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Assessment of Child Mortality and its Socioeconomic and Demographic Determinants- Evidences from the Latest National Family Health Survey of India

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Abstract

Even though the childhood mortality rates have been on a steady decline in India, they are still unacceptably high across many parts of the country. As per WHO estimates, India experienced 490 thousand new born deaths in 2020, the highest in the world. To achieve the Sustainable Development Goal (SDG) goal of reducing under-five mortality to at least as low as 25 per 1,000 live births in every country by 2030, India needs to identify factors acting as barriers in the implementation of health policies and programmes to improve accessibility, utilization and outreach of quality public healthcare systems to all.

The objective of this study is to identify and assess the impact of demographic, socio-economic and health resource factors associated with infant mortality in India. A comparative assessment of the current status of child mortality in India has been presented. Further, risk of infant deaths associated with these factors has been evaluated using a binary logistic regression. Individual child level data from the fifth National Family Health Survey (NFHS 5) has been used for the analysis.

Out of the four factors included in the model, education level of mother has come out to be the most significant determinant of infant mortality. Results show that the odds of infant mortality increase consistently as the education level of mother decreases. Those born to a mother with no education are at more than two times risk of dying within 1 year as compared to those born to a mother with higher education. An interesting finding, contrary to the historical trend, is that the risk of infant mortality in male child is significantly higher (by around 25%), as compared to that of a female child.

Key words: Maternal and Child Health; Healthcare; Under-five mortality; Infant mortality; Excess girl child mortality; Female literacy.

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1. Introduction

There is a potential association between the causes of infant mortality and factors that are likely to influence health status of the whole population, see Crevoiserat and Kim (2013). Three significant measures of child mortality are neonatal mortality – probability of dying in the first month of life, infant mortality – probability of dying before reaching the first birthday, and the under-five mortality – probability of dying before the fifth birthday. India as a member state of the United Nations had adopted the now named Sustainable Development Goals (SDGs) goals, previously known as the Millennium Development Goals, since 2000. These goals, 17 in all, aim at reducing economic and social inequities among nations - 'they recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests (https://sdgs.un.org/goals).The Sustainable Development Goal 3 (SDG 3) - Good Health and Well Being, is aimed at ensuring healthy lives and promoting well-being for all at all ages. In particular, the target of goal 3.2 is to end preventable deaths of newborns to at least as low as 12 per 1000 live births in every country and reduce under-five mortality to at least as low as 25 per 1,000 live births in every country by 2030. In India, recent data from the NFHS 5 survey report of 2019-21 have estimated neonatal mortality at 25, infant mortality rate at 35 and the under-five mortality at 42 per 1000 live births. In terms of actual number of child deaths, this is very high considering India is now expected to surpass China as the most populous country in the world with a population exceeding one billion. UNICEF has reported an estimate of 490 thousand newborn deaths in India in 2020 (Figure 1). This is nearly twice that of Nigeria which has the second highest estimated number of new born deaths at 271 thousand.

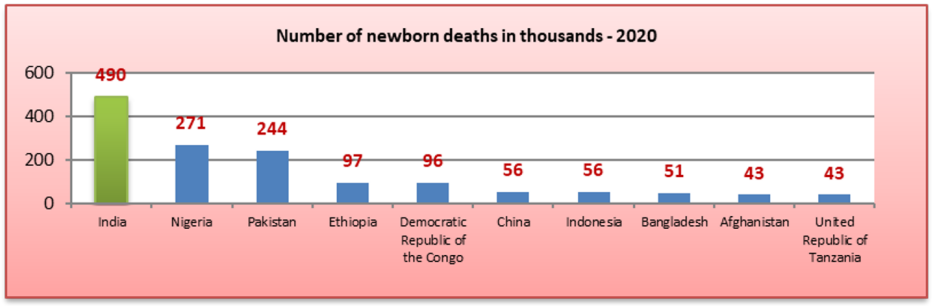

Figure 1: Number of new born deaths (in thousands) in 2020 [Data Source: https://www.unicef.org]

These numbers for India remain worrisome, even after considerable reductions in the last four decades. Evolving evidences on demographic and socioeconomic determinants of child mortality from latest national surveys will be crucial to inform health policies and overcome programmatic gaps. This paper examines the current status of child mortality in India using survey data from various sources, primarily the NFHS 5. It also analyzes the impact of some determinants currently associated with infant mortality in India.

