# Child Nutrition 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 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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***Abstract***. *Malnutrition plagues a disproportionately large number of children in India compared with most other countries. National-level data on child malnutrition in India have, however, been scarce. Recognizing this gap, India's 1992–93 National Family Health Survey (NFHS) collected anthropometric data on the height and weight of children below four years of age. The NFHS is based on a large, nationally representative sample and therefore offers a unique opportunity to study the levels and determinants of child malnutrition in the country. This report estimates levels of child malnutrition and effects of selected demographic and socioeconomic factors on child malnutrition. The analysis focuses primarily on the country as a whole, with some findings for individual states.*

*The results of the study indicate high levels of both chronic and acute malnutrition among Indian children. Fifty-two percent of all children below age four are stunted (as measured by height-for-age), 54 percent are underweight (as measured by weight-for-age), and 17 percent are wasted (as measured by weight-for-height). The extent of severe malnutrition is also substantial. Twenty-nine percent of the children are severely stunted, 22 percent are severely underweight, and 3 percent are severely wasted, according to internationally accepted definitions. The lower prevalence of wasting than stunting or underweight indicates that chronic malnutrition is more prevalent in India than acute malnutrition. Although less severe in percentage terms, the prevalence of wasting in India is about 8 times and the prevalence of severe wasting is about 25 times the prevalence in the international reference population that provides the basis for comparison.*

*There is considerable variation in the prevalence of malnutrition by state. Among the states, Bihar and Kerala have the highest and lowest prevalence of malnutrition, respectively. Even in Kerala, which has the lowest prevalence, 27 percent of children below age four are stunted, 28 percent are underweight, and 12 percent are wasted.*

*A multivariate analysis of the effects of selected demographic and socioeconomic factors on child malnutrition indicates that the strongest predictors of child nutrition in India are child's age, child's birth order, mother's education, and household standard of living. Older children and children of higher birth order are more likely to be malnourished. Children whose mothers are more educated and children who live in households with a relatively high standard of living tend to be better nourished than*

*other children. Boys and girls have about the same levels of stunting and underweight, but boys are somewhat more likely than girls to be wasted. The disadvantage of boys in this regard is surprising in view of other evidence that girls tend to receive less care than boys in India.*

***Vinod K. Mishra, Subrata Lahiri, and Norman Y. Luther***

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## INTRODUCTION

Nutrition has major effects on health. Nutrition refers to the availability of energy and nutrients to the body's cells in relation to body requirements. Malnutrition refers to any imbalance in satisfying nutrition requirements. Malnutrition among children is often caused by the synergistic effects of inadequate or improper food intake, repeated episodes of parasitic or other childhood diseases such as diarrhoea, and improper care during illness (Pelletier 1994; Ruzicka and Kane 1985).

Malnutrition is often cited as an important factor contributing to high morbidity and mortality among children in developing countries (Sommer and Loewenstein 1975; Chen et al. 1980; Vella et al. 1992a; Vella et al. 1992b; Singh 1989; Santhanakrishnan and Ramalingam 1987; Ruzicka and Kane 1985; Serdula 1988; Katz et al. 1989; Briend et al. 1988). The relationship between nutritional status and child mortality is not conclusive, however. Smedman and colleagues (1987) and the Kasongo Project Team (1983) do not find a clear relationship between nutritional status and child survival. A comprehensive review of studies of the relationship between malnutrition and child mortality in developing countries can be found in Pelletier (1998).

Malnutrition during childhood can also affect growth potential and risk of morbidity and mortality in later years of life. Malnourished children are more likely to grow into malnourished adults who face heightened risks of disease and death. Poor nutritional status of women has been associated with a higher age at menarche (Haq 1984; Roberts et al. 1986) and a lower age at secondary sterility (Karim et al. 1985).

A number of factors affect child nutrition, either directly or indirectly. The most commonly cited factors are food availability and dietary intake, breastfeeding, prevalence of infectious and parasitic diseases, access to health care, immunization against major childhood diseases, vitamin A supplementation, maternal care during pregnancy, water supply and sanitation, socioeconomic status, and health-seeking behavior. Demographic characteristics such as the child's age and sex, birth intervals (both preceding and following), and mother's age at childbirth are also associated with child nutrition (Sommerfelt and Stewart 1994; Sommerfelt 1991; Vella et al. 1992a; Vella et al. 1992b).

Several studies indicate that inadequate or improper food intake and repeated episodes of infectious diseases adversely affect children's nutritional status (Brown et al. 1982; Sommerfelt and Stewart 1994). Lutter and colleagues (1989) found that proper treatment of acute infectious diseases, especially diarrhoea, has beneficial effects for children's growth and nutritional status. Briend and colleagues (1988) found that breast-feeding improves nutritional status and child survival. Esrey et al. (1988) and Mertens et al. (1990) found that the presence of a clean water supply and sanitary facilities have beneficial effects on child growth and nutrition. Vitamin A supplementation has been shown to reduce morbidity (Ross et al. 1995; Daulaire et al. 1992) and mortality (Rahmathullah et al. 1990; Daulaire et al. 1992; West et al. 1991; Zeger and Edelstein 1989). The evidence of beneficial effects of vitamin A supplementation on morbidity and mortality in children is not conclusive, however (Vijayaraghavan et al. 1990). Inasmuch as vitamin A supplementation reduces morbidity in children, it may also improve their nutritional status.

Discrimination against girls in feeding and health care are often cited as reasons for poorer nutrition and higher mortality among girls than boys in many developing countries (Abeykoon 1995; Pebley and Amin 1991; Visaria 1987; Elfindri 1993; Bairagi 1986). However, most studies based on anthropometric data do not find a higher prevalence of malnutrition among girls (Sommerfelt and Arnold 1998; Sommerfelt and Stewart 1994; Basu 1993; Schoenbaum et al. 1995).

Many of the factors associated with child nutrition are also associated with each other. Consequently, any apparent effect of one factor on child nutrition may be due to the confounding effects of one or more of these other factors. Therefore, when assessing the effects of any one factor on malnutrition, a multivariate analysis is necessary to control for the effects of other potentially confounding factors.

Using data from India's 1992–93 National Family Health Survey (NFHS), this report analyzes the effects of selected demographic and socioeconomic factors on various dimensions of malnutrition among children below age four, as indicated by anthropometric measurements, after statistically controlling for a number of potentially confounding variables. The report complements results presented in the original NFHS national report, which, however, provides only simple cross-tabulations of the prevalence of child malnutrition by selected demographic and socioeconomic characteristics without controls.

## DATA AND METHODS

The analysis is based on data from India's 1992–93 National Family Health Survey (NFHS). Data were collected from a probability sample of 89,777 ever-married women age 13–49 residing in 88,562 households. The NFHS covered 24 states and the National Capital Territory of Delhi, which has since attained statehood. The sample represents 99 percent of India's population.

Children are the units of analysis. The NFHS collected a complete birth history, including sex and date of birth of each child, from each ever-married woman age 13–49 in the sample. It also collected information on the height and weight of children born since a cut-off date (approximately four years before the survey), as well as a number of maternal variables relating to the care of each child. From the birth histories and information linked to them, we created a child data file, into which we also merged selected household characteristics from the household data file. Thus, the child data file contains selected characteristics of children below age four, selected characteristics of their mothers, and selected characteristics of the households in which the mothers and children reside.

The NFHS collected information on both the height and weight of each child below age four in every state except Andhra Pradesh, Himachal Pradesh, Madhya Pradesh, Tamil Nadu, and West Bengal (IIPS 1995). In these five states, weight was measured but height was not because height-measuring boards were not available at the time.[1] Interviewers measured the weight of each child using a Salter scale, which is a hanging spring balance. They measured the height of children under two years of age with the child lying down on an adjustable measuring board, and the height of children age two years or older with the child standing up. The training of interviewers on height and weight measurement followed United Nations (1986) guidelines. Interviewers measured height to the nearest 0.1 centimetres and weight to the nearest 100 grams.

Our measures of child malnutrition are based on height-for-age, weight-for-age, and weight-for-height. Each of these indices provides somewhat different information about the nutritional status of children. The height-for-age index measures linear growth retardation among children, primarily reflecting chronic malnutrition. The weight-for-height index measures body mass in relation to body height, primarily reflecting acute malnutrition. Weight-for-age reflects both chronic and acute malnutrition.

The calculation of the three indices of child malnutrition involves comparison with an international reference population as recommended by the World Health Organization (Dibley et al. 1987a; Dibley et al. 1987b). The justification for use of a reference population is the empirical finding that well-nourished children in all populations follow very similar growth patterns (Habicht et al. 1974; Martorell and Habicht 1986). The Nutrition Foundation of India has concluded that the WHO standard is applicable to Indian children (Agarwal et al. 1991).

The three indices of child malnutrition are expressed in terms of standard deviation units from the median in the international reference population. Children who fall more than two standard deviations below the reference median are considered to be *malnourished*, and those who fall more than three standard deviations below the reference median are considered to be *severely malnourished*. Thus, children who are more than two standard deviations below the median of the international reference

1. These five states cluster closely around the national estimate of the percentage of children who are underweight, which is the only nutritional index that can be calculated for these states. It therefore seems unlikely that the lack of height data for these states substantially biases our national estimates of height-based measures of child nutrition.

population in terms of their height-for-age are defined as *stunted*, and those more than three standard deviations below the reference median are defined as *severely stunted*. The categories *underweight, severely underweight* (based on weight-for-age), *wasted*, and *severely wasted* (based on weight-for-height) are similarly defined. Wasting is usually associated with the failure to receive adequate nutrition in the period immediately before the survey and may be the result of seasonal variations in food supply or recent episodes of illness, especially diarrhoea.

Several factors affect the validity of these measures, including coverage of the population of children and accuracy of the anthropometric measurements. In the NFHS, about 16 percent of living children below age four were not weighed and measured (see IIPS 1995, Appendix D, Table D.3), usually because the child was not at home or because the mother refused to allow the measurements to be taken. These children are excluded from the analysis. Also excluded from the analysis are children whose month and year of birth were not reported by the mother and children with grossly improbable weight or height measurements. Two of the three measures of child nutrition (height-for-age and weight-for-age) are sensitive to accurate reporting of children's ages. Weight-for-height is the only measure that does not depend on accuracy of age reporting. The weight-for-height measure is, however, sensitive to errors in the individual component measures of weight and height, especially if the errors are in opposite directions. Further details about the quality of anthropometric data in Demographic and Health Surveys can be found in Sommerfelt and Boerma (1993).

