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RELATIONSHIP BETWEEN MATERNAL, INFANT AND NEONATAL MORTALITY RATES OF HEALTH SERVICES EXPENDITURE IN RAJASTHAN: A STATISTICAL ANALYSIS

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Abstract

The quality and availability of healthcare services are among the key indicators of a society's social and economic development. In particular, investment in healthcare services plays a crucial role in reducing maternal, infant, and neonatal mortality rates. This study focuses on understanding the relationship between health expenditure and maternal, infant, and neonatal mortality rates in the state of Rajasthan. The study utilizes secondary data compiled from various government reports, research papers, and health-related statistical resources.

In this research, Pearson's Correlation Coefficient has been used to calculate the correlation between healthcare expenditure and maternal, infant, and neonatal mortality rates. The findings reveal a strong negative correlation between health expenditure and mortality rates, indicating that as healthcare spending increases, maternal and infant mortality rates tend to decrease. Statistical analysis further confirms that this correlation is statistically significant (p-value < 0.05), leading to the conclusion that investment in healthcare services in Rajasthan can effectively reduce maternal and infant mortality rates.

However, this study is focused solely on correlation and does not provide a clear explanation of causation. Moreover, the study is based only on secondary data, which may present certain limitations. For future expansion of this research, primary data collection, analysis of healthcare service quality, and the study of other socio-economic factors can be considered. This research offers valuable insights for policymakers, public health organizations, and researchers, aiding in the improvement of healthcare services and the formulation of effective strategies in Rajasthan.

Keywords – Healthcare Services, Maternal Mortality Rate, Infant Mortality Rate, Neonatal Mortality Rate, Correlation Analysis, Rajasthan, Health Expenditure

1 Introduction

The availability and quality of healthcare services are among the key indicators of a society's overall development. The stronger the healthcare system of a country or state, the better the standard of living for its citizens. The quality of healthcare services is not limited to medical facilities alone; it also includes infrastructure, the number of trained doctors, availability of modern technology, emergency services, and access to primary healthcare. Effective

healthcare services are especially crucial for reducing **maternal, infant, and neonatal mortality rates**, as these rates reflect the overall health status of a society (WHO, 2020).

In India, several initiatives have been undertaken by the government to control maternal and infant mortality rates, particularly focusing on improving healthcare facilities in rural and underdeveloped areas. However, in large and diverse states like Rajasthan—where a significant portion of the population resides in rural areas—there are still many gaps in the availability and quality of healthcare services. A large number of women in Rajasthan still face unsafe conditions during childbirth, and many newborns die within the first few months of life due to the lack of adequate healthcare services (Ministry of Health and Family Welfare, 2022). This is why the objective of this study is to understand and analyze the relationship between health expenditure and maternal, infant, and neonatal mortality rates in Rajasthan. This study aims to develop a deeper understanding of how investment in healthcare services can contribute to lowering these mortality rates.

To improve maternal and infant health in India, the government has implemented several major schemes, including the **Janani Suraksha Yojana (JSY)**, **Pradhan Mantri Matru Vandana Yojana (PMMVY)**, and **Ayushman Bharat Yojana** (NITI Aayog, 2021). These schemes aim to provide financial assistance to pregnant women during childbirth, promote institutional deliveries, and make healthcare services more accessible for mothers and newborns. Nevertheless, in states like Rajasthan, challenges persist in both the quality and availability of healthcare services. Many remote and rural areas in the state still lack adequate medical facilities, making it difficult for women and newborns to receive timely and appropriate care. Additionally, the unavailability of trained health workers during delivery and the lack of emergency medical services are major factors contributing to higher maternal and infant mortality rates.

