MPRA

Education and Mortality in India

Motkuri, Venkatanarayana and Mishra, Uday Shankar

S. R. Sankaran Chair, National Institute of Rural Development (NIRD), Hyderabad, Centre for Development Studies (CDS), Thiruvananthapuram (Kerala)

April 2013

Education and Mortality in India

M. Venkatanarayana[#] and Uday S Mishra[*]

I Introduction

Mortality, death due to a specific cause either age-dependent factors or various age-independent factors. Premature death is the cause of concern. Phenomena which commonly bring about death include biological aging (senescence), predation, malnutrition, disease, suicide, murder and accidents or trauma resulting in terminal injury, disasters and catastrophes. Morbidity rate, which refers to the number of individuals in poor health during a given time period[1], is distinct from mortality but morbidity otherwise not received proper medical attention lead to mortality.

The **Gompertz–Makeham law** states that the death rate, of a society/community/region, is the sum of an age-independent component[2] and an age-dependent component[3] (Leonid, 1991). According to the 19th century mathematician, Benjamin Gompertz's functional relationship, death rate increases exponentially with age (Gompertz, 1821). As the biological immunity power declines and thereby the resistance to death decline by age especially older stages, the death rates increases.

However, William Makeham emphasized on multiple age-independent factors which includes socio-economic conditions and access to health care. Therefore, the age-independent component of mortality is the area of concern for long time as most of these are preventable deaths. The progress in health and medical care technology and its availability, expanding public health care institution and the control of epidemic communicable diseases have improved health outcome and life expectancy by reducing the age-independent component of mortality rate. In addition,

[#] Research Officer, S R Sankaran Chair (Rural Labour), National Institute of Rural Development (NIRD), Hyderabad.

[*] Associate Professor, Centre for Development Studies, Thiruvananthapuram.

[1] i.e. the prevalence rate or the number of newly appearing cases of the disease per unit of time, i.e. incidence rate.

[2] The Makeham term, named after William Makeham.

[3] The Gompertz function, named after Benjamin Gompertz.

better socio-economic conditions and improved access to health care led to the improved health outcomes in general and declining mortality rate in particular. A number of research studies have dwelled up on the aspects of age-independent factors.

While analyzing the impact of socio-economic factor on health outcomes in general and mortality rate or life expectancy in particular, the role of economic status defined in terms of level and distribution of income on health outcomes is well examined and established the relationship (see Rodgers 1979; Wilkinson, 1997; Wolfson et al, 1999; Muller, 2002). It indicates that investment in health care is contingent up on the income and it is equally true for an individual as well as the nation.

Similarly, there has been attempt to establish the scientific evidence for the relationship between education and health outcomes in general. Also there is a considerable amount of work done, in various parts of the globe, looking into the relationship between education and mortality rate in particular (For instance, Kittagawa et al, 1968; Comstock et al, 1977; Caldwell, 1979; Ross and Wu, 1995; Elo and Preston, 1996; Bucklund et al, 1999; Muller, 2002). Education has a direct and indirect role for better health outcomes. The direct role of education is that it brings about awareness of best practices of health care and practices related sanitation and hygiene and let an individual to adopt such practices (Caldwell, 1979). It is about changing the individuals' health behavior. Indirect role of education is that as there are individual and social returns to education, it improves the earning levels and thereby the economic status of an individual (Psacharopoulous, 2006). The improved economic status of individual would improve his/her the affordability and thereby investment in personal health care. As the economic resources form one of the many pathways linking education and health (Ross and Wu 1995), increasing educational disparities in income and work conditions may translate into increasing disparities in health (Goesling, 2007).

When looking into relationship between the levels of education and health outcomes or mortality, one has to distinguish between the educational levels of individuals and the levels of education in an environment in which an individual lives in. Definitely the health behavior of an individual is likely to change along with her/his level of education. Similarly the health behavior

of an individual depends on health care behavior in his/her environment where she/he lives in. An environment herein could be family, community, region, country.

In this context an attempt is made to understand the impact schooling/education on the mortality rate in India, in a developing country context. Present study aims at looking into differences in mortality rate by the status of completion of primary schooling.

II Methodology and Data Source

In order to examine the relationship between education and mortality four categories of mortality rates in general are considered. They are Infant Mortality Rate (IMR) – below one year, Child Mortality Rate (CMR) – Mortality rate of children age between one year and below five years, Under Five mortality for the children below five years including infants below one year, and the Crude Death Rate (CDR) – all age groups. If one is looking other way round i. e. Life Expectancy, one can consider life expectancy at birth or at the 5th years or any other point of age. In the present study the focus is on adult's level of education and adult mortality rates.

