PalArch's Journal of Archaeology of Egypt / Egyptology

HEALTH AND ECONOMIC DEVELOPMENT: A GRANGER CAUSALITY ANALYSIS

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[1]Dr. Konita Basumatary, [2]Sijousa Basumatary: Health and Economic Development: A Granger causality Analysis-- Palarch's Journal Of Archaeology Of Egypt/Egyptology 17(7). ISSN 1567-214x

Keywords: Health, Economic Development, Social, Environment.

ABSTRACT

Health and Economic development are interdependence, interrelated and interconnected to each other. Health impacted economic development through reduction in production and productivity losses. The main objective of this paper is to examine the relationship between Health and economic development. In order to examine the relationship between the two, various indicators of health and economic development are analyzed. The model undertaken in our study is multivariate regression time series and to carry Multivariate time series analysis Vector Autoregressive (VAR) model is used. To detect the direction of causality and to identify which variable acts as determining factor for another variable, Granger causality test is analyzed. Our analysis shows that lagged of population growth, GNI per capita, life expectancy, TFR, IMR, GDP and GPS granger-cause GDP growth. We have found life expectancy being granger-cause by lagged of GDP growth rate, total population, GNI per capita, CDR, TFR, IMR, GDP. Again IMR is granger-cause by GPS, GDP growth rates, life expectancy, CDR, TFR, GDP, GS, and GNI per capita.

1.1 Concept and determinants

Health is not only of good functioning of body but wider than this, which sees the health of an individual or community as being concerned not only with physical and mental status, but also with social and economic relationships. According to Economists, health is an investment not expenditure because improved health contributes to economic development in number ways. Health

impacted economic development through reduction in production losses and it increases productivity of an adult. According to Amartya Sen, health is among the basic capabilities that give value to human life. WHO report entitled " Macroeconomics and Health: investing in health for economic development" (2001) presents a completing case for investing in health care infrastructure of developing countries as prerequisite to stimulate economic development. The report conclude that as with the economic wellbeing of individual household, good population health is critical input into poverty reduction, economic growth and long term economic development.

The relationship between health and economic development is well established but the underlying mechanisms are complex and difficult to discern. The economics literature has thoroughly described many of the main forces such as technological progress, education, and physical capital accumulation driving economic growth over the time span. Likewise, the roles of medical care, individual behaviors, demographic factors and the environment in influencing health are well understood. However, understanding of the interrelations between health and economic growth and development remains somewhat limited *(Bloom, D et.al., 2018).* According to Preston, 1975, there exist a strong positive correlation between health and GDP. Countries with better health status tend to have higher incomes than countries with worse health status, a relationship known as the "Preston curve" (*Preston, 1975).*

Health of an individual or a community is affected by individual lifestyle, social and community influences, economic and environment factors. These factors include the employment opportunities, income, education, living condition, healthy diet etc. These factors are interrelated to each other and each of these factors affects others. Better employment opportunities enhance income and social status of an individual. A better employment opportunity is again determined by the education level. Low level of education is associated with lack of employment opportunities which hampers both the physical and mental health of an individual by increasing stress resulting in poor health. *Ellie C.H (2018)* while exploring the relationship between health and employment found a consistent association between employment and better health and unemployment and poorer health. He found this association for men, women, younger adult, older adult and people with disability. According to his study the relationship between employment and health appears to be bi-directional, with some evidence of health affecting employment and further evidence that employment affects health. On the other hand there is a causal relationship between health and income. Improvement in health increase productivity which in turn increases income and increased in income enhance the living condition. *Minnesota department of health* (2014) found that income is closely related to health and lower income is closely related to poor health and vice versa. In addition they found that low income in Minnesota are concentrated among population of colour and American Indian, person with less education, those living in rural areas, families with children and female

headed households. *Jerome, Aet.al (2008)* studied the effect of permanent income innovation on health for a prime aged-population. They found that income innovation have little effects on a wide range of health measures, but do not lead to increases in mortality and risky health behavior. Research shows that lower social and economic position of an individual or a community is more likely to be unhealthy behavior and better social environment are more likely to adopt the healthier one. Social and community influences comprise of the equitable access to quality health care which is considered as a challenge to health system. Many studies have pointed out that the difficulties in accessing health care are due to social exclusion, poverty and geographical barrier.

