

The persistent caste divide in India's infant mortality: A study of Dalits (ex-untouchables), Adivasis (indigenous peoples), Other Backward Classes, and forward castes

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Abstract

Using data from two national surveys, this paper examines caste differences in infant mortality in India. We find that children from the three lower caste groups—Dalits (ex-untouchables), Adivasis (indigenous peoples) and Other Backward Classes—are significantly more likely than forward-caste children to die young. While this observation largely mirrors caste differences in socioeconomic conditions, low socioeconomic status is found to be only a partial explanation for higher infant mortality among lower castes. Higher mortality risks among backward-class children are almost entirely attributable to background characteristics. However, Dalit children are most vulnerable in the neonatal period even when all background characteristics are taken into account, whereas Adivasi children remain highly vulnerable in the post-neonatal period.

Keywords: infant mortality, neonatal mortality, post-neonatal mortality, caste, India's ex-untouchables.

Resume

Au moyen des données provenant des deux enquêtes nationales, cet article examine les différences dans la mortalité infantile par caste en Inde. Nous constatons que, par rapport aux enfants des castes élevées, ceux des trois castes inférieures, notamment les dalits (les ex-intouchables), les adivasis (peuples indigènes) et autres classes défavorisées (plusieurs castes désignées comme appartenant à un groupe défavorisé) courent un risque beaucoup plus grand de mourir jeunes. Bien que cette observation reflète largement les différences entre les castes sur le plan socioéconomique, le faible niveau socioéconomique n'explique qu'en partie le taux de mortalité plus élevé chez les castes inférieures. Les risques de mortalité des enfants des castes inférieures étaient presque entièrement attribuables aux caractéristiques des antécédents de la mère. Cependant, les enfants dalits demeurent les plus vulnérables pendant la période néonatale, bien que le risque de mortalité demeure le même que celui des enfants des castes supérieures pour la période post-néonatale. L'inverse est vrai pour les enfants adivasis : les caractéristiques des antécédents expliquent leur plus grande vulnérabilité pendant la période néonatale, mais pas pendant la période post-néonatale.

Mots-clés : mortalité infantile, mortalité néonatale, mortalité post-néonatale, caste, ex-intouchables en Inde.

Introduction

Caste has been a major foundation of the Indian social structure and stratification system since ancient times. In India there are thousands of castes, which have been classified into broad social groups and ranked according to social status, power, and prestige, emanating mainly from their own and their ancestors' occupations. That people from many "lower castes" have been oppressed, disadvantaged, and discriminated in social

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and economic spheres of life, and even treated as “untouchables” for centuries is well documented in popular and scholarly literature (Desai and Dubey 2012; Desai and Kulkarni 2008; Dommaraju et al. 2008). Since the

introduction of its own constitution in 1950, India has prohibited discrimination based on caste and legally abolished the notion of untouchability, and special initiatives have been developed whereby people belonging to certain lower castes and tribes are provided special status and privileges in certain sectors such as education and employment. However, there is ample evidence that most people belonging to lower castes—ex-untouchables (Dalits hereafter), indigenous peoples (Adivasis hereafter), and other backward classes (OBCs hereafter)—still lag behind those from “forward castes” (sometimes referred to as “upper castes”) on almost all social indicators (Desai and Dubey 2012; Desai and Kulkarni 2008; Kumar et al. 2008; Majid 2012). This paper examines caste differences in infant mortality, a highly sensitive indicator of population health and wellbeing in less industrialized countries. We do so by investigating the relationship between young children’s risks of dying and their caste background, while controlling for pertinent socioeconomic characteristics. Specifically, there are three main objectives of this study: (1) determine the extent to which caste differences in infant mortality can be explained by socioeconomic background; (2) find out if caste differences in mortality risks vary by the stage of infancy; and (2) examine to what extent caste differences in infant mortality have converged over time.

Background and conceptual framework

It is well known that higher mortality rates in minority populations in most parts of the world are at least partly associated with their lower socioeconomic levels. A number of studies, originating particularly from the United States, show that racial and ethnic differences in mortality can be largely explained by socioeconomic characteristics (Crimmins et al. 2004; Hummer 1996; Williams and Collins, 1995). However, there is no dearth of counter-evidence, according to which substantial racial and ethnic differences in mortality persist even when socioeconomic status, living conditions, life style, and neighbourhood are controlled (Brown et al. 2012; Hayward et al. 2000; Williams and Sternthal 2010). At every level of socioeconomic status, blacks, for example, have poorer health outcomes and higher mortality than whites, suggesting that socioeconomic status does not fully explain racial differences in mortality. Some researchers find racism, discrimination, and stressful life events to be largely responsible for this phenomenon (Bratter and Gorman 2011; Williams 1999). According to another exception called the “epidemiological paradox” or “Hispanic paradox” (Ruiz et al. 2013), people of Hispanic descent in the United States exhibit higher life expectancy and lower infant mortality than their non-Hispanic white counterparts, despite disadvantaged socioeconomic conditions and poor access to health services. While there is no consensus on the explanations of the paradox, some researchers point to strong social ties, certain cultural practices, selective immigration, and a healthy lifestyle as protective factors (Fenelon 2013). Although it is highly presumptuous to extrapolate American experiences to Indian society, it is reasonable to hypothesize that socioeconomic background does not provide a complete explanation for understanding higher mortality among the lower castes in India.

There are hundreds of small-scale sociological and anthropological studies investigating aspects of socioeconomic life among people from certain castes and tribes in India; however, there is a relative dearth of research that focuses on caste differences in health, illness, and mortality, despite their important humanitarian and policy relevance. This is largely due to the lack of reliable data by caste at the state, regional, and national levels. However, in recent years, some large-scale national sample surveys have allowed researchers to conduct descriptive and comparative analyses of the four broad caste groups: “scheduled castes” or Dalits, “scheduled tribes” or Adivasis, “backward class” (OBCs), and upper or forward castes (Baru et al. 2010; IIPS 2000, 2007; Nayar 2007; Pandey et al. 1998). These studies show that while there has been an overall decline in infant mortality over the last fifty years, caste disparities in infant mortality persist.

