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SON PREFERENCE, THE FAMILY-BUILDING PROCESS AND CHILD MORTALITY IN INDIA

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ABSTRACT

India is a country with a pervasive preference for sons and one of the highest levels of excess female child mortality in the world (female child mortality exceeds male child mortality by 43 percent). In this paper, data from the National Family Health Survey (NFHS) are used to test the hypothesis that son preference influences parity progression and ultimately child mortality. In particular, the survival of female children may be adversely affected by the fact that female births are more often followed by the birth of a younger sibling, especially after a short birth interval. The effects of family composition are estimated with hazard models. The results show that family composition affects fertility behavior in every state examined. The effects of family composition on excess female child mortality are more complex, but female children with older sisters are often subject to the highest risks of mortality

INTRODUCTION

A preference for sons over daughters has been found in a large number of countries, but son preference attitudes and behavior appear to be most widespread in an arc of countries ranging from East Asia, through South Asia, to the Middle East and North Africa.[1] Son preference has important social and economic implications and it can substantially influence patterns of fertility and mortality as well. This article examines the impact of son preference on fertility and on sex differentials in child mortality in India, a country with pervasive son preference and a low status of women.[2]

The calculus of preferences for children of a particular sex can be understood by extending the concept of the value of children to the two sexes separately. If the net utility of having a male child outweighs that of a female child, parents are likely to prefer sons to daughters. A complex interplay of economic and sociocultural factors determines the benefits and costs of a child.[3] Studies in India have highlighted three dimensions of the utility of having a son. The first is the economic utility, which is mainly based on assistance in agricultural production, wage earnings, and security in the case of illness and during old age.[4] The social utility stems from the kinship and descent system, the status and strength provided to the family by sons, and the premium to be expected from having a son in the form of dowry payments.[5] Finally, religious utility flows from the performance by sons of important religious functions.

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[1] United Nations, *Fertility Preferences: Selected Findings from the World Fertility Survey Data* (New York: United Nations, 1985); John Cleland, Jane Verrall and Martin Vaessen, 'Preferences for the Sex of Children and Their Influence on Reproductive Behaviour', World Fertility Survey Comparative Studies No. 27, International Statistical Institute (Voorburg, Netherlands, 1983); Fred Arnold, 'The effect of sex preference on fertility and family planning: Empirical evidence', *Population Bulletin of the United Nations,* 23–24 (1987), pp. 44–55; Nancy E. Williamson, *Sons or Daughters: A Cross-Cultural Survey of Parental Preferences* (Beverly Hills, California: Sage Publications, 1976).

[2] According to the Human Development Report of the United Nations Development Program, India falls in the bottom quarter of all countries on both measures that are used to rank countries on the basis of the status of women (United Nations, *Human Development Report* (New York: Oxford University Press, 1995).

[3] Fred Arnold, Rodolfo A. Bulatao, Chalio Buripakdi, Betty Jamie Chung, James T. Fawcett, Toshio Iritani, Sung Jin Lee, and Tsong-shien Wu, *The Value of Children: A Cross-National Study: Introduction and Comparative Analysis,* Volume 1 (Honolulu: East-West Centre, 1975); Robert A. Pollak, and Susan Cotts Watkins, 'Cultural and economic approaches to fertility: Proper marriage or *mèsalliance', Population and Development Review,* 19 (3) (1993), pp. 467–496; Carol Vlasoff, 'The value of sons in an Indian village: How widows see it', *Population Studies,* 44 (1) (1990), pp. 5–20; Debra Friedman, Michael Hechter and Satoshi Kanazawa, 'A theory of the value of children', *Demography,* 31 (3) (1994), pp. 375–401; Rodolfo A. Bulatao, 'Values and disvalues of children in successive childbearing decisions', *Demography,* 18 (1) (1981), pp. 1–25; Thomas J. Espenshade, 'The value and cost of children', *Population Bulletin,* 32 (1) (1977), pp. 3–47; Michael Vlasoff, 'Labour demand and economic utility of children: A case study of rural India', *Population Studies,* 33 (3) (1979), pp. 415–428.

[4] Alaka M. Basu, 'Is discrimination in food really necessary for explaining sex differentials in childhood mortality?', *Population Studies,* 43 (2) (1989), pp. 193–210; Pranab K. Bardhan, 'Sex disparity in child survival in rural India', in T.N. Srinivasan and P.K. Bardhan (eds.), *Rural Poverty in South India* (Oxford: Oxford University Press, 1988), pp. 472–482; M. Mamdani, *The Myth of Population Control* (London: Monthly Review Press, 1972); Barbara D. Miller, *The Endangered Sex: The Neglect of Female Children in Rural North India* (Ithaca: Cornell University Press, 1981).

[5] Tim Dyson and Mick Moore, 'On kinship structure, female autonomy and demographic balance', *Population and Development Review,* 9 (1) (1983), pp. 35–60; K.M. Kapadia, *Marriage and Family in India,* 3rd edition (Bombay: Oxford University Press, 1966); I. Karve, *Kinship Organization in India* (Bombay: Asia Publishing House, 1965); John C. Caldwell, P.H. Reddy and Pat

According to Hindu tradition, sons are needed for the cremation of deceased parents because only sons (or, in their absence, grandsons or other male family members) can light the funeral pyre. Sons also help in the salvation of the souls of dead parents by performing *pind daan* (offering food and clothing to Brahmins and the poor) during certain times of the year.

Girls are often considered to be an economic liability because of the dowry system, as well as the high cost of weddings, especially in higher-caste families.[6] After marriage, a girl typically becomes a member of her husband's family and her connection with the natal family is severed to a large extent. Also, it is often humiliating for parents if a suitable marriage partner cannot be found for their daughter at an early age. Additional care needs to be taken in the case of a female child when she reaches adolescence, because chastity is considered crucial for her marriage and to protect the honor of the family. Hindu tradition does, however, provide some encouragement for a couple to have a daughter, since it is a sacrament to selflessly give a daughter away in marriage (the practice of *kanya daan*, which earns religious merit).

A strong preference for sons is often assumed to be a significant barrier to fertility reduction, but the evidence concerning this link in India and elsewhere is quite mixed.[7] On the one hand, parents may exceed their overall desired family size if they have not achieved their desired combination of sons and daughters, thereby supporting the continuation of high fertility. On the other hand, there is ample evidence of substantial fertility decline in populations where son preference remains pervasive (for

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Caldwell, *The Causes of Demographic Change: Experimental Research in South India* (Madison: University of Wisconsin Press, 1989).

[6] Sunita Kishor, 'Gender differentials in child mortality: A review of the evidence', in Monica Das Gupta, Lincoln C. Chen and T.N. Krishnan (eds.), *Women's Health in India: Risk and Vulnerability* (Bombay: Oxford University Press, 1995), pp. 19–54.

[7] Narayan Das, 'A simulation model to study the effect of sex preference on current fertility', *Demography India*, 18 (1&2) (1989), pp. 49–72; Narayan Das, 'Sex preference and fertility behaviour: A study of recent Indian data', *Demography*, 24 (4) (1987), pp. 517–530; Fred Arnold, 'Sex preference and its demographic and health implications', *International Family Planning Perspectives*, 18 (3) (1992), pp. 93–101; Arnold, 1987, *loc. cit.* in fn. 1; Michael A. Koenig and Gillian H.C. Foo, 'Patriarchy, women's status and reproductive behaviour in rural North India', *Demography India*, 21 (2) (1992), pp. 145–166; Radheshyam Bairagi and Ray L. Langsten, 'Sex preference for children and its implications for fertility in rural Bangladesh', *Studies in Family Planning*, 17 (6) (1986), pp. 193–210; Prem P. Talwar, 'Effect of desired sex composition in families on the birth rate', *Journal of Biosocial Science*, 7 (2) (1975), pp. 133–139; D.V.N. Sarma and Anrudh K. Jain, 'Preference about sex of children and use of contraception among women wanting no more children in India', *Demography India*, 3 (1) (1974), pp. 81–101; Sulabha Parasuraman, T.K. Roy and S. Sureender, 'Sex composition of children and fertility behaviour in rural Maharashtra', in K.B. Pathak, U.P. Sinha and Arvind Pandey (eds.), *Dynamics of Population and Family Welfare* (Bombay: Himalaya Publishing House, 1994); Chai Bin Park, 'How many births are attributable to preference for sex of children? A simulation analysis.' Paper presented at the Annual Meeting of the Population Association of America, San Francisco, 3–5 April 1986; M.M. Kent and A. Larson, 'Family size preferences: Evidence from the World Fertility Surveys', Reports on the World Fertility Survey No. 4 (Washington, D.C.: Population Reference Bureau, 1982); Fred Arnold and Liu Zhaoxiang, 'Sex preference, fertility and family planning in China, *Population and Development Review*, 12 (2) (1986), pp. 221–246.

example, Korea and China, as well as Indian states such as Punjab). In high-fertility societies, strong son preference attitudes may not have much of an effect on fertility behavior since contraceptive use is low and most couples continue to have children irrespective of the number of sons and daughters they have already had. Even if they do limit their family size to some extent, their childbearing decisions will probably be independent of their mix of living sons and daughters since they are likely to have had their minimum desired number of sons and daughters by sheer biological chance before they exceed their desired family size. Theoretically, the impact of sex preference should increase as fertility falls. In very low-fertility societies, however, the influence of son preference would again become muted since few couples would have more than one or two children even if they did not have their ideal number of sons and daughters. The effect of son preference on fertility, then, can be expected to be most evident in countries like India where the fertility transition is well under way, but far from complete.

