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FACTOR AFFECTING INFANT MORTALITY RATE IN INDIA: A CROSS-SECTIONAL STUDY

https://orcid.org/0009-0001-0103-0047

ABDUL HAI AHMED
Assistant Professor
Department of Economics
Alamganj Rangamati College
Alamganj, Dhubri, Assam
abdulhaiahmedrumi@gmail.com

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ABSTRACT
In this research paper, we aimed to analyze the factors that influence infant mortality rates in India by examining cross-sectional data from a randomly selected district. Our study findings indicate a significant negative correlation between female literacy rates (FLR) and infant mortality rates (IMR). Additionally, we discovered a statistically significant positive impact of the Climate Vulnerability Index (CVI) on Infant mortality rate(IMR). We employed a linear regression analysis using the Ordinary Least Square (OLS) method. We also investigated the impact of Functional Healthcare Facilities (FHC) and Female Workforce Participation Rate (FWFP) on IMR, but their effects were found to be statistically insignificant.

KEY WORDS: *Female literacy rate, Infant mortality rate, Climate Vulnerability Index, OLS*

Introduction

India has made significant progress in reducing infant mortality over the past few decades, but the country still faces significant challenges in providing adequate healthcare to all of its citizens, especially in rural areas. According to the World Bank, the infant mortality rate in India was 28.3 deaths per 1,000 live births in 2020. This is a significant decline from previous years, as the infant mortality rate in India was 66.7 deaths per 1,000 live births in 1990. (IMR Full Form, 2023)Infant mortality rate (IMR) is a measure of the number of deaths of infants under one year of age per 1,000 live births. A high infant mortality rate is generally considered to be a sign of poor health outcomes and inadequate access to healthcare for mothers and infants. There are several reasons why a high infant mortality rate is considered to be bad. The most obvious reason why a high infant mortality rate is bad is that it results in the loss of life for young children. Infants are the most vulnerable members of society and their deaths are a tragedy for families and communities. High infant mortality rates are often linked to poor maternal health, including inadequate nutrition, lack of access to prenatal care, and complications during childbirth. Poor maternal health can also have long-term health consequences for mothers. High infant mortality rates are often a reflection of inadequate access to healthcare, including prenatal care, delivery services, and postnatal care. Infants born in low-income and rural areas often have limited access to healthcare services, resulting in higher rates of infant mortality .Infant mortality rates are often higher among disadvantaged and marginalized communities, reflecting socioeconomic inequalities in access to healthcare and other resources. High infant mortality rates can also have significant economic costs, including lost productivity and healthcare expenses. In addition to these reasons, a high infant mortality rate can also be a sign of broader social and environmental challenges, including poverty, inadequate sanitation and housing, and environmental pollution. Therefore, reducing infant mortality rates is a crucial goal for public health, social welfare, and economic development.

Infant mortality rate (IMR) is affected by a complex interplay of factors, including biological, social, economic, and environmental factors. Some of the key factors that can affect infant mortality rate include:

Maternal health: Maternal health is a critical determinant of infant health and survival. Women who are malnourished, have chronic health conditions, or experience complications during pregnancy and childbirth are more likely to give birth to infants with low birth weight, preterm birth, and other health complications that can increase the risk of infant mortality.

Access to healthcare: Access to quality healthcare services, including prenatal care, delivery services, and postnatal care, is critical for ensuring the health and survival of both mothers and infants. Lack of access to healthcare services, particularly in low-income and rural areas, can contribute to higher rates of infant mortality.

Socioeconomic factors: Socioeconomic factors such as poverty, low education levels, and unemployment can all contribute to higher rates of infant mortality. These factors can affect access to healthcare, nutrition, and other resources that are critical for infant health and survival.

Environmental factors: Exposure to environmental factors such as air pollution, water pollution, and toxic chemicals can all contribute to higher rates of infant mortality. Infants are particularly vulnerable to environmental pollutants due to their still-developing organs and immune systems.

