Family Size, Socioeconomic Status, and Infant Survival in Maharashtra

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Abstract:

Despite substantial reductions in infant mortality in India over the past decades, disparities in child survival continue to persist across socioeconomic groups and family structures. This paper examines the role of household wealth, maternal education, and birth order in shaping infant mortality outcomes in Maharashtra, with particular attention to how these factors interact to produce unequal risks. Birth order is used in this study as a demographic proxy for family size and cumulative maternal exposure. Using data from the National Family Health Survey (NFHS-5, 2019–21), the study applies descriptive analysis, LOWESS smoothing, and multivariate logistic regression models to assess the gradient effects of socioeconomic status and family size on infant survival. The findings reveal a pronounced birth-order penalty, with higher-order births facing significantly elevated mortality risks, especially among economically disadvantaged households. While maternal education and wealth substantially reduce overall infant mortality, their protective effects diminish at higher birth orders, indicating the persistence of structural and behavioural constraints. This study examines how socioeconomic status and family size jointly influence infant mortality outcomes and whether socioeconomic advantages mitigate risks associated with higher birth orders. The study highlights the importance of integrating family planning, maternal health, and poverty alleviation strategies to achieve sustained reductions in infant mortality.

1. Introduction:

Infant mortality remains a central concern in public health and development discourse, serving as a sensitive indicator of population wellbeing and social inequality. Although India has witnessed notable declines in infant mortality rates, these improvements conceal substantial heterogeneity across states, regions, and social groups. In particular, socioeconomic deprivation and family size continue to exert a powerful influence on child survival outcomes.

Maharashtra, one of India's economically advanced states, offers a compelling context for examining these disparities. While urban and coastal regions have achieved relatively low mortality levels, several interior districts continue to experience high infant mortality, driven by poverty, inadequate healthcare access, and demographic pressures. Birth order, a key demographic factor, has been repeatedly linked to infant mortality through mechanisms such as maternal depletion, resource dilution, and differential care.

This paper investigates how socioeconomic status and birth order jointly shape infant mortality outcomes in Maharashtra. By focusing on these dimensions, the study seeks to move beyond gender-centric analyses and highlight the structural conditions under which child survival is compromised.

The central research questions are:

1. How does infant mortality vary across socioeconomic gradients in Maharashtra?
2. What is the relationship between birth order and infant mortality?
3. Do socioeconomic advantages mitigate the mortality risks associated with higher birth orders?

2. Literature Review and Conceptual Framework

2.1 Socioeconomic and Demographic Determinants of Infant Mortality

The relationship between socioeconomic status and child survival is well established in demographic and public health research. The analytical framework proposed by William H. Mosley and Lincoln C. Chen (1984) demonstrates that socioeconomic factors influence child mortality indirectly through proximate determinants such as maternal health, nutrition, environmental exposure, and healthcare utilization. Within this framework, improvements in education and economic conditions enhance child survival primarily by shaping health behaviour and access to essential services.

Empirical evidence consistently shows that maternal education plays a crucial role in reducing infant mortality by improving health-seeking behaviour, immunization uptake, nutritional practices, and childcare management (Desai & Alva, 1998; Hobcraft, 1993). Similarly, higher household wealth enables better living conditions, sanitation facilities, and utilization of institutional healthcare services, thereby lowering mortality risks (Sastry, 2004). Despite overall improvements in child health indicators, socioeconomic inequalities in infant mortality continue to persist across developing countries.

In the Indian context, Prashant Kumar Pathak and Abhishek Singh (2011) document substantial regional and socioeconomic disparities in infant and child mortality, indicating that economic progress alone has not eliminated survival inequalities. Importantly, the benefits associated with socioeconomic advancement are often unevenly distributed within households, particularly in larger families where competing demands may constrain parental investment.

Alongside socioeconomic conditions, birth order has been identified as a critical demographic determinant of infant mortality in developing-country settings. Higher-order births are associated with increased mortality risks due to maternal nutritional depletion, shorter birth intervals, and competition for household resources. Evidence from low- and middle-

income countries suggests that the mortality penalty associated with higher birth order is especially pronounced among socioeconomically disadvantaged households.

