TO STUDY THE IMPACT OF PUBLIC HEALTHCARE EXPENDITURE ON HEALTH INDICATORS AND HEALTH INFRASTRUCTURE IN GOA

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DECLARATION BY STUDENT

I hereby declare that the data presented in this Dissertation report entitle, "To Study The Impact of Public Health Expenditure on Health Indicators and Infrastructure in Goa" is based on the results of investigation carried out by me in Economics at the Goa Business School, Goa University under the Supervision of Prof. Avina Kavthankar and co-guidance of Prof. Sumita Datta and the same has not been submitted elsewhere for the ward of degree or diploma by me. Further, I understand that Goa University or its authorities will be not be responsible for the correctness of observations / experimental or other findings given the dissertation.

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COMPLETION CERTIFICATE

This is to certify that the dissertation report "The Impact of Public Health Expenditure on Health Indicators and Infrastructure in Goa" is a bonafide work carried out by Ms. Akshata Kiran Laturkar under my supervision in partial fulfillment of the requirements for the award of the degree of Masters of Arts in the Discipline Economics at the Goa Business School, Goa University.

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Place: Goa University

PREFACE

Undertaking this research on "The Impact of Public Health Expenditure on Health Indicators and Infrastructure in Goa" has been a profound journey of inquiry, analysis, and discovery. This dissertation represents the culmination of my academic pursuits, driven by a deep-seated passion for understanding the intricate dynamics between public health expenditure, health outcomes, and infrastructure development. The genesis of this study can be traced back to a desire to unravel the complexities of healthcare systems and their impact on population health. Goa, with its unique socio-economic and demographic profile, emerged as an ideal setting to explore these dynamics. Through meticulous research, data collection, and analysis, I have endeavoured to shed light on the multifaceted relationship between public health expenditure and its outcomes in this region.

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GRAPHS

TABLES

Abbreviations Used

Entity	Abbreviation
Death Rate	DR
Health Expenditure As Percentage Of Total State Expenditure	HEAPOTSE
Health Expenditure As Percentage Of GSDP	HEAPOG
Health Infrastructure Index Score	HIIS
Infant Mortality Rate	IMR
Per Capita Health Expenditure	PCHE
Total State Expenditure	TSE
Total State Expenditure On Health	TSEOH
World Health Organization	WHO

ABSTRACT

Public healthcare spending in Goa presents a fascinating story. This study focuses on two objectives. The study is based on time series secondary data, conducted in Goa, India for 16 years from 2004-2019. The empirical results of the robust standard errors regression model of IMR and Death Rate confirm that, there is statistical significant positive relationship between health expenditure as percentage of total state expenditure (HEAPOTSEP) and IMR at 5% level of significance. While there is statistical significant negative relation between per capita health expenditure (PCHE) and IMR of Goa at 5% level of significance. It implies that, if PCHE increases by every one unit, than IMR decreases by 0.033 units. However, there is statistically significant negative relation between total fertility rate (TFR), and mean years education of women age 20+ (MYEOW) with the Death rate. Whereas, there is positive relationship between state per capita income (SPCI) and Death rate. And they are statistically significant at 5% level of significance. The results of second objective revealed there is strong positive correlation between various indicators of public health expenditure, moderately strong correlation between PCI and MYEOW, and a strong inverse correlation present between TFR with health infrastructure index score (HIIS) from 2004-2019 of Goa.

CHAPTER 1 INTRODUCTION ON INDIA

"Svasthasya Shariram Aarogyam." our Vedas verses have also emphasised on importance of health. It means a healthy body is true wealth. In the Vedic view, true wealth is beyond material possessions but it comprises of healthy mind and body. Hence "Health is a precious wealth". Happy and healthy citizens are real wealth of a nation to progress upon. Needless to say, that poor, sick, ill, addict and unhealthy people are a liability to a nation and they swallow a good portion of its GDP in the form of health care (Vij)**.**

Health is a journey of life it doesn't have a particular destination so we have to work throughout our life to make it better. A good health help us to achieve our goals more effectively, therefore investment in health is the best wealth. "Health is a foundation to build a healthy life and fulfil our dreams." It should be the first investment of everyone's life, by taking care of our self today, we are investing in a happier and healthier future."

India, a nation brimming with diverse cultures and a rapidly growing population, faces a complex challenge in ensuring the well-being of its citizens. The story begins in the pre-independence era, when the access to healthcare was limited in India. By acknowledging this need, the Bhore Committee Report in 1946 laid the foundation for national healthcare system, with primary care approach. India's healthcare follows the Three-Tiered system with Sub-Centres (SCs) located in villages which offers basic check-ups and first aid, Primary Health Centres (PHCs) for larger areas, and Community Health Centres (CHCs) at district level, with specialist doctors. Both government and private sectors contribute significantly to healthcare in India.

Public healthcare expenditure refers to financial resources allocated by government towards promoting and protecting the health of its population. The level of expenditure on health by

government directly impacts the accessibility and quality of healthcare services available to the public. According to the Ministry of Health and Family Welfare **(MoHFW**) data, the Government Health Expenditure (GHE) as a percentage of GDP increased from 1.13% in 2014-15 to ₹.2,71,544 crores, which translates to 1.35% of GDP and ₹.2,014 per capita in 2019-20. The Union Budget 2022-23 allocated ₹86,200 crore to the Ministry of Health and Family Welfare **(MoHFW**), representing an increase from previous years. Public health expenditure in India has been increasing and showing a positive trend but it still makes up a relatively small portion of the country's GDP. According to **World Development Report 1993 (WB, 1993)** "Improved health contributes to economic growth in four ways. It reduces production losses caused by worker illness, it permits the use of natural resources that had been totally or nearly inaccessible because of diseases, it increases the enrolment of children in schools and makes them better able to learn and it frees alternative uses resources that would otherwise have to be spent on treating illness"(Vij)**.**

'Health' is a state subject in India. Both the state government and the central government have an important role in financing public healthcare. The healthcare financing is a key building block of the health system and plays an influential role in the attainment of Universal Health Coverage (UHC) goals **(Kutzin, 2013**). A World Bank study estimates that a 1% increase in public healthcare expenditure in India can lead to a 0.35% rise in GDP. This statistic underscores the potential economic returns of investing in healthcare.

India's public expenditure on health care is an important component of progressive policy. Where household incomes are low and credit market imperfections high, the vast majority of the population are unable to provide adequate health care through private expenditure. In such a scenario, public expenditure can be an important mechanism to ensure health care services to the population, especially the poorer sections of the population (Barenberg et al.).

Instead of visualizing public healthcare expenses as a loss of resources, let's imagine it as a fuel that ignites, powering its journey towards Sustainable Development Goals (SDG). India along with other countries has committed to the adoption of Sustainable Development Goals (SDGs) to end poverty, protect the planet, and ensure prosperity for all as part of a new global sustainable development agenda to be achieved by 2030. There is renewed commitment in India, to accelerate the pace of achievement of the SDGs including Goal 3 related to ensuring healthy lives and promoting well-being for all at all ages **(Health Index, n.d.)**. Government expenditure can also help to eradicate poverty and hunger that are associated with SDG 1 and SDG 2 goal.

India's health infrastructure is the lifeline of millions. Ii is a network of facilities, services and personnel that work together to prevent, diagnose and treat illness, and to promote good health. It allows citizens, "To get the care they need, when they need it." Thus, public healthcare infrastructure forms the backbone of healthcare delivery and plays crucial role in preventing and controlling the spread of diseases, promoting early diagnosis and treatment and ultimately improving health outcomes. Government as guiding hand, also prioritized affordability and accessibility and aim to reach those who might not have access to private healthcare. Equity plays a crucial role in achieving the goal of "Health for All." But healthcare infrastructure goes beyond just hospitals and doctors.

Health indicators serve as vital statistics that reflect the health status of a population. It is a metrics that provide a snapshot of various aspects of health, including mortality rates, morbidity patterns, life expectancy, and access to essential healthcare services. The interplay between these three elements is dynamic and multifaceted. Increased health expenditure by government can lead to improvement in government health infrastructure which in turn, can positively impact health indicators by reducing diseases burden improving life expectancy.

India’s public health landscape presents a picture of both signs of success and challenges. The nation has made significant strides in recent years, with increased public health expenditure and implementation of programs like NHM. Which resulted in improving health outcomes of its citizens, life expectancy has risen steadily with an Indian living an estimated 69.6 years in 2020. Another positive indicator is downward trend in Infant Mortality Rates and Maternal Mortality Rates. It also includes further expansion efforts through initiatives like Ayushman Bharat which is transforming existing PHCs into Health and Wellness Centres (HWCs). Similar programs like vaccination and education campaigns, and access to clean water and sanitation all work to prevent disease outbreaks, promote health behaviours and improve the overall health of the nation. It is not the hidden fact that India’s health care needs serious attention.

Despite advancements and growth, the Indian health system faces challenges, particularly in rural areas. In almost all the key health indicators given by World Health Organization (WHO) we lag behind. According to World Health Organisation **(WHO)** Statistics of 2018 India ranks 145 out of 194 countries. According to NITI Aayog India has a scarcity of 6 lakh doctors, 20 lakh nurses and 2 lakh dental surgeons. Though WHO recommends 1:1000 doctor to patient ratio but in rural India it is 1:11082 and in some states like Bihar it is as low as 1:28391 and UP It is 1:19962 (**NHP 2018**). Additionally, the burden of non-communicable diseases is rising, posing new challenges for healthcare system. In conclusion, upgrading facilities and ensuring consistent quality of care requires ongoing efforts. India's health infrastructure is a "Work in Progress" situation. Therefore, striving to bridge the gap between available resources and actual needs remains most important aspect in the country.

