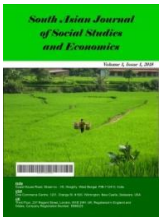

South Asian Journal of Social Studies and Economics

2(2): 1-15, 2018; Article no.SAJSSE.45431

Public Health Expenditures, Environmental Pollution and Health Outcomes: Evidence from Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/SAJSSE/2018/v2i225846
Editor(s):
(1) Dr. John M. Polimeni, Associate Professor, Department of Economics, Albany College of Pharmacy and Health Sciences, Albany, New York, USA.
Reviewers:
(1) Shahab E. Saqib, AIT, Thailand.
(2) Akinde Oluwaseun Abayomi, Federal University Ilorin, Nigeria.
(3) Chiao-Lee Chu, National Quemoy University, Taiwan.
Complete Peer review History: http://prh.sdiarticle3.com/review-history/27692

Original Research Article

Received 15 September 2018
Accepted 27 November 2018
Published 08 December 2018

ABSTRACT

The role of health in the development of a nation cannot be overemphasized. While the concept of health status and the impact of public health expenditure have continued to generate scholarly debates, this study contributes to the debate with the incorporation of the role of the environment as a determinant of health status in Nigeria. With the objective of examining the impact of Public Health Expenditures and Pollution on Nigerians Health Status, annual secondary time series data spanning 37 years (1981-2017) collected from Central Bank of Nigeria statistical bulletin and World Development Indicator were analyzed using the ARDL technique. The result shows that Public Expenditures on Health has a positive and significant impact on health outcomes in Nigeria. Again, environmental pollution as proxied by per capita CO_2 emission has a negative and significant effect on health outcome in the country. Economic growth rate was found to have positive impact but insignificant in enhancing life expectancy (proxy for health outcome) in Nigeria. On the basis of the empirical findings, it is recommended that the government should sustain the flow of resources to

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the health sector and improve on environmental practices through the formulation of new national environmental policies and better awareness campaign through the deployment of community health extension workers (CHEW).

Keywords: Health outcome; public health expenditures; environment and ARDL.

1. INTRODUCTION

Fundamentally, government has three functions: allocation, distribution and stabilization roles, all with the aim of improving the welfare of the citizens. In exercising these functions, resources are required and expended. One of the critical resources is finance. The total amount spent by the government in the process of executing allocation, distributive and stabilization roles is referred to as public expenditure. One central sector where public expenditure has proved relevant is the social sector. Following [1] and [2] regard such expenditure on social sectors such as health and education as an investment with development implications.

Public health expenditure is therefore defined on the basis of its primary target of improving health, associated with government health services. According to the [3], public health expenditure entails the provision of preventive and curative health services, and emergency aid designated for health accounted for by the public sector. The whole essence of this is to take the society to the point of optimal bliss. At this point, everyone is better off socially and otherwise.

Recalling that health is wealth, health outcome has been a key indicator of social welfare. This is obvious in its presence as a target in both the Millennium and Sustainable Development Goals. A critical look at the United Nations Report shows improvement in health related issues globally, but a close look at the Nigerian situation depicts a worrisome outlook.

Statistical evidence [4] and [5] show that in 1960, mortality rate stood at 25.68, a decade later, it declined marginally to 25.54, and the downward trends continued till 1990 when the nation recorded 24.42 which is the all time low. From 2000 to 2010, the trends reversed, with mortality rate of 26.40 and 30.48 respectively, and reaching 31.83 in 2015. These observed upward trends in recent times can be attributed to insecurity challenges, illiteracy, poverty and high cost of healthcare. Furthermore, lives in Nigeria have remained short, brutish, nasty and miserable with HIV/AIDS prevalence, communicable and non-communicable diseases and life style related illnesses like cancer and hepatitis. Hitherto, life expectancy at birth which stood at 50 years in 2008 has declined to 47 years in 2016. The performance of the health sector has remained insignificant, contributing 1.7% to GDP in 1998, 1.8% in 2008, 3.8% in 2012 and less than 2% in 2016. Environmental management has continued to suffer and as such, solid waste generation per capita has been on the increase, carbon-dioxide emission per capita (in metric ton) as a measure environmental pollution was as low as 0.33 in 1994, increased to 0.62 in 2000, rose further to 0.76 in 2005, stood at 0.58, 0.55 and 0.44 in 2010, 2015 and 2017 respectively. This figure is relatively high when compared with other developing nations, and poses a threat to good health. The poor and vulnerable Nigerians are worst hit by this adverse condition because of lack of access to quality healthcare due to high cost and low earnings.

To ameliorate this situation, public spending as a health input, has a role to play. An increase in government spending on healthcare not only leads to healthy and productive population, but implies a larger work force, which can drive faster growth episodes. Empirical studies have shown that a healthy person not only works efficiently but is also able to devote more time to economic activities that are productive [6]. Bloom et al. [7] reports that statistics attribute about 33% of growth in Gross Domestic Product (GDP) to better health outcomes, through human capital development. This correlates with the World Health Organization's documentation that 50% variation in economic prosperity between Developed Countries (DCs) and LDCs is linked to HealthCare. This shows that more inputs are committed to the production of health outcomes in DCs. Therefore, to foster the attainment of health oriented SDGs in a Less Developed Country (LDC) like Nigeria, access to healthcare through public provision and insurance scheme to support out-of-pocket health expenditure could prove viable.

