ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor (RJIF): 8.4
IJAR 2024; 10(1): 37-44
www.allresearchjournal.com
Received: 20-11-2023
Accepted: 17-12-2023

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The contribution of health outcomes and nutrition to economic growth in Sub-Saharan Africa

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DOI: https://dx.doi.org/10.22271/allresearch.2024.v10.i1a.11476

Abstract
The research was on the contribution of health outcomes and nutrition to GDP in SSA countries. This is important because an economy is only as strong as its health sector. The study covered the period from 1990 to 2018. The panel regression framework was adopted to analyse the data obtained from 36 countries. The variables are integrated after first difference, I (1) as indicated by the unit roots test. The result of both the Pedroni and Kao Cointegration tests indicate the presence of a remote equilibrium association among the variables. The results indicated GFCF and GEXH have a positive and portentous impact on GDP. LEX has insignificant and positive impact on GDP. The depth of food deficit has negative and meaningful impact on GDP. The HIV prevalence (HP) has a negative and portentous impact on GDP. Infant mortality and maternity mortality have negative and portentous impact on the level of GDP. The study concludes that GEXH, nutrition and LEX are necessary components to improving GDP in SSA countries. The study recommends amongst others an increase in budgetary allocation by all levels of government to the health care industry so as to improve salubrity condition, reduce health inequality gap among the population and in addition lead to higher growth and development.

Keywords: Economic growth, panel cointegration, depth of food deficit, health human capital, sub-Saharan Africa

Introduction
Every country aspires to attain a high and sustainable growth and development. Human capital which is the engine of productivity is one of the most pertinent explanator of economic growth, here in referred to as GDP, in both emerging and advanced economies. But one of the essential components of human capital is health human capital often exemplified as good health. Health enhancement improves the lifespan of the population, allow the accretion of knowledge and skills. Healthy people contribute more to GDP because of the gain that accrues to the society because of the healthiness of the vast majority of the people-more dividends from investments in education, more productivity and more fund saved and invested in other vital sectors of the economy. The condition of healthfulness of a country's population is very important in this regard because an economy is only as strong as its health human capital. Recent economic literature posits that the condition of healthfulness of a population is a very important determinant of GDP and advancement.

Africa being the least developing region in the world albeit with lots of potentials need to pinpoint areas for improvement in order to achieve its growth and development agenda. Health and nutrition are very pertinent for Africa's GDP and development because Africa's production is predominantly labour intensive and still more because it requires skilled manpower that will galvanize the economy to bring about the much-needed innovations for development. Developing human capital through enhancement in the nutrition and state of health of the population will boost the well-being and productive capacity not only of the individual but also of the society through positive externalities accruing from good health. The health status of a nation's population being a public good requires government intervention by way of public investment on food security, health care and adequate regulation of the health sector in general. Globally, good health has been recognized among the macroeconomic determinants of GDP but the prevailing health challenges confronting sub-Saharan African (SSA) population is a major impediment to attaining the desired economic growth and development.

Despite the abundant natural resources and large population in SSA, the region is confronted with the challenge of transforming the natural and human resources in order to attain high and enduring growth and human development.

Cross country evidence in both advanced and developing economies suggest that growth in income, nutrition and improvement of health outcomes can help reduce poverty and accelerate human development. Investing in health and nutrition lies on their potentials to boost the well-being and productive potentials not only of the individual but also of the society. Being the least developed globally, SSA countries need to optimally appropriate their resources and since the region has large population viz-a-vis large labour force, it will be better positioned economically with a healthy and productive human capital.

This is derived from the fact that haleness has a direct effect on human well-being and standard of living. In other words, health and education reinforced by adequate dietary intake are sine qua non in a country's drive to attaining economic prosperity. The United Nations (UN) Sustainable Development Goal (SDG) 3 which has impact in almost all the other 17 SDGs also shows the pre-eminent role health plays on GDP and development. But are SSA countries adequately utilizing the health and nutrition channels to attaining economic and human development?