***Cultural factors*:** Cultural factors such as traditional beliefs and practices related to infant care and feeding can also play a role in infant mortality rates. For example, cultural practices that discourage exclusive breastfeeding or that lead to exposure to harmful substances can increase the risk of infant mortality.

Infectious diseases: Infectious diseases such as pneumonia, diarrheal diseases, and malaria can all contribute to higher rates of infant mortality, particularly in low- and middle-income countries where these diseases are more prevalent.

Public health policies: Public health policies, such as vaccination programs and programs to improve maternal and infant nutrition, can have a significant impact on infant mortality rates.

Understanding and addressing these factors is critical for reducing infant mortality rates and improving the health and survival of infants around the world.

In this paper we have investigated air quality, education of the women, healthcare and economic status as factor effecting Infant Mortality Rate (IMR) in India.

Literature Review

To investigate the factors that effect infant mortality rate a numerous study has been conducted around the world. Most of the study mainly targeted many important variable such as female literacy rate, Income of the household, healthcare facility, environmental quality, labor force participation of the women as factor that effect infant mortality rate. (Suriyaakala, Deepika, & Amalendu, 2016) has analyzed the data from Indiastat.com for all Indian states and Union Territories in 2001 and 2011 to examine how infant mortality rate is affected by fertility rate, national income, women in labor force, healthcare expenditure, female literacy rates, and certain healthcare infrastructure-related variables. By utilizing regression analysis, the study not only determined the impact of these variables on infant mortality rates, but also evaluated the effectiveness of individual states and Union Territories in decreasing IMR. (Barman & Talukdar, 2014) made an attempt to find out the different socio-demography factors affecting the infant mortality rate in the state of Assam. A significant factor contributing to the death of infants is the level of education among women was found moreover their research indicated that the likelihood of maternal mortality is greater for women who are unable to read and write compared to those who are literate. (Shetty & Shetty, 2014) aimed to comprehend the underlying reasons for the negative correlation between infant mortality rate (IMR) and female literacy rate. They gathered information on the IMR and female literacy rate from four previous censuses for 28 Indian states. They analyzed the changes in both rates between consecutive censuses and calculated the decrease in IMR per percentage increase in female literacy. They observed that the drop in IMR was not constant and was most significant when the female literacy rate in the states reached 50%. A similar rapid decline was also noticed when the female literacy rate reached 65-70%. (Greenstone & Hanna, 2011) analyzed India's environmental regulations by using a vast data file on air pollution, water pollution, environmental regulations, and infant mortality. It found that India's air pollution regulations were effective in reducing particulate matter, sulfur dioxide, and nitrogen dioxide. The most successful regulation led to a slight decrease in infant mortality, but the change was not statistically significant. (Bobak & Leon, 1992) studied the relationship between air pollution and infant mortality in the Czech Republic. They used data collected between 1986-88 for 46 out of 85 districts in the country to analyze the effects of total suspended particulates (TSP-10), sulphur dioxide (SO2), and oxides of nitrogen (NOx) on infant mortality rates. The data was adjusted for socioeconomic factors such as income, car ownership, and abortion rate. The study found weak positive associations between neonatal mortality and quintile of TSP-10 and SO2, while stronger effects were observed for postneonatal mortality. The risk of postneonatal respiratory mortality increased consistently with higher levels of TSP-10, and there was also a suggestion of a positive association with SO2. they concluded that the specificity of the association between air pollution and postneonatal respiratory mortality is consistent with the known effects of air pollution on respiratory disease morbidity in children. (Loomis, Castillejos, R. Gold, McDonnel, & Borja-Aburto, 1999) aimed to examine the relationship between air pollution and infant mortality, given that previous air pollution episodes in the 1950s led to significant increases in infant mortality. The study conducted a time-series analysis in the southwestern part of Mexico City between 1993 to 1995, using mortality data from death registrations and air pollution measurements from a monitoring station. The study found that infant mortality was associated with the level of fine particles in the days leading up to death, with the strongest association observed for the average concentration of fine particles 3 to 5 days prior to death. An increase in the mean level of fine particles during this period was associated with a 6.9% excess of infant deaths. While the levels of nitrogen dioxide and ozone were also linked to infant mortality, their association was less consistent compared to fine particles. (Siah & Lee, 2015) in their research, the connection between female labor force participation rate, infant mortality rate, and fertility in Malaysia, a developing country in Asia, is investigated in both the short and long term. To conduct this study, a unit root test with two structural breaks is used, and dummy variables are created from the break dates for the bounds testing procedure. The ARDL modeling approach and Granger-causality test are also used. The findings suggest that mortality changes have a positive and significant impact on fertility rates in the long term. (Macinko, Shi, & Starfield, 2004) analyzed the impact of health system factors on the link between wage inequality and infant mortality in 19 OECD countries between 1970 and 1996, using a pooled, cross-sectional, time-series approach. The research offered a global proof of how wage disparities can affect infant mortality. The findings proposed that enhancing specific aspects of the healthcare system could potentially offset the harmful consequences of social inequalities on overall public health.