CHAPTER 2 INTRODUCTION ON GOA

In spite the national challenges, the state like Goa have shown remarkable progress. Goa, the crown jewel of India's west coast, which depict portray of pristine beaches, swaying palm trees, vibrant night life and a laid-back charm with diverse and dynamic economy.

Goa's healthcare journey has a well-established legacy from centuries. The traditional Indian medicine system like Ayurveda flourished prior to Portuguese colonization whereas the western medicine practices was introduced in Goa with arrival of Portuguese in the 16th century. The turning point came in 1842 with the establishment of the Escola Medico Cirurgica de Goa, one of the first medical schools in India. This institution is now known as the Goa Medical College (GMC). It has been continuously evolved, becoming a premier centre for medical education and research.

Goa's journey in healthcare is inspiring as its healthcare system and digital initiatives were showcased during India's G20 presidency, highlighting its success and as a model for other countries (Achievements in Health Sector in Goa Showcased in Run up to 2nd G20 Health Working Group Meeting). Public healthcare spending in Goa presents a fascinating story, compared to the national average. The expenditure caters to a range of healthcare services and health education initiatives. Both the central government and state governments contribute to government health expenditure but the State governments contribute a larger share, at about 64.2% in 2019-20, with the remaining 35.8% coming from the central government. The increase in government spending aims to reduce the burden of out-of-pocket expenses for citizens.**(National Health Accounts Estimates for India (2019-20).**

From treatment to transformation, by investing in health, to building a healthier and wealthier state; Goa can achieve its full potential through smart healthcare spending. The state allocated Rs1951.15 crore (US$240 million) to Medical, Public Health and Family

Welfare in its 2023-24 budget. This constitutes 15.26% of the total expenditure. This translates to 9.2% of the total budget being allocated towards health, which is higher than the national average for health spending by Indian states in 2022-23 (6.3%). This translates to Rs2324.65 crore, an 18% increase from the previous year. It appears that Goa prioritizes public health spending compared to the national average.**(*Goa Budget Analysis 2023-24*)**

Goa is consistently ranks among the top states in India on various health parameters, reflecting its commitment to providing quality care for all. Despite increase in public health expenditure, the picture painted by health indicators is not entirely rosy. While some indicators, like Goa's life expectancy is one of the highest in India and the state's Infant Mortality Rate (IMR) is consistently lower than the national average, indicating good prenatal and postnatal care. But other indicators such as maternal mortality rate, still remain a cause of concern. Additionally, Goa's healthcare sector not only focuses on curative services but also places emphasis on preventive healthcare measures **(*Health Index*).**

Along with the health indicators Goa's health infrastructure is characterized by a mixed bag of strengths and weaknesses. On the positive side, Goa boasts a higher doctor-to-population ratio compared to national average. Additionally, the state has witnessed an increase in the number of PHCs and Sub-health centres in recent years. However, concerns remain regarding the quality and distribution of healthcare facilities. Rural areas still lack of advanced medical facilities compared to major cities having well equipped hospitals. The total number of available beds including both government and private sector is 4600. According to WHO recommendations there should be 5 beds per 1000 population hence there is a need for 7875 beds, indicating a gap of 3275 beds in Goa's healthcare infrastructure. Currently there are 40 diagnostic centres in Goa as per norms there should be 1 diagnostic centre per 10,000 population. Therefore, there is a requirement of 157 diagnostic centres indicating a gap of 117 diagnostic centre in Goa. (**HEALTHCARE SCENARIO OF GOA 2023 »**

(Hospaccxconsulting, 2023). Furthermore, rural areas often have limited access to specialized care, forcing residents to travel long distances for treatment.

Goa's public health landscape is a fascinating tapestry woven with threads of expenditure, health indicators and infrastructure. By weaving these threads together effectively, Goa can create a healthcare system that caters to the evolving needs of its population. Every rupees invested in public health in Goa is not just a cost, but a seed sown for a healthier, happier, and economically prosperous future for all.

In conclusion, government health expenditure isn't just a social responsibility; it's a smart investment in a nation's future economic prosperity and development. By prioritizing health, government can empower individuals, stimulate economic activity and pave the way for a more sustainable and equitable society. Goa is committed to further strengthening its healthcare system by upgrading infrastructure and equipment; expanding access to affordable healthcare; and encouraging preventive healthcare practices.

2.1 Background

Following the introduction, the remaining part of the study is structured as follows: the literature review on this issue is presented in chapter 3. The data and methodology of the study are discussed in chapter 4. The empirical analysis is given in chapter 5. Findings in and discussion of the result is the main thrust of chapter 6. The conclusions are drawn in chapter 7

2.2. Objectives of the study

- To study the statistical significance of public healthcare expenditure, total fertility rate, mean year education of women age 20+ and state per capita income on Health indicators of Goa.

- To assess the correlation between state-level public healthcare expenditure indicators, total fertility rate, mean year education of women age 20+ and state per capita income with composite Health Infrastructure Index Score (HIIS).

2.3. Hypothesis/ Research questions

Objective 1

H0: There is no statistical significant effect of indicators of Public health expenditure, total fertility rate, mean year education of women age 20+ and state per capita income on health indicators of Goa.

H1: There is statistical significant effect of indicators of Public health expenditure on health Indicators, total fertility rate, mean year education of women age 20+ and state per capita income of Goa.

Objective 2

H0: There is no correlation between state-level indicators of public healthcare expenditure, total fertility rate, mean year education of women age 20+ and state per capita income with composite health infrastructure index score (HIIS).

H1: There is the correlation between state-level indicators of public healthcare expenditure, total fertility rate, mean year education of women age 20+ and state per capita income with health infrastructure index score (HIIS).

2.4 Scope of the study

Public health expenditure plays crucial role in strengthening healthcare system and improving health indicators/outcomes for a population. This study examines the relationship between public health expenditure, health indicators, and health infrastructure in the state of Goa,

India. The study will focus on two health indicators like IMR and death rate. I analysed public health expenditure data for Goa over the past 16 years (2004-2019). The health infrastructure index score, will be used as a benchmark for understanding the health infrastructure landscape of Goa, India.

This study focuses on a specific health indicators within the time frame. The study will not delve into private healthcare expenditure. Further research could explore wider range on indicators and delve deeper into specific aspects of health infrastructure.

By examining the relationship between indicators of public health expenditure, total fertility rate, means year education of women age 20+, state per capita income, health indicators, and health infrastructure index score, this study aims to gain insights into the effectiveness of Goa's health system and identify potential areas for improvement.

CHAPTER 3. LITERATURE REVIEW

This section of the paper is related to the empirical studies in the field of health expenditure, health outcomes and health infrastructure at international, national and state level.

(Abegaz and Mohammed) confirmed that there was a significant long-term co-integration between healthcare expenditure (HCE) and gross domestic product (GDP) in Ethiopia and results of the findings show that increasing GDP has a significant and positive impact on healthcare expenditure. The study suggests that government in general and Ministry of Health and the Ministry of Finance in specific to continue on their effort to increase healthcare expenditure not only by increasing government expenditure but also by enabling private health expenditure in healthcare coverage. Similarly, **(Piabuo and Tieguhong) i**nvestigated that health expenditure has a positive and significant effect on economic growth in the CEMAC sub-region and five other African countries. They found that a unit change in health expenditure can potentially increase GDP per capita by 0.38 and 0.3 units for the five other African countries that achieve the Abuja target and for CEMAC countries respectively.

Likewise**, (Balani et al.)** argued that health are prerogative of the state government in Colonial India, they used gross state domestic product and public health expenditure over 1981–2017 and robust version of Granger causality; the results reported bi-directional, non-linear relationship between public health expenditure and income at a sub-national level in India. Also there are differences in the income elasticity of public health expenditure among developed and under-developed states. The study also suggested that the increased budgetary allocation alone cannot guarantee the increase in health expenditure by states. Similarly, **(Behera and Dash)** surveyed 16 states of India from 1980 to 2014 for examining the level of heterogeneity and results confirmed that public health expenditure and states' domestic product are co-integrated in the long-run. It also observed that there is a bi-directional

Granger causality between per capita income and public health expenditure in the short-run while the causality is unidirectional in the long-run. It also implies the existence of inequalities in the share of government health expenditure with respect to state's level of economic development in India. It also offers effective fiscal policy instruments to minimising geographical inequity of health finance for achieving universal health coverage of Indian states.

Many researchers have highlighted many important determinants of healthcare expenditure in the different countries. **(Zhou et al.)** the study examined the determinants of health care expenditure among twenty-two (22) emerging countries from the year 2000 to 2018 and from the outcome of the quantile regression test revealed that economic growth and aging population could induce healthcare costs in emerging countries but the impact of industrialization, agricultural activities, and technological advancement on health expenses are found to be noticeably heterogeneous at the various quantile levels. It also found unidirectional causality between industrialization and public health expenses; whereas two-way causal influence was revealed amongst public health expenditure and GDP per capita; public health expenditure and agricultural activities. Also **(Wang and Chen)** explored the determinants of health expenditure growth by Baumol's cost disease based on the longitudinal data of 30 provincial-level administrative regions in China, from 2010 to 2017 they found that income and Baumol's cost disease have a significant positive impact on health expenditure growth. The impact of technical factors and income factor on government health expenditure is significantly positive and the determinants in the eastern region is mainly driven by Baumol's cost disease and technical factors, while the central and western regions are mainly affected by income factors and Baumol's cost disease.