To examine the relationship between education and mortality rates in a cross section study the information on deaths by levels of education in particular year or during a particular period, may serve the purpose. Using this one may derive the death rates by level of education. Such a record for whole population in India is not available unlike the situation in developed countries where the registration of births and deaths is mandatory. A longitudinal study may be involved with studying particular groups of people during a specific time period.

While applying synthetic cohort method such cohorts are derived using cross section data from a survey in different time points with a constant interval. Here we have used NSSO's quinquennial rounds 40th (1983), 50th (199394), 61st (2004-05) and 66th (2009-10) of Employment and Unemployment Survey data. NSSO data of these surveys gives individuals demographic details such as age and sex and their educational level. A synthetic cohort is created for those aged between 15 and 49 years during 1983 and grouped them into seven categories with 5-years age interval, for tracking their mortality rate for those completed of primary schooling. The 15-49 years old population in the base year, say 1983, would be in the 25-59 age bracket by 1993-94.

The NSS quinquennial survey is used track their age transition and mortality rate of the cohort during the transition. But as the NSS survey that we used herein does not give mortality details, we have derived it indirectly as explained below.

In order to explore the relationship between the education and mortality rate we have considered here those who completed primary education. We have taken the percentage of population in a particular cohort, say 15-19 age group, completed primary education in the base years. In a synthetic cohort method, the 15-19 years age cohort will be transit into 25-29 years age cohort after 10 years. Similarly it is for other age cohorts. If a particular age-cohort transits through subsequent age brackets without any death or if the death rates equal for those have not completed and those who have completed primary level of education, in that age cohort the percentage of primary completed is assumed to be not changed.

An assumption herein we have taken into account is that primary completion is possible mostly through formal schooling and if it is completed it is mostly possibly by the age 15 years, after that very unlikely one would go for completing primary schooling.

III Trends in Mortality Rates

Although India is considered to be lagging behind with respect to many of health outcome, the progress made over its past in mortality indicators particularly overall deaths rate (CDR) is considerable (Figure 3.1). The decline in mortality rate has subsequently resulted in increased life expectancy (Figure 3.2). Undoubtedly, the progress in health care technology and expansion public health institutions played crucial role in the decline of mortality. The steep rise in life expectancy in India between 1920 and 1980s is partly due to advancements in health care .and expansion of health care infrastructure in the country. Particularly the achievement in controlling the devastating effect of epidemic communicable diseases on survival chances was a great success in the progress of health care sector in India and in other developing countries as well. Although obsoleteness of health care technology in use, inadequacy of health care infrastructure and inefficiency of health care system in India is well noted, its role in the whatever health outcomes that India has attained, is considerable.

The rural-urban disparity in mortality rate is clear example for role of the age-independent factors such as socio-economic conditions and access to health care, on the health outcome in general and mortality rate in particular. Improving socio-economic conditions of rural people and increasing access to health care, over time, has led to declining rural-urban disparity.

Figure 3.1: Crude Death Rate (CDR) in India
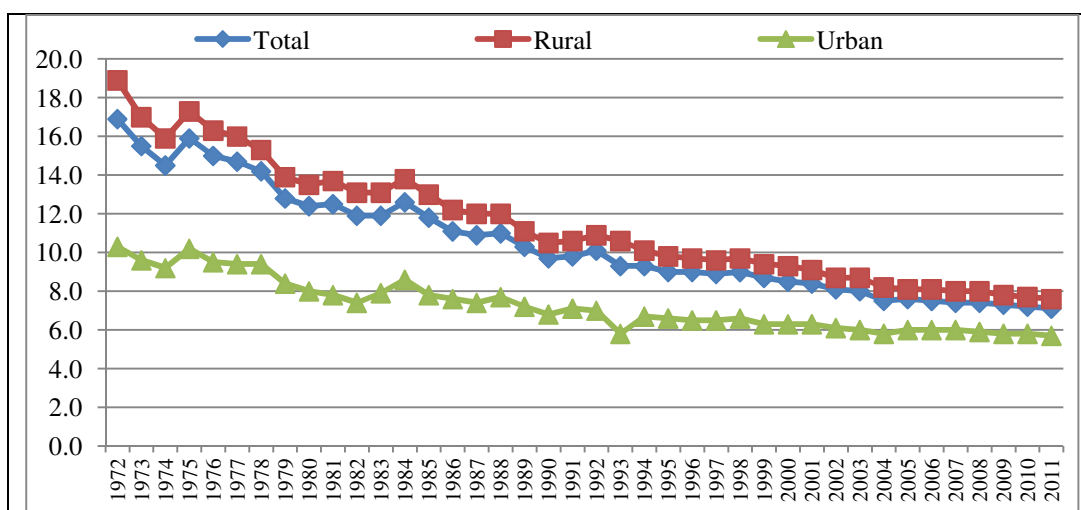
Source: Sample Registration System (SRS).

