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India's Vital Health Statistics and Relationship between Health Expenditure and GDP from 1996-2018

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Abstract: ***This paper posits to explain the condition of health in India, which is an Upper Middle Income Country, by explaining various parameters of Health which includes Life Expectancy at Birth, Crude Birth Rate, Crude Death Rate, Infant Mortality Rate and Maternal Mortality Rate. The paper is also intended to examine the relevance of Wagner's law in the sphere of health i.e. increase in Health Expenditure as GDP increases. Inter-linkages between variables such as economic growth, GDP, public health care, health expenditure is very important to analyse the health profile of a country. However, validity for the causality relationship between health expenditure incurred by the Government and GDP of a country has not been proved yet. Access to health care services is mutilated due to socio-economic conditions prevalent in low and middle income countries, thereby leading to poor health care, and unaffordable health services. By applying econometric tools like Co-Relation Analysis, Unit Root Tests, Johansen Co integration Test, Vector Auto-Regression and VAR Granger Causality/ Block Exogenity Tests, it has been found that from 1996-2018, there has been a unidirectional Causality i.e. increase in GDP leads to increase in Health Expenditure.***

Keywords: India, Health, Health Expenditure, GDP

1. Introduction

The economic prosperity and wellbeing of a country depends on the availability of the physical as well as human capital stock. Physical capital has been a focus of study while analyzing the productivity of a country i.e. physical capital is the investment which is made in business. Similarly, human capital can be understood as the investment which human beings make in themselves to enhance and increase their economic productivity. The concept of human capital is determined through investment in education and investment in health. The role of investment in medical care has been given in 'Health as an Investment' by Selma. J. Mushkin. According to the thesis, health is a part of human capital and thus, investment in health will lead to growth of the economy and productivity. (Mushkin, 1962)[56]

Health is a multifaceted concept, thus it is not easy to measure health. Health refers to the status of people's health i.e. how healthy people are. The important distinction between health and health care is that health care can be traded where as health cannot. However, the concept and the definition of health became clearer when World Health Organisation included it in its constitution in 1948. "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." (World Health Organization)[82]

Thus, health is one of the important indicators which reflects the standard of living and quality of life of the people. An increase in the quantum of health expenditure has a remarkable impact on the socioeconomic conditions in any country.

The First section of this study includes a literature review. The Second section comprises of health profile of India. The Third section explains Health Expenditure and GDP and the Fourth Section includes the methodology to analyze the relationship between health expenditures and GDP and the Last section is the conclusion and recommendations of this study.

2. Literature Review

Health has been considered as one of the important parameters that has an impact on the Gross Domestic Product of a country. Thus, there have been many studies made in accordance to relationship between expenditure on health care sector and economic growth of the country. If we look at the previous studies, there are remarkable conclusions drawn by them.

(Gizem., 2018)[10] stated that health expenditure and economic growth has a very significant relationship in the long run under 'The Relationship between Health Expenditure and Economic growth in Turkey from 1980 to 2015'. The methodology employed here includes ARDL testing approach of co integration developed by Pesaran, Shin and Smith (2001).

(Tieguhong, 2017) [66] analysed the impact of health expenditure on GDP. Abuja Declaration of 2001 required the 15% allocation of government expenditure on health but by 2013, only 5 African countries have followed this declaration. Thus, by employing OLS, Fully modified OLS and Dynamic OLS, they have made a comparative analysis, where for 1 unit change in health expenditure, there was 0.3 unit increase in GDP in CEMAC sub-region and 0.38 unit increase in GDP in the 5 countries of Africa that followed Abuja Declaration. Also, there was long run relationship between the two variables.

(Bedir, 2016)[12] explained with econometric tools like modified version of Granger Causality Test proposed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996), the two way causality between health expenditure

and economic growth in Czech Republic and Russian Federation where as Egypt, Hungary, Korean Republic, South Africa, and the Philippines support health over income and Greece, Poland, the United Arab Emirates, China, Indonesia, and the Korean Republic support income over wealth. According to this study, in endogenous growth models, capital accumulation is a pre-requirement and it is necessary to increase health expenditure to increase capital accumulation.

(Mahmoud, 2018)[49] illustrated two way relationships between health expenditure and economic growth by employing OLS Multiple Linear Regression model, Correlation Coefficient and R^2 for data pertaining to Egypt from 1990 to 2016.

(D, 2017)[4] analysed positive and significant but a weak relationship between health expenditure and GDP in terms of magnitude. The methodology applied includes Generalised Method of Moments, Simple Panel data models fixed effect and random effect), Hansen J Test and Arellano Bond Test.

(Wang, 2015)[80] studied on the issue whether more health expenditure will lead to better economic performance, by taking into consideration the empirical evidences from OECD countries. By applying Generalised Method of Moments, it was found that optimal level of health expenditure being 7.55%, when health spending is less than it, an increase in health expenses will lead to better economic performance.

(Rengin, 2012)[69] searched for the relationship between health spending and economic growth, particularly for Turkey. By statistical tools like Johansen Integration Test and Normalised Co integration Vector, there is a long run but no short run relationship between the two variables.

(Sghari, 2013)[71], from their key findings for relationship between health expenditure and GDP in Developed countries and with the help of Toda & Yamamota test for long run causality involving VAR analysed a bidirectional granger Causality.

(Karim D. O., 2016)[41] stated under a paper titled 'Health Expenditure and Economic Growth: An ARDL-Type of Analysis for Nigeria' that the growth in health expenditure or the growth in GDP had no significant contribution to the growth in GDP or to the growth in health expenditure.

(Tsaurai, 2014)[79] investigated whether Wagner's theory is relevant in explaining the health expenditure dynamics in Botswana. The methodology included Autocorrelation, Unit root test, Johansen and Juseliues co integration test and Granger Causality test. The key findings were that there was no causality relationship between health spending and GDP in Botswana.

The study of (Atilgan, 2017)[8]analysed the dynamic relationship between health expenditure and GDP for Turkey. By conducting Bound test approach, ARDL and Kalman filter modelling; it was found that 1% increase in Health expenses leads to 0.434% increase in GDP.