Environment factors have both positive and negative impact on human health. All organisms depend on environment to sustain life. Environment affects quality of life and health disparities. For most of Human histories, increased in longitivity were due to improved access to the basic necessities to lives (*Environment and Health: The Hastings centre*). WHO defines environment, as it relates to health, as "all the physical, chemical, and biological factors external to the person, and all related behaviors"(Environmental Health/ Healthy people 2010). Studies show that pollution, herbicides, agriculture chemical are linked to birth defects. Male factor infertility and female factor infertility has also been linked to air pollution, exposure to lead, house hold flame retardants and surfactants, pesticides, plastics etc. (*http: www.pcrm.org/birthdefects, www.medicinenet.com, www.sciencedirect .com, www.fertstert.org.).*

Another factor affecting Health of an individual is his lifestyle. As per the study of *archives of internal medicine 26 issue,* person who smoke and drink, poor diet are three times more likely to die from cardiovascular disease and nearly four times more likely to die of cancer. Such people have an overall premature death risk equivalent to being 12 years older. A research conducted in Iran shows that lifestyle changes in diet and the level of physical activity. Many non- communicable disease such as cancer, cardiovascular disease and diabetes which account for 60 percent of death in a year are due to a common risk factors like tobacco use, inappropriate diet and physical inactivity(*Do lifestyle changes improves health, WHO podcast 2009, episode 56*).

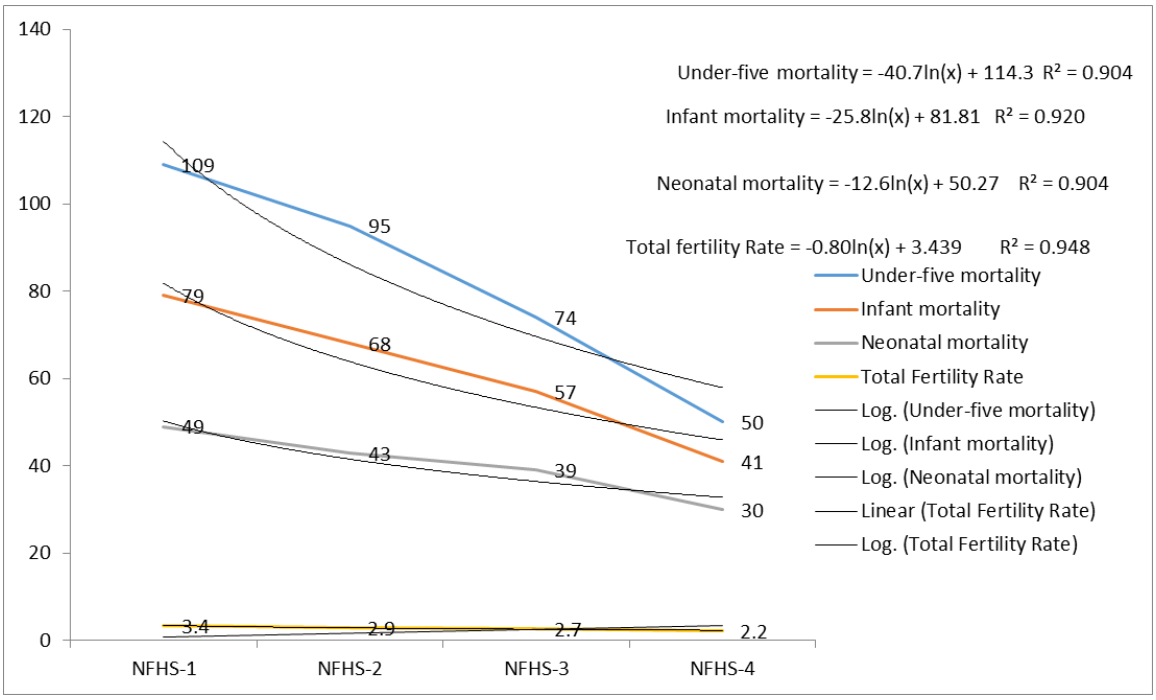
In 1957, Robert M Solow pointed out the technical progress determining the growth in U.S economy. According to Solow model, long run growth of output is measured by growth of real gross domestic product (GDP). The model also explain how investment, saving and growth responds to technical change and population growth. In the model of Harrod-Domar growth, three types of growth rates is taken into account and is sustainable if these growth rates are equal. The three growth rates are the actual growth rate, guaranteed growth rate, and natural growth rate. Harrod called such a situation the "*golden age*", which ensure macroeconomic balance the full use of capital and labor. Ruger et al., (2006) has adapted the following factors affecting the economic growth. The factors are Labour force ageing, high fertility and child mortality, as well as reduced quantity and quality of the labour force, increase

the dependency ratio (which may be seen as a measure of the unemployment of human capital in the economy), which reduces per capita income. According to his study effects of illness and malnutrition is divided into child and adult components that determine the level of labour productivity. The adult components have a direct effect on labour productivity and indirect effects through reduced access to natural resources and the economy.

