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Infant Mortality in Northern and Southern Regions of India: Differentials and Determinants

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Abstract

Using the National Family Health Survey (NFHS-3) 2005-06 data, this paper examines the differentials and determinants of IMR in northern and southern regions of India – which record two extreme levels (highest and lowest respectively). Inferential statistics, bivariate analysis and multilevel Cox proportional regression were used as the methods of analysis. The result suggests that IMR is more pronounced in the northern than southern region. This was observed across the factors taken into consideration in the study. Nevertheless, mother's illiteracy, working status, and marrying and delivering first child at a young age were the major mother-related factors for a high IMR. Birth interval of less than two years, being of small-sized at birth, being a female child, and not breastfed at the time of survey were the main child-related factors for a high IMR. Further, poor economic condition, living in a rural area and not having access to basic civic amenities were the key household-related covariates of a high IMR. Female literacy, utilization of mother and child healthcare, and availing basic civic amenities at household level is essential to bring reduction in the IMR - without which achieving the recently crafted SDG 3 will be difficult for India.

Key words: Infant mortality, Northern and Southern regions, India

I. Introduction

Mortality is one of the important demographic components that controls population growth. It has an unequal effect on the age of any given population. In general, mortality affects the younger and older populations more than the adults (Lahariya & Paul, 2010). Significant differences are observed in the prevalence of mortality among diverse socioeconomic groups and geographical regions (Saikia et al., 2009). Such diversity exists primarily due to the lack of access to basic healthcare and control over resources (Muller, 2002). Children dying before their first birthday is referred to as ôInfant mortalityô, and this is often used as a proxy indicator to assess the health and developmental status of a nation (Heisler, 2012). It is also a significant determinant of the overall fertility and life expectancy of a population (Canudas-Romo & Becker, 2011). Globally, 4.5 million deaths occurred within the first year of life in 2015 ï three-fourths of the total under-five mortality in 2015. The corresponding figure is notably higher in the African and Asian countries (IGME, 2015). In India, the infant mortality rate (IMR) is unacceptably higher than many other developing and developed countries (Singh et al., 2011). As per the latest Sample Registration System (SRS), India recorded an IMR of 39 per 1000 live births, which is 4 times higher than the IMR of Sri Lanka in 2009 (RGI, 2016; Annual Health Bulletin, 2012). The figure is 17 times higher than countries like Finland and Japan, which recorded an IMR of only 2.3 per 1000 live births in 2010 (Mac Dorman et al., 2014). The intra-country analysis further suggests that infant mortality is not uniformly distributed across the geographical regions or states in India (Singh et al., 2011). In a nutshell, most of the southern states of India have recorded an IMR which is below the national average and, in fact, achieved the Millennium Development Goal (MDG 4) ï

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by reducing the IMR to 28 ï within the stipulated time frame, that is, by 2015 (Ram et al., 2009). Contrary to this, the northern states of the country report an IMR which is disproportionately higher than the national average and has failed miserably to achieve MDG 4 (Saikia et al., 2009; United Nations, 2015; RGI, 2016). Studies arguably suggest that any change in the fertility and mortality indicators in the northern states is bound to bring a noticeable change at the national level (Kapoor, 2010; Yadav et al., 2016).

The reasons of infant deaths can broadly be divided into two ï endogenous and exogenous factors. The endogenous factors are biological in nature, related to any impairment during the formation of the foetus in the womb and other cognitive or neurological deformities inside the womb. Contrary to this, the exogenous factors are more of a social, cultural, economic and environmental nature that cause infant deaths, especially during the post-natal period (Andreev & Kingkade, 2011). Studies have proved that exogenous factors cause more infant deaths than the endogenous ones and can be prevented with proper healthcare and programmes (Wilkins, 1995; Barman & Talukdar, 2014). India is a very large and diverse country where the socioeconomic and individual attributes of the population vary greatly across the regions and affect infants diversely (Das, 1999; Bajpai & Goyal, 2004). The southern and northern states of India differ on a number of grounds, primarily socioeconomic (Joseph, 2004). Female literacy, female work participation and households having access to basic civic amenities are factors on which the southern states fare better than their northern counterparts (RGI, 2011). The health infrastructure also varies greatly between these regions (Gupta & Kumar, 2007). With this backdrop, it becomes imperative to understand the major contributing factors of IMR in the southern and northern regions with two extreme IMRs, that is the lowest and the highest, in the country. Better knowledge on this will enable articulation of key intervention areas and adoption of suitable corrective measures to bring appreciable reduction in IMR. The study specifically examines the contribution of three major components, that is mother, child and household related factors which potentially contribute to IMR in the selected regions.

II. Methodology

Data source

The third round of the National Family Health Survey (NFHS-3, 2005-06) was used to fulfil the objectives of this study. It is the Indian version of the Demographic and Health Survey (DHS) conducted on a large-scale using representative sample of households throughout the country. The survey provides estimates on fertility, infant and child mortality, practice of family planning, maternal and child health, reproductive health, nutrition, anaemia and assets or amenities at household level, and state and national levels. It incorporates many steps including scientific sampling procedure to ensure that the data properly reflect the situation of the country or the relevant state. For more details about the sampling design, data collection tools and procedures, the survey reports can be ascertained (IIPS & Macro International, 2007).

Variables

The variables used in this study can be classified as response and predictor variables.

Response variables

Infant mortality Rate ($_1q_0$): Infant mortality rate was estimated as the probability of an infant dying before the first birthday. It was calculated per 1000 live births.

Predictors

The predictor variables ï that can potentially affect the survival of an infant in the selected regions ï used in this study were drawn primarily through an extensive review of literature. These

predictors can broadly be divided into three categories: mother-related, child-related and household-related.