Section 2 contains a comparative analysis of the current state of child mortality in India with respect to the other G20 nations. In section 3, we have presented a synopsis of the major socio-economic and demographic determinants of child mortality in India based on exploratory findings from the NFHS 5 and SRS datasets. Furthermore, based on the

NFHS 5 data, impact of these determinants on infant mortality in India has been assessed using multiple logistic regression in section 4. Section 5 provides a comprehensive discussion on the findings of the sections 2, 3, and 4.

2. Child mortality in India – An assessment

The Infant Mortality Rate (IMR) of India was recorded as 125 per 1000 live births in 1978 and, almost forty five years later, it now stands at 28 per 1000 live births in 2020 (SRS bulletins, 1997-2021). The World Bank estimate of the IMR of India for the same year is 27 per 1000 live births. The overall IMR and the IMRs for both male and female child have been on a decline since 1998 as evident from the data (Figure 2). Despite the

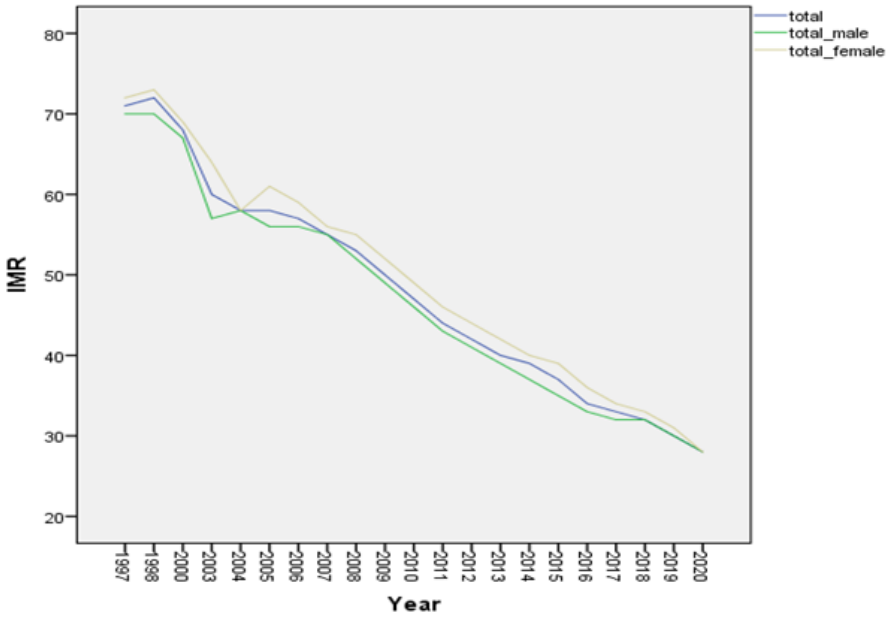

Figure 2: IMR trend in India [Data Source: SRS bulletins, 1997–2021]

substantial drop over the years, the current IMR for India (2020) does not compare well with the other G20 countries. G20 is a consortium of 19 countries and the European Union that together represent around 85% of the global GDP, over 75% of the global trade, and about two-thirds of the world population (https://www.g20.org). G20 initially focused on broad macroeconomic issues but it has since expanded its agenda to include sustainable development and health in its ambit. According to estimates of child mortality of the G20 nations in 2020 (https://data.worldbank.org), neonatal mortality rate of India is highest among these nations at 20.3 (Figure 3). 15 of these nations are below the 5 mark, with Indonesia having the next highest at 11.7. IMR of India is also the highest (Figure 4) at 27, with Japan having the lowest at 1.8. Again, 15 of these G20 nations have an IMR less than 10. The under-five mortality rate of India stands at 32.6 with Japan being the lowest again at 2.5 (Figure 5).