Considering the significance of positive health outcomes, policymakers in Nigeria have been

giving considerable attention to the issue of how public expenditure on health can be improved so as to attain better health outcomes. As documented by Odubunmi et al. [8], public expenditure on healthcare has been on the increase since independence. The health care recurrent expenditure was N12.48 million in 1970; it increased to N52.78 million in 1980 and further rose to N132.02 million in 1985. In 1989 and 1991 it was N5785.3 million and N668.40 million respectively. It rose to N1.27 billion in 2008. Furthermore, in 2012 Public Health Expenditure as a ratio of the total annual budget stood at 6%. In 2016, total public health expenditure stood at #257 billion, it increased to #304.33billion in 2017 which represents 4.17% of the annual budget. In the current 2018 budgetary only 4.23% of the total budget is proposed for health sector. It is observed from the statistical evidence that though the amount allocated increased in absolute value, its ratio has fluctuated overtime, and remains far below the African Union agreement. These trends negate the [9] that all African countries should allocate at least 15% of total budgetary provision to the health sector. When compared to other African countries with much less resources, in the last decade, Nigeria has an average of 6% of her total budget allocated to the health sector, while Rwanda allocates 18% of its national budget to the health sector, in both Botswana and Niger 17.8% of the budget is reserved to fund the health sector. In Malawi it stands at 17.1%, for Zambia it is 16.4% and 15.8% in Burkina-Faso, the better allocation to health sector in these countries have led to improved health outcomes and arguably economic prosperity.

Findings of previous studies on Public Health Expenditure and Health Outcomes relationships have been a subject of on-going enquiry in literature with mixed submissions. While Yaqub [10] documented an inverse relationship between health expenditure and health outcomes when governance indicator is incorporated; other recent studies have disagreed with the findings. In this regard, Eneji et al. [11] reported a positive relationship between healthcare expenditure and health status. The study by Edeme et al. [6] validates [11] which is a sharp departure from [10]. A resolution or informed contribution to this debate would have profound policy implications. This study incorporates environmental pollution proxied by CO_2 emission per capita into the model, this variable has not to the best of our knowledge been considered by previous studies. The rational for the inclusion of this variable is not unconnected with the increasing effect of climate change on human health.

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 hypotheses were drawn are: what impact does public health expenditure (PHE) have on the health of Nigerians? Does environmental pollution have a significant effect on the health of Nigerians?

This paper is structured into five sections, following this introductory section is section two which contains stylized facts, and the review of theoretical and empirical literature, section three deals with the methodology of the study as section four details out the descriptive and inferential analyses of data, section five concludes the study with summary of findings and policy implications.

2. LITERATURE REVIEW

2.1 Structural Composition and Stylized Facts

Healthcare service in Nigeria is more of a merit good than a pure public good. The reason being that, healthcare services are provided for by the private and public sectors in the country. The private sector entails the NGOs, private profit oriented healthcare providers, community-based organization and religious and traditional healthcare suppliers. In the public sector, Government takes the responsibility of healthcare services provision. The provision of healthcare services in the public sector is at three levels in Nigeria- the Primary, Secondary and Tertiary. At the primary level, healthcare services are at the door step of communities where preventive, curative, primitive and pre-referral cares are provided. Medical personnel that provide such services are nurses, community health officers, community health extension workers (CHEWs) and environmental health officers. The available facilities at this level include health centres and dispensaries [12]. At secondary level, there are general hospitals to provide medical, laboratory and specialized health services, such as, surgery, obstetrics, pediatrics, and gynaecology. Major health workers that are at the secondary level are doctors, nurses, midwives, laboratory scientists and pharmacists. The Tertiary level of

healthcare service provision is the highest healthcare service provision cadre in Nigeria. Such institutions within this category are usually well equipped with high technology, equipment and specialists. Specialist hospitals, teaching hospitals, and federal medical centres fall under this category.

Stemming from the foregoing, it is obvious that the economy of the Nigerian health sector is mixed. This indicates that participation is by both the private and public sectors simultaneously. To ascertain the extent of participation by both sectors, Statistics available show that while public health expenditure accounts for 36.7% of the total Health Expenditure, Out-of-Pocket health expenditure stood at 60.4% and the balance of 2.9% could be attributed to NGOs and religious organizations expenditure on healthcare [13]. Furthermore, the contribution of the sector to total national economy has remained drastically at low ebb. In 2000, it contributes 1.6%, 2% in 2003, 1.8% in 2008, and 3.2% in 2011, and stood at 3.8 in 2014 [5].

2.2 Theoretical Framework

Wagner's Law is named after the German political economist (1835-1917), who developed a "law of increasing state activity" after empirical analysis on Western Europe at the end of the 19th century. He argued that government growth 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."