Mother-related variables: Motherôs education (not educated; educated), occupation (working; not working), institutional delivery (No; Yes), and motherôs age at birth of child (<20 years; >20 years) were included as mother-related factors in the study.

Child-related variables: The study incorporated birth interval ï excluding first birth (< 2 years; 2-3 years; > 3 years), childôs size at birth as reported by mother (small; average; larger), sex of the child (male; female), and currently breastfeeding (yes; no) as the child-related factors.

Household-related variables: As household factors, wealth index (poor; middle; rich), type of residence (rural; urban), toilet facility (yes; no), social group (Scheduled Castes (SCs)/Scheduled Tribes (STs); Other Backward Classes (OBCs); general), electrification (yes; no), and religion (Hindu; Others) were included.

This study analysed the association between the selected factors and IMR at the regional level; thus region was the main predictor in the analysis. Using the definition used in NFHS-3, this paper considered southern region as unified Andhra Pradesh, Karnataka, Kerala and Tamil Nadu, whereas the northern region included the states of Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan and Uttarakhand.

III. Statistical Analysis

Inferential statistics and bivariate analysis were carried out to examine the association between IMR and its covariates. Pearsonôs Chi-squared test was performed to examine the significance of any specific relationship studied in the analysis. Multivariate analysis, in terms of multilevel Cox proportional regression, was performed to examine the impact of socio-demographic factors on childôs survival during infancy. This model was used primarily due to two reasons: first, because Cox proportional hazard regression analysis is suitable while analyzing survival data and handling censored observation, and second, in order to account for the hierarchical structure of the data (Adedini et al., 2015). Using the multilevel Cox proportional hazard model, the probability of childhood death was regarded as the hazard (Rabe-Hesketh et al., 2004). The hazard has been modeled using the following equations:

$$\ln\left(\frac{H(t)}{Ho(t)}\right) = b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \cdots \ldots\ldots\ldots\ldots\ldots\ldots\ldots + b_kX_k$$

Where, X_1.....X_k are the set of explanatory variables, and b_1, b_2é é é b_k are the coefficient estimates by Cox regression. $H_0(t)$ is the baseline hazard at time t, representing the hazard for a person with the value 0 for all the explanatory variables. H (t) is the hazard function at time t; Hazard ratio (HR) can be defined as HR= H(t) /H_0(t).

Ethical Consent

The present study used data that is available in the public domain for wider use in social research. Thus, there was no requirement to get ethical consent for the study.

IV. Results

The prevalence of infant deaths was higher in the northern region (51) than in the southern region (39). In the northern region, Rajasthan (65) recorded the highest number of infant deaths, whereas Himachal Pradesh (36) had low number of deaths. In the southern region, Andhra Pradesh

(53) and Kerala (15) recorded the highest and the lowest number of infant deaths respectively, both lower than the national average (57) (Figure 1).

The prevalence of infant deaths across the selected characteristics was higher in the northern than in the southern region. This pattern was observed across the three selected factors (mother, child and household) in the study. Motherôs illiteracy, working status, delivery at a young age and delivery in a non-health facility were the main mother-related covariates for a high IMR. The corresponding figures for each of these covariates were higher in the case of the northern region than the southern one. Nearly three fourths (74 per cent) as compared with more than half (56 per cent) of the IMR was reported by women giving birth aged below 20 years in the northern and southern regions respectively. Birth interval of less than of two years, small-size of the child at birth, child being a female and child not being on breastfeeding at the time of survey were the main child-related factors for high IMR. Again, the figures for each of these factors were higher in the northern region than in the southern region. More female infants died in the northern region (57 per cent) than in the southern region (39 per cent). The prevalence of IMR across the selected household factors was higher in the north than in the south. It was higher in the case of poor households, rural areas, households without access to toilet facility and electricity, among SCs/STs and Hindus ï noticeable in the northern region. Nearly, three-fourths (71 per cent) as compared with less than half (48 per cent) of the IMR occurred in poor households of northern and southern regions respectively ($p<0.001$) (Table 1).

The result of the Cox-hazard model (survival analysis) has been presented in Table 2. Four models were used. In the first model, only mother-related factors were considered to check their association with IMR. Child- and household-related factors were included in the second and the third models respectively. The fourth model is a complete model, wherein all the three components, that is mother, child and household factors, were incorporated to examine their association with IMR in the selected regions. It was evident from the first model that educated women have lower IMR in both the regions. However, the association was more prominent in the southern region (OR: 0.86) than in the northern region (OR: 0.63). It was statistically significant at $p<0.001$ only in the northern region. Women who delivered their first child aged above 20 years were 41 and 31 per cent less likely to experience infant mortality than those who delivered below 20 years of age in the southern and northern regions respectively ($p<0.001$).

In the second model, children (infants) born with more than two years of birth interval and with average and larger size at birth were less likely to die before completing the first year of life. Yet, the likelihood to survive was less in the northern than in the southern region for the corresponding covariates. In the third model, the economic condition of household and the prevalence of IMR were inversely correlated in the northern region at $p<.0.001$. Such an association was not found in the southern region.

In the final model, it was observed that educated women were less likely to experience death of an infant ($p<0.10$) in both the regions. In the north, women who delivered in a health facility were 51 per cent ($p<0.001$) had a higher IMR than those who had a home delivery. Infants born with more than two years of birth interval were 48 and 30 per cent less likely to die before attaining their first birthday in the southern and northern regions respectively ($p<0.001$). Further, children born with average and larger size at birth were less likely to die before their first birthday in both the regions, though it was more noticeable in the southern (OR: 51) than in the northern region (OR: 62). In the north, a female child was 1.3 times ($p<0.05$) more likely to die before completing first year of life than her male counterpart. A similar pattern was observed in the southern region; however, it was not statistically significant. Children breastfeeding at the time of survey were 35 per cent less likely to die before celebrating their first birthday in the northern region. Economic condition of the household and the prevalence of IMR were inversely related in the northern region. Children born in rich households were 42 per cent ($p<0.05$) less likely to die before completing the first year of life than children born in poor households.

