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Mortality Transition in Urban India
1970-2002

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Introduction

The focus of mortality research in India during the last fifty years has generally been on rural mortality. There are reasons for this attention. Indian society is still pre-dominantly rural; more than 72 per cent of the population of the country lives in rural areas according to the 2001 population census. Moreover, rural mortality has always been higher than the urban mortality. In any case, a focus on rural mortality has resulted in a residual attention to urban health and mortality issues. The concentration of private health care facilities in the urban areas has also led to the general belief that the private health care delivery system will be able to meet most, if not all, of the health needs of the urban population.

The situation is now changing. Urban population in the country is growing rapidly despite lower fertility and mortality as compared to the rural ares. Between 1991 and 2001, the urban population of India increased by more than 31 per cent at an average annual growth rate of 2.74 per cent per year. Both the push and the pull factors have contributed towards this migration. There is also evidence of migration from medium and small towns to big towns and cities leading to increased concentration of the urban population in large metropolitan towns and cities. According to the 2001 population census, more than 62 per cent of the urban population in India was living in size class I towns - towns with a population of 100 thousand and more. These migratory flows have changed the composition of the urban population. Urbanites are no longer the elite class of the society as they were in the past. A very substantial proportion of the urban population, today, lives in deplorable conditions with extremely poor housing, water and sanitation facilities and skeleton health care delivery infrastructure. Out of the 4378 habitations classified as urban at the 2001 population census, slum areas were reported in 640 or approximately 15 per cent of the towns and cities. Total population living in slums accounted for 15 per cent of the total urban population of the country and more than 23 per cent of the population of cities and towns reporting slums at the 2001 population census. A large proportion of the urban workforce, today, consists of poorly educated, unskilled or semi-skilled workers who contribute substantially to the pressure on the urban environment. At the same time, the pressure of rapidly increasing population combined with consumerism up to the level of madness has resulted in a very substantial increase in the environmental pollution making the situation worst.

Deterioration of the urban health environment is very well reflected in the transition in urban mortality. Although, mortality levels in the urban areas still remain substantially lower than that in the rural areas, yet transition in urban mortality has been slower than rural mortality transition. According to the sample registration system, the death rate in urban India decreased from 9.7 deaths per 1000 population per year in the year 1971 to 5.8 deaths per 1000 population per year in the year 2004 while the infant mortality rate decreased from 82 infant deaths per 1000 population per year to 40 infant deaths per 1000 population per year as compared to a decrease of 8.2 absolute points in the rural death rate and

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a decrease of 74 absolute points in rural infant mortality rate (Government of India, 2006). The expectation of life at birth in urban India, on the other hand, increased by about 9 years from 58.9 years during 1970-75 to about 67.9 years during 1998-2002 as compared to an increase of more than 13 years in the expectation of life at birth in rural India (Government of India, 1999; 2006). As the result, urban-rural gap in all indicators of mortality has narrowed down substantially with the gap in the expectation of life at birth which was around 10.9 years during the period 1970-75 reducing to around 6.7 years during the period 1998-02.

In this paper, we attempt to analyze mortality transition in urban India through a policy perspective. One problem with the analysis of urban mortality transition is that estimates of different indicators of mortality are available for the urban areas as a whole and not for different size class of towns. Unlike the rural areas, the size of urban dwellings in India varies from below five thousand to more than 16 million. Moreover, towns of different size class also differ in terms of social and economic development as well as infrastructure and facilities. But estimates of different indicators of mortality are not available by size class of towns, although it is expected that these indicators vary widely by size class of towns. The civil registration system which is perhaps the best source of information on mortality. There are, however, two major problems in the use of information available through the civil registration system. First, the system remains grossly incomplete and inefficient, especially in smaller towns. Second the system records deaths by the place of the death rather than the place of usual residence of the deceased according to the Registration of Birth and Death Act 1969 (Government of India, 1969). Since most of the health care facilities and institutions, especially the private ones, are concentrated in the urban areas, a proportion of the deaths occurring in these health care facilities and institutions are actually rural deaths which are counted as the urban deaths in the civil registration system. Obviously, assessment of urban mortality on the basis of the information available through the civil registration system overestimates the actual mortality levels in the urban areas.