A preference for children of a particular sex may also affect the treatment of sons and daughters and even their chances of survival. Son preference is believed to be the principal cause of excess female mortality that is often manifest during childhood. Research studies suggest that parents with strong son preference consider their daughters to be less valuable and provide inferior care in terms of food allocation, prevention of diseases and accidents, and treatment of sick children.[8] A strong preference for sons may also lead to the practice of female feticide or infanticide.[9] Information on female infanticide in

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[8] Anne R. Pebley and Sajeda Amin, 'The impact of a public-health intervention on sex differentials in childhood mortality in rural Punjab, India', *Health Transition Review,* 1 (2) (1991), pp. 143–169; Basu, 1989, *loc. cit.* in fn. 4; Kishor, *op. cit.* in fn. 6; V. Faveau, M.A. Koenig and B. Wojtyniak, 'Excess female deaths among rural Bangladeshi children: An examination of cause-specific mortality and morbidity', *International Journal of Epidemiology,* 20 (3) (1991), pp. 729–735; Lincoln C. Chen, Emdadul Huq and Stan D'Souza, 'Sex bias in the family allocation of food and health care in rural Bangladesh', *Population and Development Review,* 7 (1) (1981), pp. 55–70; Amfried A. Kielmann, Cecile DeSweemer, William Blot, Inder S. Uberoi, A. Douglas Robertson and Carl E. Taylor, 'Impact of child growth, nutrition and psychomotor development', in A.A. Kielmann and Associates (eds.), *Child and Maternal Health Services in Rural India: The Narangwal Experiment,* Vol. 1 (Baltimore: Johns Hopkins University Press, 1983); Jocelyn Kynch and Amartya Sen, 'Indian women: Well-being and survival', *Cambridge Journal of Economics,* 7 (3–4), September–December (1983); Monica Das Gupta, 'Selective discrimination against female children in rural Punjab, India', *Population and Development Review,* 13 (1) (1987), pp. 77–100; Michael A. Koenig and Stan D'Souza, 'Sex differentials in childhood mortality in Bangladesh', *Social Science and Medicine,* 22 (1) (1986), pp. 15–22. Pradip K. Muhuri and Samuel H. Preston, 'Effects of family composition on mortality differentials by sex among children in Matlab, Bangladesh, *Population and Development Review,* 17 (3) (1991), pp. 415–434; M. Nag, 'Sex preference in Bangladesh, India and Pakistan and its effect on fertility, *Demography India,* 20 (1991), pp. 163–185; James F. Philips, T.K. LeGrand, M.A. Koenig, and J. Chakraborty, 'The effect of a maternal and child health-family-planning project on infant and child mortality in Matlab, Bangladesh.' Paper presented at the Annual Meeting of the Population Association of America, Chicago, 30 April – 2 May 1987; Amartya K. Sen and Sunil Sengupta, 'Malnutrition of rural children and the sex bias', *Economic and Political Weekly,* Annual Number, May (1983); T. Nadarajah, 'The transition from higher female to higher male mortality in Sri Lanka', *Population and Development Review,* 19 (2) (1983), pp. 317–325.

[9] M. Kaur, 'Female feticide - A sociological perspective', *Journal of Family Welfare,* 39 (1) (1993), pp. 40–43; Madhu Kishwar, 'Abortion of female fetuses: Is legislation the answer?' *Reproductive Health Matters,* No. 2, November (1993), pp. 113–115; Lakshmi Lingam, 'Sex detection tests and female feticidal discrimination before birth, *Indian Journal of Social Work,* 3 (1) (1991), pp. 13–19; Vibhuti Patel, 'Sex discrimination and sex pre-selection tests: Abuse of advanced technologies', in Rehana Ghadially (ed.), *Women in Indian Society* (New Delhi: Sage Publications, 1988).

India is very sketchy, however, and evidence of the use of sex-selective abortions is generally based solely on institutional births, often for a single hospital. Such estimates may be seriously biased because nearly three-quarters of all births in India still take place at home.[10] When all births are taken into account, regardless of the place of delivery, the NFHS does not support the contention that the sex ratio of births in India has been rising dramatically over time. In fact, the sex ratio at birth for five-year periods remained virtually constant at 106.3–106.6 males per 100 females throughout the two decades before the 1992–93 survey.[11] This finding is consistent with Visaria's conclusion that 'the impact of amniocentesis and such sex detection tests on increasing the masculinity of the Indian population is highly exaggerated'.[12] On the other hand, Das Gupta and Mari Bhat (1996) cite statistics that suggest that more than one million additional girls 'went missing' between 1981 and 1991 (over and above the number of missing girls already implied by the skewed sex ratios in the 1981 Census) and that most of the shortage may be attributable to either sex-selective abortions or unreported female infanticide.[13]

The impact of son preference on excess female child mortality is likely to vary with the overall level of fertility. Das Gupta and Mari Bhat (1996) distinguish two effects that act in opposite directions as fertility falls.[14] The first effect is the *parity effect*. Since high-parity female children (especially those with older sisters) face particularly high risks of mortality, daughters should benefit when parents avoid high-parity births. However, the authors conclude that in India the *intensification effect*, which entails increased discrimination against girls at lower levels of fertility, more than offsets the positive influence of the parity effect as fertility falls. Others have argued that excess female child mortality should fall as fertility declines since parents with few children should be better able to provide adequate nutrition and proper medical care to all of their children, regardless of their sex. Tabutin and Willems (1995) cite evidence to support this argument in developing countries, but for the 1970s and 1980s they found that excess female child mortality only disappears at very low levels of mortality.[15]

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[10] International Institute for Population Sciences (IIPS), *National Family Health Survey (MCH and Family Planning), India 1992–93* (Bombay: IIPS, 1995), Table 9.5.

[11] IIPS, *op. cit.* in fn. 10, Table D.4.

[12] Leela Visaria, 'Deficit of women, son preference and demographic transition in India.' Paper presented at the International Symposium on Issues Related to Sex Preference for Children in the Rapidly Changing Demographic Dynamics of Asia, Seoul, 21–24 November 1994, p. 7.

[13] Monica Das Gupta and P.N. Mari Bhat, 'Intensified gender bias in India: A consequence of fertility decline.' Paper presented at the Annual Meeting of the Population Association of America, New Orleans, 9–11 May 1996.

[14] Das Gupta and Mari Bhat, *loc. cit.* in fn. 13.

[15] Dominique Tabutin and Michel Willems, 'Excess female child mortality in the developing world during the 1970s and 1980s', *Population Bulletin of the United Nations*, 39 (1995), pp. 45–78.

In addition to the direct mortality effect of the preferential treatment of sons, son preference can result in excess female child mortality through a couple's family-building behavior. There are two principal mechanisms through which family-building processes can adversely affect the survival chances of daughters. First, female children may experience increased mortality because their birth is more likely to be followed after a short interval by the birth of a younger sibling. Mortality risks during childhood have consistently been found to be positively related to short birth intervals.[16] At the national level in India, the median birth interval following a female birth is one month shorter than the median birth interval following a male birth, and very short birth intervals are slightly more common following a female birth.[17] The second effect of the family-building process on female child survival is a consequence of the employment of stopping rules in childbearing decisions. If a couple keeps having children until they have a son (or in some cases two sons, to allow for the uncertainty caused by high childhood mortality), female children will, on average, have more siblings than male children.[18] The larger size of their families, in turn, may result in an environment where there is more competition for the available resources and where infectious diseases are spread more easily. Therefore, some of the excess female mortality that has been observed during childhood may be an inadvertent consequence of family-building processes that are based on a strong underlying preference for sons.

The levels of mortality and household income are additional factors that are expected to influence the interrelationships between son preference, the family-building process, and excess female child mortality. A recent study in Bangladesh, Egypt, and South Korea found that in Bangladesh and Egypt, where mortality is high, family-building behavior is a rather weak predictor of excess female child mortality.[19] In South Korea, however, the family-building process explains excess female mortality

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[16] Pavalavalli Govindasamy, M. Kathryn Stewart, Shea O. Rutstein, J. Ties Boerma and A. Elisabeth Sommerfelt, 'High-risk Births and Maternity Care', DHS Comparative Studies No. 8 (Columbia, Maryland: Macro International, 1993); J. Hobcraft, J.W. McDonald and S.O. Rutstein, 'Demographic determinants of infant and early childhood mortality: A comparative analysis', *Population Studies,* 39 (3) (1985), pp. 363–386; Robert D. Retherford, Minja Kim Choe, Shyam Thapa and Bhakta B. Gubhaju, 'To what extent does breastfeeding explain birth-interval effects on early childhood mortality?' *Demography,* 26 (3) (1989), pp. 439–450; Pradip K. Muhuri and Jane A. Menken, 'Excess mortality of young girls in rural Bangladesh: An investigation of the circumstances of greatest jeopardy.' Paper presented at the Annual Meeting of the Population Association of America, Cincinnati, 1–3 April 1993; A. Palloni and S. Millman, 'Effects of inter-birth intervals and breastfeeding on infant and early childhood mortality, *Population Studies,* 40 (1986), pp.215–236.

[17] IIPS, *op. cit.* in fn. 10, Table 5.14.

[18] Chai Bin Park and N.-H. Cho, 'Consequences of son preference in low-fertility countries in East Asia: Rising imbalance of sex ratio at birth', *Population and Development Review,* 21 (1) (1995), pp. 59–84; Kazuo Yamaguchi, 'A formal theory for male-preferring stopping rules on childbearing: Sex differences in birth order and in the number of siblings', *Demography,* 26 (3) (1989), pp. 451–465.

[19] Minja Kim Choe, Ian Diamond, Fiona Alison Steele, and Seung Kwon Kim, 'Son preference, family building process, and child mortality', in United Nations, *Too Young to Die: Genes or Gender?* (New York: United Nations, 1996, forthcoming).

almost entirely. Presumably, in South Korea, high income and small family size allow parents to afford high-quality child care for both daughters and sons even though son preference is pronounced. In Egypt and Bangladesh, however, where parents are more constrained by limited resources, the preference for males may cause parents to allocate resources preferentially to their sons.

In this article, we test the hypothesis that son preference influences parity progression and ultimately child mortality, and that the impact of son preference varies according to the overall levels of fertility and mortality. In particular, the analysis estimates the effect of the sex of the last child and the sex composition of other surviving children on the probability of having another child, controlling for the survival status of the last child and other demographic and socioeconomic characteristics of women. The model used for analyzing child mortality is similar to the above model except that fertility behavior is included as an additional predictor.

India provides an ideal situation for exploring these relationships within the borders of a single country. Son preference is culturally imbedded in Indian society, but its strength varies substantially from one part of the country to another. Variations in fertility and mortality (as well as sex differentials in infant and child mortality) are equally impressive. Below-replacement level fertility is found in two states, but fertility remains high in many regions of the country. Similarly, infant and child mortality rates are several times as high in some states as in other states. Another advantage of focusing on India is the availability of a recently completed national survey that provides high-quality, up-to-date information on all of the key variables required for the analysis, separately for each of the major states. The data set is described in more detail in the next section. The following sections describe differences among states in female and male mortality, the reasons for selecting particular states for this study, a profile of the selected states, and the methods used in the study. The results of the multivariate analysis are then discussed and the policy implications of the findings are outlined in the final section

SOURCE OF DATA

The data analyzed in this article come from the 1992–93 National Family Health Survey of India (NFHS). The NFHS is a nationally representative sample survey, which was conducted in 25 states that include more than 99 per cent of India's population. Interviews were conducted with 89,777 ever-married women age 13–49 in 88,562 households. The households covered in the survey included more than 500,000 residents. The sample selection was based on a systematic, multistage, stratified sample design. The samples for Orissa, Uttar Pradesh, and Haryana are weighted; the samples for the other states included in this article are self-weighting.[20] The NFHS project was initiated by the Ministry of Health and Family Welfare and coordinated by the International Institute for Population Sciences in Bombay. Overall, 30 organizations were involved in the survey, including 18 Population Research Centres and 7 private-sector survey research companies. Macro International and the East-West Center provided technical assistance for the NFHS, which was funded by the U.S. Agency for International Development.