(Dr.D.Kumar, 2015)[21] conducted a causality check between public health expenditure and economic growth in BRICS countries which includes Brazil, Russia, India and China. With the help of Unit root test, Granger Causality Test and Durbin Watson Test, it has been found that there is unidirectional causality from Per Capita GDP and Public Health expenditure per person.

(Muhammed, 2017)[55] examined the effect of health financing on GDP, a panel study based on Pakistan, China, India and Bangladesh. By applying Stata 11 and Hausman Test and the key result was that the effect of health expenditure on GDP is insignificant.

(Mushkin, 1962)[56] clearly illustrated that health has a remarkable effect on the economic growth. Here health is compared with productivity; hence, spending on health lead to an increase in the human capital which ultimately increases the GDP.

Taking into consideration the analysis of triangular causality between Total Health Expenditure with GDP and Life Expectancy by (Zaman, 2017)[87], there was direct relationship between GDP and Health expenditure where as health is more sensitive to GDP as compared to life expectancy. The econometric tools applied here include STATA and Multivariable Logistic Regression.

India's Health Profile

India is one of the top growing countries with the growth rate of 7.3% in 2018 and expected growth rate of 7.5% in 2019. India is the second most populous country and most populous democracy in the world with 1.3 billion people residing in it. It is the 7th largest economy by nominal GDP and 3rd largest by Purchasing Power Parity.

Coming to India's healthcare sector, it is expected to grow at a compound annual growth rate of 29% from 2015 to 2020. India's health care expenditure amounted to 5% of its GDP. There are inequalities present in health profile among the states as well.

Table 1: Countries with Per Capita Health Expenditure (in US $)

Country	Per Capita Health Expenditure (in US $)
United States of America	9451
Switzerland	6935
Germany	5267
Sweden	5228
France	4407
Japan	4150
United Kingdom	4003
Spain	3153
Russia	1369
Mexico	1052
China	731
India	267

Source: Statista (2015), OECD

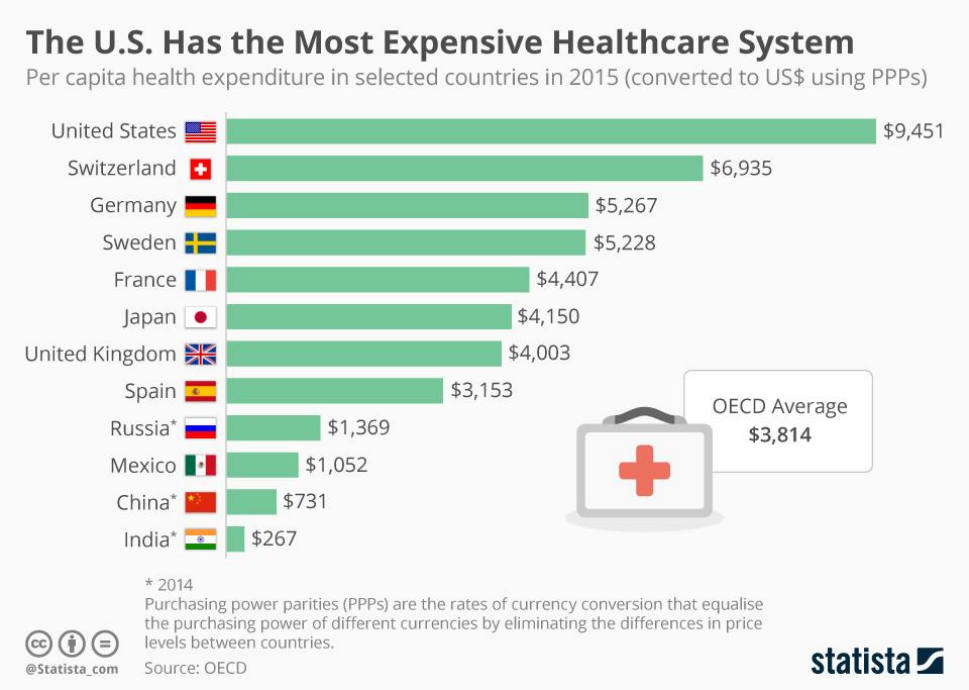

Figure 1: Country wise Per Capita Health Expenditure

Here, in the above figure from Statista (2015), United States has spent the maximum on health care with $9451. While comparing India, it has spent the least of $267 among the selected countries. Thus, in comparison to United States, India incurred merely 2.82% of United States expenditure on health.

The major indicators of health are: Life Expectancy, Crude Birth Rate, Crude Death Rate, Infant Mortality Rate and Maternal Mortality Rate. Each of these has been explained as below.

1) Life Expectancy

As defined by World Health Organisation, Life Expectancy is the average number of years that a newborn could expect to live, if he or she were to pass through life exposed to the sex- and age-specific death rates prevailing at the time of his or her birth, for a specific year, in a given country, territory, or geographic area. (World Health Organization)[85]

Table 2: Life Expectancy in India (in years)

Year	Life Expectancy(in years)
1991	58.409
1992	58.915
1993	59.421
1994	59.921
1995	60.408
1996	60.877
1997	61.327
1998	61.761
1999	62.179
2000	62.582
2001	62.977
2002	63.368
2003	63.759
2004	64.154
2005	64.556
2006	64.996
2007	65.383
2008	65.802
2009	66.219
2010	66.625
2011	67.013
2012	67.377
2013	67.714
2014	68.021
2015	68.302
2016	68.56
2017	68.8
2018	69.04