Methodology and Data Source
The analysis is based on the life tables prepared for urban India on the basis of the age specific death rates available through the sample registration system. The sample registration system provides annual estimates of age-specific death rates for the country and for its major states for the combined population as well as separately for rural and urban populations as well as for and males and females. The age specific death rates available through the sample registration system have, however, been found to be associated with random fluctuations of unknown origin. To eliminate these random fluctuations, the life tables prepared on the basis of the age specific deaths rates available through the sample registration system are for five-year period rather than annually (Government of India, 1984;

1985; 1989; 1994; 1998; 2004; 2005). One problem in using these life tables is that they are based on different methodologies of converting the observed age specific death rate to the life table function $_nq_x$. The life tables for the periods 1970-75, 1976-80 and 1981-85 are based on Greville's method (Greville, 1948) whereas life tables for the period 1986-90 on wards are constructed by using the MortPak software package developed by the Unite Nations (United Nations, 1988). The MortPak software package uses a different approach of converting the observed age-specific death rates to the life table function $_nq_x$.

In order to improve the comparability of life tables for different five-year period, we have reconstructed life tables for the periods 1970-75, 1976-80 and 1981-85 through the application of the MortPak software package. A comparison of the expectation of life at birth obtained through the application of the MortPak software package with those obtained through the application of the Greville's method reveals that the estimates of the expectation of life at birth obtained through the application of the Greville's method are higher than the estimates generated through the application of the MortPak software package. In the present analysis, we have used the MortPak software package to obtained consistent estimates of the expectation of life at birth for the period 1970-2002.

The sample registration system is the only source of information related to mortality and life expectancy in India. It is often argued that estimates available through the sample registration system are underestimates of the actual mortality. However, the degree of under reporting is estimated to be only marginal.

The paper uses the decomposition approach to study mortality transition in urban India. This approach is widely applied in studying the change in a number of demographic variables over time (Canudas Romo, 2003). Several methods have been developed to decompose the change in the expectation of life at birth into the contribution of mortality transition in different age groups (Chandra Sekar, 1949; Kittagawa, 1955; Retherford, 1972; Lopez and Ruzicka, 1977; Andreev, 1982; Pollard, 1982; United Nations, 1982; Arriaga, 1984; Pressat, 1985; United Nations, 1985; Pullum and Tan, 1992; Das Gupta, 1993; Andreev et al., 2002; Canudas Romo, 2003; Vaupel and Canudas Romo, 2003). A comparison of some of these methods has been done by Murthy (2005). Murthy has concluded that many of these methods give same the results. Canudas Romo (2003) has also observed that a number of decomposition methods complement each other by focusing on new aspects of the change that have not been revealed by other methods.

Following Murthy, we use the methodology proposed by the United Nations (United Nations, 1985) for analyzing the change in the expectation of life at birth in urban India. This methodology is an extension of an earlier methodology (United Nations, 1982). Murthy (2005) has observed that the methodology of the United Nations gives the same results as the methodology proposed by others.

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Expectation of Life at Birth in Urban India

The age-specific death rates available through the sample registration system suggest that the expectation of life at birth in urban India increased from 58.44 years during the period 1970-75 to 67.92 years during the period 1998-2002 - an increase of almost 9.5 years over a period of 27 years or an average annual increase of 0.556 years per year. The increase in the expectation of life at birth was comparatively slow in males as compared to females. The male expectation of life at birth increased by just about 7.6 years from around 58.68 years to 66.28 years between 1970-75 and 1998-2002 whereas the female expectation of life at birth increased by more than 10.3 years during the same period from 58.82 years to 69.15 at an average annual rate of almost 0.600 years per year. As the result, the gap between female and male expectation of life at birth in urban India widened from just around 0.14 years during the period 1970-75 to 2.87 years during the period 1998-2002.

