Determinants of Infant and Child Mortality in India

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Abstracts. *This study investigates the relationship between the level of socio-economic development and infant and child mortality in India. The perspective of this study is based on the "Theory of Demographic Transition" which states that improved standard of living, changes in nutrition, sanitary reforms, improved public health programs, and technological and medical advances bring down the level of mortality. The study tests the following major hypothesis: the higher the level of socio-economic development, the lower the infant and child mortality rates among the states of India. The study applies correlation and multiple regression analysis to data collected by the National Family Health Survey 1992-1993, one of the most comprehensive surveys of its kind ever conducted in India by the Ministry of Health and Family Welfare, Government of India. The findings support the theory of demographic transition in large measure revealing that the overall socio-economic development is inversely related to infant and child mortality rates among the states of India.*

Keywords: Mortality determinant; infant mortality; child mortality; India.

1. Introduction

Infant and child mortality rates are often used as important indicators of human development and general health conditions of any society. The chances that a newborn baby in many developing countries, such as India, would be alive on its first birthday are low despite an overall decline in mortality. Until 1920, infant mortality rates in India had fluctuated at a high level (230 infant deaths per 1,000 live births) due to chronic food shortages, influenza and severe epidemics (small-pox, malaria and typhoid), and poor sanitary conditions. Since 1920, there has been a steady decline in infant

mortality, followed by a rapid decline after the 1970s due to the government's efforts to extend health services to villages (Jain, 1982:143). The government's universal national immunization program, which was accelerated in the mid-1980s, was meant to reduce mortality from six major preventable diseases (tuberculosis, diphtheria, pertussis, tetanus, polio, and measles) by providing free vaccination for all children (Visaria and Visaria, 1995: 18). As a result, the infant mortality rate of India has declined from 110 in 1981 to 73 per 1,000 live births in 1994 (India, Registrar General, 1996). Like infant mortality, child mortality (deaths of children between the first and fifth birthday) in India has also declined, but it still remains at a high level with 33 deaths per 1,000 population. Despite the improvements in infant and child mortality, 1 in every 13 children still dies in the first year of life, and 1 in 9 dies before reaching age five (International Institute for Population Sciences/IIPS, 1995: 212).

Infant mortality rates reflect the socio-economic development of societies with the most socio-economically developed countries having the lowest infant mortality rates (Daugherty and Kammeyer, 1995:145). North America and Europe have the lowest rates, 7 and 9 infant deaths per 1,000 live births respectively. On the other hand, in all of Asia, the infant mortality rate is 55 infant deaths per 1,000 live births. In Latin American and Caribbean countries the rate is 31 infant deaths per 1,000 live births; and in the African countries the rate is 88 infant deaths per 1,000 live births (Population Reference Bureau, 2001). Social researchers have studied the relationship between socio-economic development and infant and child mortality many times at cross-national and sub-national levels. Although the overall infant and child mortality rates have declined in India, they vary considerably among the states of India. Therefore, the purpose of this study is to examine the role of various socio-economic factors influencing infant and child mortality in the states of India.

2. Theoretical Framework, Literature Review and Hypothesis

The perspective of this research is taken essentially from the framework of one of the most contemporary theories of fertility and mortality control. This theory states that through economic development, social changes happen that allow for high fertility and mortality rates to be replaced by a decline in fertility and mortality rates, leading to population stability in any given society. This theory has been called the "Theory of Demographic

Transition" in demography literature. Thompson (1929), Notestein (1945), Davis (1949), Coale and Hoover (1958), and Stolnitz (1964) are some of the first demographers in recent years to use the theory. According to the demographic transition theory, in the past two centuries fertility and mortality decline first in Europe and later elsewhere was largely the result of economic development. Coale and Hoover (1958: 9-10) point out:

> *"Economic development has the effect of bringing about a reduction in death rates. Economic development involves evolution from a predominantly agrarian economy to an economy with a greater division of labor, using more elaborate tools and equipment, more urbanized, more oriented to the market sale of its products, and characterized by rapid and pervasive changes in technique. It also involves improvement in transportation, communications, and productivity, and these improvements had the effect of bringing a striking reduction in death rates. The reduction in death rates may be ascribed partly to greater regularity in food supplies, to the establishment of greater law and order, and to other fairly direct consequences of economic change. Other factors contributing to decline--improvements in sanitation, the development of vaccines and other means of preventive medicine, and great and rapid strides in the treatment of disease--can themselves be considered as somewhat indirect consequence of economic change."*

With regard to mortality, the causal economic factors include more societal resources devoted to health research and development of a pest and waste management infrastructure. The social factors affecting a drop in mortality include dissemination and adoption of behaviors implied by health research and efficient use of the pest and waste management infrastructure. Societies undergoing this transition have typically experienced an initial drop in mortality, followed by a period characterized by rapid population growth. Possibly due to the negative connotations associated with death, there is typically a much more concerted initial effort by society to reduce mortality than fertility (Caldwell, 1982; Coale and Hoover, 1958; Teitelbaum, 1975; and World Bank, 1984).

A number of studies have sought to clarify the complex relationship between socio-economic development and mortality in developed and developing countries. Some researchers have stressed education as the key factor in the decline of mortality in developing countries. As the education level of society increases, infant and child mortality rates go down. This consistent finding is attributed in part to improvement in ability to provide care, including use of health services, and in part to the correlation of

education with other indicators and access to resources. Educational attainment of parents, especially that of mothers, has been found to have a significant negative relationship with levels of childcare and infant mortality (Ware, 1984). According to Caldwell (1980), mass education, which tends to emphasize modernization and secular attitudes, is the only means to enhance child survival and reduce mortality as well as fertility. The findings of demographic researchers confirm a strong negative relationship between socio-economic status and infant and child mortality. There are a variety of factors associated with socio-economic status that may have differential effects on infant and child mortality including family income, father's occupation, housing conditions, education, access to healthcare, exposure to the media and family structure (Encyclopedia of Population, 1982: 339-341).