Our analysis of the effects of demographic and socioeconomic variables on the three indices of child malnutrition is multivariate and employs logistic regression models. The response (or dependent) variable in each model is a dummy (two-category) variable that simply indicates whether a child is stunted, underweight, or wasted (i.e., whether the child is more than two standard deviations below the median of the international reference population in terms of height-for-age, weight-for-age, or weight-for-height). Thirteen predictor variables are used in the analysis. All predictor variables are categorical.

The predictor variables are: child's age in months (<12, 12–23, 24–47); sex of child (male, female); birth order of child (one, two or three, four or five, six or higher); mother's age at childbirth (13–24, 25–34, 35–49); residence (urban, rural); mother's education (illiterate, literate but less than middle school complete, middle school complete or higher); religion[2] (Hindu, Muslim, other); caste/tribe[3] (SC/ST, other);

2. Other religions include Sikh, Christian, Jain, Buddhist, and others.

3. Scheduled castes (SC) and scheduled tribes (ST) are those castes and tribes identified by the Government of India as socially and economically disadvantaged and in need of protection from social injustice and exploitation.

exposure to electronic mass media[4] (regularly exposed, not regularly exposed); household standard of living[5] (low, medium, high); mother received iron and folic acid tablets during pregnancy (yes, no); mother received two or more tetanus injections during pregnancy (yes, no); and geographic region[6] (North, Central, East, Northeast, West, South). These variables are selected for analysis because they are known to be associated with child nutrition (see, for example, Sommerfelt and Stewart 1994) and because they are readily available from the NFHS.

Two additional predictor variables considered were 'received any vaccination' (yes, no) and 'received vitamin A' (yes, no). The analysis incorporating these two variables excluded children below 12 months of age because vaccinations and vitamin A supplementation are usually received during the first year of life. Neither of these variables had a significant effect on any of the three indices of child malnutrition, and their inclusion or exclusion from the regression models did not alter the effects of any of the other 13 predictor variables. Results from the analysis that incorporated these two variables are therefore not shown in this report.

We estimate both unadjusted and adjusted effects of each of the 13 predictor variables on stunting, underweight, and wasting. In this context, 'adjusted' means that other selected demographic and socioeconomic variables are statistically controlled by holding them constant at their mean values. We present effects in the form of unadjusted and adjusted percentages malnourished for categories of each predictor variable of interest. The unadjusted percentages for categories of a given predictor variable are estimated from a separate logistic regression in which that predictor variable is the only one considered. Because each underlying regression contains just one predictor variable, the unadjusted percentages do not incorporate controls for any other, potentially confounding, predictor variables. Whereas the unadjusted percentages are based on many logistic regressions, one for each predictor variable, the adjusted percentages (for a particular response variable) are based on a single logistic

4. A woman is categorized as regularly exposed to electronic mass media if she listens to radio at least once a week or watches television at least once a week or goes to a cinema hall or theatre to see a movie at least once a month.

5. Standard of living is measured by a household assets scale that ranges from 0 to 27 (low 0, medium 1-7, high 8-27). The household assets scale scores items as follows: automobile 4, refrigerator 3, television 3, VCR/VCP 3, motorcycle/scooter 3, sewing machine 2, sofa set 2, fan 2, radio/transistor 2, bicycle 2, clock/watch 1.

6. The geographic region variable is as defined in the NFHS national report (IIPS 1995). North includes Delhi, Haryana, Himachal Pradesh, Jammu region of Jammu and Kashmir, Punjab, and Rajasthan; Central includes Madhya Pradesh and Uttar Pradesh; East includes Bihar, Orissa, and West Bengal; Northeast includes Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura; West includes Goa, Gujarat, and Maharashtra; and South includes Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu.

regression that includes all 13 predictor variables. In calculating adjusted percentages for categories of any given predictor variable, the set of control variables consists of all the other 12 predictor variables, which are controlled by setting them at their mean values. This method of presenting results when controlling for potentially confounding variables is called Multiple Classification Analysis, or MCA. In the tables, we do not show the logistic regression coefficients but rather present our results in the simple cross-tabulation format of MCA tables. The reader is referred to Retherford and Choe (1993) for further details regarding the use of MCA tables in conjunction with logistic regression analysis.

In the logistic regression analyses, the estimation of significance levels takes into account design effects due to clustering at the level of the primary sampling unit. The regressions were estimated using the STATA statistical software package (Stata Corporation 1997). Constant terms in the regressions are reset so that predicted percentages agree with observed percentages when all predictor variables in the regressions are set to their mean values.

Because urban and rural environments in India are quite different, the factors affecting child malnutrition may have different effects in urban and rural areas. And because there is considerable discrimination against girls, especially in the northern states of India, the factors affecting child malnutrition may have different effects for boys and girls. For these reasons, the analyses of factors affecting child malnutrition are also carried out separately for urban and rural areas and for boys and girls.

In some states the NFHS sample design is self-weighting, but in other states certain sectors of the population, such as urban areas, are over-sampled, necessitating the use of weights to restore the correct proportions. Some states are over-represented and others are under-represented in the sample, necessitating an additional set of weights when aggregating to the national level. All results presented in this report are based the on the weighted sample. The NFHS sample design is discussed in more detail in the original survey report (IIPS 1995).

## RESULTS

Table 1 presents the percentage of children below age four who are malnourished according to height-for-age, weight-for-age, or weight-for-height for India as a whole and for individual states. Fifty-two percent are stunted, 54 percent are underweight, and 17 percent are wasted. The percentages who are severely malnourished according to these two measures are also substantial. Twenty-nine percent are severely stunted, 22 percent are severely underweight, and 3 percent are severely wasted.

The lower prevalence of wasting than stunting or underweight indicates that chronic malnutrition is more prevalent in India than acute malnutrition. Even so, levels of wasting and severe wasting in India are many times higher than those in the

**Table 1 Among children age 0–47 months, the percentage classified as undernourished according to three anthropometric indices of nutritional status, by state, India, 1992–93**

| | Height-for-age | | Weight-for-age | | Weight-for-height | |
|---|---|---|---|---|---|---|
| **State** | **Stunted (percentage below –2 SD[a])** | **Severely stunted (percentage below –3 SD)** | **Underweight (percentage below –2 SD[a])** | **Severely underweight (percentage below –3 SD)** | **Wasted (percentage below –2 SD[a])** | **Severely wasted (percentage below –3 SD)** |
| **India** | 52 | 29 | 54 | 22 | 17 | 3 |
| **North** | | | | | | |
| Delhi | 43 | 19 | 41 | 12 | 12 | 3 |
| Haryana | 47 | 19 | 38 | 9 | 6 | 1 |
| Himachal Pradesh | U | U | 48 | 15 | U | U |
| Jammu region of Jammu and Kashmir | 41 | 19 | 44 | 14 | 15 | 3 |
| Punjab | 40 | 16 | 46 | 14 | 20 | 3 |
| Rajasthan | 43 | 27 | 42 | 19 | 19 | 5 |
| **Central** | | | | | | |
| Madhya Pradesh | U | U | 61 | 29 | U | U |
| Uttar Pradesh | 59 | 36 | 59 | 24 | 16 | 3 |
| **East** | | | | | | |
| Bihar | 61 | 39 | 63 | 31 | 22 | 4 |
| Orissa | 48 | 25 | 53 | 23 | 21 | 4 |
| West Bengal | U | U | 58 | 22 | U | U |
| **Northeast** | | | | | | |
| Arunachal Pradesh | 54 | 28 | 40 | 15 | 11 | 3 |
| Assam | 52 | 26 | 50 | 18 | 11 | 2 |
| Manipur | 33 | 16 | 30 | 7 | 9 | 1 |
| Meghalaya | 51 | 38 | 45 | 17 | 19 | 5 |
| Mizoram | 41 | 16 | 28 | 5 | 2 | 1 |
| Nagaland | 32 | 13 | 29 | 8 | 13 | 2 |
| Tripura | 46 | 21 | 49 | 19 | 17 | 1 |
| **West** | | | | | | |
| Goa | 32 | 11 | 35 | 9 | 15 | 2 |
| Gujarat | 48 | 25 | 50 | 17 | 19 | 4 |
| Maharashtra | 48 | 23 | 54 | 21 | 20 | 4 |
| **South** | | | | | | |
| Andhra Pradesh | U | U | 51 | 20 | U | U |
| Karnataka | 47 | 22 | 54 | 19 | 17 | 3 |
| Kerala | 27 | 9 | 28 | 6 | 12 | 1 |
| Tamil Nadu | U | U | 49 | 15 | U | U |

*Note*: Each of the indices is expressed in standard deviation units (SD) from the median of the international reference population. Figures in this table and in subsequent tables differ slightly from those published in the original NFHS reports because this report uses a revised set of z-scores for height-for-age, weight-for-age, and weight-for-height and because figures are for children born 0–47 months before the survey.

U: Not available because children's height was not measured.

a. Includes the children who are below minus 3 standard deviations (SD) from the international reference population median.

international reference population. The percentages of children who are wasted and severely wasted in the international reference population are estimated to be 2.28 percent and 0.13 percent, respectively (Dibley et al. 1987a; Dibley et al. 1987b). This implies that, in India, wasting is about 8 times and severe wasting about 25 times that in the reference population.

Figure 1 additionally presents levels of stunting, underweight, and wasting by urban/rural residence. The prevalences of stunting and underweight are considerably

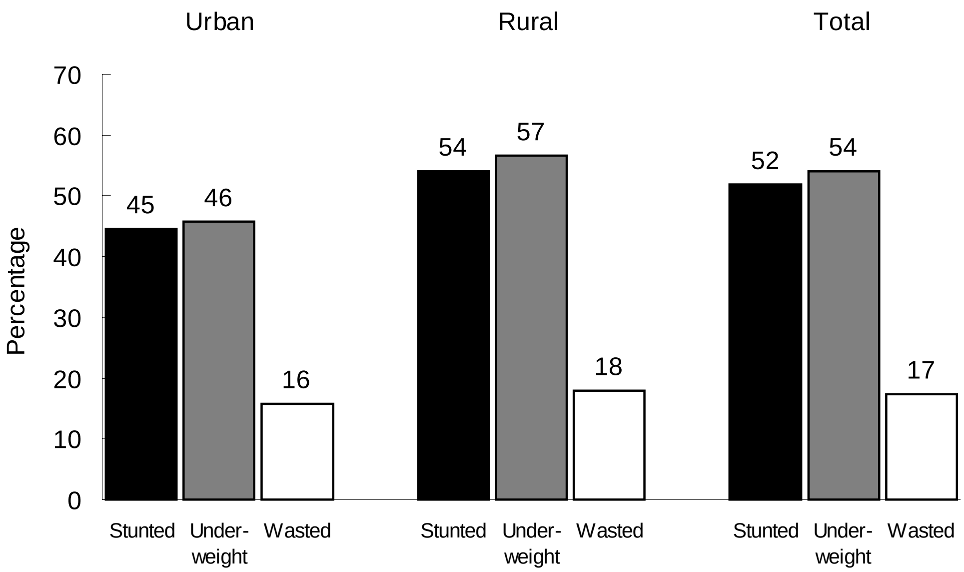


**Figure 1 Percentage of children under age four who are stunted, underweight, or wasted, by residence, India, 1992–93**

higher in rural areas than in urban areas, as expected. The prevalence of wasting is also somewhat higher in rural areas than in urban areas.

