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An Analytical Study of Infant Mortality in Maharashtra

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Abstract:
Infant mortality is a key indicator of population health, socio-economic development, and the effectiveness of healthcare systems. The present study examines the trends, patterns, and determinants of Infant Mortality Rate (IMR) in Maharashtra, with reference to broader child mortality trends in India. The study is based on secondary data obtained from the National Family Health Survey (NFHS), Sample Registration System (SRS), Census of India, and government health reports, covering the period 2010–2021. A descriptive and analytical research design is adopted, employing tools such as percentage analysis, trend analysis, and comparative analysis. The findings reveal a significant decline in infant mortality in Maharashtra, with IMR decreasing steadily across successive NFHS rounds. However, persistent rural–urban disparities remain, with rural areas recording higher mortality rates than urban areas. Gender differentials and maternal education also emerge as important determinants. The study concludes that while progress is evident, targeted rural health interventions are essential to achieve equitable reductions in infant mortality.

Keywords: Infant Mortality Rate, Child Mortality, Under-Five Mortality Rate, Rural–Urban Disparities, Maternal Health, Maharashtra, National Family Health Survey (NFHS), Public Health Policy.

INTRODUCTION:

The study of mortality has evolved significantly through history. In the ancient period, high mortality rates resulted from famine, warfare, and diseases like plague and smallpox, with life expectancy often below 35 years. The medieval period saw continued high mortality due to epidemics like the Black Death, exacerbated by poor hygiene and overcrowding. The early modern period marked the beginning of scientific mortality analysis, initiated by the introduction of vital statistics. The 19th century's Industrial Revolution initially worsened mortality due to urbanization, but later public health improvements reduced death rates. The 20th century experienced a dramatic decline in mortality due to advancements in antibiotics, immunization, and healthcare, leading to increased life expectancy. In the contemporary period, developed countries enjoy low mortality rates, while developing regions struggle with inequality and access to healthcare, as mortality patterns increasingly reflect non-communicable diseases over infectious ones.

Historically, infant mortality has been one of the most serious demographic and public health problems faced by human societies. In ancient and medieval periods, infant mortality rates were extremely high due to poor nutrition, lack of medical knowledge, unhygienic living conditions, and frequent epidemics. Many infants died soon after birth because of birth complications, infections, and absence of skilled care. Survival beyond the first year of life was uncertain, and high infant mortality was considered a normal part of life.

During the 17th and 18th centuries, scholars began to systematically study infant deaths. The work of John Graunt (1662) in England marked the beginning of demographic analysis using birth and death records. This period saw early recognition of the relationship between infant mortality and social conditions such as poverty, housing, and sanitation.

The 19th century brought mixed outcomes. Rapid industrialization initially increased infant mortality in urban areas due to overcrowding, pollution, and poor working-class living conditions. However, later in the century, improvements in public sanitation, clean water supply, vaccination, and maternal care led to a gradual decline in infant deaths.

In the 20th century, major advances in medical science, including antibiotics, immunization programs, improved obstetric care, and better nutrition, resulted in a sharp decline in infant mortality, especially in developed countries. In developing countries, progress was slower but accelerated after independence and the expansion of public health services.

In the contemporary period, infant mortality has significantly reduced worldwide, though regional disparities remain. Today, infant mortality is closely linked to healthcare access, maternal education, socio-economic development, and public health policies, making it a key indicator of human development.

Scope to Research Study:

The study on infant mortality in Maharashtra analyses geographical, temporal, thematic, data, analytical, and policy scopes. It covers all major regions, including rural and urban areas, from 2010 to 2020, focusing on Infant Mortality Rate (IMR) and various influencing factors such as socio-economic, demographic, health-related, and environmental aspects. Secondary data sources include the Sample Registration System, National Family Health Survey, and Government health reports. The analysis utilizes descriptive tools and highlights regional disparities while evaluating the effectiveness of maternal and child health policies. Limitations include the exclusion of primary surveys and dependency on secondary data accuracy.

Objectives of the Study:

- To analyse the trends, patterns, and determinants of Infant Mortality Rate (IMR) in Maharashtra.
- To examine rural–urban differentials in infant mortality.