Source: Computed from World Bank Data, Knoema: World Population Prospects

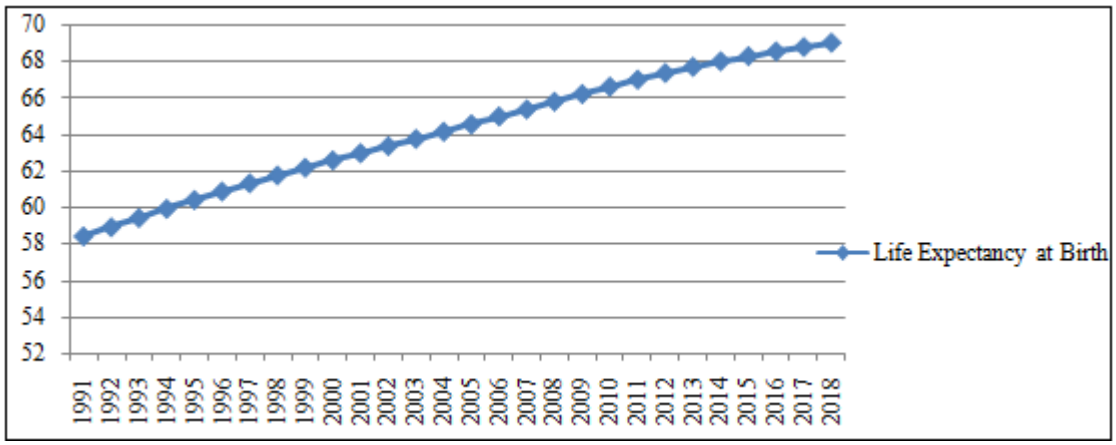

Figure 2: Life Expectancy (1991-2018)
Source: World Bank, Knoema: World Population Prospects

Taking into consideration the data for India for the period 1991-2018, the life expectancy has been increasing continuously with lowest in 1991 which was 58.4 years to highest in 2018 with life expectancy of 69.04 years. Thus, as of 2018, a person is expected to live 69.04 years.

This steady increase in the life expectancy can be because of improvement in the living conditions of people, better standard of living, advances in public health and availability of timely and efficient medications. However, according to 'The World: Life Expectancy (2018): Top 100+' retrieved from Geoba.se, Monaco ranked 1st with life expectancy of 89.37 years, followed by Japan with 86 years. United Kingdom ranked 29th with 81 years, USA ranked 53rd with 79 years. In this list, India was at 165th position with 69 years, and China, a middle income country like India has life expectancy of 76 years and was at 111th position. Thus, India has a very long way to go as compared to life expectancy.

2) Crude Birth Rate

As defined by World Health Organisation, the crude birth rate is the annual number of live births per 1,000 populations. Crude Birth Rate is generally computed as a ratio. The numerator is the number of live births observed in a population during a reference period and the denominator is the number of person-years lived by the population during the same period. It is expressed as living births per 1,000 populations. (World Health Organization)[83]

Table 3: Crude Birth Rate per 1000 people

Year	CBR per 1000 people
1991	29.5
1992	29.2
1993	28.7
1994	28.7
1995	28.3
1996	27.5
1997	27.2
1998	26.5
1999	26
2000	25.8
2001	25.4
2002	25
2003	24.8
2004	24.1
2005	23.8
2006	23.5
2007	23.1
2008	22.8
2009	22.5
2010	22.1
2011	21.8
2012	21.6
2013	21.4
2014	21
2015	20.8
2016	20.4

Source: Computed on the basis of different reports of Planning Commission, Niti Aayog, World Bank

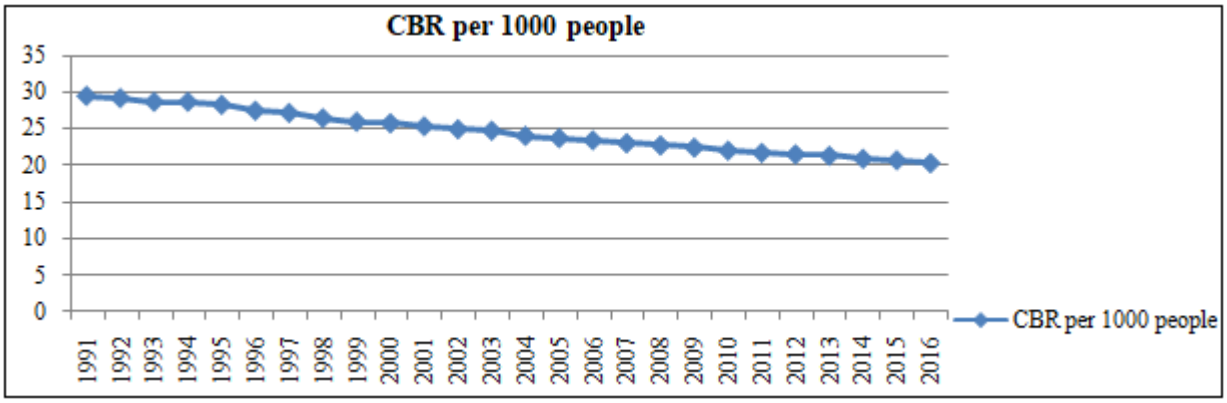

Figure 3: Crude Birth Rate (1991-2016)
Source: Planning Commission, Niti Aayog, World Bank

Retrieving the data of Crude Birth Rate from the above sources, there has been a consistent decline of CBR in India. Taking the sample of 25 years, starting from 1991 to 2016, in 1991, CBR was as high as 29.5% which has reduced down to 20.4% in 2016. Some of the causes for steady fall in CBR are:-

- Decline in the fertility rate. The SRS Statistical Report has illustrated that the Total Fertility Rate i.e. the number of children that will be born to a women during her life time, has reduced dramatically with average of 2 children per women. It should be noted that fertility rate has also declined among the poor and illiterate population.
- Increasing literacy rate among the women.
- Increased focus for family planning

However, countries like Japan, Italy, Republic of Korea and Portugal had Crude Birth Rate of 8 where as Niger had Crude Birth Rate of 48% in 2016. Thus, India has to overcome a lot of problems. However, steps taken by Government of India for family planning include New Population Policy of 2000, National Population Policy of 2002, National Rural Health Mission, National Population Stabilization Fund, etc. A petition has been given to President Ram Nath Kovind by nearly 130 lawmakers to adopt 2 child policies in India