Statement of the Problem

Globally, health has been recognised as one of the macroeconomic antecedents of GDP but the prevailing health and malnutrition challenges confronting SSA population (for instance, persistent and infectious diseases) with the attendant mortality is a major obstacle to attaining the desired GDP in the region. The high morbidity and mortality rate in SSA constitute a devastating depletion of labour force, hampers productivity and diverts scarce resources meant for other developmental needs to the treatment of diseases and care of victims. The poor investments in health care and food insufficiency in SSA have aggravated the situation as it exacerbates the health problem confronting the region. Besides health expenditure in SSA countries has generally been the lowest globally according to a report by Statista in 2020 [37].

WHO, UNICEF and World Bank Group (2019) [39] reports that SSA has the highest ratio of maternal death. More than 68% of all maternal death per year worldwide occurs in SSA. The region has been the worse hit of HIV prevalence (Eflein, 2021) [12]. According to a United Nations report, in 2020 children in SSA has the highest rates of under-5 mortality in the world at 74 deaths per 1000 live births, 14 times higher than the risk of 4 children in Europe and North America, (UN Statistics Division, 2022) [38]. Adequate feeding is widely acclaimed as one of the key factors for advancing wellness and economic prosperity of nations but malnutrition is bane to the economic advancement of SSA countries. As cited by Omilola and Sanogo (2020) [26], in 2018 58.7 million children in Africa were stunted, 13.8 million children were wasted and 9.7 million children were overweight. Globally the African continent is the most affected by the triple burden of malnutrition, as countries in the continent show a combination of undernutrition, micronutrient deficiencies and overweight, (Hawkes, 2020) [13] stated further, that of the 41 countries globally that struggle with all three forms of malnutrition, 30 are from Africa.

Amongst the empirical researches undertaken on the alliance among health outcomes, nutrition and GDP in the SSA none has considered the role of nutrition as a constituent of human health. Considering the role nutrition plays in the overall wellbeing of an individual and society at large, its role in GDP cannot be ignored. It is against this backdrop that this study empirically examines the health outcomes, nutrition and economic growth relationship among SSA countries using annual panel data from the region during the period 1990 to 2018.

The rest sections of the paper are organised as follow: next section is on literature review, next comes materials and methods; followed by results presentation and discussion while the last section is on conclusions and recommendations.

Empirical Review

Over the years different scholars have researched on different areas that pertain to this study, some within the SSA and some outside the region. Some, Pasali and Kaboine (2019) for instance exploring the impact of healthcare on growth in Africa finds that maternal, infant and child death rates are all negatively and significantly associated with GDP in Africa. They found also that LEX was positively related to GDP. The study also finds that health expenditures (HEX) have direct and indirect effects on GDP that are positive and economically meaningful. The study employed panel regression framework and used data from 48 African countries spanning from 2000 to 2015.

Ogunjimi and Adebayo (2019) [25] x-rayed the nexus among HEX, health outcomes and GDP in Nigeria for the period 1981 to 2017. Toda-Yamamoto causality framework was employed to ascertain the relationships. Their analysis showed a unidirectional causality emanating from HEX to infant death, while there was no causality between real GDP and infant death. Also, a unidirectional causality was found running from HEX and real GDP to life expectancy and maternal death; and a unidirectional causal relationship originating from real GDP to HEX.

Sarpong, Nketial-Amponsah and Owoo (2018) [31] interrogated the effect of health on GDP in 35 sampled SSA economies. Employing panel data spanning 40 years and making use of panel cointegration, panel Granger causality and the dynamic OLS methodologies, they found that health human capital is a portentous explanator of long-run GDP in SSA. The paper also showed that a bicausal relationship exists between GDP and health.