Rajasthan's **Maternal Mortality Ratio (MMR)** stands at **141 per 100,000 live births**, which is higher than the national average (Sample Registration System, 2021). This indicates that the likelihood of maternal death during pregnancy or childbirth is relatively higher in Rajasthan compared to other states. Several factors can influence maternal mortality, including poor nutrition, late detection of high-risk pregnancies, complications during delivery, and lack of postnatal care. In addition, the **Infant Mortality Rate (IMR)** and **Neonatal Mortality Rate (NMR)** are also comparatively high, indicating that there is a strong need for improvement in healthcare services in the state (National Family Health Survey-5, 2021).

On one hand, while government schemes are making efforts to improve maternal and child health, on the other hand, there is a need for an in-depth analysis of the actual outcomes of these schemes and the impact of health expenditure. In many cases, it has been observed that the reach of health schemes remains limited, or beneficiaries are unaware of them and thus cannot take advantage of them. Moreover, understanding the relationship between healthcare expenditure and the implementation effectiveness of these schemes is essential. In a state like Rajasthan,

where geographical conditions and socio-economic factors influence the availability of healthcare services, the relevance of such a study becomes even more significant.

Through this study, a deeper understanding of the relationship between healthcare expenditure and maternal, infant, and neonatal mortality rates in Rajasthan will be developed. The results can help policymakers and organizations involved in healthcare to formulate better strategies, thereby strengthening the healthcare system in Rajasthan.

2 Review of Literature

A **preliminary study conducted by the MacArthur Foundation (2006)** considered the broader framework of public expenditure in health-related sectors in the Indian Union and 14 major states. The results of the study highlighted a trend of declining health sector expenditure in the post-liberalization decade from **1993-94 to 2003-04**, as well as a phase of accelerated spending and rising **rural-urban disparities**, which were seen to have an adverse impact on society as a whole. The study concluded that there was a clear and direct relationship between government spending on health and health outcomes in terms of **life expectancy at birth**, with relatively lower rates of **infant mortality and morbidity**.

Chauhan (2011), in his study *"Public Health in India: Future Challenges"*, examined the structure of public health expenditure across different states to determine the extent to which state governments are fulfilling their responsibilities in providing public health facilities. The study employed **regression analysis** to explore the relationship between per capita health expenditure and the level of economic development (measured through per capita Gross State Domestic Product) in various states. It also analyzed the relationship among key health indicators such as **Crude Birth Rate (CBR), Crude Death Rate (CDR), Infant Mortality Rate (IMR), Expected Life for Males (ELM), and Expected Life for Females**, and their determinants—**per capita GSDP, per capita health expenditure, and literacy rate**, among others. The study showed a significant negative relationship between IMR, CDR, CBR, and per capita health expenditure. Conversely, life expectancy for both males and females showed a strong positive relationship with per capita state health expenditure.

Laxmi, Panda, and Raut (2012) in their study *"Analysis of the Structure and Determinants of Public Health Expenditure in India (with special reference to Andhra Pradesh)"*, examined the structure and determinants of public health expenditure in Andhra Pradesh during the period from **1985 to 2005**. The study found a significant increase in health expenditure in Andhra Pradesh over this period. However, as a proportion of total government expenditure and social service spending, it showed a **declining trend**, and the share of **capital expenditure remained very low**. Determinant analysis revealed that the increase in health spending was driven more by **per capita income, literacy rate, and population** rather than **fiscal deficit or infant mortality rate**. Public spending on health in the state was around **1% of GDP**, which is quite low. The

study recommends adopting effective mechanisms to improve the **efficiency of resources**, which could help increase capital investment in health by opening more hospitals in **backward areas**.

Gupta (2015), in the study titled *"Health Service System: Changing Scenario in Rajasthan"*, focused on the health situation in Rajasthan, a key area for development. The study also reflected on basic living conditions and found that the health dimension significantly and indirectly influences development. The analysis of the state's health situation was carried out using various indicators such as **birth rate, death rate, total fertility rate, concentration of health workers, maternal mortality rate, public expenditure on health**, and the **sub-national Human Development Index** for the state and the country. The study concluded that there is a **positive relationship between health and economic development**, and that the implementation of national and state-level schemes has positively influenced the health system overall.

