Chapter 1

INTRODUCTION

The main focus of mortality studies in India has been to analyse the trend in infant and child mortality and the factors associated with it, particularly with the availability of time series demographic data from Sample Registration System (SRS) as well as from large-scale surveys for various states of the country. A few studies (the detailed review of which is presented later in the chapter) have focused on analyzing the data on mortality by age and sex to understand the emerging pattern of mortality across the life cycle at the national or state level. For example, a recent study by Bhat and Navaneetham (1991) has analysed the trend in mortality in major states of India for the period 1970-86, using the data from the Sample Registration System on mortality by age and sex since 1970. Some of the major conclusions emerging from their analysis are that mortality has declined more rapidly among infants, children under 15 years and women of reproductive ages. Among adults, mortality has declined more rapidly among females than among males, the differential gain being largest in the age span 25-49 years. But in ages under 15, there was no evidence to suggest a gender differential in mortality decline. Among children and women of reproductive ages, mortality has declined more rapidly in urban areas than in rural areas but the reverse is true in the case of adult men. Based on the same SRS data, Navaneetham (1993) carries forward this work to study mortality decline in India and its major states during the period 1970-86 by estimating both life expectancy at birth as well as rate of mortality change by different age groups. The author also examined the contribution of various age groups for the increase in the life expectancy at birth during the same period. However, there appears to be very little evidence to understand the emerging age and sex specific mortality pattern across various socio-economic groups such as religion, caste/tribe, class and other

subgroups of population, in India, except for a solitary study by Jaychandran (1999) which attempts to examine mortality differentials by age and sex across such population subgroups by analyzing NFHS-1 (1992-93) data. We come back to such studies a little later in this chapter.

The two rounds of National Family Health Survey (NFHS) conducted during 1992-93 (NFHS-1) and 1998-99 (NFHS-2) provide an opportunity to study in more detail the mortality pattern by age and sex during the last decade across all the states in the country (unfortunately the most recent third round of NFHS conducted during 2005-06 does not provide such mortality data for the country). The basic results obtained from the two rounds of NFHS, including age specific death rates in broad age groups, were published in the state reports. Upon completion of the basic survey reports, the NFHS-1 and NFHS-2 data were released to the scientific community for further study. As part of this further research, a Subject Reports Series has been established. Though the subject reports include a more detailed study of infant and child mortality in India, the detailed study of mortality across all ages by state has so far not been undertaken.

The present research therefore primarily aims to examine the regional/state level pattern of mortality by age and sex as well as by various socio-economic groups in India by utilizing the combined data on mortality from NFHS-1 and NFHS-2 conducted during 1992-93 and 1998-99, respectively (details of which are discussed in the relevant chapter). Understanding the emerging mortality pattern by age and sex during the recent period can provide valuable information for social scientists, policy makers, and health professionals who are concerned with improving the survival of men and women across the life cycle in India.

A life table is a convenient tool designed to analyse mortality pattern. It helps to understand the implications of Age Specific Mortality Rates

(ASMRs) in terms of average life expectancy. In the absence of relevant data from surveys and civil registration system, it has been the practice in the country to construct life tables using age composition of the population from successive censuses. Such census based estimates are discussed a little later. With the introduction of Sample Registration System (SRS), reliable estimates of age specific death rates are available which provide an alternate base for the construction of life tables. In fact, Office of the Registrar General of India has been constructing life tables based on SRS data and has already published the same for the periods 1970-75, 1976-80, 1981-85, 1986-90, 1987-91, 1988-92, 1989-93, 1990-94, 1991-95, 1992-96,1993-97, 1994-98, 1995-99,1996-2000, 1997-01,1998-02,1999-03, 2000-04, 2001-05 and 2002-06 (Registrar General, India, 1984; 1985; 1989; 1994; 1995a; 1995b; 1996a; 1996b; 1996c; 2000; 2004; 2005; 2006; 2007a; 2007b; 2008). The International Institute for Population Sciences (IIPS), Mumbai also made an attempt to construct life tables, based on SRS data, for the period 1986-90 (Ponnapalli and Parasuraman, 1994). However, SRS data do not provide any scope to study mortality pattern by various socio-economic groups. Therefore, the present study would make an attempt to derive ASDRs and construct life tables for India, based on the data of two rounds of NFHS conducted during the last decade, to study the emerging mortality pattern across various regions/states as well as religion and class and caste groups in the country. An attempt would also be made to compare the all-India estimates with their corresponding life tables based on SRS data for the same period. This would help to validate the estimates obtained from the two rounds of NFHS data. Since SRS based life tables take into account the mortality pattern (ASMRs) for a five- year period, this practice is likely to maximize precision, provided the sampling frame and sample size under the SRS are more or less same during that period. These methodological issues are discussed later in the relevant chapter.