These surveys have also allowed researchers to carry out micro-level multivariate analyses, with the aim of disentangling the effects of caste and socioeconomic background on mortality (Das et al. 2010; Dommaraju et al. 2008; June et al. 2011; Mohindra et al. 2006; Nguyen et al. 2013; Singh-Manoux et al. 2008; Subramanian et al. 2006a, 2006b). These studies typically use logit models, with infant and child mortality as the outcome variable,

caste as the primary independent variable, and various parental characteristics as control variables. In general, these studies find that caste differences in infant and child mortality are substantially reduced after parental socioeconomic characteristics are held constant. Subramanian and colleagues (2006a, 2006b; June et al. 2011; Singh-Manoux et al. 2008) analyze mortality data from the NFHS-2 and Human Development Survey, 2004–05, and attribute caste differences in infant mortality to primarily caste differences in socioeconomic wellbeing. They also find that socioeconomic variables are largely responsible for mortality differences between Adivasi and non-Adivasi populations, although Adivasi children are still at a significantly greater risk of dying during the early childhood period (i.e., between the ages of 2 and 5 years). A major limitation of these studies is that they do not make the distinction between children who die within the first few weeks of life and those who die in later infancy. Using data from the NFHS-2, Dommaraju et al. (2008) examine the effects of caste on child mortality and find that caste differences in mortality cannot be attributed to socioeconomic factors alone. They find that socioeconomic factors play a more important role in explaining the differences between Dalits/Adivasis and OBCs than between forward and lower castes. This study groups Dalits and Adivasis in one category, in spite of considerable differences in their social, cultural, and geographic backgrounds. By analyzing rural mortality, Das et al. (2010) reinforce the findings of earlier studies and show that Adivasi children are less likely than Dalit children to die during infancy, but more likely to die during early childhood, particularly by the time they are five years old. Nguyen et al. (2013) focus on just two states, Odisha and Madhya Pradesh. By using a number of data sets, they find that in Madhya Pradesh the under-age 5 mortality among Dalits and Adivasis has fallen at a faster pace compared with that among the other caste groups, whereas in Odisha the converse is true. The study also finds that in Odisha, for both groups the neonatal mortality rate has declined at a steady pace, while in Madhya Pradesh it has stagnated. This study does not differentiate between backward and upper castes.

In the present study, we contribute to the understanding of caste differences in mortality in three ways. First, unlike some previous studies, we focus on the four caste groups—Dalits, Adivasis, OBCs, and forward castes—separately, for which pertinent data are available. Merging two caste groups into one category is of limited significance as far as policy implications are concerned.

Second, considering the fact that the measure of overall infant mortality analyzed in previous studies masks much of the fine differences in health, illness, and mortality among various population groups at different stages of life, we distinguish between mortality that occurs in the first month of life (neonatal mortality) and mortality that occurs in the following eleven months of life (post-neonatal mortality). Since causes of death in these two periods are quite different, it is useful to examine these components of infant mortality separately (Bicego and Boerma 1993; Lawn et al. 2005; Shryock et al. 1973: 405–06). Neonatal deaths are largely attributable to *endogenous* factors—perinatal and biologic-genetic causes—such as pre-term birth complications, low birth weight, asphyxia, congenital anomalies, diarrhea, tetanus, and severe infections, whereas post-neonatal deaths result from *exogenous* factors, such as poor hygiene, communicable diseases, malnutrition, and unintentional injuries, which are generally caused by socio-environmental conditions that arise after delivery. Usually, changes in socioeconomic and environmental conditions, including improvements in sanitation and public hygiene, improved nutrition, and increased availability of vaccines and antibiotics, contribute to a reduction in mortality among older children compared to younger ones. These factors are influenced by the family, community, or public policy measures as they affect conditions that arise after childbirth, when both mothers and children have survived the physiologically most vulnerable stage of life. In contrast, reducing mortality among very young infants is a more arduous task, which can only be achieved by improvements in prenatal care, health care facilities, and mothers' nutritional status, as well as reductions in infectious diseases. Thus, it is reasonable to hypothesize that net of socioeconomic factors, caste differences in mortality would be smaller during the post-neonatal period than during the neonatal period.

Third, we chart out temporal patterns in caste differences in the above measures of mortality. We hypothesize that with an increased emphasis on maternal and child health care services and special privileges for lower castes, the mortality gap between upper and lower castes would be reduced with the passage of time. Previous studies have analyzed data for just one period, and have made speculations about the convergence between various caste groups; however, with the availability of comparable data sets for various points in time, this study examines caste differences in mortality, controlling for relevant variables over time.

Data and method

This study analyses micro-data files obtained from the last two waves of the National Family Health Survey (NFHS-2, 1998–99, and NFHS-3, 2005–06). These surveys were designed to provide estimates on various aspects of demographic behaviour, including mortality and health. They were conducted by the International Institute for Population Sciences, Mumbai, under the stewardship of the Ministry of Health and Family Welfare, Government of India, and with technical assistance from ORC Macro (now known as ICF International) in Calverton, Maryland, USA. We base our analysis on information from weighted samples of births which occurred during the five years preceding the surveys.