1.2 Child and maternal health in relation to economic development

Millennium Development Goals (MDGS) has reflected the health of women, mother and child as fundamental to development. The Granger analysis of direction of association between the under-five mortality and economic growth in different countries, studied by Amiria , A and Gerdtham ,U(2013) found the bi-directional relationships between the two which indicates changes in under-five mortality have an impact on GDP and vice versa. According to Endogenous growth literature two aspect of health on productivity has been considered, the one is direct affect of health on productivity and another the spillover effect **(** example: better maternal health can result in reduced informal care time required by family members and friends who may also be part of the labour force)**.**

Fig1Trends in Early Childhood Mortality and fertility of India



Source: NFHS-4

Infant Mortality Rate is one of the important indexes of economic development and social health status of the country. It is considered as the most sensitive measures of mortality. According to the figure the infant mortality rate is seen to decline from 79 deaths per 1,000 live births (NFHS-1) to 41

deaths per 1,000 live births during NFHS-4 survey. The infant mortality rate has decreased by 38 percent over a period of 23 years (1991-92, NFHS-1 to 2015-16, NFHS-4). During the same period, the under-five mortality rate is observed to decline from 109 deaths per 1,000 live births to 50 deaths per 1,000 live births. The neonatal mortality rate is also seen to decline from 49 deaths per 1,000 live births to 30 deaths per 1,000 live births during the same period. From the estimated trend, we have observed that over the period 1991-92 (NFHS-1) to 2015-16 (NFHS-4), on average under-five mortality has declined by 41 percent and neonatal mortality by 12 percent respectively.

Scholar has pointed out those characteristics of mother including schooling, mother age at birth, previous birth interval and child and circumstances of the birth to be risk factors of early child death. Infant Mortality, under-five mortality and neo-natal though found to be declining, still gap exist between the rural and urban counterpart. Many studies show that rural areas often suffer from lack of access to health care. People living in the rural areas are ignorant, poorer, less educated and their living condition is pathetic with high rate of unemployment. Inspite of all these fewer medical practitioners can be seen with lack of healthcare workers resulting in unconventional ways of delivering healthcare to rural dwellers. Infant mortality is very much responsive to quality environment, nutritious food and sanitation and access to medical facilities. In rural areas, access to medical facilities is difficult due to critical infrastructure development (lack of proper road facilities) which has negative impact to rural health.

Table 1: Status of Maternal and Child Health

Maternal Health	NFHS-4(2015-16)			NFHS-3(2005-06)	Improvement of maternal health in NFHS4 over NFHS3 (in %)
	urban	rural	Total	Total	
Mother who had antenatal check- up in first trimester (%)	69.1	54.2	58.6	43.9	14.7
Mothers whose last birth was protected against neonatal tetanus (%)	89.9	88.6	89.0	76.3	12.7
Mothers who consumed iron folic acid for 100 days or more when they were pregnant (%)	40.8	25.9	30.3	15.2	15.1
Mothers who had full antenatal care (%)	31.1	16.7	21.0	11.6	5
Mothers who received financial assistance under Janani Suraksha Yojana (JSY) for births delivered in	21.4	43.8	36.4	na	-

an institution (%)					
Children born at home who were taken to a health facility for check-up within 24 hours of birth (%)	3.2	2.4	2.5	0.3	2.2
Institutional births (%)	88.7	75.1	78.9	38.7	40.2
Home delivery conducted by skilled health personnel (out of total deliveries) (%)	3.0	4.9	4.3	8.2	-3.9
Children age 12-23 months fully immunized (BCG, measles, and 3 doses each of polio and DPT) (%)	63.9	61.3	62.0	43.5	18.5
Children age 12-23 months who have received 3 doses of Hepatitis B vaccine (%)	63.3	62.5	62.8	na	-
Children under 5 years who are underweight (weight-for-age) (%)	29.1	38.3	35.8	42.5	-6.7
Pregnant women age 15-49 years who are anaemic	45.8	52.2	50.4	57.9	-7.5
Children age 6-59 months who are anaemic	56.0	59.5	58.6	69.4	-10.8

Source: compiled from NFHS 3 and 4 Report.

