The Impact of Public Health Financing on Maternal Healthcare in India

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Abstract

This study investigates the impact of public health financing on maternal health outcomes in India, analyzing data from 15 states from 2015 to 2020. It examines the relationship between the maternal mortality ratio (MMR) and key indicators of public health financing on maternal healthcare, such as percentage of institutional births, antenatal care visits (at least four), and postnatal care within two days of delivery. The data was collected from the National Health Profile and the National Family Health Survey (NFHS) report. Employing correlation analysis and panel data analysis using the Panel Least Squares method, Breusch-Pagan test, Hausman test, and a Fixed Effects model in E-Views, the study aims to estimate the effect of these financing-related indicators on MMR. The correlation analysis showed that during the time period 2015 to 2020, there was a strong negative correlation between MMR and all the independent variables taken for the study. The panel data analysis shows that there is a significant relationship between the dependent and independent variables, and the fixed effect model is more appropriate for the analysis of such models. The secondary data analysis also shows the improvement of maternal health over time in India, as MMR has decreased over the years. The highest MMR is found in Assam and the lowest in Kerala during the study period. The findings will provide insights into the association between public health financing and improvements in maternal health outcomes across diverse Indian states over time.

Keywords: *Maternal Health; Maternal Mortality Ratio; Public Health Financing; Panel Data.*

1. Introduction

The United Nations' Sustainable Development Goals focus on the health and well-being of people, particularly highlighted in the third goal, which aims "to ensure healthy lives and promote well-being for all." Within this goal, the organization targets "reducing the global maternal mortality ratio to less than 70 per 100,000 live births by 2030." Additionally, it strives to guarantee "universal access to sexual and reproductive health care services, encompassing the integration of reproductive health into national programs and strategies, family planning, education, and awareness." Despite these efforts, "830 women die every day from preventable causes related to pregnancy and childbirth worldwide" (United Nations, 2023). "Maternal health is the well-being of women during pregnancy, childbirth, and the postnatal period" (World Health Organization, 2019). It serves as a crucial indicator of a country's economic development concerning poverty reduction and the advancement of gender equality. This is because healthy women are an important asset for the workforce, which in turn enables them to support their families and improve their economic status, which will ultimately promote economic growth (Onarheim et al., 2016). Maternal health is vital not only for the well-being of the mother but also affects the health of the child. A healthy pregnancy is essential for fetal development and growth. It can also reduce the mortality and morbidity of infants. The maternal mortality ratio also shows the quality of health services provided by the country (Nair & Panda, 2011). Thus, there should be effective implementation of public health programs related to maternal health, which is important not only for the survival and well-being of mothers but is also crucial to solve the social, economic, and development challenges of the nation in a broader perspective (Bernet et al., 2020).

Maternal health outcomes are significantly impacted by the distribution and availability of public health funding. Sufficient financial resources are necessary for women to have access to the healthcare services they need during pregnancy, delivery, and the postpartum phase. (Roozbeh et al., 2016). Public health financing helps ensure that women, particularly those from low socioeconomic backgrounds, have access to timely and high-quality care by removing financial barriers, strengthening healthcare infrastructure, training birth attendants, and providing essential medical supplies and medications. Strategic public funding investments in maternal health have a major positive economic impact by raising productivity and reducing the costs of medical care related to complications, in addition to improving the health of mothers and their infants (Stenberg et al., 2013). Ultimately, robust public health funding is a crucial element of programs aimed at reducing maternal mortality and morbidity and promoting healthier families and communities.

The study's main objective is "to examine the impact of public health financing on maternal health outcomes in India." In order to do this, "it examines the correlation between the maternal mortality ratio and the public health financing indicators chosen for the study, including the proportion of institutional births, the number of women who attended four or more prenatal care visits, and the number of women who received postnatal care from a medical professional within two days of giving birth." When the National Family Health Survey (NFHS) 4 and 5 were conducted between 2015 and 2020, the indicators were evaluated in 15 Indian states to determine how they had improved over time. The states selected for the study are "Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal." States from both northern and southern India were chosen to account for regional differences in the availability of services and the execution of public health programs.

