Original Research Article

Public Health Expenditure and Gross State Domestic Product: A Regression Analysis

ABSTRACT:

Spending on health is essential to boosting both labour productivity and people's life expectancy. Individual ability to make necessary health expenditures is inadequate in low-income and developing nations. In this regard, the current study aims to investigate the causal relationship in India between public health spending, per capita GSDP, and the GSDP ratio, with a focus on a few chosen states. The primary states have been chosen to represent the nation, while secondary data on public health spending and GSDP has been gathered from the EPW Research Foundation. OLS is used in conjunction with a linear regression model to analyse the acquired data. To determine the increase trend of public health expenditures, trend analysis is also conducted. The findings showed that there is an inverse association between the nation's health spending and both the per capita and ratio of GSDP and public health spending. This suggests that public health spending is influenced by a variety of other factors as well. The paper's conclusion suggested placing greater focus on certain measures that assist low-income or impoverished families with regard to medical expenses.

Key words: Public health, GSDP, Productivity, Per Capita GSDP, Regression Analysis, Normality, Multicollinearity.

1. INTRODUCTION

Spending on health improves everyone's physical and mental well-being and boosts productivity. An increase in an individual's productivity raises the productivity of the economy's entire production forces (Sayın, 2015). Good health not only allows people to work longer hours but also has an impact on income levels (Piabou et al., 2017). Because of its effect on worker productivity, health can thus be seen as a significant predictor of savings and investment rates. Because of this, health care spending boosts GDP by raising income (Güvenek, 2015; Hooda, 2013). Investments in public health care enhance locals' health and foster regional economic expansion (Penghui et al., 2022). We can say that certain factors, such as the duration of one's employment, work efficiency, and average life expectancy are directly related to investments made in the field of health and the prevalence and quality of health services.

The primary determinant of health spending is income or GDP, as rising GDP per capita causes rising health spending (Hossain et al., 2017; Sriram, 2022). In this regard, Zhan (2022) contended that "the GDP is the primary driver of the growth in health spending." The percentage of people's income that is allocated to health care rising along with the amount spent on medical care per capita GDP. Consequently, economic factors that positively impacted health spending included the gross state domestic product (GSDP), revenue and capital receipts, internal debt, and so forth (Khan, 2022; Brahim,

2022). According to Junhao (2023), the GDP is the primary predictor of rising health care costs. The percentage of people's health expenditures in per capita GDP rises in tandem with increases in medical spending. Additionally, it is observed that effect of per capita GDP on health expenditure is positive and significant.

People's health also affects their average life expectancy, productive age and output, productivity, employment, and general well-being. Economic factors such as employment, income, purchasing power, and poverty all have an impact on people's health. Therefore, it has been noted that healthcare spending and the economic indices of personal income, labor productivity, per capita GDP, and other spending are positively correlated (Raghupati & Raghupati, 2020). IMR, the death rate, and the birth rate all decline in tandem with rising health spending (Sarmah and Goswami, 2022). Under these conditions, social welfare measures that provide public healthcare are crucial. Social welfare programs help to guarantee steady economic growth and enhance the quality of human capital. A robust social security system enhances citizens' health conditions, promotes the market participation of an effective labor force, and advances rapid economic and social development (Qi Hu, 2024).

The Indian government presents an annual budget that includes healthcare expenditure under the categories of medical, public health, and family welfare. Total health expenditure is the sum of public and private health expenditure and covers the provision of health services, family planning activities, nutrition activities, emergency and designated for health but does not include provision for water and sanitation. In India, health expenditure is incurred by both the central and state governments. According to the Constitution, health expenditure depends on resources from the central, state, municipal corporation, non-government organization, and other sources for financial support of the healthcare sector. India's public health spending has been woefully low since the 1940s. The Bhore Committee Report (1946) states that per capita private health spending was Rs 2.50 whereas per capita public health spending was at Rs 0.36. India spent 83% and 88% of its GDP on private health care in the 1950s and 1980s, respectively. The Bhore committee suggested establishing Primary Health Centers (PHCs) with 75 beds for every 10,000–20,000 residents and integrating curative and preventive care across all administrative levels.

