Trends and Socio-economic Inequalities in Early Neonatal Mortality in India

2022 - 23

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R. No. - Secondary/04 /2022 - 23

Research Study Submission

Title: Trends and socio-economic inequalities in Early Neonatal Mortality in India

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January 15, 2023
[Report prepared and Submitted Ministry of Health and Family Welfare, Government of India, New Delhi- 110011]

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Abstract

Although there has been a substantial decline in the infant and child mortality in the recent decade, however the reduction of NMR has been intermediate compared to the infant mortality rates. This has consistently resulted in an increased contribution of neonatal deaths to the overall infant mortality over the years. The present study systematically tries to assess the trends and determinants of Early Neonatal mortality in India using the two rounds of National Family Health Survey data (namely; NFHS-3 and 5). Bivariate and multivariate and decomposition techniques have been employed for data analysis. The prevalence of Early neonatal mortality has declined from 3% in 2005 to 2.1% in 2019-21 and declined has been observed across all sub-group of the population. Results from regression and decomposition analysis attribute mother height, birth order, sex of the child, child weight at births, caste, religion, wealth quintiles, place of delivery, media exposure, health insurance coverage and region of the residence as the major contributing factors for the decline in early neonatal mortality between 2005-06 and 2019-21. The findings of this study have policy implications as this tries to identify the factors responsible for the high rate of Early Neonatal Mortality and identify the vulnerable sub-group that are subject to a high risk group.

Key words: Early Neonatal Mortality, India, NFHS, Hazard Ratio, Decomposition

1. Introduction

Early neonatal mortality is defined as the deaths of newborn in the first week (0-6 days of life/delivery) of life. Early neonatal mortality contributes to 75% of all the neonatal deaths worldwide with approximately three-quarters of all the deaths taking place within the first week of life and one-third occurring on or within the first day of life[1]. The contribution of Neonatal deaths in under five mortalities has been increased from 40% in 1990 to 47% in 2020 globally with the majority (approximately 99%) occurring among vulnerable communities in the low and middle-income countries[2]. India constitutes one quarter of the global neonatal deaths with the highest number of newborn deaths for any country in 2019[3]. Although the evidence clearly shows that there has been a substantial decline in the infant mortality rates (IMR: 47 in 2009 to 28 per 1000 live births in 2016) in the past decade, however the reduction of NMR has been intermediate (NMR: 33 in 2009 to 22 per 1000 live births in 2019) compared to the infant mortality rates. This has consistently resulted in an increased contribution of neonatal deaths to the overall infant mortality over the years (accounting 74% of infant mortality in 2016; NFHS 2015-16 data). India shares a considerably higher neonatal death in the global data, with the most being in the early neonatal deaths. In 2016, the very early neonatal mortality was 58% more (2.4 times higher) than the late early neonatal mortality, with early neonatal mortality comprising 83% of all the neonatal deaths[4].

Most of the fatalities in the early neonatal period are preventable and could be avoided by strict adherence to the evidence-based clinical care standards at birth and providing timely and high quality essential newborn care, life-saving extra critical care for low birth weight and preterm/ill new-borns[3,5,6]. Although, India has responded to this crisis with the launch of several essential newborn survival programs/schemes (for example Janani Suraksha Yojana, Navjat Shishu Suraksha Karyakram, Family Participatory Care among several others), but, the implementation of the lifesaving interventions was not timely and rather delayed. This is because of the over prioritisation of reducing under-five child mortality in the past with an insufficient focus on managing/preventing early neonatal deaths which has been a major contributing proportion to the infant and under-five mortality rates in India. In June 2014, the Ministry of Health and Welfare, the Government of India, launched India Newborn Action Plan (part of the Global Every Newborn Action Plan) with a target of reducing (preventable) neonatal deaths <10 per 1000 live births by the end of 2030. Additionally, National Health Policy of India (under National Health Mission) envisages to reduce the NMR to 16 (currently 22 per 1000 live births) by 2025. India fell short of meeting the Millennium Development Goal

target-4 in reducing the overall under-five mortality by two-thirds by 2015 and also forecasted to be not on the proper track to achieve the SDG 3.2 target by the end of 2030. In this given context, the present study is an attempt to study the level, trend and patterns of early neonatal mortality in last fifteen years in India and its possible contributors.

2. Objectives

The broad objective of the present study is to understand the level, trend and determinants of Early Neonatal Mortality in India. To achieve the broad objectives, the specific objectives of the study are:

1. To examine the level, trend and differentials of Early Neonatal Mortality in India.
2. To study determinants of Early Neonatal Mortality in India.
3. To study the extent of contribution of each factors in Early Neonatal Mortality in India.

3. Data and Methods

3.1 Data sources

The two rounds of National Family Health Survey, namely; NFHS-3 and NFHS-5 conducted during 2005-06 and 2019-21, respectively, data have been used in the present proposed study to meet the need of aforesaid objectives. As the unit of analysis in the present study is children, hence birth files of both the survey rounds have been used for estimation of Early neonatal mortality and its determinants.

The National Family Health Survey is a nationally representative, large-scale, multi-round cross-sectional survey conducted in a representative sample of households covering more than 99 per cent of the population throughout India and has collected detailed information related to population, health, nutrition of children and women. In the NFHS-III, information of 124,385 ever-married women in the age group of 15–49 years, residing in 109,041 households in India, were captured in two phases from 29 states of India. The data recorded 56,438 births that occurred in the last 5 years preceding the survey. Multistage systematic random sampling was used to capture the respective samples under NFHS. The survey adopted a two-stage sample design in rural areas and a three-stage sample design in urban areas.