Hypotheses:

The study may test the following hypotheses:

- **H_{01} (Null Hypothesis):** There is no significant difference in infant mortality between rural and urban areas of Maharashtra.
- **H_{11} (Alternative Hypothesis):** There is a significant difference in infant mortality between rural and urban areas of Maharashtra.

Methodology:

This study employs a descriptive and analytical research design, based on secondary data. The primary data sources include the Sample Registration System, National Family Health Survey (NFHS-4 and 5), Census of India, Maharashtra Economic Survey Report, reports from the Ministry of Health and Family Welfare (MoHFW), and District Level Household Survey (DLHS), supplemented by published research articles and reports. This research covers the period from 2010 to 2021 and focuses on the entire state of Maharashtra. Analytical techniques include the calculation of the Infant Mortality Rate (IMR), percentage analysis, growth rate and trend analysis, correlation analysis, index construction as needed, and the use of tables, graphs, charts, and maps for data presentation.

WHO Definition:

Infant mortality rate is the probability of a child born in a specific year or period dying before reaching the age of one, if subject to age-specific mortality rates of that period. Infant mortality rate is strictly speaking not a rate (i.e. the number of deaths divided by the number of population at risk during a certain period of time) but a probability of death derived from a life table and expressed as rate per 1000 live births

Mortality under five in India:

Table no. 1. provides a comprehensive analysis of the Under-Five Mortality Rate (U5MR) in India, highlighting data disaggregated by gender for children under five years old. The U5MR is a crucial metric reflecting child health, maternal and child healthcare effectiveness, and socio-economic conditions. It is used by national entities like NFHS and international organizations to track progress toward Sustainable Development Goal 3, which seeks to eliminate preventable child deaths.

For female children, the U5MR is reported at 276.19 deaths per 1,000 live births, with confidence limits ranging from 231.42 to 330.66. This indicates significant mortality risks due to issues like gender disparities in nutrition and healthcare access, maternal malnutrition, and lack of post-natal care, which can vary by region.

The male U5MR is slightly lower at 262.12 per 1,000 live births, with confidence limits from 218.62 to 312.19. Although male infants are biologically more vulnerable, societal factors may disadvantage female children more severely in certain socio-economic contexts.

Overall, the U5MR for India stands at 269.03 deaths per 1,000 live births, with a confidence interval of 225.73 to 319.80. This statistic underscores the considerable burden of child mortality in the country, driven by factors like limited access to quality healthcare, malnutrition, poor sanitation, and regional disparities between affluent and underdeveloped states.

Table No. 1 Infant and Child Mortality Rates (per 1,000 live births) in India

Sr no	IND_NAME	SEX	AGE	RATE_PER_1000_N	RATE_PER_1000_NL	RATE_PER_1000_NU
1	**Mortality rate (under 5)**	FEMALE	Y_LT5	276.1938	231.4244	330.6584
2	**Mortality rate (under 5)**	MALE	Y_LT5	262.1222	218.6179	312.19
3	**Mortality rate (under 5)**	TOTAL	Y_LT5	269.03	225.7271	319.8001

The comparison reveals that the female mortality rate is marginally higher than the male rate, suggesting underlying gender biases in child care. While both rates are concerning, regional and socio-economic variations can significantly influence the observed differences.

The data (Table no 2) from the National Family Health Surveys (NFHS-3 and NFHS-4) highlight trends in the Infant Mortality Rate (IMR) and Under-Five Mortality Rate (U5MR) in India, expressed per 1,000 live births, emphasizing urban-rural disparities and temporal changes in child mortality rates.

Infant Mortality Rate (IMR): Defined as the deaths of infants under one year per 1,000 live births, the IMR, according to NFHS-4, is 29 in urban areas, showcasing better access to healthcare, institutional deliveries, and neonatal care. Conversely, rural areas exhibit a higher IMR of 46, indicating discrepancies in healthcare access, nutrition, and sanitation, leading to an overall national IMR of 41. This marks a decline from NFHS-3's IMR of 57, indicating improvements in maternal and child health services, such as immunization, antenatal care, and increased awareness.