In both surveys, response rates among women interviewed were quite high: 95.5 per cent in NFHS-2 and 94.5 per cent in NFHS-3. These surveys adopted a two-stage sampling design in rural areas and a three-stage design in urban areas. In rural areas, villages were selected in the first stage using a probability proportional to size (PPS) sampling scheme. Households were selected in the second stage using a systematic sampling scheme. In urban areas, wards were selected in the first stage using a PPS sampling scheme. Census enumeration blocks (having approximately 150–200 households) were selected in the second stage using PPS. Households were selected in the third stage using systematic sampling (IIPS 2000, 2007).

The risk of children dying before reaching their first birthday (infant mortality) is the major dependent variable in this study. Data for estimating the risks of dying were based on the number of children who were born during the five years preceding the survey (56,259 in NFHS-2; 51,172 in NFHS-3). Risk is categorized in two ways: the risk of dying in the first month of life (neonatal mortality) and the risk of dying after the first month of life but before the first birthday (post-neonatal mortality). It may be useful to note that age at death was recorded in days for children who died in the neonatal period and in months for children who died in the post-neonatal period (IIPS 2000, 2007).

The primary independent variable is the caste group of the child's mother. As mentioned before, there are four caste groups: Dalits, Adivasis, OBCs, and forward castes. Dalits include castes which were formerly labelled *untouchables* and are now classified as “Scheduled Castes” (SC) by the Government of India. Adivasis include indigenous or aboriginal peoples, who are labelled “Scheduled Tribes” (ST). OBCs—“Other Backward Classes” (OBCs) in Government of India documents—is a somewhat poorly defined category, which includes a number of educationally and socially disadvantaged castes. “Forward caste” is a remainder category, which usually consists of Brahmins, Kshatriyas, and some Vaishya castes.

There are two sets of control variables. The first set includes four demographic variables: mother's age, child's sex, region of residence (South, North, Central, East, Northeast and West), and place of residence (urban and rural). The second set includes two measures of socioeconomic status: mother's education and the standard of living index (SLI). Mother's age and child's sex are the two most important covariates of mortality among children. Studies show that children born to younger and older mothers are more likely to die than those born to middle-aged mothers (Mathews and MacDorman 2013). Generally, younger women have little knowledge, experience, or resources for parenting and are less likely to use either antenatal care or delivery care, or to have their infants immunized, whereas older women are not only at an increased risk of having adverse medical conditions such as hypertension and diabetes, but also tend to lack the required time to care for their later-born children (Sharma et al. 2008). While it is a well documented fact that female infants have a biological survival advantage over males, this is not necessarily true in the Indian sociocultural context. Usually, mortality is significantly lower among girls during the first month of life—the neonatal period, which is indicative of the biological superiority of baby girls (Ulizzi and Zonta 2002); however, the picture is reversed during the post-neonatal period, when mortality becomes susceptible to “societal manipulation” (Das Gupta 1987; Lahiri et al. 2011). Region of residence and place of residence are important from the viewpoint of geographic distribution by caste; Dalits and Adivasis are heavily concentrated in rural areas. There are important regional differences in infant mortality in India, with southern states showing lower mortality levels than northern states (Pandey et al. 1998; Ram et al. 2013). The regional differences may reflect different effects of state government policies. Mortality levels are also higher in rural than urban areas (Pandey et al. 1998; Singh et al. 2013). Basically, these two variables act as proxies for the availability and accessibility to health care facilities.

Maternal education is by far one of the most important predictors of mortality in less industrialized countries (Basu and Stephenson 2005; Caldwell 1979) and also a variable that explains much of the ethnic and cultural differences in mortality (Antai 2011). It is known to be a valid proxy for life style which in turn influences various risk factors, such as smoking, alcohol use, limited or no breastfeeding, and obesity, which are associated with health and infant mortality. Furthermore, education enables mothers to process information regarding healthy behaviours and to better utilize existing medical facilities (Vikram et al. 2012). Educational attainment, as measured by years of schooling, is known to be superior to other dimensions of socioeconomic status in an agricultural economy such as India because it can be better ascertained, with reliable accuracy, from self-reports. Also, unlike other measures such as occupation and income, it is “cumulative and irreversible” and is an important determinant of those measures. We also include a standard of living index (SLI) as a control variable, which is a summary measure of household quality of life and economic wellbeing. This index was calculated by adding scores for the following eleven variables: dwelling type, toilet facility, source of lighting, main fuel of cooking, source of drinking water, a separate kitchen, ownership of a house, ownership of agricultural land, ownership of irrigated land, ownership of livestock, and ownership of durable goods. Index scores range from 0–14 for a low SLI to 15–24 for a medium SLI and 25–67 for a high SLI (IIPS 2000, 2007).

We use the Cox proportional hazards model to estimate the net effects of caste and its covariates on the three measures of mortality described above. This model, unlike the logit model used in previous studies (cf. Dommaraju et al. 2008), allows for the inclusion of censored data on children who could not complete the exposure period at the time of interview. We present three models. The first model controls for two fundamental demographic covariates: mother's age and child's sex. The second model adds region of residence, place of residence (rural-urban), and maternal education. The third model includes SLI as an additional control. The upper/forward caste—the lowest-mortality group—is the reference category. *Infant mortality* refers to the probability of newborn children dying before reaching their first birthday. *Neonatal* and *post-neonatal mortality* refer to the probability of dying in the first and the next eleven months of life, respectively. Death is a dichotomous variable, where ‘0’ indicates that the child survived the period under study and ‘1’ indicates otherwise (i.e., the child died before reaching their first birthday in the case of infant mortality). We focus primarily on hazards ratios and their 95% confidence intervals (CI). If a hazard ratio (HR) is greater than 1, the relationship is positive, and if it is less than 1, the relationship is negative.

It may be useful to state at the outset that this study is cross-sectional, and therefore it would be somewhat presumptuous to infer causal relationships between various variables. Considering that the dependent variables are derived from information on births that occurred during the five years preceding the survey, while the independent variables refer to the survey date, there is a possibility of causality running in a reverse direction. However, retrospective information is likely to circumvent this problem to a large extent.