Sharma (2018) [32] in a similar study examined health-growth nexus in developed countries, using an unbalanced panel of 17 developed economies for the period 1870–2013 and panel generalised method of moments (GMM) estimator. The result revealed that population health has a positive and meaningful effect on both real per capita GDP and GDP. The result from the study further revealed that education was also positively associated with real per capita GDP.

Modibbo, Muktar and Inuwa (2015) [21] scrutinized the health outcomes and GDP nexus for Nigeria for the period 1961 to 2012. Using VECM and VEC Granger causality tests the findings from the study showed the existence of a long run relationship between health outcomes and GDP in Nigeria. LE and crude death rate employed as measures of health outcomes were found to have negative but statistically significant impact on the GDP. The Granger

causality test indicated the existence of unidirectional causality from LE and crude death rate to GDP.

The study by Aboubacar and Xu (2017) [1] queried the impact of HEX on the GDP in SSA using longitudinal data spanning the period 1995 to 2014. The study which employed system (GMM) methodology found that HEX has a positive and significant impact on GDP in the SSA economy. Their results equally revealed that health care is a necessity in the region.

Shah, Shahzad and Abrar ul haq (2015) [33] used panel least squares techniques (random and fixed effects models) to determine the impact of human capital on GDP of selected Asian countries. The empirical study employed panel data that span from 1990 to 2012. The study used GEXH and gross secondary school enrolment as proxy variables for human capital. Result of the of found a strong positive association of GEXH and GFCF with GDP. They also found that gross school enrolment has positive but insignificant impact on GDP.

Maijama'a, Samsudin and Khan (2015) [19] investigated the effects of HIV/AIDS epidemic on GDP in 42 SSA countries using panel data from 1990 to 2013. The result obtained using the dynamic system GMM estimator revealed that current HP rate has adverse effect on GDP per capita growth. surprisingly, AIDS had positive impact on per capital GDP growth.

Tekabe (2012) [16] studied the relationship between health and long run GDP in 5 low-income countries in SSA using unbalanced panel data during the period 1970 to 2009. Using life expectancy (herein used as LE) and death rate as proxies for health and real GDP per capita for GDP; and employing panel regression framework, the study found that death rate has a significant and negative impact on real GDP per capita. The result also showed that real GDP per capita and death rate have bidirectional association. Contrariwise, there was a unidirectional causality from LE to real GDP per capita.

Theoretical Framework

The study adopts the endogenous growth (the augmented AK variant) theoretical framework. The framework highlights the crucial role of stock competencies (human capital) to GDP (Mankiw, Romer and Weil, 1992; Piabuo and Tieguhong, 2017) [20, 27]. Health and nutrition contribute to GDP growth directly or indirectly via their effects on learning capacity, skill acquisition and innovation, labour supply and labour market participation; worker productivity, savings and investment, fertility and population control (see for instance Bloom & Canning, 2000; Alsan, Bloom & Canning, 2006; Bloom, Canning & Jamison, 2004; Bloom, Canning & Sevilla, 2003; Bloom & Canning, 2004; Bloom, Canning & Malaney, 2000; Howitt 2005; López-Casasnovas *et al*. 2005 and CMH, 2001) [6-7, 3, 8, 10, 9, 14, 30, 11]. Moreover, increasing longevity influences savings decisions. If people expect to live longer, they will save more for their retirement, Bloom and Canning, (2000) [6-7]. Higher savings rates will in principle lead to higher investment rates and thus more physical capital accumulation, which in turn fosters growth in the medium term (see Barro & Sala-i-Martin 2004) [4]. Increased LE and lower mortality rates result in increase in the labour force of a nation and thus contribute to higher output levels and per capita income.

Health and nutrition are taken into cognizance in our model because of their potentials to reduce poverty and consequently spur GDP. In fact, haleness and nutrition improvements have great impacts on the living standards of the less privileged of society because it affords with them good health and energy to participate more in economic activities, increase their income level and purchasing power, educate their children and as well improve their own education; with pragmatic and favourable consequences on their performance and GDP growth.