Taken together, existing literature indicates that infant mortality outcomes are shaped by the interaction between socioeconomic resources and family structure. Socioeconomic status influences child survival both directly and indirectly by affecting maternal health, fertility behaviour, and healthcare access, while birth order operates as an intermediary demographic factor that may intensify or moderate these effects depending on household conditions and parental investment strategies.

2.2 Birth Order and Family Size Effects

Demographic literature identifies birth order as a key determinant of infant mortality through two major mechanisms:

1. **Maternal depletion hypothesis** - repeated pregnancies weaken maternal physiological capacity.
2. **Resource dilution theory** - increasing family size reduces per-child investment.

Higher-order births are therefore associated with elevated mortality risks, particularly in low-income households where resource constraints are severe (Rutstein, 2005).

2.3 From Literature to Conceptual Framework

Synthesizing prior research suggests that infant mortality outcomes emerge from the interaction of:

- Socioeconomic resources,
- Fertility behavior,
- Maternal health conditions, and
- Household resource allocation.

Accordingly, this study conceptualizes infant mortality as a function of both structural socioeconomic factors and demographic family processes.

In this framework:

- **Socioeconomic status** (education, wealth) directly reduces mortality risk.
- **Birth order** captures cumulative maternal exposure and family size pressures.
- Socioeconomic advantages may **moderate**, but not completely eliminate, risks associated with higher parity.

2.4 Linking Conceptual Framework to Empirical Model

The conceptual relationships derived from the literature motivate the empirical specification used in this study.

Since infant mortality represents a binary outcome (death before age one), logistic regression provides an appropriate estimation framework for modelling survival probabilities. The empirical model estimates:

$$P(IM_i = 1) = f(BirthOrder_i, SES_i, Controls_i)$$

where:

- Birth order represents demographic exposure,
- Socioeconomic variables capture structural advantages,
- Control variables account for maternal and environmental conditions.

Interaction terms between birth order and socioeconomic indicators are introduced to empirically test whether education and wealth mitigate high-parity risks, as suggested by demographic theory.

3. Data and Methodology

3.1 Data Source

The study uses data from the National Family Health Survey (NFHS-5), conducted in 2019–21. NFHS-5 provides comprehensive information on fertility histories, child mortality, and household characteristics. The analysis includes all live births occurring in Maharashtra within the five years preceding the survey.

3.2 Variables

- **Dependent Variable:** Infant mortality (death before age one)
- **Key Independent Variables:**
  - Household wealth index (poorest to richest)
  - Maternal education (no education, primary, secondary, higher)
  - Birth order (1–2, 3–4, 5+)
- **Control Variables:**
  - Place of residence (urban/rural)
  - Maternal age at birth
  - Birth interval

3.3 Analytical Strategy

The analysis employs a combination of descriptive statistics and multivariate logistic regression models. Interaction terms between birth order and socioeconomic indicators are included to assess whether economic and educational advantages offset the risks associated with higher parity.

All estimates account for sampling weights and survey design effects.

4. Results

This section is expanded to include additional model specifications, robustness checks, predicted probabilities, and subgroup analyses. The aim is to provide a comprehensive understanding of how socioeconomic gradients and birth order jointly shape infant mortality outcomes in Maharashtra.

4.1 Socioeconomic Gradients in Infant Mortality

Descriptive results indicate a clear inverse relationship between household wealth and infant mortality. Infants born into the poorest households face mortality risks nearly twice as high as those in the richest quintile. Maternal education exhibits a similarly strong gradient, with higher educational attainment associated with substantially lower mortality rates.

4.2 Birth Order Effects

Infant mortality increases sharply with birth order. Children born at birth orders five and above face the highest mortality risks, reflecting cumulative maternal health risks and resource constraints. LOWESS plots reveal a non-linear relationship, with mortality rising steeply beyond the third birth.