The pace of mortality transition in urban India has however been not uniform. The period of accelerated improvement in the expectation of life at birth has been associated with a period of sluggish improvement. Between 1970-75 and 1976-80, the expectation of life at birth in urban India increased by around 1.52 years or at an average annual rate of approximately 0.3 years per year. The transition in mortality gained some momentum during the period 1976-80 through 1981-85 when the expectation of life at birth increased by more than 2.58

Figure 1
Expectation of life at birth in urban India
1970-2002

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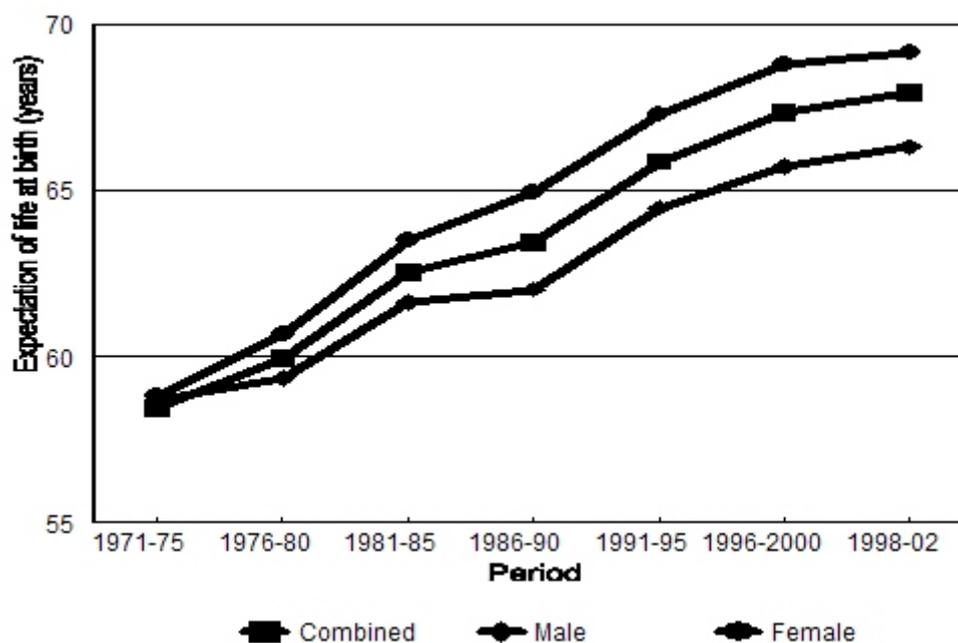
years at an average annual rate of more than 0.5 years per year. However, transition in mortality slowed down considerably during the period 1981-85 through 1986-90 when the increase in the expectation of life at birth, over a period of 5 years, was just around 0.91 or an average annual growth of less than 0.2 years per year. Mortality transition gained momentum again during the period 1986-90 through 1991-95 when the expectation of life at birth increased by more than 2.4 years at the rate of almost 0.5 years per year, on average. But the transition slowed down once again during the period 1991-95 through 1996-2000 when the expectation of life at birth in urban India increased by less than 1.5 years or less than 0.3 years per year, on average. The sluggish increase in the expectation of life at birth in urban India continued even after 1996-2000 and during the two years between 1996-2000 and 1998-2002, the expectation of life at birth in urban India increased by just 0.6 years over a period of two years or just 0.3 years per year on average.