Child Mortality and Maternal Health is closely linked to each other. Antenatal care (ANC) refer to pregnancy related health care in which the mother and fetus is given clinical assessment for obtaining the best possible outcome for mother and child. Here the health care is usually provided by a doctor, an ANM, or another health professional, to monitor a pregnancy for signs of complications, detection and treating of pre-existing and concurrent problems of pregnancy, and provides advice and counseling on preventive care, diet during pregnancy, delivery care, postnatal care, and related issues.

During the period 2005-06 to 2015-16, the improvement of maternal Health is observed. Mother who had antenatal check- up in first trimester has increased by 14.7 per cent, Mothers whose last birth was protected against neonatal tetanus was increased by 12.7 per cent, and Mothers who had full antenatal care had increased by 5 per cent respectively. Home delivery conducted by skilled health personnel (out of total deliveries) and pregnant women age 15-49 years who are anemic are also seen to have reduced by 3.9 per cent and 7.5 per cent respectively. The child health is also observed to be improving over the same period of time.

1.3 objectives:

The main objective of the paper is to examine the relationship between Health and Economic Development.

1.4 Methodology

The study is entirely based on secondary information collected from World Bank data for the period 1990 to 2017. When sets of observations are arrange for different period of time, it is called time series data. Multivariate time series analysis involves more than one variable. The variables taken in our study are Gross Domestic product (GDP), Annual GDP growth rate, Total population(TP), Gross National Income (GNI) per capita, Gross saving(GS), Gross primary school enrollment(GPS), Life expectancy at birth(LE), Crude Death rate (CDR),Total fertility rate (TFR) and Infant Mortality rate (IMR).

The model undertaken in our study is multivariate regression time series and to carry Multivariate time series analysis Vector Autoregressive (VAR) model is used. The VAR model has advantageous since it explains past and causal relationships among multiple variables overtime as well as it predict future observations. Explanation and prediction of future observations in a time series is dependent upon correctly postulating a VAR model and estimating its parameters (*Lutke Pohl, 2011*).The VAR model is one of the most flexible models for analysis of causality in multivariate time series. The model captures the linear relationship among multiple time series data. The model also provides the framework in order to study the granger causality between the various indicators of health and economic development in the study.

1.4.1 Construction of VAR model

VAR model were estimated with specific lag as desirable described in the table given in appendices. To decide whether VAR model should be constructed or not, significance of coefficient was accessed.

1.4.2 Evaluation of Granger causality

The joint generation process of the number of variables over time is described in VAR model. To detect the direction of causality and to identify which variable acts as determining factor for another variable, Granger causality test is done. The basic idea of adopting granger causality is to understand whether the latter variable is said to have causal influence on the first. The null hypothesis for granger causality is that the lag of x_t (explanatory) does not cause y_t (endogenous). The null hypothesis is rejected based on p-value. The variable x_t is said to "granger cause" variable y_t, if given the lag of y_t, lag of x_t are jointly statistically significant.

1.4.3Testing of stationarity

Before any result is analyzed, it is necessary to determined whether the time series data that we undertake is stationary or not. It is only when the data are stationary or contain no unit root, we can estimate the data. If it contain unit root, then to have to make it stationary by differencing the data sets. In this

study, the test for stationary was performed individually for the variables Gross Domestic product (GDP), Annual GDP growth rate, Total population(TP), Gross National Income (GNI) per capita, Gross saving(GS), Gross primary school enrollment(GPSE), Life expectancy at birth(LE), Crude Death rate(CDR),Total fertility rate(TFR) and Infant Mortality rate (IMR). If the time series variables were not stationary, the series was differenced and Augmented Dickey Fuller (ADF) test was applied again on the differenced time series to make it stationary.

1.5 Results and Discussion:

1.5.1 Result of stationary, VAR output, granger causality test

In our analysis, the variables annual GDP growth, Total Population (TP), Gross National Income (GNI) Per capita, Gross Domestic Product (GDP), Gross Saving (GS), Gross Primary School Enrollment (GPS), Infant Mortality Rate (IMR), life expectancy, crude death rate (CDR), Total Fertility Rate (TFR) are made stationary.

According to the VAR output, we have found lag 2 of GDP growth has positive effect on GDP growth, and both lag1 of GNI per capita, life expectancy, CDR, TFR are seen to have negatively significant. However, lags 2 of life expectancy, GNI per capita, GPS, total population are found to have positive impact on GDP. Again GS are found to be positively affected by lag 1and 2 of GDP growth, lag1of life expectancy, TFR, GPS. However it is negatively affected by lag 1 and 2 of GSD,GDP, lag 1 of IMR, CDR, lag 2 of life expectancy, lag1and 2 of GNI per capita. Again lag1 of total population, GNI per capita and GPS are found to have positive effect on GNI per capita.