**Figure 3.2: Life Expectancy (Years) at Birth in India**
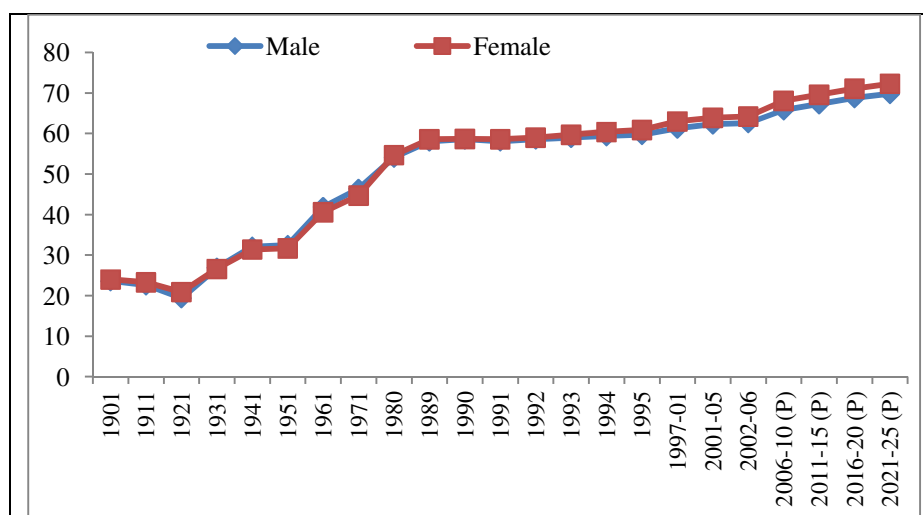
Note: p – Projected figures.

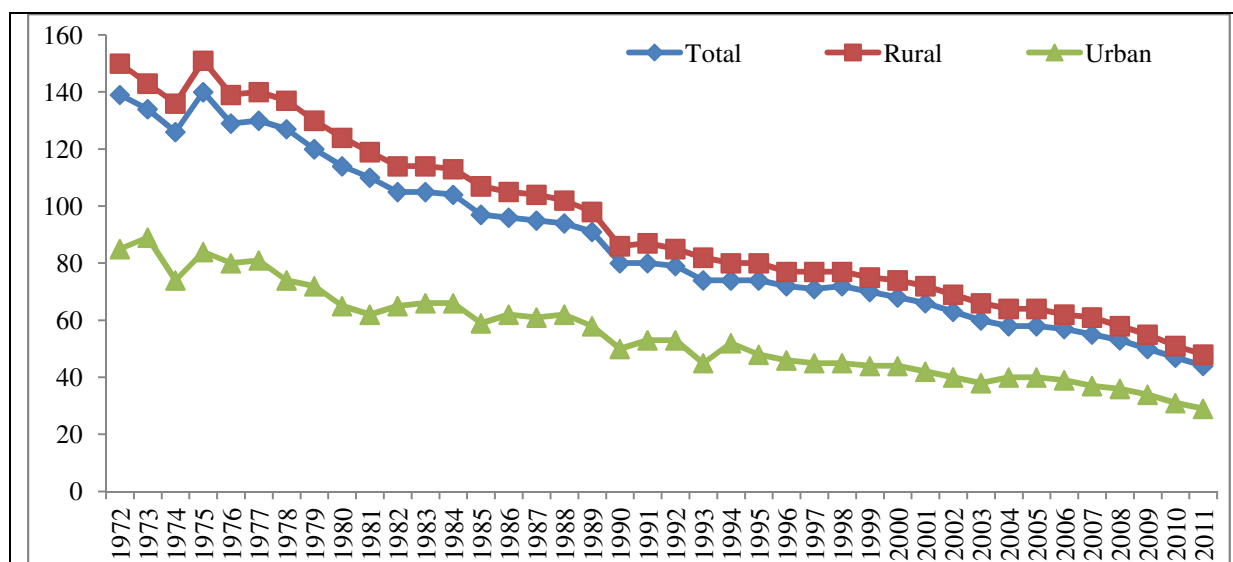**Source**: Sample Registration System (SRS).

