Infant and Child Mortality in India

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India's National Family Health Survey (NFHS) was conducted in 1992–93 under the auspices of the Ministry of Health and Family Welfare The survey provides national and state-level estimates of fertility, infant and child mortality, family planning practice, maternal and child health, and the utilization of services available to mothers and children The International Institute for Population Sciences, Mumbai, coordinated the project in cooperation with 18 population research centres throughout India, the East-West Center Program on Population in Honolulu, Hawaii, and Macro International in Calverton Maryland The United States Agency for International Development provided funding for the project

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Infant and Child Mortality in India

Abstract *This Subject Report examines infant and child mortality and their determinants for India as a whole and for individual states, using data from the 1992–93 National Family Health Survey Neonatal (first month), postneonatal (age 1–11 months), infant (first year), and child (age 1–4 years) mortality are estimated, as well as the effects of socioeconomic background characteristics, demographic characteristics, and mother's health-care behaviour, using information from women's birth histories pertaining to children born during the 12-year period before the survey*

Infant mortality declined 23 percent in India between 1981 and 1990, and child mortality declined 34 percent during the same period Nevertheless, mortality rates are still high Among children born during the 12 years before the survey, 88 out of 1,000 are estimated to die during the first year of life, and 121 are estimated to die before reaching age five In recent years, infant and child mortality have declined in every state These declines have been consistently largest for child mortality and smallest for neonatal mortality Apart from these consistent trends, however, there are substantial variations among individual states For example, infant mortality is less than 40 per 1,000 in Kerala and Goa but more than 120 per 1,000 in Orissa and Uttar Pradesh

Sex differentials in infant and child mortality reflect strong son preference in many states Most states exhibit excess male mortality during the neonatal period but excess female mortality during childhood The only exceptions are Tamil Nadu and Kerala In the country as a whole, female child mortality is 40 percent higher than male child mortality The sex differentials in infant and child mortality suggest that son preference and discrimination against female children are very strong in northern states but minimal or nonexistent in southern states

Among socioeconomic background characteristics, urban/rural residence, mother's exposure to mass media, and use of clean cooking fuel are found to have substantial unadjusted effects on infant and child mortality, but these effects are much smaller when the effects of other socioeconomic variables and basic demographic factors are controlled Mother's literacy, access to a flush or pit toilet, household head's religion and caste/tribe membership, and economic level of the household (indicated by ownership of consumer goods) have substantial and often statistically significant adjusted effects on infant and child mortality Both unadjusted and adjusted effects of most of these background characteristics are largest for child mortality and smallest for neonatal mortality

In general, demographic characteristics have substantial adjusted effects on mortality before age five The adjusted effects are not very different from the unadjusted effects (i e , the introduction of controls makes little difference) except in the case of birth order and mother's age at childbirth Adjusted neonatal mortality decreases with increasing birth order, whereas adjusted postneonatal and child mortality increase with increasing birth order The combination of effects on neonatal mortality

and postneonatal mortality results in a U-shaped relationship between birth order and infant mortality, with third-order births showing the lowest mortality Mother's age under 20 at childbirth is associated with much higher mortality of first-born children Among second and higher-order births, the relationship between mother's age at childbirth and mortality is U-shaped Children born after a short birth interval, children who are followed by a next birth within a short interval, and children with an older sibling who died all experience much higher mortality before age five than do other children Controlling for other variables does not change the effects of these factors very much

Among variables indicating mother's health-care behaviour, mother's tetanus immunization during pregnancy has a strong association with reduced neonatal mortality

This study provides information for health planners and managers responsible for programmes to reduce infant and child mortality Encouraging mothers to space births by intervals of at least 24 months will greatly enhance the survival of children Minimizing the number of births to very young mothers (under age 20) and avoiding high-order births will also substantially enhance survival chances of children during the first five years of life Family health programmes should emphasize tetanus immunization for all pregnant mothers They should also identify families that have already experienced infant or child death and should provide them with intensified maternal and child health services

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Preface

This Subject Report is a product of the Project to Strengthen the Survey Research Capabilities of the Population Research Centres (PRC) in India, more commonly known as the PRC project A major component of this project is the 1992–93 National Family Health Survey (NFHS) Findings from the NFHS provide the basis for this report

The Ministry of Health and Family Welfare (MOHFW) launched the PRC project in 1991 The MOHFW designated the International Institute for Population Sciences (IIPS), Mumbai, as the nodal agency to provide coordination and technical guidance to the NFHS Various consulting organizations collected survey data during 1992–93 in collaboration with Population Research Centres in each state Basic survey reports and summary reports for India as a whole and for 25 states (including Delhi, which recently attained statehood) were published during 1994–95 The East-West Center (Honolulu, Hawaii, U S A) and Macro International (Calverton, Maryland, U S A) provided technical assistance for all survey operations The United States Agency for International Development (USAID) provided funding for the project

Upon completion of the basic survey reports and summary reports in December 1995, the NFHS data were released to the scientific community for further study As part of this further research and as a continuation of the PRC/NFHS project, a Subject Reports series has been established The present Subject Report on infant and child mortality in India is the 11th in this series

This Subject Report is a direct outcome of a Workshop on Determinants of Infant and Child Mortality in India, held 13 November to 3 December 1996 at IIPS in Mumbai The participants were Moneer Alam (Population Research Centre Institute of Economic Growth, Delhi), Bashir Ahmad Bhat (Population Research Centre, University of Kashmir, Srinagar), Jagdish Chand (Population Research Centre, Himachal Pradesh University, Shimla), Manoj Kumar Chatterjee (Population Research Centre, Lucknow University, Lucknow), Rita Gawari (Population Research Centre, Punjab University, Chandigarh), S Gunasekaran (Population Research Centre, Gandhigram Institute of Rural Health and Family Welfare Trust, Tamil Nadu), Jyoti S Hallad (Population Research Centre, J S S Institute of Economic Research, Dharwad), D R Joshi (Population Research Centre, Mohanlal Sukhadia University, Udaipur), R

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Gayle Yamashita, Victoria Ho, Judith Tom, Jonathan Chow, and Noreen Tanouye provided computer programming and research assistance for this report, and David Cantor provided helpful technical advice Robert D Retherford and Vinod Mishra read earlier drafts of the manuscript and provided useful comments Sidney B Westley provided editorial assistance, and Loraine N Ikeda and O P Sharma provided assistance with printing and distribution

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1 Introduction

India's 1992–93 National Family Health Survey (NFHS) collected information on fertility, family planning, and maternal and child health from ever-married women age 13–49 The survey covered 25 states, including the former Union Territory of Delhi, which has since attained statehood Not covered were Sikkim, the Kashmir region of the state of Jammu and Kashmir, and the smaller union territories The areas covered by the survey account for 99 percent of the country's population

Birth histories collected from women during the survey provide information for the analysis of infant and child mortality Basic results from the survey, including some statistics on infant and child mortality, were published in a national report and 20 state reports These statistics include levels and trends of mortality before age five and differentials in mortality by selected socioeconomic, demographic, and health-care characteristics They are based on deaths that occurred during the five-year period before the survey

The current report provides more details on infant and child mortality in India as a whole and in the major states The main purpose is to estimate and interpret adjusted (net) effects on infant and child mortality of socioeconomic characteristics of mothers and households, demographic characteristics of children, and health-care behaviour of mothers Understanding the relationships between these factors and infant and child mortality can provide valuable information for social scientists, policymakers, and health professionals who are concerned with improving the survival of young children in India

Because many factors associated with variations in infant and child mortality are interrelated, it is important to attempt to isolate the effects of individual variables Hazard regression models (Cox 1972) allow us to estimate the adjusted effect of each variable while controlling for the effects of other factors that are associated with infant and child mortality Because major causes of death differ substantially at different ages, the effects on mortality of factors we examine are expected to be quite different for children of different ages The hazard models, therefore, are estimated separately for three age intervals the neonatal period (first month), the postneonatal period (1–11 months), and childhood (12–59 months)

Results from the estimated hazard models are transformed into familiar measures of mortality, namely neonatal mortality, postneonatal mortality, infant mortality (first year of life), and child mortality The effect of a factor is presented in terms of differentials in mortality between categories of that factor For example, the effect of mother's literacy is presented in the form of estimates of neonatal, postneonatal, infant, and child mortality for children of illiterate and literate mothers, with all other variables controlled by setting them at their mean values in the underlying hazard regressions These other variables include year of child's birth, child's sex, mother's age at childbirth, urban/rural residence, household head's religion and caste/tribe membership, ownership of household goods, and selected housing characteristics

Estimates are presented for states as well as for the whole country The states of India differ widely in levels of mortality, levels of socioeconomic development, and the strength of maternal and child health programmes Thus the effects of socioeconomic, demographic, and health-care factors vary by state State-level results are presented for all states except the small states in the northeast region—Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura Because the samples from these states are very small, mortality estimates are unreliable due to large sampling errors These states are included, however, in the analyses for India as a whole

Chapter 2 describes the data and methods used and includes descriptive statistics of all the variables used in the analysis Chapter 3 presents life-table estimates of mortality under age five Chapters 4 through 7 report the main findings trends and sex differentials in infant and child mortality (Chapter 4), effects of socioeconomic background characteristics on infant and child mortality (Chapter 5), effects of demographic characteristics on infant and child mortality (Chapter 6), and effects of mother's health-care behaviour on neonatal mortality (Chapter 7) Chapter 8 summarizes the results presented in previous chapters and discusses their policy implications

2 Data and Methods

DATA

Data for the NFHS were collected in 1992–93 from a probability sample of 89,777 ever-married women age 13–49 residing in 88,562 households All women surveyed by the NFHS were asked to provide a complete birth history, including sex, date of birth, and survival status for each live birth For children who had died, age at death was also collected, recorded in days for children dying in the first month of life, in months for children dying after the first month but before their second birthday, and in years for children dying at later ages

A file of children was created from these birth histories The record of each child includes selected characteristics of his/her mother and household Some child-specific variables are extracted or generated and added to the child record They include year of birth, sex, birth order, mother's age at childbirth, length of preceding birth interval, number of deceased older siblings, whether a following birth occurred before the survey and, if so, the length of the following birth interval, survival status of the child at the time of the survey, and age at death if the child died Children from multiple births are excluded from our analysis The unit of analysis in this report is the child More than one child may have the same mother and same head of household

Because we must use information on children of mothers age 13–49 at the time of survey, children in our sample who were born many years before the survey do not constitute a representative sample but rather are biased by their mother's age at childbirth For example, among children born 20 years before the survey, our data include only those whose mothers were age 29 or younger at the time of their birth In order to minimize this potential source of bias, this analysis is limited to children born in December 1979 or later Thus it includes all children born during the 12-year period before the survey The exact duration of coverage varies depending on the survey date, but no children born earlier than 13 years and 10 months before survey are included As shown in the last column of Table 2 1, this subsample consists of 163,316 children Chapter 7 is based on more recent births, namely 55,571 children born during approximately the four-year period before the survey—births since 1 January 1988 for states

Table 2 1 Overview of NFHS Month and year of field work, unweighted numbers of households and women surveyed, unweighted number of children in the birth histories, and unweighted number of children in the subsample used for analysis, by state

State	Month and year of field work		Number of households surveyed	Number of women surveyed	Number of children in birth histories	Number of children in subsample for analysis
	From	To				
India	4/92	9/93	88 562	89 777	275 172	163 316
North						
Delhi	2/93	5/93	3,577	3,457	9,869	6 040
Haryana	1/93	4/93	2 735	2 846	8 864	5 758
Himachal Pradesh	6/92	10/92	3 119	2 962	8 516	4 708
Jammu region of Jammu and Kashmir	5/93	7/93	2 839	2 766	8 407	4 935
Punjab	7/93	9/93	3 213	2 995	8 846	5 417
Rajasthan	12/92	5/93	5 014	5 211	16 372	10 363
Central						
Madhya Pradesh	4/92	8/92	5 857	6 254	19 962	12 039
Uttar Pradesh	10/92	2/93	10 110	11 438	40 811	25 130
East						
Bihar	3/93	6/93	4 748	5 949	19 072	12 132
Orissa	3/93	6/93	4 602	4 257	12 934	7 892
West Bengal	4/92	7/92	4 238	4 322	13 039	7 367
Northeast						
Arunachal Pradesh	5/93	6/93	961	882	2 728	1 973
Assam	12/92	3/93	3 255	3 006	10 409	6 501
Manipur	3/93	5/93	1 086	953	3 207	2 022
Megalaya	4/93	6/93	992	1 137	3 562	2 295
Mizoram	5/93	6/93	1 087	1 045	3 086	1 826
Nagaland	5/93	6/93	1 060	1 149	3 576	2 218
Tripura	2/93	4/93	1 139	1 100	3 569	2 104
West						
Goa	12/92	2/93	3 741	3 141	8 656	4 144
Gujarat	2/93	6/93	3 875	3 832	11 240	6 447
Maharashtra	11/92	3/93	4 063	4 106	11 941	6 837
South						
Andhra Pradesh	4/92	7/92	4 208	4 276	11 517	6 310
Karnataka	11/92	2/93	4 269	4 413	13 512	7 815
Kerala	10/92	2/93	4 387	4 332	10 784	5 635
Tamil Nadu	4/92	7/92	4 287	3 948	10 693	5 408

where the survey was conducted in 1992 and births since 1 January 1989 for states where the survey was conducted in 1993 This smaller subsample is used because data on the health-care behaviour of mothers were collected only for these births

The sample design for some states is self-weighting, but in other states certain sectors of the population, such as urban areas, are over-sampled It is, therefore, necessary to use weights to restore the correct proportions All statistics after Table 2 1 make use of weighted numbers Different sets of weights are required at the state and national levels because sampling fractions vary from state to state Thus each child has two weights, one that is used when the unit for tabulation is the state and another when the unit is the whole country A typical table in this report contains results both for India as a whole and for individual states In such a table, the national results use

the national weights, and the individual state results use the state-level weights The sample design for the survey is discussed in more detail in the original NFHS report (IIPS 1995)

Three questionnaires were used in the NFHS—one for villages (administered only in rural areas), one for households, and one for ever-married women within households Three data files correspond to these three questionnaires—the village data file, the household data file, and the individual data file For our analysis, selected household characteristics were merged into the individual data files for each woman in a household These household characteristics are the religion and scheduled-caste/tribe membership of the household head, access to a flush or pit toilet, use of clean cooking fuel, and a measure of household economic status derived from the ownership of selected consumer goods The child file used in this report was created from this augmented individual data file

LIFE-TABLE AND HAZARD MODELS

First, we compute cohort measures of mortality In other words, we follow the children in our subsample from birth and compute probabilities of dying during consecutive age intervals, using the traditional actuarial life-table method The life-table computation uses 10 age intervals 0 months, 1–2 months, 3–5 months, 6–8 months, 9–11 months, 12–17 months, 18–23 months, 24–35 months, 36–47 months, and 48–59 months From these, the following commonly used measures of mortality during infancy and childhood are computed Results are shown and discussed in Chapter 3

Neonatal mortality	The probability of dying in the first month of life
Postneonatal mortality	The probability of dying in the 2nd through 11th month
Infant mortality	The probability of dying before the first birthday
Child mortality	The conditional probability of dying between the first and fifth birthday for those who survive the first year
Under-five mortality	The probability of dying before the fifth birthday

By these definitions, infant mortality equals the sum of neonatal mortality and postneonatal mortality

The main purpose of this report is to measure the adjusted effect of each covariate (i e , each predictor variable) of mortality, controlling for the effects of other variables We accomplish this in Chapters 4 through 7 using hazard regression, which is a multivariate statistical method for survival analysis A hazard model may be thought of as a multivariate extension of the life table, combining the regression model with cohort life-table analysis In a hazard model we assume that the hazard rate (instantaneous probability of dying) depends on the values of the covariates The usual form

of the relationship between the hazard rate and the covariates is similar to that of a multiple regression with a transformed hazard function as the dependent variable The exact mathematical form of the hazard model is not given here Interested readers may consult Retherford and Choe (1993, Chapter 8)

This report does not show the hazard regression coefficients Instead, we transform the hazard-model results into a simple cross-tabulation format using multiple classification analysis (MCA) Multiple classification analysis is analogous to computing the predicted value of the dependent variable for a given set of values of the predictor variables after a regression model is estimated From a hazard model, instead of one dependent variable we estimate a life table Once the hazard regression coefficients are estimated, we can compute a life table for any given set of values of the covariates Such a set of values is transformed into a relative risk when combined with the estimated coefficients Then the relative risk is applied to the baseline life table (using the cohort life table described earlier as the baseline) to produce a predicted life table From the predicted life table, we obtain age-specific mortality rates We produce one MCA table for each covariate in the hazard model In an MCA table, the predicted mortality rate is computed for different categories of the covariate while holding the other predictor variables in the hazard model constant at their mean values

Separate hazard models are estimated for three types of mortality neonatal, postneonatal, and child mortality Models for postneonatal mortality begin with estimates of the conditional probability of dying in the second through eleventh month after birth among those who survive the first month of life These estimates are multiplied by the probability of surviving the first month to give postneonatal mortality, which is the probability of dying in the second through eleventh month among all births

Infant mortality is estimated as the sum of neonatal mortality plus postneonatal mortality If we run a hazard model for India as a whole, we use the national means of the variables and the national life table for the MCA table computation, if we run a hazard model for a state, we use the means and life table for that state For a more detailed explanation of the use of multiple classification analysis in conjunction with hazard models, see Retherford and Choe (1993, Chapter 8)

COVARIATES OF INFANT AND CHILD MORTALITY

We consider a number of covariates (predictor variables) of infant and child mortality in this report They are child's year of birth, child's sex, a set of socioeconomic background characteristics, a set of demographic characteristics, and a set of variables indicating mother's health-care behaviour

Mortality has been declining all over the world partly as a result of advances in medical knowledge and technology as well as improvement in living conditions The

child's year of birth mainly captures this general trend in mortality For both biological and behavioural reasons, mortality depends greatly on the age and sex of individuals (United Nations Secretariat 1988) We examine the effect of child's sex on infant and child mortality to see whether son preference results in sex differentials in mortality in India that are different from the general pattern observed in most other populations

Infant and child mortality are determined by both the biological endowment of children at birth and their environment after birth In developing countries, background characteristics such as mother's literacy, urban/rural residence, and household economic status are likely to affect a child's condition at birth as well as its environment, thus affecting infant and child mortality (Hobcraft, McDonald, and Rutstein 1984, Mosley and Chen 1984, United Nations 1985, 1991, 1998)

Typically, a large proportion of neonatal mortality in developing countries is due to tetanus Background characteristics can have strong effects on neonatal mortality by affecting both exposure to neonatal tetanus and its prevention Exposure to tetanus is closely related to the living conditions of the household, which are largely determined by background characteristics Prevention of tetanus can be achieved by antenatal immunization and by sanitary handling of the umbilical cord immediately after birth These factors are likely to be related to such background characteristics as mother's literacy and urban/rural residence

After the neonatal period, postneonatal and child mortality are caused mainly by childhood diseases and accidents Whether children become ill depends to some extent on their nutritional level, their environment, and their mothers' preventive health-care behaviour When they do become ill, their survival depends largely on the knowledge and behaviour of the adults who care for them and on their access to health-care facilities These factors are related in turn to background characteristics The risk of accident is also closely related to background characteristics (Mosley and Chen 1984) In general, background characteristics are expected to have stronger effects on postneonatal and child mortality than on neonatal mortality because the primary causes of death change as children age, from factors related mostly to biological conditions to factors related mostly to their environment

Some characteristics of children are related to mother's fertility behaviour, such as mother's age at childbirth child's birth order and previous and following birth intervals These characteristics are known to affect neonatal postneonatal infant, and child mortality in developing countries (Hobcraft, McDonald, and Rutstein 1985 Palloni and Milman 1986, Retherford et al 1989, United Nations 1994) First-born children and children of high birth orders are known to experience higher mortality than children of birth orders two to four Children born to women under age 20 and over age 35 are known to have higher mortality than those born to mothers age 20–34, most likely because a woman's physical condition is most favorable to childbearing during her twenties and early thirties

Short birth intervals increase mortality of children in two ways Children born after a short interval are likely to have mothers in poor health, and such children tend to have low birthweight and increased chances of neonatal mortality Short birth intervals also result in families with many children of similar ages This increases competition for family resources and attention and also increases exposure to infectious childhood diseases Children born to families in which a child has already died are more likely to die in childhood than are other children, probably because the conditions that caused the death of an older sibling affect the newborn child as well

Careful monitoring of mother's health and growth of the fetus during pregnancy can identify potential complications during pregnancy, thus improving child survival after birth Supplemental intake of vitamins and minerals during pregnancy enhances fetal growth and improves survival chances after birth Furthermore, mother's tetanus immunization during pregnancy can sharply reduce risks of mortality due to neonatal tetanus Also, timely check-ups of mother and baby after birth can improve survival chances of children

Maternal and child health services in India are designed to provide basic health services to vulnerable groups of pregnant women through programmes such as the Minimum Needs Programme, the Child Survival and Safe Motherhood Programme, and the Reproductive and Child Health Programme (IIPS 1995, Ministry of Health and Family Welfare 1998) Results in this report include estimated effects of women's health-care behaviour—such as antenatal visits, tetanus immunization, and place of delivery—on neonatal mortality These results will be useful both in evaluating current maternal and child health programmes and in providing guidelines for the future

MODEL SPECIFICATIONS AND DESCRIPTIVE STATISTICS OF COVARIATES

In this analysis, we estimate the unadjusted effect of each variable on neonatal, postneonatal, and child mortality using hazard models that include just one predictor variable Adjusted effects of each variable are estimated by three sets of hazard models The first set is used to estimate adjusted effects of child's year of birth, child's sex, and socioeconomic background characteristics Chapters 4 and 5 discuss the results of these models The second set of hazard models is used to estimate effects of demographic characteristics, as discussed in Chapter 6 Although mother's age at childbirth is included in the first set of hazard models, we do not discuss its effect until Chapter 6 The third set of hazard models is used to estimate the effects of mother's health-care behaviour, as discussed in Chapter 7

Table 2 2 shows the list of variables used in the first set of hazard models and their representations We combine household head's religion and caste/tribe membership to create a new set of categories Because members of scheduled castes and

Table 2 2 Variables used in the hazard models for estimating effects of year of birth, child's sex, and background characteristics

Variable	Representation in hazard model
Child s year of birth	Quantitative variable
Child's sex	One dummy variable (male female)
Mother s age at childbirth	Quantitative variable (age in completed years) and its square
Residence	One dummy variable (urban rural)
Mother s literacy	One dummy variable (literate illiterate)
Religion caste/tribe membership	Three dummy variables indicating four categories of household head (Hindu and neither scheduled caste nor scheduled tribe Hindu and either scheduled caste or scheduled tribe Muslim other religion)
Mother s exposure to mass media	One dummy variable (listens to radio or watches television at least once a week does neither)
Toilet facility	One dummy variable (own shared or public flush or pit toilet other)
Type of cooking fuel	One dummy variable (electricity gas biogas coal charcoal kerosene other)
Ownership of goods score	Quantitative variable (sum of points as follows 4 for car 3 each for refrigerator TV VCR/VCP motorcycle/scooter 2 each for sewing machine sofa set fan radio/transistor bicycle 1 for clock/watch)

scheduled tribes are predominantly Hindu (94% of those in a scheduled caste and 89% of those in a scheduled tribe), we replace two variables indicating religion and caste/tribe by a single variable called "religion-caste/tribe membership" This variable has four categories (1) Hindu and neither scheduled caste nor scheduled tribe (Hindu-non-caste/tribe), (2) Hindu and either scheduled caste or scheduled tribe (Hindu-caste/tribe), (3) Muslim, and (4) other religions This simply separates the largest category of the original religion variable, Hindu, into two categories according to whether a household head belongs to a scheduled caste or a scheduled tribe The other two religion categories, Muslim and other religions, remain unchanged

We create a score measuring household economic status in terms of ownership of household goods by adding the following points 4 for a car, 3 each for a refrigerator, a television, a VCR/VCP, or a motorcycle/scooter, 2 each for a sewing machine, a sofa set, a fan, a radio/transistor, or a bicycle, and 1 for a clock/watch The maximum possible score for a household is 27, and the minimum possible score is zero We use this score as an indicator of the standard of living of the household

As mentioned earlier, separate hazard models are applied to three age-specific mortality measures neonatal mortality, postneonatal mortality, and child mortality Neonatal and postneonatal mortality analyses use the 163,260 children in the subsample born in December 1979 or later for whom all predictor variables are defined The analysis of child mortality is based on the 138,414 children from the same subsample who survived the first year of life

Of course, some children were still living in one of these age periods at the time of the survey We cannot know whether such children will survive their current age period

Table 2 3 Percentage distribution of children by year of birth, child's sex, mother's age at childbirth, and background characteristics, for children born in December 1979 or later, by state

State	Year of birth			Sex is male	Mother s age at childbirth			Residence is urban	Mother is illiterate
	1979–83	1984–87	1988–93		<18	18–34	>34		
India	29	34	37	51	12	83	5	23	70
North									
Delhi	26	33	41	53	7	90	3	92	47
Haryana	27	32	41	52	9	87	4	24	70
Himachal Pradesh	29	34	37	52	6	90	4	8	52
Jammu region of Jammu and Kashmir	28	31	42	53	6	89	5	13	63
Punjab	28	32	39	53	4	93	3	26	57
Rajasthan	30	36	34	53	11	83	6	17	86
Central									
Madhya Pradesh	31	34	35	52	13	82	5	21	79
Uttar Pradesh	28	33	39	52	8	84	8	18	81
East									
Bihar	27	33	40	51	11	83	6	13	82
Orissa	28	33	39	52	12	84	4	15	67
West Bengal	31	35	34	50	17	79	4	23	59
Northeast									
Assam	29	35	36	51	15	80	4	9	65
West									
Goa	33	32	35	50	4	90	6	47	36
Gujarat	28	32	39	51	7	89	3	32	63
Maharashtra	29	33	38	51	18	80	2	38	54
South									
Andhra Pradesh	31	36	34	50	23	75	2	25	73
Karnataka	30	34	37	51	18	79	3	29	68
Kerala	32	32	36	51	6	90	4	26	17
Tamil Nadu	32	33	35	50	10	87	3	34	52

or not In life table and hazard model analysis, such cases are called 'censored', and their mortality is estimated statistically For further details on handling censored cases in life-table and hazard-model analysis, see Retherford and Choe (1993, chapters 7 and 8)