Lag1 of GDP growth, lag 1 and 2 of total population and GNI per capita, lag1of life expectancy, TFR, GS are also found to have positive effect on life expectancy. TFR is found to be negatively affected by lag1 and 2 of GDP growth, lag 2 of population growth, CDR, TFR and GS. Whereas IMR is found to be affected negatively by lag 2 of GDP growth and lag 1of GS.

Table 2: Statistics showing Granger causality Wald Tests

Equation	Excluded	Chi2	df	Prob>chi2
1.				
GDP growth	Total population	12.116	2	.002
GDP growth	GNI Per capita	9.8403	2	.007
GDP growth	life expectancy	7.078	2	0.029
GDP growth	CDR	4.5864	2	0.101
GDP growth	TFR	9.7362	2	0.008
GDP growth	IMR	10.048	2	0.007
GDP growth	GDPd1	4.9206	2	0.085
GDP growth	Gross saving(GSd1)	0.2367	2	0.888
GDP growth	GPSd1	8.2211	2	0.016
GDP growth	All	60.845	18	0.000
2.				

Total population	GDP growth	28.461	2	0.000
Total population	GNI per capita	19.756	2	0.000
Total population	life expectancy	25.896	2	0.000
Total population	CDR	20.915	2	0.000
Total population	TFR	31.678	2	0.000
Total population	IMR	18.585	2	0.000
Total population	GDPd1	12.443	2	0.002
Total population	GSd1	1.5709	2	0.456
Total population	GPSd1	8.8074	18	0.000
3.				
GNI per capita	GDP growth	0.2517	2	0.882
GNI per capita	Total population	10.471	2	0.005
GNI per capita	life expectancy	0.7919	2	0.673
GNI per capita	CDR	4.6766	2	0.096
GNI per capita	TFR	3.6954	2	0.158
GNI per capita	IMR	13.266	2	0.001
GNI per capita	GDPd1	2.3093	2	0.315
GNI per capita	Gsd1	3.418	2	0.181
GNI per capita	GPSd1	9.61	2	0.008
GNI per capita	All	207.4	18	0.000
4.				
Life expectancy	GDP growth	12.7	2	0.002
Life expectancy	Total population	86.596	2	0.000
Life expectancy	GNI percapita	15.941	2	0.000
Life expectancy	CDR	38.886	2	0.000
Life expectancy	TFR	46.993	2	0.000
Life expectancy	IMR	7.2808	2	0.026
Life expectancy	GDPd1	27.897	2	0.000
Life expectancy	GSd1	27.897	2	0.000
Life expectancy	GPSd1	3.9106	2	0.142
Life expectancy	All	1281.8	2	0.000
5.				
CDR	GDP growth	1719.3	2	0.000
CDR	Total population	1852.5	2	0.000
CDR	GNI per capita	1464.2	2	0.000
CDR	life expectancy	2402	2	0.000
CDR	TFR	4825.9	2	0.000
CDR	IMR	5695.6	2	0.000
CDR	GDPd1	4849.4	2	0.000
CDR	GSd1	1244.3	2	0.000
CDR	GPSd1	690.45	2	0.000
CDR	All	85060	18	0.000
6.				
TFR	GDP growth	11.173	2	0.004
TFR	Total population	4.5323	2	0.104

TFR	GNI per capita	2.6798	2	0.262
TFR	Life expectancy	o.71838	2	0.698
TFR	CDR	7.9819	2	0.030
TFR	IMR	7.1891	2	0.018
TFR	GDPd1	2.3771	2	0.305
TFR	GSd1	39.843	2	0.000
TFR	GPSd1	2.6121	2	0.271
TFR	All	288.46	2	0.000
7.				
IMR	GDP growth	47.701	2	0.000
IMR	Total Population	3.7255	2	0.155
IMR	GNI per capita	48.129	2	0.000
IMR	life expectancy	155.72	2	0.000
IMR	CDR	14.777	2	0.001
IMR	TFR	34.275	2	0.000
IMR	GDPd1	93.496	2	0.000
IMR	GSd1	45.659	2	0.000
IMR	GPSd1	23.455	2	0.000
IMR	All	1236.6	18	0.000
8.				
GDPd1	GDP growth	44.685	2	0.000
GDPd1	Total population	141.29	2	0.000
GDPd1	GNI percapita	2.1867	2	0.335
GDPd1	life expectancy	9.6489	2	0.008
GDPd1	CDR	71.873	2	0.000
GDPd1	TFR	9.6058	2	0.008
GDPd1	IMR	111.71	2	0.000
GDPd1	GSd1	32.133	2	0.000
GDPd1	GPSd1	99.759	2	0.000
GDPd1	All	1122	18	0.000
9.				
GSd2	GDP growth	414.63	2	0.000
GSd2	Total population	303.54	2	0.000
GSd2	GNI Percapita	337	2	0.000
GSd2	Life expectancy	234.41	2	0.000
GSd2	CDR	862.3	2	0.000
GSd2	TFR	65.567	2	0.000
GSd2	IMR	64.648	2	0.000
GSd2	GDPd1	316.87	2	0.000
GSd2	GPSd1	244.68	2	0.000
GSd2	All	4714.6	18	0.000
10.				
GPSd1	GDP growth	237.24	2	0.000
GPSd1	Total Population	484	2	0.000
GPSd1	GNI percapita	236.84	2	0.000
GPSd1	life expectancy	72.34	2	0.000