NFHS-V provides information for 707 districts, 28 states, and 8 union territories. In NFHS-V, information of 724115 ever-married women in the age group of 15–49 years, residing in 636,699 households in India. The data recorded 257995 births that occurred in last five years

preceding the survey. Two-stage stratified cluster sampling method was applied in the NFHS-V. In the first stage of the sampling, a fixed number of primary sampling units (areas) were selected, with probability proportional to their size. In the second stage, 22 households were selected within each primary sampling unit by using systematic random sampling technique. Details of the survey design and data collection procedure for both the surveys have been published elsewhere (http://rchiips.org/nfhs/index.shtml).

3.2 Dependent variable

The Early neonatal mortality is the main outcome variable in the study. It is defined as "any neonatal death occurred within first week of birth (0-6 days)". Early neonatal mortality is recoded as a binary variable in this study where '0' indicates that the child survived for more than 7 days and '1' indicates otherwise, i.e., death of the newborn within 7 days.

3.3 Independent variables

All the possible socio-economic and demographic variables have been in the analysis to see their effect and contribution in early neonatal mortality in India. The independent variables included in the study were women's age at child birth (<20, 20-34, 35-49 years); women's education (No education, Primary, Secondary and higher); mother's height (<145 cm and ≥145 cm); birth order (1, 2-3 and 4+); birth interval (<24 months ≥24 months); child sex (Male and Female); multiple births (Single and Multiple); child weight at births (Low birth weight, Normal and overweight); place of residence (urban and rural); caste (Scheduled caste, scheduled tribes, other backward classes and others); religion (Hindu, Muslim and others); wealth quintiles (Poorest, Poor, Middle, Richer and Richest); ANC visits (>4 visits and ≥ visits); Place of delivery (Home, Public sector, Private Sector and others); sex of head of the household (Male and Female); media exposure (no exposure and any exposure); any member of the household covered by health insurance (No and Yes) and region of residence (North, Central, East, Northeast, West and South).

3.4 Statistical Analysis

The present study has adopted bi-variate and multivariate analysis along with the decomposition technique for data analysis. The bivariate analysis has been used to examine the level and patterns of Early neonatal mortality.

In multivariate analysis, Cox proportional hazard model analysis has been used to show the effect of a non-biological factor on early neonatal mortality. The hazard estimates have been reported using odds ratio with 95% Confidence Interval (CI). Concentration curve and index has been used to measure the socio-economic inequalities in Early Neonatal Mortality.

In the multivariate analysis, beyond the estimation of hazard ratio, our aim was to compute the difference in early neonatal mortality between the two survey periods, and then decompose these differentials into their separate underline factors. For that purpose, we employed Fairlie's (1999, 2005) decomposition technique for the decomposition analysis, as it is particularly suited to calculating gaps for binary outcomes, that is, early neonatal mortality in the present study. The procedure computes the difference in the outcome between two groups and quantifies the contribution of group differences in the independent variable to outcome differential. The detailed procedure/methodology of decomposition is given elsewhere[7,8].

4. Results

4.1 Background characteristics of the respondents, India, 2005-06 and 2015-16

Table 1 depicts the socio-economic and demographic characteristics of the respondents in the two rounds of the survey. There were 56438 mothers in 2005-06 and 227223 mothers' in the 2019-21 who responded the child mortality related questions.

The percentage of women's age (20-34 years) at childbirth have significantly increased from 66.5% to 84% during 2005-06 to 2019-21. This points to a greater stability for women to start bearing children at the given age group. There was a huge decrease in women's age at childbirth (<20 years) from 29.2% in 2005-06 to 12.5% in 2019-21 which helps to explain the shift into women having children later. We have seen a major shift of women's education levels at childbirth from having no education (50% in 2005-06) to at least secondary education (50.7% in 2019-21). There hasn't been any significant change for women's height at childbirth (87.3% to 87.5%, 2005-06 to 2019-21 at ≥145cm). There has been a heavy reduction in birth order 4 or more from 2005-06 to 2019-21 (26.4% to 12%) which has been distributed in 1, 2 and 3 birth order with varying degree (30.3% - 39.1% for 1, 43.3% - 48.9% for 2-3). Almost equal proportion of women (72.3% - 72.6%) had Birth Interval ≥24 months for both the survey rounds. Single births are very dominant (98.4%, 2005-06 to 98.3%, 2019-21). There has been 21.5 per cent of women reported LBW in 2005-06 and 18.2% in 2019-21. The majority of the respondents were from the rural areas for both the survey rounds. Other backward caste (OBCs) were the dominating group in both the survey rounds. Again, majority of the respondents

belonged to Hindu religion (78.3% in 2005-06 and 79.4% in 2019-21). Proportions of poorest and poor people were relatively high among the participants in 2005-06 and 2019-21, respectively. There has been an increased in the ANC visits; the utilization of 4 or more ANC visits has been increased from 37.3 per cent in 2005-06 to 59.3 per cent in 2019-21. Similarly, there is a drastic decreased in the home deliveries over the years as home deliveries has been declined from 61.1% in 2005-06 to 11.2 per cent in 2019-21. Media exposure is approximately constant (53.6% - 2005-06, 52% - 2019-21). There has been a significant rise of health insurance in families (for at least 1 member). From just 2.7% to 23.2% (2005-06 - 2019-21) which is an increase of 759.25%. However, the vast majority still doesn't have any insurance (97.3% in 2005-06, 76.8% in 2019-21). Majority of the respondents were from the Central region and least from the Northeast region in all the study survey rounds.