Likewise, Indian authors have also done some similar researches. **(Ram)** the aim of this study was to examine the determinants of health-care expenditure in the Eastern region of Uttar

Pradesh and they used the Heckman two-step selection model to analyse household and individual decisions to seek care and the findings revealed that having household head aged between 31 to above 60 years, household size greater than 5 members, belonging to religion other than Hindu, non-ST category, people residing in urban area, having higher economic status, private hospitals, primary and secondary schooling of household head and having household members with chronic illnesses were determinants contributing more health-care spending. They also indicated that the majority of people visited private hospitals in the region which increased the health-care spending at large and it burdened financially to the vulnerable section of the society.

In addition to the above studies some authors have also acknowledged the public healthcare expenditure in context to centrally sponsored schemes launched by government of India. **(Ud Din et al.)** ascertained to compare India's public health expenditure at the international and state levels and they also outlined the regional disparities in National Rural Health Mission (NRHM) spending across the 21 selected states of India. They observed convergence in NRHM expenditure due to the shift in the government's attention from the non-high focus high focus states to high states through the national rural health mission policy. The coefficient of variation across the states also shows a declining trend and provides the robustness of the σ-minimising geographical inequity of health finance for achieving universal health coverage of Indian states. Alike, **(Rahman et al.)** and **Rajesh Kumar (Sinha) d**ealt with understanding of whether government scheme Rashtriya Swasthya Bima Yojana (RSBY) had improved care-seeking and reduced incidences of catastrophic health expenditure (CHE) and health expenditure-induced poverty and also explored whether the benefits were equitable. However they found that RSBY failed to achieve its objectives, it neither increased in-facility treatment (hospitalization) nor reduced the likelihood of CHE among the enrolled two blocks of Ranchi district in Jharkhand. From equity perspective,

care-seeking was much lower among the economically weaker households compared to the better-off households.

Some studies over the past decade have shown the relationship between government healthcare expenditure and health outcomes. Also, many cross-country studies have found different effects of public healthcare expenditure and health outcomes. With data spanning for 1995–2012 period, . **Abdelhafidh Dhrifi (2018**) investigated the effects of health-care expenditures on child mortality rates and found out that health expenditure has a positive effect on reducing child mortality only for upper-middle-income and high-income countries, whereas for low-income and lower-middle-income countries, health spending does not have a significant impact on child health status. The author also found that at lower development levels, public health spending had a greater effect on mortality rates than private expenditure, while at high development levels private health expenditure has a positive impact on child mortality. **(Rahman et al.)** analysed that the total health expenditure, public health expenditure and private health expenditure significantly reduced infant mortality rate and the effect of private health expenditure was greater than that of public health expenditure. The authors also noted that, the private health expenditure had a significant role in reducing the crude death rate. They also suggested that Per capita income growth and improved sanitation facilities also had significant positive roles in improving population health in the SAARC-ASEAN region by using a simultaneous-equation model for 93 developed and developing countries.

Furthermore, **(Rahman and Alam)** provided evidence that in the SAARC-ASEAN countries access to electricity, female education rate, public health expenditure, economic growth, and immunization rate, all have a positive effect on female life expectancy at birth, and a negative effect on the female adult mortality rate. The urbanization rate has a significantly positive impact on female life expectancy at birth but an insignificant impact on female adult

mortality rate. They also revealed the one-way causal relationship between the variables by using the data of 2002–2018. **(Nicholas et al.)** utilized panel data on 40 Sub-Saharan Africa (SSA) countries spanning the period 2000-2010 and by using the fixed effects estimation technique investigated the effect of public and private health expenditures on selected maternal-child health outcomes. The results indicated that public health expenditure is inversely and significantly related to infant (IMRR) and under-five (U5MR) mortalities in SSA. Though public health expenditure had negative sign, it has no significant effect on maternal mortality (MMR). Also private health expenditure did not proved to be significant in improving maternal-child health outcomes (IMRR, U5MR and MMR) in SSA. Also**, (Cardona et al.)** compared data between 2002-05 and 2007-10, stratified for urban and rural counties to measure the association between county's government spending across multiple sectors and Life Expectancy at Birth (LEB) in the U.S and the results confirmed that in rural countries, one-standard-deviation increase in social spending increased subsequent life expectancy of birth by 0.58 and 0.36 years respectively, whereas in urban countries building infrastructure spending increased subsequent LEB by 1.14 and 1.05 years in 2005 and 2010. In 2002, a one-standard-deviation increase in law and order spending significantly decreased life expectancy by 2.2 and 0.46 years in urban and rural countries, respectively.

Nevertheless, despite low gross domestic product (GDP) growth, Bangladesh has attained remarkable success in achieving healthcare outcomes. It shows both positive social determinants of health, such as women's empowerment, widespread education, and mitigation of the effect of natural disasters; and negative outcome such as pervasive poverty, and the persistence of income inequality. **(Chowdhury et al.)** reported that Bangladesh offers lessons such as how gender equity can improve health outcomes, how health innovations can be scaled up, and how direct health interventions can partly overcome socioeconomic constraints.**(Anyanwu and Erhijakpor)** surveyed 47 African countries between 1999 and

2004 and provides econometric evidence by linking African country's per capita total as well as government health expenditures and per capita income to two health outcomes: infant mortality and under-five mortality and stated that both infant and under-five mortality are positively and significantly associated with Sub-Saharan Africa and reverse is true for north Africa. Similarly,**(Compah-Keyeke et al.)** examined the relationship between public spending and under five-mortality rate (per 1000 live births as health status in Ghana. The results revealed that the availability of physicians and health insurance are the most important determinants of health status in Ghana. The study suggests that the health sector is interlinked with socio-economic development and therefore, the government of Ghana must not treat the health services in isolation but in an integrated manner to achieve the broader goals of poverty reduction, human capital formation and economic development.

As noted above, previous studies of effect of public health spending on health outcomes have found mixed results. This is true for India specific studies also. **(Barenberg et al.)** used a panel data set of Indian states between 1983–84 and 2011–12 to observe the impact of public health expenditure on the infant mortality rate (IMR), after controlling per capita income, female literacy and urbanization and they found out that 1% increase in public health expenditure of state-level GDP is associated with a reduction in the IMR by about 8 infant deaths per 1000 live births. They also observed that female literacy and urbanization reduces the IMR. **(Farahani et al.)** used the second National Family Health Survey (NFHS-2) of India to estimate the effect of state-level public health spending on mortality across all age groups, controlling for individual, household, and state-level covariates. They claimed a 10 % increase in public spending on health in India decreases the average probability of death by about 2%, with effects mainly on the young, the elderly, and women. Authors also noticed that major factors affecting mortality are rural residence, household poverty, and access to toilet facilities. Equivalently, with two-stage Probit Regression model and data from the three

rounds of National Family Health Survey (NFHS) conducted in India during 1992-93, 1998-99 and 2005-06.

(Kaushal et al.) investigated the association between public health spending and probability of infant and child death. The study reported that a10% increase in per capita public health spending is likely to reduce the probability of infant and child deaths by 0•005 and 0•003 respectively. The study also recommended the other factors affecting infant and child death were sex of the child, birth order, mother's age at birth of the index child, mother's schooling and urban-rural residence.

Double log simple regression model was used by **(Lakshmi and Sahoo)** to calculate the elasticity coefficients of health indicators with respect to health infrastructure of the state of Andhra Pradesh, India for 30 years from 1980-2010. The results confirm that 70 percent of the variation in all most all health indicators like crude birth rate, crude death rate, infant mortality rate and life expectancy at birth is explained by health infrastructure. Thus, the study recommended that public health facilities are crucial for meeting the basic health requirements of masses in the state.

From the evidence of previous studies we can conclude that health infrastructure is positively related to health outcomes. It means more and more health infrastructure develops it will lead to improvement of health outcomes. Also the available health infrastructure should be utilized efficiently to avoid wastage and for better health outcomes. The relationship between public health expenditure and health outcomes has drew a considerable attention from researches and policy makers Therefore, the various existing researches on available public health infrastructure and disparities and its impact on different health outcomes is equally important to study.

Based on a 20-year (1993–2012) panel data from seven SAARC countries **(Mohapatra)** examined three research objectives. To investigate the effect of healthcare spending on multiple health outcomes in nations after controlling for country-specific health infrastructures and economic conditions; To undertake a differential analysis of the effect of public and private healthcare spending on specific health outcomes; and to explore the presence of the differential effect of health expenditure and health infrastructure variables on health outcome variables, including mortality and morbidity indicators. Health expenditure was found to influence improved health outcomes. In addition, the differential effect of public, private and out-of-pocket (OOP) health expenditure was observed and OOP expenditures was found to be the major influencer of life expectancy, death rate and TB instances, while public expenditure was found to be influential for improving infant mortality rate (IMR). Also this study supports the notion that disaggregated effects of different health expenditure are needed to get a complete understanding of the health expenditure–health outcome linkage.

Likewise, by using data for 54 countries in the region and over the period 2003–2018 (Osakede) examined the effect of infrastructure types on health system performance in Africa. Health system performance is captured by population health outcome. By using the System GMM estimation technique the findings reported that an increase in all infrastructure types : Transport, electricity and information and communication technology (ICT) significantly reduced infant mortality, and there is significant effect of transport and ICT in improving the length of life and reducing under-five mortality. Also improvement in ICT reduced maternal deaths. It suggest that the key role of infrastructure on health system performance, with ICT shown to have more influence on health systems than other infrastructure types. Therefore the provision and use of ICT should be given top priority in the pursuit of better health system performance in Africa.