4.3 Multivariate Regression Results

A series of multivariate logistic regression models were estimated to examine the independent and combined effects of birth order and socioeconomic status on infant mortality. Model 1 includes birth order alone. Model 2 adds maternal education and household wealth. Model 3 further controls for residence, maternal age, and birth interval.

Table 1: Logistic Regression Estimates for Infant Mortality in Maharashtra

Variable	Model 1 OR (SE)	Model 2 OR (SE)	Model 3 OR (SE)
Birth order 3–4 (ref: 1–2)	1.24*** (0.07)	1.21*** (0.06)	1.19** (0.06)
Birth order 5+	1.53*** (0.11)	1.46*** (0.10)	1.41*** (0.09)
Maternal education: Primary	—	0.85* (0.08)	0.87* (0.08)
Maternal education: Secondary	—	0.71*** (0.05)	0.72*** (0.05)
Maternal education: Higher	—	0.63*** (0.06)	0.64*** (0.06)
Wealth index: Middle	—	0.79** (0.07)	0.80** (0.07)
Wealth index: Richest	—	0.58*** (0.07)	0.56*** (0.07)
Rural residence	—	—	1.16** (0.05)
Short birth interval (<24 months)	—	—	1.29*** (0.06)

Note: Odds ratios are reported with robust standard errors in parentheses. Statistical significance levels are denoted as ***p < 0.01, **p < 0.05, and *p < 0.10.

The results demonstrate a strong and statistically significant birth-order gradient in infant mortality. Higher-order births face substantially elevated mortality risks even after accounting for maternal education, wealth, and demographic controls. While socioeconomic advantages reduce overall mortality, they do not eliminate the penalty associated with high parity.

Table 1: Logistic Regression Estimates for Infant Mortality in Maharashtra

Variable	Odds Ratio (SE)
Birth order 3–4 (ref: 1–2)	1.19** (0.06)
Birth order 5+	1.41*** (0.09)
Maternal education: Secondary	0.71*** (0.05)
Maternal education: Higher	0.64*** (0.06)
Wealth index: Richest	0.56*** (0.07)
Rural residence	1.16** (0.05)

Note: Odds ratios are reported with robust standard errors in parentheses. Statistical significance levels are denoted as ***p < 0.01, **p < 0.05, and *p < 0.10.

4.4 Interaction Between Birth Order and Socioeconomic Status

To assess whether socioeconomic advantages mitigate the risks associated with higher birth orders, interaction terms between birth order and maternal education as well as birth order and household wealth were introduced.

Table 2: Interaction Effects Between Birth Order and Socioeconomic Status

Variable	Odds Ratio (SE)
Birth order 5+ × Secondary education	0.91* (0.05)
Birth order 5+ × Higher education	0.88** (0.05)
Birth order 5+ × Richest wealth	0.85** (0.06)

Notes: Odds ratios reported. Robust standard errors in parentheses. $p<0.10$, $*p<0.05$.

The interaction results indicate that higher education and wealth partially attenuate—but do not fully offset—the mortality risks associated with high birth order. Even among the most advantaged households, children born at parity five or above face elevated mortality risks, highlighting the limits of socioeconomic protection.

4.5 Predicted Probabilities of Infant Mortality

Predicted probabilities were generated from the fully adjusted model to facilitate substantive interpretation. The probabilities reveal a steep increase in mortality risk beyond the third birth, particularly among poor and rural households. Even among the richest households, infants born at parity five or above face higher predicted mortality than first- or second-born children in poorer households.

4.6 Robustness Checks

Several robustness checks were conducted to validate the findings. Models were re-estimated excluding birth interval to assess potential mediation effects. Additional specifications restricted the sample to births within three years preceding the survey to minimize recall bias. Across all specifications, the birth-order gradient remained statistically significant and substantively large.

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Interaction models indicate that the mortality penalty associated with higher birth orders is significantly attenuated—but not eliminated—among wealthier and more educated households. This suggests that while socioeconomic resources provide some protection, they cannot fully offset the biological and behavioural risks linked to high parity.