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Through the preceding discussion, it has been noted that infant mortality rate can be influenced by a range of factors, including but not limited to: women's education, women's employment status, air pollution, access to healthcare, household income, and more. The aim of this paper is to explore the impact of certain factors on infant mortality rate in India. Specifically, we will analyze the effectiveness of previously identified factors that affect infant mortality using cross-sectional data collected from various regions throughout India. Our sample was randomly selected to ensure a representative distribution of variables.

Data and Methodology

Variables

***Infant Mortality rate* (IMR)**: Infant mortality refers to the death of a child before their first birthday. The infant mortality rate (IMR) measures the number of infant deaths per 1,000 live births, making it a crucial indicator of a population's health and safety during and after childbirth. To calculate the IMR, the number of infant deaths is divided by the number of live births, and the result is then multiplied by 1,000. A lower IMR is generally indicative of better maternal and child healthcare, as well as improved socioeconomic conditions. It is taken as dependent variable.

Female literacy rate(FLR): Female literacy rate refers to the percentage of females in a population who are able to read and write with understanding. It is typically measured for individuals aged 15 years and above.

Female literacy rate = (Number of literate females in the population aged 15 years and above / Total number of females in the population aged 15 years and above) x 100%

There is a strong correlation between female literacy rate and infant mortality rate, as studies such as (Suriyaakala, Deepika, & Amalendu, 2016) and (Shetty & Shetty, 2014) have shown that higher female literacy rates are associated with lower infant mortality rates. The education and literacy of women have a positive effect on infant mortality rates as it provides them with access to health information and the ability to make informed decisions about their own health and the health of their children. This, in turn, can result in better maternal and child health outcomes, reducing the risk of infant mortality. Therefore, it is crucial to consider literacy rates as a key determinant of infant mortality rates.

***Female workforce participation rate (FWFP)*:** It refers to the percentage of women who are currently employed or seeking employment in the labor market. It is calculate as

Female Workforce Participation Rate = (Number of Women in the Workforce / Total Female Population) x 100

It is evident by the study of (Suriyaakala, Deepika, & Amalendu, 2016) to suggest that women's workforce participation rate can have a positive impact on infant mortality rate. If women are employed, they are more likely to have increased access to education, healthcare, and financial resources. This, in turn, can positively impact their health and the health of their families, including their babies. Women who work also tend to have more say in their reproductive decisions and are better able to access family planning services, which can lead to healthier pregnancies and better outcomes for both mother and child. Furthermore, the participation of women in the workforce can serve as an indicator of a family's financial standing. Therefore, it is important to consider female workforce participation rate as a key determinant of infant mortality rates.

Functional health care facilities(FHC): Functional health care facilities per 10,000 population is also taken as an independent variable. The data of FHC comprised of Functional health centres, Sub centres (SCs), Primary Health Centres (PHCs), Community Health Centres (CHCs), Health and Wellness Centres - sub centres (HWC-SCs), Health and Wellness Centres - Primary Health Centres (HWC-PHCs), Sub-divisional hospitals, district hospitals per 1000 population Access to prenatal care is a critical aspect of a functional healthcare facility as it is vital for both maternal and infant health.