Funding for public health is crucial to improve maternal health outcomes, particularly in low- and middle-income countries. Effective funding solutions can help reduce maternal mortality rates, improve access to high-quality healthcare, and increase the efficiency of resource allocation. Public health spending significantly affects maternal health outcomes by reducing maternal mortality rates. Increased domestic government spending on maternal health issues has resulted in a significant decrease in maternal mortality in Uganda. Additionally, public health spending as a percentage of total health spending has a positive impact on maternal health outcomes, underscoring the need for more government funding for maternal healthcare services to promote universal health coverage and improve health outcomes (Atuhaire et al., 2024). Maternal mortality and public health spending in the West African Economic and Monetary Union (WAEMU) are strongly correlated negatively, indicating that maternal health outcomes are improved by higher public health spending. The study highlights that although private health spending is positively correlated with maternal mortality, increasing public health care spending is crucial for reducing mother death rates. In order to build new medical facilities, improve existing infrastructure, and reduce costs for expectant mothers, WAEMU officials are urged to increase public health spending (Boundioa & Thiombiano, 2024). Public health spending, especially per capita health spending and the number of doctors, greatly improves maternal health outcomes in Bangladesh. As funding and healthcare services rise, so do maternal health indicators and life expectancy. This highlights the importance of prioritizing healthcare spending in order to enhance maternal and child health outcomes and ultimately produce a healthier population (Sultana et al., 2024).

Health financing has a significant impact on maternal health outcomes through supporting policy implementation, guaranteeing appropriate resource allocation, and encouraging collaboration between governmental and non-governmental organizations. Efficient funding options are necessary to improve access to high-quality maternal health services in Africa (Nyiramana, 2024). Public health finance is essential to improve maternal health outcomes in sub-Saharan Africa because it moderates the link between financial development and health outcomes. Consequently, this lowers maternal mortality rates and enhances general health conditions (Musah et al., 2024). Public health financing, particularly through results-based financing (RBF) and public-private partnerships (PPPs), enhances maternal health outcomes by better allocating resources, promoting high-quality care, and raising more money. This, in turn, improves access to healthcare and reduces gender disparities. (Kuteesa et al., 2024). Public health financing significantly affects maternal health outcomes in India by ensuring adequate funding for Reproductive, Maternal, Newborn, Child Health, and Nutrition (RMNCHN) programs. Increased public health spending enhances the quality of care, expands access to services, and ultimately improves maternal health outcomes (Goli et al., 2020). By demonstrating that public health spending significantly affects maternal health outcomes in Ghana and Nigeria, the study by Oladosu et al. (2022) highlights the need for increased public health funding to improve maternal health outcomes. Nigeria demonstrated a positive correlation with maternal health outcomes, whereas Ghana demonstrated a negative but insignificant correlation. Public health financing is essential to improve maternal health outcomes in Sierra Leone because it can help address systemic healthcare limitations, increase access to care, and support community health education, all of which will eventually reduce maternal mortality rates and enhance overall health outcomes (Sankoh et al., 2024). Results-based financing (RBF) can enhance maternal health outcomes by reducing facility-based maternal mortality. The fact that financial incentives improve the quality and utilization of maternal and newborn health services illustrates the significance of public health financing in this context (De Allegri et al., 2019).

Nicholas et al. (2016), and Rana et al. (2018), suggest limited impact of health spending on MMR. Nicholas et al. (2016), who focused on Sub-Saharan Africa, found that an increase of one percentage point in public health spending (as a percentage of GDP) was associated with the annual saving of roughly 7,040 children for every percentage point increase in newborn and under-five mortality. However, they did not discover any statistically significant influence on the rates of maternal deaths. This implies that general increase in spending may not be enough to address the specialized interventions required for maternal health, even though spending on general health improves child survival. Rana et al. (2018) reached a similar conclusion in a cross-country study with varying income levels that increasing health spending has no effect on maternal death rates, but it may reduce child mortality. Instead of just increasing health spending, they suggest focusing on practical measures like family planning and improving the effectiveness of the healthcare system to improve maternal health outcomes. The efficiency of health spending in enhancing maternal health outcomes is significantly moderated by the fundamental structure and governance of the healthcare system. Gebremedhin et al. (2022) demonstrates that the impact of public health insurance on maternal health care utilization was less significant than that of private insurance. This implies that in order to improve the effectiveness of public health funding in India, governance and infrastructure reforms are required. This study is substantiated by Kadarpeta et al. (2024), which highlights that the effectiveness of public funding for basic healthcare in India, including maternity healthcare is significantly influenced by governance and infrastructure.