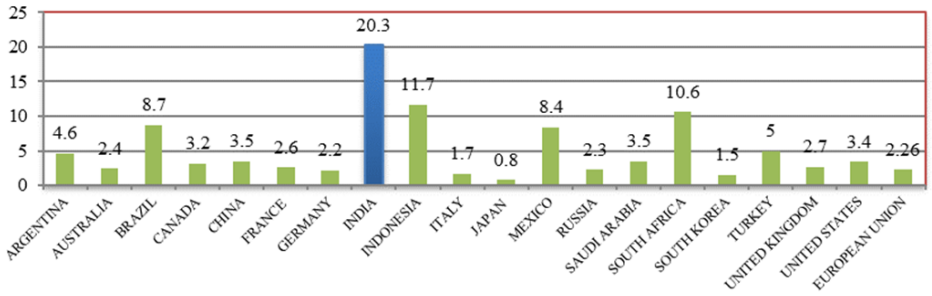

Figure 3: G20 nations: neonatal mortality rates (2020) [Data Source: https://data.worldbank.org]

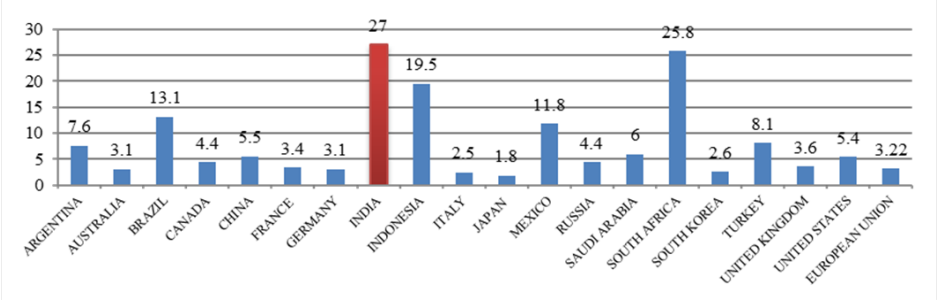

Figure 4: G20 nations: infant mortality rates (2020) [Data Source: https://data.worldbank.org)]

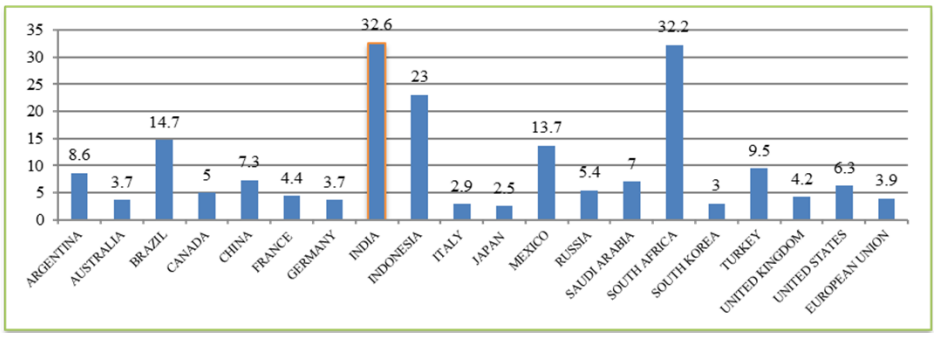

Figure 5: G20 nations: under-five mortality rates (2020) [Data Source: https://data.worldbank.org]

3. Socioeconomic and demographic risk factors of child mortality

According to World Bank estimates (https://data.worldbank.org), 65% population of India lives in rural areas. Statistics also indicate that the IMR has been uneven across the rural urban divide (Figure 6). The National Rural Health Mission was launched in 2005. One of the targets was to reduce IMR in rural areas to 30 by 2012. The Janani Suraksha Yojana (JSY) is one such program under the National Rural Health Mission. This program was introduced in 2005 with the objective of reducing maternal and neonatal mortality by promoting institutional delivery among poor pregnant women. The JSY is currently being implemented through the Accredited Social Health Activists (ASHA) and Anganwadi Workers (AWW). Under this scheme, a comprehensive package of free and cashless services is offered to all pregnant women, and sick infants up to the age of one year, in government

health institutions. The Janani Shishu Suraksha Karyakram (JSSK), thereby is aimed at reducing financial barriers to care and improving access to health services by eliminating out of pocket expenditure in all government facilities.