4.2 Prevalence of Early Neonatal Mortality (ENNM) in India, 2005-06 and 2019-21

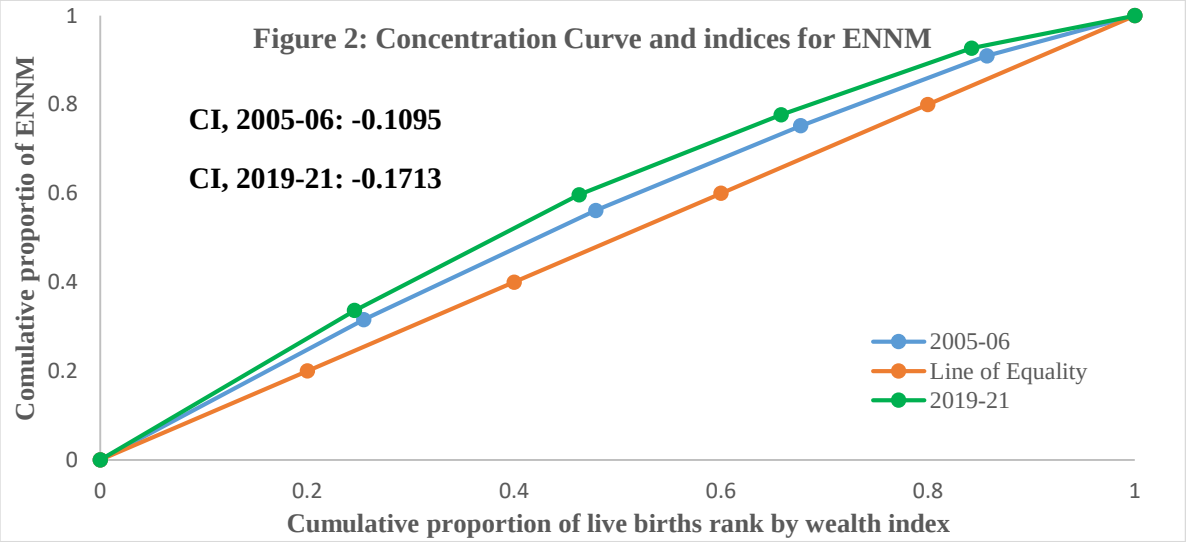
Table 2 shows the prevalence and changes in change in the early neonatal mortality (ENNM) across different demographic and socio-economic characteristics of respondents between 2005-06 and 2019-21. The prevalence of ENNM has declined from 3% in 2005 to 2.1% in 2019-21. From the table it can be seen that the prevalence of ENNM was higher among women belong to < 20 years of age (4.1% in 2005-06 and 2.9% in 2019-21), women with no education (3.5% in 2005-06 and 2.8% in 2019-21), mother with height <145 cm (4.3% in 2005-06 and 3.0% in 2019-21), among birth order one (3.8% in 2005-06 and 2.2 in 2019-21) and 4 or more (3.2% in 2005-06 and 2.8 in 2019-21). Birth interval less than 24 months also emerged as critical factor as rate of mortality was higher if birth interval is less than 24 months (4.3 in 2005-06 and 2.7 in 2019-21).

The declined in the ENNM has been observed across all the selected background characteristics of the respondents. In overall, 31.1% decline in the ENNM has had happened during 2005-06 to 2019-21. Substantial decreased were observed among women who completed primary education (31.1%), women with birth order 1 (41.7%), live in urban area (34.8%), were completed secondary level of education (13.3%), among women of richest (49.2%) and richer (35.9%) wealth quintile, completed 4 or more ANC visits (26.9%), whose delivery conducted in the private sector health facility (36.5%), who exposed to media (37.3%) and residing in the south (45.5%) and west (45.6%) regions.

4.3 Economic inequality in Early Neonatal Mortality, 2005-06 and 2019-21

Figure 1 shows the concentration curve and concentration index of ENNM for 2005-06 and 2019-21 survey rounds. Concentration curves for both rounds of the survey lie above the 45-degree diagonal line, and this indicates higher levels of ENNM among poor population (i.e. birth occurred in Poorest and poor wealth quintile). If population, irrespective of their wealth quintiles, had the same levels of ENNM the concentration curves would have been aligned with the line of equality (45-degree line). The curve for 2019-21got far to the line of equality than the curve for 2005-06, reflecting increased wealth-based relative inequalities in ENNM in India. The concentration values are negative which shows the pro-poor inequities in ENNM. The concentration index increased from -0.1095 in 2005-06 to -0.1713 in 2019-21, indicating substantial increased of wealth-related inequalities.

Figure 1: Concentration Curve and indices for ENNM for India, 2005-06 and 2019-21



4.5 Determinants of Early Neonatal Mortality

Table 3 depicts that some important factors such as mother height, birth order, sex of the child, child weight at births, caste, religion, wealth quintiles, place of delivery, media exposure, health insurance coverage and region of the residence were the significant factors associated with Early Neonatal Mortality in 2005-06 and 2019-21. Interestingly, variables women' age at child birth and women's education did not show significant association with ENNM during both the periods. Mothers' heights ≥145cm showed significantly lower risk of ENNM than if women height was less than 145 cm during 2005-06 (HR:0.674; CI: 0.476-0.953) and 2019-21 (HR: 0.753; CI: 0.680-0.834). Birth order 2-3 was significantly associated with lower level of ENNM

than 1st birth order during both the period, but result was significant only for 2019-21 (HR:0.75; CI: 0.688-0.817). Interestingly, we observed that male infants were 42% and 32.8% more likely to experience ENNM in 2005-06 and 2019-21, respectively. However, risk was attenuated.