When examined different facets of overall death rate, infant mortality is the critical factor the change in overall death rate and also for improving the life expectancy at birth. Infant and child (0-4 year age) deaths, in fact, accounts for the considerable portion of the total deaths in development countries in general and in India particular. It can be observed that infant deaths contribution was about one-fifths of the deaths occurred in the country in 2001 (Figure 3.3). If one adds child mortality (1-4 years age) to the infant mortality, its contribution would further increased to more one-fourth of the total deaths. However, the declining infant and child mortality rate in India over time (Figure 3.4) has been reducing its contribution to the total deaths in the country. The decline in infant mortality rate largely improves the life expectancy at birth and lead to reduction in overall death rate.

Figure 3.3: Percentage Distribution of Deaths by Age-Groups to Total Deaths in India
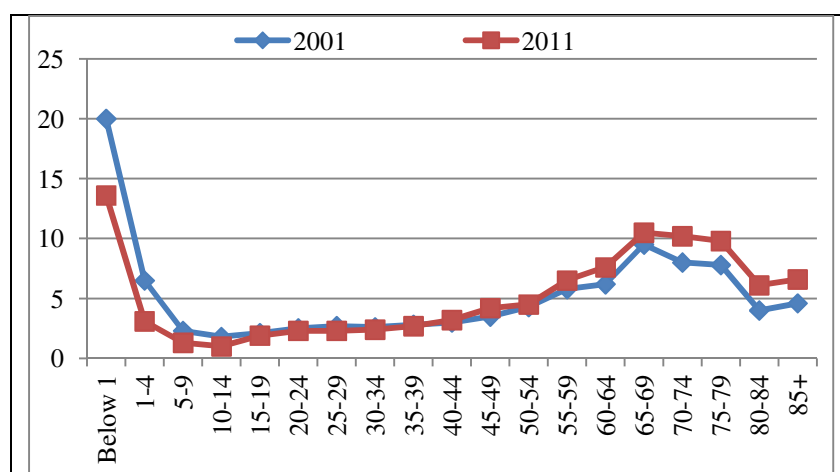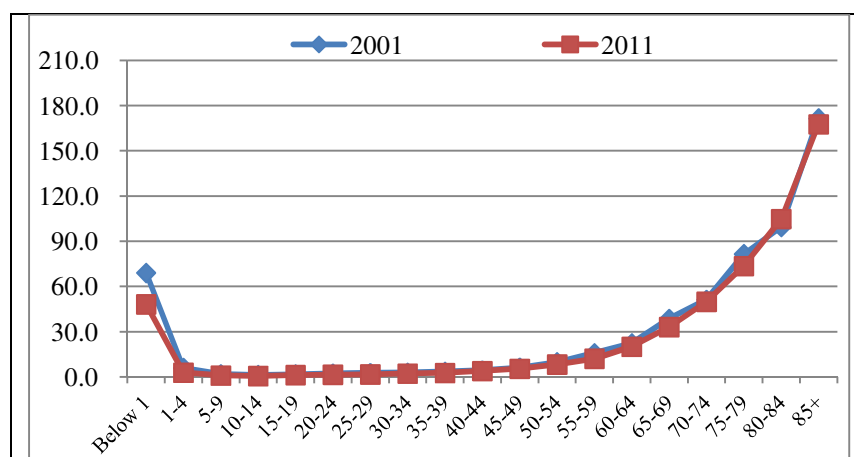

Source: Sample Registration System (SRS).

There is considerable reduction in infant mortality rate in India during the last four decades (Figure 3.4). The trend in rural-urban disparities in infant mortality is showing narrowing the gap. However, still the infant mortality rate at 44 per 1000 live birth in 2011 is considered to be very high. In respect of the infant mortality rates, India is considered to be in the lines of African countries. Despite the country's recent celebrated achievement economic progress, its performance in health outcome such as this most important indicator is observed to poor. High infant mortality rates is one way reflecting the poor socio-economic conditions at the household levels and inadequacy in public health infrastructure and poor access to health care.