Twenty years of IMR data of rural and urban population from 2000 to 2020, from the SRS bulletins was examined and analysed. It was observed that the IMR has gone down steadily in both rural and urban areas from 2000 to 2020. The gap between the two still remains high with IMR in urban areas at 19 and in rural areas is higher at 31 per thousand in 2020 (Figure 6). A t -test confirms that this difference between IMR values in rural and urban areas in 2020 is statistically significant.

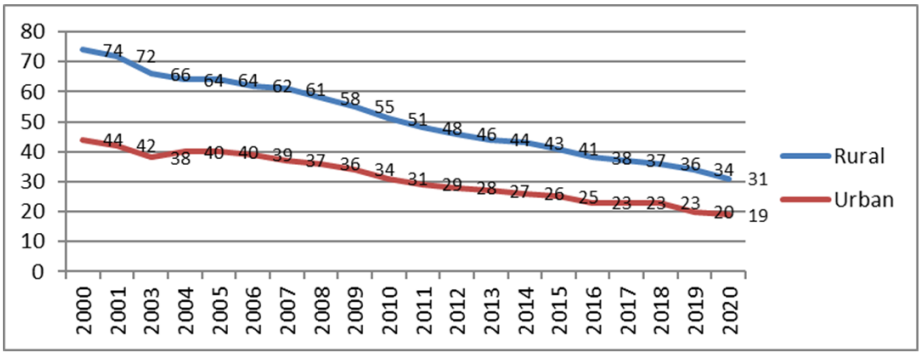

Figure 6: IMR in rural and urban areas in India, 2000-2020 [Data Source: SRS Bulletin, 2000- 2020]

Several studies have established that there is an inverse relationship between female literacy and infant mortality rate (Rao *et al.* (1996), Gokhale *et al.* (2002), Gakidou *et al.* (2010), Singh *et al.* (2011), Balaj *et al.* (2021), Okui (2023)). A meta analysis of surveys from 92 countries by Balaj *et al.* (2021) observed a reduction in under-5 mortality of $31 \cdot 0\%$ for children born to mothers with 12 years of education (*i.e.*, completed secondary education). A basic minimum level of education empowers females and helps creates awareness about health practices. Maternal health is an immediate and important factor in determining child mortality. Factors such as low birth weight, nutritional deficiency in infants are all tied to maternal health and can affect the child's survival. Socioeconomic and demographic factors identified in various studies include nutritional status of mother, age of the mother, gaps between two deliveries, access to healthcare services that ensure safe delivery along with ante natal and post natal care (Thakkar *et al.* (2023), Patel and Olickal (2021), Bora (2020) Singh *et al.* (2011)). From the observed data of educational status and percentage of institutional deliveries obtained from the NFHS 5 survey, it can be seen in Figure7 that higher the education level of the mother, the more likely she is to go for a safer delivery in a health facility with trained medical staff. Among women who had completed 12 years of schooling and above, 97 percent had opted for institutional deliveries as compared to women with no schooling among which the percentage was 75.

From Table 1, it can be observed that the most common reason for not delivering in a health facility for both rural as well as urban areas was that the woman did not think it was necessary. In rural areas 19.5 percent women said that the husband or family did not allow them to have the delivery in a health facility, 17.4 percent of women said that a health facility was too far or there was no transportation, and 15.1 percent said it costs too much. 27.6 per-

cent women in rural and 30.5 percent women in urban areas did not feet that it was necessary.

Table 1: Rural vs. urban response percentage on reasons for not delivering in a health facility

Sl. no.	Reason for not delivering in health facility	Urban	Rural
1	Costs too much	15.2	15.1
2	Facility not open	9.1	9.8
3	Too far/ no transportation	12.4	17.4
4	Don't trust/poor quality service	6.8	4.7
5	No female provider at facility	4.3	3.9
6	Husband /family did not allow	18.1	19.5
7	Not necessary	30.5	27.6
8	Not customary	3.6	3.5
9	Other	19.1	16.4