Another important development reducing infant and child mortality in developing countries is occurring with the dissemination of information on treatment of diarrheal diseases by families in the home. Diarrheal diseases are largely due to contaminated food, water and unsanitary environmental conditions that create various types of bacterial and viral agents. Therefore, simple and effective treatment of sick children can sharply decrease infant and child mortality rates (Black, 1984). This information can only be effectively disseminated when a society's economic development facilitates an extensive media communication network.

Economic development, characterized by increasing gross national product and per capita income, is a significant factor affecting mortality. Increased per capita income increases the potential tax base, allowing greater expenditures on the utilities infrastructure, which creates a general living environment that is more free of disease-causing microbes. Variables associated with this infrastructure, such as availability of water, electricity, and toilet facilities, are therefore associated either directly or indirectly with infant and child mortality (United Nations, 1973: 146-151).

Urbanization is another characteristic of socio-economic development found to have a profound influence on mortality. Infant and child mortality rates vary among groups within a country as much as they vary among countries. Throughout the developing countries of the world, conditions of life in rural areas for infants and children are very often worse than they are in cities. Beham (1979), in his analysis of mortality in the first two years of life in 12 countries of Latin America, found that rural rates exceeded urban rates by 30 to 60 percent. In India, overall mortality and infant mortality in urban areas is lower than in rural areas. The results of the National Sample Survey in 1994 showed an infant mortality rate of 51 in urban areas and 79 in rural areas

(India, Registrar General, 1996). The lower crude death rate and infant mortality rate in urban areas are attributable to better sanitary conditions, protected drinking water, and easy availability of medical facilities (Chandrasekhar, 1959).

Maturity of an infant at birth has been found to be an important factor affecting infant mortality. In the United States, it was observed that a low birth weight was the cause of two-thirds of all the neonatal deaths in 1950. It was also observed that the chances of survival increased considerably with even a moderate increase in the birth weight--the optimum birth weight ensuring survival being 3,501-4,000 grams (Shapiro et al., 1968). Higher incidence of infant mortality in developing countries can be partly attributed to behaviors of the mother prior to and during pregnancy known to cause premature birth. These include poor nutritional practices, short intervals between pregnancies, tobacco smoking, alcohol or substance abuse, and inadequate prenatal care. Inadequate prenatal care also greatly reduces the chances of survival of an infant born prematurely. According to Kessner (1973), adequate prenatal care requires medical examination beginning within the first thirteen weeks of pregnancy and continuing regularly until the delivery of the baby.

Promotion of effective family planning programs and the wide availability of contraceptives also affect infant mortality because they tend to lower the number of births to younger and older women and reduce the incidence of closely spaced births (Maine, 1981). These programs, however, can only be effective if the more fertile members of society readily adopt them. Voluntary adoption of family planning strategies is precluded by perceptions that a large number of births are required for the survival of the family, which is typical in areas with a family-based agrarian economies or high infant and child mortality rates. Although developing societies are typically becoming less agrarian, a large proportion of the population continues to make a living though family-based agriculture, and is thus dependent on large families. Traditional social norms and customs that promote early marriage and frequent childbearing are seen as possible societal responses to perceptions of high infant mortality. A study by Taylor and Takulia (1971) in India found that the use of contraception is dependent on the respondent's perception of increased child survival. Furthermore, a couple's approval of contraception decreases in proportion to the number of child deaths (Rutestein, 1974).

The preceding discussion forms the central orientation of this study. The underlying assumption behind the theory of demographic transition, as

shown through these various studies, is that as the level of development in a country increases, mortality level decreases. Thus, this study will test the following major hypothesis: *The higher the level of socio-economic development, the lower the infant and child mortality rates will be among the states of India.*

3. Data and Measurement

Data for the present study have been obtained from the National Family Health Survey (NFHS) initiated by the Ministry of Health and Family Welfare, Government of India, and conducted by the International Institute for Population Sciences, Bombay. Interviews were conducted with a nationally representative sample of 89,777 ever-married women in the age group 13-49 from the 25 states of India. The main objective of the NFHS was to collect reliable and up-to-date information mortality, maternal and child health, fertility, and family planning. Data collection was carried out in three phases from April 1992 to September 1993. The NFHS is one of the most comprehensive surveys of its kind ever conducted in India. Its purpose is to strengthen the research capabilities of the 18 Population Research Centers located in universities and institutes with national reputation throughout India (IIPS, 1995).

The two main concepts used in this research are (1) socio-economic development (measure of independent variable), and (2) mortality (measure of dependent variable). The term *"socio-economic development"* implies an ongoing process of change in a society and includes many indicators to describe the overall development of a society (Bongaarts, 1978). However, in this study the following 23 variables are selected from the NFHS data of the states of India, which are grouped into four major categories:

(a) *Education variables*: (1) the percent of the household population literate; (2) the percent of literate females; (3) the percent of the household population age 6-14 years attending school; (4) the percent of females age 6-14 years attending school; (5) the median school years attained; and (6) the percent of women age 15-45 years completing high school education and above.

(b) *Modernization variables:* (7) the percent of the urban population; (8) the percent of women age 20-24 years

married before age 18; (9) the percent of women employed; (10) the percent of households with water facility; (11) the percent of households with sanitary toilets; (12) the percent of households with electricity; and (13) the percent exposed to mass media.

(c) *Health variables:* (14) the percent of children immunized; (15) the percent of mothers receiving antenatal care; (16) the percent of mothers receiving tetanus toxoid vaccine; (17) the percent of births delivered in a health facility; (18) the percent of deliveries assisted by health professionals; and (19) the percent of underweight children under 4 years.

(d) *Family planning variables*: (20) the percent using contraceptives; (21) the percent sterilized; (22) crude birth rate; and (23) total fertility rate.

The term "*mortality*" refers to termination of life in a society. The two indicators of mortality used in this study are: (a) the infant mortality rate (IMR) ---the number of deaths to infants under 1 year of age per 1,000 live births, and (b) the child mortality rate (CMR) ---the number of deaths of children between one and five years of age per 1,000 population, of the states of India. Table 1 shows the mortality and socio-economic variables of the states of India, based on NFHS data from 1992-1993.