The crucial role that public health spending plays in improving maternal health outcomes has been shown by numerous studies carried out in different regions. Increase in public health spending typically result in lower maternal mortality rates; however, the efficacy of these expenditures can be impacted by variables such as the quality of governance and healthcare infrastructure. Therefore, the purpose of this study is to estimate the relationship between public health funding and maternal health outcomes by examining the indicators of both public health finance and maternal health.

2. Research methodology

2.1. Data for the study

In this study, indicators of maternal health outcomes and public health financing were assessed during the time period 2015 to 2020 in 15 Indian states. In the analysis, "the maternal mortality ratio (MMR)" was used as the dependent variable, which is "the number of maternal deaths per 100,000 live births during a particular period of time." "Percentage of institutional births (PIB), percentage of women who did at least four visits for antenatal care (PAC), and percentage of women who got postnatal care from the doctor or any other health personnel within two days after delivery (PPC)" were used as the independent variables. They are the indicators of public health finance related to maternal health. "Percentage of institutional births is the percentage of births taking place in a medical institution under the supervision

and care of trained health personnel. Percentage of mothers who had at least 4 antenatal care visits includes mothers visiting the hospital while they are pregnant to ensure the health of both the baby and the mother. The percentage of mothers who received postnatal care from the doctor or any other health personnel within 2 days of delivery includes the mothers who had received immediate care following the childbirth." The states selected for the study are "Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal." States representing the north and south are selected, as there exists a difference in terms of the implementation of programs related to public health and services available in different parts of the country. The data was collected from "the National Health Profile and the National Family Health Survey (NFHS) report."

There are challenges in relying on secondary data, particularly for MMR. Due to insufficient vital registries and potential social stigmas, maternal deaths in India are frequently unreported and misclassified, particularly when they take place at home or in remote areas. Even reliable sources like the National Health Profile and NFHS, despite their comprehensiveness, may have consistency issues over time and between states due to varying data collection methods and local contexts. The collection of data from multiple sources in the National Health Profile raises the risk of methodological errors, which could compromise the accuracy of comparisons and trends.

Instead of using direct financial indicators like per capita health expenditure, the study used metrics related to service utilization as independent variables. These metrics include the proportion of births that take place in an institution, the number of women who receive postnatal care within two days, and the number of women who have at least four prenatal care visits. Since direct spending statistics only display the total amount spent and do not account for the final recipients, the quality of the services obtained, or the efficiency of the allocation process, they frequently present a "black box" problem. Raising per capita health spending alone does not always translate into improved maternal health because the effectiveness of funds is greatly influenced by governance, resource allocation, and use. Expensive expenses that are misused or poorly managed can have few positive effects and ignore crucial elements like operational infrastructure or the availability of skilled labor. However, by serving as reliable substitutes for the accessibility and quality of maternal healthcare, the chosen service utilization variables produce a stronger correlation with health outcomes. Institutional births directly reflect access to trained birth attendants and emergency obstetric care, which are critical for managing delivery issues. Regular engagement with the healthcare system, which enables health education and early risk assessment, is indicated by four or more prenatal care visits. Postnatal care is necessary to address early postpartum issues, which are a leading cause of maternal mortality. These metrics subtly reflect the outcomes of public health funding and the efficacy of the public health system. For instance, a rise in institutional births indicates the need for infrastructure, qualified staff, and publicly funded programs. Increased antenatal care and post-natal care coverage demonstrate effective use of resources to improve basic healthcare and deploy community health workers. Furthermore, since detailed, consistent data on service utilization, particularly from sources like NFHS, is occasionally easier to obtain at the state level than disaggregated financial spending data, these proxies are helpful for comparative research across Indian states. This approach gives policymakers more relevant data than just tracking overall spending.