3) Crude Death Rate

According to the definition given by World Health Organisation, Crude Death Rate is the number of deaths per 1000 population. (World Health Organization)[84] According to OECD, the crude death rate is the number of deaths occurring among the population of a given geographical area during a given year, per 1,000 mid-year total population of the given geographical area during the same year. (OECD Statistics Directorate)[63]

Table 4: Crude Death Rate per 1000 people

Year	CDR per 1000 people
1991	9.8
1992	10.1
1993	9.3
1994	9.3
1995	9
1996	9
1997	8.9
1998	9
1999	8.7
2000	8.5
2001	8.2
2002	8.1
2003	8
2004	7
2005	7.3
2006	7.3
2007	7.4
2008	7.5
2009	7.6
2010	7.6
2011	7.5
2012	7.4
2013	7.3
2014	7.3
2015	7.1
2016	6.8

Source: Computed while taking into consideration the various reports of Planning Commission and NITI Aayog

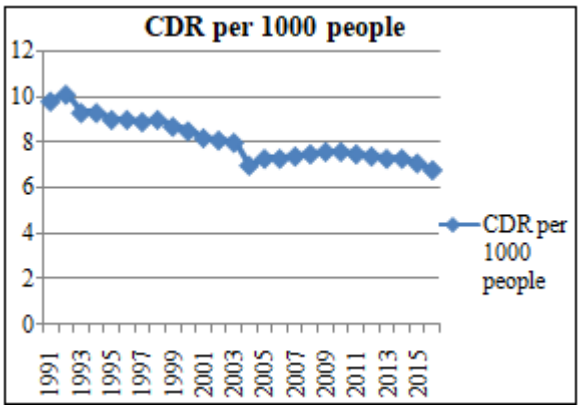

Figure 4: Crude Death Rate (1991-2016)
Source: Planning Commission, NITI Aayog

The above data for Crude Death Rate reveals that there has been a declining trend since the crude death rate has declined from 9.8 in 1991 to 6.8 in 2016. As of 2018, the CDR in India is 7.3. The country with highest CDR is Bulgaria with 15.29 where as the lowest CDR of 1.60 is at Qatar. In spite of decline in the Crude Death Rate, India ranks 89th in the world. This reduction can be cited due to several reasons which include improved nutrition, public health measures, control of epidemics, urbanisation, better medication facilities, etc. Government initiatives include National Rural Health Mission, Integrated Disease Surveillance Project, National Vector Borne Disease Control Programme, Leprosy Eradication, Iodine Deficiency Disorder, etc.

Some of the major causes for Death in India are as follows:

Table 5: Major Causes of Death in Male and Female

Cause of Death	Total	Male	Female
Cardiovascular diseases	23.3	25.1	20.8
Ill-defined/ All other symptoms, signs and abnormal clinical and laboratory findings	12.4	10	15.4
Respiratory diseases	7.6	7.8	7.5
Malignant and other Neoplasms	6.1	5.8	6.6
Prenatal conditions	5.6	5.5	5.8
Diarrhoeal diseases	5.1	4.2	6.3
Digestive diseases	4.9	6	3.5
Unintentional injuries: Other Than Motor Vehicle Accidents	4.7	4.8	4.6
Respiratory Infections	3.9	3.7	4.2
Tuberculosis	3.7	4.5	2.8
All Other Remaining Causes	22.6	22.7	22.4

Source: Health and Family Welfare Statistics in India 2017

4) Infant Mortality Rate

OECD defines Infant Mortality Rate as the number of deaths under one year of age occurring among the live births in a given geographical area during a given year, per 1,000 live births occurring among the population of the given geographical area during the same year. (OECD Statistics Directorate) [64]

Table 6: Infant Mortality Rate in Rural and Urban Areas

Year	IMR Rural areas	IMR Urban areas
1994	80	52
1995	80	48
1996	77	46
1997	77	45
1998	77	45
1999	75	44
2000	74	44
2001	72	42
2002	69	40
2003	66	38
2004	64	40
2005	64	40
2006	62	39
2007	61	37
2008	58	36
2009	55	34
2010	51	31
2011	48	29
2012	46	28
2013	44	27
2014	43	26
2015	41	25
2016	38	23

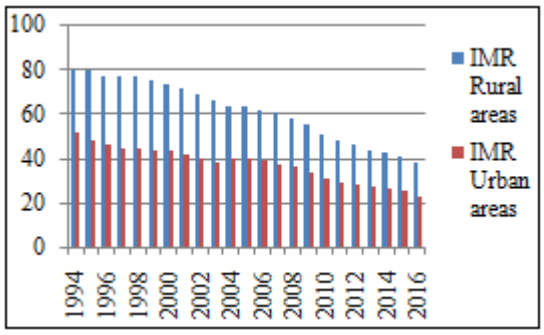

Figure 5: Infant Mortality Rate in Rural and Urban Areas (1994-2016)
Source: SRS Bulletin, O/o Registrar General of India.

The above chart shows comparison of decreasing Infant Mortality Rate in the Rural and Urban areas of India. It can be observed from the bar graph that as compared to reduction in Infant Mortality Rate in the urban areas, the Infant Mortality Rate reduced at a faster rate in the rural areas.