Similar research have been addressed by Indian states, by using descriptive statistics, log-linear regression model and Tobit model **(Dash and Mohanty)** estimated the hypothesis to test, whether the poor people from the poorer states pay significantly more for hospitalization in public health centres than those in the richer states of India. According to the authors findings, the share of direct cost for the poor using public health centres, accounts for over 80% in Bihar, Odisha and other poor states compared to just 24% in Tamil Nadu. Adjusting for socio-economic correlates, the cost of hospitalization per episode (CHPE) among the poor using PHC was 51% lower than for the non-poor using private health centres in India. Likewise, Isabelle and Ankit **(Joumard and Kumar)** found in their study that health care system in India is a mix of private and public providers and there is a great shortage of health care staff in populous and rural states of North. They suggest that longest gains in health status will come from preventive measures. Improving living conditions and lifestyle habits would have greatest impact as total sanitation campaign (Swachh Bharat Mission) which has high effect on reducing young deaths and development disorders in later stage of life. Likewise, better use of drugs would improve quality of healthcare and reduce out of pocket expenditure.

Dimple (Vij) drew attention towards available health care infrastructure disparities both in rural and urban India by providing actual status of their availability and need for their reallocation. The study also revealed measures and solutions to correct these disparities and to achieve total health care of 1.3 billion people of the country. They suggested a model health care plan which devolves around preparing a long-term strategy for qualitative as well as quantitative improvements in India's health care infrastructure by focusing on workforce capacity and competency, information and data systems and organizational capacity. They suggest government to take an integrated approach with a decentralized structure based on district level with the help of local people and local level institutions like Panchayats. Using a

panel regression model, the generalized method of moments and composite index **(Das and Guha)** examined the temporal pattern of healthcare infrastructure and manpower indicators across Indian states and regions from 2006–2020. It also investigates the monetary factors determining the quality and provision of healthcare infrastructure and manpower for India as a whole as well as for rural and tribal areas discretely. The study reveals that increased per capita public health expenditure has not translated into improved healthcare infrastructure and manpower in Indian states or tribal regions within those states. The panel generalized method of moments results confirm that developing targeted healthcare infrastructure and manpower in India as a whole, has been poorly realized.

(H et al.) the study shows at present, the Karnataka government is spending very less amount of money on health, which is about 2 per cent of the NSDP hence the Gulbarga and Belgaum divisions of Karnataka show a poor status in health infrastructure and health status**.** Among these, the Gulbarga division (means Hyderabad Karnataka) that lies in the lower position and is underdeveloped in most of the sectors compared to the rest of the regions. Lesser health infrastructure facilities in this region clearly indicate the neglect of the government intervention/interest to develop basic infrastructure facilities in this region. The study reported that the amount of government spending has to be increased and suggests that increasing the public expenditure alone, cannot serve the purpose, unless it is properly used for delivering quality infrastructure and good service mechanization**.**

Using a composite index**, (Das and Guha)** study examines the temporal pattern of healthcare infrastructure and manpower indicators across Indian states and regions between 2006–2020. The study investigated the monetary factors determining the quality and provision of healthcare infrastructure and manpower for India as well as for rural and tribal areas discretely, Inadequate public health expenditure results in a low ranking on the composite index and is reflected in the high infant mortality rates in Bihar, Uttar Pradesh, and Madhya

Pradesh, though the situation is reversed in Kerala. The panel regression model reveals that increased per capita public health expenditure results in a low ranking on the composite index and is reflected in the high infant mortality rates in Bihar, Uttar Pradesh, and Madhya Pradesh, though the situation is reversed in Kerala and has not translated into improved healthcare infrastructure and manpower in Indian states or tribal regions within those states. The public health expenditure to gross state domestic product ratio is a positively significant predictor of healthcare infrastructure and manpower in rural areas. The results confirm that developing targeted healthcare infrastructure and manpower in India as a whole, as well as for rural and tribal areas in the short term, has been poorly realized.

Based on the existing literature mentioned above, it is found that most of the studies are analysed in the developed countries like OECD, SAARC-ASEAN, CEMAC, Africa, Sub-Sahara Africa, United States etc., while others are focused on developing countries. Other studies have been reported from upper-middle-income, high-income countries, low-income and lower-middle-income countries. India, one of the fastest-growing and developing economys in the world, has a very limited number of studies on this issues. Most of the studies have focused on the impact of health expenditure on a single indicator, i.e., infant mortality or life expectancy birth rate etc. Some studies have been also done on determinants of healthcare expenditure. But none of the studies has examined public healthcare expenditure by using different crucial health outcomes at a time like infant mortality rate and death rate at individual state level along with health infrastructure index score of Goa. This is the main gap in the existing literatures and my main is to fill up this gap and prove better results.

CHAPTER 4: METHODOLOGY

4.1 Data sources and definition of variables

The study is based on time series data, conducted in Goa, India. The sample observations are 16 years. The reference period of the study is 2004-2019. The selection of the time period is based on the availability of the required data for this study. This time period could enable us to capture the surge in health expenditure and it is also the period of great significance due to the launch of National Rural Health Mission (NRHM) 2005, Janani Suraksha Yojana (JSY) 2005, Intensified Mission Indradhanush (IMI) 2014, and Ayushman Bharat Yojana (ABY) 2018. The present study has used secondary data from various sources and it is based on two objectives as mentioned above.

I have used Infant mortality Rate and Death Rate as health indicators of Goa which is the outcome variable of interest in the analysis for first objective. Infant mortality rate (IMR) is a measure that tells us the number of deaths of infants under one year of age per 1,000 live births. Death rate as indicator of health refers to number of deaths occurring in a year in Goa per 1,000 populations. The main source of data, for this two health indicators has been gathered from Sample Registration System (SRS) Bulletin, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India; RBI Bulletin and Director of Health and Family Welfare Services.

And the indicators of public expenditure on health, total fertility rate, mean years education of women aged 20+, and state per capita income are the explanatory variable of the first objective. The indicators of public health expenditure includes: health expenditure as percentage of total state expenditure (HEAPOTSE), per capita health expenditure (PCHE), and health expenditure as percent of GSDP (HEAPOG). The data on the various indicators of public health expenditure has been collected from chapter 4 of National Health Profile

(NHP), National Health Accounts (NHA) Estimates for India, and reports of the CAG on State Finances from 2004 to 2019. And the data on other independent variables has been taken from global data lab.

The first objective of this study has regressed, two equations: IMR (1) and Death Rate (2) as dependent variables on indicators of public health expenditure, total fertility rate, mean year education of women aged 20+, and state per capita income of Goa. The complete model was used to study the statistical significance between public health expenditure and other independent variables on health indicators of Goa and can be expressed as follows:

$$IMR = \beta 0 + \beta 1\ (HEAPOTSE) + \beta 2\ (PCHE) + \beta 3\ (HEAPOG) + \beta 4\ (TFR) + \beta 5\ (MYEOW) + \beta 6\ (SPCI) + u \quad \_\_\_\_\_(1)$$

$$DR = \beta 0 + \beta 1\ (HEAPOTSE) + \beta 2\ (PCHE) + \beta 3\ (HEAPOG) + \beta 4\ (TFR) + \beta 5\ (MYEOW) + \beta 6\ (SPCI) + u \quad \_\_\_\_\_(2)$$

4.2 Construction of Composite Health Infrastructure Index Score (HIIS) of Goa

For the second objective of this study, Health Infrastructure Index Score (HIIS) are the predicted variable, it refers to the numerical value assigned based on the index, that combines data from multiple indicators into a single score. A higher the health infrastructure index score generally indicates a stronger and better access to healthcare facilities. The predictor variables are the indicators of public health expenditure which includes: total state expenditure (TSE), total state expenditure on health (TSEOH), per capita health expenditure (PCHE), health expenditure as percentage of GSDP (HEAPOG). And other predictor variables such as total fertility rate(TFR), means year education of women age 20+(MYEOW), and state per capita income(SPCI). A Health Infrastructure Index Score (HIIS) is developed by taking into account, five main indicators of health infrastructure:

number of health centres which includes summation of SCs, PHCs, and CHCs; number of beds; number of total hospitals (urban + rural); number of government allopathic doctors; and total number of health assistance and workers in Goa. Then I have standardized each indicator through Max and Min scaling method. After standardization I have summed up all the indicators for each year and then divided it by 5, that is total number of health indicators. The data on various indicators of public health infrastructure was attained from chapter 5 and 6 of National Health Profile (NHP) for the year 2004 to 2019. The model is expressed as follows:

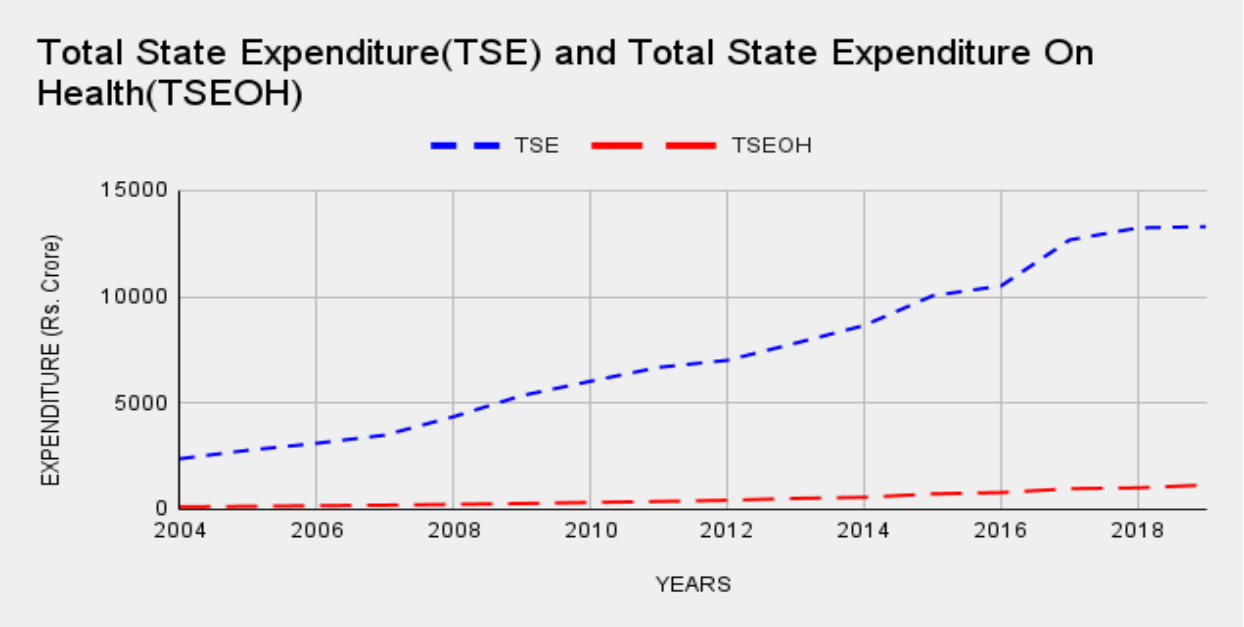
$$HIIS = \beta 0 + \beta 1\ (TSE) + \beta 2\ (TSEOH) + \beta 3\ (PCHE) + \beta 3\ (HEAPOG) + \beta 4\ (TFR) + \beta 5\ (MYEOW) + \beta 6\ (SPCI) + u$$

For the first objective, to study the statistical significance of indicators of health expenditure on the two health indicators: Infant Mortality Rate and Death rate of Goa. Given the possibility of auto correlation and heteroscedasticity in time series data, a robust standard errors were adopted throughout the analysis. This involves conducting tests to assess for these issues. While specific remedies like the Cochrane – Orcutt (CO) procedure have been considered based on the tests results, the final model employs robust standard errors regression model for both health indicators separately by using Stata software.

For the second objective, that is to assess the correlation between indicators of public health expenditure, total fertility rate, means year education of women age 20+, state per capita income and health infrastructure index score (HIIS) of Goa. I utilized heatmap from Gretl software to visualize the correlation of dependent and independent variables of my study.

CHAPTER 5. ANALYSIS

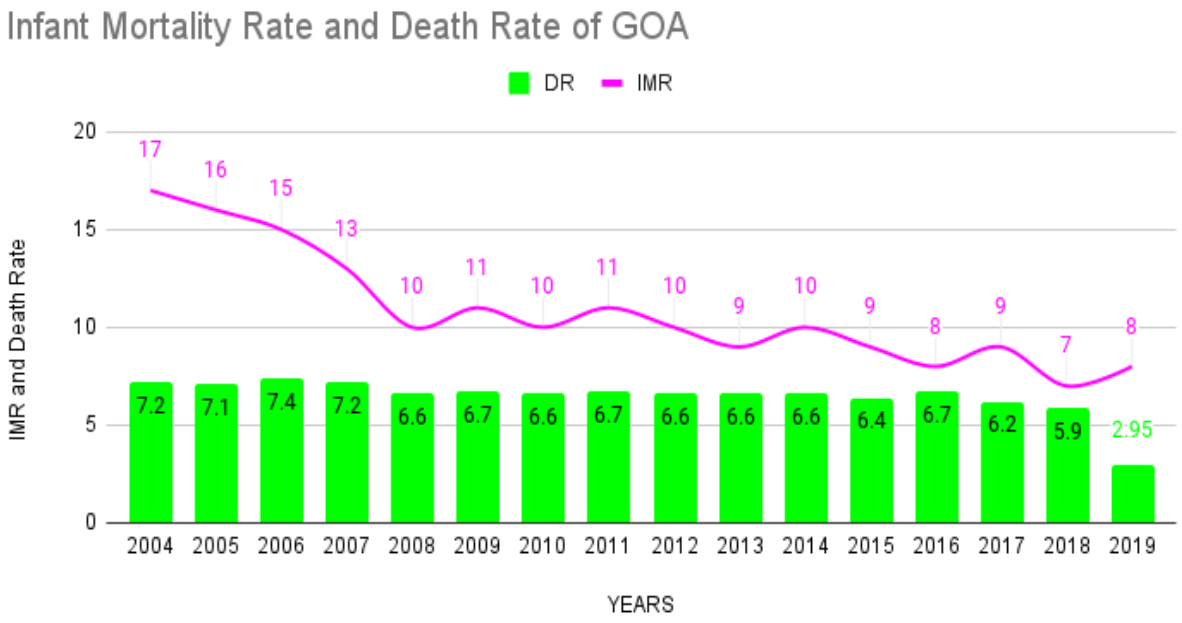
Figure 5.1: Total state expenditure and total state expenditure on health in (₹ Crore) of Goa, 2004-2019



Source: The graph is generated using secondary data.

Figure 5.1 shows yearly total state expenditure (TSE) and total state expenditure on health (TSEOH) in ₹ crore of Goa from 2004 to 2019. The x-axis represents the years and the y-axis measures the expenditures. It shows that total state expenditure has increased considerably over time. The line slants upwards throughout the graph, though the steepness of increase seems to vary. But overall, total state expenditure seems to be an upward trend. Similarly total state expenditure on health has increased over time. The line slopes upwards, though the increase isn't consistent. There seem to be period of steeper and shallower increases. While both TSE and TSEOH appears to be increasing, but TSEOH seems to be growing at a slower rate. The line for TSEOH is consistently below the line for TSE, and the gap between the two lines appears to widen over time. This suggests that health expenditure is making up a smaller proportion of total state expenditure in Goa.

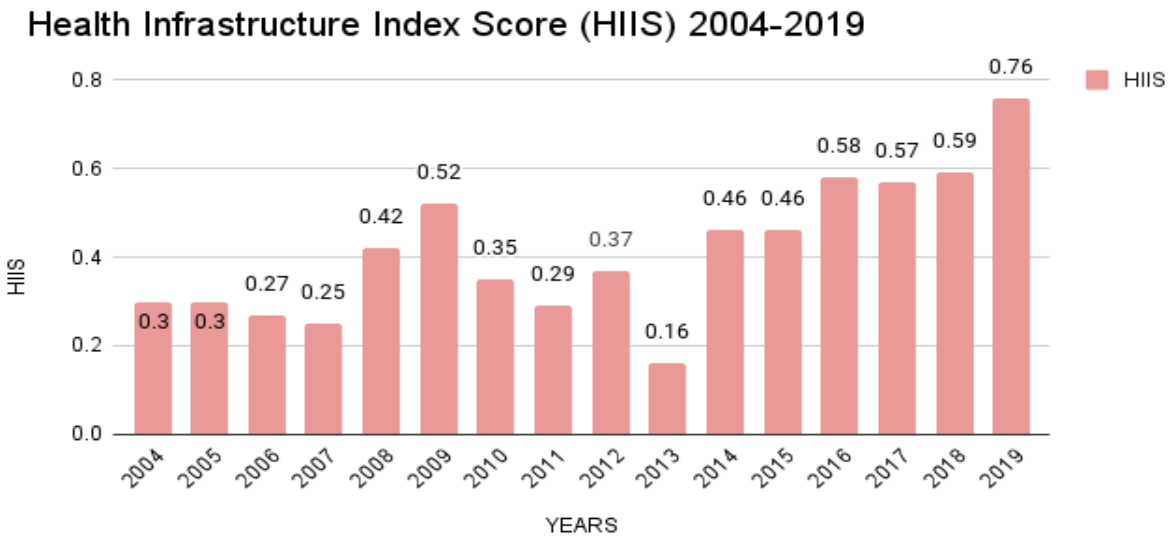
Figure 5.2: Health indicators of Goa from 2004 to 2019



Source: The graph is generated using secondary data.

Figure 5.2 depicts the health indicators: Infant Mortality Rate (IMR) and Death Rate per 1,000 populations of Goa together in a single graph. The x-axis shows years ranging from 2004-2019 and y-axis shows the Infant Mortality Rate (IMR) and Death Rate per 1,000 populations. Based on the graph, the IMR in Goa appears to have fluctuated between 2004 and 2019. In 2004 to 2006 IMR seems to be relatively stable. It appears to fluctuate slightly with increasing trend, from 2006 to 2010. However after 2011, IMR continues to increase from 11 in 2011to 8 in 2019, but at a slower rate. But overall, there is increasing trend in IMR of Goa. Similarly, Death rate per 1,000 populations of Goa also has been somewhat varied, in 2004 to 2019. In general the death rate of Goa seems to be around 6.5 between 2004 and 2017. And then, it decreased to 2.95 in 2019 from 5.9 in 2018. Comparably the IMR of Goa appears to be consistently higher than the Death Rate throughout the timeframe. The gap between the both health indicators seems to be widening over time. Also the IMR is increasing at a faster rate than Death Rate in Goa.

Figure 5. 3: Yearly Health Infrastructure Index Score (HIIS) of Goa (2004 – 2019)



Source: The graph is generated using secondary data.

The above graph shows depicts Health Infrastructure Index Score, which includes five indicators of health infrastructure of Goa. Each bar on the x-axis of the graph represents a year from 2004 to 2019. The y-axis represents the Health Infrastructure Index Score (HIIS) for the particular year. The HIIS was lowest in 2004 at around 0.3. In 2009, it slightly increased to 0.52 followed by a decreasing trend in 2010 to 2012. The score suddenly fell further to 0.16 in 2013, indicating lack of infrastructure facilities and quality in Goa. However, the HIIS gradually started increasing from 0.46 in 2014 to 0.76 in 2019 indicating improvement in health infrastructure indicators.