Figure 3.4: Infant Mortality Rate (IMR) in India

Finally, the Gompertz function, an age-dependent component, indicates the death/mortality rate increases exponentially with age (Gompertz, 1825). However, some studies have found that at more advanced ages, death rates increase more slowly – a phenomenon known as the late-life mortality deceleration (Leonid and Natalia, 1991). The Indian data for age-specific death rate validates the Gompertz function of increasing death rates with age. But the phenomenon of late-life mortality deceleration is not observed (Figure 3.5).

Figure 3.5: Age-specific death rate by sex in India, 2010

To sum up, the progress made over its past in mortality indicators in particularly overall deaths rate (CDR) in India is considerable. The decline in mortality rate has subsequently resulted in increased life expectancy. There is also considerable reduction in infant mortality rate in India during the last four decade. However, still the infant mortality rate at 44 per 1000 live birth in 2011 is considered to be very high.

IV Literacy/Schooling and Mortality

There are multiple age-independent factors of mortality. Socio-economic factors and access to health care are the most important aspects of age-independent mortality. Educational level of an individual and the educational environment are considered to play important role in health outcome and thereby mortality. Education has a direct and indirect role for better health outcome. The direct role of education is that it brings about awareness of best practices of health care and practices related sanitation and hygiene and let an individual to adopt such practices. It is about changing the individuals' health behavior. Indirect role of education is that as there are individual and social returns to education, it improves the earning levels and thereby economic status which in turn improves the affordability to health care.

There is an established relationship between maternal education in determining the level of infant and child mortality. The Figure 4.1, below, clearly exemplifies the relationship between mothers' levels of education and infant/child mortality rates in case of India. Given the relationship between mother's education and infant/child mortality rate, the high mortality in India is associated low levels of education in the country in general and among females in particular.

Also the relationship between female literacy as a proxy for maternal education, and infant mortality rate is explicit across states in India. It shows the inverse relationship between the two as those states with higher female literacy are having lower IMR and vice versa (Figure 4.2).

Figure 4.1: Infant and Child Mortality Rates in India by Educational Level of Mother, NFHS III (2005-06)
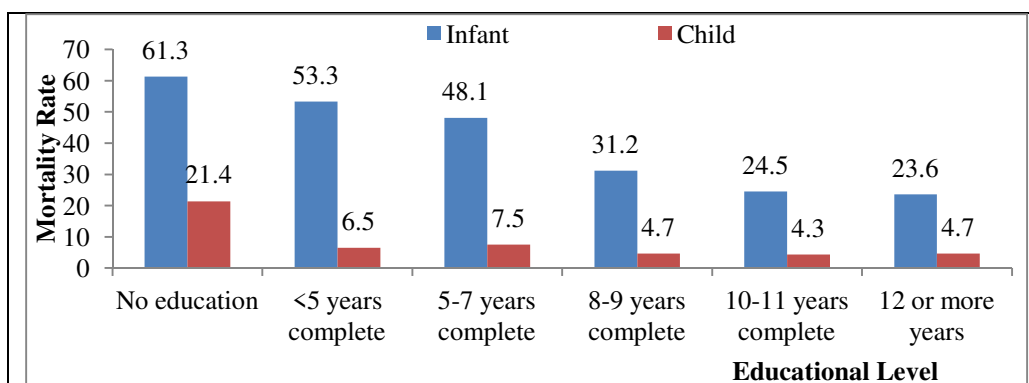
Note: 1. Mortality - Deaths per 1000 live births; 2. Infant mortality is for children below one year; 3. Child Mortality is for children completed one and those below five years.

Source: NFHS III.