Prenatal care enables early detection and treatment of health issues and also provides guidance on healthy behaviors during pregnancy. This can significantly reduce the likelihood of complications arising during pregnancy and childbirth, which can ultimately contribute to a reduction in the infant mortality rate.

Climate vulnerability index (CVI): It is a composite measure that assesses the vulnerability of a region or population to the impacts of climate change. It is constructed by taking a simple arithmetic mean of all the normalized scores such as Exposure, Sensitivity, Adaptive Capacity. Extreme temperatures can lead to dehydration, heat exhaustion, and other heat-related illnesses, which can be particularly harmful to infants who are more vulnerable to these conditions. Extreme cold can also increase the risk of respiratory infections and other illnesses, which can be more severe in infants. Therefore we have taken is as a predicate to infant mortality rate (IMR).

All variables were collected from The National Data and Analytics Platform (NDAP), and the data was gathered in 2021 at the district level in a cross-sectional manner.

Model and results

In this study, we aim to examine the relationship between infant mortality rate (IMR) and female literacy rate (FLR), female workforce participation rate (FWFP), functional health care facilities (FHC), and climate vulnerability index (CVI). To achieve this, we employed an empirical model based on ordinary least squares (OLS) regression. Through this model, we can analyze the impact of each of these factors on IMR and explore any potential correlations or patterns. By using a simple OLS regression, we are able to identify any statistically significant relationships and gain a deeper understanding of the factors that contribute to infant mortality.

$$IMR = FLR + FWFP + FHC + CVI + u \dots\dots\dots\dots\dots\dots..(1)$$

Where,

IMR= Infant mortality rate

FLR= Female literacy rate

FWFP= Female workforce participation rate

FHC =Functional Healthcare facilities

CVI= Climate vulnerability index

u= Random error

The estimated regression result is presented below-

Independent variable	Dependent variable: IMR
CVI	20.864*** (7.258)
FWFP	-2.970 (7.663)
FHC	3.307 (3.714)
FLR	-0.272*** (0.046)
Constant	60.638*** (6.485)
Observations	109
R2	0.435
Adjusted R2	0.413
Residual Std. Error	6.694 (df = 104)
F Statistic	19.995*** (df = 4; 104)
Note:	*p<0.1; **p<0.05; ***p<0.01

Discussion

The regression results indicate that the Infant Mortality Rate (IMR) is influenced by both the Female Literacy Rate (FLR) and the Climate Vulnerability Index (CVI). Specifically, the FLR has a negative effect on the IMR, while the CVI has a positive effect. Conversely, the Female Workforce Participation Rate (FWFP) and the availability of Functional Healthcare Facilities (FHC) were anticipated to have a negative and positive impact on IMR, respectively. However, the analysis reveals that these variables have no statistically significant effect on IMR. The estimated regression equation indicates that the intercept is 60.38 infant deaths per 1,000 live births, which is statistically significant at

1% level of significance. Furthermore, the Female Literacy Rate (FLR) coefficient reveals that for every one percent increase in the FLR, there is a significant reduction of 0.272 infant deaths per 1,000 live births under 1% level of significance. Similarly, the Climate Vulnerability Index (CVI) coefficient shows that an increase of 0.1 unit in the CVI results in a statistically significant decrease of 20.86 infant deaths per 1,000 live births. The observed R^2 is 0.435 which reveals that around 43.5% variation in the Infant mortality rate is explained by independent variables. The calculated F-statistic is found to be 19.995 with 4 and104 degrees of freedom which is statistically significant with 1% level of significance.