Table 2 3 gives descriptive statistics for these variables In the subsample we use for hazard regression analysis, numbers of children born during three time periods—1979–83, 1984–87, and 1988 or after—make up 29, 34, and 37 percent of the sample, respectively Fifty-one percent of children in the subsample are male, which is consistent with the normal sex ratio The proportion of male children tends to be high in northern states, however, especially in Delhi, Jammu region, Punjab, and Rajasthan In each of these states, 53 percent of children are male It is possible that some female children are missing from the birth histories in these states, especially if they died at very young ages The proportion of male children is quite low (50 percent) in West Bengal, Goa, Andhra Pradesh, and Tamil Nadu

Twelve percent of children were born to mothers under age 18 The proportion of children born to very young mothers is highest in Andhra Pradesh, Karnataka, Maharashtra, and West Bengal Only a small proportion of children were born to

Table 2 3, continued

State	Region caste/tribe of head				Mother is exposed to mass media	Have access to sanitary toilet	Use clean cooking fuel	Ownership score of household goods			
	Hindu non SC/ST	Hindu SC/ST	Muslim	Other religion				0–4	5–9	10–14	15–27
India	59	21	15	5	44	25	18	64	22	9	5
North											
Delhi	73	7	14	6	83	83	86	16	26	28	30
Haryana	59	28	6	7	56	23	18	33	34	21	12
Himachal Pradesh	68	28	2	2	61	10	13	48	31	17	4
Jammu Region of Jammu and Kashmir	52	22	21	5	67	14	23	37	32	20	11
Punjab	22	17	2	59	60	34	26	23	31	26	20
Rajasthan	53	40	6	2	26	17	9	67	20	9	4
Central											
Madhya Pradesh	57	35	6	2	36	17	13	65	20	11	5
Uttar Pradesh	62	19	18	1	30	19	10	64	24	8	4
East											
Bihar	63	16	19	1	25	14	13	75	17	5	3
Orissa	68	29	2	2	38	11	11	70	22	6	2
West Bengal	54	15	29	2	52	28	27	67	24	7	3
Northeast											
Assam	43	19	34	5	33	44	5	80	13	5	2
West											
Goa	63	6	7	24	83	40	46	34	25	18	23
Gujarat	67	21	10	2	48	30	32	57	25	11	7
Maharashtra	58	16	17	10	58	35	36	59	23	12	6
South											
Andhra Pradesh	67	20	10	3	64	22	19	69	19	8	4
Karnataka	64	18	15	3	61	26	17	67	20	8	5
Kerala	43	6	33	18	74	69	8	58	27	9	6
Tamil Nadu	67	20	7	6	70	29	21	61	23	11	4

mothers over age 34 Just under one-fourth of the children covered in this analysis live in urban areas, and just over three-fourths live in rural areas A large majority (70 percent) have mothers who are illiterate Eighty percent of children live in households where the head is Hindu, and 25 percent of these household heads belong to a scheduled caste or a scheduled tribe Fifteen percent of the children live in households where the head is Muslim and the remaining 5 percent live in households where the head is of another religion—primarily Sikh Buddhist, Jain, or Christian

Somewhat less than half of the children have mothers who listen to radio or watch television at least once a week One-fourth live in households that have access to a flush or pit toilet, and less than one-fifth live in households that use a relatively clean fuel for cooking—electricity, gas, biogas, coal, charcoal, or kerosene Scores measuring household ownership of consumer goods are generally low Sixty-four percent of children live in households with a score of less than 5, only 5 percent live in households with a score of 15 or higher

Table 2 3 shows that the distribution of children by socioeconomic background characteristics varies considerably by state Delhi, Goa, and Maharashtra have the largest proportions living in urban areas In Rajasthan, Bihar, and Uttar Pradesh, more than 80 percent of children have illiterate mothers By contrast, only 17 percent of children have illiterate mothers in Kerala

In Delhi, Himachal Pradesh, Orissa, Gujarat, Andhra Pradesh, and Tamil Nadu, more than two-thirds of sample children live in households whose heads are Hindu and do not belong to a scheduled caste or tribe In Punjab, Kerala, and Assam, less than half of the sample children live in such households The proportion of children living in households whose heads are Hindu and belong to a scheduled caste or tribe ranges from 7 percent or less in Delhi, Goa, and Kerala to more than 25 percent in Rajasthan, Orissa, Madhya Pradesh, Haryana, and Himachal Pradesh The proportion of sample children living in Muslim households ranges from 2 percent in Himachal Pradesh, Punjab, and Orissa to more than 20 percent in Assam, Kerala, West Bengal, and Jammu region In 10 of the 19 states, only 3 percent or less of children live in a household whose head is not Hindu or Muslim In Punjab, however, this group is a majority of 59 percent, mostly made up of children living in households whose heads are Sikhs The proportion is also substantial in Goa, Kerala, and Maharashtra, ranging from 10 to 24 percent Most of these household heads are Christian

In Delhi and Goa, more than 80 percent of children have mothers who listen to radio or watch television at least once a week, whereas in Bihar, Rajasthan, and Uttar Pradesh the proportion is 30 percent or less The household characteristics of access to a flush or pit toilet, use of a clean cooking fuel, and ownership of consumer goods show very large variations by state, reflecting diverse economic conditions More than 80 percent of sample children in Delhi live in households with access to a flush or pit toilet, compared with less than 20 percent in Himachal Pradesh, Orissa, Jammu region, Bihar, Rajasthan, Madhya Pradesh, and Uttar Pradesh Delhi also has by far the highest proportion of children living in households that use a clean cooking fuel, followed by Goa, the lowest proportions are in Assam, Kerala, Rajasthan, Uttar

Table 2 4 Additional variables used in the hazard models for estimating effects of demographic characteristics

Variable	Representation in hazard model
Birth order	Only for births of order 2 and higher four dummy variables indicating five categories (2 3 4 5 ≥6)
Previous birth interval	Only for births of order 2 and higher one dummy variable indicating whether interval is <24 months or not (yes no)
Whether child has deceased older sibling	Only for births of order 2 and higher one dummy variable (yes no)
Following birth	A set of dummy variables indicating monthly status of whether a following birth has occurred or not (yes no)

Table 2 5 Percentage distribution of children by additional variables included in the hazard models for estimating effects of demographic characteristics, for births during the 12 years before the NFHS, by state

State	Mother s age at childbirth			Number of children
	<18	18–19	≥20	
Birth order 1				
India	34	26	40	43 636
North				
Delhi	18	23	59	1 842
Haryana	27	31	42	1 536
Himachal Pradesh	17	30	53	1 413
Jammu region of Jammu and Kashmir	17	23	60	1 388
Punjab	11	26	63	1 545
Rajasthan	32	26	42	2 524
Central				
Madhya Pradesh	40	27	33	2 921
Uttar Pradesh	29	30	40	5 487
East				
Bihar	38	28	34	2 898
Orissa	34	26	40	2 141
West Bengal	45	24	31	1 980
Northeast				
Assam	48	20	33	1 513
West				
Goa	8	9	83	1 390
Gujarat	19	28	53	1 875
Maharashtra	41	23	36	2 028
South				
Andhra Pradesh	54	21	25	1 882
Karnataka	43	24	33	2 174
Kerala	13	20	67	2 085
Tamil Nadu	23	26	51	1 786

Pradesh, and Orissa In Assam, Andhra Pradesh, Karnataka, Rajasthan, and the three eastern states of Bihar, Orissa, and West Bengal, at least two-thirds of children live in households with ownership-of-consumer-goods scores of less than 5 By contrast, in Delhi, Goa, and Punjab, at least 20 percent of children live in households with scores of 15 or higher

The adjusted effects of demographic characteristics are estimated from hazard models that include the variables listed in Table 2 2 and Table 2 4 as predictor variables Table 2 5 shows descriptive statistics of the demographic variables Women begin childbearing early in India In the country as a whole, 34 percent of first-born children were born to mothers under age 18 Children in this category range from more than 40 percent in Andhra Pradesh, Assam, West Bengal, Karnataka, Maharashtra, and Madhya Pradesh to less than 15 percent in Goa, Punjab, and Kerala The fertility of Indian women is also characterized by rapid family building In the country as a whole, one-third of second and higher-order births occurred within 24 months of the previous birth This proportion does not vary much from state to state

Table 2 5, continued

State	Birth order					Mother's age at childbirth			% previous birth interval	% with deceased older siblings	Number of children
	2	3	4	5	≥6	<20	20–34	≥35	<24 months		
Birth order 2 or higher											
India	31	24	17	11	17	13	80	7	33	34	118 506
North											
Delhi	39	26	16	8	11	8	87	5	34	23	4 150
Haryana	33	26	17	10	14	11	84	5	36	32	4 182
Himachal Pradesh	37	27	17	9	10	8	86	5	33	25	3 253
Jammu region of Jammu and Kashmir	32	25	17	12	15	8	86	6	33	23	3 507
Punjab	38	28	17	9	8	6	90	4	37	19	3 839
Rajasthan	29	28	18	12	16	12	79	8	32	25	7 787
Central											
Madhya Pradesh	29	24	17	12	18	15	79	6	33	38	9 047
Uttar Pradesh	25	21	17	13	24	8	81	10	34	45	19 464
East											
Bihar	27	23	18	13	18	11	81	8	30	36	9 157
Orissa	33	25	17	10	14	13	82	5	30	37	5 688
West Bengal	32	23	16	11	18	17	77	6	29	34	5 320
Northeast											
Assam	25	22	17	13	23	16	78	6	36	38	4 938
West											
Goa	41	27	16	8	9	6	86	8	31	16	2 711
Gujarat	36	26	17	10	11	9	86	5	34	28	4 543
Maharashtra	37	27	16	9	11	21	76	2	34	25	4 761
South											
Andhra Pradesh	38	28	16	9	10	24	72	3	28	26	4 365
Karnataka	35	25	16	10	15	20	75	5	33	32	5 573
Kerala	49	25	10	6	10	6	87	6	29	14	3 501
Tamil Nadu	41	27	14	9	9	11	84	5	30	28	3 574

The hazard models used to estimate the effects of mother's health-care characteristics on neonatal mortality are based on variables listed in Table 2 2 plus additional variables listed in Table 2 6 Table 2 7 shows the percentage distribution of these additional variables among children born during the four-year period before the NFHS In India as a whole, about half of children have mothers who made antenatal visits to doctors or health centres, and slightly more than half have mothers who received the recommended two doses of tetanus vaccine during pregnancy Level of antenatal care varies greatly from state to state, however In general, antenatal care is relatively good in the southern and western states and poor in most states of the central, east, and northeast regions Exceptions include West Bengal where the prevalence of antenatal care is somewhat higher than in the other eastern states States in the north show large variations in antenatal care In Delhi and Punjab the prevalence of antenatal care is very high, but in Rajasthan it is very low

Table 2 6 Additional variables used in the hazard models for estimating effects of mother's health-care characteristics

Variable	Representation in hazard model
Number of antenatal visits by mother	Quantitative variable
Number of tetanus injections received during pregnancy	One dummy variable (less than two injections two or more injections)
Place of delivery of child	One dummy variable (medical facility home)

Table 2 7 Percentage distribution of children by additional variables included in the hazard models for estimating effects of mother's health-care characteristics, for births during the four-year period before the NFHS, by state

State	Percent with mother with any antenatal care	Percent with mother with ≥2 tetanus injections	Percent delivered in medical institutions	Number of children
India	49 3	53 3	25 4	55 571
North				
Delhi	80 9	72 9	44 8	1 987
Haryana	67 3	63 5	16 7	1 841
Himachal Pradesh	72 7	47 2	15 9	1 720
Jammu region of Jammu and Kashmir	78 5	68 8	21 4	1 596
Punjab	86 6	83 1	24 9	1 619
Rajasthan	23 9	28 2	11 3	3 438
Central				
Madhya Pradesh	36 3	42 7	16 0	4 097
Uttar Pradesh	30 1	36 4	11 2	9 615
East				
Bihar	27 3	30 2	12 3	3 799
Orissa	38 9	53 9	14 6	2 362
West Bengal	68 3	70 0	31 5	2 494
Northeast				
Assam	44 3	32 9	11 2	2 341
West				
Goa	94 0	84 8	87 0	1 425
Gujarat	51 1	63 1	35 8	2 074
Maharashtra	69 6	71 4	43 5	2 576
South				
Andhra Pradesh	66 8	75 1	32 8	2 078
Karnataka	64 7	69 2	37 7	2 831
Kerala	97 3	91 1	86 7	1 990
Tamil Nadu	78 1	90 1	63 6	1 852

In India as a whole, about three-quarters of children were delivered at home More than half were delivered at medical facilities in Kerala, Goa, and Tamil Nadu, and nearly half were delivered at medical facilities in Delhi and Maharashtra

The reliability of mortality estimates calculated from retrospective birth histories depends on how completely births and deaths of children are reported and how

accurately the dates of birth and ages at death are recorded Generally, the NFHS data are considered reasonably accurate (IIPS 1995) Some noticeable exceptions will be discussed in the course of this report The national and state NFHS reports contain additional details about the accuracy of the data

It should be noted that the socioeconomic background characteristics used for this analysis describe conditions at the time of the survey, which may be different from the conditions at the time of birth of each child For example, it is possible that women have changed their residence and that their housing characteristics have changed since the birth of some children included in the analysis For such children, the measurement of background characteristics will not be accurate, and the resulting effects of those characteristics will be somewhat biased The extent of such changes should not be large enough, however, to seriously affect the estimated relationships for populations of children as a whole

3 Cohort Life-Table Estimates of Mortality before Age Five

This chapter gives commonly used indicators of mortality before age five, based on cohort life-table computations, as basic measures of infant and child mortality Cohort life tables are computed by following the children in our subsample from birth and computing the probabilities of dying during consecutive age intervals, using the traditional actuarial life-table method The life-table computation uses age intervals of 0 months, 1–2 months, 3–5 months, 6–8 months, 9–11 months, 12–17 months, 18–23 months, 24–35 months, 36–47 months, and 48–59 months As mentioned earlier, the life-table computation is limited to children born since December 1979 We first calculate probabilities of survival ($l(x)$ values in conventional life-table notation) at ages 1, 3, 6, 9, 12, 18, 24, 36, 48, and 60 months in terms of the number of survivors per 1,000 births (i e , the life table radix, l(0), is set to 1,000) Age-specific cohort mortality measures (deaths per 1,000) can then be computed from these probabilities of survival as follows

Neonatal mortality	$1{,}000 - l(1)$
Postneonatal mortality	$l(1) - l(12)$
Infant mortality	$1{,}000 - l\,(12)$
Child mortality	$1{,}000 * [l(12) - l(60)] / l(12)$
Under-five mortality	$1{,}000 - l\,(60)$

Table 3 1 shows probabilities of survival to selected ages, and Table 3 2 shows mortality for selected age intervals estimated by cohort life tables for India and for 19 states Under-five mortality is quite high in India but varies widely by state In the country as a whole during the 12-year period before the survey, 121 per 1,000 births are estimated to have died before age five In Uttar Pradesh, Madhya Pradesh, Assam, Orissa, and Bihar, estimated under-five mortality is even higher, ranging from 137 to 166 per 1,000 births By contrast, under-five mortality in Kerala and Goa is less than 50 per 1,000 births Other states with levels of under-five mortality less than 100 per 1,000 births are Punjab, Maharashtra, Jammu region, Delhi, Himachal Pradesh, Tamil Nadu, and Andhra Pradesh

Table 3 1 Life table estimates of probabilities of survival to selected ages up to age five years for births during the 12 years before the NFHS, by state

State	Survival probability by age in months										
	0	1	3	6	9	12	18	24	36	48	60
India	1 000	946	936	928	919	912	903	899	891	884	879
North											
Delhi	1 000	956	958	951	943	936	931	929	925	923	920
Haryana	1 000	955	945	937	925	918	910	905	898	894	890
Himachal Pradesh	1 000	963	956	945	936	934	928	925	922	917	914
Jammu Region of Jammu and Kashmir	1 000	965	958	951	947	943	938	934	929	926	924
Punjab	1 000	967	958	952	947	944	936	935	931	928	927
Rajasthan	1 000	960	951	943	933	927	914	912	904	898	896
Central											
Madhya Pradesh	1 000	943	929	918	908	901	886	881	871	861	855
Uttar Pradesh	1 000	928	915	904	891	880	866	861	850	840	834
East											
Bihar	1 000	943	933	924	914	902	893	888	880	870	863
Orissa	1 000	934	919	904	892	873	870	869	864	859	856
West Bengal	1 000	944	935	928	922	918	913	908	901	894	893
Northeast											
Assam	1 000	945	930	919	911	907	897	890	877	862	855
West											
Goa	1 000	974	969	968	965	963	961	960	957	955	955
Gujarat	1 000	951	941	936	929	924	914	911	901	896	894
Maharashtra	1 000	963	954	950	947	944	938	937	930	927	923
South											
Andhra Pradesh	1 000	951	942	934	928	924	918	917	912	904	902
Karnataka	1 000	949	939	933	927	923	915	912	905	890	895
Kerala	1 000	977	974	972	969	968	965	964	961	959	958
Tamil Nadu	1 000	954	946	940	934	929	922	918	912	908	905

Notes Survival probabilities are expressed as numbers of survivors per 1 000 births Results are not shown for the northeastern states of Arunachal Pradesh Manipur Meghalaya Mizoram Nagaland and Tripura See text

Figure 3 1 shows estimated infant (0–11 months) and child (12–59 months) mortality for India and for individual states, ordered by the level of infant mortality Consistent with findings in the basic NFHS reports, Orissa has the highest level of infant mortality of any state, but a relatively low level of child mortality, ranking fifth from the lowest among the 19 states analysed here Assam, in contrast, has an unusually high level of child mortality compared with other states that have a similar level of infant mortality Although some studies have cited factors that could explain the exceptionally high level of infant mortality in Orissa (Institute for Research in Medical Statistics 1993), the age pattern of mortality suggests that there may be some misreporting of age at death, resulting in overestimation of infant mortality and underestimation of child mortality According to the life-table estimates for Orissa shown in Table 3 1, the survival rate drops by an unusually large magnitude between ages 9 and 12 months, followed by only a small drop after age 12 months This suggests that some child deaths that occur at ages 12–15 months are reported as infant deaths

Table 3 2 Life table estimates of mortality for selected age intervals, for births during the 12 years before the NFHS, by state

State	Neonatal mortality	Postneonatal mortality	Infant mortality	Child mortality	Under 5 mortality
India	54	35	88	36	121
North					
Delhi	35	29	64	17	80
Haryana	45	37	82	30	110
Himachal Pradesh	37	29	66	21	86
Jammu region of Jammu and Kashmir	35	22	57	21	77
Punjab	33	23	56	18	73
Rajasthan	41	33	73	33	104
Central					
Madhya Pradesh	57	42	99	51	145
Uttar Pradesh	73	48	120	52	166
East					
Bihar	57	41	98	44	137
Orissa	66	61	127	20	144
West Bengal	56	26	82	28	108
Northeast					
Assam	55	38	93	58	145
West					
Goa	26	11	37	8	45
Gujarat	49	28	77	32	106
Maharashtra	37	19	56	22	77
South					
Andhra Pradesh	50	26	76	25	98
Karnataka	51	26	77	30	105
Kerala	23	9	32	10	42
Tamil Nadu	46	24	71	26	95

Note Mortality is specified as the number of deaths per 1 000 children at risk

occurring at ages 9–11 months, resulting in an overestimation of the infant mortality rate and an underestimation of the child mortality rate

Figure 3 2 shows neonatal and postneonatal mortality for India and for individual states, ordered by the level of infant mortality Normally, neonatal mortality is considerably higher than postneonatal mortality, but for Delhi, Himachal Pradesh, Rajasthan, Haryana, and Orissa, the two mortality estimates appear unusually close It is likely that neonatal mortality is underreported in these states, postneonatal mortality is overreported, or both Neonatal mortality can be underreported if children who die during the neonatal period are omitted from birth histories Postneonatal mortality can be overreported by misreporting age at death, specifically by reporting deaths that occur shortly after age 12 months as occurring before 12 months

The age pattern of mortality varies according to the level of mortality Figure 3 3 shows life-table estimates of survivors at selected ages per 1,000 births for India and for two states Uttar Pradesh, which has the highest under-five mortality, and Kerala, which has the lowest The figure shows that mortality differences between states are much larger at older ages than at younger ages In Uttar Pradesh the survival

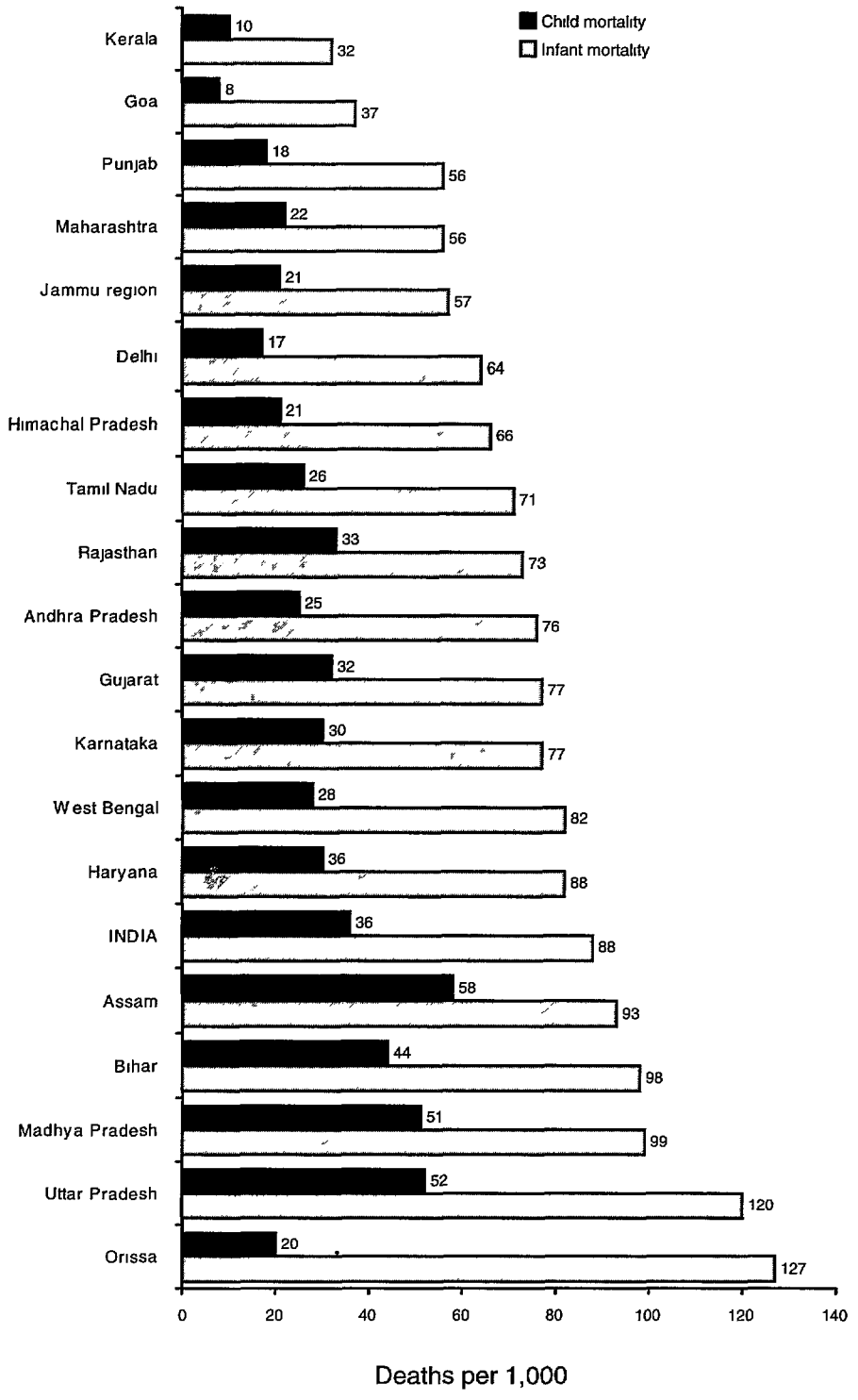

Figure 3 1 Cohort life table estimates of infant and child mortality for births during the 12 years before the NFHS, by state

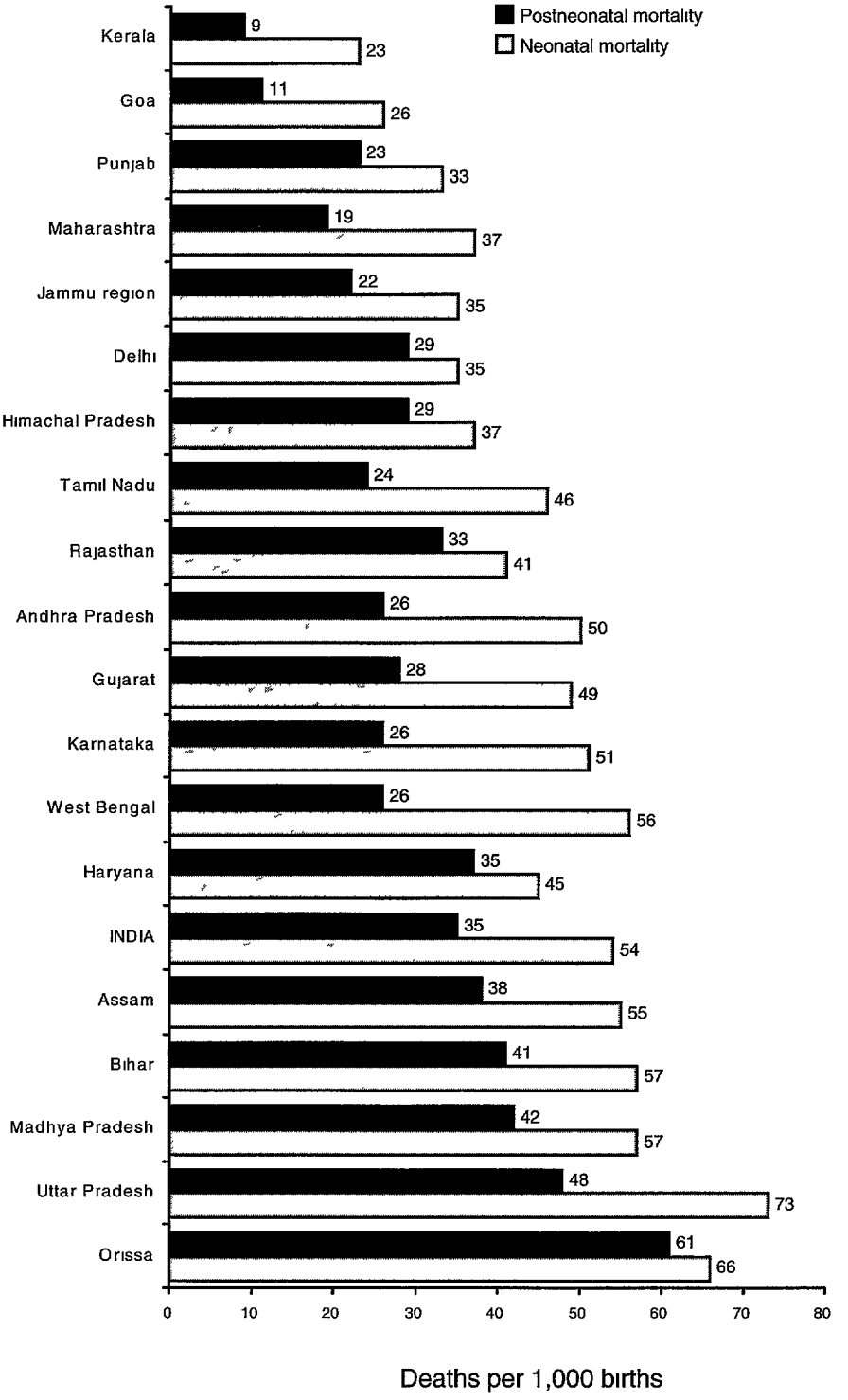

Figure 3 2 Cohort life table estimates of neonatal and postneonatal mortality for births during the 12 years before the NFHS, by state