The questionnaires for the NFHS were based on the core questionnaires from the Demographic and Health Surveys, modified to meet Indian conditions and the needs of policy makers and programme planners. The major topics covered in the survey include fertility, marriage patterns, family size preferences, the level of unwanted fertility, knowledge and practice of family planning, the potential demand for contraception, use of antenatal care services, breastfeeding and food-supplementation practices, child health and nutrition, vaccinations, and infant and child mortality. In addition, state-specific questions were added in most states on topics of interest to policy makers and researchers. These included such topics as AIDS awareness, dowry, child marriage, sex preference for children, sex preselection, and international migration.

SEX DIFFERENTIALS IN MORTALITY

In most populations at almost all ages, males have higher mortality than females.[21] However, in South Asia, female mortality has typically been found to be higher than male mortality in many age groups.[22] The National Family Health Survey found higher age-specific mortality rates for females than males in every five-year age group from age 0–4 through age 30–34 for 1991–92.[23] This pattern is consistent with the findings of the Sample Registration System (SRS) for the same years for every age group except age 30–34. Overall, the crude death rate was slightly higher for males than for females in the NFHS (10.0 vs. 9.4 per 1,000) and the same for males and females in the SRS (10.0 per 1,000). According to the SRS, the life expectancy at birth was slightly higher for males than females in 1970–80, but female life expectancy

[20] Tables for Orissa, Uttar Pradesh, and Haryana use sample weights, except for the hazard analysis tables, which are unweighted for all states.

[21] L. Heligman, 'Patterns of sex differentials in mortality in less developed countries', in A.D. Lopez and L.T. Ruzicka (eds.), *Sex Differentials in Mortality: Trends, Determinants and Consequences* (Canberra: The Australian National University, 1983), pp. 7–32.

[22] Samuel H. Preston, 'Mortality in India', in International Union for the Scientific Study of Population (IUSSP), *International Population Conference, New Delhi, 1989*, 4 (Liege: IUSSP, 1990), pp. 81–86; Shanti Ghosh, 'The female child in India: A struggle for survival', *Bulletin of the Nutrition Foundation of India*, 8 (4) (1987); Pehley and Amin, *loc. cit.* in fn. 8.

[23] IIPS, *op. cit.* in fn. 10, Table 8.3.

exceeded male life expectancy for the first time in 1981–90.[24]

Sex differentials in mortality are of particular interest for children under five years of age. The NFHS estimates slightly higher infant mortality rates for males (89 per 1,000 births) than for females (84 per 1,000 births), but the mortality disadvantage for males in the neonatal period turns into a mortality disadvantage for females in the postneonatal period (see Figure 1). The female survival disadvantage increases dramatically for children age 1–4 years. Child mortality for females (42.0 per 1,000) is 43 per cent higher than child mortality for males (29.4 per 1,000). The magnitude of the sex differential in child mortality is striking when compared to the usual pattern in less-developed countries. It is, in fact, common for female child mortality to exceed male child mortality in less-developed countries but the differences are usually very small (on average, only 2–3 per cent). Out of 46 less-developed countries for which we have comparable information from the Demographic and Health Surveys, 26 countries have higher child mortality for females than for males, but only two countries (Egypt and Pakistan) exhibit a more lopsided survival disadvantage for girls in that age group.[25]

Moreover, the situation is much more serious in Northern India than in Southern India. Table 1 shows sex differentials in child mortality for the 19 NFHS states with samples of more than 2,500 women. Only two states (Kerala and Tamil Nadu) have higher child mortality for males than for females. In every other state, female child mortality exceeds male child mortality by at least 11 per cent. Excess female child mortality exceeds 50 per cent in eight states, which are mostly in the Northern Region. The worst case is Haryana, where female child mortality is nearly 2-1/2 times as high as male child mortality. The regional averages, shown in Figure 2, indicate that excess female child mortality is most pronounced in the Northern Region and is also extremely high in the Eastern and Central Regions. On the other hand, no state in Southern, Western, or Northeastern India has a level of excess female child mortality higher than the national average.

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[24] Office of the Registrar General, India (ORGI), 'SRS Based Abridged Life Tables - 1986–90', Occasional Paper No. 1 of 1994 (New Delhi, 1994).

[25] Jeremiah M. Sullivan, Shea Oscar Rutstein, and George T. Bicego, 'Infant and Child Mortality', Demographic and Health Surveys Comparative Studies No. 15 (Calverton, Maryland: Macro International, 1994); unpublished DHS data; In a review of life tables for 30 *more developed countries*, the United Nations did not find any countries with higher female than male child mortality (United Nations Secretariat, 'Sex differentials in life expectancy and mortality in developed countries: An analysis by age groups and causes of death from recent and historical data', *Population Bulletin of the United Nations*, 25 (1988), pp. 65–107).

Table 1. Child mortality by sex

State	Male	Female	Excess female child mortality (%)
India	29.4	42.0	43
North			
Delhi	13.6	21.2	56
Haryana	18.4	43.2	135
Himachal Pradesh	17.6	25.3	44
Jammu Region of J&K	14.5	24.5	69
Punjab	12.7	23.0	81
Rajasthan	26.5	42.2	59
Central			
Madhya Pradesh	46.7	56.8	22
Uttar Pradesh	38.5	65.6	70
East			
Bihar	34.5	53.5	55
Orissa	16.1	23.4	45
West Bengal	21.7	35.4	63
Northeast			
Assam	52.9	59.6	13
West			
Goa	7.5	8.3	11
Gujarat	27.1	38.6	42
Maharashtra	19.1	23.6	24
South			
Andhra Pradesh	21.5	27.6	28
Karnataka	25.6	33.4	30
Kerala	10.0	9.4	-6
Tamil Nadu	29.0	23.2	-25

STATE PROFILES

Indian states vary dramatically on the key variables included in this article. Eight states, comprising 40 per cent of India's population, have been selected for the analysis. These states were selected to represent a wide range of conditions on the basis of their fertility and mortality levels, the strength of son preference attitudes and behavior, and the level of excess female child mortality.

Basic demographic and health indicators for these states are shown in Table 2. The degree of heterogeneity on all of the variables examined is striking. All of the states have predominantly rural populations, but the percentage of the population living in urban areas varies from only 13 per cent in Orissa to 41 per cent in Goa. Several measures of education demonstrate the high level of female illiteracy in most states and continuing discrimination against school-age girls in the utilization of

