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The Effects of Health Status and Child Mortality on the African Economies

(Kesan Status Kesihatan dan Kematian Kanak-kanak ke atas Ekonomi Afrika)

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ABSTRACT

The current study aims to examine the economic effects of health status. Employing data from 43 African countries, this study utilized the Pooled Mean Group estimation method of the Autoregressive Distributed Lag (ARDL) for cointegration to analyze the short-run and long-run relationship between health status and economic growth. In assessing the health status, we use life expectancy, infant mortality rates and mortality rate under the age of five measures. The results show that life expectancy in the long term was positively correlated with GDP per capita. In addition, infants and under-five mortality rates for both categories were negatively linked to the degree of long-term economic growth, suggesting a positive correlation between health status and growth. The study contributes to our understanding of the significance of health status as a main ingredient of economic growth in the African continent. Therefore, African policy makers are urged to pay particular attention to their healthcare services and any other factors that can help improve the health of their people.

Keywords: Life expectancy; infant mortality; under-five mortality; economic growth; panel data
JEL: I15, O40, C23.

ABSTRAK

Kajian semasa bertujuan untuk mengkaji kesan ekonomi status kesihatan di negara-negara Afrika. 43 negara Afrika dalam kajian ini dipilih berdasarkan ketersediaan data. Yang penting, tiga langkah digunakan untuk menilai status kesihatan, iaitu: jangka hayat, kadar kematian bayi dan kadar kematian di bawah umur lima tahun. Kajian itu menggunakan kaedah anggaran Kumpulan Min Berkumpulan bagi Autoregressive Distributed Lag (ARDL) untuk kointegrasi untuk menganalisis hubungan jangka pendek dan jangka panjang antara status kesihatan dan pertumbuhan ekonomi. Keputusan menunjukkan bahawa jangka hayat dalam jangka panjang berkorelasi positif dengan KDNK per kapita. Di samping itu, kadar kematian bayi dan bawah lima tahun untuk kedua-dua kategori dikaitkan secara negatif dengan tahap pertumbuhan ekonomi jangka panjang, menunjukkan korelasi positif antara status kesihatan dan pertumbuhan. Kajian itu menyumbang kepada pemahaman kita tentang kepentingan status kesihatan sebagai bahan utama pertumbuhan ekonomi di benua Afrika. Oleh itu, pembuat dasar Afrika digesa untuk memberi perhatian khusus kepada perkhidmatan penjagaan kesihatan mereka dan sebarang faktor lain yang boleh membantu meningkatkan kesihatan rakyat mereka.

Kata kunci: Jangka hayat; kematian bayi; kematian di bawah lima tahun; pertumbuhan ekonomi; data panel.
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INTRODUCTION

To understand why some countries are so poor, while some others are so rich, various theoretical and empirical studies have been conducted. Yet, finding answers remains one of the most important challenges facing economics (Acemoglu 2009). Human capital's major contribution to the degree of economic development, in both forms education and health, is beyond dispute. Giving more attention to human capital may help many developing countries to improve their rates of economic growth. It was also proposed that healthcare has a stronger prediction power than education for economic development (Barro 2013).

Higher level of income promotes the access to products and services that lead to a healthier life, such as balanced nutrition, clean drinking water and better sanitation. According to the WHO (2014), Individuals

are well-balanced in terms of mental and physical health in enhanced physiological, psychological, social and economic environments.

Over the last three decades, the improvement in the health status could have been far better than has been realized in African countries if an optimal allocation of resources had been achieved.

Global uncertainty persists the pace of economic development in African countries. The scale of economic development in the continent could be primarily influenced by human benefits from health care sectors.

The analysis thus contributes to African economies' literature by analyzing both short- and long-term links between health and per capita income. In comparison to other current research, such as Ogliye (2014), the panel unit root and cointegration analyses are used in this research taking into account the possibility of cross-sectional dependency. Also, the contribution to policy makers in the African continent is in term of the essential role played by human capital in the form of health to economic performance. Moreover, this research has used a very diverse set of time series panel data from 1990 to 2018 representing 43 countries in Africa. In the article, the health condition of the African continent was measured on the basis of different factors, including life expectancy, child mortality rates and under-five death rates. Unlike other studies (Kouton et al. 2018; Biyase & Maleka 2019; Shahbaz et al. 2019; Somé et al. 2019; Sarpong et al. 2020), the analysis then grouped the sampled countries into two categories; developed and less-developed, depending on the Human development index (HDI), in order to reduce any possible sample heterogeneity.

This study is carried to examine the effect of life expectancy, infant mortality rate, and under-five mortality rate on economic growth in Africa. More explicitly, it addressed the long-term and short-term correlations between Africa's economic growth levels and the main measures of different health status measures. The results have demonstrated the vital role played by health status and child mortality reduction in enhancing economic performance in the African continent.

The rest of the study is organized as follow. Section 2 examines relevant to recent scientific research, which exposes the current research gap, Section 3 describes the theoretical structures, the methods of estimating employed, and the data; Section 4 addresses the study's results; Section 5 summarizes the findings and policy suggestions.

HEALTH AND ECONOMIC INDICATORS OF SELECTED AFRICAN ECONOMIES

The average span for a young child born in Africa in 2011 is around 57 years, even though women may have a longer expectancy than men. On the other hand, life expectancy in other countries is about 70 years for the same child. However, within the African region, there is significant variation. For example, Sierra Leone has the lowest life expectancy for children at [i]46 years, while a child born in Mauritius is expected to have the regions longest life expectancy at 74 years (WHO 2014).

The majority of African countries are considered to be relatively less-developed and their health care systems are faced with various challenges. In many Sub-Saharan African countries, the population are rural, fertility rates are considerably higher, and there is a heavy burden of infectious diseases and stunting due to the prevalence of malnutrition (Getzen 2012). Besides, the misallocation of health care resources between urban and rural areas has resulted in a lack of access to basic medical care needs for a large percentage of the population in many African countries. Despite the abovementioned facts, the health condition in several African countries has clearly increased (such as life expectancy and the child mortality rate).