Table 7: Infant Mortality Rate per 1000 live births in India

Year	Infant Mortality Rate per 1000 live birth
1994	74
1995	74
1996	72
1997	71
1998	72
1999	70
2000	68
2001	66
2002	63
2003	60
2004	58
2005	58
2006	57
2007	55
2008	53
2009	50
2010	47
2011	44
2012	42
2013	40
2014	39
2015	37
2016	34

Source: Computed from Sample Registration System Bulletin Reports and Reports of Registrar General of India

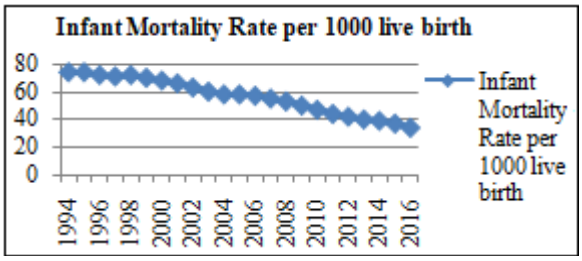

Figure 6: Infant Mortality Rate in India (1994-2016)
Source: SRS Bulletin, O/o Registrar General of India

The Infant Mortality Rate for all over India has considerably declined from 74 deaths in 1994 to 34 deaths in 2016. Female literacy is one of the factors that have a considerable impact on Infant Mortality rate. Another factor is availability of better and more efficient health care facilities and availability of health care institutions. There has been increase in Institutional Deliveries and Immunization for children in order to prevent Neo-Natal and Post-Natal Infant Mortality. Some of the steps taken by Government of India to curb infant Mortality Rate includes Navjaat Shishu Suraksha Karyakram, Special Newborn Care Units (SNCU), Home Based New Born Care (HBNC) through ASHAs, Integrated Management of Neonatal and Childhood Illness (IMNCI), Mother and Child Protection Card, Newborn Stabilization Units (NBSU), India Newborn Action Plan (INAP), etc. Some of the major reasons for Infant Mortality rate in India are stated below:-

Table 8: Major Causes of Infant Mortality Rate

Cause of Death	Total	Male	Female
Prematurity & low birth weight	35.9	35.6	36.4
Pneumonia	16.9	17	16.8
Birth asphyxia & birth trauma	9.9	10.7	9.1
Other noncommunicable diseases	7.9	8.2	7.5
Diarrhoeal diseases	6.7	6.2	7.3
Ill defined or cause unknown	4.6	4.4	4.9
Congenital anomalies	4.6	4.8	4.3
Acute bacterial sepsis and severe infections	4.2	4.2	4.3
Injuries	2.1	2	2.1
Fever of unknown origin	1.7	1.7	1.8
All other Remaining Causes	5.4	5.2	5.7

Source: Health and Family Welfare Statistics in India 2017

5) Maternal Mortality Rate

According to the definition given by World Health Organisation, Maternal Mortality is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes. (World Health Organisation)[52] It is calculated per 100000 live births.

Table 9: Maternal Mortality Rate per 100000 live births

Year	MMR per 100000 live births
2004-06	254
2007-09	212
2010-12	178
2011-13	167
2014-16	130

Source: NITI Aayog

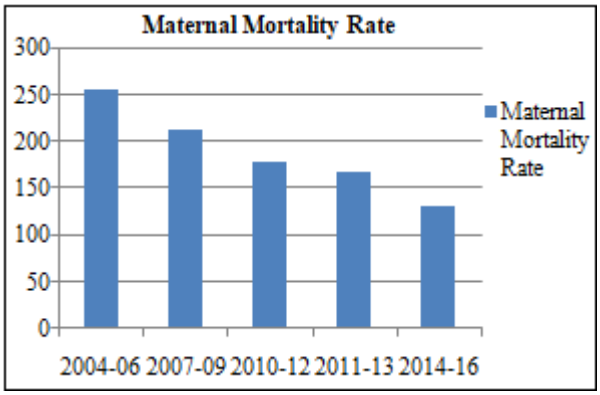

Figure 7: Maternal Mortality Rate (2004-2016)
Source: NITI Aayog

The number of women dying during childbirth in India has come down sharply. Along with this, there has been increase in the number of women having their deliveries in hospitals. The rate of maternal deaths has reduced from 254 to 130 in period of 12 years. This has become possible because of institutional deliveries, private doctors to provide free checkups to pregnant women, reduction in child marriages and below age pregnancies, treatment for anaemia, regular checkups, etc.

Table 10: Maternal Mortality Rate in various states of India (2004-2016)

State	2004-06	2007-09	2010-12	2011-13	2014-16
Assam	480	390	328	300	237
Bihar/Jharkhand	312	261	219	208	165
Madhya Pradesh/ Chhattisgarh	335	269	230	221	173
Odisha	303	258	235	222	180
Rajasthan	388	318	255	244	199
Uttar Pradesh/ Uttarakhand	440	359	292	285	201
EAG & Assam Subtotal	375	308	257	246	188
Andhra Pradesh	154	134	110	92	74
Telangana					81
Karnataka	213	178	144	133	108
Kerala	95	81	66	61	46
Tamil Nadu	111	97	90	79	66
South Subtotal	149	127	105	93	77
Gujarat	160	148	122	112	91
Haryana	186	153	146	127	101
Maharashtra	130	104	87	68	61
Punjab	192	172	155	141	122
West Bengal	141	145	117	113	101
Other States	206	160	136	126	97
Other Subtotal	174	149	127	115	93

Source: NITI Aayog

There are disparities among the different states of India with respect to Maternal Mortality Rate. The state with lowest Maternal Mortality Rate is Kerala where as the state with highest Maternal Mortality Rate is Assam. Initiatives by Government of India include Janani Suraksh Yojna (JSY), web-based Mother and Tracking System, Janani Shishu Suraksha Karyakram (JSSK), Pradhan Mantri Surakshit Matritva Abhiyan, Adolescent Reproductive Sexual Health Programme (ARSH), etc.