GPSd1	CDR	203.25	2	0.000
GPSd1	TFR	147.26	2	0.000
GPSd1	IMR	118.93	2	0.000
GPSd1	GDPd1	19.511	2	0.000
GPSd1	GSd1	48.969	2	0.000

Source: Stata output, d1 indicate first differenced

In the first equation (table 2), the null hypothesis for granger causality test is that the lagged of population growth, GNI per capita, life expectancy, TFR, IMR, GDP, GPS, CDR and GS does not cause GDP growth. **I**t is found that lagged of population growth, GNI per capita, life expectancy, TFR, IMR, GDP and GPS granger-cause GDP growth because p- value is less than 0.05. However lagged of CDR and GS are found to be insignificant. The direction of causality is therefore found from population growth, GNI per capita, life expectancy, TFR, IMR, GDP and GPS to GDP but not from CDR, GS to GDP.

In the third equation, the null hypothesis for granger causality test is that the lagged total population, IMR, GPS, GDP growth rates, life expectancy, CDR, TFR, GDP, GS does not cause GNI per capita. We have found GNI per capita to be granger- cause by lagged of total population, IMR, GPS. However GDP growth rates, life expectancy, CDR, TFR, GDP, GS are found to be insignificant. This implies that GNI per capita is granger-cause by lagged of total population, IMR, GPS but GDP growth rates, life expectancy, CDR, TFR, GDP, GS does not granger cause GNI per capita .

In the ninth equation, the null hypothesis for granger causality test is that the lagged total population, IMR, GPS, GDP growth rates, life expectancy, CDR, TFR, GDP, and GNI per capita does not cause GS. The null hypothesis is rejected and lagged total population, IMR, GPS, GDP growth rates, life expectancy, CDR, TFR, GDP, and GNI per capita are found to granger cause GS.

In the tenth equation (table2), the null hypothesis for granger causality test is that the lagged total population, IMR, GS, GDP growth rates, life expectancy, CDR, TFR, GDP, and GNI per capita does not cause GPS. However in this equation also the null hypothesis is rejected since they are found to be statistically significant.

Since we tried to analyze the direction of causality between Health and economic development, let us understand whether the indicators of health variables are affected by variables of economic development.

We have found life expectancy being granger-cause by lagged of GDP growth rate, total population, GNI per capita, CDR, TFR, IMR, GDP and GS since the p-value is found to be statistically significant (equation 4).

In the fifth equation, the null hypothesis for granger causality test is that the lagged total population, GPS, GDP growth rates, life expectancy, IMR, TFR, GDP, GS, GNI per capita does not cause CDR. However the null hypothesis has been rejected because the p-value are found to be statistically significant and this implies that lagged of GDP growth, total population, GNI per capita, life expectancy, TFR, IMR, GDP, GS, GPS grander cause CDR.

In the sixth equation, the null hypothesis for granger causality test is that the lagged total population, GPS, GDP growth rates, life expectancy, IMR, CDR, GDP, GS, GNI per capita does not cause TFR and it is found that TFR is granger-cause by GDP growth, CDR, IMR and GS. However total populations, GNI per capita, life expectancy, GDP is found to be statistically insignificant.

In the seventh equation, the null hypothesis for granger causality test is that the lagged total population, GPS, GDP growth rates, life expectancy, CDR, TFR, GDP, GS, GNI per capita does not cause IMR. According to the stata output it is seen that IMR is granger-cause by GPS, GDP growth rates, life expectancy, CDR, TFR, GDP, GS, and GNI per capita.