Characteristics of the study sample

Table 1 presents the distribution of the cases in the two samples, by independent variables, included in the study. As expected, in both surveys, the samples include a slightly larger proportion of children who are male (52 per cent). In NFHS-3, about 7 per cent of the mothers belong to the 15–19 age group, slightly lower than that in NFHS-2 (9 per cent); the proportion belonging to the age group 30 and over in NFHS-3 is similar to that in NFHS-2 (25 versus 24 per cent). Once again, this is to be expected, considering that the average maternal age has increased during the inter-survey period. The distribution of samples by rural-urban residence is also consistent with the expectation. The overwhelming majority of the sample cases live in rural areas, although their proportion is slightly lower in NFHS-3 than that in NFHS-2 (75 versus 78 per cent). In NFHS-2, the majority (57 per cent) of mothers are illiterate; in NFHS-3, this figure is significantly lower (50 per cent). Conversely, over the survey period there is a substantial increase in the proportion of mothers who have attained 9 years or more schooling (from 17 to 22 per cent). Consistent with this trend, we also find a sharp rise in the proportion of mothers with high a standard of living (16 per cent in NFHS-2 compared with 32 per cent in NFHS-3). The regional distributions of the sample cases in the two surveys are generally comparable. The distributions of sample cases by caste groups are not highly comparable between the two surveys, which may have happened due to the deliberate misreporting of

caste and the reallocation of certain castes from one group to another during the inter-survey period. Thus, about 37 per cent of the cases in NFHS-2, but only 26 per cent in NFHS-3, belong to forward castes, while about 32 per cent in NFHS-2, and 40 per cent in NFHS-3, belong to OBCs. Proportions of cases for Dalits (20 per cent) and Adivasis (10 per cent) groups are highly comparable between the surveys. In a small proportion of the cases, caste is not reported in both surveys (1 per cent in NFHS-2 and 3 per cent in NFHS-3).

Table 1. Characteristics of the samples, NFHS-2 and NFHS-3

	NFHS-2		NFHS-3	
	Percentage*	Number**	Percentage*	Number**
Caste				
Dalits	19.8	10,353	20.7	15,074
Adivasis	9.8	8,478	9.6	9,167
OBCs	32.0	15,956	40.3	8,386
Forward castes	37.1	21,424	26.4	16,746
Don't Know	1.3	523	3.0	2,182
Mother's age				
< 20 years	9.0	4,142	6.6	2,677
20–29 years	67.6	37,969	68.7	34,495
30+ years	23.5	14,623	24.7	14,383
Child's sex				
Male	51.7	29,478	52.1	26,799
Female	48.3	27,256	47.9	24,756
Region				
South	18.9	7,587	15.8	7,232
North	12.8	13,321	13.0	9,286
Central	29.5	12,526	29.7	11,659
East	22.0	9,817	25.2	8,126
Northeast	3.7	7,872	3.8	9,655
West	13.2	5,611	12.5	5,597
Place of residence				
Rural	78.1	42,210	74.7	32,072
Urban	21.9	14,524	25.3	19,483
Mother's education				
No education	57.1	30,298	50.2	21,125
1–8 years	26.2	15,642	27.8	15,337
9+ years	16.7	10,767	22.0	15,092
SLI				
Low	37.8	18,741	33.5	12,224
Medium	46.7	27,169	35.0	16,326
High	15.5	10,098	31.5	18,350

Note: * weighted percentage; ** unweighted number

Multivariate analysis

Higher infant mortality rates among lower-castes are often associated with their disadvantaged socioeconomic background. In order to address this hypothesis, we apply the Cox Proportional Hazards Model for estimating the effects of caste on infant mortality by controlling for potential confounding variables. Results presented in the basic model 1A of Table 2, which includes two fundamental demographic variables—mother's age at the time of the survey and sex of the child—as controls, show that in NFHS-2 caste differences in the likelihood of children dying during infancy are large and highly significant. Compared with the mortality risk for forward-caste children (reference category), the risks are 23 per cent greater for OBC children (HR = 1.23; CI = 1.13, 1.34), 32 per cent greater for Dalit children (HR = 1.32; CI = 1.20, 1.45), and 27 per cent greater for Adivasi children (HR = 1.27; CI = 1.15, 1.41). Surprisingly, the picture does not change much over the next seven years. Thus, in NFHS-3 (Model 1B) the relative risks for OBC (HR = 1.25; CI = 1.13, 1.39) and Adivasi children (HR = 1.28; CI = 1.13, 1.46) remain virtually unchanged, whereas the risk for Dalit children worsens somewhat (HR = 1.42; CI = 1.26, 1.59).

Table 2. Partial results of Cox Proportional Hazards Model of infant mortality, NFHS-2 and NFHS-3