Figure 4.2: Scatter Plot – Relationship between Female Literacy and Infant Mortality Rate (IMR) across States & UTs in India, 2011
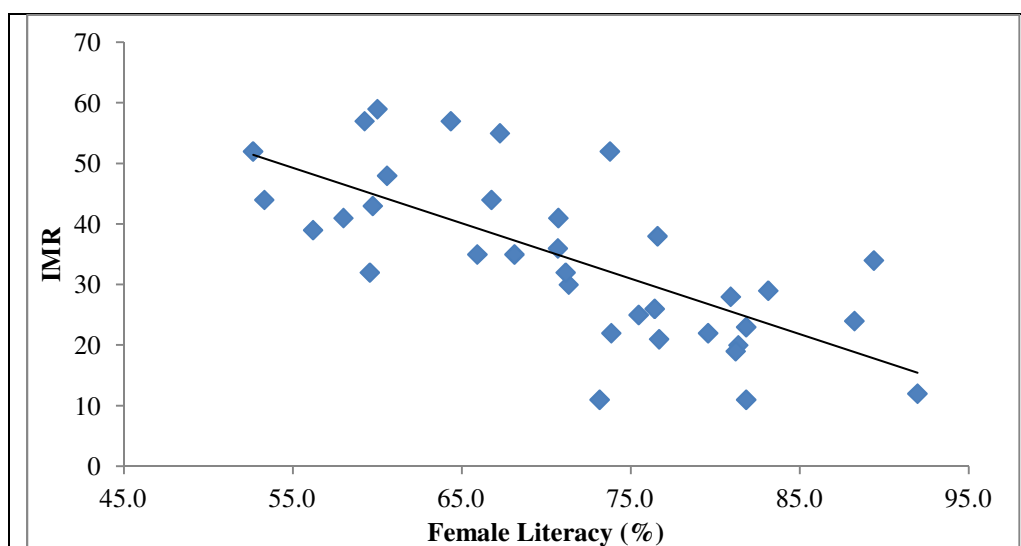
Note: 1. All States and Union Territories; 2. Overall female literacy (rural urban combined); and overall IMR (combined for rural-urban and male-female).

Source: Derived using Census of India and SRS data.

Having observed, herein the question, however, is about individuals' education levels and the mortality rates particularly in the Indian context. In order to explore the relationship between these aspects a synthetic cohort is created for those aged between 15 and 49 years taking 1983 as the base year for tracking their mortality rate by their completion of primary schooling. As
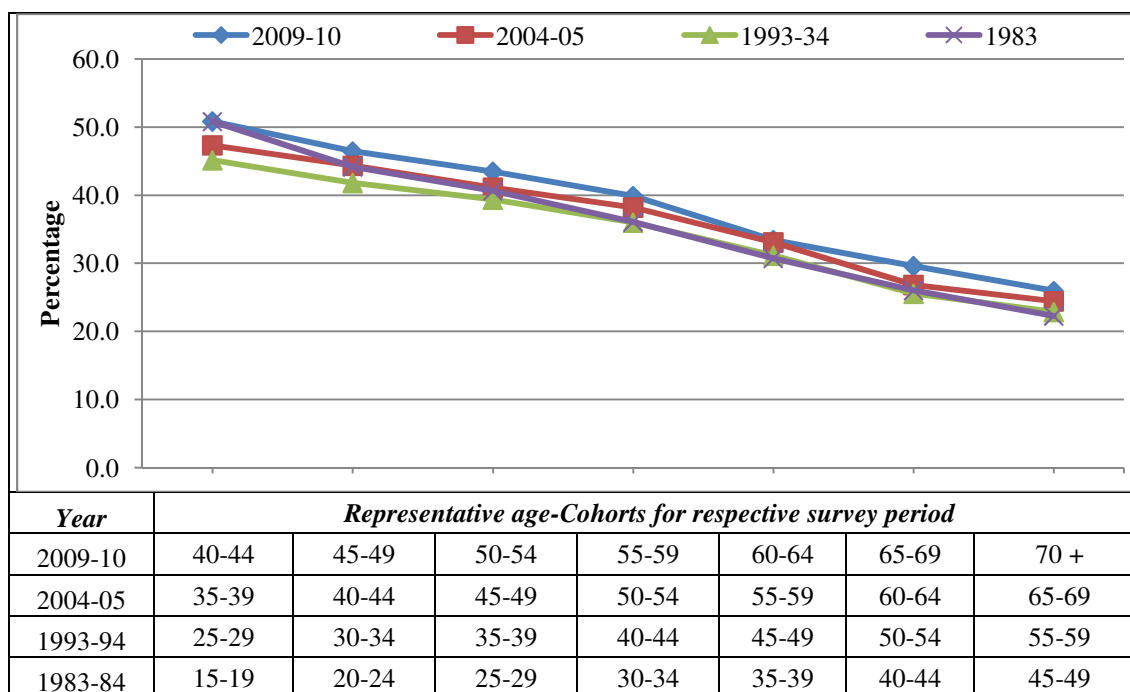
mentioned above, to reiterate, we have considered here those who completed primary education. Taking the percentage of population in a particular cohort, say 15-19 age group, which completed primary education in the base year, the percentage of the cohort completed primary when that cohort was in transit to 25-29, 35-39 and 40-44 years age cohort after 10, 20, 25 years respectively in 1993-94, 2004-05 and 2009-10, is examined. Similarly it is for other age cohorts. If a particular age-cohort transits through subsequent age brackets without any death or if the death rates equal for those have not completed and those who have completed primary level of education, in that age cohort the percentage of primary completed is assumed to be not changed. Herein, again one has to note that an implicit assumption for the above reasoning is that primary completion is possible mostly through formal schooling and if it is completed it is mostly possibly by the age 15 years, after that very unlikely one would go for completing primary schooling.