V. Discussion

This study analysed the determinants of IMR using a large sample size in the southern and northern regions, which have recorded two extreme levels (lowest and highest) of IMR in the country. It incorporated three major components, that is, mother, child, and household related factors that generally cause maximum infant deaths in any given geography or population (Dwivedi et al., 2013). Such information is imperative while identifying the region-specific major intervention areas to reduce high IMR and to offer suggestive measures for its prevention.

Results of the study present a distinct picture where all the three factors ï though they vary significantly ï have an impact on IMR in the selected regions. However, the prevalence of IMR across the selected covariates was higher in the northern than in southern region. The results of bivariate and multivariate analyses show that illiteracy, working status of women and low age at birth were the main mother-related covariates for a high IMR. Again, the corresponding figures were higher in the northern than in the southern region. These findings corroborated the results of many others which arguably suggest that illiterate and adolescent mothers experience a higher IMR (Phipps et al., 2002; Sahu et al., 2015). Facility-based childbirth is an important preventive measure to combat high IMR in any given time and place (Claeson et al., 2000). In the southern region, the effect of facility-based childbirth (institutional delivery) was evidently visible for its inverse association with IMR. However, such a relationship was not found in the northern region which could probably be due to the low quality of healthcare, especially during childbirth, in this region (Bhandari & Dutta, 2007; Baru et al., 2010). Analysis of it is out of the purview of this study. The result of the Cox-hazard model also supports the findings that women who had institutional deliveries were more likely to experience infant mortality in the northern region.

More infants born with less than two years of birth interval, having a small size at the time of birth and currently not being breastfed died than their counterparts in both the regions. Yet, the prevalence for the aforementioned child-related covariates was higher in the northern than in the southern region. This result was supported both by the bivariate and multivariate analyses carried out in this study. There are studies which evidently suggest that short birth interval, being under-nourished at birth and not being put on exclusive breastfeeding for six months leads to a high IMR (Gragnolati et al., 2005; Kumar, 2006; Da Vanzo et al., 2008; Singh et al., 2011). Further, more female infants died than their male counterparts, noticeably in the northern region. Discrimination of daughters in India is common, especially in the northern part of the country. Such social behaviour results in their negligence during her infancy and causes a higher number of deaths among female infants (Pande et al., 2006; Gaudin, 2011).

Poor economic condition, living in a rural area, having no access to toilet and electricity, and belonging to SC/ST social groups were the main household-related factors for a high IMR in both the regions. Again, the association was more prominent in the northern region as evident in both the bivariate and multivariate analyses. Poverty is the root cause of a number of problems in India. It restricts access to nutritious food, education, quality healthcare and so on (Dodd & Munck, 2001; Gupta & Kumar, 2007). In north India people predominantly live in rural areas and with low availability of basic means of livelihood. This is more common among the SC/ST groups (Borooah, 2005; Gang et al., 2008). Their poor economic condition often leads to poor utilization of essential child healthcare and causes more infant deaths in the region (Baru et al., 2010; Saikia et al., 2009; Singh, et al., 2011).

VI. Conclusion

Survival of infants from preventable causes is important to lower the fertility rate. As this was also used as an indicator of development, a region-specific programme and policy are important to bring appreciable reduction in the high IMR. Interventions in the areas of education, age of women at marriage, child feeding practices and access to basic civic amenities at the household level can bring a significant reduction in the IMR. Besides, focus needs to be shifted

towards ensuring quality care rather than providing merely physical access in order to end preventable deaths of new-borns and children under five years of age with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births under Sustainable Development Goals (SDG) 3 by 2030.

Limitations of the study

This study incorporated three major components to check their association with IMR. Though the included components capture much of the contribution to a high IMR in India, there are many other factors, such as environmental factors, which can cause a high IMR. Such information is not available in the dataset used.

References

Adedini, S. A., Odimegwu, C., Imasiku, E. N., Ononokpono, D. N., & Ibisomi, L. (2015). Regional variations in infant and child mortality in Nigeria: A multilevel analysis. *Journal of Biosocial Science, 47*(2), 165-187.

Andreev, E. M., & Kingkade, W. W. (2011). Average age at death in infancy and infant mortality level: Reconsidering the Coale-Demeny formulas at current levels of low mortality. *Max Planck Institute for Demographic Research Working Paper*, 2011-016.

Annual Health Bulletin (2012). Medical Statistics Unit. Ministry of Health, Government of Sri Lanka.

Bajpai, N., & Goyal, S. (2004). *India: towards the millennium development goals.* Background paper for the UNDP Human Development Report, 2003.

Barman, N., & Talukdar, D. (2014). Socio-economic factors affecting infant mortality rate in Assam. *International Journal of Science, Management and Technology, 3*(5), 1893-1900.

Baru, R., Acharya, A., Acharya, S., Kumar, A. S., & Nagaraj, K. (2010). Inequities in access to health services in India: Caste, class and region, *Economic and Political Weekly*, 49-58.

Bhandari, L., & Dutta, S. (2007). Health infrastructure in rural India. In *India infrastructure report 2007: Rural infrastructure*, 265-271. New Delhi: Oxford University Press.

Borooah, V. K. (2005). Caste, inequality, and poverty in India. *Review of Development Economics, 9*(3), 399-414.

Canudas-Romo, V., & Becker, S. (2011). The crossover between life expectancies at birth and at age one: The imbalance in the life table. *Demographic Research,* 24, 113-144.