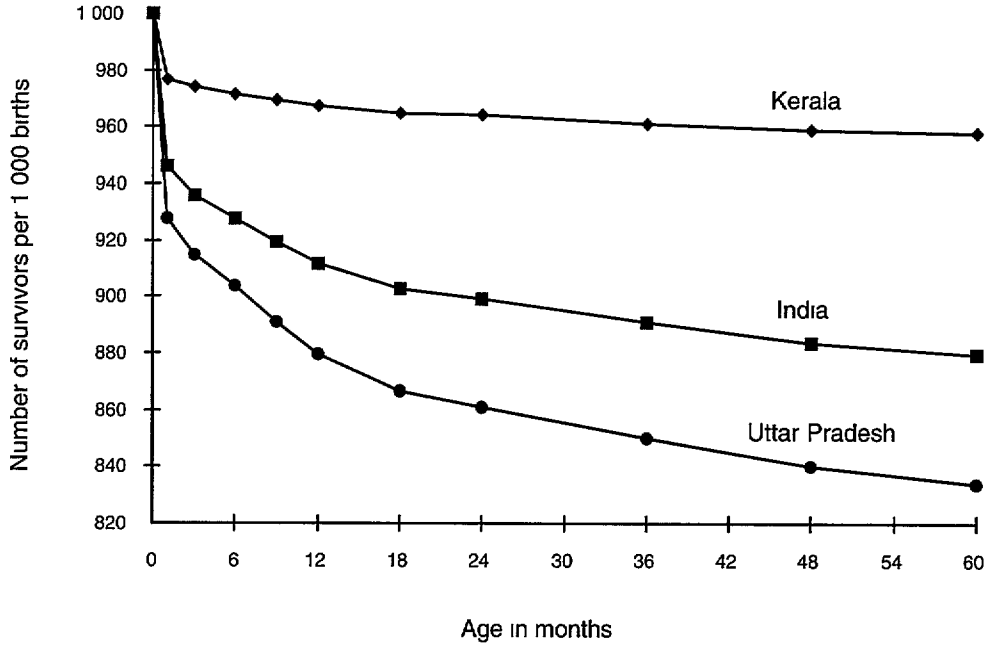

Figure 3 3 Life table estimates of survivors at selected ages per 1,000 births, for Kerala, India, and Uttar Pradesh

ratio drops steeply throughout the five-year period, but in Kerala the survival ratio changes very little after the neonatal period This is as expected because many of the risks of postneonatal and child mortality can be reduced by improvements in environment and health-care behaviour, whereas many risks of neonatal mortality have genetic origins and are difficult to reduce

In summary, infant and child mortality in India tend to be high Out of 1,000 live births in the country as a whole, 88 children are expected to die during the first year of life and 121 before reaching age five There are large variations in infant and child mortality by state, particularly among children at older ages Under-five mortality in Uttar Pradesh, for example, is nearly four times the level in Kerala Although the NFHS data on child deaths and ages at death are considered very good, in some states reporting of deaths may not be complete, and reported ages at death may be inaccurate For example, neonatal mortality may be underreported in some states, and the very high level of infant mortality in Orissa may be due partly to overestimation

4 Effects of Child's Year of Birth and Sex on Infant and Child Mortality

In this chapter we examine the unadjusted and adjusted effects of child's year of birth and sex on neonatal, postneonatal, infant, and child mortality The unadjusted effects are estimated from hazard models that include only the one factor under examination The adjusted effects are estimated from models that include the variable under examination (child's year of birth or sex) plus socioeconomic characteristics and mother's age at childbirth as predictor variables Chapter 2 provides a full description of these variables and their descriptive statistics (Tables 2 2 and 2 3) Estimates of neonatal, postneonatal, and infant mortality are expressed as number of deaths during a specified age interval per 1,000 births Estimates of child mortality are expressed as number of deaths per 1,000 children who survive the first year of life As discussed in Chapter 2, neonatal mortality, postneonatal mortality, and child mortality are estimated by three separate sets of hazard models, and infant mortality is estimated as the sum of neonatal and postneonatal mortality

CHILD'S YEAR OF BIRTH

The effect of child's year of birth as estimated from a hazard model can be interpreted as a mortality trend, but with two cautionary notes As discussed earlier, mortality in the distant past is based on a somewhat biased sample due to truncation of mother's age at childbirth There are also indications that the NFHS data suffer from some underreporting of deaths that occurred in the past especially deaths of very young children These data deficiencies are likely to result in a slight underestimation of any mortality decline, especially for neonatal mortality in some states The unadjusted and adjusted effects of year of birth are nearly identical, so we present and discuss only the adjusted effects here

As shown in Table 4 1, neonatal mortality declined substantially in India during the 1980s (18 percent in nine years) It declined in every state except Rajasthan,

Table 4 1 Adjusted neonatal, postneonatal, infant, and child mortality, by year of birth and by state

State	Year of birth							
	Neonatal mortality				Postneonatal mortality			
	1981	1984	1987	1990	1981	1984	1987	1990
India	60*	56*	53*	49	42*	38*	33*	30*
North								
Delhi	43	38*	34*	31*	28	29	29	30
Haryana	54*	49*	44*	40*	36	37	37	37
Himachal Pradesh	43	39	36	33	40*	33*	27*	22*
Jammu region of Jammu and Kashmir	46*	40*	34*	30*	35*	27*	20*	15*
Punjab	36	34	33	31	27	25	23	21
Rajasthan	40	40	41	41	29	31	34	36
Central								
Madhya Pradesh	65*	60*	55*	51*	58*	47*	38*	31
Uttar Pradesh	87*	78*	70*	63*	61*	53*	46*	40*
East								
Bihar	61	58	56	54	52*	45*	40*	34*
Orissa	69	67	66	64	85*	70*	58	48*
West Bengal	64*	59*	54*	49*	32*	28*	25*	22*
Northeast								
Assam	58	56	55	53	42	39	37	34
West								
Goa	34*	29*	25*	21*	11	11	11	11
Gujarat	56	52	48	44	29	28	27	26
Maharashtra	38	37	37	36	25*	21*	18*	16*
South								
Andhra Pradesh	53	51	49	46	30	27	25	23
Karnataka	58*	53*	49*	45*	40*	31*	24*	18*
Kerala	29	25	22	20	10	9	9	8
Tamil Nadu	48	47	46	45	30	26*	23*	20*

State	Infant mortality				Child mortality			
	1981	1984	1987	1990	1981	1984	1987	1990
India	102*	94*	86	79*	44*	38*	33*	29*
North								
Delhi	71[n]	67[n]	63[n]	60[n]	16	17	17	17
Haryana	90[n]	85[n]	81[n]	77[n]	36	32	28	25
Himachal Pradesh	83[p]	72[p]	63[p]	55[p]	34	24*	18*	13
Jammu region of Jammu and Kashmir	82*	67*	55*	45	35*	25*	18*	13*
Punjab	63	59	55	52	24	20	17	14
Rajasthan	69	71	74	77	35	34	33	32
Central								
Madhya Pradesh	123	107*	94*	82*	66*	55*	46	39*
Uttar Pradesh	148*	131*	117*	103*	69*	57	48*	40*
East								
Bihar	113[p]	104[p]	96[p]	89[p]	54*	48*	41*	36*
Orissa	154[p]	137p[p]	123[p]	112[p]	20	20	20	20
West Bengal	96*	87*	79*	72*	34	29	25	22
Northeast								
Assam	100	96	91	87	67	61	55	50
West								
Goa	45[n]	40[n]	36[n]	32[n]	10	9	7	7
Gujarat	86[n]	80[n]	75[n]	70[n]	28	31	34	36
Maharashtra	62[p]	59[p]	55[p]	52[p]	27	24	21	19
South								
Andhra Pradesh	83	78	74	69	34*	27*	21*	17*
Karnataka	98*	84*	73*	64*	43*	34	27*	21*
Kerala	38	35	31	28	13	11	9	7
Tamil Nadu	78[p]	73[p]	69[p]	65[p]	44	30*	21*	14*

where it has remained virtually constant As mentioned earlier, the Rajasthan data may suffer from some unreported deaths, particularly for earlier birth cohorts, which would result in an underestimation of mortality decline The decline in neonatal mortality is statistically significant for India and for eight states Delhi, Haryana, Jammu region, Madhya Pradesh, Uttar Pradesh, West Bengal, Goa, and Karnataka The decline is substantial but not statistically significant in Himachal Pradesh, Gujarat, and Kerala The states with the largest percentage decline in neonatal mortality during the 1980s are Goa, Jammu region, Kerala, Uttar Pradesh, and Delhi

Postneonatal mortality shows a decline of slightly greater magnitude than neonatal mortality For India as a whole, Table 4 1 shows that adjusted postneonatal mortality declined by 29 percent in nine years (from 42 deaths per 1,000 births in 1981 to 30 deaths per 1,000 births in 1990) Postneonatal mortality declined in every state except in Rajasthan, where it increased, and in Delhi, Haryana, and Goa, where it remained virtually constant The unexpected pattern in Rajasthan may be due to erroneous data The decline is statistically significant for India and for 10 states Himachal Pradesh, Jammu region, Madhya Pradesh, Uttar Pradesh, Bihar, Orissa, West Bengal, Maharashtra, Karnataka, and Tamil Nadu In three other states (Punjab, Assam, and Andhra Pradesh), the decline is substantial but not statistically significant The states showing the sharpest percentage decline in postneonatal mortality during the 1980s are Jammu region, Karnataka, Madhya Pradesh, Himachal Pradesh, and Orissa

Combining neonatal and postneonatal mortality, adjusted infant mortality in India declined by 23 percent in nine years (from 102 to 79 deaths per 1,000 births) It

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Notes to Table 4 1

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted rates the hazard regressions include the following control variables child s sex mother s age at childbirth and its square residence mother s literacy religion caste/ tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) When calculating adjusted rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not postneonatal (age 1–11 months) mortality

[P]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

also declined in most states These declines are statistically significant for India and for most states [1]

The rate of decline in child mortality is similar to the rate of decline in postneonatal mortality Adjusted child mortality in India declined by 34 percent in nine years (from 44 to 29 deaths per 1,000 births) The decline is statistically significant for India and for eight states Himachal Pradesh, Jammu region, Madhya Pradesh, Uttar Pradesh, Bihar, Andhra Pradesh, Karnataka, and Tamil Nadu It is substantial but not statistically significant in Haryana, Punjab, West Bengal, and Assam The states with the greatest percentage decline in child mortality during the 1980s are Tamil Nadu, Jammu region, Himachal Pradesh, Karnataka, Andhra Pradesh, and Kerala By contrast, child mortality does not appear to have declined in Gujarat, Delhi, or Orissa

CHILD'S SEX

In most populations, male mortality is higher than female mortality at almost all ages (Heligman 1983, United Nations Secretariat 1988) In South Asia, however, female mortality is higher than male mortality at many ages (Ghosh 1987, Office of the Registrar General, India 1994, Pebley and Amin 1991, Preston 1990), especially during the postneonatal and childhood periods Excess female mortality at postneonatal and childhood ages in India and other South Asian countries is believed to result from son preference, which leads to differential treatment of sons and daughters in terms of food allocation, prevention of diseases and accidents, and treatment of illness (United Nations 1998) In India, many researchers have documented evidence of son preference and discrimination in caring for sons and daughters (Basu 1989, Das Gupta 1987, Muhuri and Preston 1991) Studies on infant and child mortality in India also document large variations among states in the degree of son preference and associated excess female child mortality (Arnold, Choe, and Roy 1998, IIPS 1995, Mutharayappa et al 1997)

As discussed earlier, biological differences between the sexes tend to result in higher male mortality than female mortality, while parental preference for male children tends to result in higher female mortality Biological conditions affect mortality

1 In Table 4 1 and subsequent tables infant mortality is calculated as the sum of neonatal mortality and postneonatal mortality which are estimated by separate hazard models and multiple classification analysis We interpret the effect of a factor to be statistically significant at the 5 percent level if that factor is statistically significant for at least one model In Table 4 1 and the following tables an asterisk (*) indicates that the underlying factor is statistically significant in both the neonatal and the postneonatal mortality models An n indicates that the underlying factor is statistically significant in the neonatal mortality model only and a p indicates that the underlying factor is statistically significant in the postneonatal mortality model only

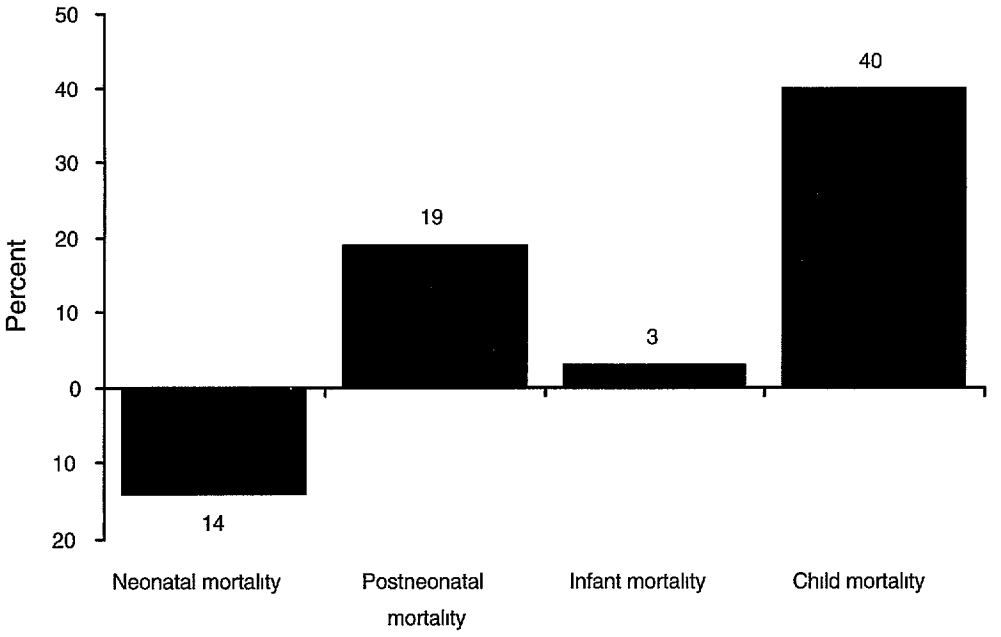

Figure 4 1 Percentage excess female mortality in India, by age

most strongly during the neonatal period, and parental care affects mortality most strongly during early childhood In states with strong son preference, we would expect somewhat higher male mortality than female mortality during the neonatal period and excess female mortality among children at older ages

Our analysis shows that there are hardly any differences in unadjusted and adjusted sex differentials in mortality, either for India or for individual states This is not surprising because child's sex is not correlated with any of the socioeconomic characteristics used as predictor variables in this analysis Our discussion of sex differentials will, therefore, be limited to the adjusted mortality estimates

Figure 4 1 shows that female mortality in India is 14 percent lowerr than male mortality during the neonatal period, which is consistent with expectations During the postneonatal period, however female mortality is 19 percent higher than male mortality Combining neonatal and postneonatal mortality infant mortality shows little difference by sex Females are at the greatest disadvantage at ages 1–4 when their risk of dying exceeds that of males by 40 percent

Table 4 2 shows adjusted neonatal, postneonatal, infant, and child mortality by sex for India and for 19 states The adjusted effect of child's sex on infant and child mortality varies by child's age and by state During the neonatal period, male mortality is higher than female mortality in every state, but the extent of the differences and their statistical significance vary Excess male neonatal mortality is large and statistically

Table 4 2 Adjusted neonatal, postneonatal, infant, and child mortality, by child's sex and by state

State	Child s sex			
	Neonatal mortality		Postneonatal mortality	
	Female†	Male	Female†	Male
India	50	58*	38	32*
North				
Delhi	34	36	34	25*
Haryana	43	48	47	30*
Himachal Pradesh	33	42	34	25
Jammu region of Jammu and Kashmir	33	37	27	18*
Punjab	31	35	25	21
Rajasthan	38	43	38	29*
Central				
Madhya Pradesh	53	62*	46	38
Uttar Pradesh	71	74	57	41*
East				
Bihar	51	63*	45	37*
Orissa	64	68	59	63
West Bengal	54	57	25	28
Northeast				
Assam	49	62*	38	37
West				
Goa	21	33	11	11
Gujarat	44	54	30	25
Maharashtra	30	45*	21	18
South				
Andhra Pradesh	44	56*	27	25
Karnataka	45	56*	27	25
Kerala	19	28*	8	10
Tamil Nadu	41	52*	22	26

State	Infant mortality		Child mortality	
	Female†	Male	Female†	Male
India	87	90*	42	30*
North				
Delhi	68	61[p]	22	13*
Haryana	89	78[p]	43	21*
Himachal Pradesh	67	67	26	17
Jammu region of Jammu and Kashmir	60	55[p]	27	16*
Punjab	56	57	21	15
Rajasthan	76	71[p]	41	28*
Central				
Madhya Pradesh	99	100*	56	47*
Uttar Pradesh	128	115[p]	68	40*
East				
Bihar	96	100*	54	36*
Orissa	123	130	24	16*
West Bengal	79	85	33	23*
Northeast				
Assam	87	99n	60	56
West				
Goa	32	44[n]	8	8
Gujarat	74	79	38	28*
Maharashtra	51	63[n]	25	19
South				
Andhra Pradesh	71	81[n]	27	23
Karnataka	72	81[n]	34	27
Kerala	28	38[n]	9	10
Tamil Nadu	63	79[n]	24	28

significant in all states in the south but small and not statistically significant in all states in the north In other regions, Madhya Pradesh, Bihar, Assam, Goa, and Maharashtra show a large and statistically significant sex differential in neonatal mortality, whereas in Uttar Pradesh, Orissa, and West Bengal, the sex differential is small and not statistically significant

Sex differentials in postneonatal mortality show contrasting patterns Tamil Nadu, Kerala, West Bengal, and Orissa show excess male postneonatal mortality In all other states, female postneonatal mortality is the same as or higher than male postneonatal mortality Postneonatal mortality is higher for females than for males in all northern and central states and in Bihar in the east The difference is statistically significant in all of these states except Himachal Pradesh and Punjab In the remaining states, the sex differential in postneonatal mortality is small and not statistically significant

Because neonatal and postneonatal mortality typically have opposite patterns, infant mortality in most states shows little difference by sex Infant mortality is substantially higher for females in Haryana and Uttar Pradesh but higher for males in Kerala, Tamil Nadu, and Goa

In Tamil Nadu and Kerala, child mortality is higher for males than for females, and in Goa child mortality is identical for both sexes As shown in Figure 4 2, child mortality is higher for females in all other states, although the degree of excess female mortality varies widely—from 7 percent in Assam to 105 percent in Haryana None of the states in the southern region show statistically significant excess female child mortality Among the five states with the greatest excess female child mortality, four are in the north Haryana, Delhi, Jammu region, and Himachal Pradesh Although the NFHS data do not show a statistically significant excess in female child

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Notes to Table 4 2

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted rates the hazard regressions include the following control variables year of birth mother s age at childbirth and its square residence mother s literacy religion caste/tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) When calculating adjusted rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

†Reference category in the underlying hazard regression

*The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

[n]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not postneonatal (age 1–11 months) mortality

[p]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

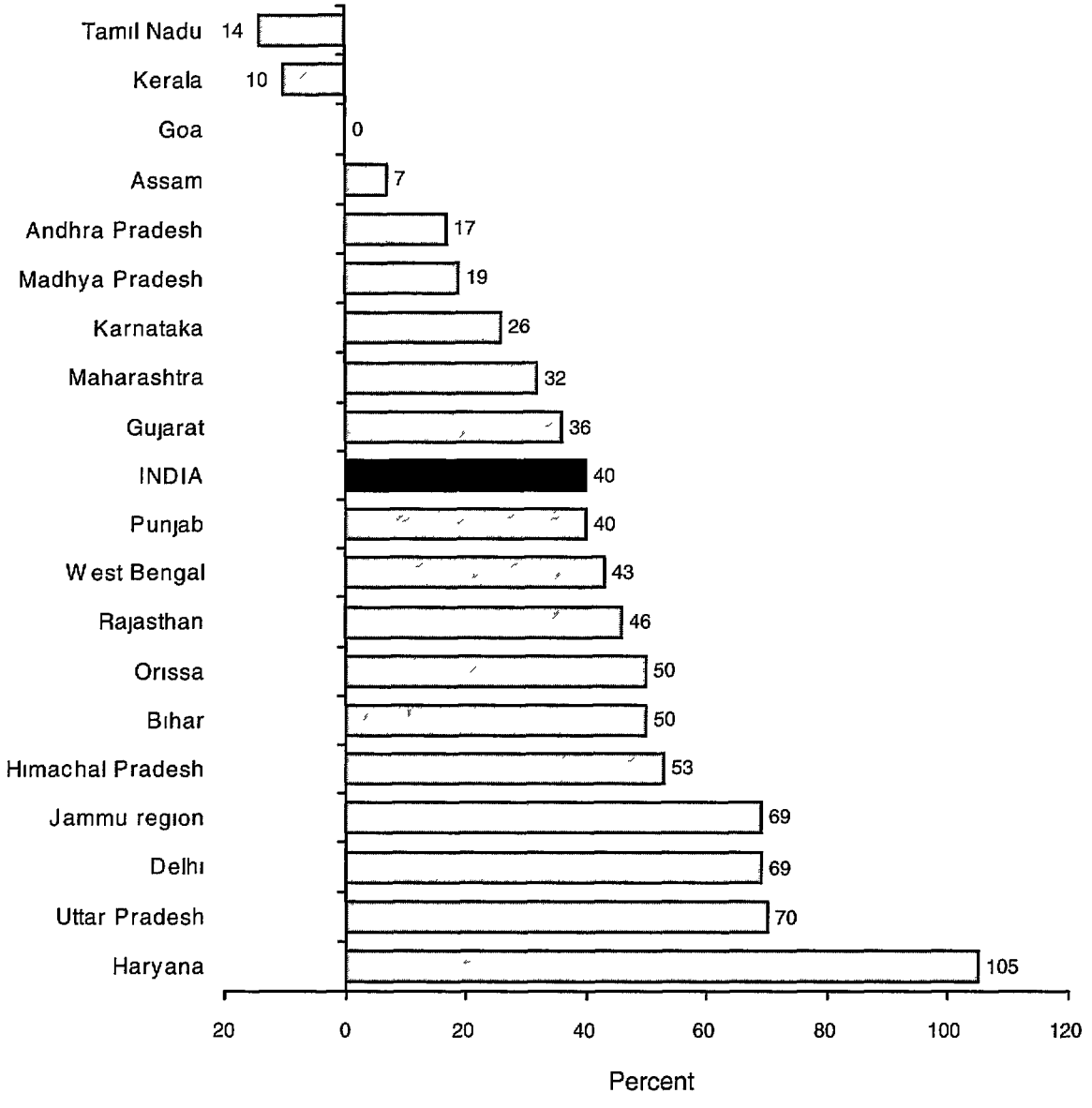

Figure 4 2 Percentage adjusted excess female child mortality, by state

mortality in Himachal Pradesh or Punjab, these states have unusually large proportions of male children, suggesting that some female children who have died are missing from the birth histories collected during the survey

Our results show that excess female mortality tends to be higher in northern states, where the traditional family system is strongly patriarchal, than in southern states with less of a patriarchal tradition The strong patriarchal tradition in northern India includes customs related to marriage, living arrangements, support for elderly parents, and funeral rituals that assign many privileges and duties exclusively to sons (Arnold, Choe, and Roy 1998, Caldwell, Reddy, and Caldwell 1989, Dyson and Moore

1983, Kapadia 1966, Karve 1965, Kishor 1995, Koenig and Foo 1992) At marriage, dowry payments impose a heavy financial burden on the parents of girls, while after marriage wives typically move in with their husbands' families, weakening ties with their own parents Such customs may cause parents to desire more sons than daughters and to discriminate against daughters, and this in turn may result in excess female postneonatal and child mortality

It will be difficult to eliminate son preference and associated excess female child mortality quickly in India because long-standing traditions are slow to change Some observers have noted, however, that the degree of son preference may be declining somewhat (Visaria 1994) Maternal and child health programmes that provide supplemental nutrition and basic health care to all children, regardless of sex, may also help reduce excess female child mortality (Pebley and Amin 1991) In areas with high excess female child mortality, family health programmes should pay particular attention to providing basic health care and supplemental nutrition to girls

5 Effects of Socioeconomic Characteristics on Infant and Child Mortality

In this chapter we examine the unadjusted and adjusted effects of socioeconomic characteristics on neonatal, postneonatal, infant, and child mortality We estimate the adjusted effects of socioeconomic variables using hazard models with the predictor variables listed in Table 2 2 We expect that the adjusted effects of most socioeconomic variables will be smaller than the unadjusted effects because the socioeconomic characteristics we examine tend to be correlated with each other For example, women who live in urban areas are more likely to be literate, to have access to a flush or pit toilet, to use clean cooking fuel, and to own a relatively large number of household goods