Some Negative Aspects of India's Health Profile

- According to last NSSO health survey which was conducted in 2013-14, medical attention was lacking. The death of people with lowest income was clearly neglected since 38.92% did not receive proper attention where as the richest top 5% population's death was not neglected to a great extent since only 2.14% did not receive medical attention. Thus, the bottom 25% people would have received medical attention before dying if they were as rich as top 5%. This reflects the inequality in the availability and distribution of health care services and health care benefits.
- Among the bottom 20% income earners i.e. the poor people, nearly 1 out of 5 individuals lose their entire earnings in the form of health care expenditure incurred for detrimental diseases. For India, it is 14.4% households. However, the real burden of health care is much higher than what is expected which forces and compels people to avoid the treatment even when one faces life threatening disease.
- The high financial burden of health services is also reflected by the out of pocket expenses incurred by individuals. In India, 65.06% is the amount of out of pocket expenditure out of total health expenditure.
- The primary healthcare sector is very weak. For example, Lancet stated that in 2015, there was merely 1 bed in government hospital for every 1833 ill people. The services provided in these hospitals are not up to the mark. For example, in 2011, 6 out of 10 less developed states did not have ICU and lacked proper sanitation facilities.
- As per Lancet study, the medical personnel and doctors were unequally distributed. In community health centres of different states all over India, there was a shortfall of specialist doctors which exceeded 80%.
- According to the NSSO Report, because of the poor quality of the health care facilities provided by government hospitals and community care centres, the proportion of people getting treatment at these places have reduced to a considerable amount. Nearly 50.7% of rural people and 50% of urban population get their ailments treated at private doctor clinics and private hospitals.
- The public expenditure on health care services has remained all time low. According to WHO database, India allocates merely 4.55% to health care out of its total budget and this represents only 1.28% of GDP.
- Another major drawback that India's health care faces is lack of up-to-date and uniform data and statistics regarding health.

6) Health Expenditure and GDP

One of the important social expenditure incurred by any country is healthcare expenditure. Government of a country has a major role to play in the contribution to healthcare expenditure. In any underdeveloped, developing or developed country, the Government's contribution in development of health care facilities and health care

infrastructure is very significant. Productive investment in health by the State can eliminate health problems and can contribute to the economic development of a country. Good health is an end in itself. A healthy worker can contribute to the economic growth of the country since with improvement in health, the productivity of people increase which helps in bolstering the GDP of the country. Thus, effect of health on the productivity of a worker illustrates the relationship between Health and GDP of a country since GDP increases with increase in the productivity levels.

Interaction between health expenditure and the economic growth of a country has received great amount of recognition. How much a country spends on health overtime is related to two concepts: - the growth of health expenditure and to the growth of the economy as a whole.

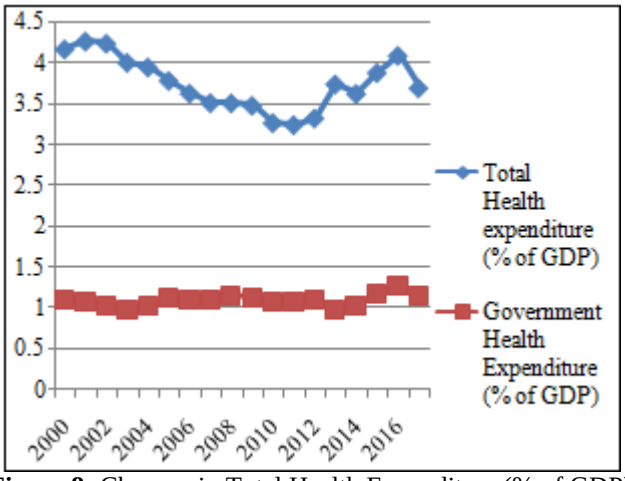

Figure 8: Changes in Total Health Expenditure (% of GDP) and Government Health Expenditure (% of GDP)
Source: Index Mundi, National Health Profile, 2018

There were several fluctuations in the Total Health Expenditure and Government Health Expenditure in comparison to GDP over the period of 17 years. Government Health expenditure has more or less remained the same i.e. around 1% of GDP where as there were changes in Total Health expenditure ranging from 4.179% of GDP in 2000 to 3.7% of GDP in 2017.

7) Research Methodology

This study used the annual time series data pertaining to GDP in crores and Health Expenditure in crores that spans from 1996-2018 i.e. 20 years. All the data has been extracted from various official sources which includes Union Budget and Economic Survey, Planning Commission of India, World Bank, Ministry of Statistics and Programme Implementation (2004-18, 2018-19), Ministry of Statistics and Programme Implementation for GDP (1993-94 series, 1999-2000 series, 2004-2005 series, 2011-2012 series), National Health Accounts of India, Health Sector Financing by Centre and State- Ministry of Health and Family Welfare, National Health Profile-2018.

(a) Correlation Analysis

The Correlation analysis was carried out using Durbin Watson Statistic for first order serial correlation and the Breusch-Godfrey Serial Correlation LM Test for higher order serial correlation.

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 1 lag			
F-statistic	68.83518	Prob. F(1,20)	0.0000
Obs*R-squared	17.04701	Prob. Chi-Square(1)	0.0000
Test Equation:			
Dependent Variable: RESID			
Method: Least Squares			
Date: 02/19/19 Time: 00:50			
Sample: 1 22			
Included observations: 22			
Presample missing value lagged residuals set to zero.			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP	0.001714	0.001929	0.888973	0.3846
RESID(-1)	0.972324	0.117194	8.296697	0.0000
R-squared	0.774191	Mean dependent var		-0.015109
Adjusted R-squared	0.762901	S.D. dependent var		0.282941
S.E. of regression	0.137772	Akaike info criterion		-1.039928
Sum squared resid	0.379621	Schwarz criterion		-0.940742
Log likelihood	13.43921	Hannan-Quinn criter.		-1.016563
Durbin-Watson stat	1.091758			

Since time series are subject to auto correlation since both the F and x^2 values are highly significant as their corresponding p values are very low. So, we reject the null hypothesis and accept the alternate hypothesis i.e. the series is subject to auto-correlation. However, as a remedial step, the health expenditure was differenced at first order and auto correlation was removed before the unit root testing was done.

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.691404	Prob. F(2,17)	0.5144
Obs*R-squared	1.579680	Prob. Chi-Square(2)	0.4539

Here, the null hypothesis is that there is no serial correlation between health expenditure and GDP of India. However, the initial results showed that there was series correlation so in order to remove that, health expenditure is converted into lagged health expenditure and thus here, p values is 0.51 which is higher than 0.10, which can be interpreted as we accept the Null Hypothesis that there is no auto correlation between GDP and Health Exp. And reject the alternate hypothesis.

