

# Causes of Death and Mortality Transition in India

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## Introduction and Background

India is been undergoing rapid demographic change over more than the three decades. Since 1980s, mortality rates have been declining continuously (Bhat 1990, James 2002). According to SRS (various reports), the mortality rates among the adult and older age groups has been declining. Nevertheless, Gompertz-Makeham law holds well and per se, the mortality rates in the old age groups rises exponentially. In parallel to this, the morbidity rates increased remarkably during the last two decade. In the current state of demographic and epidemiological transition, country is witnessing the unique phenomena of low mortality and high morbidity since the last two decade. Kumar (1993) addressed low mortality and high morbidity in Kerala, which seems to be true for India and bigger states in present demographic scenario. During the recent decades, prevalence rate (per 1000 persons) of chronic noncommunicable diseases (NCDs) increased many folds than any other category of diseases. Accordingly, structural change in causes of death was observed. Chronic NCDs have been responsible for major share of deaths than any other major categories of causes of death. Altogether, the structural changes in morbidity & causes of death and fall in mortality rates has stimulated the process of mortality transition in the country (James 2011, Kurpad et. al. 2006, Chaurasia 2006).

NSS data (1986/87, 1995/96 and 2004) revealed that trends in morbidity prevalence rate rose remarkably between 1995/96 and 2004. The shape of age pattern of morbidity and mortality are similar in the recent decade (J-shape). The structural changes in morbidity and causes of death of India unfold notable transition the country has journeyed till date. During the earlier decade of 1970s and 1980s, India was overwhelmed with burden of infectious and parasitic diseases, whereas since mid 1990s, burden of chronic NCDs has been increasing and is somewhat larger than the burden of communicable diseases. The share of deaths due to communicable diseases fell down from 47.7 percent to 22.1 percent and concomitantly the share of chronic NCDs rose from 35.9 percent to 54.9 percent during 1969-1995 (Visaria 2004). The country faces dual burden of NCDs and communicable diseases. Of the total burden, one third is accountable to communicable diseases and two-third to chronic NCDs (James 2011, John et al. 2011). The burden of chronic NCDs has been responsible for high mortality rates among oldest of old.

India underwent rapid transformation in age pattern of morbidity and mortality during the period of 1970-2007. The structural changes in morbidity and causes of death were one of the major causes for such transformation. The aging of the Indian population is evident as the proportion of aged population increased to 8.4 percent in 2011 which was 6.7 percent in 2001 (United Nations: *The 2008 and 2010 Revision*). As a result of changing age pattern of morbidity/mortality and ageing of the population, the process of mortality transition speeded up in recent decade. The study related to mortality transition w.r.t. India has been sparse. Therefore, we undertook this opportunity to examine the process of mortality transition in India and 12 bigger states during the period 1970-2007 connecting to demographic and epidemiological transition.

## Data and Methods

Age specific death rate (SRS 1970-2007) was used to construct new life tables (United Nations 1982). Truncated distribution of age at death (10+) by single age, obtained from newly

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constructed life tables, was used to estimate the modal age at death. The modal age at death of the distribution of age at death was mainly examined to understand the process of mortality transition in India and 12 bigger states during the period of 1970-2007 (Canudas-Romo 2008, Kannisto 2001). Other measure like 25<sup>th</sup> and 75<sup>th</sup> percentile of distribution of age at death was used to examine the shift in the distribution of age at death along with modal age at death. To understand the change in structure of morbidity and causes of death at national level; unit level data from NSS 1986/87, 1995/96 and 2004 on morbidity, Survey of causes of death for rural area (1971-1998), Mortality Statistics of Causes of Death (MSCD) for urban area (1975-1998), Medical Certification of Causes of Death (MCCD) mostly for urban areas (1998-2004) was used. NSS (1995-96) explicitly provide data on 17 major causes of death by sex, age, place of death and medical attention received before death for 3511 persons died during last one year. Central Bureau of Health Intelligence (CBHI<sup>3</sup>) report (2007) provides statistics on the 19 major causes of death based on ICD 10 by sex and broad age groups for time periods 1998, 1999 & 2000. The sample size for the year 1998 was 4,98,586; for the year 1999 was 4,88,619 and for the year 2000 was 5,10,588. Registrar General of India (RGI) (2001-2003) provides mortality statistics for both rural and urban population.

## Results and Discussion

We explored two broad domains: 1) structural changes in morbidity and causes of death and 2) transformation in distribution of age at death and modal age at death. NSS data revealed approx four-fold increase in the prevalence rate (per 1000 persons) of NCDs from 1986/87 to 2004. The prevalence rate (per 1000 persons) of Cardiovascular Diseases (CVDs) increased by five-fold during the same period. The age pattern of morbidity transformed to J-shape majorly contributed by chronic NCDs during the later period of 1995/96-2004 (figure 1). By age group, 75-79 age group reported highest prevalence rate of chronic NCDs. The prevalence rate of communicable diseases remained more or less unchanged during the same period. The *summary event rate* of chronic diseases among the aged population markedly increased by nearly three times (4.5 in 1995/96 to 12.3 in 2004) between 1995/96 and 2004; during the period 1986/97 to 1995/96, the summary event rate increased marginally (Young-Xu, Yinong and Chan, K Arnold 2008). Examining the trends in the prevalence rate of chronic NCDs for the three time period, the prevalence rate of Asthma increased from 15 to 27 during 1986/87 to 2004. Diabetes increased from 3.9 to 37.4; Hypertension increased from 12.8 to 54.4; and Heart disease increased from 3.8 to 26.6.