URBAN/RURAL RESIDENCE

In developing countries, living conditions are generally worse in rural areas than in urban areas, and health-care facilities are less readily available and tend to be of poorer quality These differences usually result in higher infant and child mortality in rural areas than in urban areas Most of the results reported here follow this general pattern, but many results are not statistically significant because NFHS samples in urban areas tend to be small

As shown in Table 5 1, unadjusted neonatal mortality is higher in rural areas than in urban areas in all states but Goa The unadjusted effect of urban/rural residence is quite large and statistically significant for India and for 12 states In the remaining seven states, unadjusted neonatal mortality is higher in rural areas than in urban areas, but the differences are not statistically significant The adjusted effects are much smaller than the unadjusted effects For India as a whole, the adjusted effect is negligible and not statistically significant It is statistically significant in only three states Haryana, Uttar Pradesh, and Orissa Adjusted neonatal mortality is substantially higher in rural areas than in urban areas in Punjab and Bihar, but the differences

are not statistically significant In Goa, adjusted neonatal mortality is higher in urban areas than in rural areas, and the difference is statistically significant The results for Goa should be interpreted with caution, however, because they are based on a very small number of deaths due to low levels of fertility and mortality in that state Adjusted neonatal mortality is higher in urban areas than in rural areas in a few other states, but the differences are not statistically significant

Unadjusted postneonatal mortality is higher in rural areas than in urban areas in India as a whole and in all states except West Bengal and Goa, where there is no urban/rural difference The differences are statistically significant for the country as a whole and for nine states The adjusted effects of residence on postneonatal mortality are much smaller, however, and are statistically significant only in Madhya Pradesh and Uttar Pradesh Although not statistically significant, the differences in adjusted postneonatal mortality by residence are substantial in Delhi and Jammu region In West Bengal, Goa, Haryana, Orissa, Assam, Gujarat, Maharashtra, Kerala, and Tamil Nadu, adjusted postneonatal mortality is higher in urban areas than in rural areas, but none of these differences is statistically significant

Unadjusted infant mortality is higher in rural areas than in urban areas for India and for all states except Goa, where infant mortality is higher in urban areas The adjusted effects of residence on infant mortality are much smaller than the unadjusted effects

The unadjusted effect of urban/rural residence on child mortality is very large Unadjusted child mortality in India is nearly twice as high in rural areas as in urban areas, and this difference is statistically significant Similar large, statistically significant differences are observed in nine states The adjusted effect is much smaller For the country as a whole, adjusted child mortality is only 16 percent higher in rural areas than in urban areas The adjusted effect of urban/rural residence on child mortality is only statistically significant for India and for Rajasthan Adjusted child mortality is substantially higher in rural areas than in urban areas in Uttar Pradesh, Andhra Pradesh, and Tamil Nadu, but results for these states are not statistically significant

Three general patterns emerge

1 Although there are large differences in unadjusted infant and child mortality between rural and urban areas, most of these differences disappear when we control for the effects of other variables This contrast between strong unadjusted effects and weak adjusted effects suggests that most of the urban/rural difference in infant and child mortality is due to factors closely related to residence rather than to residence itself
2 The adjusted effect of urban/rural residence on mortality tends to increase with child's age For India as a whole, the adjusted effect of residence on neonatal and postneonatal mortality is very small and not statistically significant, while the adjusted effect on child mortality is larger and statistically significant

Table 5 1 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality, by residence and by state

State	Residence							
	Neonatal mortality				Postneonatal mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	Rural†	Urban	Rural†	Urban	Rural†	Urban	Rural†	Urban
India	59	38*	54	52	39	24*	35	33
North								
Delhi	41	35	37	35	42	28	41	28
Haryana	53	28*	51	32*	38	34	35	42
Himachal Pradesh	38	30	38	33	31	13*	29	24
Jammu region of Jammu and Kashmir	37	27	36	31	24	11*	24	11
Punjab	37	24*	36	27	25	18	23	22
Rajasthan	41	38	40	41	36	20*	34	29
Central								
Madhya Pradesh	62	42*	56	62	50	22*	45	32
Uttar Pradesh	82	42*	76	57	53	31	51	37
East								
Bihar	61	35*	58	48	43	29*	41	41
Orissa	70	48	69	50*	63	51	59	70
West Bengal	58	50	53	66	26	26	24	34
Northeast								
Assam	56	49	55	61	39	28	37	42
West								
Goa	22	33*	19	37	11	11	9	13
Gujarat	54	39*	46	55	32	20*	26	31
Maharashtra	41	31*	33	44	24	14*	17	24
South								
Andhra Pradesh	55	36*	50	49	27	23	26	26
Karnataka	56	39*	50	51	30	19*	27	24
Kerala	24	22	23	26	9	8	9	10
Tamil Nadu	51	38*	44	50	25	23	22	29

State	Infant mortality				Child mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	Rural†	Urban	Rural†	Urban	Rural†	Urban	Rural†	Urban
India	98	62*	89	85	42	21*	37	32
North								
Delhi	83	63	79	63	19	17	17	17
Haryana	91	62[n]	86	74[n]	33	22	29	34
Himachal Pradesh	69	43[p]	67	58	23	8	21	20
Jammu region of Jammu and Kashmir	61	37[p]	60	42	23	12	22	16
Punjab	62	42[n]	59	50	20	13	17	21
Rajasthan	77	59[p]	74	69	40	14	37	20
Central								
Madhya Pradesh	112	64*	101	94[p]	64	23*	52	48
Uttar Pradesh	134	73*	127	94*	58	31*	53	46
East								
Bihar	104	63*	99	89	47	28	44	44
Orissa	133	98[n]	128	120[n]	20	16	19	27
West Bengal	84	76	77	100	31	18*	29	25
Northeast								
Assam	94	78	92	103	61	36*	57	63
West								
Goa	33	43[n]	29	50[n]	8	8	7	9
Gujarat	86	59*	72	87	8	8	7	9
Maharashtra	65	44*	50	68	26	18	21	24
South								
Andhra Pradesh	82	59[n]	76	75	32	12	28	16
Karnataka	86	58*	77	76	35	22*	31	29
Kerala	33	30	31	35	11	6	10	8
Tamil Nadu	76	61[n]	66	79	34	15*	30	19

3 Urban/rural residence tends to have a statistically significant or substantial effect on infant and child mortality, after adjusting for other factors, in those states where mortality levels are high

MOTHER'S LITERACY

In developing countries, mother's educational level, as indicated here by literacy status, tends to have a strong effect on the mortality of young children (Govindasamy and Ramesh 1997, Hobcraft, McDonald, and Rutstein 1984, Mosley and Chen 1984, United Nations 1985, 1991, 1998) Literate mothers usually give birth to healthier babies because they themselves tend to be healthier than mothers who are illiterate In addition, literate mothers are more likely to provide their children with a healthy environment and nutritious food than are illiterate mothers, even when other conditions are similar Lastly, literate mothers are likely to have more information about health-care facilities and to have more influence within the family in deciding to take sick children for treatment These traits are likely to result in lower mortality of children at all ages under five (Caldwell 1994, Cleland and Kaufman 1993, World Bank 1993)

Numerous arguments support a direct causal relationship between mother's literacy and infant and child mortality Some studies, however, indicate that the causal relationship is not clear, but rather that mother's literacy is often just a good indicator of other socioeconomic factors that affect infant and child mortality directly (Desai and Alva 1998, Hobcraft 1993) Results reported here bear directly on this debate

As shown in Table 5 2, the unadjusted effect of mother's literacy on neonatal mortality is large and positive for India and for all states except Himachal Pradesh

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Notes to Table 5 1

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted rates the hazard regressions include the following control variables child s sex year of birth mother s age at childbirth and its square mother s literacy religion caste/tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) When calculating adjusted rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

†Reference category in the underlying hazard regression

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not postneonatal (age 1–11 months) mortality

[P]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

Table 5 2 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality, by mother's literacy and by state

State	Mother's literacy							
	Neonatal mortality				Postneonatal mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	Illiterate†	Literate	Illiterate†	Literate	Illiterate†	Literate	Illiterate†	Literate
India	63	37	58	45*	44	20*	40	25*
North								
Delhi	45	28	36	34	42	21*	30	29
Haryana	51	34*	48	40	44	24	41	29
Himachal Pradesh	34	41	32	44	42	19*	38	21*
Jammu region of Jammu and Kashmir	38	31	35	36	24	18	20	25
Punjab	37	29	32	34	26	20	20	27
Rajasthan	40	45	40	47	36	19*	34	27
Central								
Madhya Pradesh	65	36*	62	44*	53	18*	49	23*
Uttar Pradesh	80	47*	77	56*	55	27*	52	33*
East								
Bihar	59	48*	55	69	47	21*	44	30*
Orissa	70	58*	70	59	74	40*	69	46*
West Bengal	70	40*	64	46*	30	22*	27	26
Northeast								
Assam	61	45*	58	50	43	29*	39	34
West								
Goa	46	19*	35	22*	19	8*	12	10
Gujarat	64	31	54	41	39	15*	32	21
Maharashtra	48	27*	44	30*	28	12	23	15*
South								
Andhra Pradesh	56	35*	51	45	29	19*	28	21
Karnataka	62	33*	55	42*	35	14*	31	18*
Kerala	34	22*	24	23	20	8*	12	8
Tamil Nadu	59	36*	53	40	31	19*	28	21

State	Neonatal mortality				Postneonatal mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	Illiterate†	Literate	Illiterate†	Literate	Illiterate†	Literate	Illiterate†	Literate
India	107	57*	98	70*	49	18*	42	24*
North								
Delhi	87	49*	66	63	31	10*	23	13
Haryana	95	58	89	69	41	14*	35	21
Himachal Pradesh	76	60[p]	70	65[p]	32	13*	23	19
Jammu region of Jammu and Kashmir	62	49	55	61	27	13*	20	21
Punjab	63	48	53	61	28	10*	20	16
Rajasthan	76	64[p]	73	74	38	15	35	26
Central								
Madhya Pradesh	118	54*	111	67*	66	21	57	36*
Uttar Pradesh	135	74*	129	89*	60	27*	55	39*
East								
Bihar	106	69*	98	99[p]	53	18*	48	28
Orissa	144	99*	139	105[p]	27	10*	23	14
West Bengal	100	62*	90	72[n]	36	19*	31	24
Northeast								
Assam	104	74*	97	85	77	34*	66	45*
West								
Goa	65	27*	48	32[n]	16	6	10	7
Gujarat	103	46*	87	62[p]	43	21*	36	28
Maharashtra	76	39*	68	45*	34	13*	28	17*
South								
Andhra Pradesh	85	54*	79	66	32	12*	27	19
Karnataka	97	47*	87	60*	44	14	39	18
Kerala	54	29*	36	32	27	8*	20	8*
Tamil Nadu	90	54*	81	61	40	16	33	20*

and Rajasthan, where the relationship is in the opposite, unexpected, direction These results are statistically significant for India and for every state except Himachal Pradesh, Rajasthan, Jammu region, and Punjab The adjusted effect of mother's literacy is smaller in every case Thus part of the unadjusted effect of mother's literacy on neonatal mortality is due to other variables in the model that are correlated with mother's literacy The adjusted effect remains statistically significant, in the expected direction, for India and for Madhya Pradesh, Uttar Pradesh, West Bengal, Goa, Maharashtra, and Karnataka The effect is substantial but not statistically significant in Orissa, Gujarat, and Tamil Nadu Contrary to expectations, adjusted neonatal mortality is higher for children of literate mothers in Jammu region, Punjab, Bihar, Himachal Pradesh, and Rajasthan None of these differences is statistically significant, however In fact, it is very unlikely that the true level of neonatal mortality is higher for children whose mothers are literate Rather, these results are more likely due to underreporting of neonatal deaths in families where the mother is illiterate

Unadjusted postneonatal mortality is higher for children of illiterate mothers than for children of literate mothers in India as a whole and in all states The differences are statistically significant in every state but Jammu region and Punjab These differences become much smaller after adjusting for other socioeconomic variables, but they are still substantial for India and for most states They remain statistically significant for India and for Himachal Pradesh, Madhya Pradesh, Uttar Pradesh, Bihar, Orissa, Gujarat, Maharashtra, and Karnataka In Haryana, Andhra Pradesh, and Tamil Nadu, the differences are large but not statistically significant In Jammu region and Punjab, adjusted postneonatal mortality is higher for children of literate mothers As with neonatal mortality, this unexpected result is likely due to data errors

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Notes to Table 5 2

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted rates the hazard regressions include the following control variables child s sex year of birth mother s age at childbirth and its square residence religion caste/tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) When calculating adjusted rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

†Reference category in the underlying hazard regression

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not postneonatal (age 1–11 months) mortality

[P]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

Combining neonatal and postneonatal mortality, adjusted infant mortality in India is 40 percent higher for children of illiterate mothers than for children of literate mothers It is also substantially higher in most states

As expected, unadjusted child mortality is higher for children of illiterate mothers than for children of literate mothers in India and in all states, and all the differences are statistically significant The adjusted effects are much smaller, but they remain substantial and statistically significant for India and for eight states Madhya Pradesh, Uttar Pradesh, Bihar, Assam, Maharashtra, Karnataka, Kerala, and Tamil Nadu Adjusted child mortality is also substantially higher for children of illiterate mothers in all other states except Himachal Pradesh, Jammu region, and Punjab, although these results are not statistically significant

In summary, mother's literacy emerges as an important factor associated with mortality during the first five years of life, especially after the first month The unadjusted effects on postneonatal and child mortality are very large and statistically significant in nearly all states, while the adjusted effects remain strong and statistically significant in about half of the states Controlling for other variables, mother's literacy still has a substantial and statistically significant adjusted effect on neonatal, postneonatal, and child mortality in India as a whole and in Uttar Pradesh, Madhya Pradesh, Maharashtra, and Karnataka The adjusted effect is statistically significant for both postneonatal and child mortality in Bihar It is significant for one age group and substantial but not significant for the other two in Orissa, Gujarat, and Tamil Nadu

HOUSEHOLD HEAD'S RELIGION AND CASTE/TRIBE MEMBERSHIP

Religion and membership in a scheduled caste or scheduled tribe is known to affect many aspects of life in India and is likely to affect levels of infant and child mortality as well Some of the effect of religion and caste/tribe membership on mortality may be due to differences in life-style based on traditions and beliefs Such differences may include customary practices related to childbirth, infant feeding, and health care, and these should have an effect on infant and child mortality independently of other variables Part of the effect of religion and caste/tribe membership on mortality, however, may be due to other, related, socioeconomic conditions

Table 5 3 shows unadjusted and adjusted neonatal, postneonatal, infant, and child mortality for four groups of children, based on the religion and caste/tribe membership of their household head Hindu-non caste/tribe, Hindu-caste/tribe, Muslim, and other religions Children from Hindu-caste/tribe households have the highest unadjusted neonatal mortality of the four groups, both in the country as a whole and in 12 states Children in Muslim households have the highest unadjusted neonatal mortality in six states Children in households of other religions have the lowest unadjusted neonatal mortality in India as a whole and in 12 states, while children in

Muslim households have the lowest unadjusted neonatal mortality in six states It is somewhat surprising that the Hindu-caste/tribe group has the lowest neonatal mortality in Delhi because members of scheduled castes and tribes generally have low socioeconomic status and high mortality This unexpected result may be due to the fact that many Delhi residents who are members of scheduled castes or tribes are civil servants

The religion and caste/tribe membership of the household head has a much smaller effect on neonatal mortality after adjusting for other variables The greatest contrast between unadjusted and adjusted effects relates to the difference between the Hindu-non caste/tribe and the Hindu-caste/tribe groups The unadjusted difference in neonatal mortality between these two groups is large and statistically significant for India and for eight states, but the adjusted difference is not significant for India or for five of the eight states This finding indicates that children in Hindu-caste/tribe households often experience higher neonatal mortality than other children primarily because they are disadvantaged in terms of other variables, such as mother's literacy or household economic status (indicated by ownership of consumer goods), rather than because of their household's caste/tribe affiliation per se

Similar to the results for neonatal mortality, the Hindu-caste/tribe group has the highest unadjusted postneonatal mortality in India as a whole and in 15 out of 19 states Children in Muslim households have the highest unadjusted postneonatal mortality in three states Haryana, Jammu region, and Kerala The adjusted effect of religion-caste/tribe membership is considerably smaller, but the rank ordering of the four groups does not change much The group with the highest postneonatal mortality remains the same after adjusting for other variables in all but four states

In the country as a whole and in 13 states, children in households whose heads belong to other religions have the lowest unadjusted postneonatal mortality Children from Muslim households have the lowest unadjusted postneonatal mortality in three states, and children from Hindu-non caste/tribe households have the lowest unadjusted postneonatal mortality in two states Adjustment for other variables only changes the ranking in two states Uttar Pradesh and Karnataka

Combining neonatal and postneonatal mortality infant mortality in India is highest among the Hindu-caste/tribe group, followed by Hindu-non caste/tribe, Muslim and other religions There are some variations in this ranking, however at the state level The differences in adjusted mortality are substantially smaller than the differences in unadjusted mortality, especially the difference between the Hindu-caste/tribe group and the Hindu-non caste/tribe group

Children from Hindu-caste/tribe households have the highest unadjusted child mortality in India and in 14 states Adjusting for other variables has little effect on the ranking of the four groups except to reduce the difference between the Hindu-caste/tribe and the Hindu-non caste/tribe groups The Hindu-caste/tribe group has the highest

Table 5 3 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality, by household head's religion and membership in a scheduled caste or scheduled tribe and by state

	Religion and caste/tribe membership of household head							
	Unadjusted				Adjusted			
	Hindu, not SC or ST†	Hindu, SC or ST	Muslim	Other religion	Hindu, not SC or ST†	Hindu, SC or ST	Muslim	Other religion
Neonatal mortality								
India	54	64*	48*	33*	55	56	50*	40
North								
Delhi	36	19	55*	20	36	16*	48	26
Haryana	42	52	54	37	43	48	55	41
Himachal Pradesh	37	37	43	27	37	38	47	31
Jammu region of Jammu and Kashmir	35	30	44	29	36	30	41	33
Punjab	32	42	10	32	38	40	9	31
Rajasthan	39	48*	22*	17	39	48*	22*	18
Central								
Madhya Pradesh	59	59	44	33	61	54	52	46
Uttar Pradesh	76	87*	54*	34*	75	77	61*	45
East								
Bihar	53	69*	59	62	53	66*	61	66
Orissa	69	62	54	60	71	57*	55	64
West Bengal	52	75*	57	38	55	64	54	43
Northeast								
Assam	55	53	62	27*	57	51	61	28*
West								
Goa	32	73*	29	12*	32	46	20	15*
Gujarat	49	61*	40	9	50	51	46	16
Maharashtra	36	46	31	38	38	38	32	40
South								
Andhra Pradesh	50	71*	23*	59	50	65*	26*	58
Karnataka	51	63	41	32	51	58	42	42
Kerala	23	28	29	16	24	24	28	17
Tamil Nadu	46	63*	20*	50	47	53	23	56
Postneonatal mortality								
India	34	45*	30*	20*	35	39*	30*	25*
North								
Delhi	30	41	34	8*	31	33	26	13
Haryana	35	43	47	21	39	38	38	23
Himachal Pradesh	27	34	29	17	29	30	26	20
Jammu region of Jammu and Kashmir	20	22	27	14	20	22	26	17
Punjab	23	29	28	21	27	24	33	21
Rajasthan	33	38	20	5	34	35	20*	6
Central								
Madhya Pradesh	41	51*	17*	35	43	44	24*	45
Uttar Pradesh	47	65*	38	29	48	58*	39*	40
East								
Bihar	38	48	44	39	39	44	44	42
Orissa	58	74*	32	22	61	65	32	23
West Bengal	25	30	27	14	27	27	26	16
Northeast								
Assam	36	41	41	24	38	38	39	24
West								
Goa	13	39*	7	6	13	24	5	8
Gujarat	26	41*	17	17	27	33	19	30
Maharashtra	22	25	9*	20	23	20	10*	21
South								
Andhra Pradesh	26	32	23	9	27	30	25	9
Karnataka	24	35*	26	22	25	31	27	31
Kerala	5	6	16*	13*	5	5	16*	14*
Tamil Nadu	24	28	18	23	25	23	20	27

Table 5 3, continued

	Religion/caste tribe membership of household head							
	Unadjusted				Adjusted			
	Hindu, not SC or ST†	Hindu, SC or ST	Muslim	Other religion	Hindu, not SC or ST†	Hindu, SC or ST	Muslim	Other religion
Infant mortality								
India	89	109*	77*	54*	90	95[p]	80*	65*
North								
Delhi	66	60	90[n]	28[p]	68	49[n]	75	39
Haryana	78	96	101	59	82	86	93	64
Himachal Pradesh	65	72	73	44	66	68	73	51
Jammu region of Jammu and Kashmir	55	53	72	43	57	51	66	50
Punjab	55	71	38	53	65	64	42	52
Rajasthan	72	85[n]	43[n]	23	73	83[n]	42*	24
Central								
Madhya Pradesh	100	110[p]	61[p]	68	103	98	76[p]	91
Uttar Pradesh	123	151*	92*	63[n]	123	136[p]	100*	85
East								
Bihar	92	117[n]	103	101	93	111[n]	105	107
Orissa	127	135[p]	85	82	132	122[n]	87	87
West Bengal	77	105[n]	84	52	82	92	80	59
Northeast								
Assam	91	94	103	51[n]	94	90	100	52[n]
West								
Goa	45	112*	36	19[n]	45	70	25	23[n]
Gujarat	75	103*	57	26	77	84	65	46
Maharashtra	58	71	40[p]	58	60	58	42[p]	60
South								
Andhra Pradesh	76	102[n]	45[n]	68	77	95[n]	51[n]	67
Karnataka	75	98[p]	67	54	76	88	69	72
Kerala	28	34	46[p]	28[p]	29	29	43[p]	30[p]
Tamil Nadu	70	91[n]	38[n]	73	47	53	23	56
Child mortality								
India	33	51*	32	25*	35	42*	33	32
North								
Delhi	19	19	15	6	19	13	11	12
Haryana	25	48*	36	21	27	40*	27	22
Himachal Pradesh[a]	19	32*	3	—	21	28	2	—
Jammu region of Jammu and Kashmir	19	26	27	5	21	24	22	
Punjab	12	18	28	21	16	13	29	21
Rajasthan	30	44*	24	8	31	40*	26	11
Central								
Madhya Pradesh	48	73*	11*	71	51	60	18*	103*
Uttar Pradesh	50	75*	40*	32	51	65*	42	52
East								
Bihar	41	54*	46	22	43	50	45	24
Orissa	16	36*	21	12	17	31*	19	11
West Bengal	23	39*	34*	28	24	32	33	32
Northeast								
Assam	46	71*	68*	69	52	68	59	70
West								
Goa	9	6	31*	5	8	3	29	6
Gujarat	34	44	15*	13	35	36	15*	22
Maharashtra	20	35*	14	44*	21	28	13	43*
South								
Andhra Pradesh	24	37*	21	6	24	29	30	6
Karnataka	31	40	24	11	31	35	25	16
Kerala	10	11	10	8	11	8	9	9
Tamil Nadu	25	40*	12	26	26	30	16	32

adjusted child mortality in the country as a whole and in nine states, the Muslim and other-religion groups each have the highest adjusted child mortality in four states, and the Hindu-non caste/tribe group has the highest adjusted child mortality in two states The other-religion group has the lowest adjusted child mortality in India and in seven states, the Muslim group has the lowest adjusted child mortality in seven states, the Hindu-caste/tribe group has the lowest adjusted child mortality in three states, and the Hindu-non caste/tribe group has the lowest adjusted child mortality in two states

Thus the effect on mortality of religion and scheduled caste/tribe membership varies according to child's age During the neonatal period, religion has a substantial adjusted effect on mortality, but scheduled caste/tribe membership does not In the country as a whole and in several states, the differences in adjusted neonatal mortality between the two Hindu groups tend to be smaller than the differences between these groups and the other two religious groups During the postneonatal and childhood periods, by contrast, the adjusted effect of scheduled caste/tribe membership is strong, reflected in relatively large differences between the two Hindu groups

The substantial effect of religion on adjusted neonatal mortality calls for an in-depth investigation of customs related to childbirth and care of newborns For example, it is possible that some practices common among Hindus are associated with increased risk of neonatal tetanus The three religious groups, excluding the Hindu-caste/tribe group, do not differ much in adjusted child mortality in the country as a whole, but variations are observed in most states Some of these state variations need to be interpreted with caution because sample sizes for some religious groups are small

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Notes to Table 5 3

SC = scheduled caste ST = scheduled tribe

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted rates the hazard regressions include the following control variables child s sex year of birth mother s age at childbirth and its square residence mother's literacy mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) When calculating adjusted rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

†Reference category in the underlying hazard regression

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not postneonatal (age 1–11 months) mortality

[P]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

In Himachal Pradesh respondents in the other religion category were too few for a reliable estimation of child mortality so this state was excluded from the analysis of child mortality

Some of the differences in postneonatal and child mortality related to membership in a scheduled caste or tribe can be explained by differences in other socioeconomic characteristics, such as mother's literacy, access to a flush or pit toilet, use of a clean cooking fuel, or ownership of household goods Nevertheless, substantial differences remain that are not explained by these other variables These results call for further study on scheduled caste/tribe customs related to child care

MOTHER'S EXPOSURE TO MASS MEDIA

Other things being equal, a mother's exposure to radio and television may reduce the mortality of her children because women who are exposed to mass media are likely to have access to information on health-care services and ways of enhancing maternal and child health Mother's exposure to mass media may also act as an indicator of the economic status of the household In this analysis, a woman is considered to be exposed to mass media if she listens to radio or watches television at least once a week

Table 5 4 shows unadjusted and adjusted mortality according to mother's exposure to mass media Unadjusted neonatal mortality exhibits the expected relationship it is higher for children whose mothers are not exposed to mass media in India as a whole and in all states except Rajasthan These results are statistically significant for India and for 11 states After adjusting for other socioeconomic factors, the effect of mother's mass media exposure is much smaller and is not statistically significant in India or in most states The only state where mother's exposure to mass media has a statistically significant adjusted effect in the expected direction is Himachal Pradesh In Rajasthan and Tamil Nadu, the adjusted effect is statistically significant but in the unexpected direction neonatal mortality is higher for children whose mothers are exposed to mass media

The unadjusted effects of mother's media exposure on postneonatal mortality are in the expected direction for India and for all states except Tamil Nadu and Andhra Pradesh These results are statistically significant for India and for 12 states The adjusted effects tend to be much smaller and are only statistically significant for India and for Tamil Nadu In the country as a whole, children of mothers who are not exposed to mass media have higher postneonatal mortality but in Tamil Nadu the opposite pattern is observed This unexpected result for Tamil Nadu is not easily explained