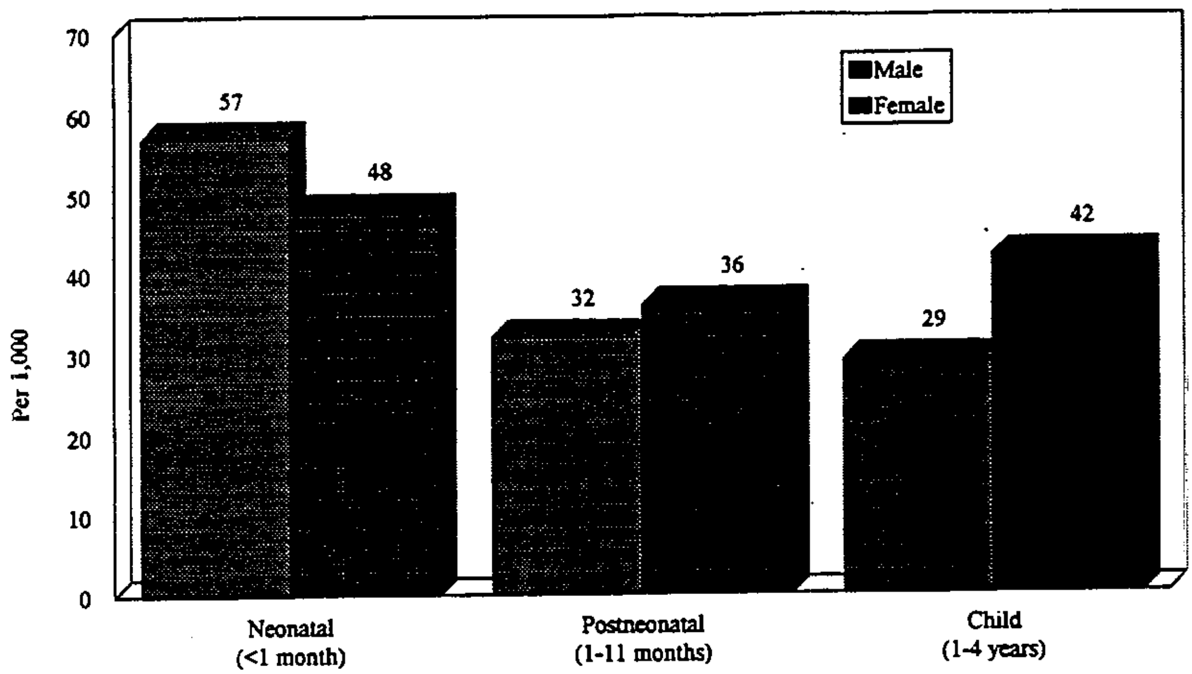

Figure 1. Infant and child mortality by sex of child

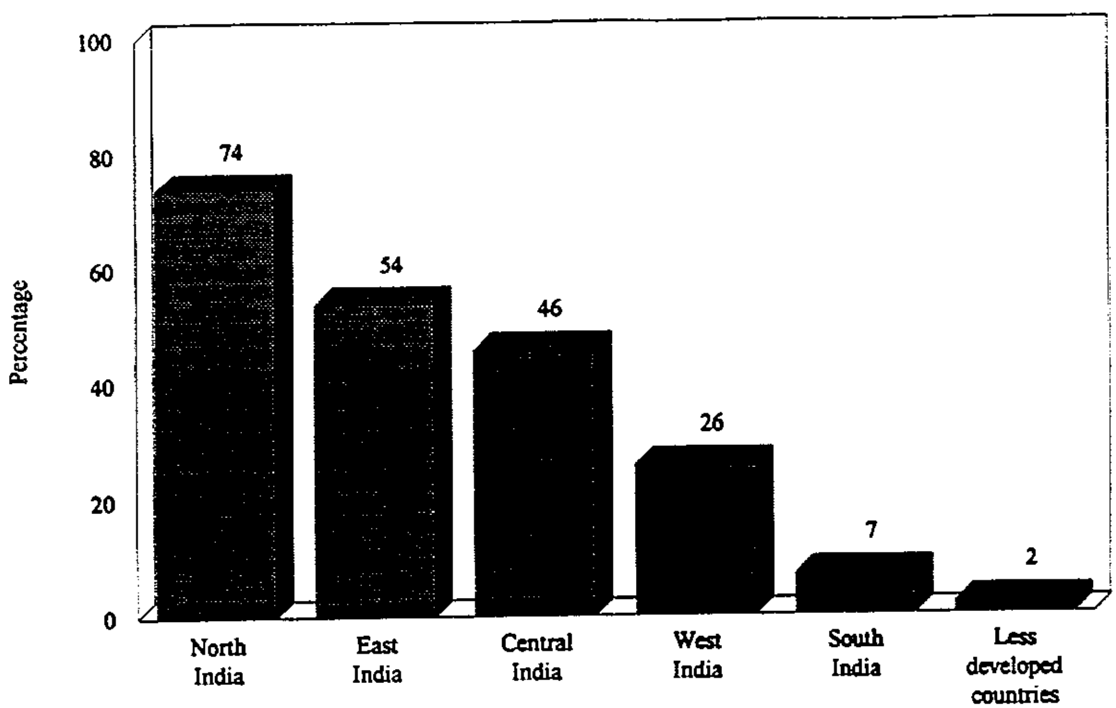

Figure 2. Average excess female child mortality by region

Table 2. State profiles

	Goa	Kerala	Tamil Nadu	Punjab	Orissa	Haryana	Rajasthan	Uttar Pradesh
Percent urban (1991)	41	26	34	30	13	25	23	20
Percent of EMW illiterate	34	16	50	53	67	64	82	76
Percent illiterate (F/M)	2.30	1.75	1.91	1.41	1.88	1.95	1.88	1.88
Percent in school (F/M)	0.98	1.00	0.92	0.93	0.81	0.86	0.55	0.63
Percent not exposed to media	15	21	22	35	61	40	70	65
Infant mortality rate	32	24	68	54	112	73	73	100
Total fertility rate	1.9	2.0	2.5	2.9	2.9	4.0	3.6	4.8
Percent of women age 20–24 married before age 18	7	19	36	15	46	57	70	64
SMAM for females	25.1	22.1	20.5	21.1	20.7	18.4	18.4	18.6
CPR	48	63	50	59	36	50	32	20
Sex preferred for next child (boy/girl)	2.0	1.6	1.7	10.5	5.3	9.6	8.5	5.0
Ideal boys/ideal girls	1.3	1.2	1.3	1.7	1.4	1.6	1.7	1.5
Wants no more (2B/2G)	1.5	1.1	1.3	4.0	2.3	9.9	8.6	3.3
Using FP (2B/2G)	1.2	1.1	1.3	2.0	2.6	2.5	5.9	2.8
Fully vaccinated (G/B)	1.01	0.95	0.91	0.79	0.90	0.88	0.79	0.76
Prevalence of three diseases (G/B)	0.87	0.85	1.00	0.84	0.95	0.83	0.95	0.91
Percent of children taken to health facility (G/B)	1.03	0.92	0.94	0.98	0.86	0.96	0.81	0.93
Median duration of breastfeeding (G/B)	1.25	0.91	1.08	0.91	1.04	0.81	0.83	0.93
Percent undernourished (G/B)	0.95	0.99	1.13	1.05	0.99	1.15	0.92	0.93
Percent severely undernourished (G/B)	0.83	1.33	1.30	1.10	1.05	1.45	1.05	0.94

EMW = ever-married women, F = female, M = male, SMAM = singulate mean age at marriage, CPR= contraceptive prevalence rate, B = boy, G = girl, FP = family planning

educational services. The majority of ever-married women in their childbearing years are illiterate in all states except Kerala and Goa. Female literacy is particularly low in Rajasthan and Uttar Pradesh, where more than three-quarters of respondents are illiterate. Past discrimination in education is evident from a comparison of female and male literacy rates for the population age 6 and above. In every state, illiteracy is much higher for females than for males. In six of the eight states, the ratio of female to male illiteracy varies within the narrow range of 1.75–1.95. The unusually high differential in Goa should be interpreted in light of the fact that overall literacy levels for both males and females are quite high in Goa.

All states have experienced considerable progress in literacy and educational attainment over time, but equality has still not been achieved in most states. The Indian constitution set a goal of providing free and compulsory education to all children below age 15 within 10 years, but most states are still far from achieving that objective. In fact, more than one-third of school-age children in India do not attend school.[26] Moreover, a substantial gap between female and male school attendance still exists in most of the states (Table 2). In Kerala and Goa, female school attendance rates are similar to the rates for males, and females are only slightly behind in Punjab and Tamil Nadu. At the other end of the spectrum, female school attendance rates are only about half as high as male rates in Rajasthan and the situation is not much better in Uttar Pradesh. Not surprisingly, these two states also have unusually high levels of son preference.

Mass media can also provide an educational function and can be used to disseminate messages about health and family planning, but the reach of mass media is very limited in some states. In Rajasthan, Uttar Pradesh, and Orissa, more than 60 per cent of women are not regularly exposed to the electronic mass media (radio, television, or movies). Since a large majority of women in those states are also not literate, they cannot be reached through the print media either. Exposure to electronic mass media is relatively high in Goa and in the southern states of Kerala and Tamil Nadu.

Infant mortality rates are several times as high in Orissa and Uttar Pradesh as in Goa and Kerala. In the remaining states, infant mortality rates are moderate, with 5–7 per cent of children dying before their first birthday.

Variations in fertility levels are also large. Two states, Kerala and Goa, have already achieved below-replacement fertility, and Tamil Nadu is well on its way to reaching that goal. On the other hand, in the highest-fertility state, Uttar Pradesh, women can be expected to have an average of nearly five children by the end of their childbearing years. Fertility is also relatively high in Haryana and Rajasthan. It is interesting to note that high fertility rates and high infant-mortality rates go hand-in-hand. The only exception is Orissa, which has achieved a below-average level of fertility despite the fact that the state has had the highest level of infant mortality in India for many years. A recent study of the causes of high

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[26] IIPS, *op. cit.* in fn. 10, Table 3.10.

infant mortality in Orissa attributed the large number of infant deaths to poverty, illiteracy, superstitious attitudes, and a number of environmental factors.[27]

Fertility has been declining over time throughout India, even in high-fertility states such as Uttar Pradesh. This reduction has been spurred by a rapid increase in the use of effective family planning methods and a substantial increase in the average age at marriage. Marriages at very young ages are becoming rare in India, but a substantial proportion of women still marry below the legal minimum marriage age of 18 years. Well over half of all women in the 20–24 age group were married before age 18 in the high-fertility Hindi-belt states of Rajasthan, Uttar Pradesh, and Haryana. The singulate mean age at marriage (SMAM) for females is also relatively low (18.4–18.6 years) in these three states. The SMAM is 2–4 years higher in Tamil Nadu, Orissa, Punjab, and Kerala. Goa stands out as having the highest age at marriage in India. Women in Goa marry, on average, at age 25, and men in Goa are typically more than 30 years old when they marry for the first time. Because of its particularly old age at marriage, Goa has managed to achieve very low fertility with only a moderately high level of contraceptive use. The contraceptive prevalence rate is around 60 per cent in Kerala and Punjab and 50 per cent in Tamil Nadu, Haryana, and Goa. The low levels of contraceptive prevalence in Uttar Pradesh and Rajasthan are notable in view of India's history of large-scale family planning efforts over a period of more than four decades.

A persistent preference for sons throughout India can been seen by examining the NFHS data on the stated attitudes of respondents, their fertility and family planning behavior, and their treatment of sons and daughters (Table 2). Women who want another child are much more likely to opt for a son than a daughter in all of the states. The ratio of the number who prefer a son to the number who prefer a daughter is high (1.6–2.0) in Kerala, Tamil Nadu, and Goa, much higher (around 5) in Uttar Pradesh and Orissa, and remarkably high (8.5–10.5) in the remaining three states. The preference for sons is corroborated by the responses to a question on how many girls and boys a woman would want if she could start over and have just the number of children she wanted. The ideal number of sons exceeds the ideal number of daughters by 20–70 per cent in every state, but the preference for sons is once again relatively low in Kerala, Goa, and Tamil Nadu. Finally, son preference can be measured by the extent to which the desire for more children depends on the current sex composition of a couple's living children. In Table 2, this measure is simplified by focusing on women with exactly two living children, and comparing those with two sons and two daughters. As expected, women with two sons are much less

[27] Institute for Research in Medical Statistics (IRMS), *Causes of Infant Deaths in Orissa: Project Report* (New Delhi: IRMS, Indian Council of Medical Research, 1993).

likely to want to have at least one more child than women with two daughters. On all three measures of attitudes, Haryana, Rajasthan, and Punjab stand out as having the strongest son-preference attitudes. Son preference can also affect family planning behavior. In every state, women with two sons are more likely to use contraception than women with two daughters. According to this measure, son preference is relatively weak among women in Kerala, Goa, and Tamil Nadu, and is most influential in Rajasthan.

The strong preference for sons in many states can ultimately lead to discrimination against female children. The NFHS contains a considerable amount of information on the treatment of young children according to their sex. All of the sex discrimination measures shown in Table 2 are measured as ratios of the estimate for female children divided by the estimate for male children. Medical care and feeding practices are the two areas that have received the most attention as determinants of sex differentials in infant and child mortality. In India as a whole, male children have a slight, but consistent, advantage over female children in immunization coverage for each of six major vaccine-preventable childhood diseases. In Goa, among children age 12–23 months, girls and boys are equally likely to have received all of the recommended vaccinations. Some discrimination against girls is evident in all of the other seven states, but the disadvantage is particularly striking in Uttar Pradesh, Punjab, and Rajasthan where full vaccination coverage for girls is less than 80 per cent as high as the coverage for boys.

Health care for children was also assessed by measuring the prevalence and treatment of childhood diseases. Mothers were asked if each of their children under age 4 was sick with a cough accompanied by rapid breathing (symptoms of acute respiratory infection), fever, or diarrhea in the two weeks before the survey. Girls were reported to be *less* likely to suffer from each of these conditions, although questions can always be raised about whether mothers recognize these problems in their daughters as readily as they do in their sons. When girls do become ill, however, they are less likely than boys to be taken to a medical facility or medical practitioner for treatment in every state except Goa. Discrimination against girls in medical treatment is particularly evident in Rajasthan and Orissa.

It has been amply demonstrated that in South Asia boys are often given preference in the amount and quality of food they consume. Although a complete assessment of feeding practices for girls and boys is beyond the scope of this analysis, Table 2 contains a relative measure of the median duration of breastfeeding for girls and boys. Girls are breastfed longer than boys in three states and shorter in the rest. The length of breastfeeding is much shorter for girls than for boys in Haryana and Rajasthan.

Poor nutritional intake and the persistence of untreated diseases can take their toll on the growth and development of children. In the NFHS, children under age 4 were weighed and measured to assess their nutritional status. Three standard measures of nutritional status were used to assess the prevalence of chronic and acute undernutrition—height-for-age, weight-for-age, and weight-for-height. The distribution of Indian children on these three measures was compared to an International Reference Population recommended by the World Health Organization.[28] This reference population has been found to be applicable to Indian children.[29] Children who fall more than 2 standard deviations below the median of the International Reference Population are considered to be moderately undernourished, and those who fall more than 3 standard deviations below the median are defined as severely undernourished. In general, children who are moderately undernourished are three times as likely to die as well-nourished children, and for those who are severely undernourished the risk of mortality is eight times as high.[30] The overall levels of undernutrition in India are among the highest in the world.[31] Among the states, girls in Tamil Nadu and Haryana are much more likely than boys to be moderately and severely undernourished.[32] Girls are also somewhat disadvantaged in Punjab and they are much more likely than boys to be severely undernourished in Kerala. It should be noted that Tamil Nadu and Kerala have very low proportions of severely undernourished children so that the sex differentials appear exaggerated in comparison with those of other states.