Over the years, the Indian government has implemented various policies and periodically formed committees to increase public health expenditure. Expanding PHC, sub-centers, and community health centers throughout states was India's plan to attain health for all by the year 2000, as well as the country's community development program (1951–1955) and first National Health Policy (1983). Similarly, the ambitious target of raising government health spending to 2-3% of GDP was established by the National Health Policy 2002, the National Rural Health Mission (NRHM-2005), and the Universal Health Coverage Report (2012). In addition, the National Health Policy of 2017 placed focus on raising government health spending as a share of GDP from 1.15% to 2.5% by 2025.

For raising the Public Health Expenditure, the government of India has taken different policies and constituted few committees from time to time over the years. India's community Development program (1951-55), first National Health Policy of 1983, and India's strategy to achieve Health for all by the year

2000, was to expand PHC, sub-centre and community health centre across states. Likewise, the National Health Policy 2002, the National Rural Health Mission (NRHM-2005) and the Universal Health Coverage Report (2012) set an ambitious goal of increasing the government health spending to 2-3% of GDP. Moreover the National Health Policy, 2017 emphasised to increase the government health expenditure as a percentage of GDP from 1.15% to 2.5% of GDP by 2025.

In India, numerous studies have been carried out to examine the state of health spending at various points in time. According to Mohammed, Ahamed, and Honakeri (2012), there was a 22% average growth rate in overall health expenditure from 2000–01 to 2010–11. However, from 2000–01 to 2010–11, the share of public spending to total public spending stayed mostly unchanged. Nonetheless, from 13.65% in 2000–01 to 14.465 in 2010–11, the share of health spending in total social service spending increased. Santhanalakshmi and Malathi (2017) found a consistent growth rate in plan allocations for family welfare and health in another analysis. Examining factors that influence government spending per person it has observed that number of hospitals positively influence government expenditure on health.

According to Dutta (2018), there was a notable rise in health expenditure from 1990–1991 to 2009–2010. Additionally, it is discovered that the coefficients for both GSDP and total spending are positive and significant at the 1% level, suggesting that rising GSDP and total expenditure in the state has resulted in rising health expenditures. Additionally, Singh and Singh discovered that India's overall public health spending as a percentage of GDP was 1.5% in 2018–19 and 1.45 in 2009–10, suggesting a stagnation in public health spending during this time. In India, per capita health spending climbed from Rs. 135.80 in 2009–10 to Rs. 1657 in 2017–18. Further, Sarmah and Goswami (2022) discovered that health spending has increased across all of North East India's states. Compared to states like Sikkim, states like Assam and Tripura have higher expenditures. For the states in the Northeast, there is a negative correlation between health indices and health spending. There is a positive correlation between health status and health spending. Even though public health spending has grown over time, it still represents a relatively small portion of GDP when compared to many other nations.

In contrast, Hooda S.K (2013) was found that the government spending has remained almost constant during the period and hovered around 1% of GDP. The level of health spending is lower than the required level of resources to provide the basic health facilities and the health expenditure has increased after the implementation of NRHM. Bhutka and Patra (2020) contended in their study that there was little variance in the rise of public health expenditure and its constituent parts in Odisha between 2001–2002 and 2014–2015. There was no discernible pattern of growth or decline in public spending on health and its constituent parts throughout the preceding year. Over this time, the amount spent on health care in a given year rose by 11.66 percent relative to the value of the year before. Sudhakara and Rajendra (2016) also noted that despite significant funding being devoted to the health sector in an effort to improve important health indicators, health issues persisted as an unresolved economic issue. The state has a high rate of mortality.

The state is having trouble providing health services due to the growing population, which necessitates significant budgetary commitments. Hooda (2020) looked at the trend in health expenditure indicators in India from 2000–01 to 2016–17 in a different study. It also attempted to identify the state-by-state distribution of these indicators. They discovered that there were falling trends in the ratio of government health spending to overall health spending based on secondary data from the World Bank and National Health Profile. Most developed states dedicate very little funding to the healthcare industry.