As mentioned earlier, data on height was not collected in the states of Andhra Pradesh, Himachal Pradesh, Madhya Pradesh, Tamil Nadu, and West Bengal. Hence height-for-age and weight-for-height are not available for children in those states. There are large variations in the prevalence of malnutrition among the remaining states. Bihar and Kerala have the highest and lowest levels of malnutrition in the country, respectively (Figure 2). In Bihar, 61 percent of children below age four are stunted, and 63 percent are underweight. Even in Kerala, which has the best nutrition according to our anthropometric measures and the lowest infant and child mortality in the country, 27 percent of young children are stunted, and 28 percent are underweight. Other states, beside Kerala, with relatively low levels of stunting and underweight are Manipur, Mizoram, Nagaland, and Goa.

The prevalence of wasting is 12 percent in Kerala and 22 percent in Bihar. The problem of wasting is most evident in Bihar and Orissa, which not coincidently have, among the states, some of the highest infant mortality rates in India. Surprisingly, the prevalence of wasting is relatively low in Uttar Pradesh, which is a comparatively poor state, and relatively high in Punjab, which is by far the economically most advanced state in the country. These anomalous findings may, in part, be due to the effect of seasonality on wasting, since both diet and diarrhoeal diseases are subject to

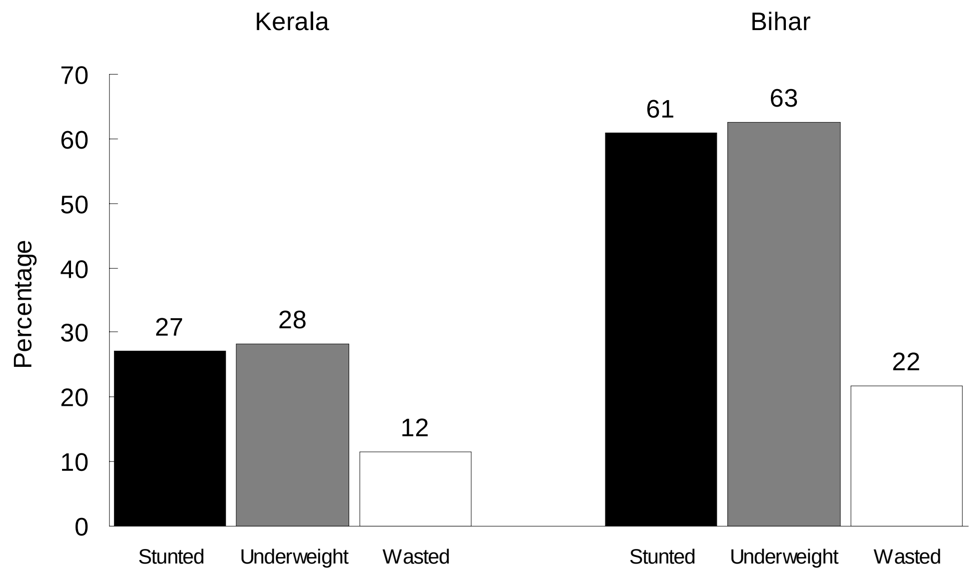


**Figure 2 Percentage of children under age four who are stunted, underweight, or wasted in Kerala and Bihar, 1992–93**

seasonal variation and since NFHS data for different states were collected in different seasons. Since such anomalies are not observed in the case of proportion underweight, which is also an indicator of acute malnutrition and should be similarly sensitive to seasonal variation, there is need to use caution in interpreting results for wasting. Seasonality should not affect the prevalence of stunting, which is an indicator of chronic malnutrition.

## Factors affecting nutritional status of children

We estimate the effects of the selected demographic and socioeconomic predictor variables on child nutrition separately for each of the three nutrition indicators—stunting, underweight, and wasting. Table 2 presents definitions and mean values of the response and predictor variables, both for India as a whole and separately for urban and rural areas and for boys and girls. Because all variables are categorical, the mean value of a variable consists of the set of proportions of women falling in each category of that variable. These proportions are expressed as percentages in the table. We have already discussed the definitions of the three response variables—stunting, underweight, and wasting—and their mean values for India and for urban and rural areas. By sex of child, there is no difference in the prevalence of stunting or in the prevalence of underweight, but, unexpectedly, the prevalence of wasting is somewhat higher for boys than for girls.

**Table 2 Variable definitions and mean values for children born in the period 0–47 months before the NFHS, by urban/rural residence and by sex of child, India, 1992–93**

| | | Mean[a] (percent) | | | | |
|---|---|---|---|---|---|---|
| | | Residence | | | Sex of child | |
| Variable | Definition | Total | Urban | Rural | Boy | Girl |
| **Response variables** | | | | | | |
| Stunted | Height-for-age is more than two standard deviation units below the median of the international reference population (height-for-age < –2 SD) | 52 | 45 | 54 | 52 | 52 |
| Underweight | Weight-for-age is more than two standard deviation units below the median of the international reference population (weight-for-age < –2 SD) | 54 | 46 | 57 | 54 | 54 |
| Wasted | Weight-for-height is more than two standard deviation units below the median of the international reference population (weight-for-height < –2 SD) | 17 | 16 | 18 | 19 | 16 |
| **Predictor variables** | | | | | | |
| Child's age 12–23 | Child's age is 12–23 months | 26 | 25 | 26 | 26 | 26 |
| Child's age 24–47 | Child's age is 24–47 months | 48 | 49 | 48 | 48 | 48 |
| Sex of child | Child is a boy | 51 | 51 | 51 | 100 | 0 |
| Birth order two or three | Child's birth order is two or three | 41 | 44 | 41 | 41 | 42 |
| Birth order four or five | Child's birth order is four or five | 19 | 17 | 20 | 20 | 19 |
| Birth order six or higher | Child's birth order is six or higher | 12 | 8 | 13 | 12 | 11 |
| Received any vaccination | Child received any vaccination | 60 | 76 | 56 | 62 | 59 |
| Received vitamin A | Child received vitamin A | 18 | 26 | 16 | 19 | 17 |
| Mother's age 25–34 | Mother's age was 25–34 years at childbirth | 34 | 37 | 33 | 34 | 34 |
| Mother's age 35–49 | Mother's age was 35–49 years at childbirth | 5 | 4 | 6 | 5 | 5 |
| Residence | Residence is urban | 23 | 100 | 0 | 23 | 23 |
| Mother's education: Literate, < middle complete | Mother is literate with less than a middle-school education | 17 | 20 | 15 | 16 | 17 |
| Mother's education: Middle complete or higher | Mother is literate with a middle-school or higher education | 17 | 38 | 11 | 17 | 17 |
| Muslim | Child lives in a household whose head is Muslim | 15 | 23 | 13 | 15 | 16 |
| Other religion | Child lives in a household whose head is neither Hindu nor Muslim | 5 | 7 | 5 | 5 | 5 |

Of the 49,006 children below age four in the sample, 52 percent are below age two, 51 percent are boys, 31 percent are of birth order 4 or higher, 60 percent received at least one vaccination, and 18 percent received vitamin A supplementation. Sixty-one percent of the children were born to mothers 24 years or younger, and about two-thirds have illiterate mothers. Twenty-three percent live in urban areas, 80 percent are Hindu, and 23 percent belong to a scheduled caste or scheduled tribe. Forty-seven percent have mothers who are regularly exposed to the electronic mass media. Twenty-nine percent live in households with a low standard of living, 52 percent in households with a medium standard of living, and the remaining 19 percent in households with a high standard of living. Mothers of 51 percent of these children received iron and folic acid tablets when they were pregnant, and mothers of 54 percent of the

**Table 2, continued**

| Variable | Definition | Mean[a] (percent) | | | | |
|---|---|---|---|---|---|---|
| | | | Residence | | Sex of child | |
| | | Total | Urban | Rural | Boy | Girl |
| Scheduled caste or scheduled tribe | Child lives in a household whose head belongs to a scheduled caste (SC) or scheduled tribe (ST)[b] | 23 | 14 | 26 | 23 | 23 |
| Media exposure | Mother listens to radio or watches television at least once a week or visits a cinema at least once a month | 47 | 76 | 39 | 47 | 47 |
| Standard of living: medium | Child lives in a household with a medium standard of living | 52 | 40 | 56 | 52 | 53 |
| Standard of living: high | Child lives in a household with a high standard of living | 19 | 47 | 11 | 19 | 19 |
| Mother received iron and folic acid tablets | Mother received iron and folic acid tablets while pregnant with specified child | 51 | 69 | 45 | 51 | 50 |
| Mother received two or more tetanus injections | Mother received two or more tetanus injections while pregnant with specified child | 54 | 75 | 48 | 54 | 54 |
| North | Child lives in Delhi, Haryana, Himachal Pradesh, Jammu Region of Jammu and Kashmir, Punjab, or Rajasthan | 12 | 13 | 11 | 12 | 11 |
| East | Child lives in Bihar, Orissa, or West Bengal | 22 | 16 | 24 | 22 | 22 |
| Northeast | Child lives in Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, or Tripura | 4 | 2 | 5 | 4 | 4 |
| West | Child lives in Goa, Gujarat, or Maharashtra | 13 | 21 | 11 | 13 | 14 |
| South | Child lives in Andhra Pradesh, Karnataka, Kerala, or Tamil Nadu | 19 | 24 | 17 | 18 | 19 |
| **Number of cases[c]** | Number of children born in the period 0–47 months before the survey | 49,006 | 11,137 | 37,869 | 25,033 | 23,973 |

a. Mean values are based on the weighted sample.

b. Scheduled castes (SC) and scheduled tribes (ST) are those castes and tribes identified by the Government of India as socially and economically disadvantaged and in need of protection from social injustice and exploitation.

c. Actual sample size varies slightly for individual variables depending on the number of missing values.

children received two or more tetanus injections during pregnancy. There are sharp urban/rural differences in the mean values of most socioeconomic variables, but not of the demographic variables. The mean values of most variables by sex of child are close to those for both sexes combined.