2.2. Empirical analysis

To examine the relationship between public health funding and maternal health outcomes, this study employs correlation analysis and panel data techniques. Specifically, the analysis utilizes the Panel Least Square method, Breusch-Pagan test, Hausman test, and Fixed Effect model "to estimate the impact of public health funding on maternal health." All statistical analyses are conducted using E-Views software. The multiple linear regression model for the study is:

$$M_{st} = \alpha_1 + \alpha_2 X_{2st} + \alpha_3 X_{3st} + \alpha_4 X_{4st} + \varepsilon_t \qquad (1)$$

In the equation, MMR is used as the dependent variable, which is represented as (M_{st}). "Percentage of institutional births (X_{2st}), percentage of women who did at least four visits for antenatal care (X_{3st}), and percentage of women who got postnatal care from the doctor or any other health personnel within two days after delivery (X_{4st})" are used as the independent variables. α_1 is the intercept, α_2, α_3, and α_4 are the coefficients associated with the independent variables, s represents a particular state, t represents time period, and ε_t is the error term.

3. Results

The secondary data analysis of the maternal mortality ratio (MMR) in 15 Indian states was done to know about the maternal healthcare status in India. During the time period when NFHS 4 was conducted, the minimum MMR was 46, and the maximum value was 237. Thus, the average MMR during the time was 128.33. On the other hand, during the period 2018 to 2020, the minimum value of MMR was 19, and the maximum was 195. It also showed an average value of 98.67. Thus, the data depicts that the average MMR in the selected 15 Indian states decreased from 128.33 in 2014-16 to 98.67 in 2018-20. This reduction in MMR shows an improvement in the maternal health of women. Figure 1 given below depicts the trend in maternal mortality ratio in 15 Indian states selected for the study during the period 2014-16 and 2018-20. It shows that MMR has decreased over the years, and the highest MMR is found in Assam and the lowest in Kerala during the study period.
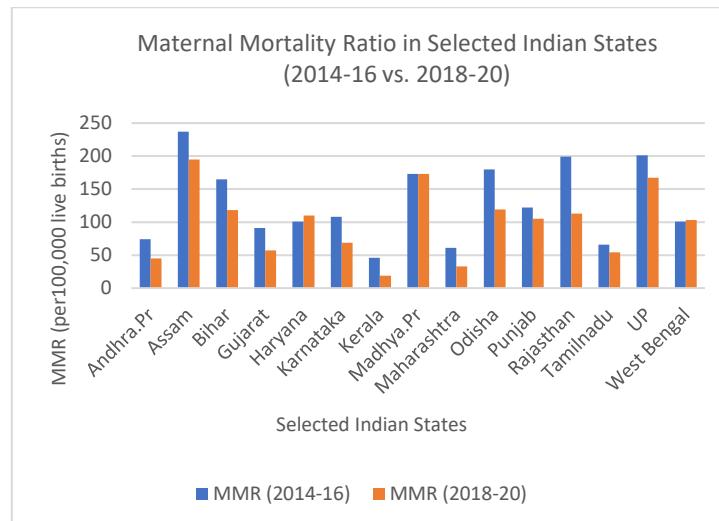
Fig. 1: Maternal Mortality Ratio Trends in Selected Indian States in 2014-16 and 2018-20.

The correlation analysis showed that during the time period 2015 to 2020, there was a strong negative correlation between MMR and all the independent variables taken for the study, as the range of Pearson correlation coefficient values for the variables was -0.77 to -0.60. It means that "an increase in the indicators of public health finance related to maternal healthcare results in a decrease in the maternal mortality ratio." The analysis also showed that the correlation was significant at both 0.01 and 0.05 levels. Tables 1 and 2 given below show the correlation analysis during NFHS 4 and NFHS 5.