The analysis indicates that the percentage of primary completed for the 15-19 and 20-24 cohort of 1983 declined during their transit to 25-29 and 30-34 age cohort after 10 years in 1993-94. It indicates that the mortality rate among primary completed in these groups might have been higher than that of among those who have not completed. For other age groups there is no change in primary completion rate between 1983 and 1993-94 indicates the same mortality rate for those who have completed and those who have not.

But since, 1990s, the mortality rate appears to be higher among those who have not completed primary schooling those who have completed. Because of this only, the percentage of primary completed has increased between 1993-94 and 2004-05, again between 2004-05 and 2009-10. It indicates an association between education and the mortality rate in India too.

However, although there exists a kind of relationship between primary completion and the crude death rates across states in India, it is not as strong as that of the relationship between female literacy/education and infant mortality rate (Figure 4.3). The correlation coefficient for the latter is – 0.73 for infant mortality and female literacy or primary completion, indicating strong relationship. Whereas, for the correlation between the crude death rate and primary completion rate among the adults (15+), the co-efficient is just about -0.42.

Figure 4.2: Primary Completion Rate (PCR) by selected age-cohorts during the last 25 years of Transit

Year	Representative age-Cohorts for respective survey period						
2009-10	40-44	45-49	50-54	55-59	60-64	65-69	70 +
2004-05	35-39	40-44	45-49	50-54	55-59	60-64	65-69
1993-94	25-29	30-34	35-39	40-44	45-49	50-54	55-59
1983-84	15-19	20-24	25-29	30-34	35-39	40-44	45-49

Note: male and female combined.

Source: Computed based on NSSO unit record data of four Quinquennial Rounds of Surveys on Employment and Unemployment

Figure 4.3: Scatter Plot – Relationship between Percentage of Primary Completed and Crude Death Rate (CDR) across Major States in India, 2009-10
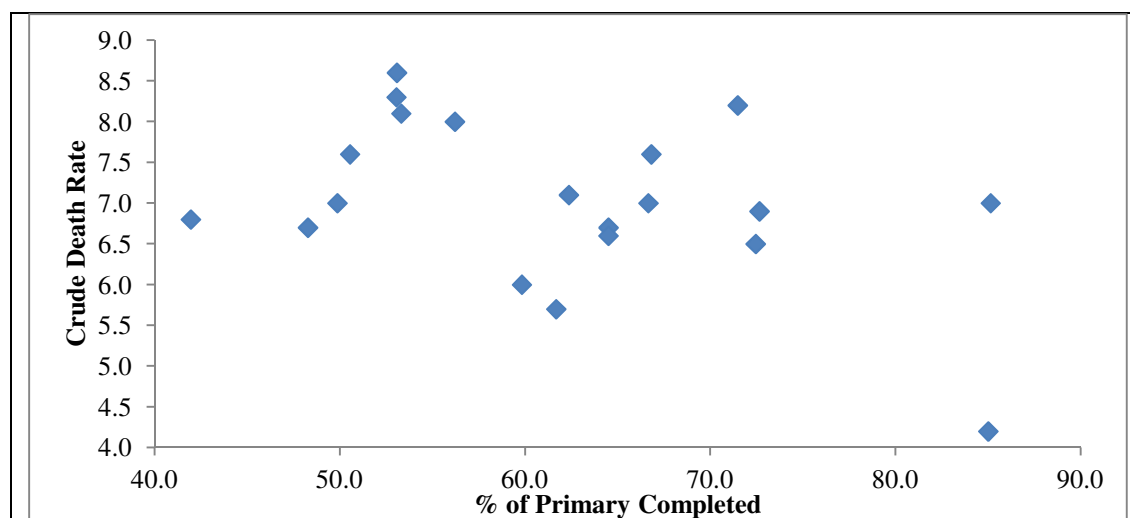
Note: 1. For 20 Major states only.

Source: NSSO (2009-10) and SRS (2010).

More than educational impact on mortality, it is the advancement in access to health care that matters and expansion of these services that matters most particularly in case of developing countries like India.