The model adopted in this study is Solow (1956) [35] neoclassical model extended by Mankiw, Romer and Weil (1992) [20]. The inclusion of stock of competencies in the augmented growth model (Solow growth model) is said to explain the diversities in output levels across countries. Suffice to say that, the more SSA countries invest in human capital the more their economies are expected to prosper than countries that do not invest in human capital. Basic augmented version of Solow model with the inclusion of stock of competencies in a panel regression framework is given as follows:

$$Y_{it} = K^{\alpha}_{it} H^{\beta}_{it} (A_{it}.L_{it})^{1-\alpha-\beta}, \ \alpha > 0, \ \beta > 0, \ \alpha+\beta < 1 \quad (1)$$

Where *Y* denotes the total output in an economy, *A* represents multifactor productivity (often generalized as technological progress or the effectiveness of labour), *K* is capital, *L* is labour and α and β are production elasticities. H connotes the stock of health capital. Equation (1) implies that there are constant returns to K, H and L together. With labour augmented technological progress represented by A, AL represents effective labour.

The theoretical framework therefore, depicts a functional relationship between health outcome variables, nutrition and GDP. Therefore, the study employs the specified model to analyse the impact of nutrition and health outcomes on GDP in SSA countries.

Materials and Methods

Data and Sample

The panel data used for the study cover the period 1990 to 2018. Of the 46 countries in SSA 36 were selected and they include: Benin, Burkina Faso, Burundi, Cameroun, Central African Republic, Comoros, Congo Democratic Republic, Cote d'Ivoire, Equatorial Guinea, Eritrea, Eswatini, Gabon, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, The Gambia, Togo, Uganda and Zimbabwe. The choice of these countries was based on the availability of consistent data.

Data: Sources, Definition and Description

Model Specification

The model for this study is based on the augmented Solow growth model, (Mankiw, Romer and Weil, 1992) [20] and a modification of Ogungbenle, Olawumi and Osasuyi's (2013) [24] model who examined the relationship among life expectancy, public health spending and GDP in Nigeria. The hybrid functional model for the study is therefore stated thus:

$$GDP = f(GFCF, GEXH, LEX, INFMR, MMR, DFD, HP) \quad (2)$$

The explicit linear long run panel regression framework of the model is stated thus:

Table 1: Nomenclature: Nature and Description of Data

Series	Definition/Proxy	Symbol of Series	Source of Data
Economic Growth	Real gross domestic product (Constant 2010 US$)	GDP	World Develop-ment Indicator, 2020
Gross fixed capital formation	stock of accumulated physical capital	GFCF	World Develop-ment Indicator, 2020
Public Health Expenditure	Domestic general government expenditure on health as a percentage of GDP	GEXH	World Develop-ment Indicator, 2020
Life Expectancy	Life expectancy at birth in years	LEX	World Develop-ment Indicator, 2020
Infant mortality rate	Infant mortality per 1000 live birth	INFMR	World Development Indicator, 2020
Nutrition intake	Depth of Food Deficit Kilocalories per Person per Day	DFD	FAO STAT various issues
Maternal mortality	Maternal mortality ratio estimates per 100,000 life births	MMR	World Development Indicator, 2020
HIV Prevalence	Prevalence of Human Immuno-Virus, Total of population ages 15-49	HP	World Development Indicator, 2020

Source: Author's compilation

$$GDP_{it}=\alpha_0+\alpha_1 GFCF_{it}+\alpha_2 GEXH_{it}+\alpha_3 LEX_{it}+\alpha_4 INFMR_{it}+\alpha_5 DFD_{it}+\alpha_6 MMR_{it}+\alpha_7 HP_{it}+\mu_{it} \quad (3)$$