**Stunting.** Table 3 shows the effects of selected demographic and socioeconomic variables on the prevalence of stunting among children below age four. As mentioned earlier, the effects are estimated using logistic regression and multiple classification analysis.

As child's age increases, there is a marked increase in stunting. In India as a whole, children age 24–47 months are more than twice as likely as infants to be

**Table 3 Unadjusted and adjusted prevalence of stunting among children age 0–47 months, by selected demographic and socioeconomic characteristics, India, 1992–93**

| | Percentage stunted | |
|---|---|---|
| **Predictor variable** | **Unadjusted** | **Adjusted** |
| **Child's age (in months)** | | |
| <12† | 25 | 24 |
| 12–23 | 57* | 57* |
| 24–47 | 64* | 64* |
| **Sex of child** | | |
| Boy | 52 | 52 |
| Girl† | 52 | 52 |
| **Birth order** | | |
| One† | 48 | 49 |
| Two or three | 50 | 50 |
| Four or five | 57* | 55* |
| Six or higher | 60* | 59* |
| **Mother's age at childbirth** | | |
| 13–24† | 52 | 55 |
| 25–34 | 51* | 48* |
| 35–49 | 55 | 43* |
| **Residence** | | |
| Urban | 45* | 53 |
| Rural† | 54 | 52 |
| **Mother's education** | | |
| Illiterate† | 58 | 56 |
| Literate, < middle complete | 46* | 49* |
| Middle complete or higher | 34* | 41* |
| **Religion** | | |
| Hindu† | 52 | 52 |
| Muslim | 54 | 53 |
| Other | 39* | 49 |
| **Caste/tribe** | | |
| SC/ST | 56* | 53 |
| Other† | 51 | 52 |
| **Media Exposure** | | |
| Regularly exposed | 44* | 51 |
| Not regularly exposed† | 58 | 52 |
| **Standard of living** | | |
| Low† | 59 | 56 |
| Medium | 54* | 53* |
| High | 37* | 44* |
| **Mother received iron and folic acid tablets during pregnancy** | | |
| Yes | 45* | 51 |
| No† | 59 | 53 |
| **Mother received two or more tetanus injections during pregnancy** | | |
| Yes | 45* | 50* |
| No† | 59 | 55 |
| **Region** | | |
| North | 43* | 44* |
| Central† | 59 | 58 |
| East | 58 | 55 |
| Northeast | 50* | 47* |
| West | 48* | 51* |
| South | 40* | 43* |

stunted. Twenty-five percent of infants and 64 percent of children age 24–47 months are stunted. A somewhat more detailed breakdown by age in Figure 3 shows that stunting is considerably less common in the first six months of life, when most babies are fully breastfed, than at older ages. The prevalence of stunting increases rapidly up to 12–23 months of age, after which it increases more slowly. The unadjusted and adjusted percentages by child's age are almost the same as shown in Table 3, indicating that the effect of child's age on stunting operates independently of the effects of the other predictor variables.

Interestingly, the prevalence of stunting is the same for boys and girls (Figure 4). This finding is somewhat surprising, inasmuch as there is widespread discrimination against girls in India (United Nations 1998). A separate analysis for Bihar and Kerala, the states with the highest and lowest prevalence of malnutrition, indicates that even in Bihar, in which the status of women is arguably the lowest of any state in India, there is no significant difference in the prevalence of stunting between boys and girls (results not shown). Some other studies have also observed the absence of the expected gender differential in nutrition in India, as well as in other developing countries with widespread discrimination against girls, but no concrete reasons for this unexpected finding are suggested (Sommerfelt and Arnold 1998; Sommerfelt and Stewart 1994; Basu 1993; Schoenbaum et al. 1995). Data from the NFHS are not sufficiently detailed to permit a more in-depth investigation of possible reasons for the unexpected absence of a gender differential in child nutrition favoring boys.

Because competition for nutrition increases as the number of children increases within a family, one might expect that children of higher birth order would have a greater risk of stunting than would children of lower birth order. Table 3 confirms this expectation. Children of birth order 4 or higher are considerably more likely to be stunted than are children of lower birth orders. Adjusting for the other 12 predictor variables makes little difference to the effect of birth order on the risk of stunting.

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*Notes to Table 3*:

Children from Andhra Pradesh, Himachal Pradesh, Madhya Pradesh, Tamil Nadu, and West Bengal are excluded because height was not measured for children in those states. A child who is more than two standard deviations below the median of the reference population in terms of height-for-age is defined as stunted. Both unadjusted and adjusted values are estimated by logistic regression. Unadjusted values are based on a separate logistic regression for each predictor variable, with that predictor variable as the only predictor variable in the regression. Adjusted values are based on a single logistic regression that includes all of the predictor variables in the table. In calculating adjusted values for categories of any given predictor variable, the set of control variables consists of all other predictor variables in the table. Constant terms in the regressions are reset so that predicted percentages agree with observed percentages when predictor variables are set to their mean values. Significance levels take design effects due to clustering into account.

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

† Reference category in the underlying logistic regression.

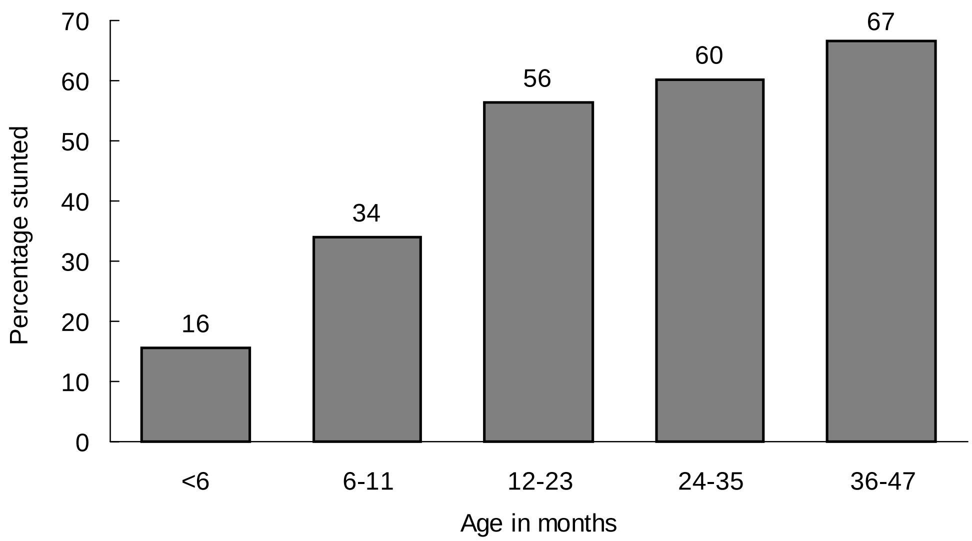


**Figure 3 Percentage of children under age four who are stunted, by age, India, 1992–93**

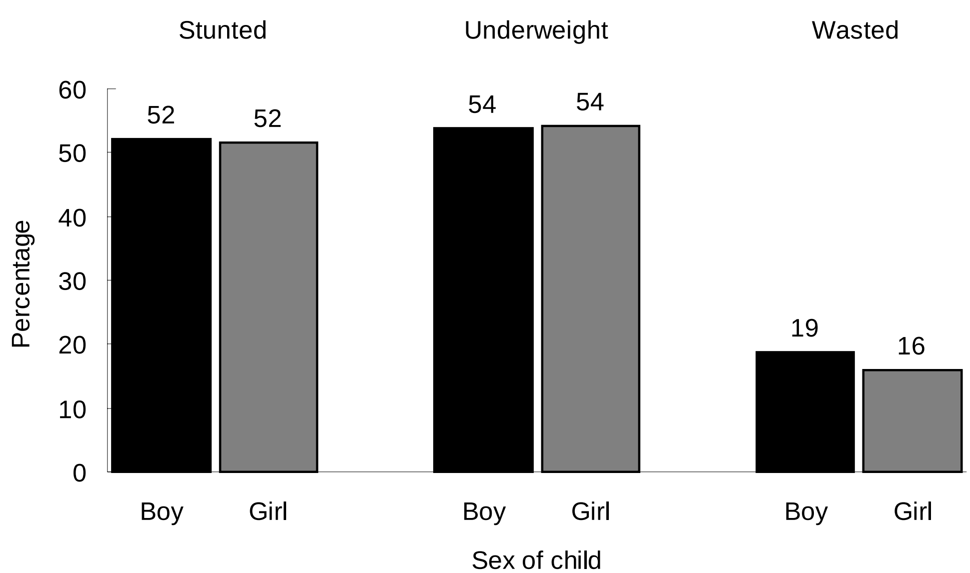


**Figure 4 Percentage of children under age four who are stunted, underweight, or wasted, by sex, India, 1992–93**

The prevalence of stunting also does not vary much by mother's age at childbirth. When the effects of the other predictor variables (including birth order) are statistically controlled, however, children born to younger mothers have a higher prevalence of stunting. Possibly this reflects improved expertise in childcare as parents get older.

The unadjusted prevalence of stunting is considerably lower in urban areas than in rural areas. However, once the other predictor variables are controlled, the relationship between residence and stunting slightly reverses and almost disappears. This suggests that the effects of urban/rural residence are mostly indirect, through the other predictor variables.

Table 3 and Figure 5 show that the differentials in stunting by mother's education are large. Even after the other predictor variables are controlled, 56 percent of children of illiterate mothers are stunted, compared with 41 percent of mothers who have completed middle school or higher. Thus mother's education has large direct effects on stunting as well as some indirect effects through some of the other predictor variables.

Hindus and Muslims have about the same prevalence of stunting, but children belonging to other religions have a considerably lower prevalence of stunting. Controlling for the other predictor variables, however, explains away most of the effect of religion, suggesting that the effects of religion stem mainly from the relatively high socioeconomic status of families belonging to other religions. Similarly, children belonging to scheduled castes or scheduled tribes have a significantly higher prevalence of stunting than do other children. Again, when the other predictor variables are statistically controlled, the effect of caste/tribe on prevalence of stunting largely disappears, suggesting that the unadjusted differences by caste/tribe stem mainly from the relatively low socioeconomic status of families who belong to a scheduled caste or scheduled tribe. Children of mothers who are regularly exposed to the electronic mass media have a lower prevalence of stunting than do children whose mothers are not regularly exposed. Controlling for the other predictor variables largely eliminates the effect of mother's media exposure, suggesting that media exposure has no independent effect on stunting.