Table 1

MORTALITY AND SOCIO-ECONOMIC DEVELOPMENT VARIABLES OF THE STATES OF INDIA, NFHS DATA: 1992-1993

State	IMR	CMR	V1	V2	V3	V4	V5	V6	V7
Andhra Pradesh	70.4 (16)	22.4 (13)	49.4 (4)	38.5 (5)	63.3 (5)	54.8 (5)	0.0 (5)	10.4 (10)	26.1 (10)
Arunachal Pradesh	40.0 (5)	33.3 (20)	52.1 (6)	42.1 (7)	71.0 (10)	65.3 (9)	1.2 (6)	7.3 (5)	14.7 (1)
Assam	88.7 (22)	58.7 (25)	60.5 (11)	50.7 (10)	70.1 (8)	66.0 (10)	2.6 (9)	7.1 (3)	36.8 (21)
Bihar	89.2 (23)	42.0 (22)	44.6 (2)	28.6 (2)	51.3 (1)	38.3 (1)	0.0 (1)	8.1 (6)	21.3 (8)
Delhi	65.4 (12)	19.0 (8)	79.0 (22)	70.8 (21)	86.9 (19)	86.3 (19)	7.3 (25)	36.9 (25)	92.2 (25)
Goa	31.9 (4)	7.2 (2)	80.6 (23)	73.1 (23)	93.5 (24)	92.5 (24)	6.5 (23)	27.2 (24)	49.6 (24)
Gujarat	68.7 (15)	37.9 (21)	63.7 (14)	51.3 (11)	75.7 (12)	68.4 (11)	4.1 (14)	16.1 (19)	35.1 (19)
Haryana	73.3 (18)	27.4 (17)	59.9 (10)	45.9 (8)	81.3 (15)	74.7 (12)	3.4 (12)	14.4 (14)	35.2 (20)
Himachal Pradesh	55.8 (10)	14.1 (4)	67.9 (18)	57.4 (17)	90.8 (23)	87.6 (21)	4.6 (18)	13.4 (12)	31.4 14)
Jammu	45.4 (7)	14.3 (5)	63.1 (12)	51.8 (12)	85.7 (18)	79.6 (18)	4.5 (17)	18.8 (21)	34.2 (17)
Karnataka	65.4 (13)	23.5 (14)	57.4 (8)	46.5 (9)	70.5 (9)	64.4 (8)	2.9 (10)	13.6 (13)	32.7 (16)
Kerala	23.8 (3)	8.4 (3)	86.0 (24)	82.4 (24)	94.8 (25)	94.8 (25)	6.7 (24)	21.3 (22)	28.1 (13)
Madhya Pradesh	85.2 (21)	49.3 (24)	49.8 (5)	34.3 (4)	62.3 (4)	54.8 (4)	0.0 (4)	7.3 (4)	23.6 (9)
Maharashtra	50.5 (8)	20.9 (11)	67.9 (17)	55.9 (15)	81.5 (16)	76.6 (14)	4.5 (16)	14.8 (16)	41.4 (22)
Manipur	42.4 (6)	20.2 (10)	74.0 (20)	63.0 (19)	90.2 (21)	86.8 (20)	5.1 (20)	22.6 (23)	32.2 (15)
Meghalaya	64.2 (11)	24.3 (15)	63.6 (13)	60.2 (18)	75.0 (11)	75.7 (13)	2.5 (8)	10.4 (11)	19.4 (2)
Mizoram	14.6 (1)	14.9 (6)	91.1 (25)	88.9 (25)	90.7 (22)	88.5 (22)	5.9 (22)	14.6 (15)	49.5 (23)
Nagaland	17.2 (2)	3.6 (1)	75.8 (21)	71.8 (22)	89.6 (20)	89.0 (23)	5.1 (21)	15.8 (18)	20.9 (7)
Orrissa	112.1 (25)	21.3 (12)	55.2 (7)	41.4 (6)	69.6 (7)	62.0 (6)	1.8 (7)	6.0 (2)	26.4 (11)
Punjab	53.7 (9)	15.0 (7)	59.2 (9)	52.0 (13)	80.8 (14)	77.8 (16)	4.1 (15)	18.3 (20)	27.9 (12)
Rajasthan	72.6 (17)	32.3 (19)	43.9 (1)	25.4 (1)	58.8 (2)	40.6 (2)	0.0 (2)	4.9 (1)	19.6 (3)
Tamil Nadu	67.7 (14)	20.1 (9)	66.4 (16)	56.1 (16)	82.4 (17)	78.7 (17)	5.0 (19)	15.2 (17)	34.7 (18)
Tripura	75.8 (20)	31.2 (18)	72.8 (19)	64.4 (20)	79.4 (13)	76.7 (15)	3.9 (13)	8.6 (7)	20.1 (4)
Uttar Pradesh	99.9 (24)	46.0 (23)	48.0 (3)	31.5 (3)	61.3 (3)	48.2 (3)	0.0 (3)	8.8 (8)	20.4 (5)

(To be continued)

(Continuation – Table 1)