In line with (Ilori, Olalere & Babatola, 2017) [15], we transform equation (3) into log-linear form that allows the use of OLS technique. In doing this they applied the double log-transformation rule. The essence of the variables' transformation is that it provides estimated parameters that can be explicitly interpreted as partial elasticities (Ilori, Olalere & Babatola, 2017) [15]. Taking natural logarithm of equation (3) and still retaining the assumption that the variables are linear equation (3) becomes:

$$\ln GDP_{it} = \alpha_0 + \alpha_1 \ln GFCF_{it} + \alpha_2 \ln GEXH_{it} + \alpha_3 \ln LEX_{it} + \alpha_4 \ln INFMR_{it} + \alpha_5 \ln DFD_{it} + \alpha_6 \ln MMR_{it} + \alpha_7 \ln HP_{it} + \mu_{it} \quad (4)$$

Based on the equation (4) the parameters must satisfy the following sign restrictions: $\alpha_0 > 0$, $\alpha_1 > 0$, $\alpha_2 > 0$, $\alpha_3 > 0$, $\alpha_4 < 0$, $\alpha_5 < 0$, $\alpha_6 < 0$, $\alpha_7 < 0$. Where μ = Stochastic term, α_i are elasticities and "ln" stands for the natural logarithm forms. All the variables are considered in the natural logarithm form at the time "t" in the benchmark model.

Method of Data Analysis

The study employed a detailed and inclusive panel econometrics technique to ascertain how health outcomes and nutrition impact GDP in SSA economies. Precisely, the following statistics and econometrics estimation procedure were employed: (i) fixed effect (FEM) and random effect (REM) regressions as well as Hausman's test (ii) panel unit root tests of stationary variable properties, (iii) panel cointegration to ascertain the presence or not of a long-term relationship among the variables and (iv) estimation of the long-run relationship, Fully Modified OLS (FMOLS).

Results and Discussion

The result of the FEM and the REM were shown in the second and third columns of Table 2. The lower part of the table shows the result of the Hausman's test. The probability of the Hausman's test of 0.0029 indicates a rejection of the null hypothesis that the REM is appropriate and an acceptance of the FEM.

The result of the FEM regression indicates that the GFCF, GEXH and LEX have a positive relationship with the GDP. The MMR, HP, DFD and INFMR have negative relationship with the GDP. A unit increase in the GFCF, GEXH and LEX caused the GDP to expand by 0.14, 1.51 and 5.22 respectively while an increase in the MMR, HP, DFD and INFMR by 1 unit each reduced the GDP by 0.18, 0.14, 0.14 and 0.75 units respectively. The R^2 in the fixed effect model indicates that 89% of the aggregate change in the explained variable has been explained by the GFCF, GEXH, LEX, MMR, HP, DFD and INFMR taken jointly. This is good enough given an unexplained variation of just 11%. The F-statistic with value of 1379.78 and probability of 0.00 indicates that the overall regression model is significant at the 5% level of significance. Thus, we do not accept the null hypothesis that all the slope coefficients are zero, which further indicates that R^2 is significantly different from zero. The t statistic indicates that the GFCF, GEXH, MMR, HP, DFD and INFMR with values of 8.15, 8.19, -2.85, -4.72, -6.00 and -9.44 with probability of 0.0000, 0.0000, 0.0046, 0.0000, 0.0000 and 0.0000 are statistically significant in explaining the variations in the GDP. This is an indication of the validation of the respective alternative hypothesis of a significant relationship. The LEX with t value of 1.876 and probability value of 0.079 is not statistically significant. It indicates a validation of the null hypothesis of no substantial relationship between LEX and GDP in SSA countries.