Table 5.4: Health Infrastructure Indicators of Goa (2004-2019)

Health Infrastructure Indicators of Goa				
Years	**2004**	**2009**	**2014**	**2019**
Total No. of Hospitals	**20**	**33**	**33**	**43**
Total No. of Health Centres	**191**	**190**	**228**	**243**
Total No. of Beds	**2639**	**2841**	**3308**	**3086**
Total No. of Allopathy Doctors	**674**	**539**	**435**	**644**
Total No. of Health Assistance and Workers	**330**	**374**	**245**	**368**

Source: The graph is generated using secondary data.

All health related aspects are influenced by the availability and access to health services. Individual households and the state are the most important stakeholders in health services systems. To protect and promote general health, the public health infrastructure must be strong. A minimum level of physical infrastructure is needed to provide public services and also to increase access to health services. Table 5.4 shows total number of hospitals, health centres, beds per 1000 population, allopathy doctors per 1,000 population, and health assistance and workers of Goa. According to WHO recommendations, Goa still falls short of 5 beds per 1,000 populations hence there is a need for 7875 beds, indicating a gap of 4,789 beds in Goa's healthcare infrastructure. Whereas Goa might have doctor-patient ratio closer to WHO's recommendations compared to the national average in India.

5.5 Table of Summary Statistic of Variables

Variables	Mean	Standard Deviation	Min	Max
TSE	**7335.5**	**3753.504**	**2376**	**13295**
TSEOH	**500.0625**	**335.1975**	**122**	**1148**
HEAPOTSE	**5.955625**	**1.137471**	**4.84**	**8.7**
PCHE	**2634.563**	**1578.689**	**861**	**5740**
HEAPOG	**1.20375**	**0.163049**	**1**	**1.5**
HIIS	**0.415625**	**0.15866**	**0.16**	**0.76**
IMR	**10.8125**	**2.94887**	**7**	**17**
DR	**6.465625**	**1.012047**	**2.95**	**7.4**
TFR	**1.730625**	**0.219164**	**1.3**	**2.28**
MYEOW	**7.7575**	**0.637427**	**6.69**	**8.98**
PCI	**190.7194**	**98.09916**	**76.96**	**313.97**

Source: the table is generated using STATA

The above table observes the summary statistics of each variables used in this study. It summarizes the total state expenditure (TSE) for the period 2004 to 2019. The average TSE of Goa was ₹7335.5crore with a standard deviation of ₹3753.50crore. The minimum and maximum values were ₹2376 and ₹13295 crore respectively. For the period 2004-2019, the average total state expenditure on health (TSEOH) in Goa was ₹500 crore with a standard deviation of ₹335.19. The minimum expenditure observed was ₹122crore and the maximum

was ₹1148 crore. The mean per capita health expenditure (PCHE) in Goa was ₹ 2634.56 the standard deviation of ₹1578.68 indicates some variation in expenditure across the years. The minimum and maximum values were ₹861and ₹5740 respectively.

The health expenditure as percentage of GSDP (HEAPOG) for Goa ranged from a minimum of 1% to a maximum of 1.5% over the time period 2004-2019 and it exhibits a mean of 1.20%. On average, Goa allocated 5.9% of its total state expenditure towards health. The minimum and maximum percentages observed were 4.84% and 8.7% respectively. The standard deviation of health expenditure as a percentage of GSDP was 1.13%, indicating some variability in resource allocation across the years.

From 2004-2019, the average IMR of Goa was 10.18 per 1,000 live births. However, there was some variation in IMR across the years, with a standard deviation of 2.94. The minimum IMR recorded during this period was 7, while the maximum observed value was 17 per 1,000 live births. The average death rate in Goa for the above mentioned time period was 6.4 deaths per 1,000 populations. The death rate ranged from a minimum of 2.95 deaths per 1,000 populations in 2004 to a maximum of 7.4 deaths per 1,000 populations in 2019.

Goa received a health infrastructure index score of 0.41in 2004. The scoring range for this index was typically between 0.16 and 0.76, with higher scores indicating a strong health infrastructure in 2019. The average total fertility rate (TFR) of Goa was 1.73. The standard deviation of 0.21 indicates some variability in total fertility rate around mean. The minimum TFR was 1.3 and maximum TFR was 2.28.

From 2004-2019, the average mean years education of women age 20+ (MYEOW) of Goa was 7.75 years. However, there was some variation in MYEOW across the years, with a standard deviation of 0.65. The minimum MYEOW recorded during this period was 6.69years, while the maximum observed was 8.98years. On average state per capita income

(SPCI) was ₹109.71 (in thousand). The minimum and maximum state per capita income observed was ₹76.96 and ₹313.97 respectively. The standard deviation of state per capita income was 98.09, indicating some variability across the years.

5.6 Regression Analysis

This section presents the analysis of the two health indicators of Goa on indicators of public health expenditure, total fertility rate (TFR), mean years education of women age 20+ (MYEOW) and state per capita income (SPCI) of Goa. A simple linear regression model was employed, for first objective: to study the statistical significance of indicators of public health expenditure and two health indicators: Infant Mortality Rate and Death Rate of Goa. The indicators of public health expenditure includes: healthcare expenditure as percentage of total state expenditure (HEAPOTSE), per capita health expenditure (PCHE) and health expenditure as percentage of GSDP (HEAPOG). The null hypothesis for this model is that, there is no statistical significance of public health expenditure indicators and other independent variables on two health indicators of Goa. And the alternative hypothesis is that, there is a statistical significance of public health expenditure indicators and other independent variables on two health indicators of Goa. Since the data used for study is time series in nature. Hence the preliminary test is to check for serial correlation for both the regression model separately. Serial correlation, also known as auto correlation occurs when the error terms in a time series regression model are not independent over time and can be problematic. If errors from past periods influence current errors, the model's estimates of how variables relate to each other become unreliable. Therefore, it is crucial to first test for serial correlation in time series analysis to ensure the validity of our findings.

Breusch - Godfrey LM test was conducted, to assess the presence of higher-order autocorrelation in the error terms of Infant Mortality Rate (IMR) regression model. The

Breusch - Godfrey LM test statistic was (12.63) with a p-value of (0.013) at lag 4. As the p-value is < 0.05 hence the result suggests the presence of statistical significant serial correlation in the residuals. This violation of the assumption can lead to biased standard errors and unreliable coefficients estimates, requiring for further investigation

To address this issue detected in the initial regression model, a Cochran - Orcutt (CO) was employed as a potential remedy. While the CO procedure doesn't directly 'correct' the data, it estimates the model by taking serial correlation into account, often leading to more reliable coefficient estimates. Following these tests, I assessed for heteroscedasticity.

Heteroscedasticity, where the variance of error terms in a regression model is not constant, can lead to biased standard errors and unreliable coefficient estimates. To assess this assumption, it is important to test for the presence of heteroscedasticity in the model. We utilized Breusch-Pagan / Cook-Weisberg test for heteroscedasticity. The results Prob > chi2 = 0.72, which is greater than 0.05 hence, we fail to reject null hypothesis and say that there is evidence of presence of heteroscedasticity in the model. This can affect the validity of regression model.

To address the presence of both serial correlation and heteroscedasticity, I adopted a robust regression approach in the final model. I have done separate robust regression model for each health indicators of Goa separately. This approach utilizes robust standard errors, which are less susceptible to these issues. By using robust standard errors, we obtain more reliable estimates for statistical inference, such as hypothesis testing about the significance of the coefficients.

Table 5.7 Robust Standard Error Regression Results of Infant Mortality Rate of Goa, 2004-2019

Variables	Coefficients	Robust Standard Error	T-Statistic	P-Value
HEAPOTSE	3.869909	0.959375	4.03	0.003
PCHE	-0.00326	0.000979	-3.33	0.009
HEAPOG	3.439276	3.738064	0.92	0.382
TFR	5.056071	3.264432	1.55	0.156
MYEOW	-2.86201	1.58913	-1.8	0.105
SPCI	0.00606	0.007122	0.85	0.417
Constant	4.499164	18.69073	0.24	0.815

Source: The results are generated using STATA

Interpretation:

Table 5.7 shows the results of robust standard error regression results of Infant Mortality Rate (IMR) of Goa. The analysis investigates the relationship between health expenditure as percentage of total state expenditure (HEAPOTSE) and Infant Mortality Rate (IMR). The coefficient for health expenditure is estimated to be 3.86, with a robust standard error of 0.95,

while this estimate suggests potential positive association with the p-value of 0.003; which indicates that this association is statistically significant at the 5% level.

There is statistical significant negative relationship between per capita health expenditure (PCHE) and IMR of Goa. The coefficient of (-0.0032) indicates that for every one unit increase in per capita health expenditure, the IMR decrease by 0.0032 units. The robust standard error of 0.0009 provides an estimate of the variability around this coefficient estimate. In this case, the p-value of 0.009 indicates that the negative relation between the independent and dependent variables is statistically significant at 5% level of significance. The regression analysis with robust standard error yielded a coefficient of 3.43 for health expenditure as percentage of GSDP (HEAPOG). However, the t-statistic (0.92) and corresponding p-value 0.382 suggest that there is no statistically significant evidence to conclude that HEAPOG is associated with IMR at the 5% level of significance.