Based on the indicators in Table 2, it is possible to divide the eight states loosely into three groups. Kerala and Goa are marked by relatively high literacy and media exposure, low fertility and mortality, a high age at marriage, a weak preference for sons, and fairly equal treatment of boys and girls. Tamil Nadu is approaching these states in many respects and for most purposes should be included in the same group. At the opposite extreme, Rajasthan and Uttar Pradesh are characterized by low literacy and media exposure, high fertility and mortality, a young age at marriage, a strong preference for sons, and discrimination against girls. The remaining states (Haryana, Orissa, and Punjab) fall in the middle.

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[28] M.J. Dibley, J.B. Goldsby, N.W. Staehling and F.L. Trowbridge, 'Development of normalized curves for the international growth reference: Historical and technical considerations', *American Journal of Clinical Nutrition*, 46 (5) (1987a), pp. 736–748; M.J. Dibley, N.W. Staehling, P. Neiburg and F.L. Trowbridge, 'Interpretation of z-score anthropometric indicators derived from the international growth reference', *American Journal of Clinical Nutrition*, 46 (5) (1987b), pp. 749–762.

[29] K.N. Agarwal, D.K. Agarwal, D.G. Benakappa, S.M. Gupta, P.C. Khanduja, S.P. Khatua, K. Ramachandran, P.M. Udani and C. Gopalan, *Growth Performance of Affluent Indian Children (Under-fives): Growth Standard for Indian Children* (New Delhi: Nutrition Foundation of India, 1991).

[30] UNICEF, *The Progress of Indian States: 1995* (New Delhi, 1995).

[31] IIPS, *op. cit.* in fn. 10; A. Elisabeth Sommerfelt and M. Kathryn Stewart, 'Children's Nutritional Status', DHS Comparative Studies No. 12 (Calverton, Maryland: Macro International, 1994).

[32] In Tamil Nadu, where children's height was not measured, undernutrition is based only on the weight-for-age measure. In all other states, the estimates are based on average levels of undernutrition on all three measures (height-for-age, weight-for-age, and weight-for-height).

Punjab is similar to Tamil Nadu in many respects, but it has been placed in the middle group because of its distinctly higher level of son preference.

MULTIVARIATE ANALYSIS METHODS

In this article, the effects of family composition on parity progression and child mortality are estimated with hazard models. The questions we ask are: (1) After the birth of a child, does the probability of having an additional child within five years depend on the sex of the previous child and the sex composition of other older siblings? and (2) Is a child's probability of dying between ages 1 and 5 affected by the child's sex and the sex composition of older siblings in the family? We answer these questions by comparing the monthly probabilities of having an additional child and the probabilities of a child dying for women with children of a given sex composition relative to the probabilities of the reference group.

Children are classified into three groups by the total number of surviving children in the family at the time of their birth: one, two, and three or more. For the fertility analysis, the number of classifications in high-fertility states is extended to four or five, depending on the overall level of fertility in each state. For each family size, a theoretically desirable sex combination of children is chosen as the reference group.[33] For women with one child, one son is the reference; for women with two children, one daughter followed by a son is the reference; and for women with three or more children, the reference group is a family whose last child is a son and whose other children include both boys and girls. For each group of children, two models are estimated. The gross-effects model includes only the sex of the last child and the sex combination of siblings. The net-effects model includes additional factors likely to have a strong effect on fertility and child mortality. We limit the factors to those that are commonly relevant in all of the states we analyze. These are mother's place of residence, mother's literacy, year of birth of the last child, maternal age, preceding birth interval, and birth order. For the analysis of parity progression, the experience of child death is also included. This is coded as a time-dependent step function changing its value from 0 to 1 at 12 months after the death of any child. For the analysis of child mortality, the birth of a younger sibling is added to the model. This is coded as a time-dependent step function changing its value at the time of birth of the sibling. For the reference groups, the probability of having another child

[33] The reference groups do not necessarily represent the sex composition that is empirically found to be most desirable. The selection of reference groups is arbitrary and does not affect the adjusted percentages that are analysed in the following sections.

within five years and of child mortality are both estimated by a life-table method applied to the group. The relative risks estimated by the hazard models are applied to the probabilities of the reference group to provide estimated parity progression rates and child mortality rates for the remaining groups.

PARITY PROGRESSION

The effects of family composition on parity progression are summarized in Table 3. The table shows the adjusted percentages of children who experience the birth of a younger sibling within five years, controlling for the effects of other factors (Appendix Tables A1–A8 show more detailed results of the fertility and mortality analyses.) In states with a total fertility rate of less than 3.0, the analysis is combined for families with three or more children. In Haryana and Rajasthan, which have total fertility rates of about four children, families with four or more children are shown separately. In Uttar Pradesh, with a total fertility rate of nearly five, one additional group is included in the analysis. It is important to include the larger family size groups in high-fertility states since the impact of sex preference may be somewhat muted at low parities in those states because a large majority of couples continue childbearing regardless of the sex composition of their children. The full effect of sex preference in those states may not appear until the higher parities.

The effects of family composition on parity progression are statistically significant in all of the states. In general, women who have no sons are more likely to proceed to have an additional child than those with at least one son. Kerala is the only state that does not exhibit son preference at any parity. Among women with two children in Kerala, parity progression is higher for women with two boys or two girls than for women with one boy and one girl, indicating a desire for at least one child of each sex.

In every state, the large majority of women with one child go on to have another child within the five-year period irrespective of the sex of the first child. For women with two children, substantial sex differences in parity progression are evident. At that parity, in every state except Kerala, women with two daughters are much more likely to have another child than women with any other sex combination of children. In the five northernmost states, women with two sons are least likely to have another child, confirming the perceived importance of having at least two male children in those states. With the exception of Punjab, these are also the five states with the highest under-five mortality rates.[34] High mortality rates in these states undoubtedly add to the desire of couples to have more than one son to insure the survival of at least one son into their old age.

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[34] IIPS, *op. cit.* in fn. 10, Table 8.8.

Table 3. Adjusted percentage of children who experience the birth of a younger sibling before age 5, by sex of last child and sex composition of older siblings (net effects)

Number of children/ Sex composition	Goa	Kerala	Tamil Nadu	Punjab	Orissa	Haryana	Rajasthan	Uttar Pradesh
One child								
M with no sibling	77	78	83	93	83	91	86	90
F with no sibling	82	78	85	94	87	91	90	92
Two children								
M with a male sibling	53	49	59	53	70	71	77	80
M with a female sibling	50	41	64	70	78	81	84	83
F with a male sibling	50	35	54	71	74	84	82	84
F with a female sibling	72	48	77	81	86	89	88	89
Three or more children[a]								
M with all male siblings	33	39	45	38	50	43	57	72
M with male and female siblings	30	34	33	30	45	42	61	72
M with all female siblings	49	36	40	55	61	70	75	78
F with all male siblings	24	36	30	28	47	47	55	71
F with male and female siblings	41	39	35	55	55	70	73	81
F with all female siblings	59	44	56	74	72	80	81	84
Four or more children[b]								
M with all male siblings						51	52	66
M with male and female siblings						41	50	67
M with all female siblings						69	69	72
F with all male siblings						48	46	64
F with male and female siblings						59	58	72
F with all female siblings						90	77	79
Five or more children								
M with all male siblings								68
M with male and female siblings								64
M with all female siblings								83
F with all male siblings								67
F with male and female siblings								69
F with all female siblings								72

Note: Adjustments are made by proportional hazard models using sex of last child, number and sex composition of siblings, urban residence, mother's literacy, year of birth of last child, mother's age, child death, previous birth interval (when applicable), and birth order as covariates. The BMDP2L program was used for the estimation.

[a]Exactly three children for Haryana, Rajasthan, and Uttar Pradesh

[b]Exactly four children for Uttar Pradesh

At third and higher parities, women with no sons are most likely to continue childbearing in every state. Women with at least two sons are generally least likely to continue. However, in no state are women with all sons the most likely group to stop bearing children. This suggests that there is at least a modicum of interest in having a mix of sons and daughters among one's children. In most cases, the second highest parity-progression ratios are for women who had a son as their first child, followed by a string of daughters. This is yet another indication of the importance of having at least two sons in many families.

Overall, the effects of family composition on parity progression are strongest in Punjab and Haryana, which are the states with the strongest son-preference attitudes. The effects of family composition are least evident in Kerala, Tamil Nadu, and Uttar Pradesh. In general, there is a tendency for the effect of sex preference on parity progression to be strongest in states with a moderate level of fertility, but the pattern is not sufficiently consistent to establish definitively a U-shaped relationship with the level of fertility.

Although the other predictors in the hazard models are not the main focus of this article, their influence on parity progression is generally statistically significant, consistent across states, and in the expected direction. In particular, women are generally much less likely to continue childbearing if they are literate, older, and live in urban areas (see Table A.5). They are also less likely to have another child if they have had a recent birth and much more likely to continue childbearing if they have experienced a child death.[35]

CHILD MORTALITY

The effects of family composition on child mortality are summarized in Table 4 in terms of adjusted child-mortality rates. In Goa, Kerala, and Punjab, because of the very low level of child mortality coupled with relatively low fertility, there were not enough deaths to estimate the effects separately by number of children, and the estimation had to be based on combined family sizes. For Goa and Kerala all family sizes are combined, and for Tamil Nadu women with one child and two children are combined.[36]

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[35] The effect of child mortality is estimated by using a time dependent dummy variable indicating the experience of death of any of the children who were surviving at the time of birth of the last child, including the last (index) child. We also calculated models with two dummy variables, one indicating the death of the index child and one indicating the death of any of the older siblings. The second model showed that most of the effect of child death is associate with the death of the index child; the death of an older sibling has only weak effects that are often not statistically significant. Most of the children who died are also the index children. For example, among women with five or more surviving children in Uttar Pradesh, 14 per cent experienced the death of a child during the five years after the birth of the last child, and 79 per cent of the deaths were among the fifth children. Estimates of the effects of other covariates from two models were nearly identical.

[36] In these cases, adjusted child mortality in Table 4 is calculated by applying the same factors for male-female differences at each relevant parity, but using different mortality estimates for the reference category from Table A3.