Figure (1) shows that the trends of GDP per capita over the period (1990 -2018) indicate some variations between the two country groups (developed and less-developed). Many countries have witnessed slight increase in their real GDP, whereas few have recorded a declining GDP per capita. Furthermore, the trends of heath indicators also varied between the two groups, however they indicate an increase in life expectancy and a decline in the infant mortality rate and under-five mortality rate. Figures (2a – 2c) show the trend of life expectancy at birth, infant mortality rate, and under-five mortality rate, respectively, for 24 selected African countries from 1990 to 2018. Overall, these figures illustrate an increase in life expectancy and a decline in the infant mortality rate and under-five mortality rate. These improvements in the health status are remarkable especially with the numerous health care obstacles in African economies. In particular, the government expenditure on health as share of GDP remains about 5 percent on average in 2017-2018, which relatively low (World Bank 2020).

LITERATURE REVIEW

Health is one of the most essential aspects to human lives. Better health and lower health-related risks such as higher incidence of out-of-pocket spending could lead to more poverty and increase child mortality (Sirag & Nor 2021; Logarajan et al. 2022). Until recently, much of the latest research has indicated that the health condition has a positive and significant impact on economic growth (Piabuo & Tieguhong 2017; Sharma 2018; Ogundari & Awokuse 2018; Azam et al. 2019; Wang et al. 2020; He & Li 2020). Nevertheless, the previous view was questioned since little proof has been given to support the idea that a substantial increase in

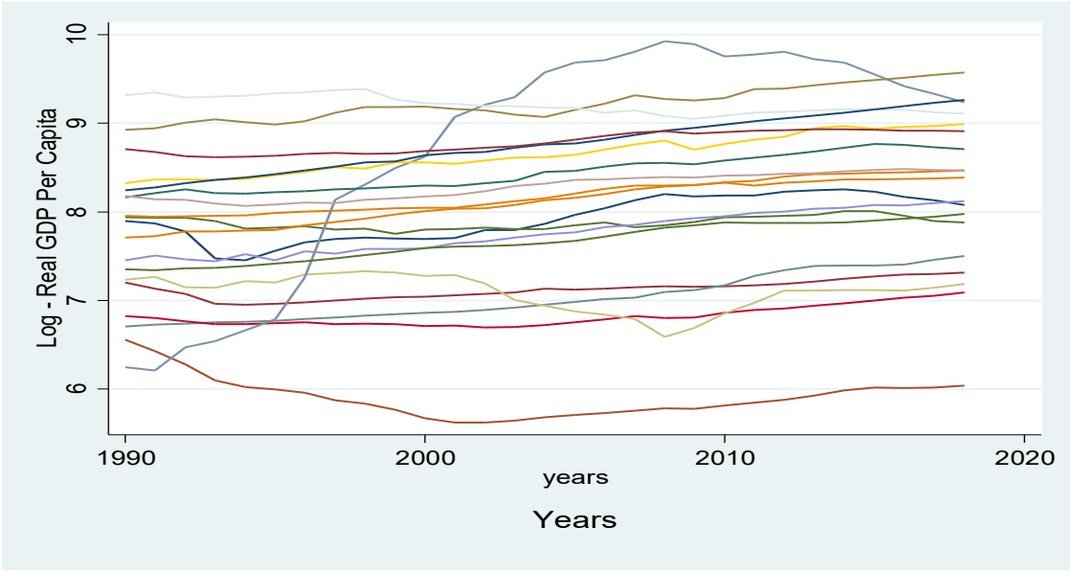

FIGURE 1. Real GDP per capita for selected African countries (1990 – 2018).
Source: World Bank (2020), authors' calculations.

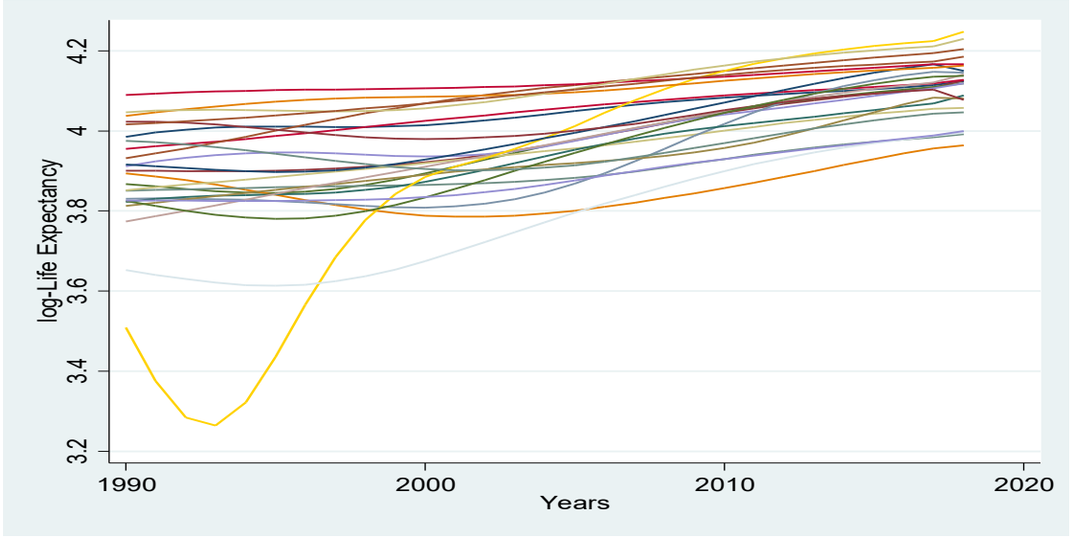

FIGURE 2A. Life expectancy at birth for selected African countries (1990 – 2018).
Source: World Bank (2020), authors' calculations.

economic development owing to the improvement in life expectancy (Acemoglu & Johnson 2007; Kasnauskiene & Michnevic 2017). Husain (2012) has by comparison provided alternate health effect projections by way of an alternative tools, timeframe, and country groupings, calculated by life expectancy, for the population, GDP, and GDP per individual. These conclusions implied that there was a substantial difference in findings from Acemoglu and Johnson (2007); that the widespread negative results of life expectancy impact on per capita revenue warranted caution; and that the rise in life expectancy may have been a positive influence on per capita income development. An alternative argument suggesting the possibility of nonlinearity between life expectancy and economic growth has emerged (Kouton et al. 2018; He & Li 2019; Okunade & Osmani 2020; Sirag et al. 2020). The main idea of such relationship may possibly accommodate both earlier views. For instance, Sirag et al. (2020) argued that life expectancy has a positive effect on economic growth initially,