Therefore, I conclude that, there is statistical significant positive relationship between health expenditure as percentage of total state expenditure (HEAPOTSEP) and IMR at 5% level of significance. While there is statistical significant negative relation between per capita health expenditure (PCHE) and IMR of Goa at 5% level of significance. It implies that, if PCHE increases by every one unit, than IMR decreases by 0.033 units.

The analysis now focuses on the second health indicator: Death Rate, of the first objective. Given the possibility of serial correlation and heteroscedasticity, I implemented a robust regression approach for the death rate regression model. Similar to first health indicator, I have conducted the Cochrane – Orcutt (CO) test to assess serial correlation and evaluating for heteroscedasticity. The final model employs robust standard errors, these are less susceptible to the aforementioned issues, providing more reliable results for statistical inference.

Table 5.8 Robust Regression Results of Death Rate, Goa 2004-2019

Variables	Coefficients	Robust Standard Error	T-Statistic	P-Value
HEAPOTSE	-1.24784	0.683812	-1.82	0.101
PCHE	0.000653	0.000548	1.19	0.264
HEAPOG	-3.35152	1.767635	-1.9	0.09
TFR	-0.93398	0.42091	-2.22	0.054
MYEOW	-1.22494	0.509855	-2.4	0.04
SPCI	0.006287	0.002759	2.28	0.049
Constant	26.13239	6.449835	4.05	0.003

Source: The output is generated using STATA

Interpretation:

Table 3 shows the robust standard error regression results of Death Rate of Goa. The robust standard errors regression analysis yields a coefficient of -1.24 for health expenditure as percentage of total state expenditure (HEAPOTSE) this indicates that as expenditure on health increases by 1% death rate decreases by 1.24 per 1,000 populations. However, the t-

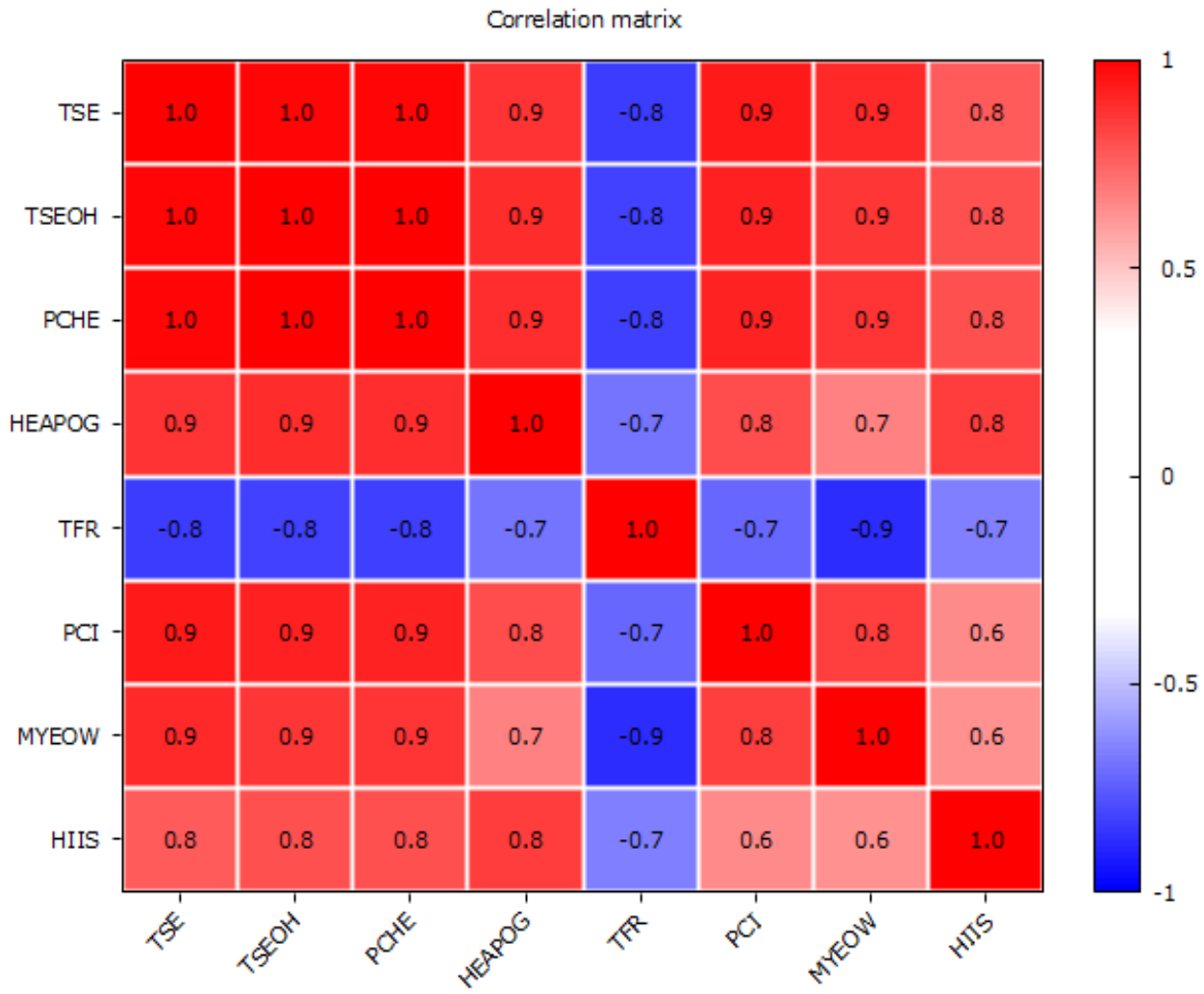
statistic of -1.82 and a corresponding p-value of 0.108, it indicates that this relationship is not statistically significant at the 5% level.

There is positive relationship between per capita health expenditure (PCHE), and negative relationship between health expenditure as percentage of GSDP (HEAPOG) with death rate. It means, 1 unit increase in PCHE can lead to change in death rate by 0.00065. However PCHE and HEAPOG has p-value >0.05 hence they are statistically insignificant at 5% level of significance.

There is negative relationship between total fertility rate (TFR), and mean years education of women age 20+ (MYEOW) with death rate. That means, if TFR increases by 1unit than death rate falls by 0.93 and if MYEOW increases by 1 year than death rate falls by 1.22 deaths per 10,000 populations. Also both have p-value 0.05 and 0.04 respectively which is <0.05. Therefore both TFR and MYEOW are statistically significant at 5% level of significance with death rate. However, state per capita income (SPCI) has positive statistical significance on death rate with p-value <0.05.

Therefore, I conclude that, there is statistically significant negative relation between total fertility rate (TFR), and mean years education of women age 20+ (MYEOW) with the Death rate. Whereas, there is positive relationship between state per capita income (SPCI) and Death rate. And they are statistically significant at 5% level of significance.

TABLE 5.9 Correlation between Public Health Expenditure and Health Infrastructure Index Score (HIIS) of Goa, 2004-2019



Source: heatmap visualised by Gretl software

Interpretation:

To achieve the second objective, I analysed the correlation patterns between indicators of Public Health Expenditure (PHE) and Goa's Health Infrastructure Index Score (HIIS). The null hypothesis of this objective is that, there is no correlation between indictors of PHE and HIIS. And the alternative hypothesis is that, there is a correlation between indicators of PHE and HIIS. I employed Gretl software to construct a heatmap. This heatmap visualized the

correlation coefficients between various public health expenditure indicators, such as total state expenditure (TSE), total state expenditure on health (TSEOH), per capita health expenditure (PCHE), health expenditure as percent of GSDP (HEAPOG), total fertility rate (TFR), per capita income (PCI), mean years education of women age 20+ (MYEOW) and the health infrastructure index score (HIIS) for the state of Goa. A heatmap offers a valuable tool and provides a clear visual representation for understanding the strength and direction (positive or negative) of correlation between multiple variables. In the heatmap, warmer colours represent stronger positive correlations, while cooler colours indicate negative correlations.

The heatmap with the red colour intensity reveals a strong positive correlation (0.8) between HIIS and TSE. This implies that higher level of total state expenditure tend to coincide with higher health infrastructure index score. There is strong positive correlation (0.8) between HIIS and TSEOH. It means that, higher level of total state expenditure specially allocated towards healthcare can leads to improvement in health infrastructure of Goa.

The heatmap shows a strong positive correlation between HIIS and PCHE, with a coefficient of (0.8) and the red colour of this cell suggests a strong positive relationship between them. It implies that a state with higher per capita health expenditure is associated with higher health infrastructure index score. There is very strong positive relationship between HIIS and HEAPOG. This means that allocating a large share of Gross State Domestic Product towards health expenditure tends to have higher health infrastructure index score in Goa.

While a heatmap reveals a correlation coefficient of -0.7 between total fertility rate (TFR) and health infrastructure index score (HIIS) of Goa. This indicates a strong inverse relationship between the two variables. As the health infrastructure index score increases (better health infrastructure), the total fertility rate tends to decrease. This suggests that areas

with stronger health infrastructure have lower birth rates. A correlation coefficient of 0.6 indicates a moderately strong positive relationship between per capita income (PCI) and health infrastructure index score (HIIS) of Goa. it indicates that higher per capita income is associated with better (HIIS) of Goa. Similarly a correlation of 0.6 indicates a moderately strong positive relationship. Positive correlation means that as the mean years education for women age 20+ (MYEOW) increases, health infrastructure index score (HIIS) of Goa also tends to increase.

Therefore with the visualization of the heatmap, I reject the null hypothesis and say that, there evidence of strong positive correlation present between indicators of health expenditure, moderately strong correlation between PCI and MYEOW, and a strong inverse correlation present between TFR with health infrastructure index score (HIIS) of Goa.