Table 4. Adjusted child mortality by sex of last child and sex composition of older siblings (net effects)

Number of children/ Sex composition	Goa	Kerala	Tamil Nadu	Punjab	Orissa	Haryana	Rajasthan	Uttar Pradesh
One child								
M with no sibling	8	2	8	7	10	18	26	34
F with no sibling	6	2	16	9	11	28	30	47
Two children								
M with a male sibling	5	12	20	15	17	19	18	38
M with a female sibling	5	12	13	15	10	16	17	30
F with a male sibling	4	10	14	19	34	25	41	53
F with a female sibling	4	10	13	19	18	47	31	48
Three or more children								
M with all male siblings	14	16	17	15	9	26	26	39
M with male and female siblings	14	16	27	21	18	13	23	31
M with all female siblings	14	16	27	16	16	10	14	29
F with all male siblings	10	13	7	29	18	27	27	66
F with male and female siblings	10	13	30	19	30	34	30	69
F with all female siblings	10	13	33	46	37	30	48	39

Note: Adjustments are made by proportional hazard models using sex of last child, sex composition of siblings, urban residence, mother's literacy, year of birth of last child, mother's age, previous death of a sibling, short preceding birth interval, birth order, and birth of next child. The BMDP2L program was used for the estimation.

In three states (Goa, Kerala, and Tamil Nadu), there is no significant effect of sex composition on child mortality. Furthermore, in Kerala and Goa, male child mortality is slightly higher than female child mortality after adjustments (as observed in most low-mortality populations). Considering that there was no evidence of son preference in fertility behavior in Kerala, the pattern of child mortality found in that state may represent the natural pattern in the absence of son preference. However, the small number of child deaths in the Kerala data requires that these results should be interpreted cautiously.

In Punjab, Rajasthan, Uttar Pradesh, and Haryana, we observe clear excess female mortality. Female children experience higher child mortality in general, and the excess mortality is more severe in families with more children. In general, excess female child mortality tends to increase with the number of female children in the family. This result is consistent with earlier findings that discriminatory practices are concentrated in families with several girls.[37] A notable exception is found in Uttar Pradesh among women with three or more children. There, female children with older brothers have higher mortality than those with no brothers.[38] Uttar Pradesh is among the poorest states in India. It is possible

[37] Dag Gupta, 1987, *loc. cit.* in fn. 8; Muhuri and Preston, *loc. cit.* in fn. 8.

[38] This pattern is consistent with the findings of an earlier survey in two rural districts of Uttar Pradesh, where girls with an older brother (but not those with an older sister) had a greater risk of dying (see George B. Simmons, Celeste Smucker, Stan Bernstein

that a girl with no brothers is less likely to be subject to increased mortality because there are no 'higher-status' competitors for limited resources. Immunological factors may also contribute to this finding. Aaby et al. (1986) argue that for immunological reasons a child is more likely to become infected with measles from an opposite-sex sibling than from a same-sex sibling.[39] Significantly, Uttar Pradesh has the lowest vaccination coverage of children for measles among the states included in this analysis.

In Orissa, there is also some evidence of net excess female child mortality. Among women with two children, female children with an older brother have much higher child mortality than others. For women with three or more children, girls in general have higher mortality than boys. The lowest mortality is found not for the reference group but for boys with no sisters. Compared to this group, girls with older female siblings have significantly higher child mortality. It should be noted that Orissa shows an unusual pattern of age-specific mortality rates. Although the infant mortality rate in Orissa is the highest among the states in India, the level of child mortality is quite low. The reasons for this unusual pattern deserve more study but are not pursued here.

With the exception of Punjab, where excess female child mortality is very high, the general pattern is that higher levels of fertility and mortality are associated with higher excess female child mortality. In Uttar Pradesh, where the effect of family composition on fertility is moderate, its effect on excess female child mortality is very strong. Whether states such as Uttar Pradesh and Rajasthan will ultimately follow the pattern of Punjab (where excess female child mortality persists) or that of Tamil Nadu (where there is no excess female mortality) is an interesting subject for further research.

ROLE OF DIFFERENTIAL PARITY PROGRESSION IN EXPLAINING EXCESS FEMALE CHILD MORTALITY

Our analysis shows that in states where excess female mortality is observed, parity progression is higher after a female child. This raises the question: Can some of the excess female child mortality be explained by the fact that daughters are more likely to be followed by a younger sibling after a very short interval? We try to answer this question by comparing the effects of family composition on child mortality with and without controlling for the effect of the birth of the next child. The effect of family composition is

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and Eric Jensen, 'Post-neonatal mortality in rural India: Implications of an economic model', *Demography*, 19 (3) (1982), pp. 371–389).

[39] P. Aaby, *et al.*, 'Cross-sex transmission of infection and increased mortality due to measles', *Review of Infectious Diseases*, 8 (1) (1986), pp. 138–143.

almost unchanged at the first and second parities in any state. At the third and higher parities, however, the effect of family composition is reduced when the birth of the next child is introduced as a factor in Orissa and Haryana (and to a smaller extent in Rajasthan and Punjab), namely in states with moderate or low levels of child mortality (see Appendix Tables A7 and A8). In Uttar Pradesh, which has high levels of both fertility and mortality, the effect did not change much. Little change was also registered in the low-mortality states of Goa, Kerala, and Tamil Nadu. Overall, the mediating role of parity progression on sex differentials in child mortality appears to be weak.

Our analyses show that the sex composition of children in the family affects subsequent fertility behavior in every state examined. In seven out of the eight states, the results of the parity progression hazard models indicate that there is a pronounced preference for sons. Because the effect is strongest in the states with a moderate level of fertility, the overall effect is likely to increase in the short run as fertility continues to fall in the populous northern states. The effects of family composition on excess female child mortality are more complex. Female children with older sisters are often (but not always) subject to the highest risks of mortality. Moreover, although excess female child mortality is generally smaller in states with low levels of mortality, there are substantial variations. Overall, the analysis suggests that son preference fundamentally affects demographic behavior. The patterns observed, however, are by no means uniform throughout India, and they can be expected to continue in a state of flux as fertility and mortality levels continue to decline.

POLICY IMPLICATIONS

The preference for sons that has been observed to varying degrees in every part of India has been shown to adversely affect both fertility behavior and sex differentials in child mortality. The desire for sons discourages some couples from discontinuing childbearing after reaching their desired number of children because they have not yet had their minimum desired number of sons. It is difficult to quantify the effect of son preference on fertility and family planning precisely, but a measure developed by Arnold (1985) can be used to estimate this effect.[40] In the case of contraceptive use, for example, the measure assumes that in the absence of sex preference, all women at a given parity would use contraception to the same extent as women at that same parity with the most desirable sex composition of children (i.e., those with the highest contraceptive prevalence rate). According to this measure, the national contraceptive prevalence rate would increase modestly, from its current level of 40.6 per cent to

[40] Fred Arnold, 'Measuring the effect of sex preference on fertility: The case of Korea', *Demography,* 22 (2) (1985), pp. 280–288.

45.5 per cent in the complete absence of sex preference. Although moderate, even an increase of this magnitude would be a boon to the family welfare programme. Similarly, the unusually high degree of excess female child mortality in almost all Indian states suggests that the strong preference for sons is substantially diminishing the chances of survival of girls between one and four years of age. For these reasons, a concerted effort to reduce son preference and increase the status of women is essential. Such efforts would be admirable in their own right, but their potential demographic benefits provide a further rationale for placing relevant policies and programmes at the top of the government's agenda.

Any programme designed to effect changes of this nature will have to deal with the fact that the preference for sons is deeply entrenched in India's cultural, religious, and social traditions. Nevertheless, some key programmes can be suggested to promote equality.

The literacy gap between men and women has been closing over time, but women are still much less likely than men to be literate and to have completed each level of education. Moreover, school-age girls (age 6–14) are still much less likely to attend school than boys of the same age (59 per cent of girls attend school compared with 76 per cent of boys). The NFHS has demonstrated that even basic literacy for women can result in substantial improvements in the demographic and health situation.[41] Renewed efforts are needed to close the female-male literacy gap and to fulfill the constitutional promise of universal compulsory education for all of India's children. Because many parents are reluctant to send their daughters to school even when adequate educational facilities are accessible, achieving the goal of educational equality will require not only the availability of school buildings and adequate personnel, but also the expansion of innovative programmes such as the provision of free lunches at school, free textbooks and school uniforms for children from poor families, and educational savings accounts for girls. These types of programmes may increase the motivation of parents to send their daughters to school or at least reduce the barriers to their attendance. The further expansion of adult female literacy programmes should also be encouraged.

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[41] It should be noted, however, that the relationship between female literacy and excess female child mortality has not been definitively established in other studies. Several analysts have found that female literacy significantly reduces the female disadvantage in child survival in India (Mamta Murthi, Anne-Catherine Guio, and Jean Drèze, 'Mortality, fertility, and gender bias in India', *Population and Development Review,* 21 (4) (1995), pp. 745–782; K. Bourne and G.M. Walker, 'The differential effect of mother's education on mortality of boys and girls in India', *Population Studies,* 45 (2) (1991), pp. 203–219; S. Amin, 'The effect of women's status on sex differentials in infant and child mortality in South Asia', *Genus,* 46 (3–4) (1990), pp. 55–69; Simmons *et al., loc. cit.* in fn. 38). But an equal number of studies in the region have found weaker or contrary results (Das Gupta, 1987, *loc. cit.* in fn.8; A. Bhuiya and K. Streatfield, 'Mother's education and survival of female children in a rural area of Bangladesh', *Population Studies,* 45 (2) (1991), pp. 253–264; Alaka M. Basu, *Culture, the Status of Women and Demographic Behaviour* (Oxford: Clarendon Press, 1992); Caldwell, Reddy, and Caldwell, *op. cit.* in fn. 5).

Although female children receive unfavorable treatment in many respects in particular states, at the national level there is no evidence in the NFHS of systematic discrimination against girls in terms of feeding practices or the nutritional status of young children. Girls are slightly less likely than boys to have received all of the recommended childhood vaccinations, but the differences are not large (at age 12–23 months, when the basic series of immunizations should have been completed, 37 per cent of boys and 34 per cent of girls have been fully vaccinated). With respect to childhood diseases, boys are slightly *more* likely to have been sick with each of the three conditions included in the survey (fever, diarrhea, and acute respiratory infection) during the two weeks preceding the survey. The most substantial sex difference in the care of children is in the treatment that children receive when they become ill. For each of the three childhood diseases mentioned above, boys are substantially more likely than girls to have been taken to a health facility or health provider and to have received appropriate medical treatment. These differences are undoubtedly an important factor underlying the excess female child mortality that is documented in the NFHS and other data sources. The difference in medical treatment cannot be explained simply by a lack of available health facilities, since parents are able to obtain medical treatment for a large majority of their sons. Once again, the solution to this problem requires creative approaches to encourage parents to seek medical care for their daughters on a par with their sons, including the design of appropriate educational and motivational programmes.