(b) Unit Root Tests

Stationarity of variables is checked through Unit Root Tests. Stationarity is where the statistical features such as mean, variance, autocorrelation, standard deviation etc. are all constant or unchanged over a period of time. Here, the two variables are Health Expenditure and GDP. If they are constant over time, then the time series is stationary and if they are not constant over time, the time series is non-stationary. As a model, if we have x as the dependent variable and y as the independent variable, then time series equation will be:

$$Xt = \alpha + \beta Yt + \varepsilon t$$

For the purpose of this study, stationarity has been checked with Augmented Dickey Fuller Unit Root Test. Here, both the variables i.e. Health Expenditure and GDP are stationary at 1st Order Difference.

ADF Statistics		
	Level	1st Order Difference
LGDP	-1.419291	-4.986923
LAGLHE	1.117113	-3.192816

LGDP Unit Root Test for Stationarity at 1st Order Difference

Null Hypothesis: D(LGDP) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=4)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.986923	0.0008
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	
*MacKinnon (1996) one-sided p-values			

LAGLHE Unit Root Test for Stationarity at 1st Order Difference

Null Hypothesis: D(LAGLHE) has a unit root			
Exogenous: Constant			
Lag Length: 3 (Automatic - based on SIC, maxlag=4)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.192816	0.0396
Test critical values:	1% level	-3.92035	
	5% level	-3.065585	
	10% level	-2.673459	
*MacKinnon (1996) one-sided p-values.			

Hence, both the variables Health Expenditure and GDP of India were stationary at !st Order Difference.

(c) Selection of Optimal Lag Length

An important aspect of empirical studies under Vector Autoregression Model is selection of optimal lag length. By estimating VAR, assuming that there is no co integration between the variables, we derive that the optimal lag length is under Schwarz Criterion i.e. 1 lag. Here, we have auto generated 1 lag length criterion (lag length 1 and 2 are for annual time series data) since the data which we have for analysis are yearly data compiled in the official accounts and publications of India.

LAG Length Criterion

VAR Lag Order Selection Criteria						
Endogenous variables: LGDP LAGLHE						
Exogenous variables: C						
Date: 02/18/19 Time: 04:03						
Sample: 1 22						
Included observations: 20						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2.235639	NA	0.005237	0.423564	0.523137	0.443002
1	55.68768	98.46964*	2.39e-05*	-4.968768*	-4.670048*	-4.910455*
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Here, since the Schwarz Information Criterion has the least value at lag 1, we select it i.e. -4.670048*

(d) Johansen Cointegration Test

Co integration Test evaluates and analyses the long term relationship between the two variables, which in current model are Health Expenditure and GDP of India. Johansen Co integration Test is a procedure for testing co integration of time series [Johansen & Juselius (1990)]. The test statistics here employs Maximum Eigen Values and Trace. The Johansen test statistics for Co integration are formulated as:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1-\hat{\lambda}_i)$$

and

$$\lambda_{max}(r, r+1) = -T ln(1-\hat{\lambda}_{r+1})$$

λ=the estimated value for the *i*th ordered eigenvalue from the Π matrix.

$\lambda trace$ Tests the null that the number of cointegrating vectors is less than equal to r against an unspecified alternative.

$\lambda trace$ = 0 when all λ_i = 0, so it is a joint test.

λmax tests the null that the number of cointegrating vectors is ***r*** against an alternative of ***r*+1.**

Date: 02/18/19 Time: 04:13				
Sample (adjusted): 4 22				
Included observations: 19 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LGDP LAGLHE				
Lags interval (in first differences): 1 to 1				
Unrestricted Co integration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.443782	12.22081	15.49471	0.1466
At most 1	0.055034	1.075516	3.841466	0.2997
Trace test indicates no co integration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Co integration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.443782	11.14530	14.26460	0.1471
At most 1	0.055034	1.075516	3.841466	0.2997
Max-eigenvalue test indicates no co integration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Since we had the time lag criterion of 1, and here we have no co-integration both at Trace and Maximum Eigenvalue, we find the causality between the variables with the help of Vector Auto-Regression Model.

(e) Causality Test

Once the relationship between the two variables i.e. Health Expenditure and GDP has been found out, i.e. no co-integration, the next step we have is to estimate the Causality between them. The basic idea behind VAR is that past can cause the present and present can cause the future but future cannot cause present and present cannot cause past. Important condition for causality test is that the variables should be stationary. Here, we try to analyse the relationship between health expenditure and GDP in India. We try to test if Health Expenditure causes GDP or the GDP causes Health Expenditure. As we know, there are 4 types of Causality between any 2 variables say x and y.

- Unidirectional Causality from y to x
- Unidirectional Causality from x to y
- Feedback or Bilateral Causality
- Independence

In our model,
Sample Size= 22 observations, from 1996-97 to 2017-18
Models of Causality: VAR Model, Block Exogenity Test, Granger Causality Test

(f) VAR Model

VAR Models (Vector Autoregressive Models) are used for analysing multivariate time series. In other words, VAR Model is a multiple equation model. Here, every endogenous variable is treated as a function of lagged values of all the endogenous variables in the system. Here, we have employed Standard VAR Model to test the causality between Health Expenditure and GDP.

Vector Autoregression Estimates		
Date: 02/18/19 Time: 04:15		
Sample (adjusted): 3 22		
Included observations: 20 after adjustments		
Standard errors in ( ) & t-statistics in [ ]		
	LGDP	LAGLHE
LGDP(-1)	0.920828	0.832892
	(0.19199)	(0.16815)
	[4.79623]	[4.95338]
LAGLHE(-1)	0.052123	0.164155
	(0.19017)	(0.16655)
	[0.27409]	[0.98563]
C	0.794136	-3.712672
	(0.94967)	(0.83173)
	[0.83622]	[-4.46381]
R-squared	0.992973	0.994864
Adj. R-squared	0.992146	0.994260
Sum sq. Resids	0.082643	0.063391
S.E. equation	0.069724	0.061064
F-statistic	1201.141	1646.429
Log likelihood	26.51077	29.16294
Akaike AIC	-2.351077	-2.616294
Schwarz SC	-2.201718	-2.466934
Mean dependent	15.43763	10.77668
S.D. dependent	0.786766	0.805965
Determinant resid covariance (dof adj.)		1.81E-05
Determinant resid covariance		1.31E-05
Log likelihood		55.68768
Akaike information criterion		-4.968768
Schwarz criterion		-4.670048
Number of coefficients		6

Here, we know the standard critical values of t which corresponds to probability values of 0.01, 0.05, 0.10 which implies that it is statistically significant i.e. we reject the null hypothesis. Any value of t less than 1.65 implies statistical insignificance.