Combining neonatal and postneonatal mortality, the unadjusted effect of mother's exposure to mass media on infant mortality is large for India and for most states, but the adjusted effect is small In India as a whole, infant mortality is slightly higher for children whose mothers are not exposed to mass media after adjusting for other socioeconomic factors Again, Tamil Nadu shows an unexpected result, with higher infant mortality among children whose mothers are exposed to mass media

Table 5 4 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality, by mother's exposure to radio or television and by state

State	Mother listens to radio or watches television at least once a week							
	Neonatal mortality				Postneonatal mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	No†	Yes	No†	Yes	No†	Yes	No†	Yes
India	61	45*	55	52	43	26*	36	33*
North								
Delhi	59	31*	45	33	47	26*	26	30
Haryana	47	44	40	50	42	33	35	39
Himachal Pradesh	41	35	46	33*	35	26	28	30
Jammu region of Jammu and Kashmir	39	34	37	34	26	20	23	21
Punjab	39	30*	33	33	32	18*	26	21
Rajasthan	38	47*	38	49*	36	25*	32	34
Central								
Madhya Pradesh	64	47*	58	56	49	32*	41	44
Uttar Pradesh	80	58*	74	69	53	38*	47	50
East								
Bihar	60	49*	55	62	46	28*	41	41
Orissa	67	65	64	70	68	50*	58	65
West Bengal	65	49*	58	54	29	24	27	26
Northeast								
Assam	58	50	54	59	42	30*	38	36
West								
Goa	38	24*	28	26	17	10	11	11
Gujarat	64	37*	52	45	39	19*	30	25
Maharashtra	42	34	34	39	25	16*	18	20
South								
Andhra Pradesh	59	45*	51	49	26	26	23	28
Karnataka	59	46*	49	52	34	22	27	26
Kerala	29	22	23	23	14	8*	9	9
Tamil Nadu	48	45	37	51*	22	25	17	28

State	Infant mortality				Child mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	No†	Yes	No†	Yes	No†	Yes	No†	Yes
India	105	71*	91	85[p]	48	24*	38	33
North								
Delhi	106	58*	71	63	27	15*	13	18
Haryana	89	77	75	89	44	22*	37	25
Himachal Pradesh	76	61	74	62[n]	36	14*	26	18
Jammu region of Jammu and Kashmir	65	54	61	55	34	16*	25	19
Punjab	71	48*	59	54	31	13	17	18
Rajasthan	74	72*	70	84[n]	37	24	33	36
Central								
Madhya Pradesh	112	79*	99	100	68	32*	52	50
Uttar Pradesh	132	96*	121	119	60	36*	51	52
East								
Bihar	106	77*	96	103	52	26*	44	42
Orissa	134	115[p]	122	135	22	16	17	26
West Bengal	94	72[n]	85	80	32	24	26	29
Northeast								
Assam	100	80[p]	92	95	81	29*	68	41
West								
Goa	55	34[n]	40	37	17	7*	11	8
Gujarat	103	56*	82	70	42	25*	33	32
Maharashtra	67	49[p]	53	59	33	16*	25	20
South								
Andhra Pradesh	85	71[n]	74	77	26	24	18	29*
Karnataka	94	68*	76	77	41	25	30	30
Kerala	44	29[p]	32	32	19	8	15	8
Tamil Nadu	71	70	54	79*	33	23	22	28

Unadjusted child mortality is consistently higher for children whose mothers are not exposed to mass media than for other children This effect is statistically significant for India and for all states except Orissa, West Bengal, Andhra Pradesh, and Tamil Nadu The adjusted effect on child mortality is much smaller than the unadjusted effect and is only statistically significant (and in the expected direction) for India and for Assam In the country as a whole, mother's exposure to radio or television has a slightly stronger adjusted effect on child mortality than on either neonatal or postneonatal mortality In Andhra Pradesh, the adjusted effect is statistically significant but in the unexpected direction

For India, the adjusted effect of mother's exposure to mass media is negligible for neonatal mortality, small but statistically significant for postneonatal mortality, and slightly larger and statistically significant for child mortality Thus the effects of mother's exposure to mass media on mortality at various ages are quite similar to the effects of urban/rural residence

ACCESS TO A FLUSH OR PIT TOILET

Access to a flush or pit toilet is potentially a very important determinant of infant and child mortality in developing countries Children in households that lack such access could have higher exposure than other children to diseases such as tetanus and digestive disorders (Puffer and Serrano 1978, United Nations 1985)

As shown in Table 5 5, unadjusted neonatal mortality is higher for children in households that do not have access to a flush or pit toilet, both in India as a whole and in all states The difference is statistically significant for India and for all states except

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Notes to Table 5 4

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted rates the hazard regressions include the following control variables child s sex year of birth mother s age at childbirth and its square residence mother s literacy religion caste/tribe of household head and household toilet facilities cooking fuel and economic level (ownership of goods) When calculating adjusted rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

†Reference category in the underlying hazard regression

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not postneonatal (age 1–11 months) mortality

[p]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

Table 5 5 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality, by type of toilet facility and by state

State	Has access to own, shared, or public flush or pit toilet							
	Neonatal mortality				Postneonatal mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	No†	Yes	No†	Yes	No†	Yes	No†	Yes
India	63	34*	57	44*	41	21*	36	31*
North								
Delhi	47	33*	37	35	45	27*	28	29
Haryana	52	28*	48	38	40	28*	37	37
Himachal Pradesh	38	33	37	40	32	14	29	31
Jammu region of Jammu and Kashmir	37	29	35	40	23	16	20	34
Punjab	38	25*	33	33	30	14	28	16
Rajasthan	41	38	41	39	37	19*	33	31
Central								
Madhya Pradesh	65	32	60	44	49	19*	44	34
Uttar Pradesh	82	42	76	59*	53	32*	47	50
East								
Bihar	62	33*	59	46	44	25	40	47
Orissa	71	38*	71	37	64	40*	59	71
West Bengal	66	36*	62	42*	31	18*	30	19
Northeast								
Assam	64	46	62	47*	46	29*	43	32*
West								
Goa	33	19	26	27	16	6*	12	10
Gujarat	61	29*	51	45	37	14*	30	23
Maharashtra	45	26*	42	30	26	11*	21	17
South								
Andhra Pradesh	56	31*	51	44	28	22	25	30
Karnataka	58	33*	51	51	30	18*	24	33
Kerala	31	21*	26	22	16	7*	13	8
Tamil Nadu	53	33*	46	47	26	20	23	26

State	Infant mortality				Child mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	No†	Yes	No†	Yes	No†	Yes	No†	Yes
India	104	55*	93	75*	44	19	36	34
North								
Delhi	91	60	66	64	32	15*	20	16
Haryana	93	56*	84	75	37	15*	33	23
Himachal Pradesh	69	47[p]	66	71	26	3*	25	4
Jammu region of Jammu and Kashmir	59	45	55	75	22	13	20	24
Punjab	67	39	61	49[p]	24	10*	19	16
Rajasthan	78	57[p]	74	70	40	13*	35	25
Central								
Madhya Pradesh	114	51*	104	78	68	15*	54	40
Uttar Pradesh	135	74*	123	109[n]	59	29*	52	48
East								
Bihar	107	57*	99	93	48	25	42	59
Orissa	135	78*	130	108[n]	22	9	19	22
West Bengal	97	54*	93	60*	36	15*	32	19
Northeast								
Assam	110	75*	106	79	72	44	59	56
West								
Goa	48	25	37	37	13	4*	10	6
Gujarat	98	43	80	68	41	19*	33	30
Maharashtra	71	37*	62	47	27	16*	20	26
South								
Andhra Pradesh	84	53n	76	74	30	13*	21	40
Karnataka	88	51	75	84	36	19*	29	34
Kerala	46	28*	39	30	16	8*	12	9
Tamil Nadu	80	52[n]	70	73	31	17*	21	41*

Himachal Pradesh, Jammu region, and Rajasthan The adjusted effect is much smaller, however, and is only statistically significant (in the expected direction) for India and for Uttar Pradesh, Orissa, West Bengal, and Assam The adjusted effect is substantial but not statistically significant in Haryana, Madhya Pradesh, Bihar, and Maharashtra In some states, adjusted neonatal mortality rates are higher for children in households with access to a flush or pit toilet than for children in households without such access, but none of these results is statistically significant

Unadjusted postneonatal mortality is higher for children in households that do not have access to a flush or pit toilet, both in India and in all states This result is statistically significant for India and for all states except Jammu region, Andhra Pradesh, and Tamil Nadu Differences in adjusted postneonatal mortality are much smaller They are statistically significant, however, and in the expected direction for India and for Punjab, West Bengal, and Assam The difference is also substantial in Madhya Pradesh but not statistically significant

Reflecting the pattern of neonatal and postneonatal mortality, infant mortality is higher for children in households that do not have access to a flush or pit toilet than for children in households that have such access

Unadjusted child mortality is higher for children in households without access to a flush or pit toilet than for children in households with access to such a facility, both in India as a whole and in all states This result is statistically significant for India and for all states except Jammu region Differences in adjusted child mortality are much smaller Adjusted child mortality is substantially higher in households without access to a flush or pit toilet in Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh, and West Bengal, but these results are not statistically significant The adjusted effect on

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Notes to Table 5 5

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted rates the hazard regressions include the following control variables child s sex year of birth mother s age at childbirth and its square residence mother s literacy religion caste/tribe of household head mother s exposure to radio or television and household cooking fuel and economic level (ownership of goods) When calculating adjusted rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

†Reference category in the underlying hazard regression

*The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not postneonatal (age 1–11 months) mortality

PThe coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

child mortality is statistically significant only in Tamil Nadu but in the unexpected direction Child mortality is higher in households with access to a flush or pit toilet than in households without such access This unexpected result is difficult to explain

In summary, the adjusted effect on mortality of household access to a flush or pit toilet is strongest for the neonatal period and becomes weaker at later ages The adjusted effect tends to be statistically significant in states with relatively high levels of neonatal mortality Uttar Pradesh, Orissa, West Bengal, and Assam This pattern suggests that the lack of access to a flush or pit toilet is associated with increased risk of neonatal tetanus

USE OF A CLEAN COOKING FUEL

For the purpose of this analysis, electricity, gas, biogas, coal, charcoal, and kerosene are considered clean cooking fuels Unclean fuels are wood and dung The type of cooking fuel used in a household could affect infant and child mortality in two ways First, if children spend a great deal of time where cooking takes place, the use of a cooking fuel that emits harmful smoke could elevate their risk of respiratory disease and hence mortality (Mishra and Retherford 1997) If this is an important hazard, then the effect of cooking fuel on infant and child mortality should be substantial, even after controlling for other socioeconomic variables Secondly, the type of cooking fuel used may be an indicator of a household's general economic status If this is the case, then we would expect to see a strong unadjusted relationship between the type of cooking fuel used and infant and child mortality, but the adjusted effect would be substantially reduced

Table 5 6 shows that unadjusted neonatal mortality is lower for children in households that use a clean cooking fuel, both in India as a whole and in all states This result is statistically significant for India and for all states except Himachal Pradesh, Rajasthan, Orissa, Assam, and Kerala Controlling for the effects of other variables reduces the effect of clean cooking fuel in most states The adjusted effect remains statistically significant only for India and for Madhya Pradesh, Bihar, and Karnataka It is substantial but not statistically significant in Himachal Pradesh, Jammu region, Rajasthan, and Gujarat

Unadjusted postneonatal mortality is also lower for children in households that use a clean cooking fuel in India and in all states This effect is statistically significant for India and for all states except Punjab, West Bengal, Andhra Pradesh, and Kerala In most cases, however, the adjusted effect is much smaller, and it is only statistically significant in Karnataka and in Uttar Pradesh In Uttar Pradesh the effect is in the unexpected direction Adjusted postneonatal mortality is higher for children in households that use a clean cooking fuel This finding is difficult to explain The

effect of using a clean cooking fuel is substantial and in the expected direction, but not statistically significant, in Himachal Pradesh, Jammu region, Rajasthan, Orissa, Assam, and Maharashtra

Combining results for neonatal and postneonatal mortality, adjusted infant mortality is moderately lower for children from households that use a clean cooking fuel, both in India and in most states In Uttar Pradesh, however, the use of a clean cooking fuel is associated with higher infant mortality

The use of a clean cooking fuel has a large unadjusted effect on child mortality in India and in all states This result is statistically significant for India and for all states except Delhi, Himachal Pradesh, Jammu region, Goa, and Kerala After adjusting for other variables, however, the effects are much smaller The adjusted effects are only statistically significant for India and for Madhya Pradesh The effects are substantial but not statistically significant in Rajasthan, Bihar, Orissa, Andhra Pradesh, and Tamil Nadu

In summary, after controlling for the effects of other variables, use of a clean cooking fuel does not appear to have a strong effect on mortality under age five Results vary widely, however, by child's age and by state Curiously, for India as a whole, use of a clean cooking fuel appears to have the strongest effect on mortality during the neonatal period

OWNERSHIP OF HOUSEHOLD GOODS

The NFHS survey collected information on the ownership of selected household goods, from which we have constructed a composite score as shown in Table 2 2 Scores for individual households can range from 0 to 27, but a large majority (64 percent) of the children covered in the NFHS come from households with an ownership score of less than 5 Only 5 percent come from households with a score of 15 or higher (Table 2 3) This score can be regarded as an indicator of the economic status of a household It is expected to have a strong effect on infant mortality and an even stronger effect on child mortality

As shown in Table 5 7, unadjusted neonatal mortality decreases as the ownership score increases This result is statistically significant for India and for all states except Jammu region and Orissa Himachal Pradesh and Rajasthan are exceptions In these states higher ownership scores are associated with higher unadjusted neonatal mortality, but the relationship is not statistically significant The adjusted effects of ownership of household goods are much smaller They are only statistically significant for India and for Delhi, Bihar, Kerala, and Tamil Nadu Punjab, Assam, Gujarat, Andhra Pradesh, and Karnataka show a sharp decline in adjusted neonatal mortality with increasing ownership of household goods, but the relationship is not statistically significant

Table 5 6 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality, by type of fuel used for cooking and by state

State	Uses electricity, gas, biogas, charcoal, or kerosene							
	Neonatal mortality				Postneonatal mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	No†	Yes	No†	Yes	No†	Yes	No†	Yes
India	60	33*	55	47	39	20*	35	32
North								
Delhi	48	33*	37	35	40	28*	26	29
Haryana	51	26*	46	41	40	26	37	37
Himachal Pradesh	39	28	39	25	33	11*	32	15
Jammu region of Jammu and Kashmir	39	26*	39	26	25	14*	24	15
Punjab	38	22*	35	27	25	19	21	30
Rajasthan	41	34	42	31	36	12*	34	21
Central								
Madhya Pradesh	64	27*	61	37*	46	23	40	51
Uttar Pradesh	77	43*	72	78	50	33	46	63
East								
Bihar	62	31*	60	40*	44	26*	42	36
Orissa	67	55	65	76	65	33*	63	43
West Bengal	61	44*	57	54	28	23	26	26
Northeast								
Assam	57	35	55	53	40	12*	39	19
West								
Goa	31	21*	30	23	15	7*	12	10
Gujarat	63	29*	54	40	38	14*	29	24
Maharashtra	44	27*	39	34	27	11*	23	14
South								
Andhra Pradesh	55	33*	49	52	28	20	26	26
Karnataka	59	24*	55	34*	32	10*	29	15*
Kerala	25	12	24	22	9	7	8	21
Tamil Nadu	53	28*	48	41	27	16*	25	20

State	Infant mortality				Child mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	No†	Yes	No†	Yes	No†	Yes	No†	Yes
India	99	53*	90	79[n]	43	16*	37	31*
North								
Delhi	88	61*	64	64	26	16	15	17
Haryana	91	52*	83	78	36	14*	30	29
Himachal Pradesh	72	39[p]	71	40	23	12	19	43
Jammu region of Jammu and Kashmir	63	40*	63	41	23	14	19	26
Punjab	62	41[n]	56	58	23	9*	18	19
Rajasthan	77	47[p]	76	52	39	8*	35	21
Central								
Madhya Pradesh	110	50*	102	88[n]	64	12*	56	30*
Uttar Pradesh	127	76*	118	141[p]	56	28*	51	60
East								
Bihar	106	56	101	76[n]	49	21	46	31
Orissa	133	89[p]	128	119	23	7	21	10
West Bengal	89	67[n]	83	80	31	20*	26	31
Northeast								
Assam	96	47[p]	94	73	63	12*	58	49
West								
Goa	46	29*	42	32	11	5	9	7
Gujarat	100	43*	83	64	41	20	33	31
Maharashtra	71	38*	62	48	28	15*	24	19
South								
Andhra Pradesh	82	53[n]	75	78	34	7*	29	14
Karnataka	90	34*	84	49*	35	15*	30	32
Kerala	34	20	32	43	10	5	10	9
Tamil Nadu	80	43*	73	62	34	9	29	18

Unadjusted postneonatal mortality decreases substantially with increasing ownership of household goods, both in India and in all states All these results are statistically significant The adjusted effects are somewhat smaller but remain statistically significant for India and for Delhi, Haryana, Punjab, Uttar Pradesh, Bihar, Orissa, Maharashtra, and Tamil Nadu In Rajasthan, Madhya Pradesh, Assam, Gujarat, Andhra Pradesh, and Karnataka the adjusted effects are substantial but are not statistically significant

Reflecting the effects on neonatal and postneonatal mortality, unadjusted infant mortality declines substantially with increasing ownership of household goods in India and in all states Adjusted infant mortality also declines with increasing ownership of household goods, both in India and in all states, but the effect is much smaller

Unadjusted child mortality declines with increasing ownership of household goods in India and in all states This result is statistically significant for India and for every state The adjusted effect is somewhat smaller, but it remains statistically significant for India and for all states except Haryana, Rajasthan, West Bengal, Goa, and Kerala In Kerala, adjusted child mortality increases slightly with increasing ownership of household goods, but the relationship is not statistically significant

In conclusion, the economic status of a household, as measured by ownership of household goods, appears to be an important determinant of infant and child mortality, particularly as children get older For India as a whole, the difference in adjusted mortality between children in households with ownership scores of 0 and scores of 15 ranges from 8 deaths per 1,000 births for neonatal mortality to 14 per 1,000 for postneonatal mortality and 29 per 1,000 for child mortality

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Notes to Table 5 6

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted rates the hazard regressions include the following control variables child s sex year of birth mother s age at childbirth and its square residence mother s literacy religion caste/tribe of household head mother s exposure to radio or television and household toilet facilities and economic level (ownership of goods) When calculating adjusted rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

†Reference category in the underlying hazard regression

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

[n]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not postneonatal (age 1–11 months) mortality

[p]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

Table 5 7 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality, by household economic level as indicated by ownership of goods and by state

	Ownership of good score[a]							
	Unadjusted				Adjusted			
	0	5	10	15	0	5	10	15
Neonatal mortality								
India	66*	51*	40*	31*	56*	53	50*	48*
North								
Delhi	63*	48*	37*	28*	52*	43*	36*	31*
Haryana	56*	49*	42*	37*	47	46	45	44
Himachal Pradesh	35	37	39	41	32	37	42	49
Jammu region of Jammu and Kashmir	40	37	34	31	33	35	37	39
Punjab	50*	40*	32*	26*	44	38	32	28
Rajasthan	40	41	42	43	41	40	40	40
Central								
Madhya Pradesh	69*	55*	44*	36*	57	57	57	57
Uttar Pradesh	88*	70*	55*	43*	75	72	69	66
East								
Bihar	67*	50*	37*	28*	65*	52*	41*	33*
Orissa	69	64	60	56	62	68	76	84
West Bengal	70*	51*	36*	26*	59	55	51	47
Northeast								
Assam	62*	49*	39*	31*	59	52	45	39
West								
Goa	45*	33*	24*	18*	32	29	26	23
Gujarat	72*	48*	33*	22*	57	49	42	36
Maharashtra	47*	36*	28*	21*	40	37	34	31
South								
Andhra Pradesh	62*	45*	33*	24*	54	48	42	37
Karnataka	66*	47*	34*	24*	57	49	43	37
Kerala	33*	23*	16*	11*	30*	23	18*	13*
Tamil Nadu	65*	43*	29*	19*	63*	44*	30*	21*
Postneonatal mortality								
India	47*	33*	23*	16*	39*	34*	29*	25*
North								
Delhi	90*	55*	33*	20*	92*	55*	33	20*
Haryana	57*	43*	32*	24*	55*	42*	32*	25
Himachal Pradesh	41*	30*	22*	16*	31	29	27	26
Jammu region of Jammu and Kashmir	28*	23	19*	16*	24	22	21	19
Punjab	46*	32*	22*	15*	45*	32	22*	15*
Rajasthan	40*	31*	23	18*	36	32	27	24
Central								
Madhya Pradesh	57*	39*	27*	19*	47	41	36	31
Uttar Pradesh	63*	45*	32*	23*	58*	46*	37*	29*
East								
Bihar	55*	33*	20*	12*	52*	34*	22*	15*
Orissa	78*	53*	36*	24*	73*	55*	41*	31*
West Bengal	32*	25*	19*	15*	29	25	23	20
Northeast								
Assam	45*	32	23*	16*	40	35	32	28
West								
Goa	24*	15*	10*	6*	17	13	10	8
Gujarat	47*	27	16	9*	35	27	22	17
Maharashtra	32*	19*	11*	6*	26*	19*	14*	10*
South								
Andhra Pradesh	31*	24*	19*	15*	31	24	19	15
Karnataka	38*	24*	15*	10*	31	25	20	16
Kerala	15*	9*	5*	3*	14	9	6	4
Tamil Nadu	34*	23*	16*	11*	36*	23*	14*	9

Table 5 7, continued

	Ownership of good score[a]							
	Unadjusted				Adjusted			
	0	5	10	15	0	5	10	15
Infant mortality								
India	113*	84*	63*	47*	95*	87*	80*	73*
North								
Delhi	154*	103*	70*	48*	144*	99*	69*	50*
Haryana	113*	92*	74*	61*	102[p]	88[p]	77[p]	69[p]
Himachal Pradesh	76[p]	67[p]	61[p]	57[p]	63	66	70	74
Jammu region of Jammu and Kashmir	68[p]	60[p]	53[p]	47[p]	57	57	57	58
Punjab	96*	72*	54*	41*	89[p]	69[p]	54[p]	43[p]
Rajasthan	80[p]	71[p]	65[p]	61[p]	77	72	68	64
Central								
Madhya Pradesh	125*	95*	71*	54*	104	98	93	88
Uttar Pradesh	151*	115*	88*	67*	133[p]	118[p]	106[p]	95[p]
East								
Bihar	122*	83*	57*	40*	117*	86*	63*	47*
Orissa	147[p]	117[p]	96[p]	81[p]	135[p]	123[p]	117[p]	115[p]
West Bengal	102*	75*	55*	41*	87	80	73	67
Northeast								
Assam	107*	81*	61*	46*	99	87	76	67
West								
Goa	69*	48*	34*	24*	49	42	36	31
Gujarat	119*	76*	49*	31*	91	76	64	53
Maharashtra	79*	55*	39*	28*	66[p]	56[p]	47[p]	41[p]
South								
Andhra Pradesh	92*	70*	53*	40*	86	72	61	51
Karnataka	103*	71*	49*	34*	88	74	62	53
Kerala	48*	32*	21*	14*	44[n]	32[n]	23[n]	17[n]
Tamil Nadu	99*	66*	44*	29*	98*	66*	45*	30*
Child mortality								
India	58*	33*	18*	10*	47*	34*	24*	18*
North								
Delhi	58*	34*	20*	11*	51*	31*	19*	12*
Haryana	54*	37*	25*	17*	35	31	29	26
Himachal Pradesh	52*	23*	10*	4*	41*	22*	12*	6*
Jammu region of Jammu and Kashmir	39*	25*	16*	10*	35*	24*	16*	11*
Punjab	67*	34*	17*	8*	67*	33*	17*	8*
Rajasthan	43*	31*	22*	16*	36	33	29	26
Central								
Madhya Pradesh	90*	46*	23*	12*	70*	49*	34*	23*
Uttar Pradesh	80*	48*	28*	16*	73*	48*	32*	21*
East								
Bihar	64*	33*	17*	9*	60*	35*	21*	12*
Orissa	31*	16*	8*	4*	29*	16*	9*	5*
West Bengal	40*	24*	14*	8*	34	25	18	14
Northeast								
Assam	91*	39*	16*	7*	75*	46*	28*	17*
West								
Goa	20*	12*	7*	4*	12	10	8	6
Gujarat	53*	33*	20*	12*	46*	33*	23*	16*
Maharashtra	40*	21*	11*	6*	33	22*	14*	9*
South								
Andhra Pradesh	43*	20*	9*	4*	43*	20*	9*	4*
Karnataka	48*	27*	15*	9*	41*	28*	19	13*
Kerala	14	9	6	4	9	10	10	11
Tamil Nadu	48*	23*	11 *	5*	43*	24*	13*	7*

SUMMARY

The unadjusted effects of socioeconomic characteristics on infant and child mortality, as estimated by hazard models, are consistent with findings based on period life tables that are given in the NFHS reports Rural residence, mother's illiteracy, household head's Hindu religion and membership in a scheduled caste or scheduled tribe, mother's lack of exposure to mass media, household's lack of access to a flush or pit toilet, use of unclean cooking fuel, and low ownership of household goods—all these variables are associated with high infant and child mortality when we examine each variable one at a time In other words, all of these variables have strong unadjusted effects on infant and child mortality

An examination of both unadjusted and adjusted effects of socioeconomic characteristics on infant and child mortality leads to three general observations First, although all the variables have strong and statistically significant unadjusted effects on mortality, their adjusted effects are much smaller and are often not statistically significant Second, the effects of most socioeconomic characteristics are smallest during the neonatal period and largest during childhood There are some exceptions For example, religion-caste/tribe and access to a flush or pit toilet have stronger effects on neonatal mortality than on postneonatal or child mortality The third general observation is that adjusted effects of socioeconomic characteristics tend to be stronger in states with high levels of mortality

Some of the variables examined here have stronger adjusted effects than others Mother's literacy and ownership of household goods have particularly strong adjusted

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Notes to Table 5 7

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted rates the hazard regressions include the following control variables child s sex year of birth mother s age at childbirth and its square residence mother s literacy religion caste/tribe of household head mother s exposure to radio or television and household toilet facilities and economic level (ownership of goods) When calculating adjusted rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