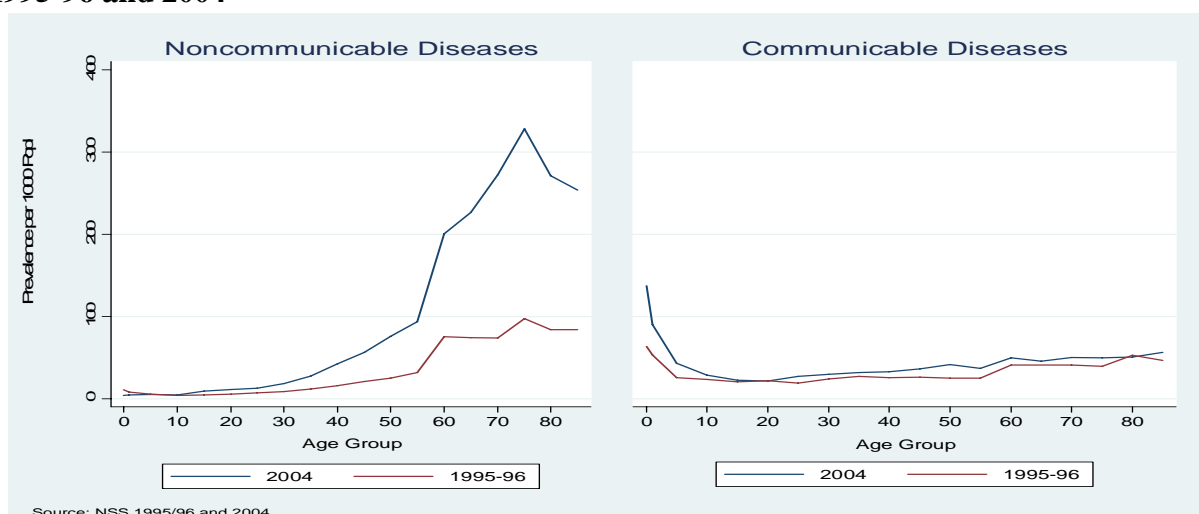
Remarkable rise in the high prevalence rate of chronic NCDs consummated with summary event rate of chronic diseases and concomitant transformation in the age pattern of morbidity and mortality, manifests the structural changes in morbidity, and per se the structural changes in causes of death (Murray and Lopez 1990, Murray and Chen 1992 and Kurpad et al. 2006). Deaths due to diseases of circulatory system were rising whereas deaths due to infectious and parasitic diseases were declining throughout the time period. Among rural population, senility was the main causes of death among the aged population and to a greater extent among females. The diseases of circulatory disease were second killer disease in rural area (SCD 1972-1997). Among urban population, both diseases of circulatory diseases and parasitic and infectious diseases were leading causes of death throughout the time period; since mid of 1980s, diseases of circulatory diseases surpassed diseases of parasitic and infectious diseases MSCD (1975-85) and MCCD (1991-95).

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<sup>3</sup> CBHI coverage is approximately 50-60 percent of deaths of total deaths registered

In recent time period 2001-2003, CVDs maintained to be the top killer diseases compared to others and profoundly among the males. Gender wise, deaths due to CVDs was higher among aged male population. Nevertheless, the prevalence rate of chronic NCDs & CVDs was modestly higher among females than males with significantly higher  $e_x$  than males. The resultant is that, among 25-69 and 70+ aged males than females, respectively, deaths due to chronic NCDs were higher by 3 percent and more than 1 percent, respectively (RGI 2009). The trends in morbidity prevalence rate of NCDs & CVDs have been analogous to the trends in deaths due to NCDs & CVDs. The rise in morbidity prevalence rate of NCDs & CVDs justified the increase in deaths due to NCDs & CVDs.

