Does Economic Inequality Matter in Cases of Infectious Childhood Diseases? An Analysis for India

Relative poverty within a population is one of the fundamental reasons for the high prevalence of infectious childhood diseases in a developing country such as India.

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Although remarkable declines in infant and child mortality have been observed in developing countries during the last quarter of the twentieth century, the incidence and the prevalence of infectious diseases among children under five years of age still persist at an alarmingly high level, especially in sub-Saharan

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Africa and South Asian countries in the ESCAP region. Over two thirds of the estimated 3.7 million deaths of children in South Asia in the year 2000 were attributable to infections such as pneumonia (acute respiratory infections), diarrhoea and measles (UNICEF, 2004; Black, Morris and Bryce, 2003). In India, diarrhoea, acute respiratory infections, tuberculosis and chronic hepatitis continue to threaten the lives of millions of children.

It is well established that the health profile of a population depends on many factors: a combination of existing environmental risks (physical, biological and social), the proportion of the population facing these different risks and the sociocultural-demographic profile of a particular region or country. While pathogens such as viruses and bacteria have been identified as causes of disease, exposure to them, while necessary in the contraction of disease, is not sufficient to cause disease. Relative poverty within a population, which results in inadequate access to and utilization of basic services, amenities and opportunities including preventive and curative health care, is one of the fundamental reasons for the high prevalence of infectious childhood diseases in a developing country such as India.

There are various approaches to study infectious childhood diseases and their relationship to illness and mortality. Medical research focuses on biological processes of infectious diseases of childhood, while social science research primarily focuses on socio-economic differentials of child mortality and largely ignores specific causes of death. Mosley and Chen's (1984) "proximate determinants of health dynamics" model, which incorporates both social and biological variables, has been adopted by a number of researchers such as Pandey and others (1998) to identify determinants of child mortality in developing countries. Their premise is that all social and economic determinants of child mortality necessarily operate through a common set of biological mechanisms or proximate determinants. These include maternal and environmental factors, nutritional deficiency, injury and personal illness control in affecting mortality (Mosley and Chen, 1984). However, these studies dealt primarily with mortality and not with morbidity per se. It seems, therefore, that the relationship between morbidity and death is held as obvious, needing no analysis on its own, while sickness leading to death is considered as a one-time event. However, Mosley and Chen (1984) have argued that death among children should be studied as a chronic disease process with multifactoral origins rather than as an acute single-case phenomenon. Thus, relatively few studies are available in this regard in developing countries. Some studies have demonstrated that unlike adults children face a greater threat to their health and well-being from exposure to parasitic and infectious diseases including diarrhoea, malaria, acute respiratory infections, tetanus and measles owing to the vulnerability of their young bodies. They have also shown that exposure is conditioned by household environmental conditions, as well as social, economic and ecological factors (Ryland and Raggers, 1998; Costello and others, 1996; Omariba, 2001). A comparative study of urban areas of Ghana, Egypt, Brazil and Thailand clearly indicates that children's health is affected by the economic status of the households and is attributable to the differences in child-care practices, for instance, the preparation of weaning foods and personal hygiene (Timaeus and Lush, 1995). Studies in India have shown that the household economy is a significant predictor in cases of infant and child mortality (Mahadevan and others, 1986; Pandey and others, 1998; Ghosh, 2003). Ghosh and Mondal (2003) have shown that the household standard of living is a significant predictor of under-five mortality but not of morbidity in rural and urban areas and urban slums in the Maharashtra State.

Along with the economic condition of the household, other spatial, demographic and socio-economic factors affect the susceptibility of children to infectious diseases in developing countries. The incidence of diarrhoea has been found to be higher in the second half of an infant's life (Yohannes, Streatfield and Bost, 1992). Babies born to young mothers are more likely to be premature, have low birth weights, suffer from complications at the time of delivery and be more prone to mortality than those born to older women (Hobcraft, McDonald and Rutstein, 1984; Pandey and others, 1998; Ghosh, 2003). Excess female mortality in the post-neonatal and childhood periods has generally been observed in India and other South Asian countries. Some studies have argued that this phenomenon is attributed to "son-preference", which leads to differential treatment of sons and daughters in terms of the allocation of food, the provision of health care and the treatment of illness (Gupta, 1986; Visaria, 1987; Arnold, Choe and Roy, 1998; Pandey and others, 1998). However, these studies did not focus on whether the sex differentials exist in cases of infectious childhood diseases. Caldwell (1979) argued that maternal education plays an important role in determining child survival, even after controlling a number of socio-economic factors. Several other studies also established the influence of maternal education on child health and survival (Cochrane, O'Hara and Leslie, 1980; United Nations, 1985; Da Vanzo and Habicht, 1986; Cleland and van Ginneken, 1989; Bicego and Boerma, 1993). Tagoe (1995) found that the prevalence of diarrhoea is negatively related to the education of mothers in Ghana, but in India's Maharashtra State, no such relationship has been observed (Ghosh and Mondal, 2003). However, Ghosh and Mondal (2003) have observed that religious and caste differentials do exist in childhood morbidity in Maharashra. Studies in India and other developing countries have suggested a negative relationship between maternal work and child health and survival (Hobcraft, McDonald and Rutstein, 1984; United Nations, 1985; Zachariah and others, 1994; Basu and Basu, 1991; Sivakami, 1997; Pandey and others, 1998; Kishor and Parasuraman, 1998). Various studies have proved that there is a very strong negative relationship between childhood immunization and the incidence of infectious childhood diseases (Ghosh and Mondal, 2003; International Institute for Population Studies (IIPS) and ORC Macro, 2000). Maternal anaemia may have detrimental effects on the health of children and may become an underlying cause of perinatal morbidity and mortality (Seshadri, 1997 and 1998; IIPS and ORC Macro, 2000).

