test was also conducted.

In this study, the Johansen (1991) co-integration technique is adopted. A stationary linear combination of the variables under consideration is called co-integrating equation. Variables co-integration implies that they share a long –run relationship and will move closely together over time, meaning that the differences between such variables are stable over time and there is some degree of convergence in the long-run.

3.5. Error Correction Model (ECM)

The error correlation mechanism is employed to tie the short-run dynamic behaviours of a variable to its long-run value. The error correlation mechanism (ECM), which was first used by Sargan and later popularized by Engle and Granger (1987) correct for disequilibrium. Given these dynamics, Engle and Granger suggested that adjustment should be involved through the (iterative) process to obtain a more parsimonious model. The ECM is stated as:

$$\Delta Y_t = \theta_0 + \theta_1 Z_{i-1} + \sum \theta_{2i} \Delta X_{i-1} + \sum \theta_{3i} \Delta Y_{i+1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where Δ denotes the first order time difference (i.eΔy, = yt – yt-1) and where εt is a sequence of independent and identically distributed random variables with mean Zero and variance. Furthermore, they prove the converse result that an ECM generates co-integrated series.

3.6 Source of Data

Studies that involves measurement of variables such as in this study, analytical method is the most appropriate method to be used. Hence secondary data for the period 1981-2021 were used and were extracted from Central Bank of Nigeria Statistic Bulletin and the National Bureau of Statistics (various issues). The scope was limited to 2021 because it is the most recent annual data available based on the variables used in the analysis for the time of the research.

4. DATA PRESENTATION

This section begins with descriptive statistics analysis of the various variables used in estimating our regression model. Thereafter, followed by the unit root test and the co-integration results. Lastly, the error correction model estimation results were analyzed. In addition to other residual diagnostic tests.

Table 4.1: Descriptive Statistics

	IMR	CO2	GASF	HIV	GEXP

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Mean	103.8900	86.81136	23793.76	1.227750	1965.426
Median	108.3000	92.00000	24590.00	1.350000	982.8450
Maximum	124.8000	107.0000	75772.70	1.500000	6264.840
Minimum	72.20000	55.00000	11940.00	0.730000	9.640000
Std. Dev.	19.36082	15.99177	10458.35	0.253291	2206.439
Skewness	-0.271950	-0.846579	3.011705	-0.600306	0.723018
Kurtosis	1.412894	2.287690	16.37136	1.784516	1.896144
Jarque-Bera	4.691219	5.623618	358.4579	4.864782	5.515864
Probability	0.095789	0.060096	0.000000	0.087827	0.063423
Sum	4155.600	3472.455	951750.6	49.11000	78617.05
Sum Sq. Dev.	14618.82	9973.732	4.27E+09	2.502098	1.90E+08
Observations	40	40	40	40	40

Source: Authors' computation using Eviews (2023)

As seen in the Table 4.1, infant mortality rate (IMR) which is a proxy for health outcome has the mean value of 103.89 ranging from 72.20 to 124.80 with a standard deviation of 19.36. Carbon iv oxide emission (CO2M) has a mean value of 86.81 ranging from 55 to 107 with a standard deviation of 15.99. Gas flaring (GASF) is seen to have a mean value of 23793.76 ranging from 11940.0 to 75772 with a standard deviation of 10458.35. Prevalence of HIV (HIV) is seen to have a mean value of 1.227 ranging from 0.73 to 1.50. Lastly, government health expenditure (GHEXP) is seen to have a mean value of 1965.426 ranging from 9.64 to 6264.84 with a standard deviation of 2206.439.

4.1 Unit Root Test Results

The ADF and the Philip Perron (P-P) unit root tests results are presented in Table 4.2. The need to complement the ADF unit root test with the P-P test stems from the fact that the P-P is a non-parametric test as it does not require selecting the level of serial correlation. It takes the same estimation as ADF test but corrects the statistics to conduct for autocorrelations and heteroscedasticity. The Philip Perron unit root test is adopted due to the negativity of some of the data of the variables under consideration. The results from both approaches show that GASF is stationary at level, the null hypothesis is rejected while we fail to reject the alternative hypothesis that the series have unit root.