[a] The ownership of goods score is the sum of points as follows with a maximum of 27 points possible 4 for a car 3 for a refrigerator television VCR/VCP or motorcycle/scooter 2 for a sewing machine sofa set fan radio/transistor or bicycle 1 for a clock/watch

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not postneonatal (age 1–11 months) mortality

[b] The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

effects (Figures 5 1 and 5 2) To a lesser extent, head of household's religion and caste/tribe membership and access to a flush or pit toilet have substantial and often statistically significant effects (Figures 5 3 and 5 4) For access to a flush or pit toilet, the adjusted effect is particularly strong on neonatal mortality In general, all these effects are larger in states where the general level of mortality is high

It would be difficult to reduce infant and child mortality by changing socioeconomic characteristics such as mother's literacy or ownership of household goods in a short period of time The findings in this section, however, can be used to identify the households most likely to experience high levels of infant and child mortality Family health programmes should concentrate their efforts on such households High-risk households include those headed by Hindus belonging to a scheduled caste or scheduled tribe, those without access to a flush or pit toilet, those with very low economic status, and those where mothers are illiterate

The relationship between religion-caste/tribe and infant and child mortality varies greatly from state to state, indicating that the effect of this socioeconomic variable is complex These results call for close examination of the customs practiced by different religious and caste/tribe groups relating to childbirth and the care of newborns and young children

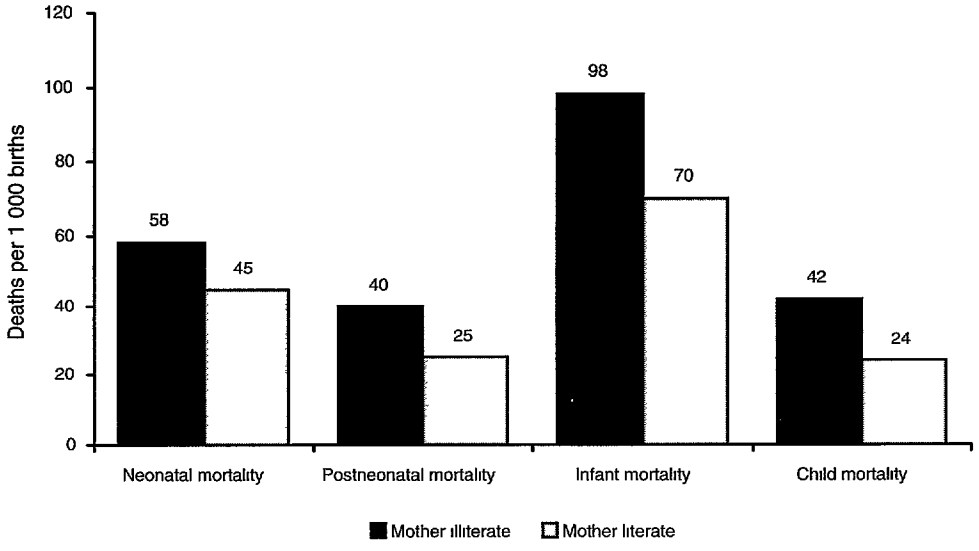

Figure 5 1 Adjusted neonatal, postneonatal, infant, and child mortality in India, by mother's literacy

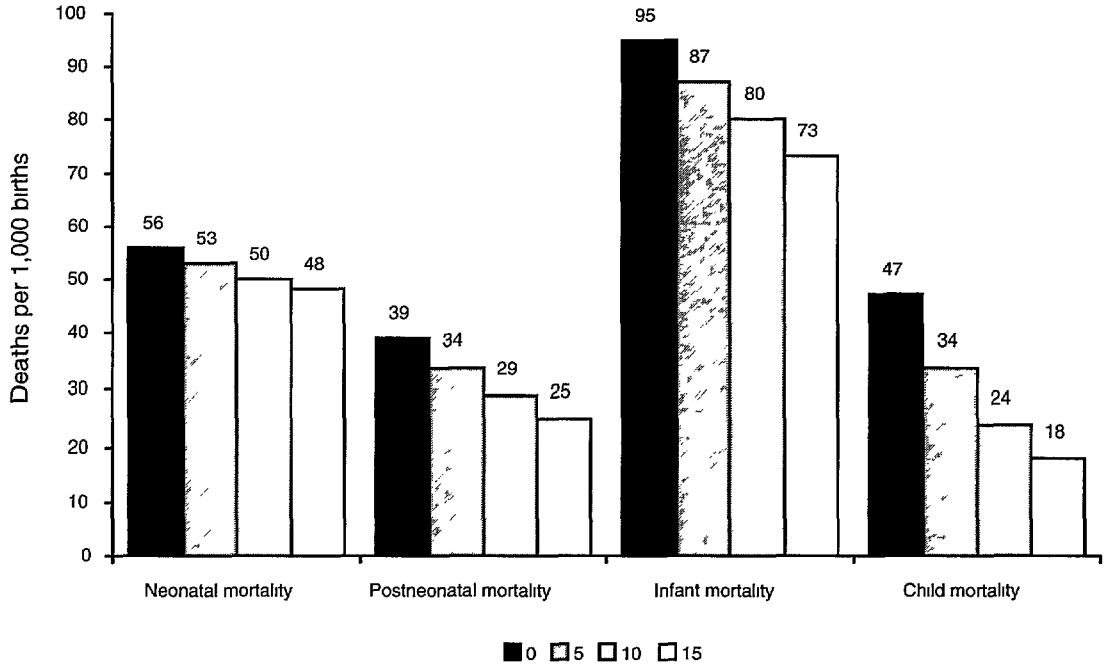

Figure 5 2 Adjusted neonatal, postneonatal, infant, and child mortality in India, by household economic level as indicated by score for ownership of goods

Note The household score for ownership of goods is the sum of points as follows with a maximum of 27 points possible 4 for a car 3 for a refrigerator television VCR/VCP or motorcycle/scooter 2 for a sewing machine sofa set fan radio/transistor or bicycle 1 for a clock/watch

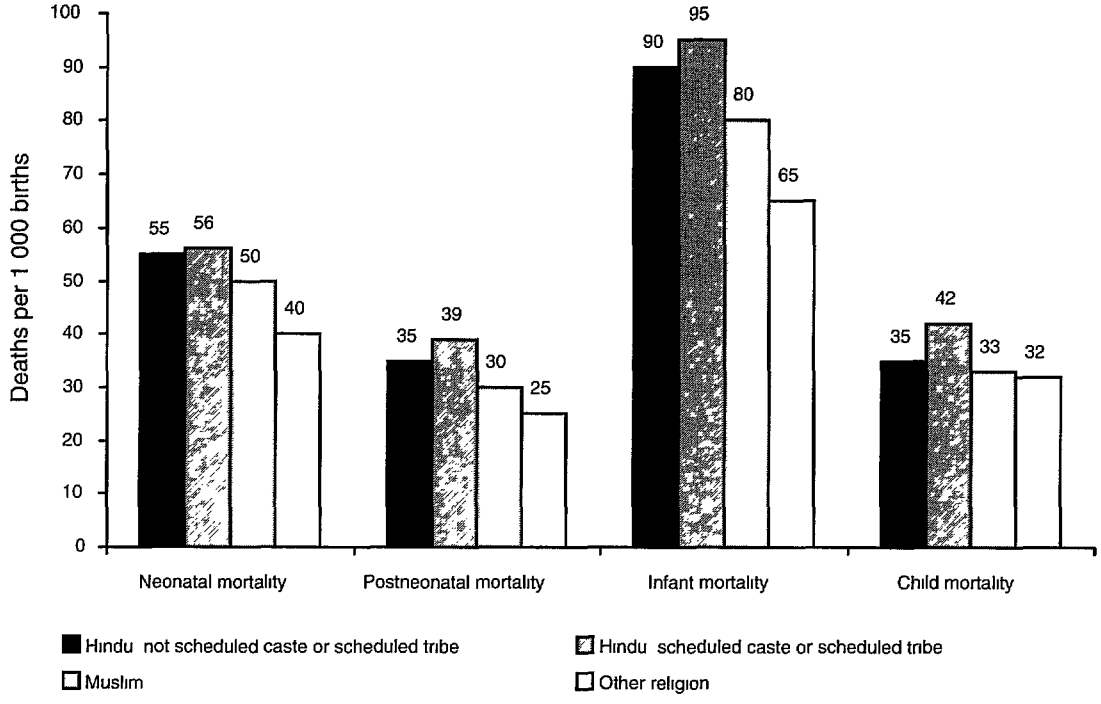

Figure 5 3 Adjusted neonatal, postneonatal, infant, and child mortality in India, by religion and scheduled-caste/scheduled-tribe membership of household head

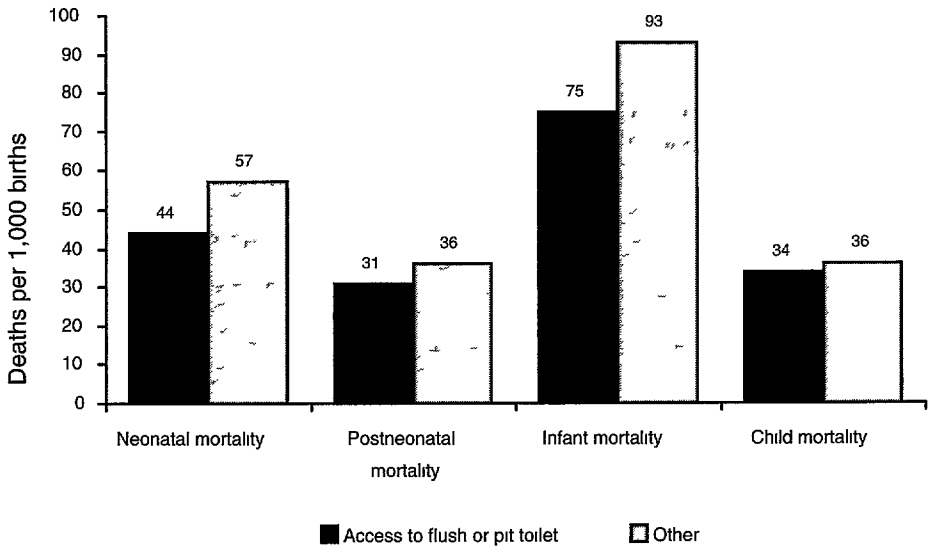

Figure 5 4 Adjusted neonatal, postneonatal, infant, and child mortality in India, by type of toilet facility available in household

6 Effects of Demographic Characteristics on Infant and Child Mortality

In this chapter we estimate unadjusted and adjusted effects of birth order, mother's age at childbirth, previous birth interval, mortality of older siblings, and following birth interval on neonatal, postneonatal, infant, and child mortality The dependent variable is a set of monthly probabilities of dying, which is a basis for calculating a complete life table We use four sets of hazard-model specifications to estimate the adjusted effects of the independent variables, depending on (1) whether the child is first born and (2) whether the model is for child mortality For first-born children, the models do not include previous birth interval or mortality of older siblings The effect of following birth interval is estimated only for child mortality because very few children in the neonatal, postneonatal, or infant age group would have a younger sibling

Birth order is coded as four dummy variables representing birth orders 3, 4, 5, and 6 and above (≥6), with birth order 2 as the reference category Mother's age at childbirth is coded as a continuous variable In order to allow a non-linear relationship between mortality and mother's age at childbirth, we also include the square of mother's age at childbirth in the model Previous birth interval is coded as a dummy variable indicating whether or not this interval is shorter than 24 months, and mortality of older siblings is coded as a dummy variable indicating whether or not any older siblings have died

We treat following birth interval as a time-dependent variable whose value may change from month to month In our hazard models for child mortality the following birth is coded as a set of dummy variables, one value for each month in childhood Its value is 0 before the birth of the next child and 1 after the birth of the next child For example, if a younger sibling is born when the child is 24 months old, the variable indicating following birth takes the value 0 for the first 24 months and then the value 1 after that Based on a multiple classification analysis (MCA) showing the effect of following birth we estimate child mortality for four hypothetical situations the

following birth occurs when the child is 24 months old, 36 months old, 48 months old, or not before child is 5 years old

BIRTH ORDER

Usually the relationship between birth order and mortality at early ages takes a U-shaped form Mortality is high for first-born children and births of very high orders and is low for births of order 2 or 3 First-order births are more likely to have a difficult birth process than later births, thus increasing the risk of neonatal mortality In addition, first-born children are likely to be raised by parents with limited skills and experience, possibly increasing the risk of infant and child mortality Births of very high order may have mothers who are physically depleted at the time of conception and throughout pregnancy They are thus more likely than other children to suffer from conditions associated with high mortality risk such as fetal growth retardation and low birth weight High-order births are also born into families that already have a number of young children who compete for resources and parental care The effects of first-order birth are likely to be strongest during the neonatal period, while the effects of high-order birth are likely to be strongest at older ages

As shown in Table 6 1, unadjusted neonatal mortality has a U-shaped relationship with birth order in India as a whole and in most states, with the highest mortality at birth orders 1 and 6 and above (≥ 6) In Goa, Andhra Pradesh, and Tamil Nadu, the relationship is generally U-shaped, but there are a few irregularities In Haryana, Himachal Pradesh, and Punjab, the relationship does not show any clear pattern In India and in nine of the 19 states, unadjusted neonatal mortality is lowest for third-order births, rather than for the second-order births that were used as the dummy variable

Adjusted neonatal mortality is estimated from a hazard model that includes socioeconomic characteristics and demographic factors such as previous birth interval, if appropriate, and mother's age at childbirth Controlling for these factors changes the effect of birth order considerably, probably because of the high correlation between birth order and mother's age at childbirth With adjustments for other factors, neonatal mortality decreases linearly with increasing birth order

Unadjusted and adjusted effects of birth order on neonatal mortality are statistically significant for India as a whole but for only a few individual states The difference between unadjusted neonatal mortality for birth orders 2 and ≥ 6 is statistically significant for five states Rajasthan, Goa, Karnataka, Kerala, and Tamil Nadu Because mortality estimates for first-order births are computed from different models than estimates for other births, we cannot calculate the statistical significance of differences in mortality for first-born children and children of higher birth orders

For many states, there are only a small number of neonatal deaths at each birth order Statistical estimation is not efficient with such small samples, particularly when

Table 6 1 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality, by birth order and by state

State	Birth order											
	Unadjusted						Adjusted					
	1	2†	3	4	5	≥6	1	2†	3	4	5	≥6
Neonatal mortality												
India	64	46	42*	48	49	59*	64	55	46*	47*	43	43*
North												
Delhi	41	30	24	33	36	43	41	38	25	29	27	24
Haryana	51	41	50	35	50	30	51	41	51	35	48	29
Himachal Pradesh	43	31	33	37	31	29	43	31	34	37	30	25
Jammu region of Jammu and Kashmir	44	27	26	31	41	35	44	37	30	28	31	19
Punjab	41	29	28	33	29	28	41	37	30	27	20	16
Rajasthan	50	38	31	34	34	53*	50	45	34	34	31	36
Central												
Madhya Pradesh	73	51	44	50	44	61	73	60	49	49	39*	44
Uttar Pradesh	91	63	58	65	74	71	91	69	63	66	71	61
East												
Bihar	69	54	48	53	41	59	69	59	51	53	38*	50
Orissa	87	57	43	57	70	58	87	61	45*	56	66	49
West Bengal	60	46	46	44	61	59	60	59	51	42	50	40
Northeast												
Assam	67	47	50	52	39	56	67	54	55	52	37	45
West												
Goa	27	26	20	23	18	57*	27	32	20	20	11	38
Gujarat	65	43	31	49	35	56	65	39	32	50	39	63
Maharashtra	47	37	27	27	23	37	47	40	29	27	20	25
South												
Andhra Pradesh	64	48	33	41	35	54	64	56	36*	38	27*	32
Karnataka	59	43	38	47	46	60*	59	50	40	45	41	44
Kerala	21	20	18	34	38	40*	21	26	19	28	29	15
Tamil Nadu	50	36	43	43	37	75	50	43	44	38	29	49
Postneonatal mortality												
India	32	29	29	35*	39*	48*	32	32	31	34	36	40*
North												
Delhi	24	25	28	27	58*	45*	24	23	29	29	63	46
Haryana	34	34	30	35	35	68*	34	33	31	36	35	69*
Himachal Pradesh	20	32	27	28	25	48	20	38	29	25	19	33
Jammu region of Jammu and Kashmir	19	25	12*	27	31	30	19	32	13	24	24	21
Punjab	17	19	27	35*	42*	25	17	23	28	31	34	17
Rajasthan	29	31	30	31	32	53*	29	36	32	31	29	40
Central												
Madhya Pradesh	39	37	41	42	46	59*	39	40	43	41	44	53
Uttar Pradesh	47	42	36	48	58	65*	47	43	38	49	59*	60*
East												
Bihar	41	40	37	40	43	49	41	40	38	42	44	45
Orissa	67	59	56	61	54	75	67	57	55	61	57	78
West Bengal	29	24	22	24	36	31	29	28	23	24	32	24
Northeast												
Assam	40	31	40	45	32	41	40	30	41	47	34	39
West												
Goa	14	5	10	16	26*	25*	14	4	9	19*	36*	52*
Gujarat	29	25	30	28	26	34	29	30	30	23	20	30
Maharashtra	19	18	18	21	22	21	19	16	18	22	24	27
South												
Andhra Pradesh	25	23	25	34	26	36	25	25	26	32	21	25
Karnataka	22	29	22	26	31	36	22	27	22	27	35	40
Kerala	7	8	8	11	28*	34*	7	9	8	11	30	20
Tamil Nadu	23	26	19	24	34	39	23	24	18	25	38	50

Table 6 1, continued

State	Birth order											
	Unadjusted						Adjusted					
	1	2†	3	4	5	≥6	1	2†	3	4	5	≥6
Infant mortality												
India	96	76	71[n]	83[p]	88[p]	108	96	87	76[n]	81[n]	80*	83*
North												
Delhi	65	55	52	60	94[p]	88[p]	65	61	55	58	91[p]	71
Haryana	85	75	81	70	85	98[p]	85	75	82	71	83	98[p]
Himachal Pradesh	63	62	60	66	56	77	63	69	63	63	49	58
Jammu region of Jammu and Kashmir	63	52	38[p]	58	72	65	63	70	43[p]	52	55	40
Punjab	58	48	55	68[p]	70[p]	53	58	60	57	58	55	33
Rajasthan	79	70	61	65	67	106*	79	82	66	65	60	76
Central												
Madhya Pradesh	112	88	85	92	90	120[p]	112	100	92	91	83[n]	97
Uttar Pradesh	138	105	94	113	132[p]	136[p]	138	112	100	115	129[p]	121[p]
East												
Bihar	110	94	85	93	84	108	110	100	88	95	81[n]	95
Orissa	153	116	99	118	124	133	153	119	100[n]	117	123	128
West Bengal	89	70	68	68	97	91	89	86	74	66	82	64
Northeast												
Assam	107	78	90	97	71	97	107	84	97	100	71	84
West												
Goa	41	31	30	38	43[p]	82*	41	36	29	39[p]	47[p]	90[p]
Gujarat	94	68	61	77	61	90	94	70	62	73	59	93
Maharashtra	67	55	45	48	44	58	67	57	47	49	43	52
South												
Andhra Pradesh	89	71	58[n]	74	61	90	89	81	63[n]	70	48[n]	57
Karnataka	81	72	60	73	78	96[n]	81	76	62	72	76	85
Kerala	28	28	26	45	65[p]	74*	28	34	28	38	59[p]	34
Tamil Nadu	73	62	61	67	71	113[n]	73	66	62	63	67	99
Child mortality												
India	26	34	38*	42*	47	53*	26	37	41	44*	48*	51*
North												
Delhi	12	10	10	18	26*	30*	12	14	13	24	35	35
Haryana	26	32	28	40	42	63*	26	44	32	38	34	57
Himachal Pradesh	14	25	25	27	30	54	14	39	37	33	30	49
Jammu region of Jammu and Kashmir	16	21	17	40	50*	60*	16	25	18	38	39	52
Punjab	13	12	27*	37*	24	35*	13	11	28*	40*	25	33
Rajasthan	27	32	32	36	41	49*	27	37	33	37	38	38
Central												
Madhya Pradesh	43	57	56	53	70	57	43	57	59	57	75	59
Uttar Pradesh	44	51	59	61	63	69*	44	54	62	63	65	68
East												
Bihar	28	48	50	49	49	45	28	50	54	56	59	56
Orissa	13	19	15	20	22	30	13	20	16	23	26	30
West Bengal	17	25	32	34	30	44*	17	23	33	38	37	53*
Northeast												
Assam	43	54	62	69	67	64	43	56	66	75	76	81
West												
Goa	9	8	5	24	16	30	9	NE	NE	NE	NE	NE
Gujarat	33	26	31	24	36	35	33	30	33	22	30	23
Maharashtra	14	21	26	28	39	26	14	20	25	30	42	32
South												
Andhra Pradesh	17	31	27	26	19	56*	17	38	33	32	22	76
Karnataka	27	37	36	34	52	42	27	30	34	40	68*	72*
Kerala	5	11	13	4	12	37*	5	9	13	4	21	68*
Tamil Nadu	20	27	36	59*	43	42	20	28	39	67	50	48

there are a large number of additional predictor variables in the estimation model For this reason, we conducted a separate analysis of statistical significance comparing unadjusted neonatal mortality for only two birth orders 3 and ≥6 The difference between unadjusted neonatal mortality at these two birth orders is statistically significant for India and for 10 out of 19 states Rajasthan, Goa, Karnataka, Kerala, Tamil Nadu, Delhi, Madhya Pradesh, Uttar Pradesh, Gujarat, and Andhra Pradesh

The first-born child's high risk of mortality diminishes after the neonatal period Unadjusted postneonatal mortality in India is quite similar for birth orders 1, 2, and 3 and rises for births at higher orders The adjusted effect of birth order is similar to the unadjusted effect, but somewhat smaller in magnitude, both for India and for most states In India, children of birth orders 5 and ≥6 experience 16 and 29 percent higher postneonatal mortality, respectively, than do children of birth order 3, controlling for the effects of other variables The unadjusted and adjusted effects of birth order on postneonatal mortality are statistically significant for India as a whole but for only a few states

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Notes to Table 6 1

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates for children of birth order two or higher are predicted values calculated from hazard regressions Adjusted mortality rates for children of birth order two or higher are computed from hazard regression models that include the following control variables length of previous birth interval number of deceased older siblings child s sex year of birth mother s age at childbirth and its square residence mother s literacy religion caste/tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) as well as the interactions of these last three variables with residence For child mortality rates length of following birth interval is added as a control variable Because some of these variables are meaningless for children of birth order one unadjusted and adjusted neonatal postneonatal infant and child mortality rates for children of birth order one are calculated from ordinary cohort life tables restricted to the population of all children of birth order one Consequently for children of birth order one there is no difference between unadjusted and adjusted values and there is no basis for determining of statistical significance When calculating adjusted mortality rates for children of birth order two or higher the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

NE Not estimated because the hazard model did not converge properly

†Reference category in the underlying hazard regression for children of birth order two or higher

The coefficient of the corresponding variable in the underlying hazard regression for children of birth order two or higher differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression for children of birth order two or higher differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not for postneonatal (age 1–11 months) mortality

[P]The coefficient of the corresponding variable in the underlying hazard regression for birth order two or higher differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not for neonatal (first month) mortality

Combining neonatal and postneonatal mortality, unadjusted infant mortality in India has a U-shaped relationship with birth order, with the lowest value for children of birth order 3 The relationship between birth order and adjusted infant mortality is similar but smaller in magnitude The U-shaped relationship between birth order and adjusted infant mortality is actually the result of a negative relationship between birth order and adjusted neonatal mortality and a positive relationship between birth order and adjusted postneonatal mortality State-level patterns are similar with some variations Unadjusted infant mortality has a clear U-shaped relationship with birth order in almost all states Adjusted infant mortality has a flatter pattern, but still U-shaped, in all states except Himachal Pradesh, Jammu region, Punjab, West Bengal, Assam, Andhra Pradesh, and Kerala

Once children survive infancy, the elevated mortality risk of first-borns disappears completely First-order births have the lowest child mortality in India as a whole and in most states Exceptions occur in Delhi, Punjab, Goa, and Kerala, where births of order 2, 3, or 4 experience slightly lower unadjusted child mortality than do first-order births The adjusted effect of birth order on child mortality is similar, both in direction and magnitude In India and in all states except Punjab, Gujarat, and Kerala, first-born children experience lower adjusted child mortality than do children of any other birth order In Punjab and Gujarat, second-born children experience slightly lower adjusted child mortality than do first born In Kerala, fourth-born children experience lower adjusted child mortality than do first born

Thus, the adjusted effect of birth order on mortality differs at different ages, as shown in Figure 6 1 For the neonatal period, mortality is highest for first-order births, no doubt due to biological factors associated with the general difficulty of first births and a tendency in India for first-time mothers to be very young For the postneonatal and childhood periods, birth order has the opposite effect, with mortality higher for higher-order births During these stages of children's development, mortality is more likely to depend on the care they receive than on biological factors Children of high-order births face competition from older siblings for food and parental attention They also face exposure to infectious childhood diseases from their siblings In addition the mother's nutritional status, which affects birth weight and lactation may decrease with high-order births

MOTHER'S AGE AT CHILDBIRTH

Children born to mothers under 20 or over 30 years old are likely to have elevated risks of mortality Very young mothers may experience difficult pregnancies and deliveries because of their physical immaturity They are also likely to have limited knowledge and confidence in caring for infants and young children Women over 30