The present study attempts first to determine the level and pattern of infectious childhood diseases among children living under different economic conditions by their background characteristics. It seeks second to examine the influence of household economic conditions on the incidence of infectious childhood diseases after controlling a number of plausible spatial, demographic and sociocultural variables that may affect the incidence of infectious childhood diseases. The hypothesis here is that economic inequality is one of the most important determinants in explaining the high prevalence of infectious childhood diseases in India.

Materials and methods

Data

Data for this study were drawn from India's second National Family Health Survey (NFHS-2), a large scale survey carried out between 1998 and 1999 by ORC Macro International, the International Institute for Population Sciences and the East-West Center. The data on fertility, mortality, morbidity, family planning and important aspects of reproductive health, nutrition and childcare were collected from a nationally representative sample of 90,303 ever-married women in the age group 15-49 years, residing in 92,486 households. In addition, the survey collected information on the incidence of disease among 30,984 children born during the three years preceding the survey and alive on the survey date. The children's mothers provided information on the childhood diseases, which included diarrhoea, acute respiratory infection, asthma, tuberculosis, malaria and jaundice (it should be mentioned that, although not a disease in itself, jaundice, or yellowing of the skin and whites of the eyes, is caused by a buildup of bilirubin levels, which may be a manifestation of liver disease or other serious conditions such as gallbladder and intestinal disorders, and infection). It should also be noted that data on the occurrence of asthma, tuberculosis, malaria and jaundice were collected for every member of the households surveyed. As the present study deals only with infectious diseases among children, it was necessary to consider the cases of diarrhoea, acute respiratory infection, tuberculosis, malaria and jaundice, which have an infectious aetiology. Asthma, which is a non-communicable disease, has been excluded from the analysis.

In order to meet the objectives of the present study, the response variable has been classified into two categories: occurrence of any of the five aforementioned infectious diseases and non-occurrence of any infectious disease.

Explanatory and control variables

NFHS also collected information on the background characteristics of mothers, children and households. The main predictor variable in this analysis was "household's economic status". As information on household income or expenditure is not directly available, the standard of living index (calculated by NFHS-2) has been taken as the proxy for household economic status. The standard of living index consists of the following household and economic characteristics: type of house, toilet facility, source of lightning, main fuel for cooking, source of drinking water, use of separate room for cooking, ownership of house, ownership of agricultural land, ownership of irrigated land, ownership of livestock and ownership of durable goods. On the basis of the composite score related to these characteristics, the household standard of living has been divided into low, medium and high levels.[1]

Because the effect of the household standard of living on the incidence of infectious diseases is likely to be confounded with the effects of some of these other variables, the selected spatial, demographic and socio-economic characteristics were controlled statistically. The variables included as controls in this analysis are as follows: place of residence (rural and urban), geographic region[2] (south, east, central, north, west and north-east); mother's age (younger than 20, 20-29 and 30 or more years); sex of the child (male, female); birth order (1, 2-3 and 4+); size of the child at birth[3] (less than average, average and greater than average); immunization status of the child (no immunization, partial immunization and complete immunization); work status of the mother (working and not-working); maternal anaemia at the time of pregnancy (no, yes); exposure to mass media[4] (no, yes); religion and caste; and crowding in the household. Religion and caste have been pooled to form a single variable categorized as "forward caste Hindu", "scheduled caste/scheduled tribe Hindu" and "other than Hindu".[5] Here "crowding" is measured as the number of persons per room; it has been grouped into two categories: "less than or equal to three persons per room" and "more than three persons per room".

Each control variable has a rationale for inclusion. The place of residence has been controlled here as it is directly correlated with a household's economic condition as well as the incidence of infectious childhood diseases. Geographic region has been controlled because it could provide some indication of the differential levels of development among the regions and differences in certain ecological and climatic conditions associated with the aetiology of diseases that may exist in the regions. Age of the mother has been controlled because young mothers are less likely to be educated and aware of childcare practices to protect their children from infectious diseases. They may also be unaware of the utilization of health-care services such as childhood immunization as their older counterparts. Sex of the child has been included as a control since it has been often argued that, in India's patriarchal society, boys are likely to receive more care than girls and therefore be less prone to infectious diseases. Birth order has been controlled in the analysis because higher birth order children are more susceptible to infectious diseases than first birth order children; higher birth order children are more likely to be neglected than lower order ones by virtue of being born into a large family. Children who are perceived by their mothers to be smaller than average, that is, underweight, at the time of birth have a presumably higher risk of infection than children perceived to be of average or larger size and thus controlled. The vaccination of children has been controlled as it is widely accepted that immunization with all the recommended vaccines remarkably reduces the incidence of infectious childhood diseases.[6]

Religion and caste are cultural variables that are controlled for cultural variations in child care. Maternal education has been controlled here as it is an important factor possibly influencing the incidence of infectious childhood diseases since more highly educated mothers, owing to their exposure to the outside world, are more aware of their own personal hygiene as well as that of their children and have greater awareness about issues of preventive, promotive and curative health care than less educated mothers. Women's participation in paid work may also have a bearing on any illness of their children caused by infectious diseases because of conflicts in time allocation between her work schedule and the time needed for child care, including breastfeeding; such participation is correlated with the household economy. Thus, women's work status has been controlled in this analysis. Further, "maternal anaemia" has been controlled here as a proxy for maternal nutritional status, which is an important factor because it is directly related to the household's economic conditions as well as the incidence of infectious childhood diseases. Undernourished mothers are more likely to give birth to premature babies, who because of their low inborn immunity presumably are more prone to infectious diseases than full-term babies. It is widely believed that exposure to mass media can play an important role in educating women about how to combat infectious childhood diseases and this factor is directly correlated with a household's economic conditions and hence controlled. On the contrary, it is likely that the reporting of disease would be higher among those women who are exposed to any sort of mass media as they are more aware of the signs and symptoms of infectious disease than mothers who are not exposed to mass media; therefore, statistically the role of mass media exposure could be negative with regard to the incidence of infectious childhood diseases.