Table 4.2: Unit Root Test Result

Variables	ADF Levels	ADF First diff	PERRON Levels	PERRON First diff
IMR	-0.970291 (0.7540)	-0.685209 (0.8385)	0.868494 (0.9940)	-3.059991 (0.0381)
CO2	-1.869133 (0.3430)	-6.477040 (0.0000)	-1.860061 (0.3471)	-6.477040 (0.0000)

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GASF	-4.419370 (0.0011)	-9.856839 (0.0000)	-4.490896 (0.0009)	-16.19238 (0.0000)
EXP	1.761300 (0.9996)	-8.287660 (0.0000)	1.552868 (0.9992)	-6.546750 (0.0000)
HIV	-2.089938 (0.2496)	-9.053054 (0.0000)	-1.958105 (0.3035)	-8.639505 (0.0000)

Source: Authors' computation using Eviews 9 (2023)

The unit root result above shows that all the variables; infant mortality rate (IMR), Carbon iv oxide emission (CO2M), Gas flaring (GASF), Prevalence of HIV (HIV) and government health expenditure (GHEXP) were not stationary at levels but are first difference stationary.

4.2 Johansen Co-integration Test Results

Table 4.3 shows co-integration results using Johansen cointegration tests. Both the trace and maximum eigen statistics revealed that there are four cointegrating equations as indicated by * symbol for the cointegrating equations. This implies a rejection of the null hypothesis of no cointegrating equations at 5% level of significance.

Table 4.3: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No, of CE(s)	Eigenvalue	Trace Statistics	0.05 critical value	Prob.**
None*	0.97	274.30	95.57	0.00
At most 1*	0.84	156.01	69.28	0.00
At most 2*	0.76	89.02	47.68	0.00
At most 3*	0.45	33.95	29.09	0.02
At most 4	0.25	11.79	15.47	0.18
At most 5	0.03	1.14	3.48	0.29
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No, of CE(s)	Eigenvalue	Max-Eigen statistics	0.05 critical value	Prob.**
None*	0.97	116.83	40.06	0.00
At most 1*	0.84	67.98	33.78	0.00
At most 2*	0.76	55.02	27.84	0.00
At most 3*	0.45	22.14	21.14	0.03
At most 4	0.25	10.86	14.24	0.18
At most 5	0.03	1.15	3.83	0.26

Source: Authors' Computation Using E-views 9 (2023).

4.3 Long Run Model

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Table 4.4: Ordinary least square result (IMR)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	138.5942	3.445658	40.22286	0.0000
CO2	0.069940	0.050052	1.397360	0.1711
GASF	1.45E-05	5.65E-05	0.257164	0.7986
GEXP	-0.007350	0.000302	-24.30142	0.0000
HIV	-21.72694	3.194719	-6.800892	0.0000
R-square	0.973	N/A	N/A	N/A
F-Stat/Prob	315.57/0.0000	N/A	N/A	N/A

Authors' computation using Eviews 9 (2023)

Table 4.4 shows the result of the long run model. It is revealed from the result that Gas flaring, carbon iv oxide emission, government expenditure have positive and significant impact on infant mortality rate which is a proxy for health outcome. Also, government expenditure and prevalence of HIV have negative effect on infant mortality rate in Nigeria at 5% level of significance.

The R-square of 0.973 shows that gas flaring, carbon iv oxide, prevalence of HIV and government expenditure can jointly explain 97.3% of the systematic variations in infant mortality rate. F-statistics probability of 0.0000 shows that the overall model is statistically significant and thus good for forecasting purpose.

Since the variables are co-integrated and there is a long run relationship among them, the error correction model (ECM) technique of estimation is therefore appropriate to reconcile the short-run disequilibrium with the long-run equilibrium relationships. The ECM results is presented in Table 4.5.