1.6 Conclusions and Recommendation

It is obvious from above discussion that health and economic development are interdependence. Health impacted economics development and vice versa which is evidence from the findings given above. A healthy individual can boosts labour productivity, educational attainment and income which in number of ways lead to economic development. So important should be given to improve the health and well being of individual.

To ensure better health to individual and to generate economic growth, since the poor people have higher incidence of child mortality, maternal mortality and higher level of diseases, they should be provided better health care facilities. Further health of poor women and girls should be given top priority. Other efforts to prevent infant mortality are that the mother should access pre-natal and new born care. They should be given easy access to health care facilities including free health check up, urgent care service and meet unmet community health needs in isolated rural areas

Malnutrition and food insecurity can also be observed as one of the important reason for infant deaths. In such cases, the efforts of health ministries and other coordination department should effectively implement pro-health policies. Healthy habit among parent should be promote for better child caring preventing from mal-nutrition as well as accessing medical research in order to understand and prevent birth defects, pre-mature birth and sudden infant death to promote healthier growth and development.

The average government expenditure on health though increasing is not sufficient. The growth in absolute value of health expenditure will not fully explain the process of development due to rise in population. Hence it is necessary per capita development expenditure in term of per- capita health services.

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Appendices

ADF Test Result

Table 1 statistic for annual GDP growth

Null Hypothesis: Annual GDP growth (%) is not stationary or having unit root
Regress lags (2)
Augmented Dickey-Fuller test for unit root **Number of observations = 25**

	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Value Critical**
Z(t)	**-3.750**	**-3.218**	**-3.000**	**-2.630**

MacKinnon approximate p-value for Z(t) = 0.0189

D.gdpgrowth	**Coefficient.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
Gdp growth						
L1.	**-1.074067**	**.333723**	**-3.22**	**0.004**	**-1.768082**	**-.3800523**
LD.	**.1388842**	**.2494102**	**0.56**	**0.584**	**-.3797926**	**.657561**
L2D.	**.0315485**	**.1883567**	**0.17**	**0.869**	**-.3601609**	**.4232578**
_ cons	**7.011138**	**2.138958**	**3.28**	**0.004**	**2.562932**	**11.45934**

Source: Stata output

Table 2 statistic for Total Population

Null Hypothesis: Total population is not stationary or having unit root
Regress lags (0)

Augmented Dickey-Fuller test for unit root		**Number of observations =**		**27**
	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Value Critical**
Z(t)	**-3.444**	**-3.736**	**-2.994**	**-2.628**
MacKinnon approximate p-value for Z(t) = 0.0096				

D.Total population	**Coefficient.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
Total population						
L1.	**-.0088124**	**.0025591**	**-3.44**	**0.002**	**-.014083**	**-.003518**
_ cons	**00270136**	**.0028544**	**9.46**	**0.000**	**.0211348**	**.0328924**

Source: Stata output

Table 3 Statistic for Gross National Income (GNI) Per capita

Null Hypothesis: GNI Per capita is not stationary or having unit root
Regress lags (0)
Augmented Dickey-Fuller test for unit root **Number of observations =** **27**

	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Value Critical**
Z(t)	**3.880**	**-3.736**	**-2.994**	**-2.628**
MacKinnon approximate p-value for Z(t) = 1.000				

D.GNI percapita	**Coefficient.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
GNI percapita						
L1.	**-.0658579**	**.0169717**	**3.88**	**0.001**	**.0309039**	**.1008118**
_ cons	**1.993091**	**15.51936**	**0.13**	**0.899**	**-29.96962**	**33.9558**

Source: Stata output

Table 4 Statistic for life expectancy

Null Hypothesis: Life expectancy is not stationary or having unit root
Regress lags (0)
Augmented Dickey-Fuller test for unit root **Number of observations =** **27**

	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Value Critical**
Z(t)	**-6.556**	**-3.736**	**-2.994**	**-2.628**
MacKinnon approximate p-value for Z(t) = 0.000				

D.lifeexpectancy	**Coefficient.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
Life expectancy						
L1.	**-.013616**	**.0021623**	**-6.30**	**0.000**	**-.0180693**	**-.0091627**

_ cons	**1.285228**	**.1378225**	**9.33**	**0.000**	**1.001378**	**1.569079**

Source: Stata output

Table 5 Statistic for crude death rate (CDR)

Null Hypothesis: CDR is not stationary or having unit root
Regress lags (0)
Augmented Dickey-Fuller test for unit root **Number of observations = 27**