Data Source: NFHS 5, 2019-21

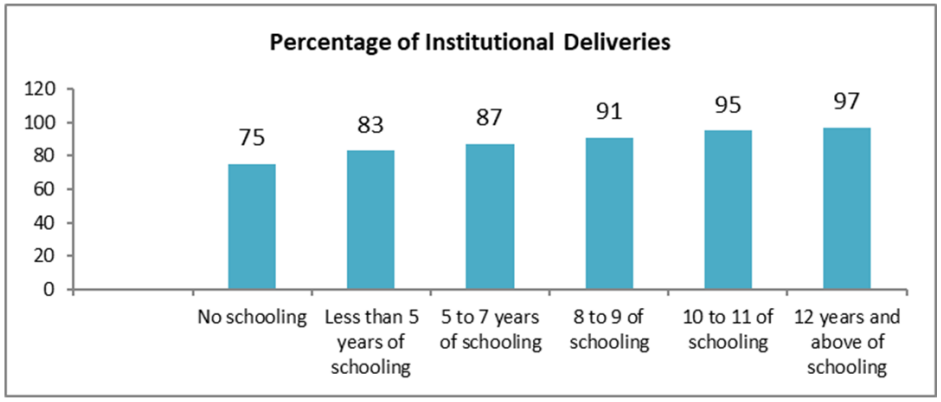

Figure 7: Percentage of institutional deliveries for different levels of schooling [Data Source: NFHS 5, 2019- 2021]

In NFHS 5 data, wealth index is a composite measure of a household's cumulative living standard and relative economic status. The wealth index is calculated using data on a household's ownership of certain selected assets which include consumer items such as a television and car; dwelling characteristics such as flooring material, type of drinking water source, toilet facilities and other characteristics that are related to wealth status (NFHS 5 India Report). On the basis of household scores, the population is divided into five equal categories (quintiles) each consisting of 20% of the population. Table 2 presents the wealth index from the NFHS 5 survey report (2019-21). The rural urban divide in economic condition is further evident from the data in this table. Nearly 76% of the wealthiest population falling in the highest two quintiles reside in urban areas as opposed to 24% in rural areas, and more than 50% of the rural population falls in the lowest two quintiles.

Table 3 indicates that, in India, the brunt of high child deaths is borne by the marginalized and socioeconomically disadvantaged sections of the population. For example, the Infant Mortality Rate in the poorest 20 percent of the population is more than 3 times higher than that in the richest 20 percent of the population. This means that an

Table 2: Distribution (in%) of wealth index by residency

Residency	Lowest	Second	Middle	Fourth	Highest	Total
India	20	20	20	20	20	100
Rural	3.2	7.2	15.5	28.6	45.5	100
Urban	27.8	26	22.1	16	8.1	100

Data Source: NFHS 5 Report, 2019-21

infant born in a relatively poor family is more than three times likely to die in infancy than an infant born in a better off family. Similar conclusions follow for neonatal and under-five mortality. A study by Goel *et al.* (2015), investigated the link between maternal health and wealth index. They concluded that the number of antenatal care (ANC) visits increased as the wealth index increased. Another study by Thakkar *et al.* (2023) came up with similar results - women with less formal education, from poorer households and belonging to rural areas had higher odds of inadequate visits. Among the reasons given for not delivering in a health facility – 'it costs too much' and 'was too far / no transportation', together constituted 27.6% respondents in urban and 32.5% respondents in urban areas respectively.

Table 3: Child mortality rates by wealth quintiles

Wealth Quintile	Neonatal Mortality	Infant Mortality	Under- Five Mortality
Lowest	39.2	53.1	63.4
Second	25.4	34.8	43.6
Middle	22.3	34.5	40.2
Fourth	19.4	29.2	33.7
Highest	10.9	16.2	19.4

Data Source: NFHS 5 Report, 2019-21

4. Risk assessment of determinants of infant mortality using NFHS 5 data

4.1. Socioeconomic and demographic determinants

Based on the review presented in the previous sections, four major factors are selected for generating evidence on associated risk of infant mortality using the NFHS 5 data. These are - type of place of residence, education level of the mother, wealth index of the household, and sex of the child. Type of place of residence is classified into two categories- rural and urban. Four levels of education were considered - no education, primary education, secondary education and higher education. All five quintiles of the wealth index from NFHS 5 survey are considered – poorest, poorer, middle, richer and richest are considered.