CHAPTER 6 FINDINGS

Public healthcare spending in Goa presents a fascinating story. This study examined the relationship between public health expenditure, health indicators, total fertility rate, and mean years education of women age 20+, state per capita income and the health infrastructure index score of Goa. The study is based on time series data, conducted in Goa, India. The sample observations are 16 years. The reference period of the study is 2004-2019. The selection of the time period is based on the availability of the required data for this study and it is also the period of great significance due to the launch of National Rural Health Mission (NRHM) 2005and other health related schemes were launched, which aimed to increase the public health expenditure and promised to improve healthcare system for all the citizens of the country. The present study has used secondary data from various sources. This study focuses on two objectives: 1)To study the statistical significance of public healthcare expenditure, total fertility rate, and mean years education of women age 20+, and state per capita income on two health indicators of Goa. And 2) To assess the correlation between state-level public healthcare expenditure indicators, total fertility rate, and mean years education of women age 20+, state per capita income and composite Health Infrastructure Index Score (HIIS) of Goa.

I have used Infant mortality Rate and Death Rate as health indicators of Goa which is the dependent variable and the indicators of public expenditure on health, total fertility rate, and mean year education of women age 20+, and state per capita income as independent variable for the first objective. The data, for this two health indicators has been gathered from Sample Registration System (SRS) Bulletin, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India; RBI Bulletin and Director of Health and Family Welfare Services. The indicators of public health expenditure includes:

health expenditure as percentage of total state expenditure (HEAPOTSE), per capita health expenditure (PCHE), and health expenditure as percent of GSDP (HEAPOG). The data on the various indicators of public health expenditure has been collected from chapter 4 of National Health Profile (NHP), National Health Accounts (NHA) Estimates for India, and reports of the CAG on State Finances from 2004 to 2019. And the data on total fertility rate, mean year education of women age 20+ and state per capita income has been taken from global data lab. The first objective of this study has divided based on two equations: IMR (1) and Death Rate (2) as dependent variables on indicators of public health expenditure, total fertility rate, and mean year education of women age 20+, and state per capita income of Goa.

For the second objective of this study, Health Infrastructure Index Score (HIIS) are the predicted variable and the indicators of public health expenditure which includes: total state expenditure (TSE), total state expenditure on health (TSEOH), per capita health expenditure (PCHE) and health expenditure as percentage of GSDP (HEAPOG) and total fertility rate (TFR), and mean years education of women age 20+(MYEOW), and state per capita income (SPCI) were the predictor variables. And the data on various indicators of public health infrastructure was attained from chapter 5 and 6 of National Health Profile (NHP) for the year 2004 to 2019.

The graph on total state expenditure (TSE) and total state expenditure on health (TSEOH) depicts that total state expenditure has increased considerably over time and shows upward trend. Similarly total state expenditure on health has increased over time but the increase isn't consistent. There seem to be period of steeper and shallower increases in TSEOH. While both TSE and TSEOH appears to be increasing, but TSEOH seems to be growing at a slower rate. The line for TSEOH is consistently below the line for TSE, and the gap between the two lines appears to widening over time. This suggests that health expenditure is making up a smaller proportion of total state expenditure in Goa.

Based on the graph of Infant Mortality Rate (IMR) and Death rate of Goa for 2004-2019, it shows that IMR in Goa appears to have fluctuated. But overall, there is decreasing trend in IMR of Goa. Similarly, Death rate per 1,000 populations of Goa also has been somewhat varied, in 2004 to 2019. Comparably the IMR of Goa appears to be consistently higher than the Death Rate throughout the timeframe. The gap between the both health indicators seems to be widening over time. Also the IMR is increasing at a faster rate than Death Rate in Goa.

A bar graphed was created for yearly Health Infrastructure Index Score (HIIS) of Goa (2004 – 2019). It showed that the HIIS was lowest, at around 0.3in 2004. In 2009, it slightly increased to 0.52 followed by a decreasing trend in 2010 to 2012. The score suddenly fell further to 0.16 in 2013, indicating lack of infrastructure facilities and quality in Goa. However, the HIIS gradually started increasing from 0.46 in 2014 to 0.76 in 2019 indicating improvement in health infrastructure indicators.

A table on health infrastructure indicators of Goa was constructed for the time period 2004-2019. According to WHO recommendations, Goa still falls short of 5 beds per 1,000 populations hence there is a need for 7875 beds, indicating a gap of 4,789 beds in Goa's healthcare infrastructure. Whereas Goa might have doctor-patient ratio closer to WHO's recommendations compared to the national average in India. indicators of Goa was constructed for the time period 2004-2019.

For the first objective, that is to study the statistical significance of indicators of public health expenditure, total fertility rate, mean years education of women age 20+, and state per capita income, on the two health indicators: Infant Mortality Rate and Death rate of Goa. Given, the possibilities of autocorrelation and heteroscedasticity in time series data. I conducted Breusch- Godfrey test to assess for serial correlation with specific remedies like the Cochrane – Orcutt (CO) procedure. Followed by, Breusch-Pagan test for heteroscedasticity and the

final model employs robust standard errors regression model for both health indicators separately by using Stata software.

The results of the robust standard errors regression model of Infant Mortality Rate (IMR) reveal that, there is statistical significant positive relationship between health expenditure as percentage of total state expenditure (HEAPOTSEP) and IMR at 5% level of significance. While there is statistical significant negative relation between per capita health expenditure (PCHE) and IMR of Goa at 5% level of significance. It implies that, if PCHE increases by every one unit, than IMR decreases by 0.033 units.

The results of the robust standard errors regression model of Death Rate confirmed that, there is negative relationship between total fertility rate (TFR), and mean years education of women age 20+ (MYEOW) with death rate. That means, if TFR increases by 1unit than death rate falls by 0.93 and if MYEOW increases by 1 year than death rate falls by 1.22 deaths per 10,000 populations. Also both have p-value 0.05 and 0.04 respectively which is <0.05. Therefore both TFR and MYEOW are statistically significant at 5% level of significance with death rate. However, state per capita income (SPCI) has positive statistical significance on death rate with p-value <0.05.Whereas, there is positive relationship between state per capita income (SPCI) and Death rate. And they are statistically significant at 5% level of significance.

To achieve the second objective, I employed Gretl software to construct a heatmap. I analysed the correlation patterns between various public health expenditure indicators, such as total state expenditure (TSE), total state expenditure on health (TSEOH), per capita health expenditure (PCHE), and health expenditure as percent of GSDP (HEAPOG), total fertility rate (TFR), and mean years education of women age 20+ (MYEOW), per capita income (PCI) and the health infrastructure index score (HIIS) for the state of Goa.

The null hypothesis of this objective is that, there is no correlation between indictors of PHE, TFR, MYEOW and PCI with HIIS. And the alternative hypothesis is that, there is a correlation between indicators of PHE, TFR, MYEOW and PCI with HIIS.

The analysis revealed that there is strong positive correlation between various indicators of public health expenditure, moderately strong correlation between PCI and MYEOW, and a strong inverse correlation present between TFR with health infrastructure index score (HIIS) of Goa. A heatmap depicts correlations, where values closer to 1 indicate stronger positive relationship and values closer to -1 indicates strong negative relationships. As seen in the heatmap, total state expenditure (TSE) shows strong positive correlation (0.8) with HIIS of Goa. This suggests that higher overall state spending on health is associated with stronger health infrastructure index score. Similarly, other public health expenditure indicators like total state expenditure on health (TSEOH), health expenditure as percentage of GSDP (HEAPOG), and per capita health expenditure (PCHE) also exhibit moderate positive correlations (0.8) with HIIS. These findings suggest that there is potential links between increased investments in health spending and a stronger health infrastructure in Goa.

CHAPTER 7 CONCLUSION

The study aimed to investigate two objectives. The first objective is to study the statistical significance of public healthcare expenditure, total fertility rate, mean years education of women and state per capita income on two health indicators of Goa. The findings revealed that, there is statistical significant positive relationship between health expenditure as percentage of total state expenditure (HEAPOTSEP) and IMR at 5% level of significance. While there is statistical significant negative relation between per capita health expenditure (PCHE) and IMR of Goa at 5% level of significance. It implies that, if PCHE increases by every one unit, than IMR decreases by 0.033 units.

It also revealed that, there is statistically significant negative relation between total fertility rate (TFR), and mean years education of women age 20+ (MYEOW) with the Death rate. Whereas, there is positive relationship between state per capita income (SPCI) and Death rate. And they are statistically significant at 5% level of significance.

The second objective is to assess the correlation between state-level public healthcare expenditure indicators such as total state expenditure (TSE), total state expenditure on health (TSEOH), per capita health expenditure (PCHE), and health expenditure as percent of GSDP (HEAPOG), total fertility rate (TFR), and mean years education of women age 20+ (MYEOW), per capita income (PCI) with composite Health Infrastructure Index Score (HIIS). The null hypothesis of this objective is that, there is no correlation between indictors of PHE, TFR, MYEOW and PCI with HIIS of Goa. And the alternative hypothesis is that, there is a correlation between indicators of PHE, TFR, MYEOW and PCI with HIIS.

The analysis revealed that there is strong positive correlation between various indicators of public health expenditure, moderately strong correlation between PCI and MYEOW, and a strong inverse correlation present between TFR with health infrastructure index score (HIIS)

from 2004-2019 of Goa. Therefore with the visualization of the heatmap, I reject the null hypothesis for the second objective of the study.

LIMITATIONS:

The analysis is subject to the following limitations:

The present study is limited to the indicators of public expenditure on health, two health indicators and health infrastructure for the state of Goa only. The study is carried out only for the limited time period from 2004 to 2019 as per the availability of the required data.

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