Table 2: Results of FEM, REM and Hausman's Test. Dependent Variable: LGDP

Variables	Fixed Effect	Random Effect
C	-3.254	-2.413
	-2.948	-2.222
	(0.0034)	(0.0268)
LGFCF	0.137	0.135
	8.154	8.205
	(0.0000)	(0.0000)
LGEXH	1.511	0.007
	8.187	0.526
	(0.0000)	(0.5994)
LLEX	5.216	1.397
	1.876	7.679
	(0.0790)	(0.0000)
LMMR	-0.182	-0.133
	-2.850	-2.129
	(0.0046)	(0.0338)
LHP	-0.143	-0.155
	-4.724	-5.350
	(0.0000)	(0.0000)
LDFD	-0.135	-0.136
	-6.004	-6.087
	(0.0000)	(0.0000)
LINFMR	-0.754	-0.123
	-9.442	-1.634
	(0.0000)	0.1030
R^2	0.89	0.62
F-statistic	1379.78	100.76
Prob (F-stat)	0.000000	0.000000
Hausman Test	Chi-square Statistics =21.70	Probability = 0.0029

Note: Figures in parentheses are probabilities and figures below coefficients are t-values

Source: Author's Computation

Table 3: Results of the Panel Unit Root Test

Variables	Statistics	Level	First Difference	Order of Integration
GDP	LLC	(0.4634)	(0.0000)	I (1)
	IPSW	(0.9999)	(0.0000)	
	ADFFC	(0.9538)	(0.0000)	
	PPFC	(0.6489)	(0.0000)	
GFCF	LLC	(0.8470)	(0.0000)	I (1)
	IPSW	(0.9998)	(0.0000)	
	ADFFC	(0.9628)	(0.0000)	
	PPFC	(0.6985)	(0.0000)	
GEXH	LLC	(0.2780)	(0.0000)	I (1)
	IPSW	(0.8909)	(0.0000)	
	ADFFC	(0.8791)	(0.0000)	
	PPFC	(0.5918)	(0.0000)	
LEXH	LLC	(0.0801)	(0.0000)	I (1)
	IPSW	(0.1870)	(0.0000)	
	ADFFC	(0.5203)	(0.0000)	
	PPFC	(0.8746)	(0.0000)	
MMR	LLC	(0.0278)	(0.0000)	I (1)
	IPSW	(0.8000)	(0.0000)	
	ADFFC	(0.9989)	(0.0000)	
	PPFC	(0.9994)	(0.0000)	
HP	LLC	(0.0780)	(0.0000)	I (1)
	IPSW	(0.1034)	(0.0000)	
	ADFFC	(0.7080)	(0.0000)	
	PPFC	(0.0000)	(0.0000)	
DFD	LLC	(0.1022)	(0.0000)	I (1)
	IPSW	(0.0986)	(0.0000)	
	ADFFC	(0.0000)	(0.0000)	
	PPFC	(0.9990)	(0.0001)	
INFMR	LLC	(0.4940)	(0.0000)	I (1)
	IPSW	(0.9958)	(0.0047)	
	ADFFC	(0.0048)	(0.0089)	
	PPFC	(0.9993)	(0.0445)	

Note: (1) LLC = Levin Lin & Chu test, IPSW = Im, Peseran and Shin W-Statistic, ADFFC = Augmented Dickey Fuller Fisher Chi-square and PPFC = Philip Perron Fisher Chi-square.
(2) Figures in parentheses are probabilities

Table 4: Pedroni and Kao Cointegration Tests Results

Statistics	Probabilities	Statistics	Probabilities
Panel V-Statistics	0.0027	Panel V-Statistics (Weighted)	0.0364
Panel rho-Statistics	0.0135	Panel rho-Statistics (Weighted)	0.0051
Panel PP-Statistics	0.0215	Panel PP-Statistics (Weighted)	0.0013
Panel ADF-Statistics	0.3589	Panel ADF-Statistics (Weighted)	0.1427
Group rho-statistic	0.0001		
Group PP-statistic	0.0001		
Group ADF-statistic	0.2261		
Kao Cointegration Test			
ADF Statistic -2.67		Probability 0.0038	