State	V8	V9	V10	V11	V12	V13	V14	V15
West Bengal	75.3 (19)	26.0 (16)	65.6 (15)	52.2 (14)	67.7 (6)	62.9 (7)	3.3 (11)	9.6 (9)
Mean	62.0	25.3	63.9	53.6	77.0	71.6	3.4	14.1
Std Deviation	24.8	13.5	12.7	16.2	12.0	15.8	2.3	7.4
Andhra Pradesh	68.6 (4)	53.4 (24)	63.4 (12)	24.4 (8)	62.2 (11)	75.2 (21)	45.0 (13)	86.3 (20)
Arunachal Pradesh	43.9 (12)	44.9 (19)	75.8 (20)	73.6 (20)	63.1 (13)	46.6 (9)	22.5 (8)	48.9 (5)
Assam	44.4 (11)	18.4 (3)	43.2 (3)	49.6 (17)	20.4 (2)	39.1 (4)	19.4 (5)	49.3 (6)
Bihar	69.1 (3)	24.9 (6)	63.6 (13)	16.5 (3)	16.6 (1)	29.5 (1)	10.7 (3)	36.8 (2)
Delhi	28.7 (16)	19.3 (4)	99.5 (25)	84.1 (24)	95.5 (25)	86.7 (25)	57.8 (19)	82.4 (17)
Goa	7.2 (25)	29.7 (11)	92.5 (23)	43.5 (16)	91.7 (23)	85.2 (24)	74.9 (25)	95.4 (24)
Gujarat	33.4 (15)	43.2 (17)	75.1 (18)	35.8 (12)	76.6 (18)	55.4 (10)	49.8 (14)	75.7 (14)
Haryana	57.3 (6)	28.9 (10)	73.0 (15)	26.9 (9)	85.0 (20)	60.1 (11)	53.5 (15)	72.7 (12)
Himachal Pradesh	24.2 (18)	47.7 (22)	57.6 (11)	12.6 (2)	90.2 (22)	66.8 (17)	62.9 (21)	76.0(15)
Jammu	20.5 (19)	27.5 (9)	57.3 (9)	19.1 (4)	86.7 (21)	72.2 (20)	65.7 (24)	79.5 (16)
Karnataka	51.2 (9)	47.0 (21)	75.6 (19)	31.2 (11)	64.0 (15)	70.1 (19)	57.2 (18)	83.5 (19)
Kerala	19.3 (20)	24.7 (5)	21.0 (1)	70.9 (19)	60.3 (9)	79.2 (23)	54.4 (16)	97.3 (25)
Madhya Pradesh	73.3 (1)	32.4 (13)	55.8 (8)	21.3 (6)	62.4 (12)	41.0 (6)	29.2 (10)	52.1 (8)
Maharashtra	53.9 (8)	49.0 (23)	78.5 (21)	40.8 (15)	73.6 (16)	62.8 (14)	64.1 (22)	82.7 (18)
Manipur	14.3 (23)	53.5 (25)	47.0 (5)	83.1 (23)	62.1 (10)	67.8 (18)	29.1 (9)	63.4 (10)
Meghalaya	28.1 (17)	41.8 (16)	47.6 (6)	54.3 (18)	42.6 (6)	46.4 (8)	9.7 (2)	51.8 (7)
Mizoram	13.3 (24)	33.2 (15)	40.1 (2)	98.3 (25)	76.0 (17)	61.3 (12)	56.4 (17)	88.9 (22)
Nagaland	16.4 (21)	43.7 (18)	72.1 (14)	79.3 (21)	76.9 (19)	44.6 (7)	3.8 (1)	39.3 (3)
Orrissa	45.5 (10)	25.9 (8)	50.9 (7)	12.2 (1)	27.8 (3)	39.5 (5)	36.1 (12)	61.6 (9)
Punjab	14.9 (22)	7.7 (1)	98.6 (24)	36.7 (13)	92.0 (24)	65.5 (15)	61.9 (20)	87.9 (21)
Rajasthan	69.5 (2)	31.4 (12)	57.3 (10)	19.8 (5)	51.9 (8)	30.1 (2)	21.1 (7)	31.2(1)

(To be continued)

(Continuation – Table 1)

State	V8	V9	V10	V11	V12	V13	V14	V15
Tamil Nadu	36.1 (14)	46.7 (20)	74.6 (17)	29.4 (10)	63.8 (14)	78.0 (22)	64.9 (23)	94.2 (23)
Tripura	41.1 (13)	25.7 (7)	44.1 (4)	79.4 (22)	45.1 (7)	65.5 (16)	19.0 (4)	64.9 (11)
Uttar Pradesh	63.9 (5)	13.4 (2)	74.3 (16)	22.9 (7)	31.9 (4)	35.5 (3)	19.8 (6)	44.7 (4)
West Bengal	56.4 (7)	33.0 (14)	84.9 (22)	40.4 (14)	32.9 (5)	61.3 (13)	34.2 (11)	75.3 (13)
Mean	39.8	33.9	64.9	44.2	62.1	58.6	40.9	68.9
Std Deviation	20.6	12.6	19.2	26.2	23.4	17.0	21.2	19.8

(To be continued)

(Continuation Table 1)