If t≥2.56, P=0.01
If t= 2.55 to 1.96, P=0.05
If t= 1.95 to 1.65, P=0.10

If we look at our results, t statistics for LGDP(-1)→LAGLHE is [4.95338] which is greater than 2.56 critical value, so here we accept the alternate hypothesis and reject the null hypothesis. The inference here is that LGDP(-1) is highly related to LAGLHE. So, GDP determines Health Expenditure.

Conversely, t statistics for LAGLHE(-1)→LGDP is [0.27409] which is less than 1.65 critical value, so here we accept the null hypothesis and reject the alternate hypothesis. The inference here is that LAGLHE(-1) is not related to LGDP. So, Health Expenditure does not determined GDP.

Thus, there is **Unidirectional Causality from GDP to Health Expenditure**

Block Exogenity Test

VAR Granger Causality/Block Exogeneity Wald Tests			
Date: 02/18/19 Time: 04:47			
Sample: 1 22			
Included observations: 20			
Dependent variable: LGDP			
Excluded	Chi-sq	df	Prob.
LAGLHE	0.075126	1	0.7840
All	0.075126	1	0.7840
Dependent variable: LAGLHE			
Excluded	Chi-sq	df	Prob.
LGDP	24.53597	1	0.0000
All	24.53597	1	0.0000

Under Block Exogenity Test, when LGDP is the dependent variable i.e. Health Expenditure causes GDP, the probability value is 0.78 which is much higher than acceptable limit of 0.10. So, we reject the Alternate Hypothesis and accept the Null Hypothesis that Health Expenditure does not determine GDP.

Similarly, when LAGLHE is the dependent variable i.e. GDP causes Health Expenditure, the probability value is 0.0000 which is within the acceptable limits. So, we reject the Null Hypothesis and accept the Alternate Hypothesis that GDP determines Health Expenditure. Here also, there is **Unidirectional Causality from GDP to Health Expenditure.**

Granger Causality Test

Pairwise Granger Causality Tests			
Date: 02/19/19 Time: 08:51			
Sample: 1 22			
Lags: 1			
Null Hypothesis:	Obs	F-Statistic	Prob.
LAGLHE does not Granger Cause LGDP	20	0.07513	0.7873
LGDP does not Granger Cause LAGLHE		24.5360	0.0001

Here, as we can analyse, that under LAGLHE does not Granger Cause LGDP, the probability value is 0.7873, which is much higher beyond acceptable probability limit of 0.10 so we accept the Null Hypothesis and reject the Alternate hypothesis. Therefore, Health Expenditure does not determine GDP. Similarly, under LGDP does not Granger Cause LAGLHE, the probability value is 0.0001. So, we reject the null hypothesis and accept the alternate hypothesis. Therefore, GDP determines Health Expenditure.

Thus, there is **Unidirectional Granger Causality from GDP to Health Expenditure.**

3. Conclusion and Lessons for India

Projections obtained for Health Expenditure and GDP in India from 1996-97 to 2017-18 shows that there is Unidirectional Causality between GDP and Health Expenditure i.e. GDP determines the Health expenditure in India. Increase in GDP leads to increase in Health Expenditure. Thus, the Wagner's Law of Increasing State Activities which states that the quantum of public expenditure increases as the national income grows, is applicable in the field of Health expenditure as well. With the help of statistical tools, the Wagner's Law in the sphere of health expenditure has been proved valid for India i.e. as GDP and economic growth increases in the country, there is increase in the Health Expenditure.

The main purpose of this study is to analyse and visualize in general the quantum of government health expenditures incurred by India and it's health vital statistics and economic growth of the country in terms of GDP from 1996-2018. What we can conclude here is that health care expenditure is yet not sufficient to meet the needs of the people. In comparison to Developed countries, India still lacks behind in the sphere of health care services. Thus, some of the lessons and recommendations for India are:-

- Increase in the wages of skilled doctors would attract them to provide their services in rural parts of the country.
- To reduce the rural-urban disparities since people in urban areas receive very efficient health services where as residents of rural India are subject to merely primary health care. Thus, to reduce this gap, it is necessary to build health infrastructure in rural India.
- To increase the concentration of efficient doctors in public sector since in India, private sector is a major player in the health sector. Not all the people in India can afford private health care service; hence it is necessary to facilitate people with Public Health care services which the people can afford.
- As compared to global health care spending, India's quantum is very less. It spends merely around 1% of its GDP on health. Thus, this has to be increased to avail world class facilities and to further bring down the Birth rate, Death rate, IMR and MMR.
- In India, we have large number of unlicensed health practitioners. Thus, a strict law and overview is required to monitor the health system.
- To provide medicines to the people at a concessional rate
- Awareness among the people for health care and various programs
- Health insurance is being held by very few population of the country. Hence, Government run health insurance should be provided to the poor and below the poverty line people so that their health care expenses will be covered by the Government.
- Spending more expenditure on research in the field of medicine and health, this will provide quicker and efficient means to cure diseases.
- Proper implementation and regulation of the health care schemes initiated by the Government of India like Rashtriya Bal Swasthya Karyakram (RBSK), Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCH+A), Shishu Surakhsha Karyakram, Pradhan Mantri Swasthya Suraksha Yojna and many more. Proper monitoring of these schemes are extremely important.
- Revise the curriculum which is taught in medical schools and medical colleges
- Support NGOs and local bodies that provide services regarding health to poor and marginalised people

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