4.4 ECM Results

Table 4.5: Regression result (IMR)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IMR(-1)	1.049482	0.029474	35.60668	0.0000
CO2	-0.000756	0.008186	-0.092300	0.9270
GASF	-1.77E-05	9.03E-06	-1.965787	0.0578
HIV	-3.502410	0.744383	-4.705115	0.0000
GEXP	0.000546	0.000226	2.414656	0.0215
C	-2.788527	4.064466	-0.686075	0.4975
ECT(-1)	-0.216799	0.041217	-5.259888	0.0423
R-squared	0.99	N/A	N/A	N/A

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Adj. R-squared	0.98	N/A	N/A	N/A
F-stat/Prob	10049.76/ 0.0000	N/A	N/A	N/A

Author's computation using Eviews (2022)

Table 4.5 shows the result of the ECM model. It is revealed that first period lag of infant mortality rate (IMR) in Nigeria has a positive and significant impact on infant mortality rate (IMR). Gas flaring (GASF) and carbon IV oxide emission (CO2) according to the result are seen to respond negatively to infant mortality rate. While carbon IV oxide emission (CO2) was not statistically significant, gas flaring (GASF) was significant at 10% level. The prevalence of HIV has negative effect on infant mortality rate at 1% level of significance. Lastly, government expenditure from the result above has a negative effect on infant mortality rate at 1% level of significance.

The R-square coefficient of 0.99 shows that the independent variables can jointly explain 99% variation in infant mortality rate in Nigeria. The F-statistics of 0.0000 means that the overall model is statistically significant at 1% level. The main issue in ECM model is the adjustment of the economy to changes in the variables shown by the coefficient of ECT (-1). The IMR has adjustment coefficient of -0.216. This is rightly signed and lies between zero and one, and also highly significant at 1% level as required by theory. This indicates that the economy can adjust to changes in IMR to the turn of 21% in a given period. The 21% value also shows that the speed of adjustment to equilibrium in the case of any temporary disequilibrium is moderately high.

4.5. Residual Diagnostic Test Results

A variety of diagnostic tests were carried out to further ascertain the credibility of the model. The model was tested for autocorrelation (serial correlation LM test), Residual Heteroskedasticity test and Histogram normality test.

Table 4.6: Serial correlation and Heteroskedasticity test

Test	Value	Probability
Chi-sq (Heteroskedasticity)	2.426184	0.0479
LM-Stat (serial correlation)	6.541753	0.0044
Histogram normality test	0.988350	0.6100

Source: *Authors' computation (2023) using Eviews 9.*

Considering the null hypothesis of "there is no autocorrelation", the result in Table 4.6 indicates that the probability value of (0.0044) is statistically significant which accepts the null hypothesis. Also, given the null hypothesis that "the variables are Heteroskedastic" the result reveals that the probability value of (0.0479) rejects the null hypothesis and accept the alternate hypothesis of "the variables are Homoskedastic". Lastly, given the null hypothesis that "the variables are not normally distributed" the result reveals that the probability value of (0.6100) rejects the null hypothesis and accept the alternate hypothesis that "the variables are normally

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distributed. Therefore, residuals are serially uncorrelated, homoskedastic and normally distributed which means the model is valid and can be used for policy recommendations.

4.6 Discussion of Result

The paper examined government health expenditure, environmental pollution and health outcome utilizing annual time series data for the period of 1981 through 2021. The study revealed that gas flaring (GASF) and carbon IV oxide emission (CO2) according to the result do not have significant effect on infant mortality rate as they were not statistically significant at 5% level. Hence, environmental pollution does not significantly influence the death of infants in Nigeria. The result negates the findings of environmental health perspective (2020) which stated that Nigeria has the third highest infant mortality rate in the world with about 20% caused by respiratory tracts infections. Due to a lack of development in rural areas, there is high population migration to urban areas leading to more environmental-related problems (Babanyara et al. 2010). Problems such as air pollution, water pollution, solid waste management, urban poverty, deforestation, desertification, wind erosion, and flooding increase, causes more risk to the environment and the population in highly industrialized cities in Nigeria. However, in the developed countries epidemiologic studies have demonstrated decline of air pollution levels and improved respiratory health in children. The non-significant impact of gas flaring (GASF) and carbon IV oxide emission (CO2) on infant mortality rate could be that these pollutants are not the major cause of infant mortality rate in Nigeria.