	Model 1A		Model 1B		Model 2A		Model 2B		Model 3A		Model 3B	
	NFHS-2	HR	NFHS-3	HR	NFHS-2	HR	NFHS-3	HR	NFHS-2	HR	NFHS-3	HR
Caste												
Forward ^(R)												
Dalits	1.32***	(1.20, 1.45)	1.42***	(1.26, 1.59)	1.18***	(1.07, 1.30)	1.19***	(1.06, 1.34)	1.12**	(1.01, 1.23)	1.17**	(1.03, 1.32)
Adivasis	1.27***	(1.15, 1.41)	1.28***	(1.13, 1.46)	1.18***	(1.06, 1.32)	1.10	(0.96, 1.26)	1.15**	(1.01, 1.26)	1.08	(0.94, 1.24)
OBCs	1.23***	(1.13, 1.34)	1.25***	(1.13, 1.39)	1.15***	(1.06, 1.26)	1.09	(0.97, 1.21)	1.13***	(1.03, 1.23)	1.09	(0.97, 1.22)
Don't know	1.63***	(1.22, 2.16)	1.09	(0.87, 1.36)	1.25	(0.93, 1.67)	1.06	(0.84, 1.32)	1.15	(0.86, 1.55)	1.09	(0.87, 1.36)
Child's sex												
Male ^(R)												
Female	0.96	(0.90, 1.03)	0.95	(0.88, 1.03)	0.95	(0.89, 1.02)	0.95	(0.87, 1.02)	0.95	(0.89, 1.02)	0.95	(0.88, 1.03)
Mother's age												
< 20 years												
20-29 years	0.30***	(0.27, 0.34)	0.27***	(0.23, 0.31)	0.33***	(0.29, 0.36)	0.29***	(0.25, 0.33)	0.33***	(0.30, 0.37)	0.29***	(0.25, 0.34)
35+ years	0.26***	(0.22, 0.28)	0.19***	(0.16, 0.23)	0.26***	(0.23, 0.29)	0.20***	(0.17, 0.24)	0.26***	(0.23, 0.29)	0.21***	(0.18, 0.25)
Region of residence												
South ^(R)												
North												
Central												
East												
Northeast												
West												
Place of residence												
Rural ^(R)												
Urban												
Mother's education												
No education												
1-8 years												
9+ years												
SLI												
Low ^(R)												
Medium												
High												

Note: * significant at 0.05 level, ** significant at 0.01 level, *** significant at 0.001 level, R: reference category.

In these models, mother's age is a highly significant covariate of infant mortality, showing that children born to younger women (15–19-year age group) are more than three times as likely to die before reaching their first birthday as those born to women in the older age groups (20–29 years and 30+). Surprisingly, child's sex fails to emerge as a significant covariate. However, as shown later, an overall measure of infant mortality is deceptive at times for studying the relationship between child's sex and mortality. Gender differences in mortality are more significant in the neonatal period, suggesting that boys are significantly more likely than girls to die in the first month of life, while the converse is usually true in the post-neonatal period.

When we extend the analysis by adding three variables—region of residence, place of residence, and maternal education—the results change substantially (Models 2A and 2B). Region of residence and place of residence carry highly significant coefficients, showing that children from rural areas and from all non-Southern regions, except for the West, are at a greater risk of dying early; however, they do not influence the relationship between caste and infant mortality in a significant way. Consistent with previous research (Basu and Stephenson 2005; Caldwell 1979; Cleland and Van Ginneken 1988; Singh-Manoux et al. 2008), maternal education emerges as a very important predictor. In both NFHS-2 and NFHS-3, children born to women with 9 years or more of schooling are slightly less than half as likely to die in the first year of life as those born to women with no education (NFHS-2: HR = 0.56; CI = 0.49, 0.63 and NFHS-3: HR = 0.58; CI = 0.51, 0.66). Maternal education exerts an important influence on the relationship between caste and infant mortality, while also explaining some of the effects of other control variables. In NFHS-2, the differences in mortality risk between the three lower caste groups and the forward castes are minimized considerably. In NFHS-3, mortality differences between forward-caste, OBC, and Adivasi children are fully accounted for by maternal education, although Dalit children still remain at higher risk (HR = 1.19; CI = 1.06, 1.34). With the addition of SLI, which is also highly correlated with maternal education, the relative risk for Dalit children is further reduced, but still statistically significant (NFHS-2: HR = 1.12; CI = 1.01, 1.23; NFHS-3: HR = 1.17; CI = 1.03, 1.32). This implies that the two socioeconomic variables—maternal education and SLI—are strong predictors of infant mortality, but do not fully explain the excess mortality among Dalits.

Given the limitations of the measure of infant mortality as discussed earlier, we carry out separate analyses for mortality during the neonatal and post-neonatal periods (Table 3). Consistent with previous research (Choe et al. 1995; Modin 2002), we find that girls are significantly less likely than boys to die in the neonatal period, which is indicative of their innate biological survival advantage. However, this is not necessarily true in the post-neonatal period, when the effects of sociocultural milieu overshadow the effects of biology, and girls become increasingly exposed to various societal factors affecting health, illness, and death. This observation holds particularly true in the Indian context (Das Gupta 1987; Subramanian et al. 2006a). We also find that children from rural areas are at greater risk of dying young than those from urban areas; however, they remain more vulnerable in the neonatal period even when other background characteristics are controlled. Somewhat similar findings emerge in the case of region of residence. Children from non-southern regions are significantly more likely than those from southern regions to die young. In contrast to the pattern of relationship between pertinent background characteristics and infant mortality described above, we find that maternal education is more strongly related to post-neonatal than neonatal mortality. In NFHS-3, for example, children born to women with 9 years or more of schooling are at a 29 per cent lower risk of dying in the neonatal period, compared with those born to illiterate women (HR = 0.71; CI = 0.61, 0.82). The gap between the two groups of children is much larger (64 per cent) in the post-neonatal period (HR = 0.36; CI = 0.28, 0.45). SLI is also a more powerful predictor of post-neonatal than of neonatal mortality.

Results presented in Table 3 show that among the lower caste groups, OBCs have made the most impressive gains in reducing infant mortality. In both study waves, the baseline model (Models 1A and 2A) shows that OBC children are slightly more than 20 per cent as likely as forward-caste children to die in the neonatal period (NFHS-2: HR = 1.23; CI = 1.11, 1.36; NFHS-3: HR = 1.24; CI = 1.09, 1.40). When background characteristics (except for SLI) are held constant, this gap is reduced to 16 per cent (HR = 1.16; CI = 1.04, 1.29) in NFHS-2 (Model 3A). However, the gap disappears altogether in the NFHS-3 (Model 3B), suggesting that the excess neonatal mortality among OBC children is entirely attributable to background characteristics—maternal education in particular. The picture is even more dramatic in the post-neonatal period. After adjusting for the above-mentioned variables, there is a trivial mortality gap between OBCs and forward-caste children in both NFHS-2 and NFHS-3.