Table 1: Correlation Analysis During NFHS 4

Test	"Maternal mortality ratio during NFHS4"	"Percentage of institutional births"	"Percentage of mothers with 4 antenatal care visits"	"Percentage of mothers with postnatal care"
Pearson Correlation	1	-.720**	-.770**	-.622*
Sig. (2-tailed)	-	.002	.001	.013
N	15	15	15	15

Table 2: Correlation Analysis During NFHS 5

Test	"Maternal mortality ratio during NFHS5"	"Percentage of institutional births"	"Percentage of mothers with 4 antenatal care visits"	"Percentage of mothers with postnatal care"
Pearson Correlation	1	-.689**	-.619*	-.601*
Sig. (2-tailed)	-	.005	.014	.018
N	15	15	15	15

"** Correlation is significant at the 0.01 level (2-tailed)".
"*Correlation is significant at the 0.05 level (2-tailed)".

Panel data analysis using Panel least square method, Breusch-Pagan test, Hausman test, and Fixed Effect model is used "to estimate the impact of public health funding on maternal health outcomes." First, Panel Least Square or POLS is used. The null hypothesis for the panel least squares assume that "there exists no relationship between the variables of maternal health and public health financing related to maternal health." The alternate hypothesis is that "there exists a significant relationship between the dependent and independent variables." Table 3 given below shows the result obtained in the Panel Least Squares method.

Table 3: Result Obtained in Panel Least Square Method

Variable	Coefficient	t-statistic	Probability
PIB	122126.8	0.408	0.000
PAC	113260.2	0.303	0.000
PPC	102462.3	0.20	0.000

The result obtained in panel least squares shows that "for all the variables p-value is less than the 5% significance level and the t-statistic is 0.000." It means that the null hypothesis of no relationship between the variables gets rejected, indicating "a significant relationship between the dependent variable maternal mortality ratio (MMR) and independent variables, which are percentage of institutional births (PIB), percentage of women who did at least four visits for antenatal care (PAC), and percentage of women who got postnatal care from the doctor or any other health personnel within two days after delivery (PPC)." Then the Breusch-Pagan (BP) test is applied, in which the null hypothesis is "POLS is more appropriate than the Fixed Effect Model (FEM) and Random Effect Model (REM)." If the significance value or p-value is greater than 0.05, accept the null hypothesis and apply POLS. If the p-value is less than 0.05, then reject the null hypothesis and apply FEM or REM. Table 4 given below shows the output obtained in the Breusch-Pagan test.

Table 4: Result Obtained in Breusch-Pagan Test

Null hypothesis: No effects			
Alternate hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives			
Test	Cross-section	Time	Both
"Breusch-Pagan"	41.17786 (0.0000)	6.272257 (0.0123)	47.45012 (0.0000)
"Honda"	6.416998 (0.00000	2.504447 (0.0061)	6.308414 (0.0000)
"King-Wu"	6.416998 (0.0000)	2.504447 (0.0061)	6.705919 (0.0000)

"Standardized Honda"	8.574066 (0.0000)	2.764752 (0.0028)	3.295555 (0.0005)
"Standardized King-Wu"	8.574066 (0.0000)	2.764752 (0.0028)	4.151675 (0.0000)
"Gourie roux, et al."	-	-	47.45012 (0.0000)

In the analysis p-value is less than 0.05. So, Random Effect Model is applied. Then Hausman test is applied in which the null hypothesis is "REM is appropriate than FEM. If p-value is greater than 0.05, accept the null hypothesis and apply REM. If p-value is less than 0.05, reject the null hypothesis and apply FEM. Table 5 shows the result of Hausman test.

Table 5: Result of Hausman Test

Test Summary	Chi-Square Statistic	Chi-Square degrees of freedom	Probability Value	
Cross-section random	37.537	3	0.0000	
Cross-section random effects test comparison				
Variable	Fixed	Random	Var.(diff.)	Prob.
PIB	-716340.8	3096.48	58930422	0.0000
PAC	-758238	1231824	13074061	0.0000
PPC	-348322	20688.663	66338792	0.0000

In the analysis, the p-value is 0.0000 for all the independent variables, which is less than 0.05. Thus, the null hypothesis gets rejected, indicating that the fixed effect model is appropriate for the analysis. So, the Fixed Effect Model is applied to find out the empirical results of the analysis. Table 6 shows the results obtained using the fixed effect model.