Breastfeeding is nearly universal in India. According to the first National Family Health Survey (NFHS-1), 1992-1993, 95 per cent of all children born during the four years before the survey had been breastfed. Breastfeeding generally continues beyond infancy; the median duration of breastfeeding is slightly more than two years (IIPS, 1995). According to NFHS-2, 97.5 per cent of all children born during the three-year period prior to the survey had been breastfed. Thus, in spite of the immense importance of breastfeeding on child health, the effect of this factor cannot be studied since there is hardly any variation in this practice in India. Another important variable, "child nutritional status", would influence the risk of morbidity and hence ought to be used as an explanatory factor. However, the possibility of a reciprocal effect, that is, illness adversely affecting weight and height, commonly used in anthropometric measurements of nutritional status such as weight-for-age, height-for-age and weight-for-height, must be recognized. This makes it difficult to interpret the influence of nutritional status on illness, especially in regression analysis of survey data. In addition, for many children anthropometric measurements were not obtained in the survey; hence, inclusion of nutritional status variables would substantially reduce the sample size. Although nutritional status has not been included in the initial analysis, an alternate scheme of analysis has been adopted in which this variable has been included as an additional variable, and the results are presented in a subsequent section.

Some other limitations of the survey data also need to be discussed. First, morbidity always shows seasonal variations; it is generally found to be relatively high just after the monsoon (rainy) season and relatively low just after winter. Thus, the prevalence of morbidity, as seen in the NFHS, may not represent the actual scenario prevalent in India, as the period of the survey varies among states. Second, during the survey, the children were not examined and the mothers were not given a precise definition of what constituted an episode of an infectious disease considered here. The questions which were asked in the survey measure the mother's perception of her child's health rather than assess a disease according to a clinical profile. This may create variations among different socio-economic groups because perceptions of illness are not the same across different social groups. Third, loss of memory of events as well as misinterpretation of the reference period can also contribute to the problems associated with the prevalence of diseases considered here (Bateman and Smith, 1991; Gaminiratne, 1991). This could, to some extent, affect the estimates of influence of various variables obtained here. Nevertheless, the NFHS dataset provides the individual data on a large number of children along with background information, thus permitting detailed analysis.

Methods

The analysis focuses on how the household standard of living affects the incidence of infectious childhood diseases, after controlling for all these potentially confounding variables. Again, since the incidence and the cause of infectious childhood diseases vary widely by children's age, separate analysis is needed for the children of different age groups, namely, those less than 6 months of age, 6-11 months of age and 11 or more months of age. Since two categories exist for the response variable (whether the child is affected by any of the five infectious diseases or not), three sets of logistic regressions have been employed for the children in the three different age groups. The generalized logistic regression equation can be written in the following form:

$$\text{logit } q = \beta_0 + \sum \beta_i X_i \quad (i = 1, 2, \ldots, 14)$$

where q is the probability that a child is affected by an infectious disease;

$\text{logit } q = \ln[q/(1-q)]$ and $\{X_i\}$ $(i = 1, 2...., 14)$ are the predictor variables, β_0 is the intercept and β_i $(i = 1, 2,..... 14)$ the regression coefficient(s). The results of the logistic regressions of the above equations are transformed into simple cross-tabulations of probability of any infectious disease using multiple classification analysis (Retherford and Choe, 1993). This involves calculating adjusted values of the response variable for each category of predictor variable.

Results and discussion

Prevalence of infectious childhood diseases

Prevalence of infectious childhood diseases by place of residence is shown in table 1. It has been revealed that, among all the listed types of infectious diseases, the prevalence of diarrhoea is highest (19.7 per cent) at the all-India level. The prevalence rates of acute respiratory infections and malaria are comparatively higher in rural areas (20.3 per cent and 4.4 per cent respectively) than in urban areas. The prevalence of other diseases does not vary significantly according to the place of residence. For the country as a whole, the prevalence of any infectious disease is more than 35 per cent, with little variation between rural and urban areas (about 36 per cent in rural areas and more than 32 per cent in urban areas).

Table 1. Prevalence of infectious diseases among children, by place of residence, India, NFHS-2, 1998-1999

Nature of infectious diseases	Percentage of children ill with the disease during the specified reference period		
	Rural	Urban	Total
Diarrhoea[a]	19.8	19.3	19.7
Acute respiratory infection[a]	20.3	15.9	19.2
Tuberculosis[b]	0.6	0.6	0.6
Malaria[c]	4.4	2.1	3.8
Jaundice[d]	1.6	1.1	1.4
Any infectious disease	**36.7**	**32.4**	**35.6**
Total number of children	**22,839**	**8,145**	**30,984**

[a] Reference period was 15 days preceding the survey date.

[b] Reference period was at the time of the survey (point prevalence).

[c] Reference period for malaria was 3 months preceding the survey date.

[d] Reference period for jaundice was 12 months preceding the survey date.

Prevalence of diseases by economic groups and selected background characteristics

Table 2 presents the prevalence of infectious childhood diseases by selected background characteristics among three different economic groups. It has been observed that the prevalence of diseases varies significantly according to the household's living standard. Among the lower economic group, the prevalence of infectious diseases among children is more than 38 per cent; it declines to 30 per cent for the higher economic group. If spatial characteristics are considered, children in rural areas are more prone to infectious diseases than their urban counterparts irrespective of economic groups, although the difference is not significant. Since NFHS-2 did not specify slum households in its dataset, except for Mumbai metropolis, it is difficult to determine whether the children who live in slum areas of towns and cities also suffer greater vulnerability to illnesses than their rural counterparts. It should be mentioned here that using NFHS-2 data, Ghosh and Mondal (2003) have observed that unadjusted under-five morbidity is higher among children in slum areas of Mumbai than among children in rural and non-slum urban areas of Maharashtra State. Children in the southern part of India are less prone to infections than any other part of the country irrespective of economic status. Southern India comprises the following states: Andhra Pradesh, Kerala, Karnataka and Tamil Nadu. Children in the central region of the country are highly susceptible to infectious diseases across economic groups. Children of lower and medium economic status in the north-eastern region are significantly more affected by infectious diseases. It has also been observed that, as household economy increases, the prevalence of infectious diseases among children decreases in all regions. It seems that these differences in the prevalence of diseases among regions are possibly due to the variations in certain ecological and climatic conditions associated with the aetiology of specific diseases and also may be due to the differential level of socio-economic development among these regions.