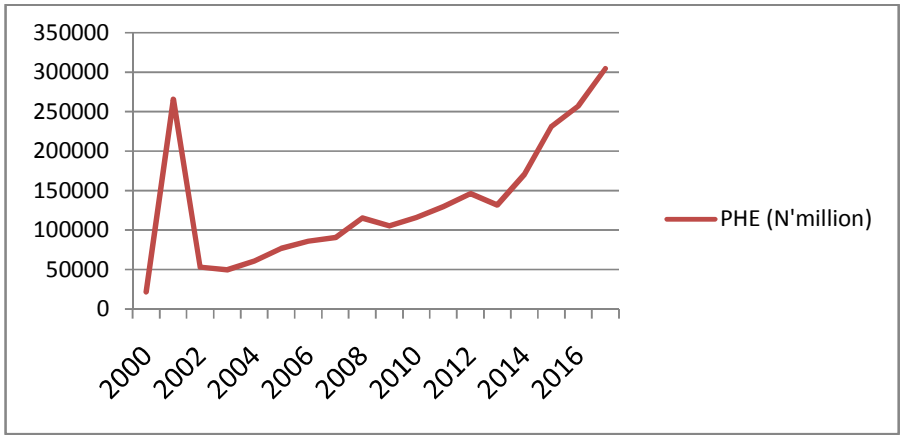

Fig. 1. PHE (N'million)
Source: Author's Computation

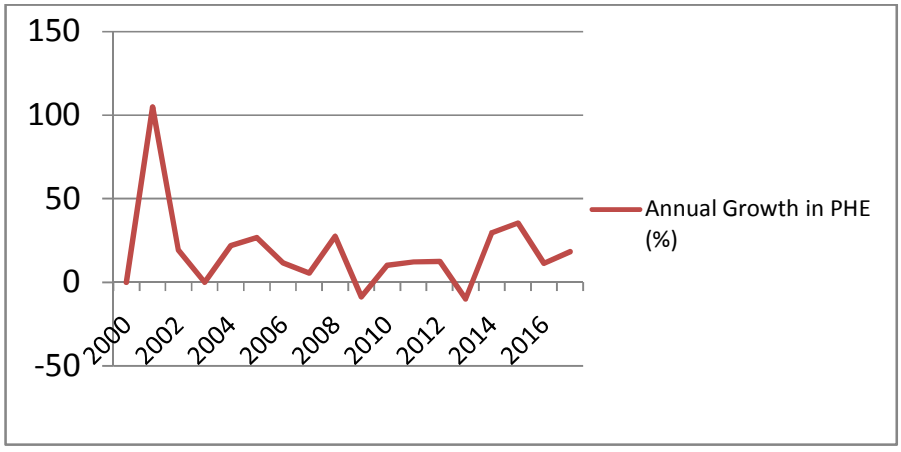

Fig. 2. Annual growth in PHE (%)
Source: Author's Computation

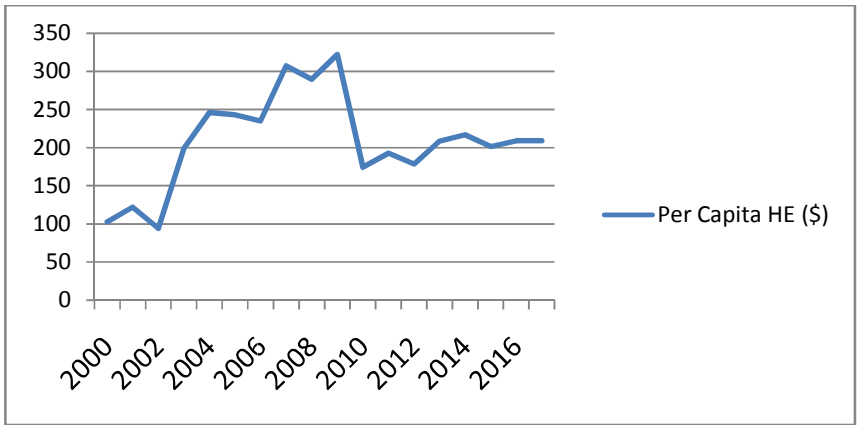

Fig. 3. Per Capita HE ($)
Source: Author's Computation

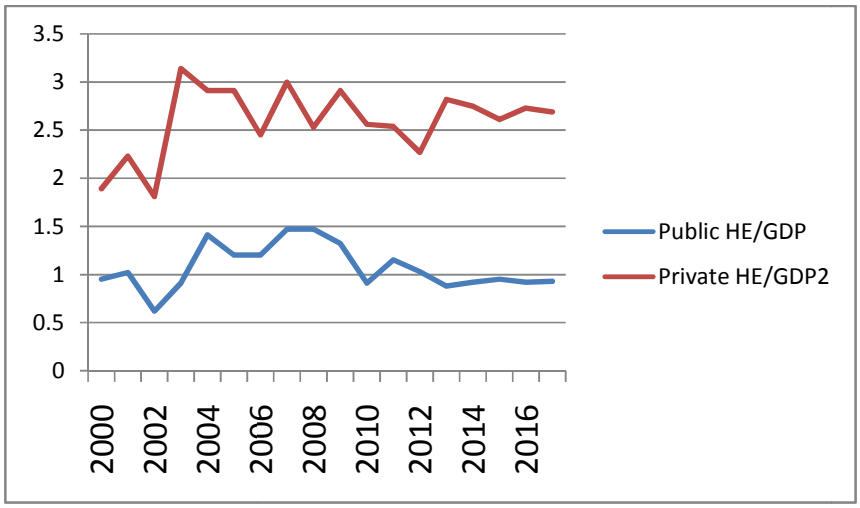

Fig. 4. Public and private HE/GDP
Source: Author's Computation

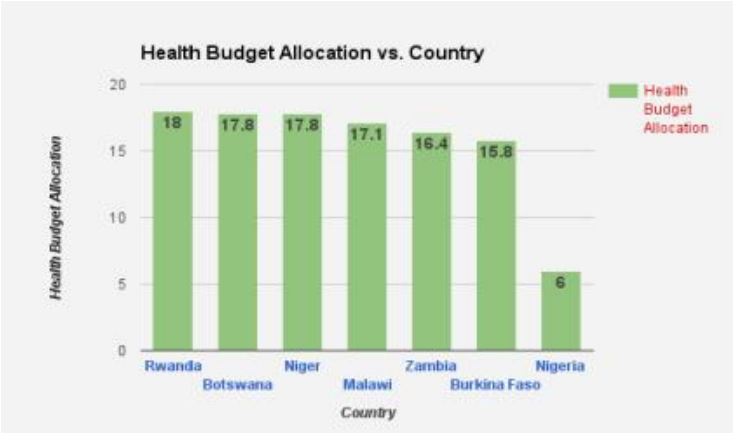

Chart 1. Budgetary allocation to health among African Countries
Source: WHO

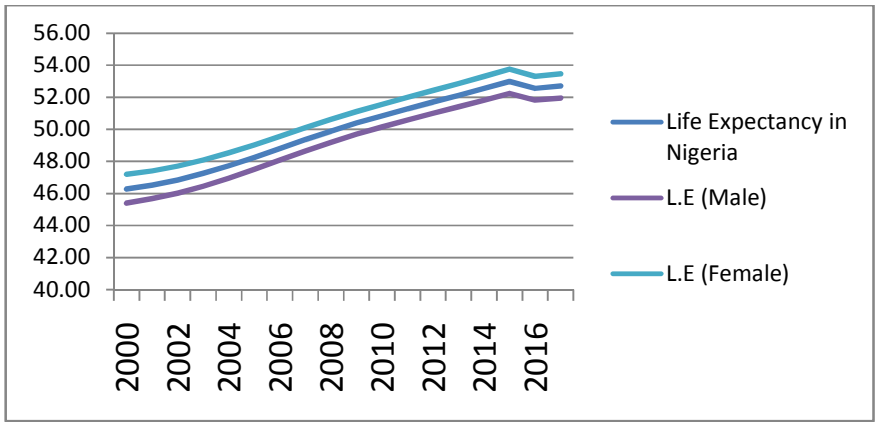

Fig. 5. Trends in life expectancy at birth in Nigeria
Source: Author's Computation using WDI data (2018)

Table 1. Mortality rate in Nigeria (2000-2017)

Years	Mortality rate (%)	Total mortality	Neonatal mortality	Adult female mortality
2000	13.72	425.41	49.3	387.33
2001	13.91	427.44	48.3	390.53
2002	14.1	429.46	47.1	393.74
2003	13.76	424.15	46	389.44
2004	13.99	418.83	44.8	385.14
2005	17.18	413.52	43.7	380.84
2006	16.94	408.21	42.6	376.54
2007	16.68	402.89	41.6	372.24
2008	16.88	399.44	40.7	368.10
2009	16.56	395.99	39.7	363.96
2010	16.31	392.54	38.8	359.82
2011	16.06	389.09	37.9	355.68