If the calculated residual heteroscedastic, the Ordinary Least Squares (OLS) estimators and their associated regression predictions although remain unbiased and consistent, they are no longer the most efficient estimators (known as the Best Linear Unbiased Estimators or BLUE). Consequently, the regression predictions may also be less efficient (T.S. Breusch & A.R. Pagan 1979) . the Breusch-Pagan test reveals the test statistic to be 6.8142 with 4 degrees of freedom with p-value 0.146 under the null hypothesis of homoscedasticity, Since P-value is less than 0.05(5%level of significance) we have no evidence of residual heteroscedasticity. Jarque–Bera Test reveals the test statistic 0.0074584 with 2 degrees of freedom having the P-value of 0.9963 under the null of normally distributed residuals, which has been accepted by the test result (J. B. Cromwell, W. C. Labys and M. Terraza ,1994). Moreover Variance Inflation Factors (VIF), is found to be less than two for each independent variable therefore the problem of Multicollinearity does not seem to exist.

Conclusion

In this study, we examined various factors that impact infant mortality rates using cross-sectional data collected from a randomly selected district level data . Our findings reveal a strong negative correlation between Female literacy rates(FLR) and Infant mortality rates(IMR). In other words, increasing female literacy rates can be an effective approach to combat the problem of infant mortality rates. Additionally, our study indicates that climate change and air pollution have a significant positive impact on Infant mortality rates(IMR). Therefore, mitigating air pollution and addressing climate change can contribute to better maternal health outcomes.

Our research aligns with existing literature in this field. However, we acknowledge that our study has limitations. For instance, while many studies demonstrate that family income has a negative impact on Infant mortality rates(IMR), we did not directly incorporate it in our study. Instead, we used female workforce participation as a proxy for household income level. Furthermore, we did not account for the correlation between female literacy rates and female workforce participation in our analysis.

References

1. IMR Full Form. (2023, January 1). Retrieved from testbook: https://testbook.com/full-form/imr-full-form
2. Barman, N., & Talukdar, D. (2014). SOCIO-DEMOGRAPHIC FACTORS AFFECTING INFANTING INFANT MORTALITY RATE. *International Journal of Science, Environment and Technology*.
3. Bobak, D. M., & Leon, D. (1992). Air pollution and infant mortality in the Czech Republic, 1986-88. *THE LANCET*, 1010-1014.
4. Greenstone, M., & Hanna, R. (2011). ENVIRONMENTAL REGULATIONS, AIR AND WATER POLLUTION, AND INFANTMORTALITY IN INDIA. *NBER WORKING PAPER SERIES*.
5. Loomis, D., Castillejos, M., R. Gold, D., McDonnel, W., & Borja-Aburto, V. H. (1999). Air Pollution and Infant Mortality in Mexico City. *Lippincott Williams & Wilkins*, 118-123.
6. Macinko, J., Shi, L., & Starfield, B. (2004). Wage inequality, the health system, and infant mortality in wealthy industrialized countries,

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SIF 7.399

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Journal in Arts, Commerce, Education & Social Sciences

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1970–1996. *Social Science & Medicine*, 279-292.

7. Shetty, A., & Shetty, S. (2014). The Impact of Female Literacy on Infant Mortality Rate in Indian States. *Current Pediatric Research*, 49-56.
8. Siah, A. K., & Lee, G. H. (2015). Female labour force participation, infant mortality and fertility in Malaysia. *Journal of the Asia Pacific Economy*, 613-629.
9. Suriyaakala, V., Deepika, M., & Amalendu, J. (2016). Factors Affecting Infant Mortality Rate in India: An Analysis of Indian States. *Intelligent Systems Technologies and Applications* (pp. 707–719). Springer, Cham.
10. IPCC. 2014. "Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects." Cambridge University Press. https://www.cambridge.org/core/books/climate-change-2014-impacts-adaptation-and-vulnerability-part-a-global-andsectoral-aspects/1BE4ED76F97CF3A75C64487E6274783A.
11. J. B. Cromwell, W. C. Labys and M. Terraza (1994): Univariate Tests for Time Series Models, Sage, Thousand Oaks, CA, pages 20–22
12. T.S. Breusch & A.R. Pagan (1979), A Simple Test for Heteroscedasticity and Random Coefficient Variation. Econometrica 47, 1287–1294