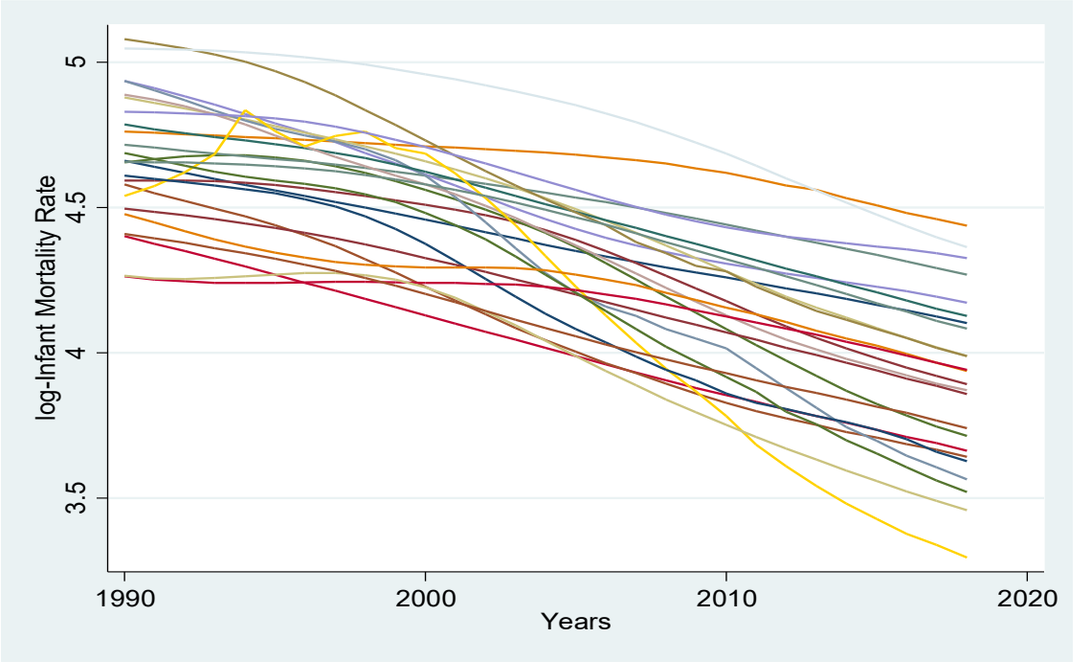

FIGURE 2B**.** Infant Mortality Rate for selected African countries (1990 – 2018).
Source: World Bank (2020), authors' calculations.

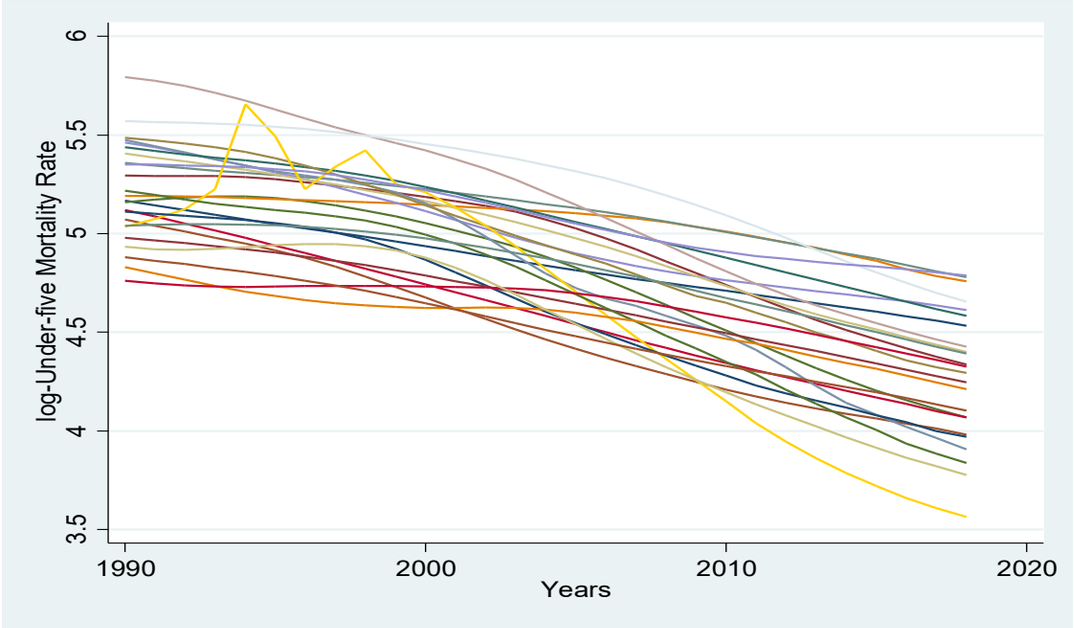

FIGURE 2C**.** Under-five Mortality Rate for selected African countries (1990 – 2018).
Source: World Bank (2020), authors' calculations.

but beyond the turning point it has a negative impact on economic growth. The literature of the developing countries of the link between health and economic development is well known. The problems at hand, however, remain to be recognized by African nations. A summary of previous longitudinal health studies and the economic growth level in African countries is given in the following section.

Established influences and processes affecting economic growth are a critical phase in the implementation of policies to achieve higher growth rates in Africa. Bloom and Sachs (1998), for example, stressed the fundamental factors affecting the pace of African economic development. They concluded that economists should go past macro-economic policy and market liberalization and deepen their comprehension of the relations between the physical and social environments. Intense and structural research is definitely required in order for regional health and economic success to connect complicatedly. Block (2001) studied African economic development in a subsequent report, questioning the premise that the growth effects of specific explanatory variables are the same in Africa as elsewhere. The study of regression has shown that Africa's shutdown to trade is more expensive for growth, natural resources have been disadvantageous to institutional development and a variety of variables have not shown such beneficial effects outside Africa which have decreased population growth or improved institutional efficiency. In sub-Saharan African and OECD nations, Gyimah-Brempong and Wilson (2004) have analyzed the influence of human health wealth on development per-capita income. They observed that the rate of growth of per capita income was significantly and favorably determined by the health stock of human resources, utilizing a complex panel estimator. The findings indicated that 220 and 30 percent of the per capita growth rate could be linked to health, respectively in sub-Saharan African and OECD nations. They concluded that in the sub-Saharan African countries, the structure of ties between health, human resources and the pace of growth was close to that of OECD countries. Their results indicate that improved reserves of human health resources have culminated in higher state revenues.