A number of other beneficial policies or programmes could be recommended, but initiating and implementing them will be difficult in the context of high levels of illiteracy, a lack of contact with the mass media (half of women are not regularly exposed to any type of electronic mass media), the relative isolation of women (more than three-quarters of women do not work outside the home), and a lack of political will to tackle some of these seemingly intractable problems. Community-based programmes, such as those in Indonesia or 'mothers' clubs' in South Korea, can overcome many of these barriers. In addition, some laws which could improve the situation are already on the books, such as the minimum legal age of marriage of 18 for women and laws against dowry, but enforcement efforts are negligible.

Son preference is likely to persist in India for some time, particularly in North India. It remains to be seen how quickly the states with a strong son preference will move in the direction of the Southern Indian states, which are characterized by a relative lack of son preference and a relatively weak impact of son preference on demographic behavior. Leela Visaria cites some evidence of a general decline in son preference and also notes that: 'There is evidence of inter-generational tensions and conflicts such that some elderly are beginning to feel that daughters rather than sons are more dependable for emotional and even financial support'.[42] If these types of changes in the instrumental value of daughters and sons become more widespread, son preference may become weaker even in Northern India, and the demographic consequences of son preference highlighted in this article may become less important in the future.

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[42] Visaria, *loc. cit.* in fn. 12, p.17).

APPENDICES

Table A1. Descriptive statistics of variables used for parity progression and child mortality

Covariates	Goa	Kerala	Tamil Nadu	Punjab	Orissa	Haryana	Rajasthan	Uttar Pradesh
One child								
Number of cases	1391	1992	1840	1600	2354	1645	2797	6231
Male (%)	52.3	51.4	49.6	51.8	51.0	52.4	53.0	51.0
Female (%)	47.7	48.6	50.4	48.2	49.0	47.6	47.0	49.0
Mean year of birth	86.6	86.6	86.5	86.8	86.7	87.0	86.6	86.7
Mean age of mother	23.9	22.0	20.7	21.4	19.9	20.0	19.9	20.0
Urban residence (%)	49.3	28.0	37.1	28.5	15.5	24.5	18.0	18.7
Mother is literate (%)	74.8	91.4	55.9	52.8	35.2	39.6	19.0	15.0
Two children								
Number of cases	1138	1682	1498	1508	2018	1456	2410	5425
Male, with male sibling (%)	22.9	24.9	24.0	26.5	26.8	25.5	28.0	26.8
Male, with female sibling (%)	24.8	24.4	26.2	27.5	25.6	24.3	25.7	25.9
Female, with male sibling (%)	27.1	26.0	24.0	24.1	23.9	26.4	24.4	24.7
Female, with female sibling (%)	25.3	24.8	25.8	22.0	23.7	23.9	21.9	22.7
Mean year of birth	86.5	86.6	86.5	86.9	86.9	87.0	86.5	86.7
Mean age of mother	26.2	24.6	23.3	23.8	22.7	22.8	22.5	23.0
Urban residence (%)	50.6	28.0	34.8	28.4	16.1	27.0	18.7	18.6
Mother is literate (%)	70.5	88.5	51.6	50.1	34.5	27.0	16.1	14.4
Previous child death (%)	9.5	6.3	15.8	11.7	23.4	19.1	15.6	28.0
Short preceding interval (%)	16.1	13.3	12.0	20.6	13.2	16.6	13.2	15.2
Three or more children								
Number of cases	1328	1361	1564	2033	2704	2072	4305	9430
Male, sibs are all male (%)	7.8	10.1	9.7	7.7	7.6	6.7	9.2	9.3
Male, sibs are mixed (%)	30.8	29.8	29.5	33.7	32.8	35.7	35.9	34.2
Male, sibs are all female (%)	12.1	12.1	12.8	12.6	10.5	11.8	8.6	7.9
Female, sibs are all male (%)	8.3	11.2	8.6	7.9	8.4	7.7	8.3	8.8
Female, sibs are mixed (%)	31.5	27.3	26.9	27.9	30.6	29.2	31.5	32.1
Female, sibs are all female (%)	9.5	9.5	12.5	10.2	10.2	8.9	6.6	7.7
Mean year of birth	85.7	85.7	85.8	86.5	86.8	86.8	86.5	86.8
Mean age of mother	28.7	27.4	27.2	27.4	26.7	26.7	27.2	27.7
Urban residence (%)	43.4	25.0	30.4	24.7	15.6	24.5	17.3	18.3
Mother is literate (%)	51.4	75.7	41.7	33.4	33.2	24.5	11.2	12.6
Previous child death (%)	14.2	12.1	25.8	16.2	30.7	28.2	18.7	36.6
Short preceding interval (%)	13.1	11.0	10.9	14.9	13.7	14.3	13.0	15.1

Table A2. Life table estimates of percentage of children who experience the birth of a younger sibling before age 5

Number of children/ Sex composition	Goa	Kerala	Tamil Nadu	Punjab	Orissa	Haryana	Rajasthan	Uttar Pradesh
One child, male	77	78	83	93	83	91	86	90
Two children, male with female sibling	50	41	64	70	78	81	84	83
Three or more children,[a] male with both male and female siblings	30	34	33	30	45	42	61	72
Four or more children,[b] male with both male and female siblings						41	50	67
Five or more children, male with both male and female siblings								64

[a]Exactly three children for Haryana, Rajasthan, and Uttar Pradesh

[b]Exactly four children for Uttar Pradesh

Table A3. Life table estimates of child mortality

Number of children/ Sex composition	Goa	Kerala	Tamil Nadu	Punjab	Orissa	Haryana	Rajasthan	Uttar Pradesh
One child, male	8	2	18	7	10	18	26	34
Two children, male with a female sibling	5	12	13	15	10	16	17	30
Three or more children, male with both male and female siblings	14	16	27	21	18	13	23	31

Table A4. Gross effects (relative risks) of sex of last child and sex combination of older siblings on parity progression, estimated by hazard models

Number of children/ Sex composition	Goa	Kerala	Tamil Nadu	Punjab	Orissa	Haryana	Rajasthan	Uttar Pradesh
One child								
Male	0.88*	0.98	0.95	0.97	0.87**	0.99	0.88**	0.92**
Female	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Two children								
Male, with male sibling	1.01	1.35**	0.85	0.68**	0.79**	0.77**	0.82**	0.92*
Male, with female sibling	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Female, with male sibling	0.97	0.87	0.74**	1.03	0.92	1.16	0.94	1.05
Female, with female sibling	1.47**	1.29**	1.38**	1.43**	1.25**	1.42**	1.18**	1.25**
Three or more children[a]								
Male, sibs are all male	1.19	1.03	1.44**	1.50**	1.27**	1.23	0.90	1.04
Male, sibs are mixed	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Male, sibs are all female	1.62**	0.89	1.26	2.01**	1.58**	1.98**	1.41**	1.20*
Female, sibs are all male	0.81	0.83	1.02	1.12	1.12	1.24	0.85	1.03
Female, sibs are mixed	1.40**	1.17	1.06	2.25**	1.34**	2.25**	1.46**	1.36**
Female, sibs are all female	2.20**	1.10	1.96**	4.25**	2.25**	3.01**	1.84**	1.53**
Four or more children[b]								
Male, sibs are all male						1.49	1.14	0.94
Male, sibs are mixed						(ref)	(ref)	(ref)
Male, sibs are all female						1.67**	1.60**	1.18
Female, sibs are all male						0.95	0.97	1.03
Female, sibs are mixed						1.62**	1.30**	1.19**
Female, sibs are all female						3.26**	2.17**	1.52**
Five or more children								
Male, sibs are all male								1.12
Male, sibs are mixed								(ref)
Male, sibs are all female								1.69**
Female, sibs are all male								1.13
Female, sibs are mixed								1.10
Female, sibs are all female								1.21

Note: The effects are estimated by proportional hazard models using the BMDP2L program.

(ref): Reference group

*$p < 0.10$

**$p < 0.05$

[a] Exactly three children for Haryana, Rajasthan, and Uttar Pradesh

[b] Exactly four children for Uttar Pradesh

Table A5. Net effects (relative risks) of sex of last child and sex combination of older siblings on parity progression, estimated by hazard models

Covariates	Goa	Kerala	Tamil Nadu	Punjab	Orissa	Haryana	Rajasthan	Uttar Pradesh
One child								
Male	0.87	1.01	0.94	0.97	0.86**	0.98	0.87**	0.92**
Female	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Urban residence	0.89*	1.13**	0.99	0.93	1.07	0.97	0.97	1.09**
Mother is literate	0.89*	0.72**	1.04	1.01	1.23**	1.03	1.02	1.06
Year of birth	0.95**	0.95**	0.98**	0.98**	0.97**	1.00	0.96**	0.98**
Mother's age	0.90**	0.96**	0.96**	0.96**	0.95**	0.95**	0.98**	0.96**
Child death[a]	1.60**	1.47**	1.34**	1.32**	1.20**	1.25**	1.21**	1.31**
Two children								
Male, with male sibling	1.10	1.29**	0.88	0.62**	0.80**	0.74**	0.80**	0.91**
Male, with female sibling	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Female, with male sibling	1.00	0.82	0.75**	1.03	0.89	1.12	0.94	1.05
Female, with female sibling	1.83**	1.24*	1.44**	1.39**	1.31**	1.32**	1.14*	1.24**
Urban residence	0.85*	0.89	0.87	0.81**	0.92	0.85**	0.82**	0.79**
Mother is literate	0.81**	0.57**	0.84**	0.67**	1.01	0.74**	0.75**	0.95
Year of birth	0.93**	0.90**	0.95**	0.97**	0.95**	0.94**	0.93**	0.96**
Mother's age	0.90**	0.90**	0.92**	0.93**	0.93**	0.94**	0.96**	0.94**
Child death[a]	1.89**	1.70**	1.37**	1.51**	1.47**	1,60**	1.23**	1.37**
Short preceding interval	1.10	0.89	1.01	1.15*	1.04	0.98	1.09	1.04
Three or more children[b]								
Male, sibs are all male	1.14	1.19	1.48*	1.33*	1.17	1.04	0.90	1.00
Male, sibs are mixed	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Male, sibs are all female	1.89**	1.09	1.26	2.26**	1.59**	2.20**	1.49**	1.20**
Female, sibs are all male	0.78	1.09	0.90	0.93	1.05	1.15	0.84	0.97
Female, sibs are mixed	1.46**	1.19	1.08	2.23**	1.34**	2.24**	1.40**	1.32**
Female, sibs are all female	2.48**	1.41*	2.03**	3.79**	2.13**	3.00**	1.76**	1.45**
Urban residence	0.76**	0.80*	1.05	0.84**	0.82**	0.88	0.90	0.78**
Mother is literate	0.80**	0.79**	0.73**	0.58**	0.92	0.57**	0.67**	0.82**
Year of birth	0.92*	0.95**	0.88**	0.96**	0.94**	0.95**	0.92**	0.95**
Mother's age	2.91**	0.88**	0.95**	0.92**	0.94**	0.94**	0.97**	0.95**
Child death[a]	1.76**	1.65**	1.73**	1.54**	1.71*	1.66**	1.67**	1.48**
Short preceding interval	1.03	1.04	1.51**	1.08	1.02	1.03	1.35**	1.22**
Birth order	0.99	1.56**	1.02	0.99	0.98			

Table A5. Continued.