Claeson, M., Bos, E. R., Mawji, T., & Pathmanathan, I. (2000). Reducing child mortality in India in the new millennium", *Bulletin of the World Health Organization, 78*(10), 1192-1199.

Das, A. (1999). Socio-economic development in India: A regional analysis. *Development and Society, 28*(2), 313-345.

Da Vanzo, J., Hale, L., Razzaque, A., & Rahman, M. (2008). The effects of pregnancy spacing on infant and child mortality in Matlab, Bangladesh: How they vary by the type of pregnancy outcome that began the interval", *Population Studies, 62*(2), 131-154.

Dodd, R., & Munck, L. (2001). *Dying for change: poor people's experience of health and ill-health.* World Health Organization & World Bank.

Dwivedi, S. N., Begum, S., Dwivedi, A. K., & Pandey, A. (2013). Determinants of infant mortality in rural India: A three-level model. *Health, 5*(11), 1742.

Gang, I. N., Sen, K., & Yun, M. S. (2008). Poverty in rural India: Caste and tribe. *Review of Income and Wealth, 54*(1), 50-70.

Gaudin, S. (2011). Son preference in Indian families: Absolute versus relative wealth effects. *Demography, 48*(1), 343-370.

Gragnolati, M., Shekar, M., Gupta, M. D., Bredenkamp, C., & Lee, Y. K. (2005). *India's undernourished children: A call for reform and action*. Washington, DC: World Bank.

Gupta, R., & Kumar, P. (2007). Social evils, poverty & health. *Indian Journal of Medical Research, 126*(4), 279.

Heisler, E. J. (2012). The US infant mortality rate: International comparisons, underlying factors, and federal programs. *Congressional Research Service,* 1-29.

IGME UN. (2015). *Levels and trends in child mortality: Report 2015.* New York: The Inter-Agency Group for Child Mortality Estimation (UN IGME), UNICEF.

International Institute for Population Sciences (IIPS) and Macro International, (2007). *National Family Health Survey (NFHS-3) Report, 2005–06; India*, Vol. 2. Mumbai: IIPS.

Joseph, M. (2004). Northern states versus Southern states: A Comparative analysis. *Working Paper No. 134.* New Delhi: Indian Centre for Research on International Economics Relations.

Kapoor, S. (2010, May). Infant mortality rates in India: District level variations and correlations. Paper presented at 6th Annual Conference on Growth and Development (pp. 16-18). Available at: http://www. isid.ac.in/~pu/conference/dec_10_conf/Papers/ShrutiKapoor.pdf

Kumar, S. (2006). Malnutrition in children of the backward states of India and the ICDS programme. *Journal of Health and Development*.

Lahariya, C., & Paul, V. K. (2010). Burden, differentials, and causes of child deaths in India. *The Indian Journal of Paediatrics, 77*(11), 1312-1321.

MacDorman, M. F., Matthews, T. J., Mohangoo, A. D., & Zeitlin, J. (2014). International comparisons of infant mortality and related factors: United States and Europe, 2010. *National vital statistics reports:From the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System, 63*(5), 1-6.

Muller, A. (2002). Education, income inequality, and mortality: A multiple regression analysis. *British Medical Journal, 324*(7328), 23.

Pande, R., Malhotra, A., Mathur, S., Mehta, M., Malhotra, A., Lycette, M. A., & Lary, H. (2006). Son preference and daughter neglect in India. Accessed on 12 November 16 Available at: https://www. unfpa.org/sites/default/files/resource-pdf/UNFPA_Publication-39764.pdf

Phipps, M. G., Sowers, M., & DeMonner, S. M. (2002). The risk for infant mortality among adolescent childbearing groups", *Journal of Women's Health, 11*(10), 889-897.

Rabe-Hesketh, S., Skrondal, A., & Picklesz, A. (2004). *GLLAMM Manual*, Division of Biostatistics Working Paper Series, University of California, Berkeley.

Ram, F., Mohanty, S. K., & Ram, U. (2009). *Progress and prospects of millennium development goals in India.* International Institute for Population Science: Mumbai, India. Accessed on 7th October 2016. Available at: http://iipsindia.org/pdf/a08mohanty_report.pdf

Office of the Registrar General, India (2011). *Census of India*. New Delhi: Office of the Registrar General, Government of India.

Office of the Registrar General, India (2016). *Sample Registration System Bulletin.* New Delhi: Registrar General, India, Ministry of Home Affairs, Government of India. http://www.censusindia.gov.in /vital_statistics/SRSBulletin2014 .pdf

Sahu, D., Nair, S., Singh, L., Gulati, B. K., & Pandey, A. (2015). Levels, trends & predictors of infant & child mortality among Scheduled Tribes in rural India. *The Indian Journal of Medical Research, 141*(5), 709.

Saikia, N., Jasilionis, D., Ram, F., & Shkolnikov, V. M. (2009). Trends in geographical mortality differentials in India. Rostock: Max Planck Institute for Demographic Research. Accessed on: 12th September 2016, Available at: http://www.demogr.mpg.de/papers/working/wp-2009-013.pdf

Singh, A., Pathak, P. K., Chauhan, R. K., & Pan, W. (2011). Infant and child mortality in India in the last two decades: A geospatial analysis, *PLoS One, 6*(11), e26856.

United Nations (2015). *India and the MDGs: Towards a sustainable future for all.* United Nations Country Team, India, Accessed on 5th November 2016. Available at: http://in.one.un.org/img/uploads/India _and_the_MDGs.pdf

Wilkins, K. (1995). Causes of death: How the sexes differ. *Health Rep, 7*(2), 33-43.

Yadav, A. K., Gouda, J., & Ram, F. (2016). Self-reported morbidity and burden of disease in Uttar Pradesh, India: Evidence from a national sample survey and the million deaths study. *Journal of Biosocial Science, 48*(4), 472-485.