The prevalence of diseases also varies according to demographic characteristics. Although not much variation in the prevalence of diseases has been observed during early infancy among economic groups, variations become pronounced during later infancy and early childhood. Children more than 6 months old are very susceptible to infectious diseases; however, prevalence declines somewhat among children in higher economic strata. Some differences have also been observed in the prevalence of diseases by mother's age and by economic group. The children of older women in higher economic groups have a lower prevalence of infectious diseases than others. Boys are more likely to be affected by diseases than girls, although the prevalence decreases as the living standard of the household increases. It has also been observed that higher order children are more prone to infectious diseases than lower order children irrespective of household economy. The prevalence tends to be low among first order children in higher economic groups. Low birth-weight children are more prone to infectious diseases than others across economic groups. However, the prevalence of such diseases declines significantly as the living standard of the household increases. Among the socio-economic characteristics considered in this study, it can be argued that the children of forward caste Hindus are less prone to diseases than others, and the prevalence is significantly low among the children of forward caste Hindu households of higher economic status. The prevalence of infectious diseases is higher among children in lower economic strata who are members of "other than Hindu" religions. Disease prevalence is significantly higher among those children whose mothers are illiterate and also from poor families. The prevalence declines significantly among the children of relatively affluent families and of more highly educated mothers. Women in the lower economic strata who work outside the home are more likely to have children who are susceptible to illness. Maternal anaemia seems to be a very significant predictor in explaining the prevalence of infectious childhood diseases. The prevalence of diseases is higher for children whose mothers were anaemic during pregnancy irrespective of the economic condition of the households, although the prevalence declines sharply among affluent families. Prevalence is also low among the children of higher economic groups, if they received the complete immunization package. Since the reporting of illness among children tends to be more prevalent among women who have greater exposure to the mass media, the prevalence of infectious diseases is higher among children whose mothers are exposed to mass media of any sort irrespective of their household's economic status. The prevalence of diseases does not vary significantly according to the degree of crowding in households, except in high-income households. It has also been found that the prevalence of diseases is low among well-nourished children in higher economic groups.

Table 2. Percentage of children affected by any infectious disease, by standard of living and by selected background characteristics, India, NFHS-2, 1998-1999

Background characteristics	Standard of living index: Low		Medium		High	
	Number	Percentage affected	Number	Percentage affected	Number	Percentage affected
All children	**9,823**	**38.3**	**14,931**	**36.0**	**5,829**	**30.0**
Spatial variable						
Place of residence						
Rural	8,693	38.3	11,052	36.7	2,818	31.7
Urban	1,130	37.8	3,879	34.2	3,011	28.5
Geographic region						
South	1,346	27.8	2,109	25.8	778	21.6
East	2,788	39.8	1,958	35.4	514	25.7
Central	2,204	41.5	3,324	41.5	978	38.4
North	1,169	38.1	3,729	35.4	2,354	31.8
West	788	35.4	1,604	33.9	785	27.0
North-east	1,528	41.9	2,207	40.9	420	27.6
Demographic variables						
Child's age (months)						
<6	1,816	32.2	2,667	31.5	975	27.7
6-11	1,569	46.6	2,482	43.1	971	36.3
12+	6,438	37.9	9,782	35.5	3,883	29.1
Mother's age (years)						
<20	2,210	39.3	3,149	38.1	730	35.5
20-29	5,573	37.9	9,217	35.4	4,103	30.2
30+	2,040	38.2	2,565	35.8	996	25.5
Sex						
Male	5,027	38.5	7,777	37.4	3,172	31.5
Female	4,796	37.9	7,154	34.6	2,657	28.4

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Table 2. *(Continued)*

Background characteristics	Low		Medium		High	
	Number	Percentage affected	Number	Percentage affected	Number	Percentage affected
Birth order						
1	2,178	38.0	4,381	35.9	2,335	28.8
2-3	3,903	38.6	6,609	34.6	2,821	30.0
4+	3,742	38.1	3,941	38.6	673	34.5
Size of the child at birth						
< Average	2,696	41.4	3,768	40.1	1,126	36.9
Average	5,829	36.2	8,998	34.0	3,799	28.4
> Average	1,292	40.9	2,151	37.6	900	28.6
Socio-economic variables						
Religion/caste						
Forward caste Hindu	3,676	36.4	7,525	34.2	3,688	29.3
SC-ST Hindu[a]	3,780	38.1	3,240	36.1	560	34.3
Other than Hindu	2,367	41.4	4,166	39.2	1,581	30.4
Maternal education						
Illiterate	7,835	37.9	7,791	37.0	936	31.8
Primary-middle completed	1,809	39.8	5,343	36.8	1,871	35.3
Higher educated	177	36.2	1,794	29.8	3,022	26.2
Work status						
Not-working	5,981	37.7	11,051	34.7	4,920	30.2
Working	3,841	39.1	3,877	39.9	909	29.5
Maternal anaemia						
No	7,194	34.1	10,611	31.9	4,218	26.3
Yes	2,622	49.7	4,313	46.3	1,607	39.8
Child immunization[b]						
No	1,504	38.6	1,310	39.3	128	31.3
Partial	2,886	40.6	3,936	38.7	1,233	32.1
Complete	1,699	32.5	4,154	31.3	2,422	27.5
Mass media exposure						
No	7,091	37.0	5,596	35.9	448	33.0
Yes	2,732	41.5	9,335	36.2	5,381	29.8
Crowding						
≤3 persons/room	4,189	39.0	8,948	36.2	4,791	29.2
>3 persons/room	5,615	37.7	5,981	35.9	1,036	34.0
Nutritional status						
Undernourished	4,230	42.2	5,321	39.2	1,248	33.8
Not-undernourished	3,496	36.8	6,777	35.6	3,623	29.7

[a] Scheduled caste and scheduled tribe.