4.2. Methodology and results

Individual level data of children from NFHS 5 (file name: IAKR7EDT), downloaded from the website of DHS [www.dhsprogram.com], was used for the analyses. Respondents (mothers) are between 15 to 49 years of age. Since the age at death is in rounded-off months, deaths till 11 months of age have been categorized as infant mortality. Children who were alive at the time of interview and were 12 months or older are considered as those who did not experience infant mortality. Summary of the data by different factors are provided in

Table 4. A binary logistic regression with response variable as infant mortality status of children has been fitted with the four factors (type of place of residence, education level of the mother, wealth index of the household, and sex of the child), while adjusting for the age of the respondent (mother) at the birth of her first child. Results of the fitted logistic regression are presented in Table 5. All analyses have been performed using R software.

Out of the four factors included in the model, education level of mother has come out to be the most significant determinant of infant mortality. Results show that the odds of infant mortality increase consistently as the education level of mother decreases. Those born to a mother with no education are at more than two times risk of dying within 1 year as compared to those born to a mother with higher education (college and above). Similarly, odds of infant mortality among children born to mothers with primary and secondary education are around 2 times and 1.6 times of the odds for those born to mothers with higher education. Although the estimated odds of infant mortality associated with lower wealth index quintiles, as compared to that for the Richest group, are all higher, only two of the odds ratios are statistically significant. That is, it does indicate higher odds of infant mortality in relatively poorer households, but the odds do not increase consistently through the subsequent lower levels of wealth quintiles. An interesting result is that there is no significant difference in the odds of infant mortality among children born in households residing in rural areas as compared to those residing in urban households. The risk of infant mortality in male child is significantly higher (by around 25%), as compared to that of a female child.

5. Discussion

Child mortality rates in India are highly variable across the rural urban divide. Despite two decades of implementation of policies and programs to improve child mortality with particular focus in rural areas, IMR in rural areas of India continue to be significantly and consistently higher than in urban areas. The insignificant odds ratio of infant mortality in urban areas as compared to rural areas, may be indicative of the narrowing gap, but in terms of the IMR, NFHS 5 India report specifies that the under-five and infant mortality rates are still considerably higher in rural areas than in urban areas. Similar conclusions were given by Kumar *et al.* (2022) based on data from the earlier NFHS 4 survey. Their study found an existing rural-urban gap in under-five mortality and the authors suggested that the social and health policies need to reach rural children from poor families and uneducated mothers.

Based on the results of the present study we can conclude that female literacy remains one of the risk factors associated with child mortality in India. Improvements in the literacy rate of women will have a positive impact in reducing child mortality. The fact that 27.6 percent women in rural and 30.5 percent women in urban areas felt that it was not necessary to go for institutional deliveries, indicates a lack of awareness about safe deliveries, importance of antenatal and postnatal care, proper nutrition of the mother. It reflects a casual approach towards the birthing process. With reproductive and child health services being improved through Health and Wellness centres and primary health care centres, the decision to avail Antenatal care (ANC) and Postnatal care (PNC) services may depend more on awareness than on economic status. Consequently, the education level of mother can be expected to be a more significant determinant of infant mortality than household wealth index quintiles. Ensuring education of women up to a minimum level would play a vital role here to empower women to make better choices regarding health services. Policies and programs need to be