Figure1: Prevalence of infant mortality (per 1000 live birth) in regions of India, NFHS-3 (2005-06)

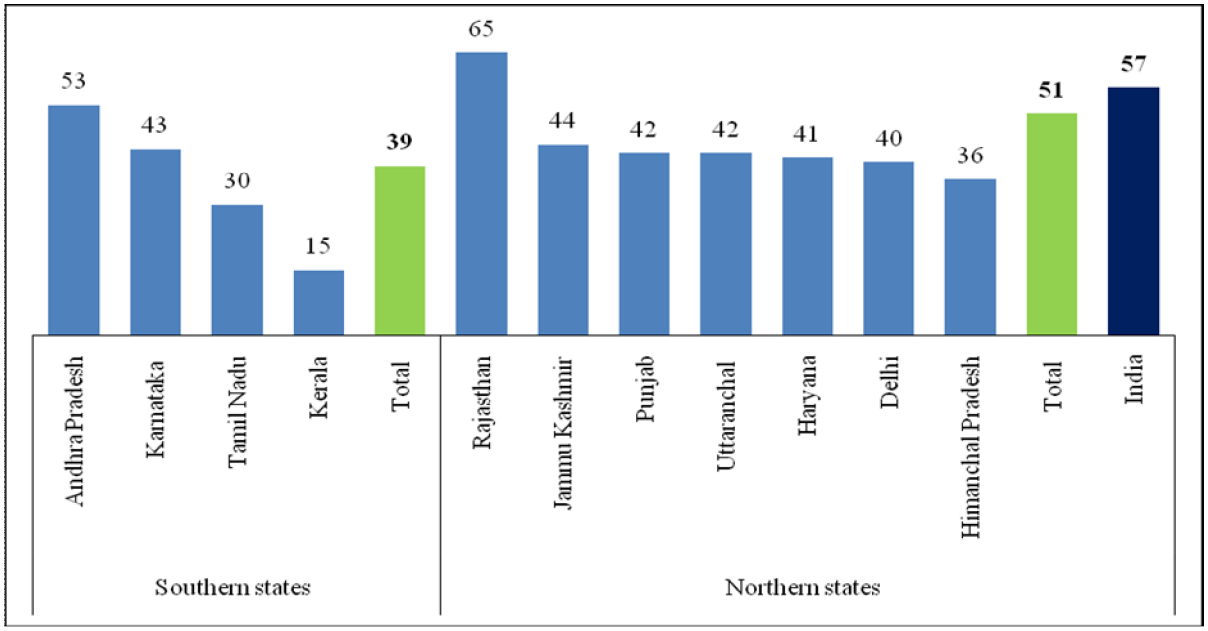
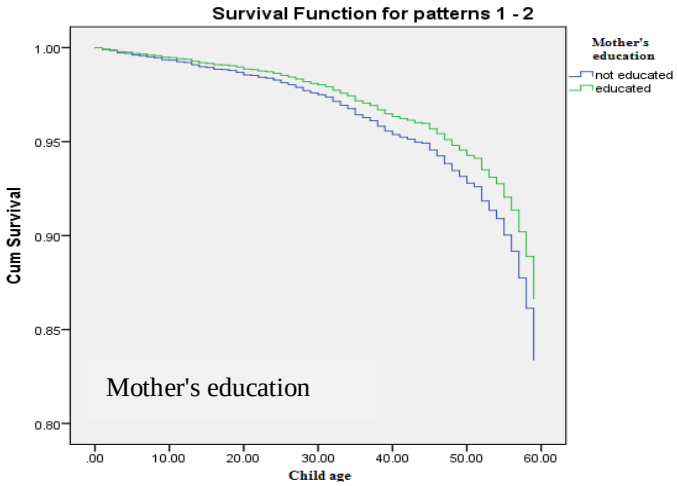
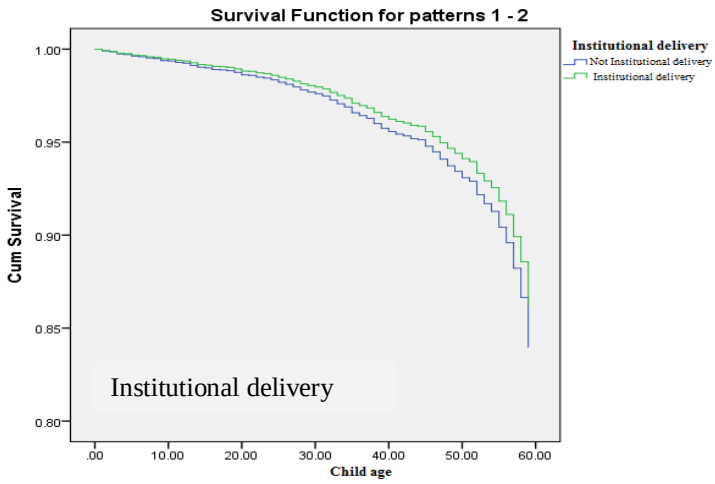
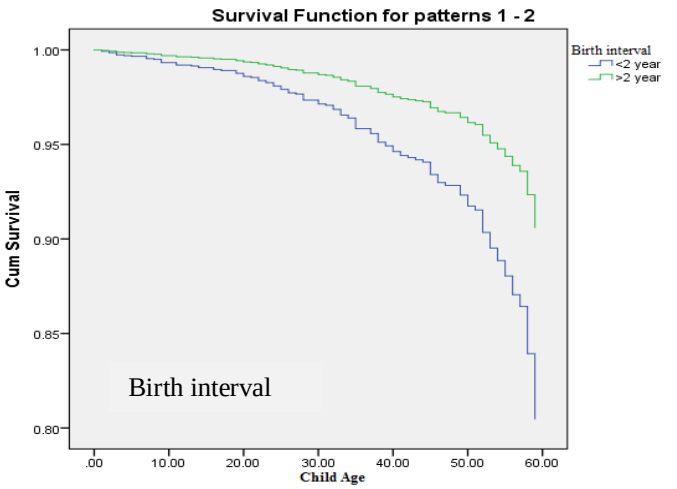
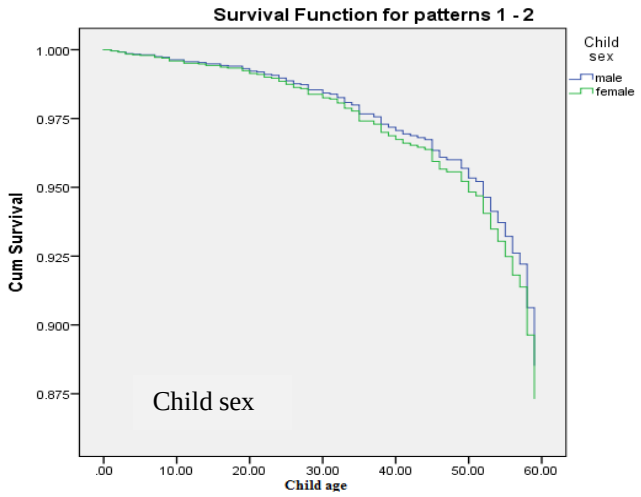