[b] Only the children aged more than 11 months have been included. The total numbers of children in the low, medium and high standard of living indices are 6,089; 9,400 and 3,783, respectively, with the means being 37.9, 35.6 and 29.1 per cent.

Net effect of selected spatial, demographic and socio-economic characteristics

Table 3 depicts the adjusted percentage probability of any infectious diseases by selected spatial, demographic and socio-economic characteristics in three different age groups of children. The results are discussed according to the age groups shown in the table 3.

Table 3. Adjusted probability (in per cent) of any infectious childhood disease, by selected spatial, demographic and socio-economic characteristics, India, NFHS-2, 1998-1999

Background characteristics	Child's age is <6 months		Child's age is 6-11 months		Child's age is >11 months	
	Number	Adjusted probability	Number	Adjusted probability	Number	Adjusted probability
Main predictor						
Standard of living						
Low (ref.)	1,807	31.7	1,564	47.0	6,072	37.2
Medium	2,665	31.2	2,479	42.1**	9,382	35.0*
High	974	29.9	969	37.5**	3,777	31.5**
Spatial variables						
Place of residence						
Rural (ref.)	4,153	31.8	3,654	43.3	14,022	35.1
Urban	1,293	29.0	1,358	41.0	5,209	34.6
Geographic region						
South (ref.)	686	20.4	739	32.8	2,758	24.8
East	975	33.3**	835	43.8**	3,298	37.1**
Central	1,236	34.6**	1,037	48.3**	3,972	39.8**
North	1,318	31.2**	1,146	42.6**	4,506	35.6**
West	514	31.5**	571	44.1**	2,058	32.9**
North-east	717	33.4**	684	43.2**	2,639	37.7**
Demographic variables						
Mother's age						
<20 (ref.)	974	33.9	972	41.9	3,934	38.8
20-29	3,395	30.4	3,105	44.4	11,888	34.7**
30+	1,077	31.0	935	37.9	3,409	31.7**
Sex						
Male (ref.)	2,802	32.5	2,655	43.3	10,042	36.2
Female	2,644	29.6*	2,357	42.0	9,189	33.7**
Birth order						
1 (ref.)	1,531	31.4	1,545	43.3	5,591	34.3
2-3	2,366	29.5	2,161	42.1	8,432	34.9
4+	1,549	33.2	1,306	42.9	5,208	36.0

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Table 3. *(Continued)*

Background characteristics	Child's age is <6 months		Child's age is 6-11 months		Child's age is >11 months	
	Number	Adjusted probability	Number	Adjusted probability	Number	Adjusted probability
Size of the child at birth						
< Average (ref.)	1,534	34.3	1,234	44.3	4,557	38.7
Average	3,289	29.7**	3,024	41.3	11,828	33.0**
> Average	623	31.0	754	45.6	2,846	37.6
Other socio-economic variables						
Religion/caste						
Forward caste Hindu (ref.)	2,676	30.7	2,487	42.6	9,276	33.7
SC-ST Hindu[a]	1,357	31.0	1,253	40.8	4,727	35.0
Other than Hindu	1,413	32.0	1,272	44.7	5,228	37.3**
Maternal education						
Illiterate (ref.)	3,046	31.6	2,602	42.7	10,269	35.5
Primary-middle completed	1,569	32.6	1,521	45.5	5,745	36.4
Higher educated	831	26.8*	889	38.0	3,217	31.2**
Work status						
Not-working (ref.)	4,222	30.1	3,688	41.6	13,427	34.0
Working	1,224	34.7**	1,324	45.7*	5,804	37.3**
Maternal anaemia						
No (ref.)	3,841	28.2	3,565	38.0	13,936	31.4
Yes	1,605	38.7**	1,447	54.6**	5,295	45.3**
Immunization status[b]						
No (ref.)	--	--	--	--	2,926	36.1
Partial	--	--	--	--	8,041	37.0
Complete	--	--	--	--	8,264	32.7**
Mass media exposure						
No (ref.)	2,513	28.6	1,997	40.0	8,088	32.8
Yes	2,933	33.4**	3,015	44.5*	11,143	36.6**
Crowding						
≤3 persons/room (ref.)	2,970	31.0	2,983	42.2	11,530	35.3
>3 persons/room	2,476	31.2	2,029	43.4	7,701	34.5
Total children	**5,446**		**5,012**		**19,231**	
intercept	**-1.428**		**-0.906**		**-0.988**	
-2LL	**6,572.71**		**6,611.44**		**24,067.69**	
Pseudo R2	**0.044**		**0.061**		**0.059**	

Note: Adjusted probabilities are estimated by logistic regression. For any given predictor variable, the set of control variables consists of all the other predictor variables in the table. When calculating adjusted percentages for categories of a given predictor variable, other variables are held constant at their mean values (for details, see Retherford and Choe, 1993).

[a] Scheduled caste and scheduled tribe.

[b] Immunization status has been considered only for children more than 11 months of age.

* p<0.05, ** p<0.01.