Table 3 and Figure 6 show that the standard of living of the household in which the child resides has a strong effect on the prevalence of stunting, as expected. The unadjusted prevalence of stunting among children in households with a low standard of living is 59 percent, compared with 37 percent for children in households with a high standard of living. This differential is reduced to 56 and 44 percent when the other predictor variables are controlled, indicating a strong direct effect of standard of living on prevalence of stunting.

Children of mothers who received iron and folic acid tablets when they were pregnant have a lower prevalence of stunting than do children whose mothers did not

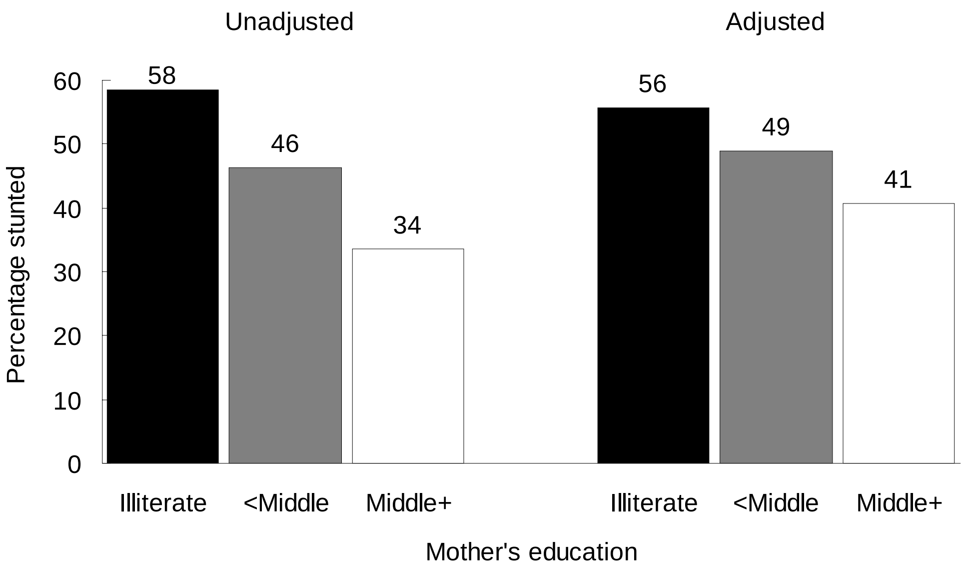


**Figure 5 Unadjusted and adjusted percentages of children under age four who are stunted, by mother's education, India, 1992–93**

*Note*: In this figure and in subsequent figures, "<Middle" means literate but less than middle school complete, and "Middle+" means middle school complete or higher education.

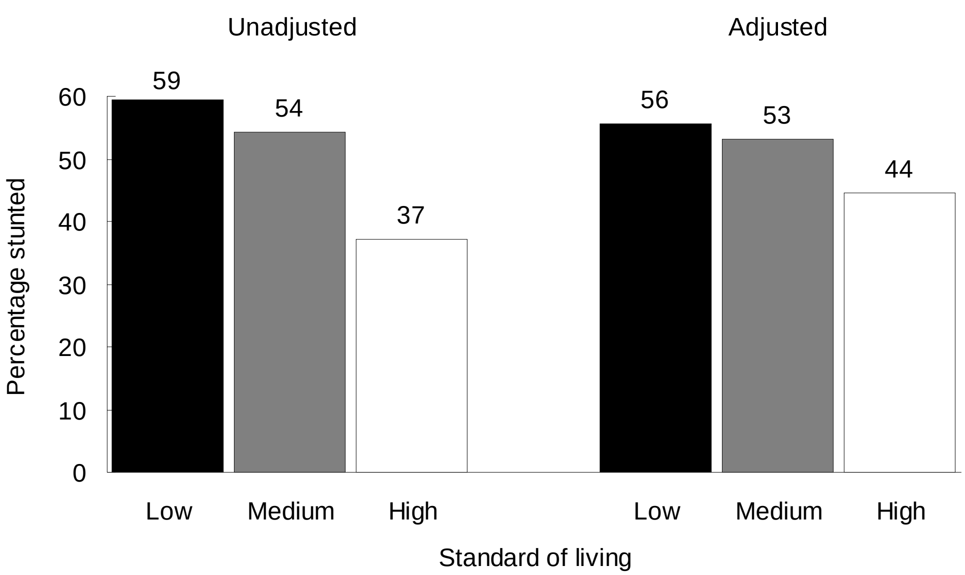


**Figure 6 Unadjusted and adjusted percentages of children under age four who are stunted, by household standard of living, India, 1992–93**

receive iron and folic acid tablets during pregnancy. Controlling for the selected demographic and socioeconomic variables, however, virtually eliminates this effect, and it becomes statistically nonsignificant.

Children of mothers who received two or more tetanus injections when they were pregnant have a significantly lower prevalence of stunting than do children whose mothers did not receive tetanus injections during pregnancy. Controlling for the other predictor variables substantially reduces this effect, but it remains statistically significant. This finding is consistent with earlier evidence from the NFHS that a mother having two or more tetanus injections during pregnancy is a good proxy for that mother's health-seeking behavior for her children (Luther 1998).

Table 3 also presents the prevalence of stunting by geographic region. Both the unadjusted and adjusted prevalence of stunting are highest in the central region and lowest in the south. Controlling for the other predictor variables does not make much difference in these geographic differentials, indicating that geographic region exerts a substantial independent effect on the prevalence of stunting. The reason for this geographic effect is unclear. It may have something to do with variations among the states in the availability and quality of health services, which are, for the most part, offered through state-level departments of health and family welfare.

Table 4 shows the effects of the demographic and socioeconomic variables on stunting, broken down by urban/rural residence and by sex of child. Only adjusted effects are presented. In both urban and rural areas, the effects of most predictor variables are similar to the effects for India as a whole. The exception is the effect of caste/tribe. Children belonging to scheduled-caste or scheduled-tribe households in urban areas have a significantly higher prevalence of stunting than do children belonging to other castes, while in rural areas there is no difference in the prevalence of stunting by caste/tribe. The adjusted effects of all predictor variables are similar for boys and girls considered separately or together, as shown in Table 3.

**Underweight.** Table 5 shows the effects of the predictor variables on the proportion of children who are underweight. The findings for underweight are mostly similar to those for stunting.

Thirty-one percent of infants and more than 61 percent of children age 12–47 months are underweight. For reasons that are unclear, the proportion underweight does not increase monotonically with age as it does in the case of stunting. Instead, it peaks at age 12–23 months and then declines slightly at 24–47 months. Adjusting for the control variables makes virtually no difference to the effect of age on the proportion underweight.

There is no difference in the proportion underweight by sex of child, regardless of whether the other predictor variables are controlled (see also Figure 4). The proportion

**Table 4 Adjusted prevalence of stunting among children age 0–47 months, by selected demographic and socioeconomic characteristics, by urban/rural residence, and by sex of child, India, 1992–93**

| | Percentage stunted | | | |
|---|---|---|---|---|
| | Residence | | Sex of child | |
| Predictor variable | Urban | Rural | Boy | Girl |
| **Child's age (in months)** | | | | |
| <12† | 19 | 25 | 26 | 22 |
| 12–23 | 49* | 59* | 58* | 57* |
| 24–47 | 58* | 66* | 63* | 66* |
| **Sex of child** | | | | |
| Boy | 45 | 54 | NA | NA |
| Girl† | 45 | 54 | NA | NA |
| **Birth order** | | | | |
| One† | 42 | 52 | 50 | 48 |
| Two or three | 43 | 51 | 49 | 50 |
| Four or five | 50* | 57* | 54* | 56* |
| Six or higher | 52* | 61* | 63* | 56* |
| **Mother's age at childbirth** | | | | |
| 13–24† | 48 | 57 | 56 | 54 |
| 25–34 | 40* | 50* | 48* | 48* |
| 35–49 | 38* | 45* | 42* | 45* |
| **Residence** | | | | |
| Urban | NA | NA | 53 | 52 |
| Rural† | NA | NA | 52 | 52 |
| **Mother's education** | | | | |
| Illiterate† | 52 | 57 | 57 | 55 |
| Literate, < middle complete | 45* | 50* | 48* | 50* |
| Middle complete or higher | 36* | 43* | 40* | 41* |
| **Religion** | | | | |
| Hindu† | 45 | 54 | 52 | 51 |
| Muslim | 43 | 56 | 52 | 53 |
| Other | 43 | 51 | 48* | 50 |
| **Caste/tribe** | | | | |
| SC/ST | 50* | 54 | 54 | 51 |
| Other† | 44 | 54 | 52 | 52 |
| **Media Exposure** | | | | |
| Regularly exposed | 44 | 54 | 52 | 50 |
| Not regularly exposed† | 46 | 54 | 52 | 52 |
| **Standard of living** | | | | |
| Low† | 51 | 57 | 56 | 55 |
| Medium | 49 | 54* | 54 | 52* |
| High | 39* | 47* | 43* | 46* |
| **Mother received iron and folic acid tablets during pregnancy** | | | | |
| Yes | 44 | 53 | 52 | 50 |
| No† | 46 | 55 | 53 | 53 |
| **Mother received two or more tetanus injections during pregnancy** | | | | |
| Yes | 43* | 53 | 51 | 50* |
| No† | 52 | 56 | 55 | 55 |
| **Region** | | | | |
| North | 43* | 44* | 45* | 43* |
| Central† | 55 | 60 | 58 | 58 |
| East | 47 | 57 | 57 | 54* |
| Northeast | 34* | 50* | 50* | 45* |
| West | 43* | 53* | 50* | 51* |
| South | 34* | 46* | 42* | 45* |

of underweight children increases with birth order, again regardless of whether demographic and socioeconomic variables are controlled. The unadjusted proportion underweight varies irregularly by mother's age at childbirth, but it declines monotonically, as in the case of stunting, when the other predictor variables are controlled.

The proportion underweight is considerably lower among children living in urban areas than in rural areas. When the other predictor variables are controlled, however, the effect of urban residence on proportion underweight becomes small and statistically nonsignificant. This finding indicates that the effects of urban/rural residence are felt indirectly through the other predictor variables, as in the case of stunting.