Palani (2018), in the study *"Public Health Sector Expenditure in Tamil Nadu"*, stated that Tamil Nadu has achieved better health outcomes in terms of mortality indicators, even surpassing developed Western nations in some cases. However, the state is now facing **new challenges and issues** in its healthcare sector as it transitions through a phase of **healthcare transformation**. The study examined the **structure of health expenditure in Tamil Nadu**, revealing that the state's total spending on health increased by only **0.13% per year**, indicating stagnation.

Shahraki and Ghadiri (2021), in their study *"Impact of Good Governance and Public Health Expenditure on Child Health Status"*, highlighted that **public health expenditure and the quality of governance** are among the key factors affecting the health status of the population. The study aimed to investigate the combined effects of good governance and public health spending on children's health status in **upper-middle-income countries**. The findings revealed that **improvements in governance indicators increased the efficiency of public health expenditure** and improved child health outcomes. Therefore, the study recommends enhancing governance, increasing public health expenditure, investing in healthcare infrastructure, improving GDP, and increasing **women's employment**, especially in countries with high child mortality rates.

3 Research Objectives

I To understand the relationship between **healthcare expenditure and maternal mortality rate** in the state of Rajasthan.

II To examine the **statistical correlation** between healthcare expenditure and **infant mortality rate**.

III To calculate the **Pearson correlation** between **neonatal mortality rate and healthcare expenditure**.

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4 Hypotheses of the Study

H_0 (Null Hypothesis): There is no statistically significant relationship between healthcare expenditure and maternal, infant, and neonatal mortality rates.

H_1 (Alternative Hypothesis): There is a significant negative correlation between healthcare expenditure and maternal, infant, and neonatal mortality rates.

5 Research Methodology

This study is based on **secondary data** focused on the state of Rajasthan. The aim of the study is to understand the relationship between healthcare expenditure and maternal, infant, and neonatal mortality rates. For this purpose, **statistical techniques** have been employed to analyze the data and assess the effectiveness of healthcare services.

The required data has been collected from various official and credible secondary sources, including the National Health Mission (NHM), NITI Aayog, Ministry of Health and Family Welfare, Department of Health, Government of Rajasthan, and various research papers. The data includes information on healthcare expenditure, maternal mortality rate (MMR), infant mortality rate (IMR), and neonatal mortality rate (NMR).

For data analysis, the **correlation technique** has been used. Using **Pearson's Correlation Coefficient**, the study examines the relationship between healthcare expenditure and the different mortality rates (maternal, infant, and neonatal). The **Pearson's r value** is used to determine the **direction and strength** of the correlation.

6 Result

Table 1: Medical Expenditure on Maternal Mortality Rate

		Expenditure on medical services (Rs. in crore)	Maternal Mortality Rate
Expenditure on medical services (Rs. in crore)	Pearson's R	—	
	P-Value	—	

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Maternal Mortality Rate	Pearson's R	-0.943	—
	P-Value	0.001	—

The above table clearly shows that the Pearson's correlation coefficient between healthcare expenditure and maternal mortality rate is **-0.943**, indicating a **strong negative correlation**. As observed, the **p-value is 0.001**, which is **less than 0.05**, indicating that the correlation between healthcare expenditure and maternal mortality rate is **statistically significant**.

Table 2: Medical Expenditure on Infant Mortality Rate

		Expenditure on medical services (Rs. in crore)	Infant Mortality Rate
Expenditure on medical services (Rs. in crore)	Pearson's R	—	
	p-value	—	
Infant Mortality Rate	Pearson's R	-0.967	—
	p-value	0.001	—

This table indicates a strong negative correlation between healthcare expenditure and infant mortality rate, with a Pearson's R of -0.967. The p-value is 0.001, which is below 0.05, confirming that the results are statistically significant.