In their 2018 study, Das, Ray, and Das investigate whether the major Indian states are approaching a single level of per capita health spending based on state-level capital expenditures allocated by the federal government to public and medical health from 1990–1991 to 2009–2010. The Reserve Bank of India's capital expenditure statistics from various states as well as the Barro and Sala-i-Martin (1992) method of convergence were used. According to the study, there is absolute beta convergence, and the states' inclination toward divergence is shown by the alpha results. The concentration of health expenditures and inequality have been measured using the Gini Coefficient and Theil Index, which indicate increasing inequality until 2003–2004, at which point a trend towards equality begins.

In light of this, the current study aims to examine the trends in public health spending in India and examine the relationships between public health spending and the ratio of gross state product to per capita GDP. We also wish to investigate the hypothesis that there is no correlation between the ratio of gross state product and public health expenditures and per capita GDP.

There are four main components to this study. The study's history and problem were covered in the first section. The technique was covered in the second portion, and the third section contains the results and discussions. The results and conclusion were covered in the last section.

2. METHODOLOGY

The study looks at the spending on public health in a few chosen Indian states. Assam, Andhra Pradesh, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal are the states that have been chosen. Additionally, the gross state product ratio and per capita GDP of the chosen states have been taken into consideration.

The data used in this paper came from secondary sources. The EPW Research Foundation Time Series Data contains the information needed for analysis. Since the focus of the research is public health spending, information about private health spending is not well documented. To examine the study's aims, data is analyzed using statistical tools. An effort was made to gather information for as many states as feasible.

2.1. Statistical tools

In order to achieve the study's goals, secondary data was used for all variables, including health expenditure (total for all of India), per capita gross state product, and ratio of gross state product, which

were derived from EPW Research Foundation Time Series Data. The data was averaged over a period of five years, from 2015–16 to 2019–2020. The trend of India's public health spending for a few chosen states, using data from 1991–1992 to 2019–2020, is displayed using a line graph. The study employed Multiple Linear Regression to analyze the association between health expenditure and per capita GSDP and ratio of GSDP.

2.1.1 Test Statistics: Some diagnostic tests were done in order to check whether the variables are reliable or not. Such are –

(i) Multicollinearity: Two tests, such as the correlation coefficient and the variance inflation factor, have been used to identify multicollinearity.

(a) Correlation Coefficient: The Pearson correlation coefficient, which ranges from -1 to +1, was employed in the initial attempt. It can range from 0 (no correlation) to +1 (perfect positive correlation), with -1 being perfect negative correlation. The issue of multicollinearity emerges when the variables have a strong correlation and the Pearson Correlation Coefficient is more than 0.5.

(b) Variance Inflation Factor: If the estimated variables are correlated, the variance of the estimated regression coefficient is inflated to the extent that it is measured by the variance inflation factor (VIF). On the other hand, tolerance is just the VIF's opposite. The likelihood of multicollinearity among the variables increases with decreasing tolerance values. The absence of correlation between the independent variables is indicated by the value of VIF=1. A VIF value of 1<VIF<5 indicates a moderate level of correlation between the variables. VIF's difficult value, which identifies highly linked variables, falls between 5 and 10. Multicollinearity among the predictors in the regression model is present if VIF is between 5 and 10, and regression is indicated if VIF is greater than 10.

(ii) Normality: The normality test is one of the assumption tests in multiple regression. It is used to determine whether the residuals are normally distributed or not. The hypothesis for the normality test is taken as

H_0: Residuals are normally distributed.

H_1: Residuals are not normally distributed.

Residuals are the difference between the actual and the predicted Y variables.

Shapiro-Wilk test has been used on this occasion for normality test. This normality test is effective for small samples. In this test criterion, we see the p-value and are compared with the previously set alpha which is 0.05(5%).

If the p-value>0.05: H_0 is accepted

If the p-value<0.05: H_0 is rejected and hence H_1 is accepted.

2.1.2 Regression Model: The regression model used for the analysis can be expressed as follow:

$$Y = \beta_0 + \beta_1 PCGSDP + \beta_2 RGSDP + \mu \quad \text{----- (i)}$$

Where,

Y= Health Expenditure,

PCGSDP= Per Capita Gross State Domestic Product,

RGSDP= Ratio of Gross State Domestic Product

For the estimation of the above equation (i), we had transform it into the regression equation as.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \mu \quad \text{------- (ii)}$$

Where, X_1 indicates PCGSD and X_2 indicates RGSDP.