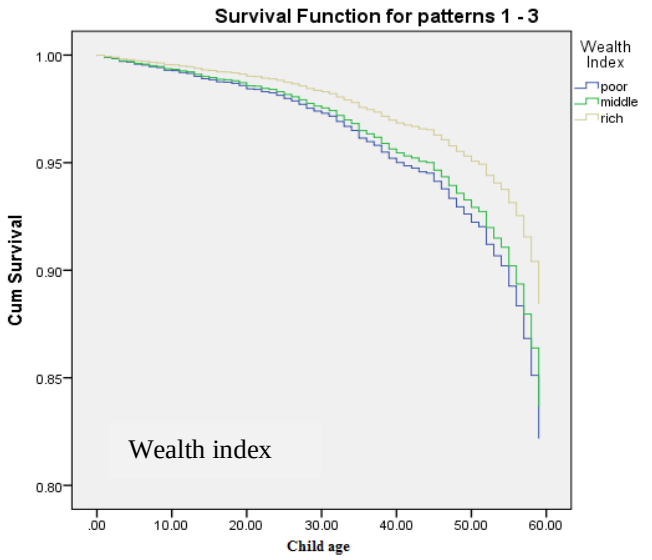
Figure 2: Survival curve of infant mortality by mother, child and household factors in the southern region, India, NFHS-3 2005-06











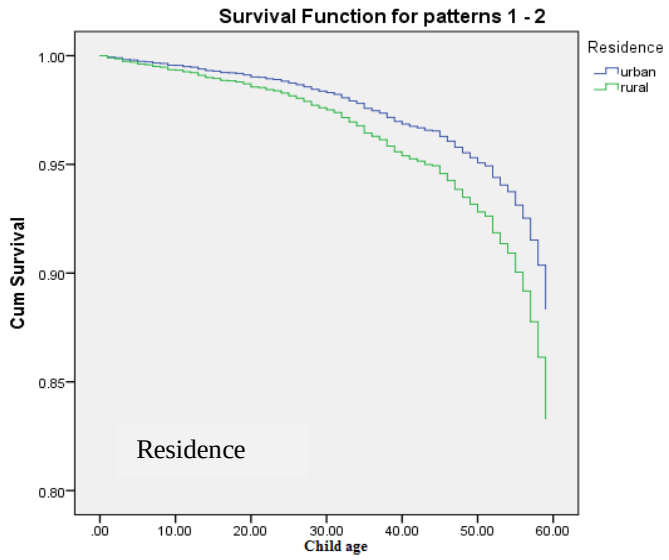
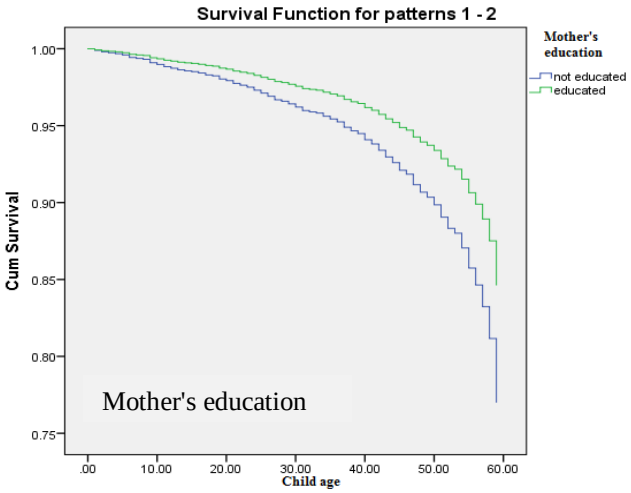
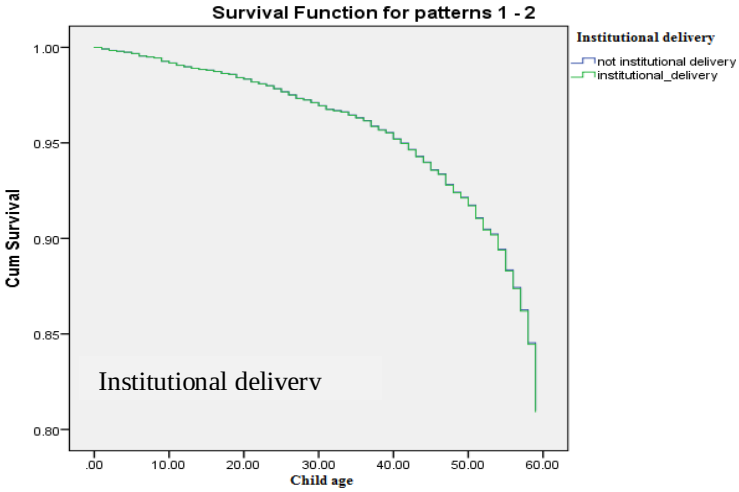
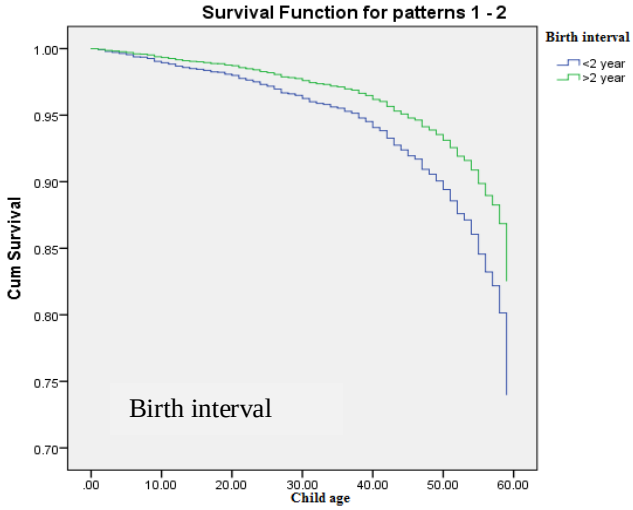
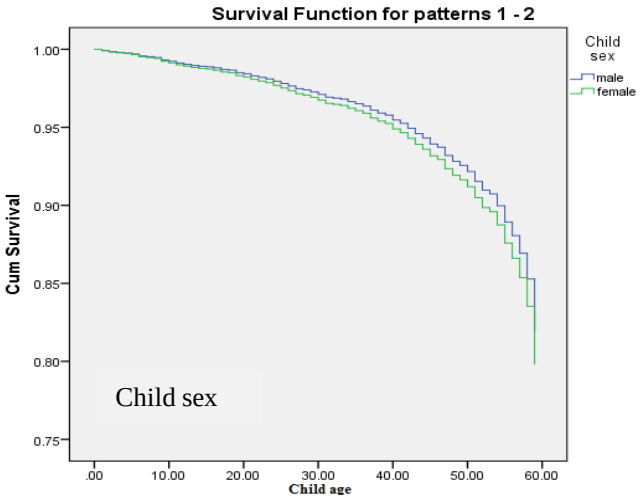