Under-Five Mortality Rate (U5MR): Measuring deaths of children under five, NFHS-4 reports a U5MR of 34 in urban regions and a significant increase to 56 in rural regions, reflecting challenges like

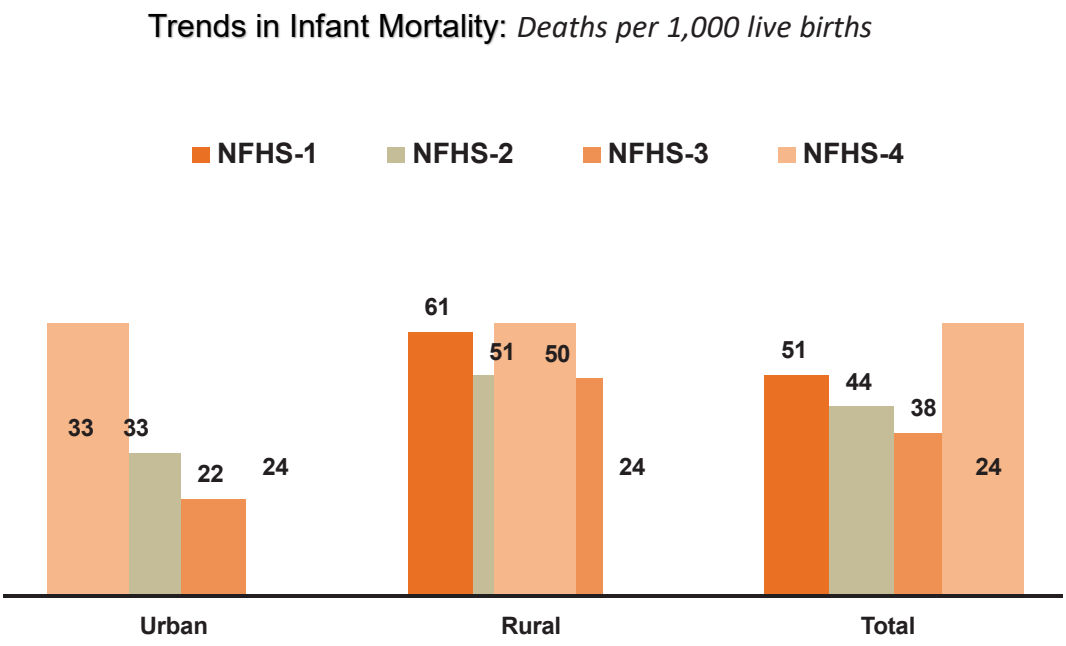
malnutrition and poor living conditions, resulting in a national U5MR of 50. This shows substantial progress from NFHS-3's U5MR of 74, attributed to advancements in healthcare, nutrition initiatives, and sanitation efforts.

Urban-Rural Disparities: The data clearly indicate that rural mortality rates remain markedly higher than those in urban settings, underscoring issues of unequal healthcare access, lower female literacy rates, higher poverty levels, and inadequate infrastructure in rural regions.

The findings from NFHS-3 to NFHS-4 demonstrate a consistent decline in both infant and child mortality in India, reflecting the effectiveness of health initiatives, while also highlighting ongoing challenges in rural areas that necessitate targeted policy interventions.

(Table no 2) from the National Family Health Surveys (NFHS-3 and NFHS-4) highlight trends in the Infant Mortality Rate (IMR) and Under-Five Mortality Rate (U5MR)

Sr. No.	Indicators	NFHS 4			NFHS 3
		Urban	Rural	Total	Total
1.	Infant mortality rate (IMR)	29	46	41	57
2.	Infant mortality rate (IMR) (U5MR)	34	56	50	74



The infant mortality rate in Maharashtra:

The infant mortality rate in Maharashtra in NFHS-4 is estimated at 24 deaths before the age of one year per 1,000 live births, down from the NFHS-3 estimate of 38, the NFHS-2 estimate of 44, and the NFHS-1 estimate of 51.

As expected, boys have a higher mortality rate than girls, especially during the neonatal period (in the first month of life) and between ages 1 and 5 years. Not much difference is observed in mortality rates of

girls and boys during the post neonatal period (ages 1-11 months). The infant mortality rate is almost identical in rural and urban areas, but child mortality is slightly higher in rural areas than urban areas. The infant mortality rate is lowest for children whose mothers have no schooling and highest for those whose mothers have less than 10 years of schooling.