Figure 2
Increase in expectation of life at birth in different time periods
in urban India
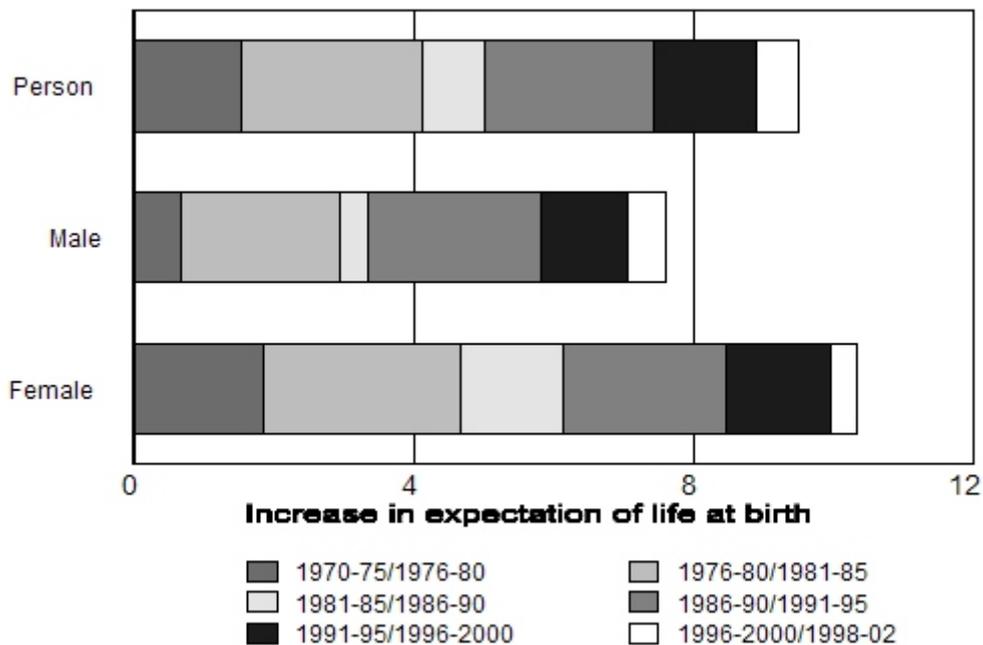
Alternatively, out of the total gain of approximately 9.5 years in the expectation of life at birth in urban India between 1970-75 and 1998-2002, a gain of almost 5 years was confined to only two five-year time periods - 1976-80/1981-85 and 1986-90/1991-93. In the remaining period of the duration 1970-75 through 1998-2002, total gain in the expectation of life at birth was less than 4.5 years. This indicates that mortality transition in urban India has largely been

confined to the periods 1976-80/1981-85 and 1986-90/1991-93 only. In the remaining periods, pace of transition has been slow. This has particularly been the situation in case of mortality transition in males where more than 62 per cent of the total increase in the expectation of life at birth was confined to the periods 1976-80/1981-85 and 1986-90/1991-95; the remaining period of the duration 1970-75 through 1998-2002, the male expectation of life at birth increased by less than 2 years. During the period 1981-85/1986-90, the male expectation of life at birth in urban India increased by only about 0.4 years or by just 0.08 years per year, on average indicating that the male mortality transition in urban India almost stagnated during this period.

By comparison transition in female mortality has been relatively smooth. The absolute increase in male expectation of life at birth for different five-year periods of the duration 1970 through 2000 varied from a minimum of 0.41 years to a maximum of 2.45 years. In females, on the other hand, this increase varied between 1.46 years to 2.81 years. In fact, momentum in female mortality transition could be maintained even during those periods when transition in male mortality has been slow as may be seen from figure 2. For example, during the period 1981-85 through 1986-90, female expectation of life at birth increased by almost 1.5 years as compared to and increase of just 0.4 years in males. Similarly, during the period 1970-75/1976-80, the female expectation of life at birth increased by almost 1.85 years whereas the increase in the male expectation of life at birth was just around 0.67 years. On the other hand, during the period 1986-90/1991-95, the gain in the male expectation of life at birth was more than the gain in the female expectation of life at birth (Table 1).