The correlation between fitness, health status and economic growth determinants in sub-Saharan Africa was explored by Ogliye (2014). The findings from the Dynamic Estimate methodology used by Arellano-Bond in 40 countries, showed that the statistically important effects of infant mortality and life expectancy were alcohol intake, urbanization and carbon pollution. None of the measures of health status was therefore an essential determinant of economic development in the country, suggesting the need for improved health of the community to have positive effects on growth. On the contrary, Eggoh et al. (2015) have given data for a range of 49 African countries from 1996 to 2010, utilizing cross-sectional and complex panel strategies, and the partnership between human resources (education and health) and economic development. Even though they observed that schooling and health spending impaired economic development, a small positive impact was accomplished on economic growth through the stock of available capital (life expectancy).

Health significance is acknowledged by its rising influence on labour production and longer-term economic development. The empirical results from Shahbaz et al. (2019) have had major policy ramifications, where development of population welfare has been key to raising labor efficiency in the Sub-Saharan African countries and longer-term economic development. They concluded that governments should introduce main economic mechanisms into the design of sustainable development policy to enable the population of sub-Saharan Africa to live expectancy. Ogunjimi and Adebayo (2019) analyzed the relationship between Nigeria's expenditures on health, health results and development from 1981 to 2017, using data from one country. The findings of the Toda-Yamamoto tests showed that there were unidirectional causality from health expenditure to mortality among babies, although there were no causation between GDP and infant mortality; a unidirectional causal correlation between health expenditure, accurate GDP, life expectancy and maternal mortality; The study therefore proposed that the government of Nigeria make concerted efforts to raise health expenses in order to fulfil the suggestion of the WHO, at least, that all countries could contribute to the healthcare sector at least 13% of their annual budget, since it will ensure the required health results and the usage of new technologies. Furthermore, the impacts of human capital on development in sub-Saharan Africa have been examined and took into account by Ogundari and Awokuse (2018) specifically the two indicators of human capital: health and education. The data panels for 35 countries from 1980 to 2008 used a complex framework simplified moment measurement and evaluated tool. The analytical results found that all human resource metrics have a beneficial impact on economic development. More significantly, the health status effect was comparatively higher than the educational effects on economic development. Their findings demonstrated the relevance for economic development in the African area of both indicators of human resources. Moreover, in the 35 sub-Saharan African nations, Sarpong et al. (2020) analyzed the health impact on economic development using panel data from 1997-2016. Data were evaluated using the panel co-integration test, the Granger Test and the lowest-square dynamics estimator. The findings revealed that health is a significant factor of economic development. More precisely, a 1% rise in the standard of health by 0.207%, calculated by per capita health expenditure. Furthermore, the findings show that

the economic growth is affected by institutional quality on human health resources. The causal link between growth and health has been found to be bidirectional.

Few researchers analyzed the topic rather from a particular viewpoint, so they concentrated on variables like health spending as a result of the correlation between health and economic development. Interestingly, in 24 countries in sub-Saharan Africa, Kouton et al. (2018) analyzed the presence of threshold effects in the nexus of health-economic development. In order to reduce the variability of the sample with respect to the threshold variable, they used the dynamic table threshold model. The studies have demonstrated that life expectancy has a significant and meaningful effect on economic development and the effect has grown as spending on public health rises. The approximate threshold was 3.5% for public health investment / GDP, suggesting that public health spending is projected to have a greater effect on economic development than the threshold life expectancy. You also related these effects to how citizens would not be efficient even if their life expectancy were improved because they were willing to sustain and enhance their health status. They suggested more health investments to allow access to healthcare smoother. Similarly, Somé et al. (2019) analyzed in the panel results for 48 countries spanning the period 2000 to 2014 the association between health spending, health outcomes and economic development in Africa. Their findings revealed the detrimental and important correlation between the death rates of mothers and children with Africa's economic development. Furthermore, life expectancy was related favorably to the growth trend. A 9.4 year rise in life expectancy contributed to a GDP growth of 1% per individual. The paper also showed that spending on health had a significant and economically important direct and indirect influence on the pace of economic development. The key policy implications of their report are to invest more resources on the public health sector more effectively in order to improve in health, and to take advantage of the favorable externalities that contribute to economic development. Saad and Nor (2018) found a positive link between health expenditure and economic development in low and middle income countries. The relation between life expectancy and development in 10 African countries for the duration between 1985 and 2017 has been investigated by Biyase and Maleka (2019). The fixed effects are used to measure the possible endogeneity between life duration and economic development using a two-stage minimum quadrature estimator. The findings found that health status was favorably related to economic development in terms of life expectancy. Neofytidou and Fountas (2020) recently investigated the short and long term ties between wellness, GDP and GDP per capita using a panel of 19 developed countries from 1950 to 2013. As measures of health status they depend on life expectancy at the birth. In addition, co-integration study of the panel and causal measures of Granger were introduced. Their results showed that the predicted impact of life on economic development both in the short and long term had a strong and statistically relevant influence. Their inference was, however, that health status was a crucial component for an economy's economic development.

The majority of the related literature in the context of African economies have some of the following limitations. Mostly, health status has been measured using a single indicator. Health indicators, such as life expectancy could to a large extent be subject to aggregation bias and, thereby, using additional measures to health status would be more meaningful. The studies which dealt with the health-growth nexus using panel data from the perspective of African countries used relatively smaller time/or fewer cross-sectional dimensions. Since economic growth is a phenomenon that occurs in the long run, using long time series data is a significant factor in obtaining an accurate estimate of the correlation between health and growth economic. Most importantly, majority of the previous studies that used macro panel data have ignored the potential cross-sectional correlation. Paying no attention to the contemporaneous correlation of the errors may bias the estimates of the parameters if cross-sectional dependence does exist. Therefore, our study aims to contribute to the literature and filling the existing gaps in the health-growth nexus, especially in the context of Africa.

THEORETICAL FRAMEWORK, METHODOLOGY AND THE DATA

The Solow model is one of the most influential in the economic growth theories and it considered the base for any subsequent related work. In this research the augmented Solow model according to Weil (2012) will be our theoretical reference. The model endogenously incorporates the influence of human capital on economic growth.

$$Y = AK^{\alpha}\left(hL\right)^{1-\alpha}$$

where Y is output, A is productivity, K is physical capital, h refers to human capital, L denotes the number of workers, hL is the total input by labor. Human capital captures two aspects, health and education. The above equation can be re-written in the following per worker form:

$$y = h^{1-\alpha}Ak^{\alpha}$$

where y and k are output per worker and capital per worker, respectively. The derived equation for the steady-state level of output per worker is expressed as:

$$y^{ss} = \left(h^{1-\alpha}A\right)^{1/(1-\alpha)}\left(\frac{\gamma}{n+\delta}\right)^{\alpha/(1-\alpha)}$$

$$= h \times \left[A^{1/(1-\alpha)} \left(\frac{\gamma}{n+\delta} \right)^{\alpha/(1-\alpha)} \right]$$

where γ is the investment rate, n is the population growth rate, and δ is the rate of depreciation. This equation makes clear that the steady-state level of output is directly proportional to h, the measure of labor input per worker. It indicates that a better health status of labor stimulates productivity and thereby output increases. In this study, life expectancy at birth and child mortality rate are used as indicators for human capital in the form of health.