Table 5 and Figure 7 show that mother's education has a large effect on the proportion of children who are underweight. The proportion underweight among children of illiterate mothers is 60 percent, compared with 36 percent among children of mothers who have completed middle school or higher. Adjusting for the other predictor variables reduces the effect of mother's education on the proportion of children underweight, but the effect remains large and statistically significant, indicating a substantial direct effect as in the case of stunting. This finding suggests that efforts to improve women's education may contribute directly as well as indirectly to better child nutrition. An important reason for the large direct effect may be that educated women are more knowledgeable about proper nutrition and sanitation and make better use of health services.

Hindu and Muslim children differ little in the proportion underweight, but a much lower proportion of children of other religions are underweight. The adjusted proportion underweight is about the same across religions, however, indicating that the lower proportion underweight among children of other religions is primarily due to their higher socioeconomic status. The proportion underweight is higher among children belonging to a scheduled caste or scheduled tribe than among other children, but the adjusted proportion underweight is about the same. This suggests that the

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*Notes to Table 4*:

Children from Andhra Pradesh, Himachal Pradesh, Madhya Pradesh, Tamil Nadu, and West Bengal are excluded because height was not measured for children in those states. A child who is more than two standard deviations below the median of the reference population in terms of height-for-age is defined as stunted. Adjusted values in a column are based on a single logistic regression that includes all of the predictor variables in the table. In calculating adjusted values for categories of any given predictor variable, the set of control variables consists of all other predictor variables in the table. Constant terms in the regressions are reset so that predicted percentages agree with observed percentages when predictor variables are set to their mean values. Significance levels take design effects due to clustering into account.

NA: Not applicable

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

† Reference category in the underlying logistic regression.

**Table 5 Unadjusted and adjusted prevalence of underweight children age 0–47 months, by selected demographic and socioeconomic characteristics, India, 1992–93**

| | Percentage underweight | |
|---|---|---|
| **Predictor variable** | **Unadjusted** | **Adjusted** |
| **Child's age (in months)** | | |
| <12† | 31 | 30 |
| 12–23 | 64* | 65* |
| 24–47 | 61* | 61* |
| **Sex of child** | | |
| Boy | 54 | 54 |
| Girl† | 54 | 54 |
| **Birth order** | | |
| One† | 50 | 51 |
| Two or three | 53* | 53* |
| Four or five | 58* | 57* |
| Six or higher | 60* | 59* |
| **Mother's age at childbirth** | | |
| 13–24† | 55 | 56 |
| 25–34 | 52* | 50* |
| 35–49 | 57 | 48* |
| **Residence** | | |
| Urban | 46* | 53 |
| Rural† | 56 | 54 |
| **Mother's education** | | |
| Illiterate† | 60 | 57 |
| Literate, < middle complete | 51* | 53* |
| Middle complete or higher | 36* | 43* |
| **Religion** | | |
| Hindu† | 54 | 54 |
| Muslim | 56 | 55 |
| Other | 43* | 53 |
| **Caste/tribe** | | |
| SC/ST | 58* | 55 |
| Other† | 53 | 54 |
| **Media Exposure** | | |
| Regularly exposed | 47* | 54 |
| Not regularly exposed† | 60 | 54 |
| **Standard of living** | | |
| Low† | 62 | 59 |
| Medium | 56* | 55* |
| High | 38* | 45* |
| **Mother received iron and folic acid tablets during pregnancy** | | |
| Yes | 49* | 53 |
| No† | 60 | 55 |
| **Mother received two or more tetanus injections during pregnancy** | | |
| Yes | 49* | 53 |
| No† | 60 | 56 |
| **Region** | | |
| North | 42* | 43* |
| Central† | 59 | 58 |
| East | 60 | 58 |
| Northeast | 47* | 44* |
| West | 53* | 55* |
| South | 48* | 50* |

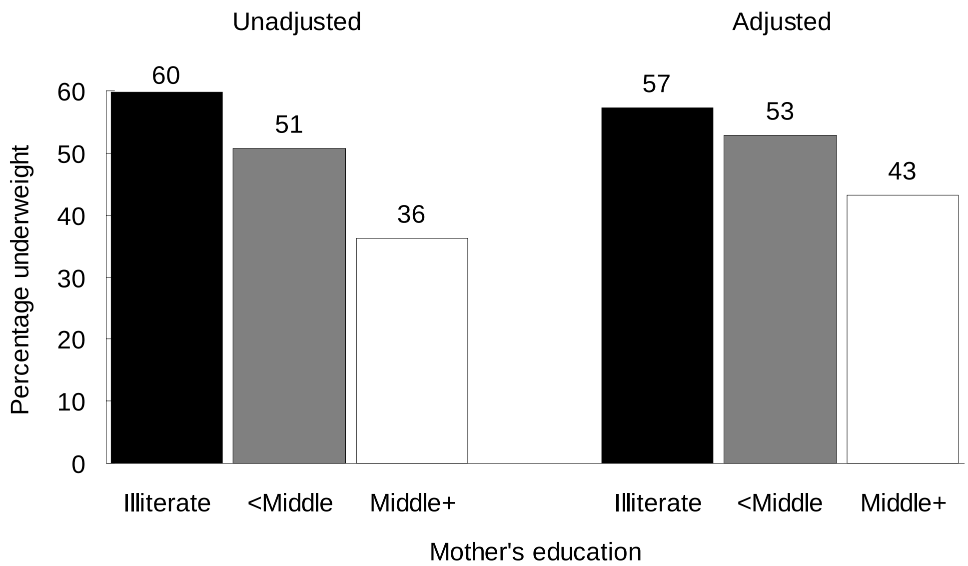


**Figure 7 Unadjusted and adjusted percentages of children under age four who are underweight, by mother’s education, India, 1992–93**

higher proportion underweight among children belonging to a scheduled caste or scheduled tribe is due primarily to their lower socioeconomic status, as in the case of stunting.

A considerably lower proportion of children whose mothers are regularly exposed to electronic mass media are underweight than the proportion among children whose mothers are not regularly exposed. When the other predictor variables are controlled, however, the effect of mother’s media exposure disappears, indicating that mother’s media exposure has no independent effect on the proportion of children underweight, as in the case of stunting.

Table 5 and Figure 8 show that household standard of living has a large negative effect on the proportion of children who are underweight. Controlling for the other

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*Notes to Table 5*:
A child who is more than two standard deviations below the median of the reference population in terms of weight-for-age is defined as underweight. Both unadjusted and adjusted values are estimated by logistic regression. Unadjusted values are based on a separate logistic regression for each predictor variable, with that predictor variable as the only predictor variable in the regression. Adjusted values are based on a single logistic regression that includes all of the predictor variables in the table. In calculating adjusted values for categories of any given predictor variable, the set of control variables consists of all other predictor variables in the table. Constant terms in the regressions are reset so that predicted percentages agree with observed percentages when predictor variables are set to their mean values. Significance levels take design effects due to clustering into account.
*The coefficient of the corresponding variable in the underlying logistic regression differs significantly from zero at the 5 percent level.
† Reference category in the underlying logistic regression.

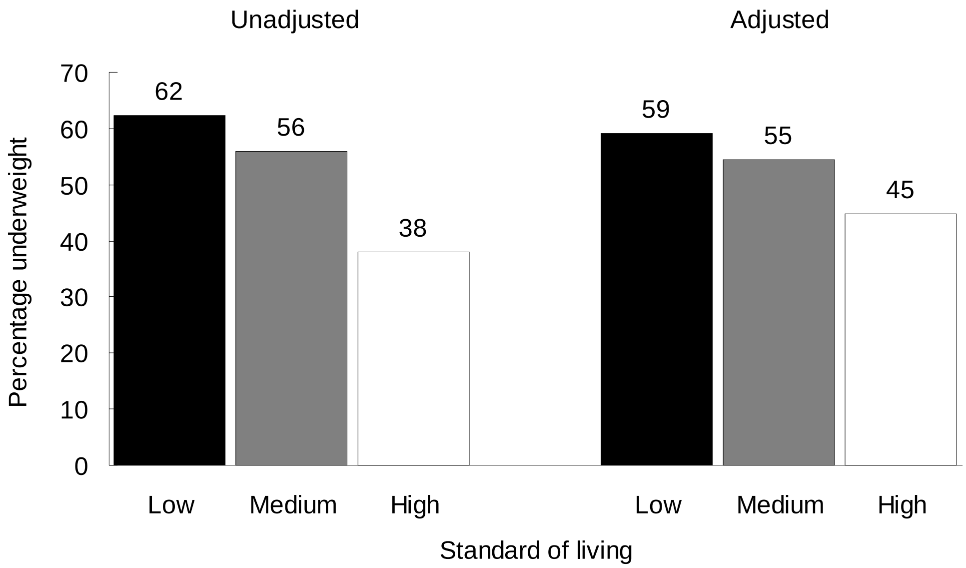


**Figure 8 Unadjusted and adjusted percentages of children under age four who are underweight, by household standard of living, India, 1992–93**

predictor variables somewhat reduces this effect, but it remains large and statistically significant. The adjusted proportion underweight is 59 percent among children in households with a low standard of living and 45 percent among children in households with a high standard of living, indicating that living standard has a large direct effect on the prevalence of underweight, as in the case of stunting.

The proportion underweight is considerably lower among children whose mothers received iron and folic acid tablets during pregnancy than among other children. The adjusted effect of this variable is, however, greatly reduced and statistically nonsignificant. The effect of mother's tetanus injections during pregnancy on the proportion of children underweight shows a similar pattern. These findings indicate that neither iron and folic acid tablets nor tetanus injections for pregnant women has an independent effect on the proportion of their children who are underweight.

The proportion of children who are underweight varies somewhat by geographic region, with the central and eastern regions having the highest proportions underweight and the north and northeast regions having the lowest proportions. This regional variability persists even after potentially confounding factors are controlled.