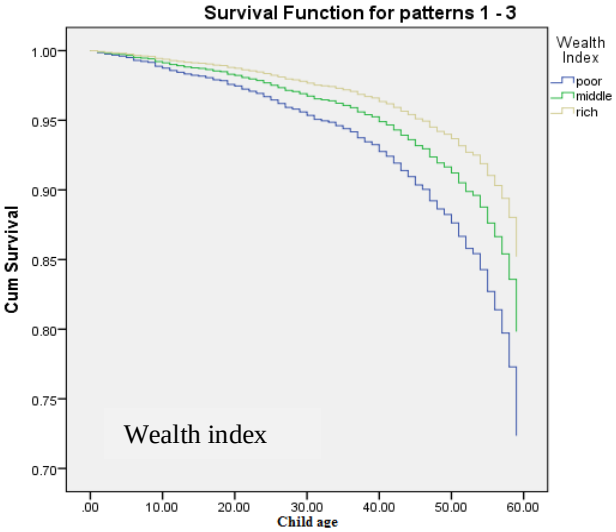
Figure 3: Survival curve of infant mortality by mother, child and household factors in the northern region, India, NFHS-3 2005-06











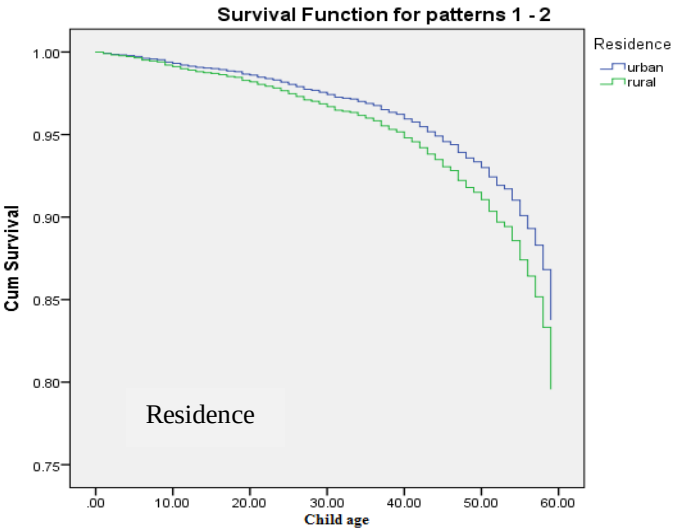


Table 1: Mother, child and household covariates of infant mortality rate in Southern and Northern regions of India, NFHS 2005-06