Table 6: Result of Fixed Effect Specification

Effects Specification	
Cross-section fixed (dummy variables)	
Mean dependent var-23520301	Adjusted R-squared-0.551046
Akaike info criterion-35.87758	R-squared-0.578118
Schwarz criterion-36.09197	Log likelihood--3574.758
Hannan-Quinn criterion-35.96434	F-statistic-21.35436
Durbin Watson stat-1.086786	Prob (F-statistic)-0.000000

The "Cross-section fixed" specification in Table 6 makes sure that observed relationships are not solely the product of fundamental state differences by using dummy variables to account for the unique, unchanging characteristics of each state. The mean dependent variable (23520301) in the dataset represents the average MMR. Akaike information criterion, Schwarz criterion, and Hannan-Quinn criterion are model comparison techniques, in which lower numbers denote a better model. In the result of fixed effect specification, the R-squared value obtained is 0.578118, which means that "57.81% of changes in the dependent variable, maternal mortality ratio, which is the indicator of maternal health, are caused due to changes in the independent variables such as, percentage of institutional births, percentage of women who did at least four visits for antenatal care, and percentage of women who got postnatal care from the doctor or any other health personnel within two days after delivery, which are the indicators of public health funding on maternal healthcare and the state-specific fixed effects." . The Adjusted R-squared (55.1%), which remains close to the R-squared (57.8%), indicates a good model fit that is not inflated by extra variables. The probability value of 0.0000, which is less than 0.05 at a 5% significance level, also shows the significant relationship between the dependent and independent variables of the study. The statistical significance of the entire model is confirmed by this highly significant p-value, indicating that the independent variables taken together significantly affect MMR.

4. Discussion

The strong negative correlation observed between the maternal mortality ratio (MMR) and the selected indicators of public health financing on maternal healthcare—institutional births, antenatal care (PAC) visits, and postnatal care (PPC)—between 2015 and 2020 suggests a significant association. It shows that as the utilization of these essential maternal health services increases the number of maternal deaths tends to decrease. This result is consistent with previous research that emphasizes how important it is to have access to and use maternal health services in order to lower the number of maternal deaths (Sharma et al. 2020; UNFPA, 2024). It reflects the immediate effects of professional delivery care, routine prenatal checkups to detect and treat issues, and prompt postnatal care for both the mother and the baby. Deliveries at institutions are guaranteed to take place under the careful supervision of qualified medical personnel equipped to manage crises. Timely PPC is essential for addressing postpartum complications and providing critical care for the new mother and baby, while adequate PAC enables the early detection and management of pregnancy-related risks such as pre-eclampsia or gestational diabetes (McCauley et al., 2022).

Improvements in service utilization are associated with lower MMR in all states under study, according to the panel data analysis, which is further supported by the efficacy of the fixed effects model. Although not directly measured in our study, the fixed effects model aids in controlling for state-specific time-invariant characteristics that may have an impact on maternal health outcomes. For example, a state's general health infrastructure, long-standing health policies, or sociocultural factors may all be involved. The varied advancements and current inequalities in maternal health outcomes throughout the country are reflected in the observed temporal decline in MMR throughout India, with Assam continuously showing the highest rates and Kerala the lowest rates during the study period (NFHS-5, 2021). Kerala's consistently low MMR is often credited to its robust primary healthcare system, high literacy rates, and efficient health program implementation (Kutty, 2000). A more recent perspective on the long-standing benefits of Kerala's healthcare system can be found in another study by Mol et al. (2025). It is a good, contemporary example of research that supports the long-held understanding of the "Kerala Model" and its contributions to excellent health indicators, including low MMR, with its combination of strong primary healthcare, high literacy and empowerment, and effective program implementation. Its careful analysis of Kerala's accomplishments directly supports the study's conclusions, despite the fact that it recommends replicating Kerala's strategy using Bihar as a comparison case. However, Assam's higher MMR might be a result of socioeconomic issues, geographic accessibility issues, and possibly, differences in the quality and accessibility of maternal health care. Overall, MMR decreased throughout India during the study period, which is encouraging and indicates that national-level initiatives and advancements in healthcare access are being effective. However, the significant differences between states highlight the need for targeted interventions and policy adjustments that address the specific challenges and contexts of higher-burden states like Assam.