Separate analyses of the proportion of children who are underweight, broken down by urban/rural residence and by sex of child, are presented in Table 6. Only adjusted effects are shown. Among the demographic variables, child's age, birth order, and mother's age at childbirth have significant effects on the proportion underweight. Among the socioeconomic variables, mother's education and standard of

**Table 6 Adjusted prevalence of underweight children age 0–47 months, by selected demographic and socioeconomic characteristics, by urban/rural residence, and by sex of child, India, 1992–93**

| | Percentage underweight | | | |
|---|---|---|---|---|
| | Residence | | Sex of child | |
| Predictor variable | Urban | Rural | Boy | Girl |
| **Child's age (in months)** | | | | |
| <12† | 24 | 32 | 30 | 29 |
| 12–23 | 55* | 68* | 67* | 63* |
| 24–47 | 54* | 63* | 60* | 63* |
| **Sex of child** | | | | |
| Boy | 45 | 57 | NA | NA |
| Girl† | 47 | 56 | NA | NA |
| **Birth order** | | | | |
| One† | 42 | 54 | 51 | 50 |
| Two or three | 45 | 55 | 53 | 53* |
| Four or five | 52* | 59* | 56* | 58* |
| Six or higher | 53* | 61* | 61* | 58* |
| **Mother's age at childbirth** | | | | |
| 13–24† | 49 | 59 | 57 | 56 |
| 25–34 | 42* | 53* | 50* | 50* |
| 35–49 | 37* | 51* | 45* | 51* |
| **Residence** | | | | |
| Urban | NA | NA | 52 | 54 |
| Rural† | NA | NA | 54 | 54 |
| **Mother's education** | | | | |
| Illiterate† | 52 | 59 | 57 | 58 |
| Literate, < middle complete | 47* | 54* | 53* | 52* |
| Middle complete or higher | 39* | 45* | 45* | 42* |
| **Religion** | | | | |
| Hindu† | 47 | 56 | 54 | 54 |
| Muslim | 43 | 58 | 55 | 54 |
| Other | 41* | 57 | 52 | 54 |
| **Caste/tribe** | | | | |
| SC/ST | 49 | 58 | 55 | 55 |
| Other† | 45 | 56 | 54 | 54 |
| **Media Exposure** | | | | |
| Regularly exposed | 46 | 56 | 54 | 53 |
| Not regularly exposed† | 46 | 57 | 54 | 55 |
| **Standard of living** | | | | |
| Low† | 61 | 60 | 59 | 59 |
| Medium | 52* | 56* | 55* | 55* |
| High | 37* | 50* | 44* | 46* |
| **Mother received iron and folic acid tablets during pregnancy** | | | | |
| Yes | 46 | 56 | 53 | 54 |
| No† | 46 | 57 | 55 | 54 |
| **Mother received two or more tetanus injections during pregnancy** | | | | |
| Yes | 46 | 56 | 53 | 54 |
| No† | 50 | 58 | 57 | 56 |
| **Region** | | | | |
| North | 41* | 43* | 43* | 43* |
| Central† | 55 | 60 | 60 | 57 |
| East | 46* | 61 | 58 | 58 |
| Northeast | 30* | 47* | 45* | 43* |
| West | 46* | 58 | 54* | 57 |
| South | 40* | 54* | 48* | 52* |

living have large and significant effects. The adjusted effects tend to be greater in urban areas than in rural areas. The separate analysis by sex of child shows a rather similar pattern. Effects of the various predictor variables included in the analysis are quite similar for boys and girls.

**Wasting.** Table 7 shows unadjusted and adjusted effects of the predictor variables on the prevalence of wasting among children below age four. The findings on wasting differ somewhat from the findings on stunting and underweight, although the two sets of findings are broadly similar. The effects of the predictor variables on wasting tend to be smaller and, in some cases, less consistent with expectation than the effects of the same variables on stunting and underweight.

Child's age has an inverted U-shaped relationship with the prevalence of wasting, with children age 12–23 months more likely to be wasted than infants or children age 24–47 months. Controlling for the other predictor variables does not reduce this effect, indicating that child's age has an independent effect on the prevalence of wasting. The lower prevalence of wasting among infants may stem mainly from the fact that most infants in India are breastfed.

Boys are more subject to wasting than girls, unlike stunting and underweight, which affect boys and girls equally (see also Figure 4). In light of the widespread discrimination against girls in feeding and medical care in India, this finding is contrary to expectation. Controlling for the other predictor variables does not alter the effect of gender on wasting, indicating that the higher prevalence of wasting among boys cannot be explained by these other variables.

In contrast to the prevalence of stunting and underweight, the prevalence of wasting does not vary much by birth order of child. Mother's age at childbirth also does not have much effect on wasting, except among children born to mothers age 35–49, who have a somewhat higher prevalence of wasting. The lack of an effect of birth order may reflect the fact that wasting is primarily a result of acute malnutrition rather than chronic malnutrition.

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*Notes to Table 6*:

A child who is more than two standard deviations below the median in a column of the reference population in terms of weight-for-age is defined as underweight. Adjusted values are based on a single logistic regression that includes all of the predictor variables in the table. In calculating adjusted values for categories of any given predictor variable, the set of control variables consists of all other predictor variables in the table. Constant terms in the regressions are reset so that predicted percentages agree with observed percentages when predictor variables are set to their mean values. Significance levels take design effects due to clustering into account.

NA: Not applicable.

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

† Reference category in the underlying logistic regression.

**Table 7 Unadjusted and adjusted prevalence of wasting among children age 0–47 months, by selected demographic and socioeconomic characteristics, India, 1992–93**

| | Percentage wasted | |
|---|---|---|
| **Predictor variable** | **Unadjusted** | **Adjusted** |
| **Child's age (in months)** | | |
| <12† | 13 | 13 |
| 12–23 | 29* | 29* |
| 24–47 | 15* | 15 |
| **Sex of child** | | |
| Boy | 19* | 19* |
| Girl† | 16 | 16 |
| **Birth order** | | |
| One† | 16 | 17 |
| Two or three | 17 | 18 |
| Four or five | 19* | 18 |
| Six or higher | 17 | 16 |
| **Mother's age at childbirth** | | |
| 13–24† | 17 | 17 |
| 25–34 | 17 | 17 |
| 35–49 | 20 | 21* |
| **Residence** | | |
| Urban | 16* | 17 |
| Rural† | 18 | 17 |
| **Mother's education** | | |
| Illiterate† | 19 | 18 |
| Literate, < middle complete | 17* | 17 |
| Middle complete or higher | 13* | 14* |
| **Religion** | | |
| Hindu† | 18 | 17 |
| Muslim | 17 | 18 |
| Other | 15* | 18 |
| **Caste/tribe** | | |
| SC/ST | 20* | 19* |
| Other† | 17 | 17 |
| **Media Exposure** | | |
| Regularly exposed | 16* | 17 |
| Not regularly exposed† | 19 | 18 |
| **Standard of living** | | |
| Low† | 20 | 19 |
| Medium | 18* | 17 |
| High | 14* | 16 |
| **Mother received iron and folic acid tablets during pregnancy** | | |
| Yes | 17* | 18 |
| No† | 18 | 17 |
| **Mother received two or more tetanus injections during pregnancy** | | |
| Yes | 17* | 18 |
| No† | 18 | 17 |
| **Region** | | |
| North | 16 | 16 |
| Central† | 16 | 16 |
| East | 22* | 21* |
| Northeast | 11* | 11* |
| West | 20* | 21* |
| South | 15 | 16 |

Children living in urban areas have slightly lower prevalence of wasting than those living in rural areas. When the other predictor variables are controlled, however, the adjusted effect of urban/rural residence on wasting vanishes. This suggests that the effect of residence is indirect through the other predictor variables.

As in the case of stunting and underweight, Table 7 and Figure 9 show that mother's education is among the strongest predictors of wasting in children. Although the effects are reduced after adjusting for the effects of the other predictor variables, the adjusted effects remain statistically significant.

Children belonging to religions other than Hindu or Muslim have a somewhat lower prevalence of wasting, but religion has no effect on wasting once the other predictor variables are controlled. This suggests that the lower proportion wasted among children of other religions is primarily due to their relatively high socioeconomic status, as in the case of stunting and underweight.

Children belonging to a scheduled caste or scheduled tribe have a somewhat higher prevalence of wasting than do children belonging to other households, even after adjusting for the effects of the other predictor variables. Thus, the effect of caste/tribe on wasting is only partially explained by the other predictor variables, unlike the cases of stunting and underweight, where the effect of caste/tribe is completely explained by the other variables.

Children of mothers regularly exposed to the electronic mass media have a lower prevalence of wasting, as expected. But, as in the case of stunting and underweight, this effect of media exposure becomes small and statistically nonsignificant once the other demographic and socioeconomic variables are controlled.

Table 7 and Figure 10 show that household standard of living has a large unadjusted effect on the prevalence of wasting. Unlike the effects on stunting and underweight, the introduction of controls considerably reduces the effect of living standard on wasting, and the adjusted effect is no longer statistically significant.

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*Notes to Table 7*:

Children from Andhra Pradesh, Himachal Pradesh, Madhya Pradesh, Tamil Nadu, and West Bengal are excluded because height was not measured for children in those states. A child who is more than two standard deviations below the median of the reference population in terms of weight-for-height is defined as wasted. Both unadjusted and adjusted values are estimated by logistic regression. Unadjusted values are based on a separate logistic regression for each predictor variable, with that predictor variable as the only predictor variable in the regression. Adjusted values are based on a single logistic regression that includes all of the predictor variables in the table. In calculating adjusted values for categories of any given predictor variable, the set of control variables consists of all other predictor variables in the table. Constant terms in the regressions are reset so that predicted percentages agree with observed percentages when predictor variables are set to their mean values. Significance levels take design effects due to clustering into account.

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

† Reference category in the underlying logistic regression.