Covariates	Goa	Kerala	Tamil Nadu	Punjab	Orissa	Haryana	Rajasthan	Uttar Pradesh
Four or more children[c]								
Male, sibs are all male						1.37	1.05	0.98
Male, sibs are mixed						(ref)	(ref)	(ref)
Male, sibs are all female						2.21**	1.69**	1.16
Female, sibs are all male						1.25	0.90	0.91
Female, sibs are mixed						1.71**	1.26**	1.16**
Female, sibs are all female						4.35**	2.14**	1.42**
Urban residence						0.78**	0.91	0.82**
Mother is literate						0.39**	0.55**	0.76**
Year of birth						0.96**	0.93**	0.94**
Mother's age						0.97**	0.97**	0.94**
Child death[a]						1.51**	1.71**	1.45**
Short preceding interval						1.20	1.10	1.18**
Birth order						0.97	1.02	
Five or more children								
Male, sibs are all male								1.13
Male, sibs are mixed								(ref)
Male, sibs are all female								1.74**
Female, sibs are all male								1.09
Female, sibs are mixed								1.15**
Female, sibs are all female								1.24
Urban residence								0.90
Mother is literate								0.76**
Year of birth								0.96**
Mother's age								0.94**
Child death[a]								1.62**
Short preceding interval								1.13
Birth order								1.21**

Note: The effects are estimated by proportional hazard models using the BMDP2L program.

(ref): Reference group

*$p < 0.10$

**$p < 0.05$

[a]Child death is a time dependent dummy variable indicating the death of any child among those who were surviving at the time of birth of the index child with a 12 months lag.

[b]Exactly three children for Haryana, Rajasthan, and Uttar Pradesh

[c]Exactly four children for Uttar Pradesh

Table A6. Gross effects (relative risks) of sex of last child and sex combination of older siblings on child mortality, estimated by hazard models

Number of children/ Sex composition	Goa[a]	Kerala[a]	Tamil Nadu	Punjab[b]	Orissa	Haryana	Rajasthan	Uttar Pradesh
One child								
Male	1.37	1.17	1.12	0.75	0.89	0.65	0.87	0.73**
Female	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Two children								
Male, with male sibling	nc	nc	1.48	nc	1.47	1.25	1.04	1.24
Male, with female sibling	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Female, with male sibling	nc	nc	1.08	nc	3.04*	1.43	2.38**	1.80**
Female, with female sibling	nc	nc	1.02	nc	1.90	3.12*	1.91	1.66**
Three or more childreu								
Male, sibs are all male	nc	nc	0.73	0.74	0.43	1.85	1.16	1.34
Male, sibs are mixed	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Male, sibs are all female	nc	nc	1.11	0.67	0.93	0.74	0.65	0.97
Female, sibs are all male	nc	nc	1.26	1.70	1.12	2.14	1.18	2.43**
Female, sibs are mixed	nc	nc	1.24	0.93	1.80	3.67**	1.34	2.38**
Female, sibs are all female	nc	nc	1.43	2.64**	2.20	3.00**	2.20**	1.36

Note: The effects are estimated by proportional hazard models using the BMDP2L program.

(ref): Reference group

nc: The estimation procedure did not converge.

*p < 0.10

**p < 0.05

[a] Models for Goa and Kerala include all births of order 1–6.

[b] The first model for Punjab is for 1–2 children combined.

Table A7. Net effects (relative risks) of sex of last child and sex combination of older siblings on child mortality estimated by hazard models, not controlling for the birth of the next child

Covariates	Goa[a]	Kerala[a]	Tamil Nadu	Punjab[b]	Orissa	Haryana	Rajasthan	Uttar Pradesh
One child								
Male	1.38	1.19	1.12	0.75	0.88	0.65	0.87	0.72**
Female	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Urban residence	0.74	0.52	0.47	1.20	0.91	0.80	0.34**	0.51**
Mother is literate	0.83	0.51*	0.50	0.23**	0.23**	0.68	0.49	0.81
Year of birth	0.94	0.91	0.84**	1.07	0.99	0.94	1.01	0.93**
Mother's age	0.95	0.95	0.85**	1.07	1.04	0.94	0.98	0.93**
Previous child death	0.81	0.57		3.20*				
Short preceding interval	2.09	0.52		2.38*				
Birth order	1.28	1.58**		0.57				
Two children								
Male, with male sibling	nc	nc	1.51	nc	1.59	1.24	1.07	1.25
Male, with female sibling	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Female, with male sibling	nc	nc	1.07	nc	3.39**	1.52	2.45**	1.82**
Female, with female sibling	nc	nc	1.03	nc	1.93	2.88**	1.89	1.65**
Urban residence	nc	nc	0.87	nc	1.27	0.66	0.49	0.68*
Mother is literate	nc	nc	0.42**	nc	0.27**	0.11**	0.12**	0.70
Year of birth	nc	nc	1.05	nc	1.07	0.94	1.02	0.96**
Mother's age	nc	nc	0.93	nc	0.85**	1.10*	0.96	0.93**
Previous child death	nc	nc	1.53	nc	0.62	0.53	2.12**	1.44**
Short preceding interval	nc	nc	0.61	nc	2.10*	4.24**	1.32	1.36*
Three or more children								
Male, sibs are all male	nc	nc	0.70	0.69	0.50	1.99	1.10	1.24
Male, sibs are mixed	nc	nc	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Male, sibs are all female	nc	nc	1.06	0.75	0.94	0.85	0.64	0.93
Female, sibs are all male	nc	nc	0.23	1.39	1.03	2.32	1.18	2.19**
Female, sibs are mixed	nc	nc	1.19	0.88	1.82	3.65**	1.35	2.31**
Female, sibs are all female	nc	nc	1.41	2.30*	2.33*	3.26*	2.25**	1.29
Urban residence	nc	nc	0.74	0.92	0.56	1.08	0.49*	0.37**
Mother is literate	nc	nc	0.61	0.59	0.65	0.30**	0.66	0.57**
Year of birth	nc	nc	0.85**	0.95**	1.08	1.01	0.96*	0.94**
Mother's age	nc	nc	1.00	0.90**	1.01	0.92	0.97	0.99
Previous child death	nc	nc	1.21	1.39	1.92*	1.38	2.35**	1.32*
Short preceding interval	nc	nc	1.21	1.97*	3.30**	2.20**	1.49	2.64**
Birth order	nc	nc	0.92	1.07	0.86	1.28	1.03	0.92

Note: The effects are estimated by proportional hazard models using the BMDP2L program. Blank entries indicate that the covariate is not included in the estimation model.

nc: The estimation procedure did not converge.

*p < 0.10

**p < 0.05

[a]Models for Goa and Kerala include all births of order 1–6.

[b]The first model for Punjab is for 1–2 children combined.

Table A8. Net effects (relative risks) of sex of last child and sex combination of older siblings on child mortality estimated by hazard models, controlling for the birth of the next child

Covariates	Goa[a]	Kerala[a]	Tamil Nadu	Punjab[b]	Orissa	Haryana	Rajasthan	Uttar Pradesh
One child								
Male	1.37	1.19	1.12	0.78	0.92	0.65	0.88	0.72*
Female	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Urban residence	0.73	0.52	0.47	1.23	0.88	0.80	0.34**	0.49**
Mother is literate	0.82	0.52*	0.50	0.23**	0.22*	0.68	0.49	0.81
Year of birth	0.94	0.96	0.85**	1.00	1.00	0.94	1.02	0.93**
Mother's age	0.95	0.96	0.85**	1.08	1.05	0.94	0.98	0.94**
Previous child death	1.12	0.55		3.01*				
Short preceding interval	2.09	0.52		2.27*				
Birth order	1.29	1.59**		0.59				
Birth of next child[c]	0.66	1.71	1.24	2.35*	2.36	0.53	1.61	1.52**
Two children								
Male, with male sibling	nc	nc	1.53	nc	1.72	1.22	1.10	1.26
Male, with female sibling	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Female, with male sibling	nc	nc	1.10	nc	3.45**	1.54	2.46**	1.80**
Female, with female sibling	nc	nc	1.00	nc	1.83	2.98**	1.85	1.61**
Urban residence	nc	nc	0.86	nc	1.29	0.66	0.49	0.69*
Mother is literate	nc	nc	0.43*	nc	0.28**	0.11**	0.12**	0.70
Year of birth	nc	nc	1.05	nc	1.09	0.95	1.03	0.97**
Mother's age	nc	nc	0.93	nc	0.86**	1.09*	0.96	0.93**
Previous child death	nc	nc	1.53	nc	0.63	0.53	2.10**	1.42**
Short preceding interval	nc	nc	0.60	nc	1.95	4.22**	1.31	1.35
Birth of next child[c]	nc	nc	1.58	nc	3.03**	0.51	2.00**	1.60**
Three or more children								
Male, sibs are all male	nc	nc	0.64	0.69	0.50	2.02	1.12	1.25
Male, sibs are mixed	nc	nc	(ref)	(ref)	(ref)	(ref)	(ref)	(ref)
Male, sibs are all female	nc	nc	1.00	0.75	0.90	0.74	0.61	0.93
Female, sibs are all male	nc	nc	0.24	1.39	1.01	2.29	1.18	2.18**
Female, sibs are mixed	nc	nc	1.13	0.88	1.70	3.02**	1.31	2.27**
Female, sibs are all female	nc	nc	1.21	2.23**	2.06	2.60	2.11**	1.26
Urban residence	nc	nc	0.72	0.92	0.57	1.09	0.49*	0.37**
Mother is literate	nc	nc	0.65	0.59	0.64	0.35**	0.69	0.58**
Year of birth	nc	nc	0.87*	0.96**	1.10	1.01	0.97	0.94**
Mother's age	nc	nc	1.01	0.90**	1.03	0.92*	0.97	1.00
Previous child death	nc	nc	1.20	1.39	1.93**	1.28	2.28**	1.28*
Short preceding interval	nc	nc	1.07	1.97*	3.27**	2.05**	1.47	2.52**
Birth order	nc	nc	0.90	1.07	0.84	1.32	1.04	0.93
Birth of next child[c]	nc	nc	4.00**	1.21	2.68**	3.84**	1.74**	1.96**

Notes: The effects are estimated by proportional hazard models using the BMDP2L program. Blank entries mean that the covariate is not included in the estimation model.

nc: The estimation procedure did not converge.

*$p < 0.10$

**$p < 0.05$

[a] Models for Goa and Kerala include all births of order 1–6.

[b] The first model for Punjab is for 1–2 children combined.

[c] Birth of next child is a time-dependent dummy variable.