State	V16	V17	V18	V19	V20	V21	V22	V23
Andhra Pradesh	74.8 (21)	32.8 (17)	49.3 (18)	49.1 (10)	47.0 (11)	44.8 (22)	24.2 (20)	2.6 (21)
Arunachal Pradesh	31.9 (4)	19.9 (10)	21.3 (5)	39.7 (19)	23.6 (5)	10.7 (4)	34.6 (2)	4.3 (2)
Assam	34.9 (6)	11.1 (2)	17.9 (3)	50.4 (8)	42.8 (10)	4.4 (1)	30.4 (8)	3.5 (8)
Bihar	30.7 (3)	12.1 (5)	9.0 (1)	62.6 (1)	23.1 (4)	18.6 (7)	32.1 (4)	4.0 (4)
Delhi	72.5 (20)	44.3 (21)	53.0 (20)	41.6 (17)	60.3 (24)	23.3 (9)	26.6 (13)	3.0 (13)
Goa	83.4 (23)	86.8 (24)	88.4 (24)	35.0 (21)	47.8 (12)	30.5 (12)	17.2 (25)	1.9 (25)
Gujarat	62.7 (14)	35.6 (18)	42.5 (16)	50.1 (9)	49.3 (14)	41.0 (19)	27.2 (11)	3.0 (12)
Haryana	63.3 (15)	16.7 (9)	30.3 (10)	37.9 (20)	49.7 (16)	34.8 (17)	32.9 (3)	4.0 (3)
Himachal Pradesh	47.4 (10)	16.0 (8)	25.6 (8)	47.0 (13)	58.4 (22)	45.8 (23)	28.2 (9)	3.0 (11)
Jammu	68.9 (16)	21.9 (11)	31.2 (11)	44.5 (16)	49.4 (15)	29.7 (11)	27.9 (10)	3.1 (10)
Karnataka	69.8 (17)	37.5 (19)	50.9 (19)	54.3 (5)	49.1 (13)	42.5 (20)	25.9 (16)	2.9 (18)
Kerala	89.8 (24)	87.8 (25)	89.7 (25)	28.5 (24)	63.3 (25)	48.3 (25)	19.6 (24)	2.0 (24)
Madhya Pradesh	42.8 (9)	15.9 (7)	30.0 (9)	57.4 (3)	36.5 (9)	31.5 (14)	31.6 (6)	3.9 (5)
Maharashtra	71.0 (19)	43.9 (20)	53.2 (21)	54.2 (6)	53.7 (18)	46.2 (24)	26.3 (15)	2.9 (17)
Manipur	48.0 (11)	23.0 (12)	40.4 (15)	30.1 (22)	34.9 (7)	13.8 (6)	24.4 (19)	2.8 (19)
Meghalaya	30.0 (2)	29.6 (14)	36.9 (14)	45.5 (15)	20.7 (3)	10.0 (3)	31.9 (5)	3.7 (6)
Mizoram	42.5 (8)	48.9 (22)	61.5 (22)	28.1 (25)	53.8 (19)	44.6 (21)	20.8 (23)	2.3 (23)
Nagaland	33.0 (5)	6.0 (1)	22.2 (7)	28.7 (23)	13.0 (1)	6.4 (2)	31.3 (7)	3.3 (9)
Orrissa	53.8 (12)	14.1 (6)	20.5 (4)	53.3 (7)	36.3 (8)	31.6 (15)	26.5 (14)	2.9 (16)
Punjab	82.7 (22)	24.8 (13)	48.3 (17)	45.9 (14)	58.7 (23)	34.0 (16)	25.0 (18)	2.9 (15)
Rajasthan	28.3 (1)	11.6 (4)	21.8 (6)	41.6 (18)	31.8 (6)	27.7 (10)	27.0 (12)	3.6 (7)

(To be continued)

(Continuation – Table 1)

State	V16	V17	V18	V19	V20	V21	V22	V23
Tamil Nadu	90.1 (25)	63.4 (23)	71.2 (23)	48.2 (12)	49.8 (17)	39.5 (18)	23.5 (21)	2.5 (22)
Tripura	58.7 (13)	30.7 (15)	33.5 (13)	48.8 (11)	56.1 (20)	19.1 (8)	23.1 (22)	2.7 (20)
Uttar Pradesh	37.4 (7)	11.2 (3)	17.2 (2)	59.0 (2)	19.8 (2)	13.1 (5)	35.9 (1)	4.8 (1)
West Bengal	70.4 (18)	31.5 (16)	33.0 (12)	56.8 (4)	57.4 (21)	30.6 (13)	25.5 (17)	2.9 (14)
Mean	56.8	31.1	40.0	45.5	43.5	28.9	27.2	3.1
Std Deviation	20.2	21.9	21.2	10.0	14.5	13.7	4.6	0.7

Source: International Institute for Population Sciences (IIPS). 1995. *1992-1993 National Family Health Survey.* Bombay, India.

Note : **Dependent Variables:** IMR = Infant mortality rate, and CMR = Child mortality fertility rate.

Independent Variables: (a) ***Education variables***: (V1) percent household population literate, (V2) percent female literate, (V3) percent household population age 6-14 years attending school, (V4) percent female age 6-14 attending school, (V5) median school years attained, and (V6) percent women age 13-49 completing high school education and above; (b) ***Modernization Variables***: (V7) percent urban population, (V8) percent women married age 20-24 years before age 18, (V9) percent women age 13-49 employed, (V10) percent households with drinking water facility from pipe or pump, (V11) percent households with sanitary toilets, (V12) percent households with electricity, and (V13) percent exposed to mass media; (c) ***Health Variables:*** (V14) percent children immunized, (V15) percent mothers receiving antenatal care, (V16) percent mothers receiving tetanus toxoid, (V17) percent births delivered in health facility, (V18) percent deliveries assisted by health professionals, and (V19) percent underweight children under 4 years; (d) ***Family Planning Variables***: (V20) percent using contraceptives, (V21) percent sterilized, (V22) crude birth rate, and (V23) total fertility rate.

Numbers in parentheses indicate the ranks of the respective values of the mortality rates--infant mortality rate and child mortality rate, and socio-economic development variables, including education, modernization, health and family planning.

4. Analysis of Data and Results

The analysis of data and results presented below are based on three commonly used statistical procedures appropriate for the respective levels of measurement for the variables used, those are (1) Pearson's correlation coefficient measures the association between interval level variables, (2) Spearman's correlation coefficients measures the association between the composite ordinal level variables, and (3) multiple regression analysis models measures the interval mortality variables using the predictor variables of socio-economic development.

4.1 Pearson's Correlation Coefficients

Table 2 presents Pearson correlation coefficients between socio-economic development variables and mortality rates (IMR and CMR) in India. An examination of the data shows that of the total 23 socio-economic development variables, 22 variables are related to infant mortality rate in the direction predicted by demographic transition theory. Of these, 10 are statistically significant at the 5 percent level, while 5 more are significant at the 1 percent level. Furthermore, all the socio-economic development variables are related to child mortality rate in the predicted direction. Of these, 4 are statistically significant at the 5 percent level, while 13 are significant at the 1 percent level. These results confirm the major hypothesis derived from the demographic transition theory that the higher the level of socio-economic development, the lower the infant and child mortality rates among the states of India. The results of the major categories of socio-economic development and mortality rates are as follows:

(a) *Education*: Among the six education variables, all are correlated in the predicted direction with both infant mortality and child mortality rates. Of these, five statistically significant at the 1 percent level, including percent of the household population literate (-0.705 and -0.630), percent of literate females (-0.735 and -0.646), percent of the household population age 6-14 years attending school (-0.747 and -0.745), percent of female age 6-14 years attending school (-0.729 and -0.721), and median school years attained (-0.656 and -0.683). The variable the percent of women completing high school education and above is statistically significant at the 5 percent level with infant mortality rate (-0.501) and at the 1 percent level with child mortality rate (-0.574).