	Test Statistic	1% Critical Value	5% Critical Value	10% Value Critical
Z(t)	**-16.556**	**-3.736**	**-2.994**	**-2.628**

MacKinnon approximate p-value for Z(t) = 0.000

D.CDR	Coefficient.	Std. Err.	t	P>t	[95% Conf. Interval]	
CDR						
L1.	**-.0678545**	**.0040986**	**-16.56**	**0.000**	**-.762957**	**-.0594137**
_ cons	**.4425676**	**.0351884**	**12.58**	**0.000**	**.3700957**	**.5150395**

Source: Stata output

Table 6 Statistic for Total Fertility Rate (TFR)

Null Hypothesis: TFR is not stationary or having unit root
Regress lags (0)
Augmented Dickey-Fuller test for unit root **Number of observations = 27**

	Test Statistic	1% Critical Value	5% Critical Value	10% Value Critical
Z(t)	**-2.708**	**-3.736**	**-2.994**	**-2.628**

MacKinnon approximate p-value for Z(t) = 0.0727

D.TFR	Coefficient.	Std. Err.	t	P>t	[95% Conf. Interval]	
TFR						
L1.	**-.0176971**	**.0065363**	**-2.71**	**0.012**	**-.0311588**	**-.0042355**
_ cons	**-.0119947**	**.0205741**	**-0.58**	**0.565**	**-.0543679**	**.0303785**

Source: Stata output

Table 7 Statistic for Gross Domestic Product (GDP)

Null Hypothesis: GDP is not stationary or having unit root
Regress lags (0)
Augmented Dickey-Fuller test for unit root **Number of observations = 26**

	Test Statistic	1% Critical Value	5% Critical Value	10% Value Critical
Z(t)	**-3.265**	**-3.736**	**-2.997**	**-2.629**

MacKinnon approximate p-value for Z(t) = 0.0165				
D.GDPD1	**Coefficient.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**
GDP					
L1.	**-.7199793**	**.2204917**	**-3.27**	**0.003**	**-1.175052**	**-.2649069**
_ cons	**69.6473**	**27.026**	**2.58**	**0.017**	**13.866**	**125.427**

Source: Stata output, GDPD1 represent GDP after first order difference

Table 8 Statistic for Gross Saving

Null Hypothesis: Gross saving is not stationary or having unit root
Regress lags (0)
Augmented Dickey-Fuller test for unit root **Number of observations = 25**

	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Value Critical**
Z(t)	**-7.374**	**-3.750**	**-3.000**	**-2.630**
MacKinnon approximate p-value for Z(t) = 0.000				

D.GSD1	**Coefficient.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**
GSD1					
L1.	**-1.392**	**.188889**	**-7.37**	**0.000**	**-1.78368**	**-1.002147**
_ cons	**-.2161154**	**.2585175**	**-0.84**	**0.412**	**-.750899**	**.318668**

Source: Stata output, GSD2 represent gross saving after second order difference

Table 9 Statistic for Infant Mortality Rate (IMR)

Null Hypothesis: IMR is not stationary or having unit root
Regress lags (0)
Augmented Dickey-Fuller test for unit root **Number of observations = 27**

	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Value Critical**
Z(t)	**-4.089**	**-3.736**	**-2.994**	**-2.628**
MacKinnon approximate p-value for Z(t) = 0.0010				

D.IMR	**Coefficient.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**
IMR					
L1.	**-.00559**	**.00136**	**-4.09**	**0.000**	**-.008405**	**-.00277**
_ cons	**-1.777**	**.08565**	**-20.75**	**0.000**	**-1.95376**	**-1.60093**

Source: Stata output

Table 10 Statistic for Gross Primary School Enrollment (GPS)

Null Hypothesis: GPS is not stationary or having unit root
Regress lags (0)

Augmented Dickey-Fuller test for unit root		**Number of observations =**	**27**	
	Test Statistic	**1% Critical Value**	**5% Critical Value**	**10% Value Critical**
Z(t)	**-4.770**	**-3.743**	**-2.997**	**-2.629**
MacKinnon approximate p-value for Z(t) = 0.0001				

D.GPSD1	**Coefficient.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
GPSD1						
L1.	**-.9937895**	**.2083468**	**-4.77**	**0.000**	**-1.423796**	**-.5637829**
_ cons	**.8331516**	**0.4919858**	**1.69**	**0.103**	**-.1822572**	**-1.84856**

Source: Stata output, GPSD1 represent Gross Primary School enrollment after first difference.