Children less than 6 months of age (early infancy)

It has been observed that, during the early infancy period, the household's economic condition does not play a significant role in the prevalence of infectious diseases. This is probably due to the fact that during the early infancy period children primarily depend on breast milk for nourishment. In addition to breast milk, inborn immunity and less exposure to contaminated agents during the early period of life contribute to the lower significance of the household's living standards. This finding is on par with that of earlier studies (e.g., Habtemarium, 1994; Olugbemiro and others, 1994). Region of residence is a very significant predictor in this age group, even after controlling all other variables. Except for children in southern India, the probability of contracting infectious childhood diseases is significantly high in all other regions of the country and it is highest among children in the central region. Regional variations in infectious childhood diseases are possibly due to the differences in certain agro-climatic conditions associated with the aetiology of these ailments. In addition to ecological conditions, differential levels of socio-economic development between the regions could also account for the emerging morbidity status differences.

The central region of India, for instance, is considered less developed in terms of the general level of educational attainment, macro-economic conditions, basic infrastructure such as road networks, and the availability and utilization of basic health-care facilities, whereas the southern part of the country is more developed in terms of the above indicators. These factors could help to explain the emerging morbidity differences among the regions. Boys are significantly more susceptible to be affected by any infectious disease than girls. The size of a child at the time of birth, which is taken as a proxy for birth weight, has been found to be a significant predictor in this case. Children whose size was average at the time of birth are significantly less likely to suffer from any of the infectious diseases. It has been observed that children of more highly educated women are significantly less likely to suffer from illnesses. Women who work outside the home are significantly more likely to have children who are vulnerable to illness, even after controlling all other socio-economic and demographic variables. These findings confirm the earlier studies done in this field, as previously mentioned (Sivakami, 1997; Pandey and others, 1998; Kishor and Parasuraman, 1998). It has been found that maternal anaemia during pregnancy is very significantly and positively related to the prevalence of infectious diseases among children.

Children 6-11 months of age (late infancy)

In general, children 6-11 months of age were found to be more susceptible to infectious diseases than any other age group considered in this study. This phenomenon is possibly due to the fact that six months after birth a child's inborn immunity becomes weaker and he or she is exposed to different types of food. A household's standard of living is a significant predictor in the prevalence of infectious childhood diseases in this case. The probability of infectious diseases declines sharply as the household's standard of living increases (from 47 per cent for a lower standard of living to about 37.5 per cent for a higher standard of living). In addition to weakening inborn immunity, the higher prevalence of diseases may be attributed to the fact that, in the households of lower economic status, the risk of infections among children is heightened during the weaning period as the child's food is prepared possibly in an unhygienic physical and social environment, as was found in earlier studies in this regard (Yohannes, Streatfield and Bost, 1992; Woldemicael, 1999; Timaeus and Lush, 1995). Other significant predictors for this age group are geographic region, the work status of the mother, maternal anaemia during pregnancy and exposure of the mothers to mass media. The direction of these variables is similar, as is seen among the children younger than six months of age.

Children more than 11 months of age (early childhood)

For children more than 11 months of age, the household standard of living is a very significant predictor of infectious childhood diseases, as previously observed. The probability of infection declines from more than 37 per cent for children in lower economic strata to about 31.5 per cent for those in higher economic strata, for plausible reasons previously mentioned. All other variables which are found to be significant predictors of disease for children in the above-mentioned age groups are also significantly associated with infectious diseases in a similar direction. In addition, the probability of infectious diseases is significantly higher among the children of younger mothers, but it declines sharply with the increasing age of the mother. This is probably because older mothers are more experienced in child care and more knowledgeable about personal hygiene and the preparation of food in a clean environment after the weaning period than the younger mothers. Also, "other than Hindu" children are significantly more susceptible to infection. Because this category comprises various other religions, such as Islam, Christianity, Sikhism and Buddhism, it is difficult to identify the plausible reason behind this variation. A detailed examination of the cultural factors influencing child-care practices is called for, because these factors cannot be addressed with the available data and they are beyond the scope of this study. Childhood immunization, which has been incorporated in the analysis only for children in this age group, has been found to be a very significant predictor in lowering the prevalence of infectious childhood diseases. The probability of infection decreases from 36 per cent for non-immunized children to about 32.7 per cent for children who are completely immunized. This finding supports that of earlier studies in this field (e.g., Ghosh and Mondal, 2003; IIPS and ORC Macro, 2000).

Result of alternate analysis

In the preceding analysis, the nutritional status of the children was not included as an explanatory factor because of the possibility of reverse causation, as discussed previously. However, it is well established that nutritional status is a major determinant of the health and well-being of children because chronic illnesses are associated with poor nutrition among children. NFHS-2 provides information concerning child nutritional status on three different anthropometric indices: weight-for-age, height-for-age and weight-for-height. In the present study, weight-for-age has been included in the analysis as an additional variable since it is a composite measure that takes into account both chronic and acute undernutrition (categorized as undernourished and not-undernourished). Children who are more than two standard deviations below the international reference median (Dibley and others, 1987a and 1987b) on this index are considered to be underweight. A high non-response rate (more than 19 per cent) has been found in the data on all the anthropometric indices because either the child was not at home at the time of the investigator's visit or the mother refused to allow the child to be weighed and measured. Also excluded from the analysis are children whose month and year of birth were not known and those with grossly improbable height or weight measurements (IIPS and ORC Macro, 2000). As a result, of the 30,984 children in the earlier analysis, 5,995 were dropped and 24, 989 cases were retained.

Logistic regressions by age of the child have been performed on the data in a manner similar to that described previously. The results are given in the appendix. The effect of household economic status, which is the main predictor variable in the analysis, on infectious childhood disease is similar to that seen in the previous analysis. It may be observed that childhood nutritional status does not have any significant effect on infectious childhood disease up to the end of the first year of life, even after controlling all other variables obtained here. However, it has a profound positive impact on child health and survival after infancy. It has been observed that the probability of infectious disease is nearly 4 percentage points higher among undernourished children than those children who are not undernourished. This is possibly due to the fact that nutritional status plays a significant role in child health and survival after the weaning period, when inborn immunity becomes weak and the child more exposed to environmental contamination. The effects of other variables on infectious childhood disease are more or less similar to those from the previous analysis, which have already been discussed.