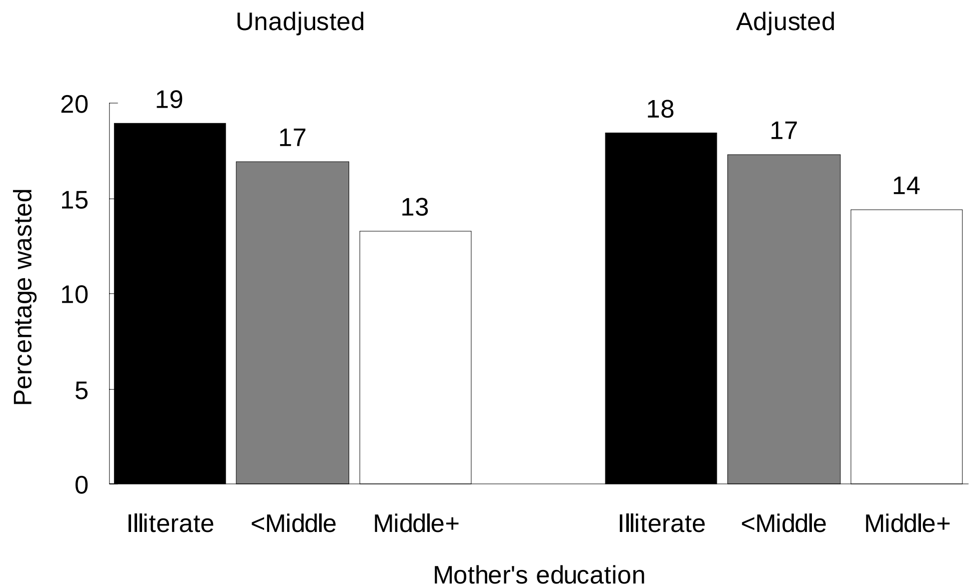


**Figure 9 Unadjusted and adjusted percentages of children under age four who are wasted, by mother’s education, India, 1992–93**

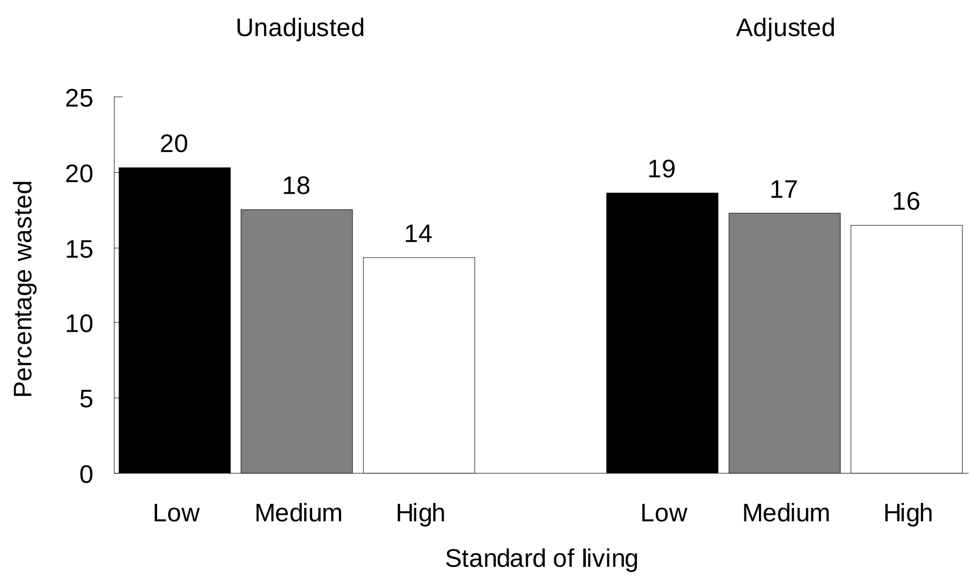


**Figure 10 Unadjusted and adjusted percentages of children under age four who are wasted, by household standard of living, India, 1992–93**

Whether mothers received iron and folic acid tablets or two or more tetanus injections during pregnancy has virtually no effect on the prevalence of wasting among children. By geographic region, the east and the west regions have the highest prevalence of wasting, and the northeast region has the lowest.

Table 8 presents adjusted prevalence of wasting by selected demographic and socioeconomic characteristics separately for urban and rural areas and for boys and girls. The effects of child's age on wasting, both by residence and by sex of child, are similar to those for the sample as a whole, as shown earlier in Table 7. Boys have considerably higher prevalence of wasting than girls in rural areas, but in urban areas the gender difference is small and statistically nonsignificant. This finding is contrary to expectation, given that discrimination against girls tends to be more severe in rural areas than in urban areas.

The effects of birth order and mother's age at childbirth, as estimated separately for urban and rural areas and for boys and girls, are similar to those for the sample as a whole, as shown earlier in Table 7. The effects of mother's education, however, are not similar. Mother's education has a statistically significant effect on wasting among children living in rural areas (but not urban areas) and among girls (but not boys). The effects of religion are similar for boys and girls, but children belonging to religions other than Hindu or Muslim have the lowest prevalence of wasting in urban areas and the highest prevalence of wasting in rural areas. The effects of caste/tribe on wasting are similar for boys and girls and for urban and rural areas, but they are not statistically significant for girls or for urban areas. Media exposure has a small significant effect in the expected direction for girls, but not for boys.

Standard of living has a negative but statistically nonsignificant effect on wasting for both boys and girls. It has virtually no effect on wasting in rural areas, but a negative and statistically significant effect in urban areas. The two variables related to mother's health behavior during pregnancy have virtually no effect on wasting, either by residence or by sex of child. The effects of geographic region by residence and by sex of child resemble the effects of geographic region for the sample as a whole.

## CONCLUSION

India has disproportionately large numbers of malnourished and severely malnourished children below four years of age according to anthropometric data on stunting (height-for-age), underweight (weight-for-age), and wasting (weight-for-height) from the 1992–93 National Family Health Survey (NFHS). Fifty-two percent of all children below age four are stunted, and 29 percent are severely stunted. Fifty-four percent are underweight, and 22 percent are severely underweight. Seventeen percent are wasted, and 3 percent are severely wasted. The lower prevalence of wasting than

**Table 8 Adjusted prevalence of wasting among children age 0–47 months, by selected demographic and socioeconomic characteristics, by urban/rural residence, and by sex of child, India, 1992–93**

| | Percentage wasted | | | |
|---|---|---|---|---|
| | Residence | | Sex of child | |
| Predictor variable | Urban | Rural | Boy | Girl |
| **Child's age (in months)** | | | | |
| <12† | 14 | 13 | 14 | 12 |
| 12–23 | 27* | 30* | 32* | 27* |
| 24–47 | 12 | 15* | 15 | 14 |
| **Sex of child** | | | | |
| Boy | 16 | 20* | NA | NA |
| Girl† | 15 | 16 | NA | NA |
| **Birth order** | | | | |
| One† | 15 | 18 | 18 | 16 |
| Two or three | 15 | 18 | 19 | 16 |
| Four or five | 19* | 18 | 20 | 16 |
| Six or higher | 16 | 16 | 17 | 15 |
| **Mother's age at childbirth** | | | | |
| 13–24† | 17 | 17 | 19 | 16 |
| 25–34 | 13* | 18 | 19 | 15 |
| 35–49 | 21 | 22* | 20 | 22* |
| **Residence** | | | | |
| Urban | NA | NA | 18 | 17 |
| Rural† | NA | NA | 19 | 16 |
| **Mother's education** | | | | |
| Illiterate† | 16 | 19 | 19 | 18 |
| Literate, < middle complete | 18 | 17 | 20 | 15* |
| Middle complete or higher | 15 | 14* | 17 | 12* |
| **Religion** | | | | |
| Hindu† | 16 | 18 | 19 | 16 |
| Muslim | 16 | 18 | 19 | 16 |
| Other | 12* | 21* | 18 | 18 |
| **Caste/tribe** | | | | |
| SC/ST | 18 | 20* | 21* | 18 |
| Other† | 15 | 17 | 18 | 16 |
| **Media Exposure** | | | | |
| Regularly exposed | 16 | 17 | 19 | 15* |
| Not regularly exposed† | 16 | 18 | 19 | 17 |
| **Standard of living** | | | | |
| Low† | 21 | 18 | 20 | 17 |
| Medium | 17* | 18 | 19 | 15 |
| High | 14* | 18 | 17 | 16 |
| **Mother received iron and folic acid tablets during pregnancy** | | | | |
| Yes | 16 | 18 | 19 | 16 |
| No† | 15 | 18 | 19 | 16 |
| **Mother received two or more tetanus injections during pregnancy** | | | | |
| Yes | 16 | 18 | 19 | 16 |
| No† | 17 | 17 | 19 | 15 |
| **Region** | | | | |
| North | 16 | 15 | 16 | 15 |
| Central† | 16 | 16 | 18 | 14 |
| East | 16 | 23* | 24* | 18* |
| Northeast | 7* | 12* | 13* | 9* |
| West | 18 | 22* | 21* | 21* |
| South | 15 | 17 | 17 | 17 |

of stunting or underweight indicates that chronic malnutrition is more prevalent in India than acute malnutrition. However, the prevalence of wasting is about 8 times and the prevalence of severe wasting is about 25 times the levels in the international reference population.

There are considerable variations in the prevalence of malnutrition among states. Bihar and Kerala are the states with the highest and lowest prevalence of malnutrition in the country. Even in Kerala, which is also the state with the lowest infant and child mortality rates, 27 percent of children below age four are stunted, 28 percent are underweight, and 12 percent are wasted.

Multivariate analysis of the selected demographic and socioeconomic determinants of child nutritional status indicates that the strongest predictors of child nutrition in India, once other variables are controlled, are child's age and birth order, mother's education level, and household standard of living. Older children and children of higher birth order tend to have poorer nutritional status. Children whose mothers are more educated and those who live in households with a relatively high standard of living have better nutrition. Boys and girls have about the same level of stunting and underweight, while wasting is somewhat higher among boys than among girls. In the face of much evidence that girls receive inferior care in India, this finding that girls fare at least as well if not better than boys in terms of nutrition is difficult to explain and warrants further investigation.

The findings of this study should be interpreted cautiously because of the problem of age misreporting. Previous research indicates that some births that occurred during the period 0–4 years before the NFHS tend to be erroneously reported as having occurred during the period 5–9 years before the survey (Narasimhan et al. 1997). This means that some children below age four are reported as older than they really are. To the extent that this kind of age exaggeration occurs, the estimates of stunting and underweight, which are based on height-for-age and weight-for-age,

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*Notes to Table 8*:

Children from Andhra Pradesh, Himachal Pradesh, Madhya Pradesh, Tamil Nadu, and West Bengal are excluded because height was not measured for children in those states. A child who is more than two standard deviations below the median of the reference population in terms of weight-for-height is defined as wasted. Adjusted values in a column are based on a single logistic regression that includes all of the predictor variables in the table. In calculating adjusted values for categories of any given predictor variable, the set of control variables consists of all other predictor variables in the table. Constant terms in the regressions are reset so that predicted percentages agree with observed percentages when predictor variables are set to their mean values. Significance levels take design effects due to clustering into account.

NA: Not applicable.

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

† Reference category in the underlying logistic regression.

may exaggerate the extent of malnutrition. Moreover, to the extent that age exaggeration is more pronounced among those with less education and lower socioeconomic status, the age misreporting may exaggerate the estimated socioeconomic differentials in stunting and underweight. On the other hand, the estimates of wasting, which are based on weight-for-height, are not affected by age misreporting.

Despite this caveat, the findings of this study should be useful for identifying categories of children who are at particularly high risk of malnutrition. The findings also imply that the prevalence of malnutrition can be reduced by improving educational levels of mothers, by raising household living standards, and by reducing higher-order births by means of family planning. Such efforts should be combined with programmes that raise women's awareness of the nutritional requirements of children.

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