V Concluding Remarks

There is an established relationship between education and health outcomes like infant mortality and overall mortality. The relationship between primary completion and the crude death rates across states in India is not as strong as that of the relationship between education and infant mortality rate. It could be because of the fact that more than educational impact on mortality, it is the advancement in access to health care that matters and expansion of these services that matters most particularly in case of developing countries like India.

* * *

Reference

Backlund E, Sorlie PD, Johnson NJ (1999) "A Comparison of the Relationships of Education and Income with Mortality: the National Longitudinal Mortality Study", *Social Science Medicine*, Vol.49, pp: 1373-84.

Caldwell, J. C. (1979) "Education as a Factor in Mortality Decline: An Examination of Nigerian Data*", Population Studies*, Vol. 33, No. 3 (Nov., 1979), pp. 395-413.

Comstock, George W; and James A. Tonascia (1977) "Education and Mortality in Washington County, Maryland", *Journal of Health and Social Behavior*, Vol. 18, (March), pp: 54-61.

Deaton, Angus and Christina Paxson, (1999) "Mortality, Education, Income and Inequality among American Cohorts", *Working paper No. 7140*, NBER.

Elo, Irma T; and Samuel H. Preston (1996) "Educational Differentials in Mortality: United States, 1979-85", *Social Science and Medicine*, Vol. 42(1), pp: 47-57.

Goesling, Brian (2007) "The Rising Significance of Education for Health?", *Social Forces*, Vol. 85, No. 4 (Jun., 2007), pp. 1621-1644.

Gompertz, B. (1825) "On the Nature of the Function Expressive of the Law of Human Mortality, and on a New Mode of Determining the Value of Life Contingencies". *Philosophical Transactions of the Royal Society of London* **115**: 513–585.

Kitagawa, Evelyn M. and Philip M. Hauser (1968) "Education Differentials in Mortality by Cause of Death: United States, 1960", *Demography*, Vol. 5, No. 1 (1968), pp. 318-353.

Leonid A. Gavrilov & Natalia S. Gavrilova (1991) **The Biology of Life Span: A Quantitative Approach,** New York: Harwood Academic Publisher.

Lleras-Muney, Adriana (2005) "The Relationship between Education and Adult Mortality in the United States," *Review of Economic Studies*, Vol. 72(1) pp.:189-221.

Mazumder, Bhashkar (2008) "Does Education Improve Health? A Re-examination of the Evidence from Compulsory Schooling Laws", *Economic Perspectives*, 2-16.

Makeham, W. M. (1860) "On the Law of Mortality and the Construction of Annuity Tables". *J. Inst. Actuaries and Assur. Mag.* **8**: 301–310.

Muller, Andreas (2002) "Education, Income Inequality and Mortality: A Multiple Regression Analysis", *British Medical Journal*, Vol. 324, No. 7328 (Jan. 5, 2002), pp. 23-25.

Psacharopoulos, George (2006) "The Value of Investment in Education: Theory, Evidence, and Policy", *Journal of Education Finance*, Vol. 32 (2), Fall, pp. 113-136.

Rodgers, G. B. (1979) "Income and Inequality as Determinants of Mortality: An International Cross-Section Analysis", *Population Studies*, Vol. 33, No. 2 (July, 1979), pp. 343-351.

Ross C. E. and Wu C. (1995) "The links between education and health", *American Sociological Review,* Vol. 60, pp. 719-*745.*

Venkatanarayana, M. and Suresh V Naik (2009) "Workforce in Health Care Sector", *Asian Economic Review*, Vol. ().

Veneman, Ann M. (2007) "Education is Key to Reducing Child Mortality: The Link between Maternal Health and Education", *UN Chronicle*, Volume XLIV Number 4.

Wilkinson, Richard G. (1997a) "Socioeconomic Determinants of Health: Health Inequalities: Relative or Absolute Material Standards?", British *Medical Journal*, Vol. 314, No. 7080 (Feb. 22, 1997), pp. 591-595.

Wilkinson, Richard G. (1997b) "Income Inequality Summarises the Health Burden of Individual Relative Deprivation (Commentary)", *British Medical Journal*, Vol. 314, No. 7096 (Jun. 14, 1997), pp. 1727-1728.

Wolfson, Michael; George Kaplan, John Lynch, Nancy Ross and Eric Backlund (1999) "Relation between Income Inequality and Mortality: Empirical Demonstration", *British Medical Journal*, Vol. 319, No. 7215 (Oct. 9, 1999), pp. 953-955.