New-borns with normal weight and overweight were less likely to experience deaths than newborn birth weight 2.5 kg at the time of birth during both the period. For illustration, Normal weight new-borns were 69% (HR: 0.315; CI: 0.238-0.417) and 70% (HR:0.305; CI: 0.455-0.569) less likely to die during 2005-06 and 2019-21, respectively, than newborn with weight less than 2.5kg. Place of residence was not statistically significant on ENNM mortality in both surveys round. Both the surveys have witnessed that the risk of ENNM was less among OBCs than SC/ST, though results were not significant. Similarly, in case of religion, the risk of ENNM was less among the Muslim than Hindus, but the results were not significant in both the survey round.

Analysis further indicates that effect of economic strata was an important factor of ENNM. Children born in the richest family had significantly 39% less chance of death than children born in the poorest family during 209-21. However, there was a significant difference between poorest and richest in ENNM during 2005-06, even the risk of ENNM was higher children born to Middle and Richest families than poorest, though results were not significant. For 2005-06, results were not significant for place of delivery variables, but, for 2019-21, results show the significant association between Place of delivery variable and ENNM. The place of delivery variable showed a very peculiar result, the chance of ENNM was 30.3% and 70.0% more likely among the children those whose birth were taken place in public and private sector hospital, respectively than whose birth were taken place at Home during 2019-21.

As for as region of the residence variable is concerned, result indicates that the risk of ENNM was 33% (HR: 0.674; CI: 0.557-0.816), 17% (HR: 0.830; CI: 0.703- 0.981) and 28% (HR: 0.723; CI:0.616-0.849) less likely in Northeast, West and South region respectively than North region during 2019-21. The Similar, patterns were also observed for 2005-06, though, expect Northeast, none of the region showed the significant result.

4.6 Decomposition Analysis: contribution of each factors in Early Neonatal Mortality in India between 2005-06 and 2019-21

The results of Fairlie (1999) decomposition analysis are shown in Table 5 in terms of difference in early neonatal mortality between NFHS-5 and NFHS-3 for India. The Early neonatal mortality gap between NFHS-3 and NFHS-5 was 0.00927, that is, the mortality was 30.9%

higher for NFHS-3 than NFHS-5. The set of socio-economic and demographic covariates we have considered are able to explain 71.7% of the overall gap (that is, the explained part or due to differences in the distribution of characteristics). From the results of Fairlie's decomposition, we also found that mother's age at child birth, mother's educational attainment, child's birth order, place of residence, health insurance coverage and place of delivery explain the majority of the gap in early neonatal mortality between NFHS-3 and NFHS-5. Contribution of mother's age at child birth and educational attainment is significant in explaining the gap. Mothers whose age at child birth was 20 years or more and educated women contributed 33.0% and 26.0% respectively to the explained difference. Birth order four or more, absence of health insurance coverage in the household and public sector health facilities as a place of delivery contributed 12.2%, 11.6% and 8.9% respectively to the explained gap. Contribution of place of residence (2.1%), mothers with less than 145 cm height (1.5%) and sex of the newborns (1.4%) was marginal in explaining the gap between NFHS-3 and NFHS-5.

5. Summary and Discussion

Newborn mortality a very sensitive indicator of development of any country. It shows socio-economic progress and health system efficiency of any country. Present study is an attempt to track the course of early neonatal mortality in India during last fifteen years by using the nationally representative data. The results of the analysis demonstrate that though there is a reduction in the early neonatal morality with time, but progress is not satisfactory and it is at it high level. Analysis further indicates that younger (<20 years) or older (≥35 years) maternal age, being a male child and birth occurred at health facilities were associated with higher likelihood of early neonatal mortality. On the other hand, higher level of women education, women age ≥145cm, birth order 2-3, child's weight (more than 2.5 kg) at birth, OBC caste, higher wealth quintile, exposure to media, any member of household covered by health insurance and west and south as a region of residence had a protective effect against early neonatal mortality. We have reconfirmed the significance of these known risk factors for early neonatal deaths in the context of this country.

Though maternal age is not significantly associated with early neonatal mortality, however risk of ENNM is higher among younger age women and older women. The risk of mortality in younger women could be due to the fact that the mother did not reach her full physical or reproductive maturity for child bearing. Newborn delivered by younger mothers are more prone to being born premature, and having low birth weight and congenital malformations [9]. The

association between early neonatal mortality and late maternal age could be due to higher risk of delivering high or low birth weight babies among older mothers[10]. Further, advanced maternal age is associated with antenatal and delivery complications [11] which in-turn affect the early neonatal deaths[12,13].

Mother's height emerged as a critical determinant of ENNM in the study. Maternal height is an important determinant of intrauterine growth restriction and low birth weight[14]. Low birth weight is significantly associated with the risk of mortality[15]. Our study also shows that the risk of ENNM is higher among the low birth weight New-borns. The result reveals that in both the survey period male new-borns are more likely to die than female new-borns. It is said that female child is biologically stronger than male child. Previous studies have also found that male child have been found to be at increased risk of mortality and morbidity relative to their female counterparts in not only the perinatal period but also throughout their entire lifespan.

Analysis further suggests that the risk of ENNM is lesser in Muslim community than Hindu, though results are not significant. This could be because of feeding practices and caring practices. In addition, the concentration of SC/STs caste groups is much higher in the Hindu religion than in Muslims [16], and SCs/STs are known for their disadvantaged position in society and their bearing on Mortality and morbidities. Our findings also confirm the same.