MODEL SPECIFICATION

Based on the augmented Solow economic growth model, the econometric model will be specified as follows:

$$lnGDP_{it} = \delta_0 + \delta_1 lnHS_{it} + \delta_2 Z_{it} + \varepsilon_{it} \quad (1)$$

Where, GDP is the GDP per capita, HS refers to health status indicators such as life expectancy at birth (*LE*), infant mortality rate (*IMR*), and under-five mortality rate (*U5MR*), Z is a vector of explanatory variables: physical capital (*K*), population growth (*PG*), foreign direct investment (*FDI*), and inflation (*INF*), t=1,2,… ,T, i=1, 2, …, N, δ_i are the estimated coefficients, and ε is the error terms. The other explanatory variables are necessary to specify the economic growth model correctly. The effect of life expectancy of economic growth will be measured by the value of δ_1, and since all the variables are expressed in log form the estimated coefficients are elasticities.

POOLED MEAN GROUP

The conventional methods of panel estimation, namely the fixed effects and random effects, the instrumental variables, and the GMM techniques, enable the variability of the intercepting to model the individual effects. Although the intercept represents to some degree a difference in cross-sectional units (N), the slope homogeneity, particularly when the time series (T) is wide, is strongly challenged. As reported by Pesaran and Smith (1995), it is quite restrictive that the pitch coefficient should be the same for all individuals if T is broad and that the parameters can be calculated inconsistently and highly misleadingly. Therefore, the Mean Group (MG) estimator was proposed by Pesaran and Smith (1995) for both N and T to be high. The MG permits a long and short run distinction of the slope coefficients between classes. In general, for each cross-section the regression is computed, and the mean of each coefficient is defined. Another severe example, though, is the heterogeneity of the pitch coefficients in the short and long races. Pesaran et al. (1999) indicated that the Pooled Mean Group (PMG) is an intermediate technologic that makes it possible to differ in short term with coefficients between classes but limits long-term coefficients to the same.

To estimate the PMG model, equation (1) will written in the following form:

$$\begin{aligned}
\Delta lnGDP_{it} &= \gamma_{0i} + \gamma_{1i} lnGDP_{i,t-1} + \gamma_{2i} lnHS_{i,t-1} \\
&+ \gamma_{3i} lnK_{i,t-1} + \gamma_{4i} lnPG_{i,t-1} + \gamma_{5i} lnFDI_{i,t-1} \\
&+ \gamma_{6,i} lnINF_{i,t-1} + \sum_{j=1}^{p} \theta_{1ij} \Delta lnGDP_{i,t-j} \\
&+ \sum_{j=0}^{p} \theta_{2ij} \Delta lnLE_{i,t-j} + \sum_{j=0}^{p} \theta_{3ij} \Delta lnK_{i,t-j} \\
&+ \sum_{j=0}^{p} \theta_{4ij} \Delta lnPG_{i,t-j} + \sum_{j=0}^{p} \theta_{5ij} \Delta lnFDI_{i,t-j} \\
&+ \sum_{j=0}^{p} \theta_{6ij} \Delta lnINF_{i,t-j} + \mu_{it} \quad (2)
\end{aligned}$$

Where γ_1, γ_2, γ_3, γ_4, γ_5 and γ_6 are the long-run dynamic coefficients, and θ_1, θ_2, θ_3, θ_4, θ_5 and θ_6 are the coefficients of the short-run dynamic, the μ_{it} refers to the residual term, and p indicates time lags. Following Pesaran et al. (1999), the ARDL (1, 1, 1, 1, 1, 1) is estimated since the lag order is more of a concern only in small time series dimension. The PMG limits long-term coefficients to be homogeneous and thus uses the largest probability estimator instead of the normal smallest squares (OLS). Note that the health status indicators shall not be used simultaneously, however, three separate models will be estimated for the two group of countries and the overall results can be compared. Model (1) will include life expectancy at birth as a measure for health status. Model (2) and model (3) include infant mortality rate and under-five mortality rate, respectively. Although the PMG estimator allows for heterogeneity, however, we will divide countries into two groups according to their level of Human Development Index (HDI).

THE DATA

Mainly the secondary data between 1990 and 2018 was used for the analysis presented in this work. Data were gathered from a range of international institutions, including the World Bank and the WHO. The study examined the relationship between health and economic growth in Africa both in short and long term. As measures of health, life expectancy at birth, child mortality and the death rates of under five were used. The correlation between health and economic development in the African continent has been studied. In addition, certain control variables related to the growth model were used in the study.

The World Bank's World Development Indicators has been utilised to collect the data on GDP per capita (constant prices). The World Health Organization (WHO)

was the source of health status indicators, namely, life expectancy at birth, child mortality rate measured per 1000, and under-five mortality rate measured per 1000. Finally, data for the other explanatory variables, such as physical capital (K) measured by gross capital formation as a percentage of GDP, population growth rate (PG), foreign direct investment (FDI) net inflows as a share of GDP, and the GDP deflator to measure for inflation (INF), were collected from the World Bank Data Base.

Whilst this research initially aimed to analyse all African countries, countries with no available data were excluded. The availability of data is one of the important factors in research, as it increases the reliability of the results. Therefore, this research utilised all of the available data for 43 African countries. Importantly, to acknowledge and reduce the variation across countries the sample was separated into two groups, based on their HDI level: developed and less-developed. The developed countries group contained 19 medium, high, and very high HDI countries, while the less-developed countries group contained 24 low HDI countries. The list of countries for both groups are shown in the appendix.