Background characteristics	India		Southern Region		Northern Region	
	IMR	χ^2at 5% level	IMR	χ^2at 5% level	IMR	χ^2at 5% level
Mother Factors						
Mother's Education						
Not Educated	1611 (69.6)	0.000	121 (47.2)	0.012	244 (63.1)	0.000
Educated	966 (43.2)		228 (35.9)		130 (37.9)	
Mother's Occupation						
Not Working	1471 (53.0)	0.000	197 (34.4)	0.002	204 (45.7)	0.006
Working	1105 (62.3)		153 (47.7)		171 (60.0)	
Institutional Delivery						
Not Institutional	1744 (62.1)	0.000	109 (47.5)	0.011	234 (51.4)	0.708
Institutional	780 (45.2)		240 (36.2)		141 (50.9)	
Mother's Age at Birth						
< 20 Year	878 (74.1)	0.000	146 (56.0)	0.000	110 (74.0)	0.000
> 20 Year	1698 (50.4)		203 (32.0)		265 (45.0)	
Child Factors						
Birth Interval						
< 2 Year	866 (81.8)	0.000	97 (58.2)	0.000	124 (72.6)	0.000
>2 Year	819 (38.6)		84 (22.0)		87 (54.7)	
Birth Size						
Small	765 (82.6)	0.000	77 (49.0)	0.012	123 (70.2)	0.000
Average & Larger	1709 (48.1)		256 (35.4)		240 (43.7)	
Child Sex						
Male	1301 (54.5)	0.045	186 (39.6)	0.814	184 (46.3)	0.035
Female	1275 (58.9)		163 (38.6)		191 (57.1)	
Currently Breastfeed						
No	1258 (71.8)	0.000	225 (54.9)	0.000	218 (83.1)	0.000
Yes	1318 (47.1)		124 (25.7)		157 (33.4)	
Household Factors						
Wealth Index						
Poor	1529 (69.9)		123 (48.4)		161 (71.2)	0.000
Middle	517 (57.3)	0.000	106 (44.3)	0.000	69 (44.9)	
Rich	530 (36.3)		121 (30.2)		144 (41.1)	
Type of Residence						
Urban	483 (41.4)	0.000	99 (30.0)	0.001	89 (43.0)	0.050
Rural	2093 (61.8)		251 (44.5)		286 (54.5)	
Toilet Facility						
No Facility	1697 (64.0)	0.000	303 (47.1)	0.000	230 (59.5)	0.000
Facility	877 (46.3)		147 (31.6)		145 (42.0)	
Social Group						
SCs[1]/STs[2]	877 (63.8)		119 (53.1)		144 (59.7)	0.004
OBC[3]	1005 (55.0)	0.000	172 (35.5)	0.001	120 (55.8)	
General	615 (50.8)		46 (29.8)		99 (39.6)	
Electricity						
No	1186 (68.5)	0.000	49 (57.6)	0.002	94 (61.4)	0.051
Yes	1163 (46.7)		264 (36.7)		252 (48.9)	
Religion						
Hindu	2057 (57.9)	0.009	303 (41.7)	0.006	292 (52.0)	0.608
Others	496 (51.0)		46 (28.8)		83 (49.0)	

Note: In parentheses is prevalence of IMR per 1000 live births; SCs[1]: Scheduled Castes; STs[2]: Scheduled Tribes; OBCs[3]: Other Backward Classes.

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Table 2: Result of survival analysis by mother, child and household characteristic for IMR in Southern and Northern regions in India, NFHS 2005-06

Background characteristics	India				Southern India				Northern India			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Mod	Model 4	Model 1	Model 2	Model 3	Model 4
	Mother	Child	HH	Complete	Mother	Child	HH	Complete	Mother	Child	HH	Complete
Mother Factors												
Mother's Education												
Not Educated®	1.000			1.000	1.000			1.000	1.000			1.000
Educated	0.655			0.709	0.855			0.667	0.631			0.747
Mother's Occupation												
Not Working®	1.000			1.000	1.000			1.000	1.000			1.000
Working	0.994			0.876	0.877			1.001	1.269			0.893
Institutional												
No®	1.000			1.000	1.000			1.000	1.000			1.000
Yes	0.868			0.904	0.929			0.962	1.202			1.513
Mother's Age at Birth												
< 20 Years®	1.000			1.000	1.000			1.000	1.000			1.000
> 20 Years	0.694			0.914	0.595			0.754	0.687			0.750
Child Factors												
Birth Interval												
< 2 Years®		1.000		1.000		1.000		1.000		1.000		1.000
> 2 Years		0.544		0.564		0.475		0.524		0.624		0.697
Birth Size												
Small®		1.000		1.000		1.000		1.000		1.000		1.000
Average &		0.498		0.529		0.508		0.508		0.606		0.618
Child Sex												
Male®		1.000		1.000		1.000		1.000		1.000		1.000
Female		1.064		1.066		1.112		1.207		1.399		1.302
Currently												
No®		1.000		1.000		1.000		1.000		1.000		1.000
Yes		0.951		0.805		1.219		1.193		0.702		0.650
Household Factors												
Wealth Index												
Poor®			1.000	1.000			1.00	1.000			1.000	1.000
Middle			0.840	0.857			1.1	0.759			0.656	0.699
Rich			0.592	0.735			1.0	0.887			0.523	0.588
Type of Residence												
Urban®			1.000	1.000			1.00	1.000			1.000	1.000
Rural			0.922	0.963			1.2	1.377			0.896	0.884
Toilet Facility												
No Facility®			1.000	1.000			1.00	1.000			1.000	1.000
Facility			0.883	0.978			0.7	1.005			0.812	0.788
Caste												
SCs[1]/STs[2]®			1.000	1.000			1.00	1.000			1.000	1.000
OBC[3]			0.964	0.925			0.8	0.893			0.905	0.951
GEN			0.908	0.886			0.7	0.954			0.844	0.796
Electricity												
No®			1.000	1.000			1.00	1.000			1.000	1.000
Yes			0.890	0.878			0.8	1.176			1.153	1.105
Religion												
Hindu®			1.000	1.000			1.00	1.000			1.000	1.000
Others			0.907	0.887			0.8	1.241			1.036	1.038

®Reference category; ***p<.0.001; **p<.05*; p<0.10; SCs[1]: Scheduled Castes; STs[2]: Scheduled Tribes; OBCs[3]: Other Backward Classes; HH: Household.