2012	13.48	385.63	37	351.54
2013	13.2	382.01	36.3	346.91
2014	13.16	378.39	35.5	342.29
2015	13	374.77	34.7	337.66
2016	12.7	378.39	34.1	342.29
2017	12.4	377.18	34.77	340.74

Sources: Column 2, Index Mundi, (2018), Columns 2-5, WDI

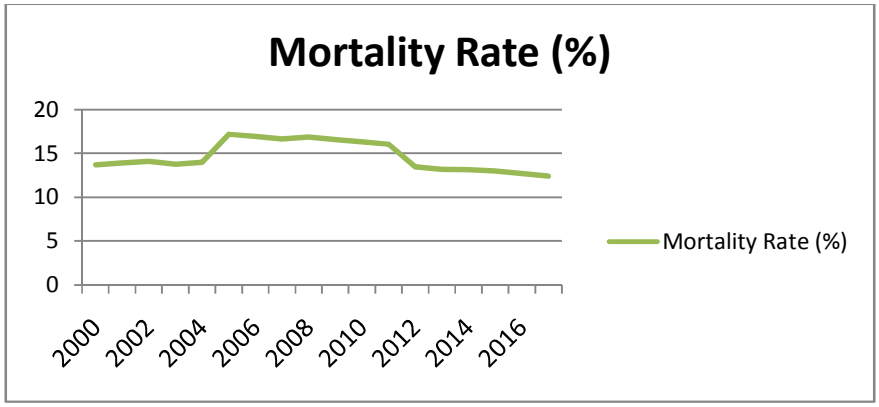

Fig. 6. Mortality rate in Nigeria (2000-2017)
Source: Author's Computation using WDI data (2018)

Table 2. Comparative analysis using 2015 data on solid waste generation and collection in Africa

Countries	Total generation	Total collection	Percentage collected (%)	Per capita generation
Algeria	10,905	10,032	92	442
Angola	2126	914	43	175
Benin	792	182	23	197
Burkina Faso	892	357	40	186
Cameroon	3448	1483	43	281
Ivory Coast	1878	751	40	175
Egypt	18,350	11,560	63	500
Ethiopia	1615	646	40	110
Ghana	444	377	85	33
Kenya	1071	429	40	110
Morocco	10,326	8,880	86	533
Nigeria	17,451	7,329	42	204
Senegal	1,070	225	21	190
South Africa	23,214	11,607	50	730
Tunisia	2,154	840	39	296

Source: Linus Mofor (2015) Renewable and sustainable energy review

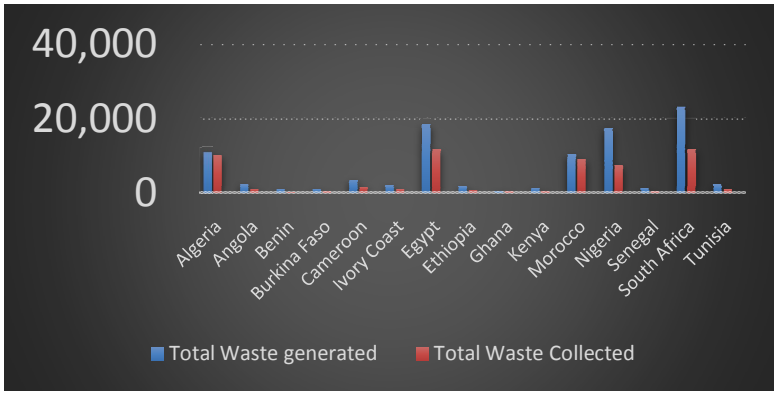

Chart 2. Waste analysis amongst selected African countries, 2015
Source: Author's Computation