Before continuing with the empirical analysis, some preliminary analysis of the descriptive statistics and correlation were carried out. Table (1) reports a descriptive analysis of both country groups for the entire period. The overall number of observations (Obs) was 551 when using the high-HDI, or developed countries group, while the less-developed country group had 696 observations. Besides, the mean, which shows the expected or typical value, and standard deviation (Std. Dev.) are presented. Given the means of each variable for both groups, the variations in the data set were greater in the developed country group, as compared to the less-developed country group, as can be seen from the standard deviation values. Finally, the minimum (Min) and maximum (Max) values are shown. The less-developed country group had a lower range than the developed country group. Table (2) presents the correlation coefficients among the variables in both of the sampled groups. It shows a positive correlation between LE and the GDP, whereas a negative correlation is indicated between IMR, U5MR, and the GDP in both of the sampled groups. This indicated a potential direct correlation between the status of health and economic growth. Moreover, other variables were positively correlated with the GDP, except for INF which had a negative correlation with the GDP.

RESULTS AND DISCUSSION

The use of macro panel data to deter spurious regression is a popular analytical method to measuring both unit root and cointegration. A unit root test is usually used to assess if the sequence is stationary or not. Consequently, two classes of countries were considered: developing and poor countries and root unit panel analyses were done for each category. A root panel test was performed, that is, to verify the order of the integration variables, by the Cross-Sectional Augmented IPS (CIPS) test, developed by Pesaran (2007). The CIPS root test is critical as it takes cross-sectional dependency into consideration. The consequence of the CIPS Unit Root Test is described in Table (3). The findings revealed that all variables of order one and order zero were integrated. A non-stationary I(1) vector was observed between the two classes.

The co-integration test was used to investigate the nature of a meaningful association of long-term variables after determination of the order of the integration variables. The effects of the cointegration experiments are seen in Table (4). The findings of the co-integration test of Pedroni (2004) show that there is a long-standing link between actual per capita GDP and all health metrics and the control variables. Notice that the two sampled classes (developed and less developed countries) were being evaluated for a co-inclusion partnership. The plurality of the seven research statistics have been seen to be meaningful, at least at 10%, and the null hypothesis of no cointegration has thus been dismissed in most models.

THE FINDINGS OF CROSS-SECTIONAL DEPENDENCE TEST

For applied macroeconomists the topic of cross-sectional reliance has become a major concern. As other pre-tests such as unit root tests and cointegration tests, a cross-sectional reliability test in panel data regression is an important phase before the parameters of any model(s) are calculated. If cross-sectional dependency is present, the inability to know whether errors are simultaneously associated can contribute to partial estimates. Current research has therefore pursued this pattern, utilising the Pesaran (2004) test, and evaluated cross-sectional dependency. Table (5) illustrates that virtually all simulations have not dismissed either developing or less-developed country groups' null hypothesis of no trans-sectional reliance. Without a contemporary correlation, the collected average group appraisal methodology was permitted to be used.

THE FINDINGS OF POOLED MEAN GROUP

For the underdeveloped countries community, table (6) shows the findings of the PMG study. The results revealed that the long-term health effect calculated by birth life expectancy was optimistic and important at the 1% mark. In fact, an improvement in life expectancy of 1% will contribute to an increase in GDP per capita of around 1.27%. The implicit concept from the previous findings was that the GDP per capita would rise marginally in life expectancy. In comparison, the effects of the growing model are Model (2) and Model (3),

TABLE 1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Developed					
GDP	551	7.976	0.924	5.621	9.929
LE	551	4.094	0.149	3.750	4.350
IMR	551	3.775	0.606	2.468	4.884
U5MR	551	4.107	0.717	2.617	5.410
K	551	3.110	0.442	0.422	4.100
PG	551	1.098	0.573	-1.455	1.915
FDI	551	2.271	0.507	-2.280	5.129
INF	551	3.606	0.811	-0.835	10.196
Less-Developed					
GDP	696	6.450	0.536	5.299	7.849
LE	696	3.980	0.133	3.265	4.247
IMR	696	4.337	0.346	3.296	5.079
U5MR	696	4.820	0.404	3.564	5.795
K	696	3.062	0.433	-0.552	4.166
PG	696	2.262	0.191	-1.453	2.716
FDI	696	1.959	0.426	-1.912	3.941
INF	696	3.015	0.552	-2.370	5.149

Source: Research findings

TABLE 2. Correlation matrix

				Developed				
	GDP	LE	IMR	U5MR	K	PG	FDI	INF
GDP	1							
LE	0.36	1						
IMR	-0.50	-0.83	1					
U5MR	-0.49	-0.87	0.99	1				
K	0.41	0.33	-0.18	-0.20	1			
PG	0.31	0.39	-0.18	-0.21	0.37	1		
FDI	0.07	-0.003	-0.02	-0.03	0.24	0.02	1	
INF	-0.40	-0.38	0.43	0.42	-0.25	-0.11	-0.06	1
				Less-Developed				
GDP	1							
LE	0.45	1						
IMR	-0.33	-0.83	1					
U5MR	-0.36	-0.83	0.97	1				
K	0.26	0.33	-0.26	-0.26	1			
PG	0.08	0.41	-0.13	-0.11	0.11	1		
FDI	0.05	0.22	-0.27	-0.28	0.38	0.09	1	
INF	-0.12	-0.21	0.20	0.16	0.04	-0.09	-0.02	1

Source: Research findings

TABLE 3. CIPS unit root test results

Variables	Developed		Less-Developed	
	Intercept	Intercept & Trend	Intercept	Intercept & Trend
GDP	-2.208**	-2.281	-1.977	-2.042
LE	-1.831	-2.730**	-2.080*	-2.517*
IMR	-2.021	-3.396***	-2.245***	-2.843***
U5MR	-1.199	-2.619	-2.136*	-3.249***
K	-2.347**	-3.007***	-2.719***	-3.018***
PG	-1.925	-2.305	-2.676***	-2.543
FDI	-3.568***	-4.226***	-3.127***	-3.232***
INF	-4.037***	-4.345***	-4.310***	-4.535***
ΔGDP	-3.812***	-4.245***	-4.504***	-4.696***
ΔLE	-2.683***	-2.284	-2.034	-1.547
ΔIMR	-2.370**	-2.329	-2.290**	-1.959
ΔU5MR	-2.901***	-2.585	-2.155**	-2.016
ΔK	-5.411***	-5.335***	-5.493***	-5.547***
ΔPG	-2.609***	-2.280	-2.310***	-3.581***
ΔFDI	-5.722***	-5.950***	-5.637***	-5.526***
ΔINF	-5.704***	-6.079***	-6.020***	-6.182***

Note: ***, **, * denote 1%, 5%, 10%, respectively. In the Less-Developed countries other unit root tests were used for the variables LE and it confirmed that the variable is I(0).
Source: Research findings