Table 2
PEARSON CORRELATION COEFFICIENTS BETWEEN SOCIO-ECONOMIC DEVELOPMENT VARIABLES AND MORTALITY RATES IN INDIA

Socio-economic Development Variables	Infant Mortality Rate	Child Mortality Rate
(a) Education		
1. Percent household population literate	-0.705 **	-0.630 **
2. Percent literate females	-0.735 **	-0.646 **
3. Percent attending school	-0.747 **	-0.745 **
4. Percent female attending school	-0.729 **	-0.721 **
5. Median school years attained	-0.656 **	-0.683 **
6. Percent Women Completing HS Education and above	-0.501 *	-0.47 **
(b) Modernization		
7. Percent urban population	-0.191	-0.252
8. Percent women married before age 18	0.714 **	0.682 **
9. Percent women employed	-0.300	-0.240
10. Percent households with drinking water facility	0.052	-0.115
11. Percent households with sanitary toilets	-0.61 **	-0.278
12. Percent households with electricity	-0.621 **	-0.620 **
13. Percent exposed to mass media	-0.47 *	-0.638 **
(c) Health		
14. Percent children immunized	-0.306	-0.497 *
15. Percent mothers receiving antenatal care	-0.381	-0.565 **
16. Percent mothers receiving tetanus toxoid vaccine	-0.186	-0.487 *
17. Percent birth delivered in health facility	-0.468 *	-0.485 *
18. Percent deliveries assisted by health professionals	-0.540 **	-0.570 **
19. Percent underweight children under 4 years	0.813 **	0.623 **
(d) Family Planning		
20. Percent using contraceptives	-0.162	-0.308
21. Percent sterilized	-0.163	-0.375
22. Crude birth rate	0.425 *	0.572 **
23. Total fertility rate	0.478 *	0.659 **

Note: ** Indicates a correlation coefficient which is significant at 0.01 level, two-tailed test.
* Indicates a correlation coefficient which is significant at 0.05 level, two tailed-test.

(b) *Modernization:* Among the seven modernization variables, all but one are correlated in the predicted direction with both infant and child mortality rates. Of thee six variables correlated with the infant mortality rate, three are statistically significant at the 1 percent level, including percent women married before age 18 (0.714), percent of households with sanitary toilets (-0.617) and percent households with electricity (-0.621). Another variable, percent exposed to mass media (-0.471) is significant at the 1 percent level. Furthermore, all seven variables are correlated with child mortality rate. Of these, three are significant at the 1 percent level. These include percent

married before age 18 (0.682), percent households with electricity (0.620) and percent exposed to mass media (-0.638).

(c) *Health:* Among the six health variables, all are correlated in the predicted direction with both infant and child mortality rate. Of these, two variables are correlated with infant mortality rate at the 1 percent level, including percent of deliveries assisted by health professionals (-0.540) and the percent of underweight children under 4 years (0.813), while another percent birth delivered in health facility (-0.468), is significant at the 5 percent level. Three variables are related to child mortality rate at the 1 percent level, including percent mothers receiving antenatal care (-0.565), percent deliveries assisted by health professionals (-0.570) and percent underweight children under 4 years (0.623). The remaining three variables are significant at the 1 percent level, including percent children immunized (-0.497), percent mothers receiving tertanus toxoide vaccine (-0.487) and percent birth delivered in health facility (-0.485).

(d) *Family Planning:* Among the four family planning variables, all are correlated in the predicted direction with both infant mortality and child mortality rates. Crude birth rate (0.425 and 0.572) and total fertility rate (0.478) are correlated with infant mortality rate at the 5 percent level. Crude birth rate (0.572) and total fertility rate (0.659) are correlated with child mortality rate at the 1 percent level.

4.2 Spearman's Correlation Coefficients

In this study an attempt is made to devise a composite measure of each category of socio-economic development, including education, modernization, health, and family planning. Although the variables comprising the composite measures are varied, they represent equally weighted aspects of the broad constructs of the level of development used by demographers (Amonker, 1975; Population Crisis Committee, 1988; United Nations, 1991).

The composite measure of each category of the socio-economic development is calculated by ranking all the states of India with respect to socio-economic development variables--that is, ranked within each variable with highest development value receiving a rank of 25 and the lowest development value receiving a rank of 1. Thus, each state has a rank for each variable as shown in Table 1. The composite measure of each category is obtained by summing up the ranks of values of each variable as shown in Table 3. Furthermore, the states are ranked for each measure category of

socio-economic development. Similarly, all the states of India are ranked with respect to each measure of mortality (IMR and CMR) ---that is, ranked within each measure with lowest rate receiving a rank of 1 and the highest rate receiving a rank of 25, as shown in Table 1.