3. RESULTS AND FINDINGS

We have discovered that public health spending in India has been rising since 1991 based on secondary data on health spending that we were able to collect from the EPW foundation. Figure 1 illustrates the trend line in this context. The trend line also showed an upward trend in India as a result of the government of India's occasionally adopted policies and committees. However, after 2014, the trend line has gotten much steeper. It suggests that the 2014-formed administration has made significant progress toward enhancing India's healthcare system.

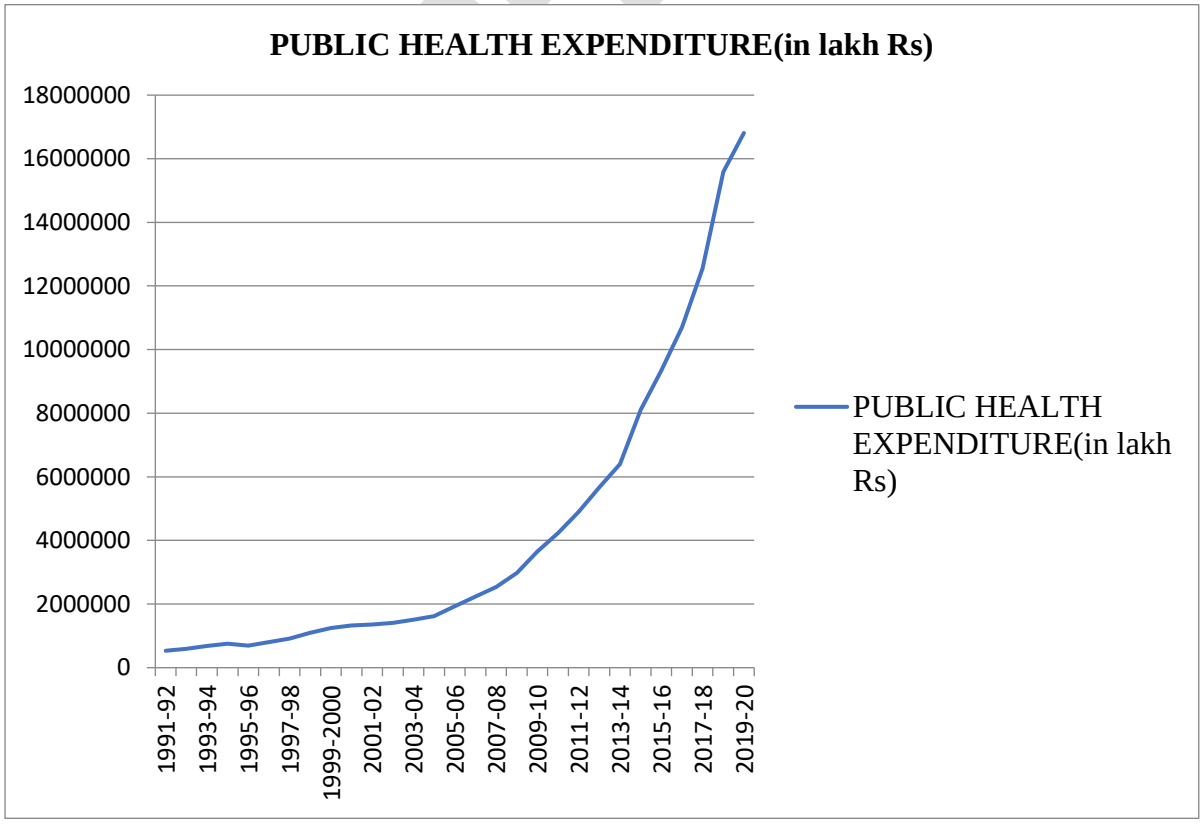

Figure 1: Trends in public health expenditure

Source: EPW Research Foundation Time Series Data

Some tests were done to check the reliability of the data and its validity in order to form the regression model. The values of those tests are given in below tables –

Table 1: Correlation Value

		Ratio of GSDP	Per Capita GSDP
Ratio of GSDP	Pearson Correlation	1	-.395
Per Capita GSDP	Pearson Correlation	-.395	1

Source: Author's own calculation

Given that the ratio of gross state product to per capita gross state product is -0.395, the above table indicates that there is no positive link between the two. A Pearson Correlation value of more than 0.5 indicates the presence of correlation between two independent variables.