Conclusion and policy recommendations

Three major findings emerge from this study. First, the prevalence of infectious childhood diseases in India is quite high in rural and urban areas. Second, the economic condition of the household is one of the significant predictors of infectious childhood diseases that may occur after early infancy. Third, apart from household economic conditions, the covariates most subject to intervention are geographic region (i.e., region of residence), maternal education, work status of the mother, incidence of maternal anaemia during pregnancy and immunization of children.

What are the policy implications of these findings? First of all, effective policies and programmes are urgently required to reduce the occurrence of these potentially fatal childhood illnesses; episodes of these diseases early in life can have adverse effects over the entire life cycle. Poor health directly reduces cognitive potential and indirectly undermines schooling through absenteeism, insufficient attention to lessons and early dropping out of school. Since infectious childhood diseases are invariably linked with the immediate household environment, policies and programmes should address the issue of access to clean water and sanitation, and safe and adequate housing. According to the 2001 Indian census data, only 36 per cent of households have access to a toilet facility, about 77 per cent of households have access to safe drinking water and about 52 per cent of households are built of permanent materials (Office of the Registrar General, 2003). The Government should provide basic health care, including insurance, especially for rural communities. Information, education and counselling activities concerning disease symptoms and preventive behaviour need to be strengthened. To reduce the burden of infectious diseases, the nutritional status of children should be enhanced. A study by Dreze and Goyal (2003) revealed that the mid-day meal scheme of the Indian Government, which was introduced in mid-1995, helped to enhance child nutrition, school attendance and social equity.

Though the role of income-related factors in child health and survival is complex owing mainly to the multifaceted nature of income itself, our findings clearly indicate that household income (or, to be precise, standard of living, as employed in the analysis) plays a very positive and significant role in combating infectious diseases during childhood. A higher living standard is associated with better rearing of children in terms of nutrition and health care during the period of later infancy and early childhood and significantly reduces the risk of infectious diseases. It is worth mentioning that great income disparity among various segments of the population in India still persists. Using 1999-2000 data from the National Sample Survey Organization, Sen and Himanshu (2004) found that in rural areas per capita consumption expenditure among the richest 20 per cent of the Indian population is nearly three times higher than that of the poorest 40 per cent of the population. In urban areas this difference is more than four times higher. Therefore, the public distribution system for providing foodgrains to the poor and the food-for-work programme must be strengthened in order to reduce this inequality. Public health and nutrition programmes must make greater efforts to meet the needs of the poor in both rural and urban areas. This is particularly important now because government expenditure on health care has substantially declined over the years owing to implementation of structural adjustment programmes.

In this analysis, pronounced regional differences in the prevalence of infectious diseases among children have been observed. Children of the central, eastern and north-eastern regions of India are most subject to intervention. As discussed previously, these regions of the country are relatively more underdeveloped than other regions in terms of basic amenities, infrastructure, health care and other macro-economic indicators. Special policies and programmes are urgently needed for children in these regions. These may include educating mothers about child care and feeding practices during weaning time, promoting hand-washing before feeding the child, ensuring the cleanliness of water and the household environment, and using mosquito nets, among others. Policies and programmes should also address the issue of overall development in these regions of the country.

The importance of maternal education has been well established and widely accepted. Maternal education influences child health and survival through various pathways: raising the age at marriage, enhancing socio-economic status, providing greater health choice for children, including interaction with medical personnel, cleanliness and emphasis on child quality (Caldwell, 1979; Ware, 1984; Pandey and others, 1998; Ghosh, 2003). Our study is in agreement with earlier findings that higher maternal education is one of the important determinants of child health and survival even after controlling a number of demographic, socio-economic and spatial variables. Thus, policy measures should focus on enhancing maternal education as early as possible.

Participation in the labour force, as indicated by women's work status, is a key institutional change associated with socio-economic development. The results of this analysis show that women who work outside the home are significantly more likely to have children who are vulnerable to suffering from illness, even after controlling all other socio-economic and demographic variables. However, this does not in any way imply that the employment of mothers should be discouraged. The morbidity status of children may also vary according to the nature of the mother's occupation, which is beyond the scope of this analysis. Occupation depends on one's level of education and to some extent the results mirror the education-morbidity relationship previously observed. Working mothers, particularly those working in the informal sector, resume their duties soon after childbirth owing to a lack of social security. As a result they spend less time in child care and feeding. Therefore, it is important to think over the matter as a point of social security.

Maternal anaemia, which has been included in the analysis as a proxy for the maternal nutritional level, was found to be one of the significant predictors in determining the prevalence of infectious childhood diseases for all age groups of children. Therefore, special programmes on antenatal care should be vigorously implemented, which may include free distribution of iron and folic acid tablets to all expectant mothers and ensuring the consumption of these to avoid the incidence of maternal anaemia. Because it has been observed that complete immunization of children is a significant predictor in lowering the incidence of infectious diseases, the Universal Immunization Programme should be strengthened throughout the country. Not a single child should be missed in attempting to provide complete immunization.

The factors identified as significant in predicting the prevalence of infectious childhood diseases suggest the direction that the national health policies and programmes could take. Some of these are easily amenable to interventions, as discussed above. These interventions may have a fundamental impact on basic personal and domestic hygiene, particularly in the preparation of children's food, feeding practices (e.g., breastfeeding) and the importance of conveying these ideas to mothers and in turn reducing the incidence of infectious childhood diseases.

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Endnotes

1. The scale of standard of living ranges from 0 to 67 (0-14 for low, 15-24 for medium and 25-67 for high).

2. The geographic region variable is as defined in the NFHS national report (IIPS and ORC Macro, 2000): "south" includes Andhra Pradesh, Karnataka, Kerala and Tamil Nadu; "east" includes Bihar, Orissa and West Bengal; "central" includes Madhya Pradesh and Uttar Pradesh; "north" includes Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab and Rajasthan; "west" includes Goa, Gujarat and Maharashtra; and "north-east" includes Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.