Table 3
COMPOSITE MEASURES OF SOCIO-ECONOMIC DEVELOPMENT OF THE STATES OF INDIA, BY MAJOR CATEGORIES

State	Education	Modernization	Health	Family planning
Andhra Pradesh	34 (5)	90 (10)	99 (18)	74 (20)
Arunachal Pradesh	43 (7)	94 (13)	51 (8)	13 (2)
Assam	51 (8)	61 (6)	30 (3)	27 (6)
Bihar	13 (2)	35 (1)	15 (1)	19 (4)
Delhi	131 (22)	144 (24)	114 (21)	59 (14)
Goa	141 (24)	146 (25)	141 (25)	74 (21)
Gujarat	81 (13)	109 (17)	85 (15)	56 (13)
Haryana	71 (11)	91 (12)	81 (14)	39 (9)
Himachal Pradesh	109 (19)	106 (15)	75 (12)	65 (15)
Jammu	98 (17)	99 (14)	94 (16)	46 (10)
Karnataka	57 (9)	110 (18)	97 (17)	67 (17)
Kerala	144 (25)	90 (11)	139 (24)	98 (25)
Madhya Pradesh	25 (4)	55 (5)	46 (6)	34 (7)
Maharashtra	94 (16)	119 (22)	106 (19)	74 (22)
Manipur	123 (20)	119 (23)	79 (13)	51 (11)
Meghalaya	74 (12)	73 (7)	54 (9)	17 (3)
Mizoram	131 (23)	118 (21)	116 (22)	86 (24)
Nagaland	125 (21)	107 (16)	40 (5)	19 (5)
Orrissa	35 (6)	45 (4)	50 (7)	53 (12)
Punjab	87 (14)	111 (19)	107 (20)	72 (19)
Rajasthan	9 (1)	42 (2)	37 (4)	35 (8)
Tamil Nadu	102 (18)	115 (20)	129 (23)	78 (23)
Tripura	87 (15)	73 (8)	67 (10)	70 (18)
Uttar Pradesh	23 (3)	42 (3)	24 (2)	9 (1)
West Bengal	62 (10)	81 (9)	74 (11)	65 (16)

Note: The composite measure of each category, including education, modernization, health and family planning is obtained by summing up the ranks of values of each variable as shown in Table 1.

Table 4 presents Spearman's correlation coefficients four composite measures of socio-economic development and infant mortality and child mortality rates. An examination of the data shows that all four major categories of socio-economic development have negative association with infant mortality rate and child mortality rate as predicted by the demographic transition theory. Three of the composite measures are statistically significant at the 1 percent level, including education (-0.768 and -0.822), modernization (-0.718 and -0.654) and health (-0.588 and -0.662). The category of family planning is only statistically significant at the 1 percent level with child mortality rate (-0.562), but is not statistically significant with infant mortality rate (-0.364).

Table 4
SPEARMAN'S CORRELATION COEFFICIENTS BETWEEN THE COMPOSITE MEASURES OF THE SOCIO-ECONOMIC DEVELOPMENT AND MORTALITY RATES IN INDIA

Socio-economic development	Infant mortality rate	Child mortality rate
1. Education	- 0.768 **	- 0.822 **
2. Modernization	-.0.718 **	- 0.654 **
3. Health	- 0.588 **	- 0.662 **
4. Family planning	- 0.364	- 0.562 **

Note: ** Indicates a correlation coefficient which is significant at 0.01 level, two-tailed test.
* Indicates a correlation coefficient which is significant at 0.05 level, two tailed test.

4.3 Multiple Regression Analysis

Finally, in an effort to present a causal model using the variables of socio-economic development to predict each measure of mortality, a multiple regression analysis is carried out. The models were developed by screening the correlation matrix of independent variables to exclude those with high covariance. Beta coefficients were systematically eliminated, resulting in the final models presented in Table 5. The table includes: (1) coefficient estimate (Beta); (2) the values of *t* statistics corresponding to each coefficient estimate; (3) the value of *t* significance; (4) the value of the *R* square, the overall fitness of the model, and (5) the value of *F* statistics.

Table 5
MULTIPLE REGRESSION ANALYSIS BETWEEN SOCIO-ECONOMIC DEVELOPMENT VARIABLES AND MORTALITY RATES IN INDIA, BY MODELS

Socio-economic Development Variables	(a) Infant Mortality Rate			(b) Child Mortality Rate		
	Beta	t	Sig	Beta	t	Sig
1. Percent household population literate	-0.278	-1.737	0.096	--	--	--
2. Percent women completing HS education	--	--	--	-0.536	-1.993	0.060
3. Percent urban population	--	--	--	0.503	2.149	0.044
4. Percent children immunized	--	--	--	-0.408	-2.434	0.024
5. Percent underweight children under 4 years	0.622	3.888	0.001	0.417	2.572	0.018
	Constant = 26.304			Constant = 10.180		
	R Square = 0.702			R Square = 0.643		
	F = 25.866 ***			F = 9.023 ***		
	N = 25			N = 25		

Note: *** Indicates significant at 0.001 level, two-tailed test.

Model A uses two measures of socio-economic development, percent household population literate and percent underweight children under 4 years, to explain 70.2 percent of the variance in the infant mortality rate. This model exhibits a high F ratio statistic (25.866) that is significant at the 0.1 percent level. The t significance for percent underweight children under 4 years is highly significant (0.001), while the relatively higher Beta value indicates that it explains most of the variance in infant mortality rate. These data suggest that malnutrition among babies under 1 year is a major cause of high infant mortality rate in India. Although percent household population literate is not significant at the 5 percent level (p-value = 0.96), the relatively high Beta value suggests that higher household literacy levels have a substantial inverse impact on infant mortality and explain much of its variation.

Model B uses four measures of socio-economic development to explain variance in the child mortality rate, which include percent women completing high school education, percent urban population, percent children immunized, and percent underweight children under 4 years. Together, these four variables explain 64.3 percent of the variance in child mortality rate. The F ratio statistic (9.023) is significant at 0.1 percent level. Although the t statistic of one variable, percent women completing high school, is not quite significant at the 5 percent level (p-value = 0.060), the relatively high Beta value (-0.536) suggests that it explains much of the variation in child mortality. The remaining independent variables are all significant at the

5 percent level, and their Beta values suggest that they each explain a considerable portion of the variance in child mortality rate.

5. Conclusion

Although the states of India differ widely in socio-economic characteristics and infant and child mortality rates, the findings of this study support the demographic transition theory in large measure revealing 22 of the 23 socio-economic development variables are correlated in the expected direction with infant mortality rate, and all 23 variables are in the expected direction in regard to child mortality rate. The study reveals that overall level of health care, education, and modernization accompanied by effective access to family planning information and services play a significant role in lowering mortality. Finally, the study suggests that higher level of population literacy, education of women, child immunizations together with a lower level of underweight children under 4 years, lead to infant and child mortality decline.