Findings of the Study

1. Significant Decline in Infant and Child Mortality in India

The analysis of NFHS-3 and NFHS-4 data reveals a substantial decline in both Infant Mortality Rate (IMR) and Under-Five Mortality Rate (U5MR) in India over time. The national IMR declined from 57 per 1,000 live births in NFHS-3 to 41 in NFHS-4, while the U5MR reduced from 74 to 50 during the same period. This decline reflects improvements in maternal and child healthcare services, immunization coverage, institutional deliveries, and public health interventions.

2. Persistent Urban–Rural Disparities in Child Mortality

Despite overall progress, rural areas continue to experience considerably higher mortality rates than urban areas. According to NFHS-4, the IMR stands at 46 in rural areas compared to 29 in urban areas, while U5MR is 56 in rural areas and 34 in urban areas. This highlights persistent inequalities in healthcare access, nutrition, sanitation, maternal education, and infrastructure between rural and urban regions.

3. Gender Differentials in Under-Five Mortality

The study finds that female under-five mortality (276.19 per 1,000 live births) is marginally higher than male mortality (262.12) at the national level. This suggests the presence of gender-based disparities in child care, nutrition, and healthcare access, particularly in socio-economically disadvantaged regions. However, overlapping confidence intervals indicate that the magnitude of gender difference varies across regions and population groups.

4. High Overall Burden of Child Mortality in India

The overall Under-Five Mortality Rate for India is estimated at 269.03 per 1,000 live births, indicating a high child mortality burden. This underscores continuing challenges related to malnutrition, preventable diseases, unsafe drinking water, poor sanitation, and uneven healthcare delivery systems across states.

5. Consistent Improvement in Infant Mortality in Maharashtra

Maharashtra has shown a steady and notable decline in Infant Mortality Rate across successive NFHS rounds. The IMR declined from 51 in NFHS-1 to 24 in NFHS-4, reflecting significant progress in maternal and child health outcomes. This improvement can be attributed to better healthcare infrastructure, increased institutional deliveries, improved immunization coverage, and effective implementation of public health schemes.

6. Reduction in Rural–Urban Gap in Maharashtra

The trends indicate that the gap between rural and urban infant mortality in Maharashtra has narrowed over time. While rural IMR remains higher than urban IMR, the difference has reduced considerably by NFHS-4, suggesting improved outreach of health services in rural areas.

7. Higher Male Mortality in Early Childhood Stages

The findings indicate that male children exhibit higher mortality during the neonatal period and early childhood (1–5 years), which aligns with biological vulnerability patterns. However, gender differences are less pronounced during the post-neonatal period (1–11 months).

8. Influence of Maternal Education on Infant Mortality

The study finds a strong association between maternal education and infant mortality. Infant mortality is lowest among children of mothers with higher education levels and highest among those whose mothers have limited or no formal education, highlighting the importance of female literacy and awareness in improving child survival.

9. Effectiveness of Public Health Interventions

The declining trends in IMR and U5MR at both national and state levels indicate the positive impact of government health programmes, such as immunization drives, maternal nutrition schemes, antenatal and postnatal care services, and sanitation initiatives. However, regional disparities suggest uneven

implementation and outcomes.

10. Need for Targeted Policy Interventions

Despite overall progress, the findings emphasize the need for focused and region-specific interventions, particularly in rural and socio-economically backward areas, to further reduce infant and child mortality and achieve national and global health targets.

Testing and Results

The analysis of data from successive rounds of the National Family Health Survey (NFHS) reveals clear rural–urban differences in Infant Mortality Rate (IMR) in Maharashtra. Although the overall IMR in the state has declined substantially over time, rural areas consistently exhibit higher infant mortality than urban areas across all NFHS rounds.

NFHS-4 data indicate that while urban Maharashtra has achieved relatively lower infant mortality due to better healthcare infrastructure, institutional deliveries, and neonatal care, rural areas continue to face challenges related to healthcare access, maternal nutrition, sanitation, and awareness. Even though the rural–urban gap has narrowed in recent years, it has not been eliminated.

These observed differences demonstrate that place of residence remains an important determinant of infant mortality in Maharashtra. Based on the empirical findings, it is concluded that infant mortality in Maharashtra significantly varies between rural and urban areas, with rural regions experiencing relatively higher mortality rates. This confirms the need for targeted rural health interventions to further reduce infant mortality and achieve equitable child health outcomes across the state.

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