Table 4: Data summary and distribution with respect to factors

Variable	Overall distribution/ summary [Total infants included = 18757]	Survival status-wise distribution	
		Died under the age of one year [674]	Alive after one year of birth [18083]
b5: Child is alive	No: n = 674 Yes: n =18083	n = 674	n = 18083
v106: Highest education level of mother	1: No education: n= 2680 2: Primary: n= 1907 3: Secondary: n = 10462 4: Higher: n = 3708	1: No education: n= 136 2: Primary: n= 91 3: Secondary: n = 372 4: Higher: n = 75	1: No education: n= 2544 2: Primary: n= 1816 3: Secondary: n = 10090 4: Higher: n = 3633
v025: Type of place of residence	1: Rural: n= 14653 2: Urban: n= 4104	1: Rural: n= 534 2: Urban: n= 140	1: Rural: n= 14119 2: Urban: n= 3964
b4: Sex of child	1: Female: n= 8976 2: Male: n= 9781	1: Female: n= 289 2: Male: n= 385	1: Female: n= 8687 2: Male: n= 9396
v190: Wealth index combined	1: Poorest: n= 1282 2: Poorer: n= 2799 3: Middle: n = 3628 4: Richer: n = 4586 5: Richest: n = 6462	1: Poorest: n= 56 2: Poorer: n= 139 3: Middle: n = 126 4: Richer: n = 178 5: Richest: n = 175	1: Poorest: n= 1226 2: Poorer: n= 2660 3: Middle: n = 3502 4: Richer: n = 4408 5: Richest: n = 6287

designed to ensure that women complete at least a basic minimum level of 12 to 15 years of schooling for the effects of education to reflect truly on the individuals.

The results for male and female IMR indicate that a male child is at a significantly higher risk of mortality than a female child during the first year of life. Historically, IMR for females in India have been higher than that of males (Figure 2). However, as per the finding from our study, the risk of infant mortality is higher for male children than female children. This is corroborated by the higher male IMR as per the NFHS 5 India report which may be indicative of a recent change in trend in male and female IMR in India. Some earlier studies, like, Graunt (1977), Naeye *et al.* (1971), Waldron (1983), have attributed childhood mortality differences in sex to genetic and biological factors arguing that male children are more susceptible to diseases as compared to their female counterparts, and hence have lower survival rates. However, some later studies, like, Garenne (2003), and Pongou (2013), have argued that while prenatal environment and child biology are important contributing factors to sex differences in infant mortality, the effect of biology is much less important than the literature suggests. In the absence of any conclusive evidence on this research question, there

is a need for further investigation through well designed India-specific studies to identify and understand the possible changes in the infant mortality trends in India.

Table 5: Results of the logistic regression

Fitted Logistic Regression	Parameter	B	Std. Error	Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
				Wald Chi-Square	df	Sig.		Lower	Upper
	(Intercept)	-2.678	0.0392	4657.601	1	0.000	0.069	0.064	0.074
Type of place of residence	Urban	-0.067	0.0125	28.922	1	0.000	0.935	0.912	0.958
	Rural	0[a]					1		
Highest educational level of mother	No education	0.234	0.0266	77.267	1	0.000	1.264	1.199	1.331
	Primary	0.158	0.0275	33.020	1	0.000	1.171	1.110	1.236
	Secondary	0.026	0.0262	0.959	1	0.327	1.026	0.975	1.080
	Higher	0[a]					1		
Wealth index of household	Poorest	0.697	0.0186	1401.574	1	0.000	2.007	1.935	2.081
	Poorer	0.480	0.0185	675.638	1	0.000	1.616	1.559	1.676
	Middle	0.318	0.0185	294.752	1	0.000	1.374	1.325	1.425
	Richer	0.199	0.0187	113.458	1	0.000	1.220	1.177	1.266
	Richest	0[a]					1		
Sex of child	Male	0.078	0.0083	87.778	1	0.000	1.081	1.064	1.099
	Female	0[a]					1		
Covariate	Age of respondent at 1st birth	-0.033	0.0012	711.625	1	0.000	0.968	0.965	0.970

To conclude, socioeconomic and demographic factors continue to contribute to the disparities in the risk of infant mortality. These factors have the potential to create barriers for effective implementation of health programmes. With thousands of children in India still not being able to make it beyond the initial crucial years of their lives, there is an urgent need to identify and address such barriers in implementation and utilization of public healthcare programmes. Such steps will be imperative for India to achieve the Sustainable Development Goal (SDG) goal of reducing under-five mortality to at least as low as 25 per 1,000 live births by 2030.

A limitation of this analysis is that regional variations have not been considered and analysis has been performed at the national level only. Also, factors, like ANC visits, PNC, *etc.* have not been included as there was a lot of missing data.

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