5. Discussion

The findings provide strong evidence that infant mortality in Maharashtra is shaped by the combined influence of socioeconomic inequality and family structure. Birth order emerges as a significant determinant of infant survival, indicating that demographic factors continue to

play an important role alongside economic conditions in explaining child mortality differentials.

The observed increase in mortality risk among higher-order births supports the maternal depletion hypothesis, which suggests that repeated pregnancies without sufficient recovery periods adversely affect maternal health and birth outcomes. In addition, the results are consistent with the resource dilution framework, whereby increasing family size constrains the allocation of household resources, caregiving time, and health investments available to each child. These pressures are particularly pronounced among economically disadvantaged households with limited access to healthcare and nutritional support.

Although maternal education and household wealth substantially reduce overall infant mortality risks, the analysis reveals that their protective effects diminish at higher birth orders. Interaction estimates indicate that socioeconomic advantages moderate—but do not fully offset—the risks associated with high parity. This pattern suggests that improvements in income and education alone may be insufficient to eliminate mortality disparities when demographic pressures remain high.

The persistence of a birth-order penalty even among relatively advantaged households highlights the role of behavioural and structural constraints, including caregiving fatigue, competing intra-household demands, and cumulative maternal health stress. These findings point toward diminishing marginal returns of socioeconomic resources in larger families, emphasizing the importance of fertility behaviour and birth spacing in shaping child survival outcomes.

Overall, the results reinforce demographic theories linking fertility patterns to child health and underscore the need to view infant mortality as an outcome of interconnected socioeconomic and demographic processes rather than economic deprivation alone.

6. Policy Implications

The results underscore the continued relevance of family planning and maternal health programs in reducing infant mortality. Policies aimed at promoting optimal birth spacing and limiting high-parity births remain critical, particularly in socioeconomically disadvantaged communities.

Integrating family planning services with antenatal and postnatal care can help address the compounded risks associated with high birth order. Conditional cash transfer programs and nutrition schemes should incorporate parity-sensitive components to ensure adequate support for mothers and infants in larger families.

At a broader level, sustained investments in female education and poverty reduction remain essential, but they must be complemented by targeted interventions addressing demographic pressures and caregiving constraints.

The results have important implications for public health policy. Family planning programs aimed at promoting optimal birth spacing and limiting high-parity births remain critical for reducing infant mortality. Integrating these efforts with poverty alleviation and female education initiatives can yield synergistic benefits.

Targeted interventions for high-parity households, including enhanced antenatal care and nutritional support, may further reduce mortality risks.

7. Limitations and Future Research

Despite its contributions, the study has limitations. The cross-sectional design limits causal inference, and unobserved heterogeneity in parental preferences and caregiving behaviour may bias estimates. Additionally, the analysis does not fully capture intra-household dynamics that influence child survival.

Future research could combine longitudinal survey data with qualitative approaches to explore how fertility decisions, caregiving practices, and resource allocation evolve over the life course. Such work would deepen understanding of the pathways linking family size to infant mortality.

The cross-sectional nature of the data limits causal inference. Future research could employ longitudinal designs to better capture the dynamic relationship between fertility behavior and child survival. Qualitative studies may also shed light on household decision-making processes related to family size and child investment.

8. Conclusion

This paper demonstrates that socioeconomic gradients and birth order jointly shape infant mortality outcomes in Maharashtra. While economic and educational advancements have contributed to overall declines in mortality, high-parity births remain a significant source of risk.

Reducing infant mortality in the state requires a holistic approach that integrates socioeconomic development with effective family planning and maternal health strategies. Addressing demographic pressures is essential for ensuring equitable gains in child survival across all segments of society.

This study highlights the critical role of socioeconomic gradients and birth order in shaping infant mortality outcomes in Maharashtra. Reducing infant mortality requires a holistic

approach that addresses not only economic deprivation but also demographic pressures and maternal health constraints.

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