Table 3. Partial results of Cox Proportional Hazards Model of neonatal and post-neonatal mortality, NFHS-2 and NFHS-3

	NFHS-2				NFHS-3			
	Model 1A		Model 1B		Model 2A		Model 2B	
	Neonatal mortality		Post-neonatal		Neonatal mortality		Post-neonatal	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Caste								
Forward ^(R)								
Dalits	1.30***	(1.16, 1.46)	1.35***	(1.15, 1.59)	1.39***	(1.21, 1.60)	1.49***	(1.20, 1.85)
Adivasis	1.14**	(1.00, 1.30)	1.53***	(1.30, 1.80)	1.10	(0.94, 1.29)	1.73***	(1.39, 2.14)
OBCs	1.23***	(1.11, 1.36)	1.23***	(1.06, 1.43)	1.24***	(1.09, 1.40)	1.28**	(1.05, 1.55)
Don't know	1.26	(0.85, 1.86)	2.33***	(1.54, 3.52)	1.06	(0.82, 1.39)	1.15	(0.77, 1.71)
Child's sex								
Male ^(R)								
Female	0.86***	(0.79, 0.94)	1.18***	(1.06, 1.32)	0.87***	(0.79, 0.95)	1.16**	(1.01, 1.33)
Mother's age								
< 20 years								
20–29 years	0.29***	(0.26, 0.34)	0.31***	(0.26, 0.38)	0.26***	(0.22, 0.31)	0.30***	(0.23, 0.40)
35+ years	0.24***	(0.21, 0.28)	0.26***	(0.21, 0.32)	0.17***	(0.14, 0.21)	0.25***	(0.19, 0.34)
Region of residence								
South ^(R)								
North								
Central								
East								
Northeast								
West								
Place of residence								
Rural ^(R)								
Urban								
Mother's education								
No education								
1–8 years								
9+ years								
SLI								
Low ^(R)								
Medium								
High								

Note: * significant at 0.05 level, ** significant at 0.01 level, *** significant at 0.001 level, R: reference category.

Mortality experiences of Dalit children are worse. Not only are they more likely than forward-caste children to die at both stages of infancy, but also appear to have become increasingly vulnerable over time. In the baseline model in NFHS-2, they are at a 30 per cent greater risk in the neonatal period and at a 35 per cent greater risk in the post-neonatal period, compared with forward-caste children. In the NFHS-3, these risks are higher, at 39 per cent and 49 per cent, respectively. The socioeconomic disadvantage of Dalits mirrors these patterns. Thus, when background characteristics are held constant, the gap in post-neonatal mortality risks between Dalit and forward-caste children is substantially reduced in both NFHS-2 and NFHS-3. However, this does not quite happen in the case of neonatal mortality. As shown in Models 3A and 4A, Dalit children remain vulnerable in both the NFHS-2 (HR = 1.18; CI = 1.05, 1.33) and the NFHS-3 (HR = 1.21; CI = 1.05, 1.40). The inclusion of SLI in the model lessens the Dalit effect slightly (Model 5A: HR = 1.12 CI = 1.00, 1.27 and Model 6A: HR = 1.19; CI = 1.03, 1.38).

Surprisingly, Adivasi children are in much better condition than Dalit children in the neonatal period. They are only slightly more vulnerable than forward-caste children in terms of mortality risk in this period, even when no background characteristics are taken into account. However, they are highly vulnerable in the post-neonatal period, when all background characteristics are accounted for. In both surveys, their excess mortality is quite

Table 3. (continued)

	NFHS-2				NFHS-3			
	Model 3A		Model 3B		Model 4A		Model 4B	
	Neonatal mortality		Post-neonatal		Neonatal mortality		Post-neonatal	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Caste								
Forward ^(R)								
Dalits	1.18***	(1.05, 1.33)	1.17*	(0.99, 1.38)	1.21***	(1.05, 1.40)	1.15	(0.92, 1.43)
Adivasis	1.09	(0.95, 1.26)	1.35***	(1.13, 1.61)	1.01	(0.85, 1.19)	1.29**	(1.03, 1.63)
OBCs	1.16***	(1.04, 1.29)	1.15*	(0.99, 1.34)	1.11	(0.97, 1.26)	1.04	(0.85, 1.27)
Don't know	0.99	(0.66, 1.49)	1.70**	(1.12, 2.59)	1.06	(0.81, 1.39)	1.05	(0.71, 1.57)
Child's sex								
Male ^(R)								
Female	0.85***	(0.79, 0.93)	1.17***	(1.05, 1.31)	0.86***	(0.79, 0.95)	1.15*	(1.00, 1.32)
Mother's age								
< 20 years								
20–29 years	0.32***	(0.28, 0.36)	0.34***	(0.28, 0.42)	0.27***	(0.23, 0.32)	0.33***	(0.25, 0.44)
35+ years	0.25***	(0.22, 0.29)	0.26***	(0.21, 0.33)	0.18***	(0.15, 0.22)	0.26***	(0.19, 0.35)
Region of residence								
South ^(R)								
North	1.22**	(1.05, 1.43)	1.83***	(1.44, 2.32)	1.38***	(1.13, 1.67)	1.31*	(0.97, 1.77)
Central	1.40***	(1.21, 1.63)	1.92***	(1.53, 2.42)	1.87***	(1.57, 2.23)	1.78***	(1.36, 2.33)
East	1.11	(0.94, 1.30)	1.48***	(1.16, 1.89)	1.52***	(1.26, 1.84)	1.29*	(0.96, 1.73)
Northeast	1.03	(0.85, 1.24)	1.59***	(1.21, 2.07)	1.26**	(1.02, 1.55)	1.58***	(1.17, 2.13)
West	1.07	(0.88, 1.30)	1.12	(0.82, 1.53)	1.25*	(1.00, 1.56)	0.96	(0.67, 1.39)
Place of residence								
Rural ^(R)								
Urban	0.85***	(0.76, 0.95)	0.87*	(0.75, 1.02)	0.86***	(0.77, 0.96)	0.99	(0.85, 1.16)
Mother's education								
No education								
1–8 years	0.82***	(0.74, 0.91)	0.79***	(0.69, 0.91)	0.92	(0.82, 1.03)	0.71***	(0.61, 0.84)
9+ years	0.68***	(0.58, 0.78)	0.35***	(0.27, 0.45)	0.71***	(0.61, 0.82)	0.36***	(0.28, 0.45)
SLI								
Low ^(R)								
Medium								
High								