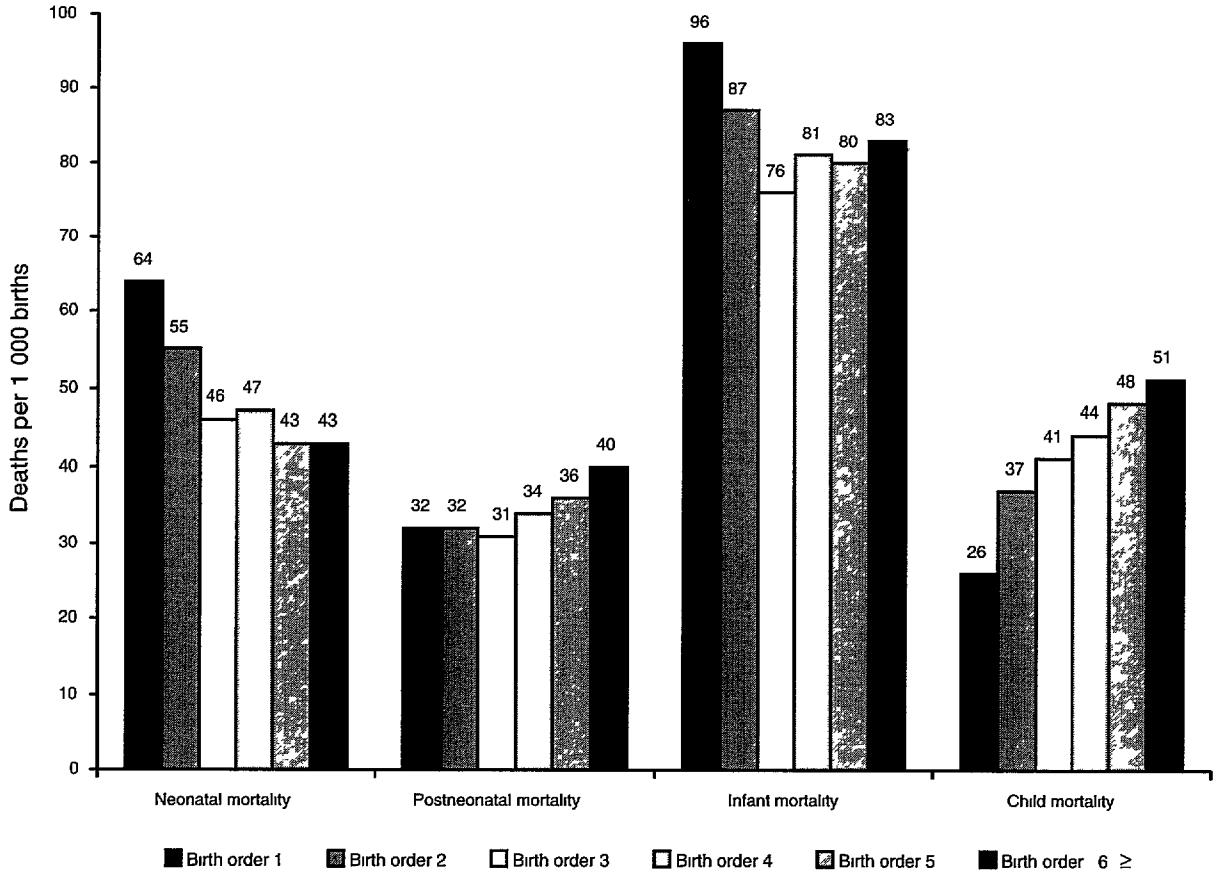

Figure 6 1 Adjusted neonatal, postneonatal, infant, and child mortality in India, by birth order

may also experience age-related problems during pregnancy and delivery Thus we expect a U-shaped relationship between mother's age at childbirth and infant and child mortality

We examine the effect of mother's age at childbirth separately for first-born children and for all other children Table 6 2 shows the effect of mother's age on first-born children In India as a whole, the unadjusted effect of mother's age at childbirth is very large and statistically significant for all measures of mortality First-born children born to mothers under age 20 experience much higher neonatal, postneonatal, infant, and child mortality than do first-born children born to older mothers, both in India as a whole and in most states Exceptions are postneonatal mortality in Orissa, Andhra Pradesh, and Kerala These exceptions are not statistically significant, however, and may be due to small sample sizes because the analysis is restricted to first-born children

For first-born children, the unadjusted effect on neonatal mortality of mother's age at childbirth is statistically significant in eight states Jammu region, Uttar Pradesh,

Bihar, Orissa, West Bengal, Assam, Gujarat, and Karnataka The unadjusted effect on postneonatal mortality is only significant in five states (Uttar Pradesh, West Bengal, Goa, Gujarat, and Maharashtra), and the unadjusted effect on child mortality is only significant in six states (Punjab, Uttar Pradesh, Bihar, Orissa, Gujarat, and Tamil Nadu) The adjusted effect is similar to the unadjusted effect, but it is smaller For first-born children, the adjusted effect of mother's age at childbirth on neonatal mortality is not statistically significant in Uttar Pradesh or West Bengal, the adjusted effect on postneonatal mortality is not statistically significant in Uttar Pradesh, Goa, or Maharashtra, and the adjusted effect on child mortality is not statistically significant in Punjab, Bihar, or Tamil Nadu

Table 6 3 shows the unadjusted and adjusted effects of mother's age at childbirth on neonatal, postneonatal, infant, and child mortality for second and higher-order births The unadjusted effect on neonatal mortality is quite large and statistically significant For India as a whole, neonatal mortality is lowest among children born to mothers age 25–30 and is much higher for very young and very old mothers Similar U-shaped patterns occur in all states except Haryana and Punjab, where neonatal mortality goes down with mother's age at childbirth The unadjusted effect is statistically significant in 11 out of 19 states Curiously, of the six northern states the relationship is statistically significant only in Rajasthan

For second and higher-order births, the adjusted effect on neonatal mortality of mother's age at childbirth has a similar U-shaped pattern to the unadjusted effect but is much smaller In six states where the unadjusted effect is statistically significant (Rajasthan, Bihar, Assam, Goa, Maharashtra, and Karnataka), the adjusted effect is not significant The adjusted neonatal mortality rate goes down with mother's age in Gujarat, Delhi, Goa, Haryana, and Punjab, although the effect is small and not statistically significant except in Gujarat In Jammu region, West Bengal, and Tamil Nadu, the adjusted neonatal mortality rate goes up with mother's age, but the relationship is not significant

The effect of mother's age at childbirth on postneonatal mortality of second and higher-order births is similar to the effect on neonatal mortality In India as a whole and in 10 states, the unadjusted effect is U-shaped and statistically significant, with postneonatal mortality lowest for children of mothers age 25–30 The adjusted effect is similar in shape but somewhat smaller in magnitude in India and in most states It is statistically significant in only five states

The unadjusted effect of mother's age at childbirth on infant mortality of second and higher-order births has a U-shaped pattern in all states but Punjab The adjusted effect shows more variation The pattern of the effect departs from the U shape in seven states, but the relationship is not statistically significant

The unadjusted effect of mother's age at childbirth on child mortality of second and higher-order births is similar to the effect on neonatal and postneonatal mortality

Table 6 2 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality for children of birth order one, by mother's age at childbirth and by state

State	Age of mother at childbirth											
	Neonatal mortality						Postneonatal mortality					
	Unadjusted			Adjusted			Unadjusted			Adjusted		
	15	20	25	15	20	25	15	20	25	15	20	25
India	87*	57	46*	76	59*	55*	43*	27*	21	35	29	27*
North												
Delhi	53	41	36	40	41	42	58	26	11	30	24	18
Haryana	65	48	42	57	49	47	57	29	18	48	30	21
Himachal Pradesh	70	42	31	59	42	34	40	19	12	32	19	14
Jammu region of Jammu and Kashmir	92*	41*	32*	75*	40*	38*	21	21	12	17	20	15
Punjab	49	45	31	44	44	33	21	15	17	17	15	19
Rajasthan	63	46	39	66	44	40	41	26	17	39	26	18
Central												
Madhya Pradesh	79	69	73	73	71	87	43	33	32	36	35	43
Uttar Pradesh	120*	84	72*	108	86	80	71	38*	27*	61	39	31
East												
Bihar	104*	57	46	96*	58*	53*	46	35	36	39	38	42
Orissa	114*	77	73	107*	78*	79*	60	67	43	50	71	52
West Bengal	89*	47	34*	71	52	49	49*	19*	14*	39*	20	21*
Northeast												
Assam	91*	52*	48*	84*	54*	57*	48	31	26	42	33	34
West												
Goa	128	49	21	51	36	25	49*	17*	10	19	13	12
Gujarat	117*	58*	48*	91*	59*	61*	66*	24	17	48	25*	21*
Maharashtra	70	42	25	60	44	31	30*	14	10	25	15	13
South												
Andhra Pradesh	77	56	40	69	61	49	24	22	23	21	24	28
Karnataka	88*	46*	34*	79*	49*	39*	28	18	13	21	21	21
Kerala	40	22	16	26	20	20	11	13	4	7	13	4
Tamil Nadu	56	47	50	46	48	58	24	21	20	18	21	26

State	Infant mortality						Child mortality					
	Unadjusted			Adjusted			Unadjusted			Adjusted		
	15	20	25	15	20	25	15	20	25	15	20	25
India	129*	84*	68*	111*	88*	82*	66*	34	24*	49	36	34*
North												
Delhi	111	68	47	70	66	60	26	16	7	NE	NE	NE
Haryana	122	76	60	105	79	69	63	32	21	46	33	28
Himachal Pradesh	110	61	42	91	61	48	85	25	14	56	34	30
Jammu region of Jammu and Kashmir	113[n]	62[n]	44[n]	92[n]	60[n]	54[n]	40	35	15	24	30	28
Punjab	70	60	48	61	60	52	39	19*	19*	27	18	23
Rajasthan	104	71	56	105	70	58	46	34	27	35	28	23
Central												
Madhya Pradesh	122	102	106	108	106	130	81	50	33	70	55	48
Uttar Pradesh	191	122*	99	170	125	112	96*	52*	41*	70*	48	44
East												
Bihar	149[n]	91[n]	82[n]	135[n]	96[n]	95[n]	65*	41*	39	77	61	66
Orissa	174[n]	144[n]	116[n]	158[n]	149[n]	131[n]	43*	13	14	56	24	31
West Bengal	137	65*	48*	111[p]	72[p]	71[p]	44	25	21	40	27	27
Northeast												
Assam	139[n]	83[n]	74[n]	126[n]	87[n]	91[n]	78	57	38	66	72	73
West												
Goa	177[p]	66[p]	30[p]	71	49	37	35	15	8	29	13	8
Gujarat	183*	83*	65*	140*	83*	83*	87*	25*	16*	71	27*	23*
Maharashtra	100[p]	55[p]	35[p]	85	60	44	41	19	14	47	26	20
South												
Andhra Pradesh	100	78	63	91	85	77	41	28	6	32	28	9
Karnataka	116[n]	64[n]	47[n]	100[n]	69[n]	60[n]	56	33	19	40	36	30
Kerala	51	34	20	33	34	24	29	11	8	147	96	107
Tamil Nadu	80	68	70	63	69	84	100*	31	17	79	34	23

For India as a whole, the unadjusted effect has a U-shaped pattern, and the relationship is statistically significant A similar U-shape pattern is observed in 10 states and is statistically significant in five states By contrast, in Punjab, Bihar, Assam, Goa, Maharashtra, Andhra Pradesh, and Karnataka, unadjusted child mortality among second and higher-order births decreases as mother's age at childbirth increases The effect is statistically significant in Bihar Adjusted child mortality decreases as mother's age at childbirth increases in India as a whole, and the effect is statistically significant A similar pattern is observed in eight states—Punjab, Rajasthan, Bihar, Assam, Maharashtra, Karnataka, Kerala, and Tamil Nadu—although the effect is not statistically significant in any of these states By contrast, in Orissa, Delhi, Madhya Pradesh, Uttar Pradesh, West Bengal, and Gujarat, the relationship between mother's age at childbirth and child mortality among second and higher-order births shows a U-shaped pattern, but the effect is only statistically significant in Orissa

According to the NFHS, 34 percent of first-born children in India were born to mothers under age 18 (Table 2 5) The proportion is especially high in Andhra Pradesh, Assam, West Bengal, Karnataka, Maharashtra, and Madhya Pradesh Our findings indicate that mortality before age five can be reduced substantially if women wait until they are in their 20s to begin childbearing Few children in India are born to mothers age 35 or over Thus, reducing births to older women would only have a small impact on infant and child mortality

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Notes to Table 6 2

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions Adjusted mortality rates for children of birth order one are computed from hazard regression models that include the following control variables child s sex year of birth residence mother s literacy religion caste/tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) as well as the interactions of these last three variables with residence For child mortality rates length of following birth interval is added as a control variable When calculating adjusted mortality rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life Because mother s age at childbirth and its square are coded as continuous variables there is no reference category

NE Not estimated because the hazard model did not converge properly

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not for postneonatal (age 1–11 months) mortality

[p]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

Table 6 3 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality for children of birth order two or higher, by mother's age at childbirth and by state

	Age of mother at childbirth									
	Unadjusted					Adjusted				
State	15	20	25	30	35	15	20	25	30	35
Neonatal mortality										
India	77	53*	43*	42	49*	58*	49*	45*	46*	52*
North										
Delhi	62	38	28	26	29	32	32	31	29	28
Haryana	76	54	40	31	25	51	46	41	37	33
Himachal Pradesh	40	33	31	31	35	38	31	30	34	44
Jammu region of Jammu and Kashmir	37	30	28	30	35	21	24	29	35	45
Punjab	48	37	29	24	21	30	30	29	28	27
Rajasthan	62*	41*	33*	32*	39*	44	37	34	36	41
Central										
Madhya Pradesh	99*	58*	43	41*	50*	70*	52*	46*	46	54*
Uttar Pradesh	110*	77	62*	58*	62*	89*	71*	62*	61	66*
East										
Bihar	78*	59*	49*	45*	47	58	53	50	50	52
Orissa	78	60	52	49	53	63	56	53	53	57
West Bengal	61	50	46	47	55	40	44	50	56	64
Northeast										
Assam	68*	52*	46*	45*	51*	52	48	47	50	57
West										
Goa	76*	38*	24*	20*	22*	27	26	25	24	24
Gujarat	134*	60*	36*	29*	33*	112*	60	38*	29*	26
Maharashtra	79*	37*	24*	22*	29*	49	33	27	27	31
South										
Andhra Pradesh	80*	43*	33*	35	54*	51*	39*	38*	44*	65
Karnataka	72*	48*	39*	39	46*	58	47	42	41	44
Kerala	47*	25*	19*	21	34*	36*	23*	20	23*	36
Tamil Nadu	47	40	39	43	55	35	36	40	47	57
Postneonatal mortality										
India	48*	36*	31*	31*	37*	45*	36*	32*	31*	33*
North										
Delhi	91*	40*	26*	24*	34*	85*	41*	26	24*	30
Haryana	59	40	34	34	42	61	44	35	31	31
Himachal Pradesh	65*	37*	27*	26*	31	35	32	30	29	30
Jammu region of Jammu and Kashmir	26	23	22	22	23	12	17	23	27	27
Punjab	16	24	28	26	19	13	22	28	28	22
Rajasthan	51*	37*	31*	30*	35*	45	37	33	31	32
Central										
Madhya Pradesh	69*	48	40	38*	43	67*	50*	41*	37	38*
Uttar Pradesh	69*	52	45*	45*	52	75*	55*	46*	44	47*
East										
Bihar	78*	48*	37*	35*	41*	80	49*	37*	35	39*
Orissa	110*	72	55	49*	51*	82	69	59	52	47
West Bengal	29	25	24	26	31	23	23	25	28	34
Northeast										
Assam	60*	40*	33*	33*	41*	56*	39	33*	35	44*
West										
Goa	19	14	11	8	6	53	25	12	6	3
Gujarat	30	31	29	25	20	16	26	32	28	19
Maharashtra	34	24	17	13	11	29	23	18	14	10
South										
Andhra Pradesh	33	26	24	25	30	31	26	25	26	29
Karnataka	51*	32*	24*	22*	25	47	33	25	21	20
Kerala	22	11*	8*	10*	18	30	14	9	8	11
Tamil Nadu	32	26	24	23	24	33	29	25	21	17

Table 6 3, continued

State	Age of mother at childbirth									
	Unadjusted					Adjusted				
	15	20	25	30	35	15	20	25	30	35
Infant mortality										
India	125*	89*	74*	73*	86*	103*	85*	77*	77*	85*
North										
Delhi	153[p]	78[p]	54[p]	50[p]	62[p]	117[p]	72[p]	57[p]	53[p]	58[p]
Haryana	135	95	74	65	67	112	90	76	68	64
Himachal Pradesh	105[p]	71[p]	58[p]	57[p]	66[p]	73	63	60	63	74
Jammu region of Jammu and Kashmir	63	53	50	51	59	33	41	51	62	73
Punjab	65	61	57	50	40	43	52	58	57	49
Rajasthan	113*	78*	64*	63*	74*	89	74	67	67	73
Central										
Madhya Pradesh	168*	106	83	79*	93*	136*	102*	87	84*	92*
Uttar Pradesh	179*	128	106*	102*	114*	164*	126*	108*	104*	113*
East										
Bihar	156*	107*	86*	80*	88*	138[p]	102[p]	87[p]	84[p]	91[p]
Orissa	188[p]	132[p]	107[p]	99[p]	104[p]	144	125	112	105	104
West Bengal	90	75	70	73	86	63	68	74	84	99
Northeast										
Assam	129*	93*	79*	79*	92*	108p	87[p]	81[p]	85[p]	101[p]
West										
Goa	96[n]	52[n]	35[n]	28[n]	28[n]	80	51	37	31	27
Gujarat	164[n]	90[n]	64[n]	54[n]	53[n]	127[n]	86[n]	70[n]	57[n]	45[n]
Maharashtra	113[n]	61[n]	41[n]	35[n]	40[n]	77	57	46	41	41
South										
Andhra Pradesh	112[n]	70[n]	57[n]	61[n]	84[n]	82[n]	66[n]	62[n]	70[n]	94[n]
Karnataka	124*	80*	63*	61*	71*	105	80	67	62	65
Kerala	69*	36*	28*	31*	52*	66[n]	36[n]	29[n]	31[n]	48[n]
Tamil Nadu	79	66	63	66	79	68	66	65	68	74
Child mortality										
India	65*	45*	37*	35*	39*	63*	49*	41*	37*	37*
North										
Delhi	26	15*	11*	13*	20*	34	21	16	17	23
Haryana	29	35	38	37	31	20	37	47	42	26
Himachal Pradesh	43	29	25	27	39	30	32	36	43	55
Jammu region of Jammu and Kashmir	14	20	28	37	48	17	23	29	35	38
Punjab	32	25	21	18	16	34	27	22	17	14
Rajasthan	51	39	34	33	36	49	41	36	32	31
Central										
Madhya Pradesh	98*	67*	53*	48*	51*	86	66	56	53	56
Uttar Pradesh	88*	67*	57*	55*	59*	84	68	60	58	61
East										
Bihar	93*	61*	46*	39*	38*	90	65	52	46	46
Orissa	48*	23*	16	16*	25*	38*	23*	18*	19*	25*
West Bengal	42	32	28	29	35	54	37	30	28	30
Northeast										
Assam	93	74	61	51	45	97	83	69	58	47
West										
Goa	13	11	10	10	10	13	NE	NE	NE	NE
Gujarat	48*	31*	26*	27*	37	32	27	27	30	38
Maharashtra	27	28	26	22	16	30	30	26	20	14
South										
Andhra Pradesh	35	32	28	24	20	36	42	39	28	15
Karnataka	78	48	33	27	25	106	58	35	22	16
Kerala	28	14	10	10	15	74	26	12	7	5
Tamil Nadu	43	38	35	34	35	62	46	37	32	29

PREVIOUS BIRTH INTERVAL

Table 6 4 shows that both unadjusted and adjusted effects of previous birth interval on neonatal mortality are large and statistically significant in India as a whole and in every state There are only small differences between unadjusted and adjusted effects For India, adjusted neonatal mortality is more than twice as high for children born within 24 months of the previous birth as for children born after a longer interval The adjusted effect of previous birth interval is especially high in Jammu Region, West Bengal, Haryana, and Madhya Pradesh Delhi, Himachal Pradesh, and Kerala have the smallest differences in adjusted neonatal mortality by previous birth interval, but these differences are, nevertheless, statistically significant

The effects of previous birth interval on postneonatal mortality are similar The adjusted effect is especially large in Jammu region, Delhi, and Madhya Pradesh All effects are statistically significant except the unadjusted effect in Goa and the adjusted effect in Goa and Tamil Nadu

Combining neonatal and postneonatal mortality, adjusted infant mortality in India is more than twice as high for children born within 24 months of a previous birth as for other children Short previous birth intervals increase infant mortality in all states by factors ranging from about 70 to 170 percent

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Notes to Table 6 3

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions Adjusted neonatal postneonatal infant and child mortality rates for children of birth order two or above are computed from hazard regression models that include the following control variables birth order length of previous birth interval number of deceased older siblings child s sex year of birth residence mother s literacy religion caste/tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) as well as the interactions of these last three variables with residence For child mortality rates length of following birth interval is added as a control variable When calculating adjusted mortality rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life Because mother s age at childbirth and its square are coded as continuous variables there is no reference category

NE Not estimated because the hazard model did not converge properly

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not for postneonatal (age 1–11 months) mortality

[P]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

The unadjusted effect of previous birth interval on child mortality is somewhat smaller than the unadjusted effects on neonatal and postneonatal mortality, both in India as a whole and in most states It is statistically significant in only 10 of the 19 states In general, the effects of previous birth interval tend to be highest in states where child mortality is high Adjusted effects are only slightly smaller than unadjusted effects, and there are only two differences in statistical significance In Jammu region, the unadjusted effect is not statistically significant, but the adjusted effect is, while in Punjab, the unadjusted effect is statistically significant, but the adjusted effect is not

These findings show clearly that previous birth interval has a large and statistically significant effect on infant and child mortality They provide a strong rationale for advocating child spacing to improve child survival According to the NFHS, one-third of all Indian children of birth order 2 and higher are born within 24 months of the previous birth (Table 2 5) For children born after another sibling, lengthening the previous birth interval to at least 24 months would reduce mortality under age 5 by about 17 percent

MORTALITY OF AN OLDER SIBLING

Children in families where an older sibling died at a young age are likely to have heightened mortality risks themselves They may face adverse biological conditions that affected the older sibling or a family environment associated with high risks of infant and child mortality

Table 6 5 shows that mortality of an older sibling has a consistent, strong, and statistically significant effect on neonatal mortality In India as a whole, unadjusted neonatal morality is 97 percent higher for children with an older sibling who died than for other children A large and statistically significant unadjusted effect is observed in all states except Himachal Pradesh The adjusted effect is only slightly smaller Adjusted neonatal morality in India is 85 percent higher for children with an older sibling who died than for other children The adjusted effect is statistically significant for India and for all states except Haryana and Himachal Pradesh

The unadjusted and adjusted effects of mortality of an older sibling on postneonatal mortality are similar to the effects on neonatal mortality but they are smaller and statistically significant in fewer states and the difference between the unadjusted and adjusted effects is larger Unadjusted postneonatal mortality in India is 89 percent higher for children with an older sibling who died than for other children The difference in adjusted postneonatal mortality is only 47 percent The unadjusted effect is statistically significant in 13 states and the adjusted effect is significant in eight states

Combining neonatal and postneonatal mortality, unadjusted infant mortality in India is 95 percent higher for children with an older sibling who died than for other children The difference in adjusted infant mortality is somewhat smaller, at 71 percent

Table 6 4 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality for children of birth order two or higher, by length of previous birth interval and by state

State	Previous birth interval (months)							
	Neonatal mortality				Postneonatal mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	<24†	≥24	<24†	≥24	<24†	≥24	<24†	≥24
India	82	37*	79	37	58	26*	56	27*
North								
Delhi	45	25	41	26	64	20*	59	21*
Haryana	76	29	72	30	57	29*	55	30*
Himachal Pradesh	44	28	44	28	49	24*	47	24*
Jammu region of Jammu and Kashmir	54	22*	56	22*	44	16*	45	16*
Punjab	46	22	42	23*	42	19*	41	20*
Rajasthan	65	28*	61	29*	58	26*	54	27*
Central								
Madhya Pradesh	94	37*	88	38*	84	32*	79	33*
Uttar Pradesh	112	49	108	50*	86	37	83	37*
East								
Bihar	88	40	86	41	66	34	62	35*
Orissa	98	42*	96	43	104	48	99	49*
West Bengal	92	38	92	38	46	21	47	20*
Northeast								
Assam	75	39*	73	40*	62	29	60	29*
West								
Goa	47	18*	42	19*	11	9	10	9
Gujarat	69	31*	62	33*	41	23*	41	23*
Maharashtra	53	24*	49	25*	34	15	32	15
South								
Andhra Pradesh	71	33*	70	34*	45	21	45	21
Karnataka	71	35*	67	36*	40	23	36	24
Kerala	33	20*	32	20*	17	8	17	8
Tamil Nadu	63	34*	67	34*	33	22	32	22

State	Infant mortality				Child mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	<24†	≥24	<24†	≥24	<24†	≥24	<24†	≥24
India	140	63*	135	64*	59	34*	60	36
North								
Delhi	109	45*	100	47*	23	10*	28	14
Haryana	133	58*	127	59*	63	27*	67	30
Himachal Pradesh	92	52*	92	52*	34	25	50	32
Jammu region of Jammu and Kashmir	98	39*	101	38*	40	25	44	24
Punjab	88	41*	83	43*	31	17*	29	18
Rajasthan	124	54*	115	56*	53	30*	49	31*
Central								
Madhya Pradesh	178	69*	167	71	88	48*	91	49*
Uttar Pradesh	198	86	191	88	93	48*	95	50*
East								
Bihar	155	74	148	76	78	39*	83	45*
Orissa	201	90	195	91*	33	16*	36	17
West Bengal	138	59	139	59	44	28*	43	30*
Northeast								
Assam	136	68*	132	69*	95	49	99	57*
West								
Goa	59	27n	52	29n	16	8	NE	NE
Gujarat	110	54	103	56	32	27	33	26
Maharashtra	86	38*	81	40	28	24	27	25
South								
Andhra Pradesh	115	55*	114	55*	38	26	47	33
Karnataka	111	58*	103	61*	47	35	42	39
Kerala	50	28*	49	28*	14	11	12	12
Tamil Nadu	96	56*	99	56n	42	33	45	36

For the country as a whole, the unadjusted effect on child mortality is large and statistically significant, but it is smaller than the effects on neonatal and postneonatal mortality Unadjusted child mortality is 71 percent higher for children with an older sibling who died than for other children A similar pattern is observed at the state level, but the unadjusted effect is statistically significant in only nine out of 19 states Adjusted effects are somewhat smaller Adjusted child mortality in India is 31 percent higher for children with an older sibling who died than for other children Among states, the adjusted effect is statistically significant only in Rajasthan In Punjab and Kerala, death of an older sibling has no effect on child mortality after adjusting for other variables

In summary, the death of an older sibling has a decreasing effect on a child's risk of mortality as the child's age increases This suggests that similar mortality experience among siblings may be due primarily to biological factors In order to enhance child survival, health-care programmes should give special attention to families that have experienced previous infant or child mortality, especially during pregnancy and immediately after the birth of subsequent children