Table 3: Medical Expenditure on Raw Mortality

		Expenditure on medical services (Rs. in crore)	Raw mortality rate
Expenditure on medical services (Rs. in crore)	Pearson's R	—	
	p-value	—	
Raw mortality rate	Pearson's R	-0.917	—
	p-value	0.001	—

This table also reveals a strong negative correlation between healthcare expenditure and crude death rate, with Pearson's R = -0.917. The p-value of 0.001 indicates a statistically significant relationship.

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7 Conclusion

This study was conducted in the state of **Rajasthan**, and the analysis clearly shows that there is a **significant negative relationship** between **healthcare expenditure** and various **mortality rates** (maternal, infant, and neonatal).

The Pearson correlation coefficient between maternal mortality rate and healthcare expenditure was found to be -0.943, indicating a strong negative correlation. This means that as healthcare spending increases, the maternal mortality rate decreases significantly. The p-value (0.001) is less than 0.05, which confirms that this correlation is statistically significant.

The Pearson's correlation coefficient between infant mortality rate and healthcare expenditure was -0.967, showing an even stronger negative correlation than with maternal mortality. The p-value (0.001) further validates the statistical significance of this relationship, proving that greater investment in healthcare plays a crucial role in reducing infant mortality.

Similarly, the **correlation coefficient** between **neonatal mortality rate** and healthcare expenditure was **-0.917**, again indicating a **strong negative correlation**, and the **p-value (0.001)** confirms that this relationship is **statistically significant**.

The findings of this study make it evident that increased expenditure on healthcare leads to a significant reduction in maternal, infant, and neonatal mortality rates. The negative correlation values indicate that as more resources are allocated to healthcare services, there is a marked decline in mortality rates. Furthermore, the statistically significant p-values indicate that these results are not merely coincidental, but rather reflect a genuine and impactful relationship.

Hence, investing in healthcare is critically important to improve public health outcomes, reduce mortality rates, and enhance the quality and accessibility of maternal and child healthcare services.

8 Future scope of the study

A significant relationship has been found between healthcare expenditure and maternal, infant, and neonatal mortality rates, indicating that investment in healthcare plays an effective role in reducing mortality rates. However, there is still a need for in-depth research on several aspects of this area. In the future, studies on this topic can be expanded to explore the quality of healthcare services, comparative conditions in rural and urban areas, the impact of government schemes, the role of socio-economic factors, comparative analysis with other states, and long-term effects.

Research can also focus on how the quality of healthcare services—such as the availability of facilities in hospitals, the number of trained doctors, and the quality of prenatal care—affects

mortality rates. Similarly, a comparative analysis of rural and urban healthcare systems in Rajasthan can help policymakers create region-specific effective strategies.

Another key area for future research is evaluating the impact of government schemes such as the Janani Suraksha Yojana (JSY), Pradhan Mantri Matru Vandana Yojana (PMMVY), Ayushman Bharat Yojana, and the National Health Mission (NHM). Analyzing these schemes will help in understanding their actual contribution to reducing maternal and infant mortality.

Additionally, education level, economic status, social awareness, and nutrition levels—which are important socio-economic determinants—should also be considered in future studies, as they can significantly influence mortality outcomes. The study can also be extended to include a comparative analysis with other states such as Bihar, Uttar Pradesh, Madhya Pradesh, and Jharkhand, to better understand the relative effectiveness of healthcare services across states.

Furthermore, analyzing the long-term effects of healthcare investment can provide insight into the sustainability and lasting impact of such reforms over the years. All of these potential studies can assist policymakers, researchers, and health service institutions in formulating more effective strategies, which can further reduce maternal and child mortality rates in Rajasthan and across India.

Thus, a comprehensive study of the impact of healthcare investment can serve as a guiding framework for future policy-making and health sector improvements, ensuring better health services for the most vulnerable sections of society and contributing to the overall improvement of health indicators.

9 Study limitations

This study is based on secondary data, which inherently comes with the limitations of not including primary data. Also, correlation only reflects the relationship between two variables and does not imply causation. Moreover, some other potential socio-economic and cultural factors influencing mortality rates have not been included in this study.

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