****Source*:** Author's Computation

The result of the stationarity tests for all the variables indicates an acceptance of the null hypothesis of a unit at the levels. However, after the first differences were taken, the variables did not have unit root. Thus, the variables became integrated of order one, I (1). This paves the way for the cointegration test. Again, eleven statistics were used for this purpose as shown in the Pedroni Cointegration test. Also, the Kao residual Cointegration test was also conducted, all in a bid to ascertain the existence or not of a remote equilibrium consanguinity among the variables. The result of the Pedroni and Kao Cointegration tests are shown Table 4 below:

Pedroni's Cointegration test result indicates that seven out of eleven statistics are significant. Since this forms majority we conclude that, a remote stable alliance exists among the variables. The result of the Kao cointegration test with a probability of 0.0038 further indicates the existence of a remote stable relationship among the variables. This result paves way for us to estimate the panel (FMOLS). The result of the panel FMOLS is shown in the table below:

Table 5: Results of Panel FMOLS Result for Model. Dependent Variable: LGDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGFCF	0.147196	0.025382	5.799123	0.0000
LGEXH	0.021726	0.020571	1.056178	0.2916
LLEX	1.491352	0.279042	5.344535	0.0000
LMMR	-0.293972	0.097518	-3.014538	0.0027
LHP	-0.109032	0.048355	-2.254800	0.0247
LDFD	-0.127594	0.034162	-3.734976	0.0002
LINFMR	-0.083126	0.117455	-0.707725	0.4796

***Source*:** Author's Computation

The result of the panel FMOLS indicates that GFCF, GEXH and LEX have long run positive correlation with the GDP.

The maternal mortality rate, HIV prevalence, depth of food deficit and infant mortality rate have a distant negative association with the GDP. A unit increase in the GFCF, GEXH and LEX increased the GDP by 0.147, 0.022 and 1.491 in the long run. A unit increase in the maternal mortality ratio, HIV prevalence, depth of food deficit and infant mortality by 1 unit each reduced the GDP by 0.293, 0.109, 0.128 and 0.083 units in the long run. The R^2 of 0.993 indicates that changes in gross fixed capital formation, life expectancy, maternal mortality, human immunodeficiency virus prevalence and depth of food deficit account for about 99% of changes in economic growth. Thus, the model explains 99% of the variations in GDP. This is very good given that only 1% is left unexplained and this can be attributed to the stochastic term. The result indicates that GFCF, LEX, MMR, HP and DFD with t values of 5.799, 5.344, -3.015, -2.255 and -3.759 with probabilities of 0.0000, 0.0000, 0.0027, 0.0247 and 0.0002 are statistically significant in the long run. The GEXH and INFMR are not statistically significant in the remote future.

Discussion of Findings

The research has been on the nexus among health outcomes, nutrition and GDP in SSA. The result indicates that infant mortality has a negative and significant impact on GDP. This finding is consistent with the study by Some, Pasali and Kaboine (2019) [36] who found a negative and significant relationship between infant mortality and GDP in Africa. This indicates that infant mortality has a detrimental impact on the level of GDP in SSA. The result indicates further that GEXH has a significant and positive impact on the level of GDP among SSA countries. This result corroborates with those of Aboubacar and Xu (2017) [1] and Shah, Shahzad and Abrar ul haq (2015) [33] who found a positive and significant relationship between health expenditure and GDP among SSA countries. This result insinuates that improved spending by government on health-related issues has the potential of bringing about the desired growth among SSA countries.

The study found a positive and significant relationship between GFCF and GDP. This result agrees with that of Shah, Shahzad and Abrar ul haq (2015) [33] who found a significantly positive association between GFCF and GDP in Nigeria. Increase in the stock of physical capital in SSA countries would positively advance GDP in the region. The result further shows that LEX has a positive but insignificant impact on GDP. The result is at variance with those of Sharma (2018) [32] who found a positive and significant relationship between health outcome and economic advancement among seventeen advanced countries. This is however justifiable since our study is on yet to be industrialized sub-Saharan African countries when compared to developed economies with high LEX. This result is also not in agreement with that of Modibo, Muktar and Inuwa (2015) [21] who found negative and significant relationship between LEX and economic upswing in Nigeria. This result is relevant considering the fact that Nigeria constitutes the largest economy in SSA.