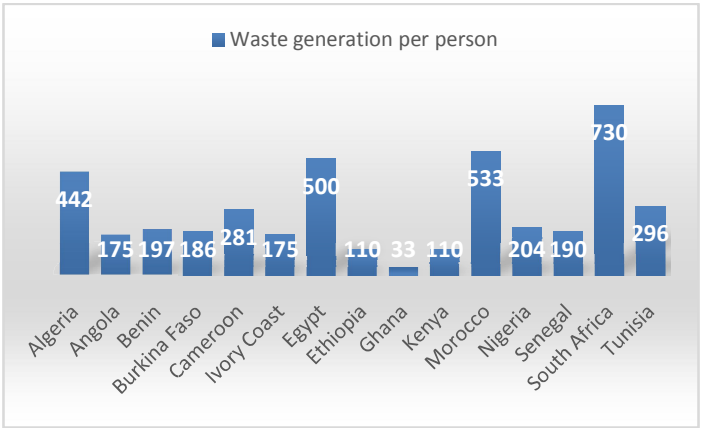

Chart 3. Waste generation per person
Source: Author's computation from (WDI, 2015)

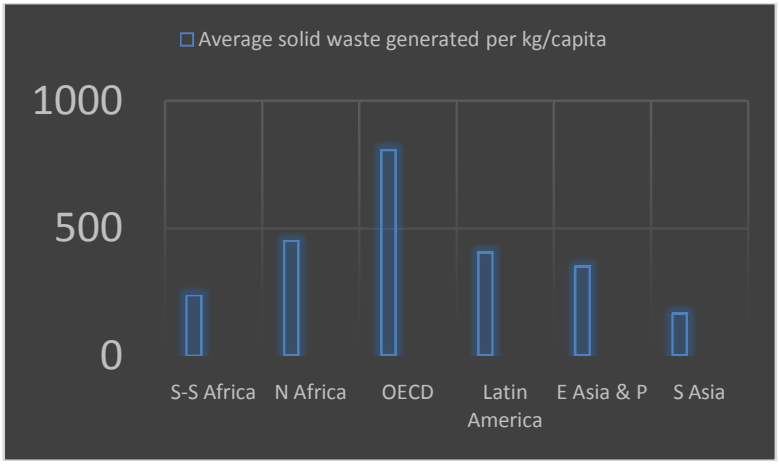

Chart 4. Regional representation of waste generation per capita/kg/annnum
Source: Author's computation from (WDI, 2015)

Trend in Carbon-dioxide Emission per capita (Metric tons) in Nigeria.

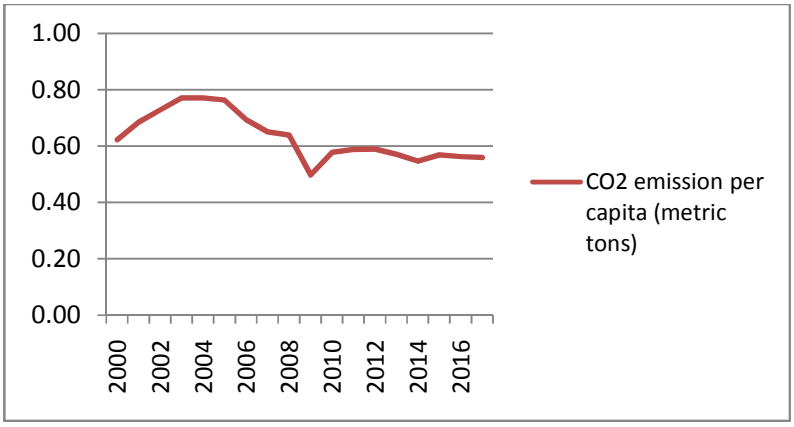

Fig. 7. CO2 emission per capita (metric tons)
Source: Author's Computation using WDI data (2018)

Wagner [14] 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 pension or 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 monopolize. Governments will have to offset these effects by providing social and merit goods through budgetary means. The second reason forms the fulcrum of this study.

2.3 EMPIRICAL REVIEW

2.3.1 Public health expenditure and health status

The relationship between public expenditure on health and Nigerians health status has continued to generate scholarly debates. Following [15] as cited in [8], governments in the world over are expected to perform two major functions of protection of lives and property and provision of public goods of which healthcare and education dominate.

There have been divergent reports on the correlation between government expenditure on health and health status in Nigeria. Some

schools of thought are of the opinion that increased government expenditure on healthcare promotes good health, reduce poverty and inequality, while the other schools of thought opined that improved devotion of resources to medical care has worsen the health status of Nigerians due to corruption and illiteracy.

The above notwithstanding, [6] investigates the effects of public health expenditure on life expectancy and infant mortality in Nigeria. The study found that public health expenditure has a long run equilibrium relationship with health outcomes in Nigeria. Furthermore, urban population and HIV prevalence rate significantly affect health outcomes in Nigeria, while GDP per capita bears no effect on health outcomes. The study submitted that government health expenditure remains an integral component in improving health outcomes in the country.