It would be interesting to compare the change in the expectation of life at birth in urban India with the model schedule of change in the expectation of life at birth developed by the United Nations for preparing population projections (Stover and Kirmeyer, 1999). The model schedule developed by United Nations is based on the assumption that the expectation of life at birth, for males and females increases by 2.0 to 2.5 years respectively over each five-year period when the expectation of life at birth at the beginning of the period is less than 60 years and subsequently at a slower rate. On the basis of this model schedule, we have estimated the likely levels of the expectation of life at birth during the period 1996-2000 given the expectation of life at birth during the period 1970-75. The exercise suggests that if mortality transition in urban India would have followed the model schedule, the male expectation of life at birth would have been be around 68-70 years and female expectation of life at birth would have been around 69-71 years during the period 1996-2000. Against these likely levels, the actual male and female expectation of life at birth in urban India during 1996-2000 was estimated to be 65.73 years and 68.76 years respectively (Figure 3). It appears that female mortality has more or less been able to follow the slow rise path of the model schedule of United Nations but transition in male mortality has definitely lagged behind.

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Figure 3
Actual and Expected Transition in Expectation of Life at Birth
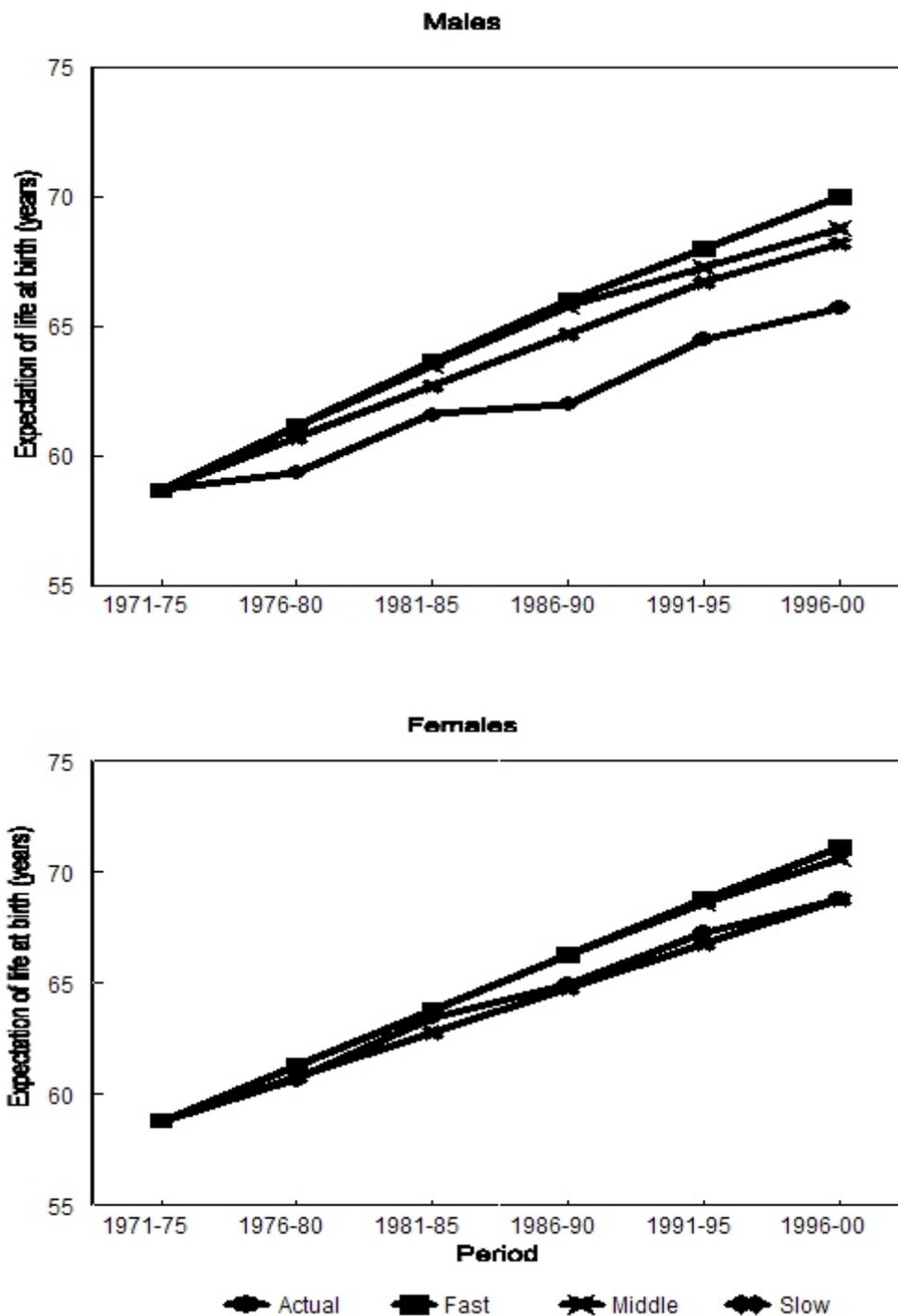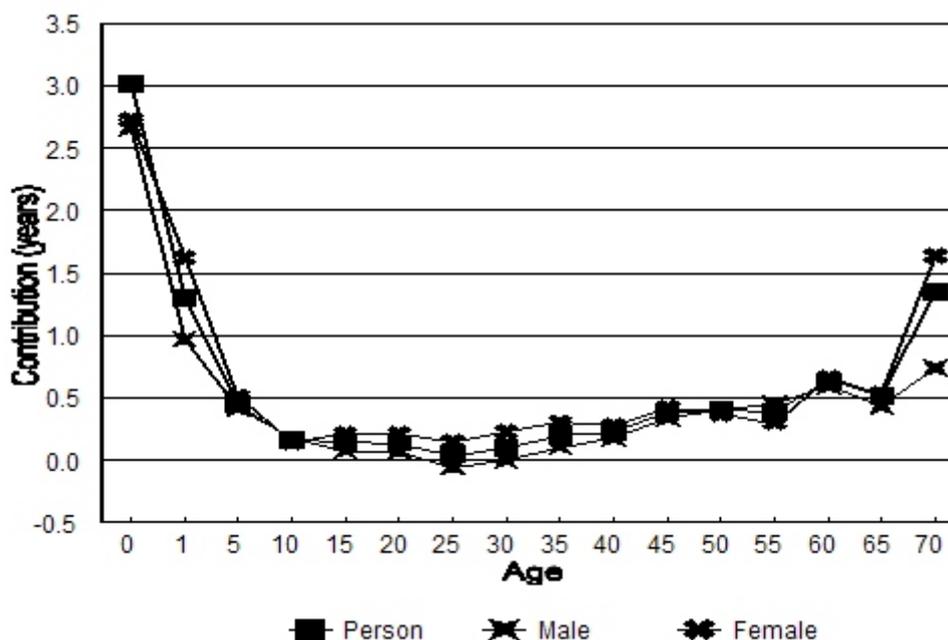Urban India