apparent. After controlling for all background variables, including maternal education and SLI, in both NFHS-2 and NFHS-3 Adivasi children are slightly more than 25 per cent as likely as forward-caste children to die in the post-neonatal period (Model 5B: HR = 1.28; CI = 1.07, 1.53; Model 6B: HR = 1.27; CI = 1.00, 1.60).

Discussion and conclusions

Using data from the latest two waves of India's National Family Health Survey (NFHS-2: 1998–99 and NFHS-3: 2005–06), this study examines the relationship between young children's risk of dying and their caste background. Consistent with previous research (Dommaraju et al. 2008; June et al. 2011; Mohindra et al. 2006; Nguyen et al. 2013; Singh et al. 2013; Singh-Manoux et al. 2008; Subramanian et al. 2006a, 2006b), we find that despite large improvements in health conditions and reductions in mortality in India in recent years, children from lower castes continue to experience higher mortality than those from forward castes. Estimates obtained from the Cox Proportional Hazards Model show that in NFHS-2, with mother's age and child's sex controlled, OBC, Dalit, and Adivasi children are 23, 32, and 27 per cent more likely, respectively, than forward-caste children to die in the first year of life. In NFHS-3, the relative risks remain virtually unchanged for Adivasi and OBC chil-

Table 3. (continued)

	NFHS-2				NFHS-3			
	Model 5A		Model 5B		Model 6A		Model 6B	
	Neonatal mortality		Post-neonatal		Neonatal mortality		Post-neonatal	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Caste								
Forward ^(R)								
Dalits	1.12*	(1.00, 1.27)	1.10	(0.94, 1.30)	1.19**	(1.03, 1.38)	1.11	(0.89, 1.39)
Adivasis	1.05	(0.92, 1.21)	1.28***	(1.07, 1.53)	0.99	(0.84, 1.18)	1.27**	(1.00, 1.60)
OBCs	1.13**	(1.01, 1.25)	1.12	(0.97, 1.31)	1.11	(0.97, 1.27)	1.04	(0.84, 1.27)
Don't know	0.9	(0.60, 1.36)	1.59**	(1.04, 2.43)	1.11	(0.85, 1.46)	1.03	(0.68, 1.57)
Child's sex								
Male ^(R)								
Female	0.86***	(0.79, 0.93)	1.16**	(1.04, 1.30)	0.87***	(0.79, 0.96)	1.16**	(1.00, 1.33)
Mother's age								
< 20 years								
20–29 years	0.32***	(0.28, 0.36)	0.36***	(0.29, 0.43)	0.280***	(0.23, 0.33)	0.34***	(0.25, 0.45)
35+ years	0.25***	(0.22, 0.29)	0.27***	(0.22, 0.34)	0.19***	(0.15, 0.23)	0.28***	(0.20, 0.38)
Region of residence								
South ^(R)								
North	1.29***	(1.10, 1.51)	2.05***	(1.61, 2.60)	1.44***	(1.19, 1.76)	1.33*	(0.98, 1.80)
Central	1.45***	(1.24, 1.68)	2.02***	(1.60, 2.54)	1.88***	(1.57, 2.24)	1.76***	(1.35, 2.31)
East	1.10	(0.93, 1.29)	1.46***	(1.14, 1.86)	1.49***	(1.23, 1.80)	1.22	(0.91, 1.64)
Northeast	1.03	(0.85, 1.24)	1.55***	(1.19, 2.03)	1.30**	(1.06, 1.60)	1.55***	(1.15, 2.10)
West	1.07	(0.88, 1.30)	1.1	(0.81, 1.51)	1.27**	(1.02, 1.59)	0.97	(0.67, 1.40)
Place of residence								
Rural ^(R)								
Urban	0.87**	(0.78, 0.98)	0.94	(0.80, 1.10)	0.89**	(0.80, 1.00)	1.06	(0.90, 1.26)
Mother's education								
No education								
1–8 years	0.86***	(0.78, 0.96)	0.88*	(0.76, 1.02)	0.96	(0.85, 1.07)	0.77***	(0.65, 0.92)
9+ years	0.78***	(0.67, 0.92)	0.47***	(0.36, 0.62)	0.77***	(0.66, 0.91)	0.41***	(0.32, 0.54)
SLI								
Low ^(R)								
Medium	0.91**	(0.82, 1.00)	0.83***	(0.73, 0.94)	0.94	(0.83, 1.06)	0.85*	(0.72, 1.02)
High	0.69***	(0.58, 0.81)	0.48***	(0.37, 0.62)	0.80***	(0.68, 0.93)	0.71***	(0.56, 0.90)

dren, whereas Dalit children are at an enhanced risk (42 per cent). Ironically, these regressive incidents happened at a time when many governments were formed on the basis of caste, politics and various programs and policies were introduced for the uplift of the lower castes. It appears that maternal and child health care programmes such as the Child Survival and Safe Motherhood Programme, and National the Maternity Benefit Scheme, did not fully reach the most vulnerable sections of society.