Table 3. Carbon-dioxide Emission per capita (Metric tons) in Nigeria

Years	CO_2 emission per capita (metric tons)
2000	0.62
2001	0.68
2002	0.73
2003	0.77
2004	0.77
2005	0.76
2006	0.69
2007	0.65
2008	0.64
2009	0.50
2010	0.58
2011	0.59
2012	0.59
2013	0.57
2014	0.55
2015	0.57
2016	0.56
2017	0.56

Source: WDI data bank, accessed on 06/04/ 2018

Using infant mortality rate previous studies found that the contribution of health care spending to health status is either small or statistically insignificant [16]. However, other studies have found a positively significant relationship between expenditure on health care and health status of the poor [17].

Eneji et al. [11] 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. The findings of this study were corroborated by Edeme et al. [6].

However, a contrary submission to Eneji et al. [11] was documented while investigating how governance affects the effectiveness of public health expenditure in Nigeria by Yaqub et al. [10]. The study used data on public health expenditure and governance variable captured by the corruption perception index regressed on infant mortality, under -five mortality and life expectancy, employing both the ordinary least squares and the two-stage least squares, the overall thesis of the study is that public health expenditure has negative effect on infant mortality and under-5 mortalities when the governance indicators are incorporated.

Following [18] with the aim to ascertain the differences in the health care systems of emerging Brazil, Russia, Indonesia, China and South Africa (BRICS) countries based on panel data, reports a positive relationship between government health expenditure and infant mortality rate. This indicates that the higher the level of public expenditure on health, the worse the health outcomes in BRICS countries. The possible reasons for this could be the weak institutions which promotes corruption and poor allocation to health sector in these countries.

While these studies reviewed so far have focused at the national level of healthcare provision and financing, [19] took time to water down the analysis to the state level. In their analysis, the study utilizes the multivariate analytical tool to describe the relationship that exists between health care financing, health facility utilization and health outcome in Nigeria. The focus of the research was on women who are of child bearing age and who had given birth to at least one child within the past five years. The study documents that the high levels of infant mortality and morbidity rate was associated with the high incidence of out-of-pocket payment, and the wide disparity and inequality in income distribution. The study further observed a disproportionate disparity in the spatial distribution of health facilities, with concentration of health facilities at the urban areas rather than the rural areas, which of course contributed to the poor service demand. To ameliorate the situation, the review of the current Federation revenue distribution formula, with emphasis given to the Local Government Areas (who are the principal institution responsible for primary health care in Nigeria) and the speedy

implementation of the National Health Insurance Scheme (NHIS) are crucial the study submitted.

Again, in an earlier study in 2010, [19] investigate the causal direction and the existence of a long run relationship between government health expenditure, poverty and health status in Nigeria. The study established a strong causal bi-directional relationship running between life expectancy and poverty in Nigeria and further report the existence of a long-run relationship between poverty and health status in the country. However, they found a non-significant long run relationship between health status and government health expenditure. They conclude that policies to improve health status should be such that would promote adult literacy level, reduce the poverty and income disparity, and increasing budgetary allocation to funding health sector.

Fayissa [20] estimate health production function for Sub–Saharan Africa based on Grossman framework with panel data analysis. Overall results suggest that 'a health policy, which may focus on the provision of health, services, family planning programs, and emergency aids to the exclusion of other socioeconomic aspects may do little in efforts directed toward improving the current health status of the region'.

Anyanwu et al. [21] using an econometrical evidence linking African countries' per capita income, government health expenditure and per capita income to two health outcomes: infant mortality and under-five mortality. The relationship is examined, using data from 47 African countries between 1999 and 2004; health expenditures have a statistically significant effect on infant mortality and under-five mortality. The sizes of the elasticity estimates are in line with those reported in the literature. For African countries, their results imply that total health expenditures (as well as the public component) are certainly important contributor to health outcomes. In addition, we find that both infant and under-five mortality are positively and significantly associated with Sub-Saharan Africa. The reverse is true for North Africa. While ethno-linguistic fractionalization and HIV prevalence positively and significantly affect the health outcomes, higher numbers physicians and female literacy significantly reduce these health outcomes. These results have important implications for attaining the targets envisioned by the Sustainable Development Goals.

3. METHODOLOGY

This study employed the Autoregressive Distributive Lag (ARDL) bound test to Co-integration to determine the impact of public health expenditure on health and non-health SDGs in the long run. The preliminary stationarity test carried using the Augmented Dickey Fuller (ADF) and the Phillips Perron (PP) unit root test indicates that the variables were integrated of order zero and one, thus, the ARDL model is adopted in order to test for simultaneously for both short run and long run estimation of the models.

3.1 Model Specification

The data series utilized in the study were secondary data and included annual data on public health expenditure (PHE), Life Expectancy (LEXP), Carbon-dioxide emission per capita (V) and Economic Growth Rate (YGR) of the Nigerian Economy from 1981 to 2017.

$$LEXP = f(PHE, V, YGR) \quad (1)$$

The econometric form of the model is:

$$LEXP_t = \beta_0 + \beta_1 PHE_t + \beta_2 V_t + \beta_3 YGR_t + \mu_t \quad (2)$$

Meanwhile, we introduced natural log in the model to improve the linearity assumption of the model and to also eliminate the problem of multicollinearity and homoskedasticity that could be present in the model. Thus:

$$\ln(LEXP_t) = \beta_0 + \beta_1 \ln(PHE_t) + \beta_2 \ln(V_t) + \beta_3 YGR_t + \mu_t \quad (3)$$

The white noise variable (μ_t) takes care of other variables that have influence on the dependent variable but not captured in the model

Where:

$LEXP_t$ = Life Expectancy at Birth at time t, as a proxy for Health Outcome. Though other health outcomes such as maternal mortality and infant mortality are capable of being employed, our choice of this variable as proxy for health outcome was informed by data availability.