3. Most babies in India are not weighed at the time of birth. Thus, in addition to birth weight, mothers were asked whether the babies were "large, average, small or very small" at the time of birth. The "size of the child at birth" has been incorporated in the analysis as a proxy for birth weight and categorized as "less than average, average and greater than average".

4. Here "exposure to mass media" has been created from three separate variables, namely, "read newspaper or magazine at least once a week", "watch television at least once a week" and "listen to radio at least once a week". These three variables are found to be strongly associated with each other and so a composite variable has been obtained from the three: "exposure to mass media of any sort". If a woman was exposed to any of these three, then she is regarded as having been exposed to any sort of mass media.

5. Scheduled castes and scheduled tribes are castes and tribes identified by the Government of India as socially and economically backward and in need of special protection from social injustice and exploitation.

6. According to the relevant WHO guideline, the immunization package should be completed within the first year of life, so the variable "child immunization" has been controlled for children more than 11 months of age.

APPENDIX

Adjusted probability (in per cent) of any infectious childhood disease after inclusion of child's nutritional status as an additional control variable, by selected spatial, demographic and socio-economic characteristics, India, NFHS-2, 1998-1999

Background characteristics	Child's age <6 months		Child's age 6-11 months		Child's age >11 months	
	Number	Adjusted probability	Number	Adjusted probability	Number	Adjusted probability
Main predictor						
Standard of living						
Low (ref.)	1,318	33.9	1,283	47.7	4,833	38.0
Medium	2,022	33.5	2,062	43.1*	7,710	35.8*
High	766	31.6	839	38.3**	3,184	32.6**
Spatial variables						
Place of residence						
Rural (ref.)	3,093	33.6	3,025	44.1	11,347	35.8
Urban	1,013	32.3	1,159	42.0	4,380	35.7
Geographic region						
South (ref.)	581	21.1	658	33.8	2,420	25.7
East	761	34.7**	723	44.2**	2,779	37.1**
Central	781	39.2**	749	49.3**	2,806	41.7**
North	1,040	34.1**	993	44.2**	3,804	36.5**
West	418	33.8**	516	45.0**	1,800	34.0**
North-east	525	36.2**	545	44.3**	2,118	39.4**
Demographic variables						
Mother's age (years)						
<20 (ref.)	729	35.8	787	44.0	3,177	39.8
20-29	2,569	32.5	2,643	44.6	9,792	35.4**
30+	808	33.6	754	39.1	2,758	32.7**
Sex						
Male (ref.)	2,131	35.1	2,215	43.9	8,225	36.9
Female	1,975	31.4*	1,969	43.0	7,502	34.6**
Birth order						
1 (ref.)	1,162	34.8	1,305	43.8	4,629	35.5
2-3	1,803	30.8*	1,815	43.1	7,008	35.5
4+	1,141	35.8	1,064	43.8	4,090	36.6
Size of the child at birth						
< Average (ref.)	1,139	36.4	1,036	45.0	3,751	39.4
Average	2,449	31.8**	2,504	41.9	9,588	33.8**
> Average	518	33.6	644	47.2	2,388	38.5

.../

APPENDIX *(Continued)*

Background characteristics	Child's age <6 months		Child's age 6-11 months		Child's age >11 months	
	Number	Adjusted probability	Number	Adjusted probability	Number	Adjusted probability
Other socio-economic variables						
Religion/caste						
Forward caste Hindu (ref.)	2,035	33.0	2,105	43.6	7,721	34.7
SC-ST Hindu[a]	1,027	34.5	1,041	42.3	3,853	35.9
Other than Hindu	1,044	32.8	1,038	44.4	4,153	37.8**
Maternal education						
Illiterate (ref.)	2,225	33.8	2,094	43.9	8,092	36.2
Primary-middle completed	1,221	35.3	1,319	45.8	4,915	37.3
Higher educated	660	28.1*	771	38.4*	2,720	32.1**
Work status						
Not-working (ref.)	3,181	32.3	3,079	42.1	10,954	34.9
Working	925	36.9*	1,105	47.3**	4,773	37.8**
Maternal anaemia						
No (ref.)	2,886	30.3	2,966	38.9	11,327	32.3
Yes	1,220	40.8**	1,218	54.9**	4,400	45.5**
Immunization status[b]						
No (ref.)	--	--	--	--	2,058	38.2
Partial	--	--	--	--	6,463	37.8
Complete	--	--	--	--	7,206	33.4**
Mass media exposure						
No (ref.)	1,794	30.8	1,572	41.1	6,285	33.5
Yes	2,312	35.3*	2,612	44.9	9,442	37.4**
Crowding						
≤3 persons/room (ref.)	2,253	33.6	2,523	43.0	9,553	36.3
>3 persons/room	1,853	33.0	1,661	44.2	6,174	35.1
Nutritional status						
Undernourished	452	33.8	1,432	43.9	8,401	37.7**
Not undernourished (ref.)	3,654	33.2	2,752	43.3	7,326	33.6
Total children	**4,106**		**4,184**		**15,727**	
Intercept	**-1.184**		**-0.721**		**-0.937**	
-2LL	**5,063.37**		**5,533.32**		**19,769.77**	
Pseudo R^2	**0.053**		**0.062**		**0.063**	

Note: Adjusted probabilities are estimated by logistic regression. For any given predictor variable, the set of control variables consists of all the other predictor variables in the table. When calculating adjusted percentages for categories of a given predictor variable, other variables are held constant at their mean values (for details, see Retherford and Choe, 1993).

[a] Scheduled caste and scheduled tribe.

[b] Immunization status is considered only for children more than 11 months of age.

* $p<0.05$, ** $p<0.01$.

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