TABLE 4. Cointegration test results

	Less-Developed					
	Model (1)		Model (2)		Model (3)	
Test Stats.	Panel	Group	Panel	Group	Panel	Group
v	-2.48	-	-2.29	-	-2.81	-
rho	2.93	5.01	3.28	5.04	2.74	4.84
t	0.35	1.78	1.39	2.42	0.13	2.09
ADF	3.83	3.28	2.51	1.89	2.97	3.39
	Developed					
	Model (1)		Model (2)		Model (3)	
Test Stats.	Panel	Group	Panel	Group	Panel	Group
v	-2.45	-	-2.94	-	-2.98	-
rho	2.75	4.23	3.68	4.35	3.47	4.27
t	0.48	1.17	2.32	1.97	2.07	1.78
ADF	1.24	2.05	5.54	4.21	4.04	3.38

Source: Research findings

TABLE 5. Cross-sectional dependence test results

	Less-Developed		
	Model (1)	Model (2)	Model (3)
Pesaran CD-test	-0.118 (0.91)	-1.028 (0.30)	-1.493 (0.14)
	Developed		
Pesaran CD-test	8.324 (0.00)	0.124 (0.90)	0.779 (0.44)

Note: between brackets are the probability values of the Pesaran CD test.
Source: Research findings

calculating the situation by infant mortality rates and the mortality rate of the under-five, respectively. The long-term effects of the two measures was unfavorable and important at 1% significance, namely child mortality and under-five mortality. The study found that a reduction of 1% in child and under-five death rates would contribute to increases in GDP per capita of 0.43% and 0.34%. These results confirmed prior life expectancy observations, and together they figured out clearly that health status is one of Africa's main development drivers. The beneficial impact of physical capital on long-standing economic development was one of the results from this report. The long-term impact of population development on the other side is either negative (Model 1) or negative (Models 2 & 3). International direct investment has however been shown to have a significant long-term influence on economic development. Since the long-term GDP per capita effects of inflation proved negative.

For the category of developed countries, table (7) highlights the effects of health status and economic development. The effects of the PMG estimator for higher HDI countries indicated that a positive and statistically relevant long-term economic growth effect of the life expectancy at 1% was achieved. A 1% rise in life expectancy triggered a per capita GDP move of roughly 1.65%. This showed that economic development was driven by improving wellbeing. Furthermore, unfavorable and statistically important other measures of health status, including the child mortality rate and the mortality rate of the under-five, were identified. Similarly, a reduction in child mortality rates (infant and under-five), which represent an improvement in the overall health status, would be translated into higher economic growth. The results of the three health status variables were in line with prior theoretical expectations. Moreover, the long-run findings revealed that economic growth was positively influenced by the stock of physical capital. This confirmed the idea that physical capital is an essential element for the economic growth process. However, population growth appears to have been negatively related to economic growth, in two out of the three estimated models. On the contrast, the effects on economic development on the long-term effect of foreign direct investment has been shown to be significant. Although inflation seemed to have a negative effect on long-term economic development, market stability was a significant factor for maintaining economic growth in African countries.

ROBUSTNESS ANALYSIS USING DOLS

To estimate the long-term correlation between health and economic development, the Dynamic Ordinary Least Squares (DOLS) technology was utilized for robustness analyses. Table (8) and (9) shows the findings of the cointegration regression obtained by the DOLS estimation for both groups of countries. The results show how significant the health status is, in both sample of countries, for economic growth in Africa. In fact, life expectancy has been shown to have a beneficial effect on real GDP per individual. In comparison, child mortality and mortality rates aged under five have had a detrimental impact on economic development. The key findings produced by the PMG estimator have been widely endorsed and have pointed to an underlying growth factor. As with the earlier findings, in relatively high-HDI (developed group) countries we noticed that the health condition had a higher effect on economic development than in the lower (low-developed) HDI countries. The other explanatory predictor effects were close to those of the key findings in the two classes of the experiments but were not reliably optimistic in model (1) and model (2) for population growth in the less established community, relative to negative in model (3). The suggested positive effect on economic growth of population growth might mean the value of labor as a factor that boosts productivity and thus enhances economic growth.

Prior studies that have noted the importance of human capital to a sustained economic growth. The present study was designed to determine the effect of health status on economic growth in 43 selected African countries. The current study found that improving life expectancy and reducing infant and under-five mortality rates stimulates the economic growth in African. This study supports evidence from previous literature (e.g. Ogundari & Awokuse 2018; Kouton et al. 2018; Biyase & Maleka 2019; Shahbaz et al. 2019; Somé et al. 2019; Sarpong et al. 2020). This result may be explained by the fact that better health status leads to higher output through increasing productivity. The results provided by this study are similar to that of Eggoh et al. (2015) and Isreal et al. (2019) indicating that human capital stock is vital for economic growth in the African countries. However, the findings of the current study are different from those of Ogliye (2014) who found no relationship among health status determinants and economic growth in sub-Saharan African countries. The differences in the obtained outcomes could be attributed to the heterogeneity of the sampled countries and the appropriate estimation strategy. Unlike Ogliye (2014), this study adopted an estimator that allows for individual heterogeneity, namely, the PMG. Also, this study set out with the aim of assessing the importance of health to economic growth by dividing countries into groups according to their level of economic development. The most interesting finding was that in relatively more developed countries the impact of health on economic growth tends to be higher compared to less-developed countries. The observed variation in the magnitude of the impact of health on growth between developed and less-developed African countries might imply the significance of controlling for heterogeneity when panel data is used.