The result of the relationship between wealth quintiles and ENNM is in the expected direction. The risk of ENNM is less among the children born in rich households than poor is due to the fact that the rich have better access to healthcare resources, better knowledge and awareness, and better purchasing power.

The findings illustrate the negative association between health facility delivery and ENNM. our results are in similar line with the previous research[17]. Though, some studies have also highlighted no association between institutional delivery and early neonatal survival [18–20]. This higher likelihood or insignificant relationship could be due to increased association between delivery complications and institutional deliveries[21,22] as most complicated pregnancies rush to health facilities. In addition to management of delivery complications at the health facility, new-borns could be benefitted from primary interventions in a health facility[23]. In this context, the 'Three Delays Model' implies that delays in recognizing a need to seek care and reaching care could cause adverse outcomes due to delays in receiving care[23,24].

The study has not found any significant differential in ENNM between rural and urban areas. Besides, place of residence, this study did not find any association of maternal education, and

household wealth status (except, richest in 2019-21) with early neonatal mortality. Though previous studies from different countries found associations of socioeconomic conditions with early neonatal deaths[13,18]. The recent analyses from several other studies found that socioeconomic inequalities in neonatal mortality in low and middle-income countries are falling. The probable reason that has been put forward for the reduction of these inequalities is that the 'reduction of inequalities' allied with maternal and child health care services utilization.

The west and south regions have shown the lower risk of ENNM than North region. It is because of West and south region are known for their socio-economic development, i.e. high SGDP, higher level of literacy, higher level of urbanization and relatively better health care system, which are the catalyst factor for child survival.

The results from the decomposition analysis indicate the imperative factors that contribute to the difference in infant mortality between 2005-06 and 2019-21 in India. It is found that most of the factors considered for the study significantly contribute to explaining the gap in early neonatal mortality over the period. The imperative factors are mother's age at child birth, mother's educational attainment, birth order, place of residence, any member of the household covered by health insurance and place of delivery are the major determinants of early neonatal mortality that have major contribution for difference between two study periods.

6. Conclusion and Policy Implications

This study suggests that the prevalence of early neonatal mortality is higher India, though it has shown the decline trend over the year. Moreover, factors associated with early neonatal mortality more or less are the same as Infant and child mortality. The running national programs for decreasing all types of childhood mortality have been focusing on educating women, increasing age at marriage, age at first birth, reducing the gender differentials and emphasis are given to other socio-economic development indicators. As the early phase of life is very prone to newborn mortality, hence only quantity is not enough for further reduction in childhood mortality, therefore it is recommended to focus on the quality of maternal health care services. Further, rigorous implementation of public health programmes such as Integrated Management of Neonatal and Childhood Illnesses (IMNCI) at the community level and F-IMNCI at health facilities, NSSK, JSSK, HBNC, and recently launched India Newborn Action Plan (INAP) is recommended, so that avoidable deaths can be avoided to achieve the SDG-3.

Tables

Table 1: Sample distribution by background characteristics of the respondents, India, 2005-21

Background characteristics	2019-21		2005-06	
	%	N	%	N
Women's age at child birth				
<20 years	12.5	28,497	29.2	16,493
20-34 years	84.0	1,90,773	66.5	37,544
35-49 years	3.5	7,952	4.3	2,400
Women's education				
No Education	21.4	48,502	50.0	28,237
Primary	12.3	27,907	14.0	7,920
Secondary	50.7	1,15,220	30.9	17,463
Higher	15.7	35,594	5.0	2,817
Mother Height				
<145cm	12.5	27,513	12.7	6,865
≥145cm	87.5	1,92,281	87.3	47,326
Birth order				
1'	39.1	88,860	30.3	17,106
2-3'	48.9	1,11,141	43.3	24,429
4 or more	12.0	27,222	26.4	14,902
Birth Interval				
<24month	27.4	37,614	27.7	10,860
≥24 month	72.6	99,879	72.3	28,356
Child Sex				
Male	52.0	1,18,074	52.1	29,415
Female	48.0	1,09,149	47.9	27,022
Multiple births				
Single	98.3	2,23,255	98.4	55,541
Multiple	1.8	3,968	1.6	897
Child Weight at births				
LBW(500-2450)	18.2	37,434	21.5	4,135
Normal	67.5	1,38,831	58.8	11,314
Overweight(3.5kg+	14.3	29,409	19.7	3,786
Place of residence				
Urban	26.7	60,602	25.3	14,303
Rural	73.3	1,66,621	74.7	42,135
Caste				
SC	24.6	52,931	21.5	11,739
ST	10.6	22,743	9.9	5,389
OBC	46.0	98,792	42.0	22,962
Others	18.8	40,485	26.6	14,559
Religion				
Hindu	79.4	1,80,408	78.3	44,152
Muslim	16.3	36,936	17.1	9,641
Others	4.4	9,879	4.6	2,596
Wealth quintiles				