The study further revealed that the prevalence of HIV has negative effect on infant mortality rate at 1% level of significance. This is contrary to apriori expectation because HIV is supposed to bring about the death of infants. However, the result shows that HIV does not contribute immensely to infant mortality rate in Nigeria, thus collaborating the findings of Lily et al. (2020), that HIV/AIDS is not a major direct cause of neonatal death. Maternal HIV status affects newborn survival by causing an increased risk of stillbirth and death in the neonatal period and infancy, even among those babies who do not become HIV-positive. Also according to CDC (2021) if pregnant women have HIV and take HIV medicine as prescribed throughout pregnancy and childbirth, and give HIV medicine to their babies for 4 to 6 weeks after giving birth, the risk of transmitting HIV to their babies can be 1% or less. After delivery, pregnant women can prevent transmitting HIV to their babies by avoiding breastfeeding, since breast milk contains HIV. If the husband has HIV, he can encourage to get and stay on treatment. This will help prevent him from transmitting HIV to the wife. Hence, people with HIV who take HIV medications as prescribed and get to keep an undetectable viral load have effectively no risk of transmitting HIV to an HIV-negative partner through sex (CDC, 2021).

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Lastly, government expenditure from the result above has a positive effect on infant mortality rate at 1% level of significance. This means the impact of health financing has not been adequately felt as regards IMR reduction. This finding collaborates the finding of Rolle et al. (2020), that low government expenditure has contributed poorly to the reduction of IMR. The rise in IMR could be as a result of corruption in the government administration. Corruption has often manifested in Nigeria's health sector through the supply of fake drugs, substandard equipment, willful misdiagnosis of diseases, sharing of unallocated budget funds, inflation of contracts, diversion of drugs, favoritism in treatment and appointments based on political patronage.

5 Conclusions and Recommendations

Using annual time series data for the years 1981 through 2021, the study investigated government health spending, environmental pollution, and health outcomes. According to the study's findings, carbon IV oxide emissions (CO2) and gas flaring (GASF) had no direct effect on infant mortality rate. The conclusions of Environmental Health Perspective (2020), which claimed that respiratory tract infections account for 20% of Nigeria's newborn death rate, the third-highest rate in the world, are refuted by the data. The study also showed that newborn mortality rates are negatively impacted by HIV prevalence at a 1% level of significance. Given that HIV is thought to cause newborn death, this defies a priori expectation .In other words, infant mortality rate in Nigeria is not significantly impacted by HIV. Finally, at a 1% level of significance, the government spending from the aforementioned result had a positive impact on infant death rate. This indicates that the effects of health finance have not yet been fully felt. In summary, the study identified a significant connections between health expenditure and health outcomes, and a weak relationships between environmental pollution and health outcomes in Nigeria.

The study suggested the following recommendations:

1. Government should improve public health expenditure as well as build financial efficiency, accountability and transparency in the health sector to ensure proper utilization of health spendings.
2. Health insurance should be encouraged to cater for unforeseen health occurrences.
3. Government should introduce programs to create awareness on the negative impact of unhealthy environmental practices, such as indiscriminate refuse dumping.
4. An environmental sanitation plan to separate residential and industrial areas should be implemented as environmental pollution has a long run adverse effect on health outcome.
5. Government should review current federation revenue distribution formula, with emphasis given to the local government area.
6. Government should increase her policy efforts and initial more programs in reducing HIV prevalence rate among pregnant women, as this would lead to reduction of its impact on infants mortality.

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