The theme "Population and Development," adopted by the third once-in-a-decade International World Population Conference held in Cairo, Egypt in 1994 (United Nations, 1994) represents a significant change in thinking about population shifting in emphasis from family planning to development. In addition, a Program of Action was developed, which covers a wide range of topics that reach into every aspect of human existence, such as infant and maternal mortality, education, status of women, family relationships, poverty, urban development, reproductive health care and family planning. While population policies and programs have long been equated with family planning and fertility control, the Cairo Program of Action emphasizes population within the context of socio-economic development. The Program of Action asserts that population growth can be stabilized and development efforts enhanced by the emancipation of women, i.e., by providing women with education, expanding value of the female child, legislating equality, and promoting access to economic and political power. The Plan of Action also emphasizes the promotion and expansion not only of family planning programs, but health care programs as well to bring about a decline in fertility and mortality.

The results presented here have several important policy implications for reducing infant and child mortality. Governmental policies aimed at intensifying child immunization programs, improving educational levels, especially of women, creating basic awareness about health problems through

mass media, providing effective child health care services, promoting sanitary reforms and access to clean water, especially in urban areas, introducing nutritional programs for children, developing prenatal care and obstetric programs, increasing hospitalization for deliveries, and providing effective family planning services should have a significant impact on infant and child mortality.

References

Amonker, R. G. 1975. "Family Planning Performance in India." *Asian Survey*. XV: 586-597.

Beham, Hugo. 1979. "Socio-economic Determinants of Mortality in Latin America." Paper Presented at the World Health Organization Meeting on *Socio-economic Determinants and Consequences of Mortality*. Mexico City, June.

Black, Robert E. 1984. "Diarrheal Diseases and Child Morbidity and Mortality." In W. Henry Mosley and Lincoln C. Chen, eds.: 141-161. *Child Survival: Strategies for Research Population and Development Review*. Supplement to Volume 10.

Bongagaarts, J. 1978. "A Framework for Analyzing the Proximate Determinants of Fertility." *The Population Development Review*: 105-132.

Caldwell, J. C. 1980. "Mass Education as Determinants of the Timing of Fertility Decline." *Population and Demography*. 5: 55-60.

-------. 1982. *Theory of Fertility Decline*. New York: Academic Press.

Chandrasekhar, S. 1959. *Infant Mortality in India 1901-1955*. London: George Allen & Unwin Ltd.

Coale, A. J. and E. M. Hoover. 1958. *Population Growth and Economic Development in Low-Income Countries*. Princeton, NJ: Princeton University Press.

Davis, K. 1949. *Human Society*. New York: Macmillan.

Encyclopedia of Population. (1982)."Infant and Child Mortality." *International Encyclopedia of Population*, Volume 1: 339-341. New York: Free Press.

Daugherty, H. G. and K. C. W. Kemmeyer. 1995. *An Introduction to Population*. New York: The Guilford Press.

India, Registrar General. 1996. *Sample Registration Bulletin*. Volume 30, Number 1. New Delhi: Vital Statistics. Division, January.

International Institute for Population Sciences. 1995. *National Family Health Survey, India 1992-1993*. Bombay.

Jain, S. P. 1982. "Mortality Trends and Differentials." Population of India: Country. Economic and Social Commission for Asia and Pacific. New York: United Nations. *Monograph Series*, No. 10: 135-157.

Kessner, David M. 1973. *Infant Death: An Analysis by Maternal Risk and Health Care*, Volume I. Washington, D.C.: National Academy Press.

Maine, Deborah. 1981. *Family Planning: Its Impact on the Health of Women and Children*. New York: Center for Population and Family Health, Columbia University.

Notestein, F. W. (1945). "Population--the Long View." In T. W. Schultz (ed.), *Food for the World:* 36-57. Chicago: University of Chicago Press.

Population Crisis Committee.1988. *"Country Rankings of the Status of Women: Poor, Powerless and Pregnant." Briefing Paper* No. 20. June. Washington, D.C.

Population Reference Bureau. 2001. *World Population Data Sheet*. Demographic Data and Estimates for the Countries and Regions of the World. Washington D.C.

Ruzstein, S. O. 1974. "The Influence of Child Mortality on Fertility in Taiwan." *Studies in Family Planning* 5: 182-188.

Shapiro Sam, E. R. Schlesinger, and R. E. L. Nisbitt. 1968. *Infant, Perinatal, Maternal, and Childhood Mortality in the United States*. Cambridge, Mass.: Harvard University Press.

Stolnitz, G. J., 1964. "The Demographic Transition: From High to Low Birth Rates and Death Rates." In Ronald Freedman (ed.), *Population: The Vital Revolution:* 30-46. New York: Doubleday.

Taylor, C. E. and H. Takulia. 1971. *Integration of Health and Family Planning in Village Sub-Centres. Report on the Fifth Narangwal Conference*. November 1970. Punjab, India: Johns Hopkins Rural Health Research Center.

Teitelbaum, M. S., 1973. "Relevance of Demographic Transition for Developing Countries." *Science*, 18: 420-425.

Thompson, W. S., 1929. "Population." *American Journal of Sociology*, 34: 959-975.

United Nations. 1973. "Mortality." *The Determinants and Consequences of Population Trends*. Volume I. ST/SOA/SER.A/50. New York.

-------. 1991. Human Development Index. *Human Development Report*. Development Programme. New York.

-------. 1994. *Report of the International Conference on Population and Development*. Cairo, 5-13 September. New York.

Visaria Leela, and Pravin Visaria. 1995. "India's Population in Transition." *Population Bulletin*, Volume 50, No. 3. Washington, D.C.: Population Reference Bureau.

Ware, Hellen. 1984. "Effects of Maternal education, Women's Roles and Child Care on Mortality." In W. Henry Mosley and Lincoln C. Chen. (eds.) *Population and Development Review*, Supplement to Volume 10: 192-214.

World Bank. 1984. *World Development Report*. New York: Oxford University Press.

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