Poorest	24.6	55,818	25.5	14,377
Poor	21.7	49,328	22.4	12,654
Middle	19.5	44,404	19.8	11,181
Richer	18.4	41,831	18.0	10,154
Richest	15.8	35,841	14.3	8,072
ANC visits				
<4	40.7	69,264	62.7	24,695
≥4	59.3	1,00,834	37.3	14,667
Place of delivery				
Home	11.2	25,406	61.1	34,461
Public sector	61.9	1,40,698	18.0	10,166
Private sector	26.2	59,618	20.2	11,405
Others	0.6	1,465	0.7	407
Sex of head of the household				
Male	84.8	1,92,738	88.9	50,145
Female	15.2	34,484	11.2	6,293
Media exposure				
No exposure	48.0	1,09,098	46.4	26,143
Any exposure	52.0	1,18,124	53.6	30,211
Any member of the household covered by health Insurance				
No	76.8	1,74,428	97.3	54,902
Yes	23.2	52,795	2.7	1,535
Region				
North	13.4	30,430	13.0	7,314
Central	27.9	63,383	29.7	16,759
East	26.1	59,302	25.2	14,239
Northeast	3.6	8,263	3.8	2,139
West	12.5	28,285	12.5	7,065
South	16.5	37,559	15.8	8,922
Total	100	2,27,223	100	56,438

Note: Cases may not be equal due to missing values.

Table 2: Prevalence of Early neonatal mortality in India by socio-economic characteristics, India, 2005-06-2019-21.

Background characteristics	2019-21		2005-06		Absolute change	% Change
	%	N	%	N		
Women's age at child birth						
<20	2.9	28,497	4.1	16,493	-1.2	-29.7
20-34	1.9	1,90,773	2.5	37,544	-0.6	-22.9
35-49	2.6	7,952	3.4	2,400	-0.8	-22.1
Women's education						
No Education	2.8	48,502	3.5	28,237	-0.7	-19.4
Primary	2.4	27,907	3.5	7,920	-1.1	-31.1
Secondary	2.0	1,15,220	2.3	17,463	-0.3	-13.3
Higher	1.2	35,594	1.4	2,817	-0.2	-17.3
Mother Height						
<145cm	3.0	27,513	4.3	6,865	-1.3	-29.3
≥145cm	1.9	1,92,281	2.8	47,326	-0.9	-31.3
Birth order						
1'	2.2	88,860	3.8	17,106	-1.6	-41.7
2-3'	1.7	1,11,141	2.3	24,429	-0.5	-23.5
4+	2.8	27,222	3.2	14,902	-0.4	-11.0
Birth Interval						
<24 months	2.7	37,614	4.3	10,860	-1.7	-38.0
≥24 months	1.6	99,879	1.9	28,356	-0.4	-18.1
Child Sex						
Male	2.3	1,18,074	3.3	29,415	-1.1	-32.2
Female	1.9	1,09,149	2.6	27,022	-0.8	-29.3
Multiple births						
Single	1.9	2,23,255	2.8	55,541	-0.9	-32.1
Multiple	11.4	3,968	14.6	897	-3.3	-22.4
Child Weight at births						
LBW(500-2450)	3.1	37,434	3.0	4,135	0.1	3.7
Normal	0.9	1,38,831	1.0	11,314	-0.1	-6.1
Overweight(3.5kg+)	1.8	29,409	1.8	3,786	0.1	4.6
Place of residence						
Urban	1.5	60,602	2.3	14,303	-0.8	-34.8
Rural	2.3	1,66,621	3.2	42,135	-1.0	-29.7
Caste						
SC	2.4	52,931	3.3	11,739	-0.8	-25.8
ST	2.3	22,743	3.1	5,389	-0.7	-24.2
OBC	2.0	98,792	3.0	22,962	-0.9	-31.5
Others	1.6	40,485	2.8	14,559	-1.2	-41.5
Religion						
Hindu	2.1	1,80,408	3.1	44,152	-1.0	-32.8
Muslim	1.9	36,936	2.4	9,641	-0.5	-19.8
Others	1.6	9,879	2.6	2,596	-1.1	-41.3
Wealth quintiles						

Poorest	2.8	55,818	3.7	14,377	-0.9	-23.8
Poor	2.5	49,328	3.3	12,654	-0.8	-24.7
Middle	1.9	44,404	2.9	11,181	-1.0	-33.8
Richer	1.7	41,831	2.6	10,154	-0.9	-35.9
Richest	1.0	35,841	1.9	8,072	-0.9	-49.2
ANC visits						
>4	1.8	69,264	2.1	24,695	-0.3	-13.3
≥4	1.1	1,00,834	1.5	14,667	-0.4	-26.9
Place of delivery						
Home	2.9	25,406	3.0	34,461	0.0	-0.7
Public sector	1.9	1,40,698	2.6	10,166	-0.7	-25.8
Private sector	2.0	59,618	3.1	11,405	-1.1	-36.5
Others	2.1	1,465	12.6	407	-10.5	-83.0
Sex of head of the household						
Male	2.1	1,92,738	3.0	50,145	-1.0	-32.1
Female	2.1	34,484	2.7	6,293	-0.6	-21.7
Media exposure						
No exposure	2.5	1,09,098	3.3	26,143	-0.9	-25.7
Any exposure	1.7	1,18,124	2.7	30,211	-1.0	-37.3
Any member of the household covered by health Insurance						
No	2.1	1,74,428	3.0	54,902	-0.9	-29.1
Yes	1.8	52,795	2.0	1,535	-0.2	-9.1
Region						
North	1.6	30,430	2.7	7,314	-1.1	-39.7
Central	2.8	63,383	3.5	16,759	-0.7	-20.3
East	2.3	59,302	3.2	14,239	-0.8	-25.9
Northeast	1.8	8,263	2.7	2,139	-0.9	-33.9
West	1.4	28,285	2.6	7,065	-1.2	-45.6
South	1.2	37,559	2.2	8,922	-1.0	-45.5
Total	2.1	2,27,223	3.0	56,438	-0.9	-31.1

Note: Cases may not be equal due to missing values.