Since SRS is the major source of time-series data on mortality and fertility indicators in the country, particularly since the early 1970s, it would be interesting to examine the trend in the expectation of life at birth as well as at other ages by sex during the last three decades. In other words, this would help to understand the emerging trend in relation to improved survival chances of men and women across the life cycle in various part of the country. Moreover, understanding the trends and pattern of mortality is useful in the projection of population for future years, and it is generally considered as base for future planning of any country and for the resource allocations made for each section of the population.

Objectives

The present research primarily aims to examine region and community specific mortality pattern in India by utilizing the combined data on mortality from NFHS-1 and NFHS-2, conducted during 1992-93 and 1998-99 respectively, in order to minimize sampling errors in the estimates of mortality indices for various population sub-groups.

The specific objectives of the study are:

1. To study the feasibility of use of repeated sampling technique in the same population to maximize precision of the mortality estimates compared to those generally derived from one time surveys.

2. To estimate age and sex specific death rates along with their sampling errors based on NFHS-1 (1992-93) and NFHS-2 (1998-99), and to compare these individual estimates with that of the combined estimates (with their respective sampling errors) to establish the efficacy of the combined estimate.

3. To derive stable regional and state level age specific death rates by sex and residence and by various socio-economic groups such as religion, caste/tribe and household standard of living based on the combined estimates.

4. To construct sex-specific abridged life tables for the last decade (1992-1998) for the various states and regions of India as well as for the different socio-economic sub-groups of the population based on age and sex specific death rates derived under the study, to enable the study of mortality pattern in the country.

5. To establish the efficiency of the life table estimates through computation of the sampling error.

6. To compare the life table estimates along with their sampling errors derived under the study with SRS-based life tables for the same period in order to validate the life table estimates derived under the study.

7. To study the trend in average expectation of life at different ages since the early 1970s and to understand the likely pattern of mortality in the future in the country.

REVIEW OF LITERATURE

A substantial body of work including the pioneering work by Kingsley Davis (1951) exists on the study of levels, trends and determinants of mortality during the last half of the century using a number of indicators for the south Asian region including India. While a detailed review of mortality trend is beyond the scope of the present study, the various studies examining mortality trend in developing countries, particularly in Asian countries, seem to suggest that the level of mortality was high during the early 1920s or before and it is only after 1950 that a tremendous progress in the reduction in mortality was evidenced in these countries (Bhinde and Kanitkar, 1978), although

the pace of decline was slower during the 1960s (Arriaga, 1989). An examination of levels and trends in mortality in 10 Asian countries for the period 1950-1980 by Pathak and Murthy (1983) has noted that despite considerable reduction in mortality levels in most countries, the pace of its decline had slowed between 1970 and 1980. Similarly, using a number of indicators, Ruzicka (1983) has analysed the pattern of mortality decline in selected countries of the ESCAP region since the 1950s which also provides evidence of mortality differentials with respect to social and economic inequalities. The author also gives a speculation on the future prospects of mortality decline in the light of national government's commitment to achieve health for all by 2000. A comparison of trends in mortality in five south Asian countries namely Bangladesh, India, Nepal, Pakistan and Sri Lanka during 1942-1980 was made by Caldwell and Ruzicka (1985). The study discusses the pace of mortality decline through various indicators, sex differentials in life expectancy and factors contributing to these trends. The authors further postulate the vital role of education, particularly female education, rather than improvement in health facilities, in mortality decline from micro level studies undertaken by them in selected villages in India and Bangladesh.

The slow pace of decline in mortality during the 1960s in several developing countries including India for which life tables are available has been noted by Arriaga (1989). Moreover, the author notes that reduction in infant mortality has invariably been the largest single-age contributor to the change in life expectation. Furthermore, countries with the same level of mortality in the late 1960s were found to have different trends in mortality in the 1970s making it difficult to predict the likely trends.

A number of studies have also specifically addressed various aspects of mortality for India. While the earlier studies mainly analysed mortality based on census data (Registrar General and Census Commissioner of India, 1961, 1977; Sinha and Lahiri, 1976; Visaria

1969; Kohli, 1977; Bhat, 1987; Jain, 1982; Preston and Bhat, 1984), it is only after the 1970s that Indian data became more rich and diverse enough to form a solid basis for estimating levels and trends in vital rates. In the recent period, a number of studies have analysed mortality trends since the 1970s using a number of indicators including expectation of life at birth (Kurup, 1983; Jain, Visaria and Visaria, 1985; Bhat, and Navneetham, 1991; Chaurasia, 1992 and 1993; Navneetham, 1993; Rajan, 1993; Goyal, 1994).