In essence, this study provides evidence supporting the crucial link between public health financing, leading to increased utilization of key maternal healthcare services, and improved maternal health outcomes. It emphasizes that continued and strategic investments in strengthening institutional deliveries, ensuring comprehensive antenatal care, and promoting timely postnatal care are vital for further reducing maternal mortality in India and achieving greater equity across its diverse states.

5. Conclusion

According to this study, public health financing significantly reduced maternal mortality in India between 2015 and 2020 by increasing the use of institutional births, prenatal care, and postnatal care. The robust results from the panel data analysis using a fixed effects model and the strong negative correlation highlight how important these vital maternal health services are in saving women's lives. In order to guarantee access to and use of these life-saving interventions, it is imperative that public health systems be strengthened through consistent and strategic investments. This will ultimately help mothers to have a healthier future. Even though MMR has decreased generally in India, the ongoing differences between states like Assam and Kerala underscore the necessity of focused and situation-specific interventions to attain fair maternal health outcomes nationwide. It is unlikely that a one-size-fits-all strategy will be successful in enhancing maternal health in a multicultural nation like India. Programs and policies must be customized to each state's particular opportunities and problems while taking into consideration its socioeconomic, cultural, and geographic characteristics. This could entail focusing on specific elements of service delivery that are less effective in some states, addressing cultural customs that impede healthcare utilization, or developing alternative approaches to enhancing access in remote areas. The ultimate objective is to go beyond a general improvement and work towards "equitable maternal health outcomes," where all women have an equal chance of a safe pregnancy and delivery, regardless of where they live.

Future research should focus on the application of fintech technologies in health finance, specifically how digital payment systems and mobile banking could enhance cash flow and accountability for maternal health programs. Research may also examine the causal mechanisms through which governance quality (such as transparency, anti-corruption efforts, and decentralization) directly influences how well health spending affects MMR, as opposed to merely concentrating on correlations.

6. Policy implications

The study's conclusions have important policy ramifications for improving maternal health outcomes in India. Given the obvious correlation between lower MMR and service utilization, public health funding must be maintained and possibly increased, with a focus on strengthening the infrastructure, human resources, and service delivery systems for maternal healthcare. Improving access to and encouraging the use of institutional births, thorough prenatal care (including four or more visits), and prompt postnatal care within the first two days of delivery should be the top priorities of policy. This could entail removing geographical restrictions, enhancing service quality, and increasing community awareness. Given the notable interstate differences, especially the persistently higher MMR in states such as Assam, targeted interventions that are adapted to the unique difficulties and socioeconomic circumstances of these areas must be developed and put into place. This could entail addressing the root causes of poor maternal health, allocating resources strategically, and implementing creative service delivery models. The significance of a strong primary healthcare system is underscored by the achievement of low MMR in states such as Kerala. Enhancing early access and lowering the need for more involved interventions can be achieved by solidifying the primary healthcare system and guaranteeing the availability of trained birth attendants and critical maternal health services at the community level. Healthcare-seeking behaviour can be influenced by sociocultural factors. Policies should work to remove these obstacles by promoting the value of institutional births, PAC, and PPC through culturally relevant health education initiatives and community engagement strategies. It is essential to regularly monitor maternal health indicators and the success of policies that have been put into place. Interventions will be evidence-based and effective if data from sources such as the National Health Profile and NFHS are used to monitor progress and pinpoint areas that need more focus. Furthermore, exploring the effectiveness of results-based financing (RBF) models in incentivizing improved maternal health outcomes, particularly in diverse Indian state contexts, would be crucial. This includes analyzing the mechanisms by which RBF influences service quality and uptake for institutional births, PAC, and PPC. In order to address the wider determinants of maternal well-being, improving maternal health necessitates a multi-sectoral approach involving cooperation between the health sector, education, women and child development, and other pertinent departments (Souza et al., 2023). By implementing these policy recommendations, India can further accelerate its progress in reducing maternal mortality and achieve greater equity in maternal health outcomes across all its states.

Author's contributions

First author-analysis and writing. Second author- data collection and revising.

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Data availability

The datasets used during the current study are available from the corresponding author on reasonable request.

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