PHE_t = Public Expenditure on Health at time t
V_t = CO_2 emission per capita at time t, a proxy variable for environmental pollution
YGR_t = Economic Growth Rate per annual at time t

μ_t = error term
β_0 = Constant (initial stock of health at birth)
$\beta_1 - \beta_3$ = Partial elasticity of the explanatory variables
$\beta_0 > 0$; $\beta_1 > 0$; $\beta_2 < 0$; $\beta_3 > 0$

4. DISCUSSION OF RESULTS

Table 4 shows the central tendency of the data. The mean reveals the average of the various variables. Maximum and minimum are the maximum and minimum values of the series in the current sample. The mean and the median of all variables employed in the model fall between the minimum and the maximum values obtained in the descriptive statistics. The standard deviation reveals the extent to which a variable is spread out around its mean. For PHE and YGR, their standard deviations are high compared to their means, but for LEXP, and V, their standard deviations are lower than their means. This shows a high coefficient of variation for the former set of data and a low coefficient of variation for the latter data series. The Jarque-Bera statistic is a goodness-of-fit test of whether the skewness and kurtosis of data matches a normal distribution. The test shows that if each of the variables is statistically significant, indicated by a zero probability, it indicates that the null hypothesis: "the distribution is normal" is rejected. Therefore, the farther the probability statistic of a variable is from zero, the lower its Jarque-Bera statistic, thus it is more normally distributed. For instance, PHE and YGR have the closest probability to zero (i.e. 0.00) and have the highest Jarque-Bera statistics of (16.57) and (99.87) respectively, while V and LEXP, have the farthest probability from zero of 0.37, and 0.08, and the lowest corresponding Jarque-Bera statistics of (1.97), and (4.99) respectively. Skewness of a symmetric distribution, such as the normal distribution is zero. Positive skewness implies that the distribution has a long right tail and negative skewness has a long left tail. From the table above, it can be seen that all other variables are positively skewed except V. Kurtosis measures the peakedness or flatness of the distribution of the series. If it exceeds 3 then the variable is peaked, if it is less than 3, it is flat. The Kurtosis result shows that PHE and YGR are in nature, that is, they are peaked as they have values greater than 3, but other variables- LEXP and V are flat as they have kurtosis values lesser than 3.

4.1 Unit Root Test Result

Testing for the existence of unit roots is a principal concern in the study of time series models and co-integration. According to Iyoha and Ekanem [22], the presence of a unit root implies that the time series under investigation is non-stationary; while the absence of a unit root shows that the stochastic process is stationary. The time series behaviour of each of the data using dual approaches of the ADF and the PP unit root tests are presented in Table 5 and Table 6. The need to complement the ADF unit root test with the PP test, stems from the fact that the PP is a non parametric test as it does not require to select 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 YGR is stationary at level, the null hypothesis is rejected while we fail to reject the alternative hypothesis that the series having unit root.

4.2 Co-integration Test Result

Co-integration test is to determine whether there is long-run relationship between the dependent and independent variables in the model. The ARDL co-integration technique is used in determining the long run relationship between series with different order of integration [23] and [24].

Pesaran et al. [24] provided the bound for the critical value for the asymptotic distribution of the F-statistic. For various situation (for instance different numbers of variables, (k+1)), they give lower and upper bound on the critical values. In each case, the lower bound is based on the assumption that all the variables are I(0), and the upper bound is based on the assumption that all the variables are I(1). If the computed F-statistic falls below the lower bound we would conclude that the variables are I(0), so no co integration exists. If the F-statistics exceeds the upper bound, we conclude that we have co-integration. Finally if the F-statistic falls between the bounds, the test is inconclusive.

Table 7 shows that the F-statistic 17.32 is greater than the 1%, 2.5%, 5% and 10% lower and upper bound test and we can therefore conclude that there is co-integration; hence the variables are co-integrated in the long run.

4.3 ARDL Estimation of Result

The coefficient of error correction term which is negative and significant conforms to theoretical expectation. The speed of adjustment when there is disequilibrium in health outcomes is about 84% per annum. This shows a high adjustment speed back to equilibrium. The coefficients of PHE in the short run model at

Table 4. Descriptive statistics and normality test for all variables in data set

Statistical tools	PHE	LEXP	V	YGR
Mean	62210.58	47.26	0.60	4.56
Median	26535.50	45.18	0.59	4.84
Maximum	304330	52.98	0.87	33.74
Minimum	339.15	44.40	0.33	-10.75
Std. Dev.	79129.46	3.05	0.17	6.94
Skewness	1.46	0.72	-0.04	1.58
Kurtosis	4.48	1.91	1.87	10.52
Jarque-Bera	16.57	4.99	1.97	99.87
Probability	0.00	0.08	0.37	0.00
Sum	2305792	1748.56	22.12	164.20
Sum Sq. Dev.	2.25	334.07	1.04	1685.41
Observations	37	37	37	36

Source: Author's Computation using Data extracted from CBN Statistical Bulletin and WDI data.