Most of the studies on India seem to suggest that although mortality showed a decline after 1921, it was only after 1951 that such a decline was more sharply evident, which is largely attributed to the improvement in public health measures, medical services and socio-economic development (Sinha and Zacharia, 1984). Between the 1950s and 1960s life expectancy at birth in India increased by 13-14 years, it being 32.5 years for males and 31.7 for females during 1941-50 and 46.4 for males and 44.7 for females during 1961-70 (Registrar General and Census Commissioner, 1977). As per SRS estimate, it was about 50 years during the early 1970s (i.e. 1970-75) with expectation of life at birth (e_o^o) still being slightly in favour of males (50.5 years) than females (49.0 years). The regular availability of SRS life tables makes it possible to establish the trend in life expectancy for the country. For example, e_o^o for both sexes increased from 52.3 years (52.5 for males and 52.1 for females) during 1976-80 to 63.5 years (62.6 for males and 64.2 for females) during 2002-06, although the increase in e_o^o was relatively much slower during the 1990s compared to that during the 1980s. Interestingly, the sex differentials in mortality show a reverse pattern in favour of females, particularly after 1981 (Registrar General, India, 2008). Infant and child mortality improvements contributed largely to the country's increase in the life expectancy. The slight slow down in the mortality decline during the 1990s once again can be attributed to the stagnancy in the level of

IMR, particularly since the mid-1990s for a large number of states in the country (Das and Dey, 2003).

As mentioned earlier, a life table is a convenient tool to analyse mortality pattern by age and sex in terms of average life expectancy and their trend overtime. While this branch of demographic research is not new and has a history of more than three centuries, the volume of work done in developing countries like India is much less in comparison with that available for the developed countries. However, such a gap narrowed down with developments of the model life tables (Coale & Demeny, 1966; United Nations, 1982). In the absence of reliable relevant data from surveys and civil registration system, it has been the practice in the country during the 1960s or before to construct life tables using age composition of the population from successive censuses. For most of these earlier decades, an all-India life table has been constructed to depict the average level of mortality within the country. However, apart from the all-India life tables, zonal life tables for five zones (but not for all states) were constructed for the decades 1951-60 and 1961-70. In this regard, life tables prepared by census actuary are available until 1961-70 (Registrar General, India, 1977) except for the period 1911-21 and 1931-40, for which the same were constructed by Kingsley Davis (1951).

A number of other studies also constructed life tables for India based on census or survey data. For example, Sinha and Lahiri (1976) constructed life tables for the states of India for the period 1951-1961 in view of the fact that official life tables were not available for various states. In fact, as mentioned earlier, for the period 1951-61 only zonal life tables (for five zones) were constructed by census actuary. Moreover, the available mortality data at that time indicated quite a variation in the level of mortality across the states in India. It was therefore felt by the authors to make life tables for the decades 1951-60 from the age returns of 1951 and 1961 censuses for each state of

India to study the level of mortality in terms of e_o^o by state, and to promote a variety of demographic analysis. In view of the serious problem in the data, the authors made an attempt to make use of stable population techniques to estimate the life table population after making adjustments for boundary changes and inter-state migrations during the decades 1951-60, which however did not have significant effect on the census age distributions. The results indicate that e_o^o in the states of India during the 1951-61 ranged between 35 to 43 years among the 14 major states studied and the e_o^o was found to be more than 40 years in only 6 states. Accordingly, the level of IMR was found to be very high and ranged between 170-225 deaths per 1000 live births in the country. In another study, Malaker and Guha Roy (1990) had made an attempt to construct life tables for India from 1901-11 to 1971-81 with particular attention to the period 1921-41, for which official life tables are not available, and to project for the decades 1981-91 and 1991-2001 by adopting a Brass relational model to improve on the official life tables prepared by census actuaries, as the authors felt that earlier actuarial life tables were based on a British model of sex differentials in mortality leading to higher life expectancies for official sources. Mari Bhat (1987), as a part of his doctoral dissertation, developed inter-censal mortality estimation procedures to reduce sensitivity to age misreporting and applied the same to Indian national data since 1881 and to state-level data since 1951. The study highlights that both mortality and fertility in India have declined more rapidly during the 1970s. His estimate suggests that e_o^o increased by about 14 years between 1951-61 and 1971-81. During the same period the crude birth rate is estimated to have fallen by 20 percent. The study also analysed age and sex specific mortality trends and noted large regional variations.

In another study, Lahiri (1985) described a procedure for constructing an abridged life table from the data on age distribution obtained from

two consecutive censuses without resorting to any smoothing of the age distribution. This technique was applied to data for India to construct the life tables for the periods 1951-61 and 1961-71. The results indicate that e_o^o for males was 40.2 years during the decades 1951-61, which increased to 50.7 years for the period 1961-71. Similarly, e_o^o for females during 1951-61 was 38.9 years, which increased to 48.0 years during 1961-71, indicating higher life expectancy for males than that for females during those periods.