The result from my analysis further revealed that the HP has negative and portentous impact on the GDP. This agrees with the result of Maijama'a, Samsudin and Khan (2015) [19] who found a negative correlation between the HP and per capita GDP. The result is however at variance with those of Uzoma (2014) who found an inelastic and insignificant relationship between HP and GDP per capita. The study also found that maternal mortality has significant and negative impact on GDP. This corresponds with the findings of Liya (2012) who found a negative and significant relationship between mortality and GDP.

Policy Implications

The positive and significant impact of GEXH on GDP revealed that improved health spending is important for GDP among SSA countries. The implication of the insignificant impact of LEX on GDP among SSA countries is that LEX is still below expectation since it has not transformed the economic prosperity of the region. The negative impact of both infant and maternal mortalities in the findings also revealed that both infant and maternal mortalities are detrimental to GDP in SSA.

Conclusion and Recommendations

Drawing from the Augmented Neoclassical growth model, the study investigated the role of health outcomes and nutrition in promoting GDP in SSA countries. The health sector constitutes the most crucial aspect of any society. This is why successive governments in the world have given the health sector a special, but not satisfactory priority as shown by the outbreak of COVID 19 virus that crippled the health sector of even the most advanced countries. The situation is however worrisome in SSA countries, where the health sector has been relegated to the background. In most cases, African countries are low in the allocation of fund to the health institutions, while the impact of such negligence of the health institutions continues to manifest in the form of high adult and infant mortalities, increase in HIV prevalence, reduction in life expectancy, low level of capital formation, etc.

Our result however revealed that if well managed, adequate GEXH could be a tool of improving both GDP and development in the SSA countries. The study revealed further that life expectancy in Africa has not improved the level of prosperity, when compared to the developed world because the life expectancy in SSA countries is still low and the quality of life is also low. The study concludes that the high level of infant and adult mortalities in the SSA countries has been inimical to the GDP in SSA countries. The study further revealed that the high level of HIV prevalence has not encouraged the level of growth among SSA economies. The study concludes further that the high level of food deficit among SSA countries has hindered the quantum of income growth among SSA economies. The study however revealed that improvement in capital formation and an increase in the allocation of funds to the health sector could have incremental breakthrough on GDP in both immediate and remote future. Consequently, the following recommendations are proposed for the purpose of policy formulation and implementation:

i. Government at all levels across sub-Saharan Africa should increase the monetary allocation to the health sector to at least 15% of their annual national budget in line with the benchmark of the 2001 Abuja Declaration by African heads of government [Organization of Africa Unity (OAU), 2001] [23]. If such funds are well managed, particularly for the primary health sector, the level of national income and development will increase in both the short tern and distant future.
ii. Special attention should be given to reinvigorate the HIV prevention treatment, stigmatization and increased

funding campaign to reduce the prevalence of HIV. This will bring about a healthier population which is vital in both the near and remote future for improving the level of economic growth and development.

iii. Infant and maternal mortalities should be brought to the barest minimum. Also, funds should be channelled for immunization against childhood killer diseases. Free medical care to pregnant women is also vital. This will enhance the level of capital formation which in turn will expand the quantum of economic growth.

iv. Life expectancy could be increased if among SSA countries more funds are made available for research and development on new ways of managing killer diseases like cancer, diabetes, etc. This also can be through increased funding for development of new drugs, prevention and treatment. This will improve the life expectancy among African countries which will improve the level of GDP and development both in the short-run and long-run.

v. The depth of food deficit could be drastically reduced through food sufficiency by increasing the level of food production with high local content. This will accelerate the growth of aggregate national income.

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