**Figure 1: Age Pattern of Prevalence Rate of NCDs and Communicable Diseases, India, 1995-96 and 2004**

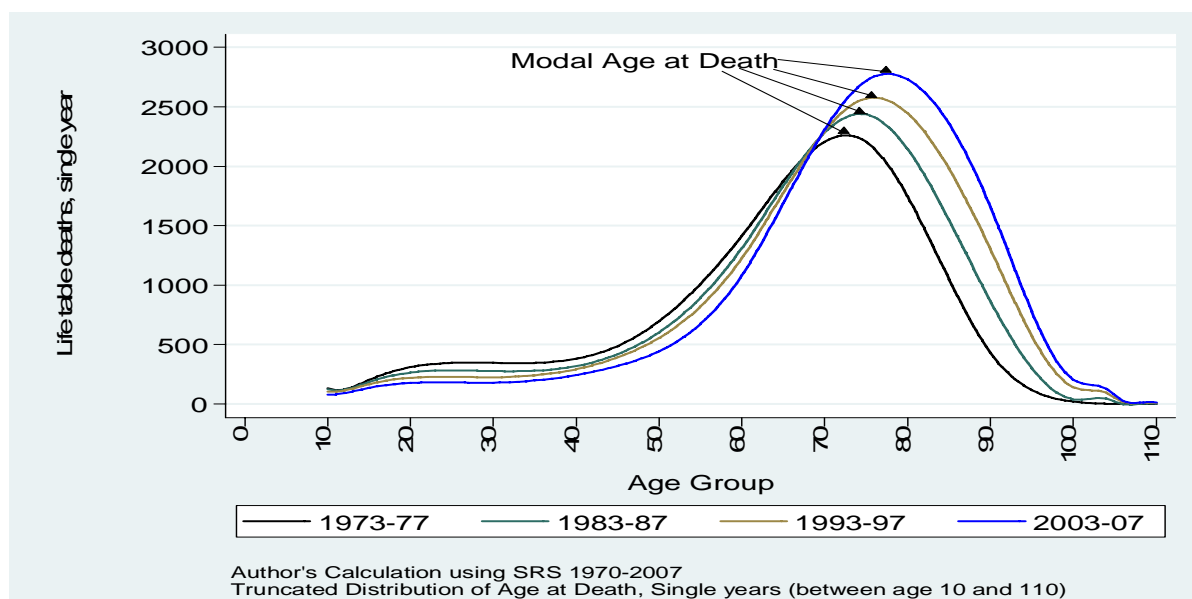


The  $e_0$  of India among females and males, respectively, increased by 12 and 15 years, respectively, during 1970-2007 (Registrar General 2009). During this short period, the distribution of age at death underwent significant transformation. The distribution of age at death was bimodal during 1970s and 1980s; transformed to unimodal during the later period. The IMR halved down during the period of 1970-2007 and adult mortality rate significantly declined. Though the mortality rates declined for all ages, the mortality rates increased exponentially in older ages. The rapid decline in infant, adolescent and young adult mortality rates significantly contributed to the increasing concentration of deaths among the later adult and older ages. The reduction in toll deaths, due to major epidemic killer diseases viz. cholera, plague, smallpox, malaria, was achievement in bringing down the mortality rates through vaccinations or medical interventions by mid of 1970s (Padmanabha 1982, Banthia and Dyson 1999). The immunization of children and basic health interventions made improvement in the health status of the population by mid of 1990s (Claeson et al. 1999, Measham et al. 1999, Visaria 2004). The entire period of 1970-2007 manifested significant structural changes in the morbidity and causes of death concomitant with changing age pattern of morbidity and mortality. Moreover, the later period of 1990-2007 endorsed the significant rise in NCDs & CVDs accompanied by fall in mortality rates for all ages.

With structural changes in morbidity & causes of death and contemporaneous transformation in distribution of age at death, progress in mortality transition was evident during the period 1970-2007. The following figure 2 demonstrates the progress in mortality transition depicting the transition in distribution of age at death and rise in modal age at death. The phenomenon of increasing concentration of death near the modal age at death (M) and concomitant rise in modal

age at death attests the progress in mortality transition. The modal age death increased linearly among both females ( $r^2=0.9515$ ) and males ( $r^2=0.9020$ ). Among females and males, respectively, the M values increased from age 74 and age 71, respectively, in 1970-74, to age 79 and 76, respectively, in 2003-07. The M values increased by 5 years for both females and males. Alongside, 50 percent of deaths between the age range 50-75, in 1970-74, was shifted between the age range 65-85, in 2003-07. The shift in the distribution of age at death was apparent.

**Figure 2: Truncated Distribution of Age at Death and Modal Age at Death for Selected Years, Female, India**



The results showed marked progress in the mortality transition. The linear increase in modal age at death (M) was propelled by the increase in  $e_x$  and structural changes in morbidity and causes of death. The M values raised by almost double compared to 2.7 years increase in  $e_{70+}$  during the entire period. Rise in M values is evidence to the dominance of old age mortality over the adult age mortality (Canudas-Romo 2008) as the country experiences shift in the mortality transition. Analyses revealed that the mortality transition is in progress and to a great extent for females than males. However, the gap between females and males has been reducing, esp. during the recent decade. Regional (state) variation persists. Among the bigger states, Kerala has been foremost where old age mortality has been in dominance since 1970s. In Uttar Pradesh, the old age mortality has been in dominance since 1990s. During 1970s and 1980s, adult age mortality had dominance in Uttar Pradesh. In general, demographically advanced states have been leading in mortality transition compared to demographically less advanced states. Comparative assessment of the modal age at death and other measures revealed significant variation among the selected states.

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