To examine the multicollinearity between the independent variables, a second analysis VIF was employed.

Table 2: Variance Inflation Factor (VIF) Value

Model	Collinearity Statistics	
	Tolerance	VIF
Per Capita GSDP	0.844	1.185
Ratio of GSDP	0.844	1.185

Source: Author's own calculation

Because the VIF value of 1.185 implies that there is no multicollinearity among the independent variables, the above table demonstrates that there is no multicollinearity among the independent variables, i.e., per capita GSDP and ratio of GSDP. There is a problem with multicollinearity, which indicates that there is strong correlation between independent variables, if the VIF value is between 5 and 10. Again, multicollinearity does not exist if the tolerance value is large.

In order to check the normality of the given data, Shapiro Wilk test has been run for the dependent variable health expenditure.

Table 3: Tests of Normality

	Shapiro-Wilk	
	df	Sig.
Health Expenditure	22	0.130

The dependent variable, health expenditure, is displayed in the above table as having a normal distribution, as indicated by the Shapiro-Wilk test's "p" value of 0.130. Data are normally distributed if the "p" value is higher than the alpha value of 0.05 that was previously set. If not, the data are not normally dispersed.

The test that follows demonstrates the validity and reliability of the data, allowing for the application of further statistical methods. Table 4 displays the findings of the numerous linear models that were used to examine the relationship between public health spending and the ratio of gross state product and per capita GDP.

Table 4: Coefficients and Summary

Variables	R Square	B	Sig.
Constant	0.516	1.192E6	0.000***
Ratio of GSDP		-2.583E7	0.000***
Per Capita GSDP		-249718.225	0.037**

Source: Author's own calculation

N.B.: *** Indicate highly significant, **Moderately significant, *Indicate significant

Dependent Variable: Health Expenditure

Independent Variable: Ratio of GSDP, Per Capita GSDP

Since there is a relationship between health spending and both the ratio of GSDP and per capita GSDP, the null hypothesis has been rejected. The model is moderately fitted, meaning that only 51.6% of the variation in a dependent variable can be explained by the independent variables, according to the R square value of 0.516. Health expenditure and the GSDP ratio have a negative relationship that is significant at the 5% level of significance. A 1% increase in the GSDP ratio will result in a 2.58 reduction in health. Additionally, there is a significant negative relationship, significant at the 1% level of significance, between health expenditure and per capita GSDP. It means that a 1% increase in the per capita GSDP will result in a 249718.225 drop in health expenditures.

As a result, the findings show that the link between health spending and per capita GSDP is inverse. It suggests that there are additional factors influencing health expenditures in addition to GSDP. However, the current investigation is unable to identify those aspects because secondary data is not available.

4. CONCLUSION

According to Serif Canbay and Mustafa Kirca (2022), there is no causal association between health expenditures and per capita income in the BRICS+T countries, despite the study's findings that there is a negative relationship between health expenditures and per capita GSDP and the ratio of GSDP. The report also shows that, for a few chosen states, public health spending in India is trending upward. Even though public health spending is rising annually, there are still issues with India's healthcare system, including poor care quality, low cost, low accountability, unethical treatment, overcrowding in clinics, a lack of coordination between the public and private sectors, obstacles to accessing services and medications, and a lack of public health knowledge. Due to these disadvantages, wealthier Indians are more likely to use the private healthcare system, which is more out of reach for low-income families and results in unequal access to healthcare for all.

The Indian government should periodically establish committees to provide recommendations for raising health spending and to take necessary action to ensure that public health is in good shape. Nonetheless, the central government's Ayushman Bharat Scheme is an essential step in helping low-income families with their medical expenses. Therefore, the government ought to place more focus on programs like this one that can help impoverished families with their medical expenses.

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