The research presented here indicates that background characteristics such as maternal age, child's sex, region of residence, rural-urban residence, maternal education, and SLI account for much of the caste differences in infant mortality, although they do not adequately address certain anomalies. When these characteristics—particularly maternal education and SLI—are controlled, differences between OBCs and forward castes in infant mortality in both neonatal and post-neonatal periods are diminished in NFHS-2 and eliminated in NFHS-3. Socioeconomic background characteristics also account for much of the excess mortality among Dalit children, although they still have a 19 per cent higher risk of death (in NFHS-3) in the neonatal period, compared with forward-caste children. It is possible that in addition to individual-level factors, macro-level characteristics such as physical environment, residential segregation, social inequalities and discrimination, which “get under the skin,” result in higher neonatal mortality among Dalits, especially those at the bottom of the social and economic hierarchy. Presumably, these factors discourage many Dalits to avail and/or utilize antenatal and prenatal ser-

vices and healthcare facilities for child delivery (Chalasanı 2012; McKinnon et al. 2014; Paudel et al. 2013), and also result in stress-related birth outcomes, such as preterm deliveries (Pike 2005) and low birth weight (Ellen 2000). Certain traditional and cultural practices and beliefs associated with pregnancy and childbirth may also be responsible for excess neonatal mortality among Dalits (Ghosh 2012; Kesterton and Cleland 2009).

In stark contrast, Adivasi children are at most risk in the post-neonatal period, even when all background characteristics are taken into account, although they are at a much lower risk in the neonatal period. The reasons for this epidemiological paradox are not clear. It is possible that certain cultural practices among the Adivasis protect newborn children from infections and other factors responsible for deaths in the neonatal period (Das et al. 2010), whereas harsh environmental conditions, malnutrition, lack of medical facilities in remote and rural areas, discriminatory medical practices, and persistent socioeconomic deprivation result in elevated health and mortality risks in later childhood. Underreporting of births and neonatal deaths may also be partially responsible for lower neonatal mortality among the Adivasis compared with other caste groups. These are mere speculations which need to be examined in future studies. In sum, the Dalit experience suggests that programmes and policies that focus on increased access to prenatal and antenatal care and healthcare facilities for child delivery need to be intensified in less advantaged sections of society, whereas the Adivasi experience suggests, however, that these efforts would be incomplete if the post-neonatal stage of life is neglected.

Our results also suggest that a global measure of infant mortality would be misleading to fully understand mortality dynamics in a less industrialized country such as India. Wherever possible, analyses need to differentiate between neonatal and post-neonatal mortality. Since neonatal and post-neonatal deaths are affected by a different set of factors, policymakers need to adopt different strategies to deal with mortality in these two stages of life. We find that in both surveys, Dalit children are significantly more likely than forward-caste children to be at risk of dying in the first year of life. This finding is true in the case of neonatal mortality but not post-neonatal mortality. In fact, mortality risks for Dalit children are not significantly different from forward-caste children's in the post-neonatal period. We also find that the overall infant mortality risks for Adivasi children are no different from forward-caste children. However, the differences between the two groups are significant in the post-neonatal period, but not in the neonatal period.

The evidence presented in this study suggests that including Dalits and Adivasis in a single category hides the fine differences that exist between the two groups in terms of socioeconomic status, health, and mortality. Although historically both groups have been at the bottom of the social hierarchy in India, and have faced continuous discrimination in their social and economic lives, they are highly different from each other due to their dissimilar residential locations and cultural practices. They are also different in terms of the pace of socioeconomic progress over time. Thus, as discussed earlier, while Dalit children are at a greater risk of dying during early infancy, Adivasi children are at a greater risk of dying during later childhood. Further research is needed to identify how sociocultural forces shape individual beliefs and health-related behaviours among the Dalits and Adivasis.

A few comments on the limitations of this study are in order. First, the data used for the analysis are dated. Infant mortality statistics in NFHS-2 refer to approximately the 1994–98 period, while statistics in NFHS-3 refer to the 2002–06 period. They may not capture much of the developments that have taken place in recent years, in terms of reductions in mortality and policy initiatives such as the National Rural Health Mission (NRHM) and Janani Suraksha Yojana (Mother Security Scheme)—a conditional cash transfer programme—which were launched in 2005. Second, the control variables included in this study do not fully capture the socioeconomic status that may be responsible for caste differences in mortality. If we were to include some macro-level variables (such as neighbourhood, residential segregation), various cultural practices, and programmes and policies, caste differences in mortality may have been more adequately addressed. Third, data on the background variables included in this study were measured on the survey date, while the dependent variable—infant mortality—was derived from the number of children who were born during the five years preceding the survey. However, we do not expect this to be an important bias, because none of the characteristics (except perhaps for SLI) is likely to be influenced by infant mortality. Fourth, data on infant mortality in a less industrialized country such as India is suspect to recall lapse, failure to report a sad event, and, consequently, underreporting of deceased children. This may have happened more among the Adivasis, who report significantly lower neonatal mortality

than Dalits, much closer to that among OBCs. Finally, the four caste groups included in this study present just a global picture. In each group, there are hundreds of castes, some of which are better-off and less discriminated than others. Among the Dalits, for example, some lower castes have been recently identified as “Maha Dalits” (or extremely oppressed) or “extremely backward”, while some others are in much better conditions in certain geographic regions. Hopefully, the 2011 Census of India, which collected data for all castes, will enable researchers and policymakers to go beyond simplistic generalizations based on broad categories of caste.

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