SHORT INTERVAL TO NEXT BIRTH

Children who experience the birth of a younger sibling during early childhood may experience high mortality for many reasons If a woman becomes pregnant again very soon after childbirth, her lactation may be affected and breastfeeding may stop

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Notes to Table 6 4

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted mortality rates the hazard regressions include the following control variables birth order number of deceased older siblings child s sex year of birth mother s age at childbirth and its square residence mother s literacy religion caste/tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) as well as the interactions of these last three variables with residence For child mortality rates length of following birth interval is added as a control variable When calculating adjusted mortality rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

†Reference category in the underlying hazard regression

NE Not estimated because the hazard model did not converge properly

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not for postneonatal (age 1–11 months) mortality

[p]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

Table 6 5 Unadjusted and adjusted neonatal, postneonatal, infant, and child mortality for children of birth order two or higher, by whether they have deceased older siblings and by state

	Child has deceased older sibling(s)							
	Neonatal mortality				Postneonatal mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
State	No†	Yes	No†	Yes	No†	Yes	No†	Yes
India	38	75	39	72*	27	51*	30	44*
North								
Delhi	24	69	24	63	26	47*	29	35
Haryana	37	50	37	50	31	52*	34	43
Himachal Pradesh	31	36	31	35	26	48*	26	49*
Jammu region of Jammu and Kashmir	23	69*	23	69	20	31	21	29
Punjab	23	75*	23	83	23	46*	23	40*
Rajasthan	29	79*	29	77*	26	74*	27	68*
Central								
Madhya Pradesh	37	80*	39	75*	33	70*	36	61*
Uttar Pradesh	51	87*	55	81*	38	65	43	55
East								
Bihar	41	74*	41	74*	34	59*	35	55
Orissa	48	67*	49	65*	53	73	57	66
West Bengal	40	74*	41	72*	23	33*	24	30
Northeast								
Assam	42	64	43	62*	35	42	37	39
West								
Goa	20	63	21	50	9	16	10	8
Gujarat	33	69	35	60	23	44*	24	41*
Maharashtra	26	53	25	56	18	25	19	19
South								
Andhra Pradesh	34	71	34	71*	21	47*	22	43*
Karnataka	35	74*	37	69*	26	32	28	28
Kerala	20	57*	20	45	9	28*	10	15
Tamil Nadu	35	63*	38	53*	23	28	25	24

	Infant mortality				Child mortality			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
State	No†	Yes	No†	Yes	No†	Yes	No†	Yes
India	65	127*	68	116*	34	58	39	51
North								
Delhi	50	115*	53	98[n]	11	24	17	21
Haryana	69	102*	72	93	31	50*	38	43
Himachal Pradesh	57	84[p]	57	85[p]	25	39	36	40
Jammu region of Jammu and Kashmir	43	100[n]	44	98[n]	28	33	31	25
Punjab	46	121*	46	122	19	29	21	21
Rajasthan	55	152*	56	144	29	76*	29	72*
Central								
Madhya Pradesh	70	149	75	136	51	71*	57	65
Uttar Pradesh	90	152*	98	137	51	73*	59	66
East								
Bihar	75	134*	77	129*	45	55	53	57
Orissa	102	140*	106	130[n]	17	25	20	22
West Bengal	63	107*	64	102[n]	29	36	34	31
Northeast								
Assam	77	106[n]	79	101[n]	58	68	72	65
West								
Goa	29	79[n]	31	58[n]	9	17	NE	NE
Gujarat	57	112*	59	101*	25	39	26	36
Maharashtra	43	77[n]	44	75[n]	24	28	27	21
South								
Andhra Pradesh	55	118	56	114	26	42*	35	41
Karnataka	61	106[n]	64	96	34	49*	39	43
Kerala	28	85*	30	60[n]	11	20	12	12
Tamil Nadu	59	91[n]	63	77[n]	31	49*	38	40

prematurely The young child's nutrition and growth may suffer, making the child increasingly susceptible to diseases and mortality Also, a younger sibling may compete for care and attention within the family, and the presence of other young children in the household may increase a child's exposure to infectious diseases Because it is very rare for a child to have a younger sibling during infancy, we analyse the effect of interval to next birth on child mortality only

As shown in Table 6 6, subsequent birth interval has no effect on child mortality among first-born children, but it does have an effect on children of second and higher-order birth For second and subsequent children in India who already have a younger sibling by the time they are age two, unadjusted child mortality is 45 percent higher than it is for children who do not have a younger sibling by age five A short subsequent birth interval is associated with higher unadjusted child mortality in all states except Gujarat, where child mortality shows little variation by subsequent birth interval The unadjusted effect of subsequent birth interval on child mortality is statistically significant in Delhi, Himachal Pradesh, Uttar Pradesh, Bihar, West Bengal, Assam, and Andhra Pradesh The adjusted effect is only slightly smaller than the unadjusted effect in India as a whole and in most states In Himachal Pradesh the unadjusted effect is statistically significant, but the adjusted effect is not By contrast, in Madhya Pradesh the adjusted effect is statistically significant, but the unadjusted effect is not

It is interesting that first-born children do not experience increased risk of child mortality if a younger sibling is born before they reach age five It appears that mothers'

Notes to Table 6 5

Neonatal postneonatal infant and child mortality rates are expressed as deaths per 1 000 Infant mortality rates are computed as the sum of neonatal and postneonatal mortality rates Both unadjusted and adjusted mortality rates are predicted values calculated from hazard regressions For adjusted mortality rates the hazard regressions include the following control variables birth order length of previous birth interval child s sex year of birth mother s age at childbirth and its square residence mother s literacy religion caste/tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) as well as the interactions of these last three variables with residence For child mortality rates length of following birth interval is added as a control variable When calculating adjusted mortality rates the control variables are set at their mean values for the specific group of children under consideration For neonatal postneonatal and infant mortality rates this group includes all children in India or a specified state who were born in December 1979 or later For child mortality rates it includes all children in India or a specified state who were born in December 1979 or later and who survived the first year of life

†Reference category in the underlying hazard regression

NE Not estimated because the hazard model did not converge properly

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for neonatal (first month) mortality but not for postneonatal (age 1–11 months) mortality

[P]The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level for postneonatal (age 1–11 months) mortality but not neonatal (first month) mortality

Table 6 6 Unadjusted and adjusted child mortality, by following birth interval and by state

State	Following birth interval for birth order 1 (months)							
	Unadjusted				Adjusted			
	24	36	48	No following birth†	24	36	48	No following birth†
India	39	39	40	40	39	40	40	40
North								
Delhi	NE	NE	NE	NE	NE	NE	NE	NE
Haryana	35	35	36	36	35	35	36	36
Himachal Pradesh	37	33	30	28	42	37	31	28
Jammu region of Jammu and Kashmir	27	28	28	29	28	28	29	29
Punjab	19	20	21	21	19	20	21	21
Rajasthan	23	29	34	36	22	29	34	36
Central								
Madhya Pradesh	57	57	57	58	60	59	58	58
Uttar Pradesh	46	52	58	60	47	53	58	60
East								
Bihar	77	67	55	48	76	67	55	48
Orissa	37	32	23	19	38	33	23	19
West Bengal	34	33	32	31	33	32	31	31
Northeast								
Assam	73	70	65	62	73	69	65	62
West								
Goa	11	10	10	10	10	10	10	10
Gujarat	33	31	29	29	35	32	30	29
Maharashtra	39	32	30	25	39	32	30	25
South								
Andhra Pradesh	23	25	28	29	25	26	28	29
Karnataka	36	37	38	38	36	37	38	38
Kerala	NE	NE	NE	NE	NE	NE	NE	NE
Tamil Nadu	38	37	36	36	40	38	37	36

State	Following birth interval for birth order 2 or higher (months)							
	Unadjusted				Adjusted			
	24	36	48	No following birth†	24	36	48	No following birth†
India	58*	51*	44*	40	53*	48*	43*	40
North								
Delhi	31*	22*	20*	13	25*	19*	18*	13
Haryana	61	48	42	36	51	43	40	36
Himachal Pradesh	75*	57*	39*	28	69	54	37	28
Jammu region of Jammu and Kashmir	31	30	29	29	31	30	29	29
Punjab	28	24	22	21	25	23	21	21
Rajasthan	41	39	36	36	38	37	36	36
Central								
Madhya Pradesh	70	65	60	58	67*	64	60*	58
Uttar Pradesh	80*	71*	63*	60	75*	68*	62*	60
East								
Bihar	83*	71*	56*	48	75*	66*	54*	48
Orissa	28	26	21	19	27	25	21	19
West Bengal	62*	47*	33*	31	58*	45*	33*	31
Northeast								
Assam	101*	88*	73*	62	87*	79*	69*	62
West								
Goa	NE	NE	NE	NE	NE	NE	NE	NE
Gujarat	26	28	28	29	26	27	28	29
Maharashtra	29	27	26	25	27	26	26	25
South								
Andhra Pradesh	58*	49*	37*	29	54*	47*	36*	29
Karnataka	52	47	41	38	47	44	40	38
Kerala	17	14	12	12	15	13	12	12
Tamil Nadu	49	42	39	36	46	41	38	36

care of first-born children does not change much when a second child is born and risks of infectious diseases do not increase significantly when the number of young children in a family changes from one to two

SUMMARY

In general, demographic characteristics have consistent and substantial effects on mortality before age five at both the national and state levels The adjusted effects are not very different from the unadjusted effects except in the cases of birth order and mother's age at childbirth Three demographic characteristics have especially large adjusted effects on infant and child mortality—previous birth interval, mortality of an older sibling, and subsequent birth interval These findings suggest that under-five mortality can be reduced substantially by encouraging women to delay the onset of childbearing and to increase the interval between births

Spacing births at intervals of at least 24 months will greatly enhance child survival Minimizing the number of births to mothers under age 20 and helping families stop having children after four births will also enhance the survival chances of children Finally, family health programmes should provide families that have experienced an infant or child death with intensified maternal and child health support to avoid further mortality Such support should include basic antenatal care, guidance on home care of well babies, immunizations, and treatment of common childhood illnesses such as diarrhoea and respiratory infections

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Notes to Table 6 6

Child mortality rates are expressed as deaths per 1 000 Both unadjusted and adjusted child mortality rates are predicted values calculated from hazard regressions For adjusted child mortality rates the hazard regressions include the following control variables birth order length of previous birth interval for second and higher order births presence of deceased older sibling(s) child s sex year of birth mother s age at childbirth and its square residence mother s literacy religion caste/tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) as well as the interactions of these last three variables with residence When calculating adjusted child mortality rates the control variables are set at their mean values for the specific group of children under consideration The group of children under consideration here includes all children in India or a specified state of birth order two or higher who were born in December 1979 or later and who survived the first year of life

†Reference category in the underlying hazard regression

NE Not estimated because the hazard model did not converge properly

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

7 Effects of Antenatal and Delivery Care on Neonatal Mortality

In this chapter, we examine the effects of antenatal and delivery care on neonatal mortality, specifically, the effects of number of antenatal-care visits, immunization of pregnant women against tetanus, and delivery in a medical facility This analysis is based on 55,571 children born during the four years before the NFHS Because this sample is smaller than the samples used in earlier chapters and because mortality data for a large proportion of these children are only available for a short period, estimation of postneonatal and child (age one through four) mortality would not be reliable We, therefore, carry out this analysis for neonatal mortality only

NUMBER OF ANTENATAL-CARE VISITS

Table 7 1 shows unadjusted and adjusted probabilities of a child dying during the neonatal period by number of antenatal-care visits made by the mother during pregnancy The antenatal-care visits reported here do not include home visits made by health workers For India as a whole, the table shows a very sharp decline in unadjusted neonatal mortality as the number of antenatal-care visits increases The adjusted effect is much smaller, but it remains statistically significant A similar pattern in unadjusted neonatal mortality is observed in all states except Jammu region and Maharashtra The unadjusted effects of number of antenatal-care visits are statistically significant for India and for 10 of the 19 states

The adjusted effects of antenatal-care visits on neonatal mortality are much smaller in all states except Himachal Pradesh, where they are larger, and in Madhya Pradesh and Orissa, where they remain virtually unchanged The adjusted effects are statistically significant only for India and for Himachal Pradesh, Madhya Pradesh, and Orissa Delhi, Uttar Pradesh, Goa, Andhra Pradesh, Karnataka, and Tamil Nadu show a sharp decline in adjusted neonatal mortality with increasing number of antenatal-care visits, but the adjusted results for these states are not statistically

Table 7 1 Unadjusted and adjusted neonatal mortality, by number of antenatal-care visits made by mother and by state

State	Number of antenatal-care visits made by mother							
	Unadjusted				Adjusted			
	0	2	4	6	0	2	4	6
India	53*	43*	35*	28*	46*	43*	41*	39*
North								
Delhi	49*	40*	33*	27*	43	37	32	28
Haryana	40	37	34	31	32	36	40	46
Himachal Pradesh	44	34	26	20	57*	34*	21*	12*
Jammu region of Jammu and Kashmir	25	26	28	29	23	25	28	32
Punjab	33	32	31	30	27	30	33	36
Rajasthan	34	33	33	32	34	34	34	34
Central								
Madhya Pradesh	56*	40*	28*	20*	54*	41*	31*	24*
Uttar Pradesh	62*	45*	33*	24*	56	50	45	41
East								
Bihar	53	44	37	31	50	48	46	44
Orissa	67*	45*	30*	20*	65*	46*	33*	24*
West Bengal	52*	44*	37*	31*	40	42	45	47
Northeast								
Assam	62*	44*	31*	22*	50	50	50	50
West								
Goa	46*	32*	23*	16*	24	21	19	17
Gujarat	45	39	33	28	39	39	39	39
Maharashtra	31	30	30	30	18*	26*	37*	54*
South								
Andhra Pradesh	59*	47*	37*	30*	54	46	39	33
Karnataka	50	45	41	37	47	44	42	39
Kerala	30*	23*	17*	12*	16	14	13	11
Tamil Nadu	63*	51*	41*	33*	50	46	42	38

Notes Neonatal mortality rates are expressed as deaths per 1 000 Both unadjusted and adjusted neonatal mortality rates are predicted values calculated from hazard regressions For the adjusted mortality rates the hazard regressions include the following control variables whether mother received at least two tetanus injections during pregnancy whether child was delivered at a medical facility child s sex year of birth mother s age at childbirth and its square mother s literacy residence religion/caste tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) as well as the interactions of these last three variables with residence When calculating the adjusted neonatal mortality rates the control variables are set at their mean values for the particular group of children under consideration This group includes all children in India or a specified state who were born by January 1988 or later (January 1989 or later for Haryana and states surveyed during the third round of the NFHS Arunachal Pradesh Bihar Gujarat Jammu region of Jammu and Kashmir Manipur Meghalaya Mizoram Nagaland Orissa Punjab Tripura and Delhi) Because number of antenatal care visits is coded as a continuous variable there is no reference category

*The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

significant It is not surprising that the adjusted effects on neonatal mortality are much smaller and less often statistically significant than the unadjusted effects This is because antenatal-care visits are likely to be correlated with socioeconomic background variables such as urban/rural residence and mother's literacy, which are included in the model for adjusted effects

In Maharashtra, Haryana, Jammu region, Punjab, and West Bengal, the adjusted effect of number of antenatal-care visits tends to increase neonatal mortality, although this effect is only statistically significant in Maharashtra This unexpected effect is

observed in Jammu region both before and after adjustment for other variables It is possible that women in these states who report frequent antenatal-care visits experience high-risk factors associated with neonatal mortality Another possibility is that women in these states who have few antenatal-care visits tend to underreport neonatal deaths

TETANUS IMMUNIZATION OF PREGNANT MOTHERS

Tetanus is one of the major causes of neonatal mortality in developing countries (Stanfield and Galazka 1984) In such countries, it is highly recommended that pregnant women receive at least two doses of tetanus toxoid vaccine (Dastur et al 1993, Jones 1983) Table 7 2 shows the unadjusted and adjusted effect of mother's full tetanus immunization on a child's probability of dying during the neonatal period In India as a whole, mother's tetanus immunization has a substantial effect on unadjusted and adjusted neonatal mortality Both unadjusted and adjusted effects are statistically significant, reflecting the importance of the protection conferred by tetanus immunization

The unadjusted effect of mother's full tetanus immunization reduces neonatal mortality in all states except Jammu region This effect is statistically significant in 12 states The adjusted effect is smaller in most states and is statistically significant in only six Uttar Pradesh, Orissa, West Bengal, Assam, Maharashtra, and Tamil Nadu The adjusted effect is substantial, but not statistically significant, in Delhi, Haryana, Punjab, Rajasthan, Bihar, Gujarat, Andhra Pradesh, and Kerala In Himachal Pradesh, adjusted neonatal mortality is slightly higher for children whose mothers received full tetanus immunization than for other children

In summary, the adjusted effect of mother's full tetanus immunization on neonatal mortality is statistically significant in India as a whole and is either statistically significant or substantial in 14 of the 19 states, including most of India's populous states with high mortality These findings suggest that immunizing pregnant women against tetanus is an important programme intervention for reducing neonatal mortality in India

PLACE OF DELIVERY

Children delivered at a medical facility are likely to experience lower mortality than children delivered at home because such facilities usually provide a sanitary environment and medically correct birth assistance If complications develop during childbirth, medical professionals can attend to the problem immediately In a developing country such as India, however, most women who deliver their children at a medical facility enjoy a high socioeconomic status as measured by the indicators used in this

Table 7 2 Unadjusted and adjusted neonatal mortality, by mother's tetanus immunization during pregnancy and by state

State	Mother received at least two tetanus injections during pregnancy			
	Unadjusted		Adjusted	
	No†	Yes	No†	Yes
India	59	33*	55	35*
North				
Delhi	53	26*	46	27
Haryana	47	31	49	31
Himachal Pradesh	35	32	32	35
Jammu region of Jammu and Kashmir	25	28	27	27
Punjab	48	29	44	30
Rajasthan	35	30	38	25
Central				
Madhya Pradesh	54	37*	48	42
Uttar Pradesh	67	35*	64	39*
East				
Bihar	54	40	52	43
Orissa	74	40*	71	42*
West Bengal	66	35*	63	36*
Northeast				
Assam	67	27*	67	27*
West				
Goa	74	14*	NE	NE
Gujarat	54	32*	50	34
Maharashtra	57	24*	66	22*
South				
Andhra Pradesh	63	38*	56	39
Karnataka	49	40	45	42
Kerala	32	10*	22	10
Tamil Nadu	114	37*	96	38*

Notes Neonatal mortality rates are expressed as deaths per 1 000 Both unadjusted and adjusted neonatal mortality rates are predicted values calculated from hazard regressions For the adjusted mortality rates the hazard regressions include the following control variables number of mother s antenatal care visits whether child was delivered at a medical facility child s sex year of birth mother s age at childbirth and its square mother s literacy residence religion/caste tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) as well as the interactions of these last three variables with residence When calculating the adjusted neonatal mortality rates the control variables are set at their mean values for the particular group of children under consideration This group includes all children in India or a specified state who were born by January 1988 or later (January 1989 or later for Haryana and states surveyed during the third round of the NFHS Arunachal Pradesh Bihar Gujarat Jammu region of Jammu and Kashmir Manipur Meghalaya Mizoram Nagaland Orissa Punjab Tripura and Delhi)

NE Not estimated because the hazard model did not converge properly

†Reference category in the underlying hazard regression

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

analysis Poor women only deliver their children in a medical facility if they anticipate a complication In this situation, delivery in a medical facility would be expected to reduce neonatal mortality when measured independently, but after adjusting for socioeconomic variables, the effect would be expected to disappear or to reverse direction

Table 7 3 shows this pattern For India as a whole, unadjusted neonatal mortality is lower for children delivered in a medical facility than for children delivered at

Table 7 3 Unadjusted and adjusted neonatal mortality, by place of delivery and by state

State	Place of delivery			
	Unadjusted		Adjusted	
	Home†	Medical facility	Home†	Medical facility
India	46	35*	41	52*
North				
Delhi	30	33	22	48
Haryana	34	52	31	82*
Himachal Pradesh	33	36	31	47
Jammu region of Jammu and Kashmir	28	25	29	22
Punjab	29	43	27	52*
Rajasthan	33	37	33	39
Central				
Madhya Pradesh	46	42	41	78*
Uttar Pradesh	54	50	50	86*
East				
Bihar	50	44	47	68
Orissa	54	51	50	82
West Bengal	44	39	39	52
Northeast				
Assam	53	32	51	45
West				
Goa	35	16	NE	NE
Gujarat	42	34	37	43
Maharashtra	36	25	30	31
South				
Andhra Pradesh	47	35	43	43
Karnataka	43	42	39	52
Kerala	21	10	8	11
Tamil Nadu	56	35*	50	38

Notes Neonatal mortality rates are expressed as deaths per 1 000 Both unadjusted and adjusted neonatal mortality rates are predicted values calculated from hazard regressions For the adjusted mortality rates the hazard regressions include the following control variables number of mother s antenatal care visits whether mother received at least two tetanus injections during pregnancy child s sex year of birth mother s age at childbirth and its square mother s literacy residence religion/caste tribe membership of household head mother s exposure to radio or television and household toilet facilities cooking fuel and economic level (ownership of goods) as well as the interactions of these last three variables with residence When calculating the adjusted neonatal mortality rates the control variables are set at their mean values for the particular group of children under consideration This group includes all children in India or a specified state who were born by January 1988 or later (January 1989 or later for Haryana and states surveyed during the third round of the NFHS Arunachal Pradesh Bihar Gujarat Jammu region of Jammu and Kashmir Manipur Meghalaya Mizoram Nagaland Orissa Punjab Tripura and Delhi)

NE Not estimated because the hazard model did not converge properly

†Reference category in the underlying hazard regression

The coefficient of the corresponding variable in the underlying hazard regression differs significantly from zero at the 5 percent level

home The adjusted values show the opposite effect The apparent advantage of delivering in a medical facility is due mostly to the influence of other socioeconomic variables, with place of delivery acting as a proxy After controlling for the effects of variables such as mother's literacy and household economic status, neonatal mortality is actually higher for children delivered in a medical facility than for children delivered at home Both unadjusted and adjusted results are statistically significant

State-level results show the same pattern In all but three states where unadjusted neonatal mortality is lower for children delivered in a medical facility, adjusted neonatal mortality is higher for such children In all five states where unadjusted neonatal mortality is higher for children delivered in a medical facility, adjusted neonatal mortality is also higher The adjusted results are statistically significant in five states Delhi, Haryana, Punjab, Madhya Pradesh, and Uttar Pradesh The adjusted association between delivery in a medical facility and heightened neonatal mortality is also substantial, but not statistically significant, in Himachal Pradesh, Bihar, Orissa, West Bengal, and Karnataka

After adjusting for other variables, delivery in a medical facility is associated with lower neonatal mortality in only three states Jammu region, Assam, and Tamil Nadu In Jammu region and Assam, the adjusted effect is small, and none of the adjusted effects is statistically significant

8 Conclusions and Policy Recommendations

Infant and child mortality are moderately high in India, varying widely from state to state Among children born during the 12 years before the NFHS, infant mortality was 88 deaths per 1,000 births in India as a whole At the state level, infant mortality ranged from fewer than 40 deaths per 1,000 births in Kerala and Goa to more than 120 deaths per 1,000 births in Orissa and Uttar Pradesh All states experienced a reduction in infant and child mortality over the 12-year period before the survey This reduction was proportionately largest for child mortality and smallest for neonatal mortality

Sex differentials in infant and child mortality reflect strong son preference in many states During the neonatal period, most states exhibit excess male mortality, which is the biological norm During childhood, however, all states except Tamil Nadu and Kerala show excess female mortality In India as a whole, child mortality is 40 percent higher for girls than for boys Data on sex differentials in infant and child mortality suggest that son preference and discrimination against female children are more prevalent in India's northern states than in the south

Several socioeconomic characteristics have a substantial effect on infant and child mortality even after adjusting for the effects of other variables These are mother's literacy, household access to a flush or pit toilet, household head's religion and caste/tribe membership, and household economic status as indicated by ownership of consumer goods In all cases, the adjusted effects are smaller than the unadjusted effects, but they are often statistically significant For most of these socioeconomic characteristics, the adjusted effects are largest for child mortality and smallest for neonatal mortality Some socioeconomic characteristics have a substantial unadjusted effect on infant and child mortality but a negligible adjusted effect These are rural/urban residence, mother's exposure to mass media, and use of a clean cooking fuel

Although it is not feasible to raise the socioeconomic status of every household in India in a short period of time, the family health programme can use information on the effects of socioeconomic characteristics to improve infant and child survival by targeting families at high risk The results reported here indicate that health

intervention programmes should focus on illiterate mothers and on households that are poor, that are headed by members of scheduled castes or scheduled tribes, and that lack access to a flush or pit toilet Such programmes should make sure to reach both male and female children

One of the most interesting findings in this report concerns the relationship between birth order, mother's age at childbirth, and mortality of infants and young children After adjusting for other variables, neonatal mortality goes down with increasing birth order, while postneonatal and child mortality go up (Figure 6 1) Among children born to mothers at various ages, those born to mothers in their late 20s have the lowest adjusted mortality rates Mortality is particularly high for children born to mothers under age 20

These findings indicate that a decline in fertility, by reducing the proportion of higher-order births, will tend to lower the overall level of child mortality At the same time, the overall level of neonatal mortality may rise because a larger proportion of all births will be high-risk first births This potential increase in neonatal mortality can be avoided, however, by encouraging women to wait until age 20 to start having children During the 12-year period before the NFHS, 34 percent of first-born children were born to mothers under age 18, and 60 percent were born to mothers under age 20 Reducing this large proportion of births to very young mothers will lower neonatal mortality dramatically

For children who are not first born, previous birth interval has by far the largest effect on infant and child mortality of any factor analysed in this report Children born less than 24 months after a previous birth are more than twice as likely to die during infancy and two-thirds more likely to die during childhood compared with children born after a longer interval Because about one-third of second and higher-order births in India are born less than 24 months after a previous birth, a programme that encourages women to space births at intervals of at least 24 months would have a major impact on infant and child mortality

The results also show that families that have already experienced the death of an infant or child are at much greater risk than other families of another infant or child death Family health programmes should identify such families and provide them with intensified health services and guidance

Finally, among health-care interventions, immunization of pregnant women against tetanus has a substantial effect in reducing neonatal mortality Family health programmes should be strengthened to provide this basic health-care service to all pregnant women

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