Table 5. Augmented Dicky Fuller (ADF) unit root test

Variables	At Level			At First difference			Order of integration
	1%	5%	t-critical	1%	5%	t-critical	
PHE	-3.6537	-2.9571	-1.0710	-3.6394	-2.9511	-6.3218	I(1)
LEXP	-3.6463	-2.9540	-0.9690	-3.6329	-2.9484	-3.3195	I(1)
V	-3.6268	-2.9458	-1.9840	-3.6329	-2.9484	-5.8288	1(1)
YGR	-3.6329	-2.9484	-4.5663				I(0)

Source: Author's computation from CBN and WDI data

Table 6. Phillip-Perron (PP) unit root test

Variables	At level			At first difference			Order of integration
	1%	5%	t-critical	1%	5%	t-critical	
PHE	-3.6268	-2.9458	-0.4882	-3.6329	-2.9484	-3.8449	I(1)
LEXP	-3.6268	-2.9458	0.9993	-3.6329	-2.9484	-3.3385	I(1)
V	-3.6268	-2.9458	-2.0110	-3.6329	-2.9484	-5.8287	1(1)
YGR	-3.6329	-2.9484	-4.5514				I(0)

Source: Author's computation from CBN and WDI data

Table 7. ARDL bound co-integration test (Model One)

Estimated Model: $LnLEXP_t = f(\mathrm{LnPHE_t}, \mathrm{LnV_t}, \mathrm{YGR_t})$
Optimal Lags: (4, 4, 4, 4)
F- Statistics: 17.32*

Level of significance	Lower Bound	Upper Bound
10%	2.37	3.2
5%	2.79	3.67
2.5%	3.15	4.08
1%	3.65	4.66

Source: Author's computation using CBN and WDI data

Table 8. ARDL Long and Short Run Result

Dependent Variable: $LnEXP_t$

Long Run Estimates				Short Run Estimates			
Variable	**Coefficient**	**t-stat**	**Prob**	**Variable**	**Coefficient**	**t-stat**	**Prob**
$LnPHE_t$	0.0472**	5.4837	0.000	$LnEXP_{t-1}$	0.931**	35.298	0.0000
LnV_t	-0.1166**	-2.8322	0.0083	$LnPHE_t$	-0.0005	-0.3644	0.7181
YGR_t	0.0013	0.6820	0.5007	$LnPHE_{t-1}$	0.0038*	2.5310	0.0171
C	3.5278**	60.214	0.0000	LnV_t	0.0140**	3.3311	0.0024
				LnV_{t-1}	-0.0050	-1.3736	0.1801
				YGR_t	8.83*	0.7802	0.4416
Statistical Properties of Results				C	0.2439*	2.5644	0.0158
R^2		0.996		ECT(-1)	-0.8423*	-3.7869	0.0000
Adj R^2		0.996					
F-statistic		1491.87					
Prob(F-statistic)		0.0000					
Durbin-Watson Stat		1.91					
Akaike Info Criterion		-8.0594					
Schwarz Criterion		-7.7515					

Source: Author's Computation using CBN and WDI data (Eviews 10)

current period negates the expectation of positive relationship but it is insignificant at 5% while it conforms to the expectation at previous year showing a positive significant relationship between LEXP and PHE. This shows there is a one period time lag for PHE to impact on health status in the short run. V negates the expectation of negative relationship but significant at 1%, however, the lag of V by one period conforms to the expectation of a negative relationship which is insignificant. YGR is expected to have a positive relationship with LEXP, the short run result conforms to the expected positive relationship at the current period. In summary, the short run estimates show that all the variables except YGR are significant at one time or the other to the dependent variable.

In the long run, Public Health Expenditure (PHE) has a positive value of 0.0472 significant at 1%, showing that increase in government expenditure on health increases life expectancy and thus an improvement in health outcomes. This shows that a 1% increase in PHE will lead to a 0.0475% increase in life expectancy. This conforms to the a-prior expectation of a positive relationship. The result also shows that CO2 (V) is inversely related to LEXP such that a percentage increase in V will lead to a 0.075% significant decrease in life expectancy in the long run. This result conforms to the a-priori expectation. This can be rationalized by the fact that the environmental pollution has serious health implications in terms. YGR has a positive relationship with LEXP implying that a higher economic growth rate in the country will lead to an increase in the life expectancy of Nigerians in the long run. While all the variables have significant relationship with LEXP only YGR has insignificant relationship with LEXP in the long run as shown by their probability values. This is attributable to the fact that growth in Nigeria has not been inclusive. The growth process has been driven by few sectors like oil and services which have limited employment capacity. The benefit of the growth episodes has not been distributed equitably in terms of employment and income which could enhance health care accessibility and in turn life expectancy.

The R^2 of 0.996 shows overall goodness of fit of the model and that over 99% variation in life expectancy can be explained by the changes in the explanatory variables while the probability (F-statistic) value of 0.00000 confirmed that the model employed in the analysis is of good fit.

5. CONCLUSION

From the empirical evidence, this study vehemently concludes that PHE has significant positive impact health outcomes in Nigeria. Beyond this, environmental pollution negatively and significantly affect health status in the country and economic growth has over time played a limited role in stimulating better health outcomes in Nigeria due to the fact that growth has not been inclusive enough to foster

better healthcare through redistribution of resources to the majority of the poor and vulnerable in Nigeria.

6. RECOMMENDATIONS

On the basis of the empirical findings, this study recommends the following policy options:

This study recommends that in the face of dwindling public resources, the government should sustain and continually improve when necessary the level of allocation to the health sector so as to maintain the improving trend in life expectancy recorded in the country over the last few years. In addition, environmental sustainability campaign must be encouraged since environmental variable showed a negative and significant impact on life expectancy in the Nigeria. This could be facilitated through the engagement of more Community Health Extension Workers (CHEW) trained and posted to communities for continual awareness campaign on preventive healthcare measures and friendly environmental practices in line with international best practices on Health and Environment. The government at all levels should enact a comprehensive environmental management policy, ensure every citizen and residents have a copy. This would obviously increase the awareness of the populace on the negative impact of unfriendly environmental practices such as indiscriminate refuse dumping amongst others.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://prh.sdiarticle3.com/review-history/27692