Table 3: Determinants of Early neonatal mortality, 2005-06 to 2019-21, India

Background characteristics	2019-21		2005-06	
	AOR	95% CI	AOR	95% CI
Women's age at child birth				
<20®				
20-34	0.936	[0.836,1.048]	0.881	[0.655,1.187]
35-49	1.201	[0.966,1.493]	0.764	[0.319,1.833]
Women's education				
No Education®				
Primary	1.023	[0.901,1.162]	1.287	[0.848,1.953]
Secondary	1.034	[0.931,1.148]	0.879	[0.599,1.291]
Higher	0.902	[0.765,1.064]	0.701	[0.393,1.250]
Mother Height				
<145cm®				
≥145cm	0.753***	[0.680,0.834]	0.674*	[0.476,0.953]
Birth order				
1st ®				
2-3'	0.750***	[0.688,0.817]	0.761	[0.575,1.006]
4 or more	0.907	[0.794,1.035]	0.832	[0.520,1.331]
Child Sex				
Female®				
Male	1.328***	[1.230,1.433]	1.421**	[1.103,1.832]
Child Weight at births				
LBW(500-2.450 kg) ®				
Normal	0.305***	[0.280,0.331]	0.315***	[0.238,0.417]
Overweight(3.5kg+)	0.509***	[0.455,0.569]	0.497***	[0.356,0.693]
Place of residence				
Urban®				
Rural	1.075	[0.960,1.205]	0.878	[0.658,1.172]
Caste				
SC/ST®				
OBC	0.931	[0.854,1.016]	0.789	[0.558,1.116]
Others	0.784***	[0.690,0.891]	1.046	[0.743,1.472]
Religion				
Hindu®				
Muslim	0.944	[0.827,1.076]	0.672	[0.427,1.057]
Others	0.774**	[0.647,0.925]	1.032	[0.681,1.565]
Wealth quintiles				
Poorest®				
Poor	1.037	[0.934,1.152]	1.291	[0.647,2.576]
Middle	0.903	[0.796,1.023]	1.365	[0.702,2.653]
Richer	0.898	[0.776,1.038]	1.275	[0.639,2.544]
Richest	0.610***	[0.503,0.739]	0.991	[0.467,2.105]
Place of delivery				
Home®				
Public sector	1.303***	[1.119,1.517]	0.908	[0.605,1.363]
Private sector	1.700***	[1.432,2.019]	1.233	[0.805,1.888]
Others	1.710*	[1.024,2.855]	0.596	[0.142,2.502]
Media exposure				
No exposure®				
any exposure	0.913*	[0.837,0.996]	1.07	[0.738,1.550]
Any member of the household covered by health Insurance				
No®				

Yes	0.985	[0.901,1.076]	0.479*	[0.234,0.981]
Region				
North®				
Central	1.347***	[1.193,1.521]	0.873	[0.546,1.397]
East	1.173*	[1.026,1.341]	0.650	[0.404,1.045]
Northeast	0.674***	[0.557,0.816]	0.590*	[0.363,0.959]
West	0.830*	[0.703,0.981]	0.664	[0.433,1.021]
South	0.723***	[0.616,0.849]	0.779	[0.512,1.186]

Note: * p<0.05, ** p<0.01, *** p<0.001; ®: reference category, AOR: Adjusted Odds Ratio

Table 4: Results of Fairlie Decomposition Analysis showing the contribution of selected factors in the early neonatal mortality between 2005-06 and 2019-21.

Raw Difference	**Total Difference Explained**		**Difference Unexplained**	
0.00927004	0.00664326		0.00230109	
In Percent	71.7		24.8	
Background Characteristics	**% Contribution in Explained Difference**	**p>z**	**95% Confidence Interval**	
Mother's age at birth				
<20				
20 and above	33.0	0.000	9.100	0.000
Mother's educational attainment				
Not educated				
Educated	26.0	0.001	3.420	0.001
Mother's Height				
Greater than 145 cm				
Less than 145 cm	1.5	0.000	2.950	0.003
Birth Order				
Less than 4				
4 and above	12.2	0.000	3.040	0.002
Sex of Child				
Female				
Male	1.4	0.000	2.850	0.004
Place of residence				
Urban				
Rural	2.1	0.000	2.440	0.015
Caste				
Others				
Scheduled Caste/Scheduled Tribe	0.5	0.000	1.130	0.257
Religion				
Non - Hindu				
Hindu	1.3	0.000	2.720	0.007
Wealth status				
Non-poor				
Poor	1.2	0.000	1.600	0.109
Media Exposure				
Yes				

No	0.2	0.000	0.460	0.648
Insurance				
Yes				
No	11.6	0.001	0.920	0.357
Region				
Others				
North	0.0	0.000	-0.1400	0.885
Place of Delivery				
Non - Public				
Public	8.9	0.001	0.770	0.438

References

1. UNICEF. The neonatal period is the most vulnerable time for a child. https://data.unicef.org/topic/child-survival/neonatal-mortality/. Published 2021. Accessed January 10, 2023.

2. United Nations Inter-Agency Group for Child Mortality Estimation. Levels & Trends in Child Mortality: Report 2020, Estimates developed by the United Nations Inter-Agency Group for Child Mortality Estimation. United Nations Children's Fund, New York. https://www.unicef.org/reports/levels-and-trends-child-mortality-report-2020. Published 2020. Accessed January 10, 2023.