TABLE 6. PMG Results for less-developed group

	Model (1)	Model (2)	Model (3)
	Long-run		
LE	1.271*** (16.29)		
IMR		-0.429*** (-15.44)	
U5MR			-0.340*** (-14.99)
K	0.328*** (13.35)	0.385*** (8.68)	0.392*** (9.08)
PG	-0.457*** (-4.16)	0.024 (0.93)	0.011 (0.49)
FDI	0.048** (2.42)	0.132*** (4.07)	0.124*** (4.03)
INF	-0.032** (-2.26)	-0.105*** (-5.52)	-0.100*** (-5.33)
	Short-run		
ECT	-0.168*** (-4.34)	-0.181*** (-5.06)	-0.187*** (-4.90)
ΔLE	1.196* (1.70)		
ΔIMR		0.235 (0.50)	
ΔU5MR			0.222 (0.56)
ΔK	0.036 (0.73)	0.011 (0.41)	0.006 (0.23)
ΔPG	0.006 (0.02)	-0.084 (-0.26)	-0.123 (-0.38)
ΔFDI	0.006 (0.44)	-0.005 (-0.57)	-0.005 (-0.54)
ΔINF	-0.010*** (-2.96)	-0.002 (-0.55)	-0.002 (-0.52)
Constant	0.263*** (4.31)	1.301*** (5.20)	1.302*** (4.95)

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
Source: Research findings

TABLE 7. PMG Results for developed group

	Model (1)	Model (2)	Model (3)
	Long-run		
LE	1.649*** (11.59)		
IMR		-0.192* (-1.88)	
U5MR			-0.514*** (-25.90)
K	0.086* (1.77)	0.534*** (3.58)	0.151*** (3.55)
PG	-0.730*** (-8.97)	-1.719*** (-3.92)	0.064 (1.13)
FDI	0.128** (2.22)	0.114 (1.53)	0.234*** (4.67)
INF	-0.206*** (-4.27)	0.045 (0.97)	-0.098*** (-2.82)
	Short-run		
ECT	-0.0627* (-1.91)	-0.046** (-2.44)	-0.125*** (-2.83)
ΔLE	0.870 (1.62)		
ΔIMR		-1.464* (-1.93)	
ΔU5MR			-2.415 (-1.07)
ΔK	0.030 (1.57)	0.019 (1.00)	0.009 (0.55)
ΔPG	0.289 (1.03)	0.278 (1.35)	0.286 (1.21)
ΔFDI	-0.006 (-0.69)	-0.005 (-0.61)	-0.017 (-1.82)
ΔINF	-0.011 (-065)	-0.023 (-1.32)	-0.009 (-0.86)
Constant	0.112 (1.50)	0.374** (2.16)	1.080*** (2.74)

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
Source: Research findings

TABLE 8. DOLS Results for less-developed group

Variable	Model (1)	Model (2)	Model (3)
LE	1.20*** (42.52)		
IMR		-0.14*** (-52.08)	
U5MR			-0.01*** (-75.50)
K	0.19*** (15.87)	0.01*** (12.69)	0.04*** (5.80)
PG	3.85*** (17.81)	0.31*** (3.54)	-0.76*** (4.80)
FDI	0.04*** (7.72)	0.16*** (11.09)	0.11*** (10.75)
INF	-0.08*** (-20.66)	-0.04*** (-7.08)	-0.03*** (-5.29)

t statistics in parentheses
* p<0.1, *** p<0.01
Source: Research findings

TABLE 9. DOLS Results for developed group

Variable	Model (1)	Model (2)	Model (3)
LE	3.60*** (20.19)		
IMR		-0.26*** (-78.00)	
U5MR			-0.24*** (-78.03)
K	0.14*** (4.22)	0.02*** (15.26)	0.11*** (8.40)
PG	-0.62*** (-10.93)	-0.29*** (-12.23)	-0.40 (-0.92)
FDI	-0.01** (-2.23)	0.04*** (5.01)	0.03 (1.04)
INF	-0.02*** (-5.99)	-0.05*** (-5.99)	-0.05*** (-5.43)

t statistics in parentheses
** p<0.05, *** p<0.01
Source: Research findings

CONCLUSION

Health status is one of the most significant determinants of economic development, especially in many countries of Africa. This study analyzed the effect on economic development of health status using panel data from 1990-2018 from 43 African countries. The research employed three health metrics, namely: life expectancy at birth, infant mortality rates and the mortality rate of under-five. Furthermore, according to their stage of development, the countries were divided into two categories determined by HDI to reduce the sample heterogeneity. In addition, the analysis employed the approach of calculating both long- and short-term dynamics by the Pooled Mean Group. The unit root and co-integration tests showed that there was a meaningfully long-term relation between the non-stationary variables in both classes of countries. As to health status, the findings have shown that life expectancy in both classes of countries has a positive and clear correlation with economic development. In addition, it was identified that the child mortality rate was adversely and substantially linked to economic growth in both classes. Similarly, in all sampled classes of nations, the mortality rate for less than five was a detrimental and important correlation with economic development. The negative indication was that lower maternal death rates and lower infant mortality would contribute to faster economic development. In general, the results offered considerable evidence for the theoretical hypothesis that assumed a correlation between health and economic growth. The findings of our study add to the literature by evaluating both short- and long-term links between health status and economic growth. The current research makes contribution through using panel unit root and cointegration analyses besides taking the possibility of cross-sectional dependency into account.

From the outcomes of this research, the following policy recommendations have emerged. First, to improve economic growth, health care systems should be given high priority, especially in less-developed African countries, by increasing its share of total government expenditure. In other words, efforts should be directed to reduce the misallocation of health sector resources to improve health status in many African countries. Also, many countries need to raise additional funds to enable their health care systems to operate effectively, which will lead to a better population health status. This calls for mobilizing the efforts of regional and international development partners to address health issues and empower health care systems, especially in Africa's least developed countries. Moreover, African countries

are urged to put more effort into all of the aspects that are directly or indirectly related to the health of their population. For example, increasing and/or improving the education level of individuals, especially females, will help to reduce child mortality, in general. Another recommendation is that ongoing efforts by governments, the private sector and civil society organizations to reduce poverty and income inequality must be strengthened and supported to improve health status and, thus, achieve higher economic growth. Further, the economic development authorities in African countries should focus more on human capital, rather than physical capital and natural resources for sustained long-run economic growth. Finally, as a recommendation for future research, a thorough investigation of the factors that affect health status in many African countries is urgently needed to provide governments with a clear direction to improve and maintain better population health.

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APPENDIX

TABLE I. List of Countries.

Group 1: Developed	Group 2: Less-Developed
Algeria	Benin
Angola	Burkina Faso
Botswana	Burundi
Cameroon	Central African Republic
Democratic Republic of Congo	Chad
Congo Republic	Comoros
Egypt	Cote d'Ivoire
Equatorial Guinea	Gambia
Eswatini	Guinea
Gabon	Guinea-Bissau
Ghana	Madagascar
Kenya	Malawi
Mauritius	Mali
Morocco	Mauritania
Namibia	Mozambique
South Africa	Niger
Seychelles	Nigeria
Tunisia	Rwanda
Zimbabwe	Senegal
	Sierra Leone
	Sudan
	Tanzania
	Togo
	Uganda