The study by Pathak and Singh (1992) proposed a method for estimating expectation of life at birth at sub-national level. The authors developed new regression models to estimate e_o^o without utilizing any model life tables. This technique was illustrated to estimate e_o^o at the regional as well as district level for the state of Uttar Pradesh in India. The validity of these estimates has been established by considering the infant mortality rate and probability of survival of the children up to the age of five years of various divisions and district under study, in the absence of any direct check on such estimates.

As mentioned earlier, with the introduction of the Sample Registration System (SRS), reliable estimates of Age Specific Death Rates (ASDRs) are available by state which provide an alternative base for the construction of life tables for India and its constituent states. In this regard, as noted earlier, the Office of the Registrar General of India has been constructing life tables, based on SRS data, for the five year period starting with 1970-75. Each of these publications presents data on life expectancy by sex and residence at different ages for India and its states (Registrar General, India, 1999). There is a wide variation among the states in the e_o^o even during the recent period (Registrar General, India, 2007b). Madhya Pradesh has the lowest and Kerala has the highest e_o^o. Within a state, the e_o^o is higher for urban

areas than rural areas. Also, the male e_o^o is generally lower than the female e_o^o, which is a reversal of the pattern observed during the early 1970s and before. A number of other studies also made use of SRS data to construct life tables for India and/or its states to study the emerging pattern of mortality across the life cycle (Ghosal, 1985; Navaneetham, 1993, Ponnapalli and Parsuraman, 1994). For example, Navaneetham (1993) made use of SRS based age specific death rates covering the period 1970 to 1986 to study mortality decline in India and in its major states by estimating life expectancy by age and sex.

There are studies which made use of hospital or Municipal Corporation based data to study cause specific mortality pattern or to construct cause-specific life tables (Gupta and Rao, 1973; Ram and Dhar, 1992; Choudhary and Rajbongshi, 2006). These studies however have focused on urban areas, mainly in metropolitan cities, while such an analysis is missing for the vast rural population as a result of lack of good quality mortality data.

With the availability of other national level survey data like the three rounds of National Family Health Survey (NFHS) in the country, it is possible to study mortality differentials by geographic areas and by socio-economic groups due to availability of the relevant information in these demographic and health surveys. For example, Jaychandran (1999; 2003) examined NFHS-1 (1992-93) data to study cause of death and mortality differentials across the population subgroups in India with respect to age and sex by analyzing the life expectancies at different ages. As expected, the life expectancy at exact ages varies across population subgroups and also between males and females within the same subgroups. Significant differences in e_o^o were noted by region, residence, religion, caste/tribe, standard of living and levels of infant mortality, indicating that mortality/health condition of the population is more dependent on living condition and or standard of living rather than affiliation to any religion or caste/tribe. The sex

differentials in e_o^o in majority of the population subgroups studied were mainly attributed to discrimination against females in the age group 1-14 years and disadvantage of females in the reproductive ages, particularly at 15-29 years, although overall, females belonging to households with high standard of living and those from south India have lower mortality compared to their counterparts. The author however made use of first round of NFHS, but not the second round of NFHS (3rd round of NFHS does not provide relevant mortality data) to study all-India or regional pattern (not the state-level pattern) which could partly be due to small sample size at the state level. Nevertheless, keeping in mind the non-availability of good quality data on mortality, such studies on health inequalities in the population have important policy implications.

Organization of the Thesis

The thesis is divided into nine chapters. The present first chapter has provided the focus and rationale of the study followed by the study objectives and a review of the relevant literature in the area. Chapter 2 describes the methodological aspects pertinent to the study of mortality, particularly the importance of survey data since civil registration data is far from complete in the Indian context. The chapter further gives details of the data on mortality from the NFHS and SRS which are to be used in the present study and finally provides a framework that has guided the analysis. Chapters 3 to 8 detail the various results obtained under the study. The pattern of age specific death rate at the state, region and country level derived from mortality data of NFHS 1 & 2, is given in Chapter 3 while the abridged life tables by residence and sex, based on these ASDRs, at the country level are given in Chapter 4 and the same by various states of the country are discussed in Chapter 5. The pattern of life expectancy by various socio-economic characteristics forms the focus of Chapter 6 while Chapter 7 provides a comparison of life expectancy derived from

NFHS data under the present study with that of estimates based on SRS data source. Chapter 8 provides the trend in average expectation of life at different ages observed over the previous three decades from the SRS and the likely future pattern of life expectancy in the country. Finally, Chapter 9 summaries the main results of the study and draws conclusions with regard to region and community specific mortality pattern in the country based on repeat surveys.