3. Chou VB, Walker N, Kanyangarara M. Estimating the global impact of poor quality of care on maternal and neonatal outcomes in 81 low- and middle-income countries: A modeling study. *PLOS Med*. 2019;16(12):e1002990. doi:10.1371/JOURNAL.PMED.1002990

4. IIPS and ICF. National Family Health Survey (NFHS-4) 2015-16 India. *Int Inst Popul Sci ICF*. 2017:1-192. doi:kwm120 [pii]10.1093/aje/kwm120

5. Nove A, Friberg IK, de Bernis L, et al. Potential impact of midwives in preventing and reducing maternal and neonatal mortality and stillbirths: a Lives Saved Tool modelling study. *Lancet Glob Heal*. 2021;9(1):e24-e32. doi:10.1016/S2214-109X(20)30397-1

6. Lawn JE, Kerber K, Enweronu-Laryea C, Bateman OM. Newborn survival in low resource settings—are we delivering? *BJOG An Int J Obstet Gynaecol*. 2009;116(SUPPL. 1):49-59. doi:10.1111/J.1471-0528.2009.02328.X

7. Fairlie RW. An extension of the Blinder-Oaxaca decomposition technique to logit and probit models. *J Econ Soc Meas*. 2005;30(4):305-316. doi:10.3233/JEM-2005-0259

8. Fairlie RW. The Absence of the African-American Owned Business: An Analysis of the Dynamics of Self-Employment. *https://doi.org/101086/209914*. 1999;17(1):80-108. doi:10.1086/209914

9. Kenny LC, Lavender T, McNamee R, O'Neill SM, Mills T, Khashan AS. Advanced maternal age and adverse pregnancy outcome: evidence from a large contemporary cohort. *PLoS One*. 2013;8(2). doi:10.1371/JOURNAL.PONE.0056583

10. Berkowitz GS, Skovron ML, Lapinski RH, Berkowitz RL. Delayed Childbearing and the Outcome of Pregnancy. *http://dx.doi.org/101056/NEJM199003083221004*. 2010;322(10):659-664. doi:10.1056/NEJM199003083221004

11. Mekonnen Y, Tensou B, Telake DS, Degefie T, Bekele A. Neonatal mortality in Ethiopia: Trends and determinants. *BMC Public Health*. 2013;13(1):1-14. doi:10.1186/1471-2458-13-483/TABLES/3

12. Khanam R, Ahmed S, Creanga AA, et al. Antepartum complications and perinatal mortality in rural Bangladesh. *BMC Pregnancy Childbirth*. 2017;17(1):1-8. doi:10.1186/S12884-017-1264-1/TABLES/4

13. Owais A, Faruque ASG, Das SK, Ahmed S, Rahman S, Stein AD. Maternal and Antenatal Risk Factors for Stillbirths and Neonatal Mortality in Rural Bangladesh: A Case-Control Study. *PLoS One*. 2013;8(11):e80164. doi:10.1371/JOURNAL.PONE.0080164

14. World Health Organization. Maternal anthropometry and pregnancy outcomes: a WHO collaborative study. *World Heal Organ*. 1995;73.

15. Black RE, Allen LH, Bhutta ZA, et al. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet*. 2008;371(9608):243-260. doi:10.1016/S0140-6736(07)61690-0

16. Ganguly D, Goli S. Child survival in India: Hindus now catching up with Muslims Why are Hindus catching up with Muslims? 2022.

17. Fikree FF, Gray RH. Demographic survey of the level and determinants of perinatal mortality in Karachi, Pakistan. *Paediatr Perinat Epidemiol*. 1996;10(1):86-96. doi:10.1111/j.1365-3016.1996.tb00029.x

18. Kumar C, Singh PK, Rai RK, Singh L. Early neonatal mortality in India, 1990-2006. *J Community Health*. 2013;38(1):120-130. doi:10.1007/S10900-012-9590-8/METRICS

19. Engmann C, Walega P, Aborigo RA, et al. Stillbirths and early neonatal mortality in rural Northern Ghana. *Trop Med Int Heal*. 2012;17(3):272-282. doi:10.1111/J.1365-3156.2011.02931.X

20. Nankabirwa V, Tumwine JK, Tylleskär T, Nankunda J, Sommerfelt H. Perinatal mortality in eastern Uganda: a community based prospective cohort study. *PLoS One*. 2011;6(5). doi:10.1371/JOURNAL.PONE.0019674

21. Liambila WN, Kuria SN. Birth attendance and magnitude of obstetric complications in Western Kenya: a retrospective case-control study. *BMC Pregnancy Childbirth*. 2014;14(1):1-15. doi:10.1186/1471-2393-14-311/FIGURES/2

22. Sarker BK, Rahman M, Rahman T, Hossain J, Reichenbach L, Mitra DK. Reasons for Preference of Home Delivery with Traditional Birth Attendants (TBAs) in Rural Bangladesh: A Qualitative Exploration. *PLoS One*. 2016;11(1). doi:10.1371/JOURNAL.PONE.0146161

23. Moyer CA, Dako-Gyeke P, Adanu RM. Facility-based delivery and maternal and early neonatal mortality in sub-Saharan Africa: A regional review of the literature. *Afr J Reprod Health*. 2013;17(3):30-43. doi:10.4314/ajrh.v17i3.

24. Waiswa P, Kallander K, Peterson S, Tomson G, Pariyo GW. Using the three delays model to understand why newborn babies die in eastern Uganda. *Trop Med Int Health*. 2010;15(8):964-972. doi:10.1111/J.1365-3156.2010.02557.X

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