Figure 4
Contribution of mortality transition in different age groups
to the increase in the expectation of life at birth
1970-75/1998-2002

The contribution of changing mortality by age group to overall change in the expectation of life at birth may be determined through the decomposition procedure. Results of the exercise are given in table 3 and shown in figure 4. For the combined population, the greatest contribution to the increase in the expectation of life at birth was from mortality improvement in the first year of life. During the period 1970-75 through 1998-2002, improvements in infant survival accounted for more than 3 years of the total increase of almost 9.5 years in the expectation of life at birth. In addition to mortality improvements in the first year of life, mortality improvements in the age group 70 years and above and 1-4 years have also been the major contributors to the total increase in the expectation of life at birth. These three age groups almost accounted for nearly 60 per cent of the total increase in the expectation of life at birth. On the other hand, mortality improvement in the age group 10-34 years accounted for only about 6 per cent of the total increase in the expectation of life at birth.

Among males, main contributors to the increase in the expectation of life at birth were again the age groups 0-1 years; 1-4 years and 70 years and above. However, the contribution of the age group 1-4 years was larger than the contribution of the age group 70 years and above. Moreover, mortality improvements in the age group 10-34 years accounted for less than 4 per cent of the increase in the expectation of life at birth. In fact, among males, mortality

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Figure 5
Standard deviation of the contribution of mortality transition
in different age groups to change in the expectation of life at birth
in different five-year time periods
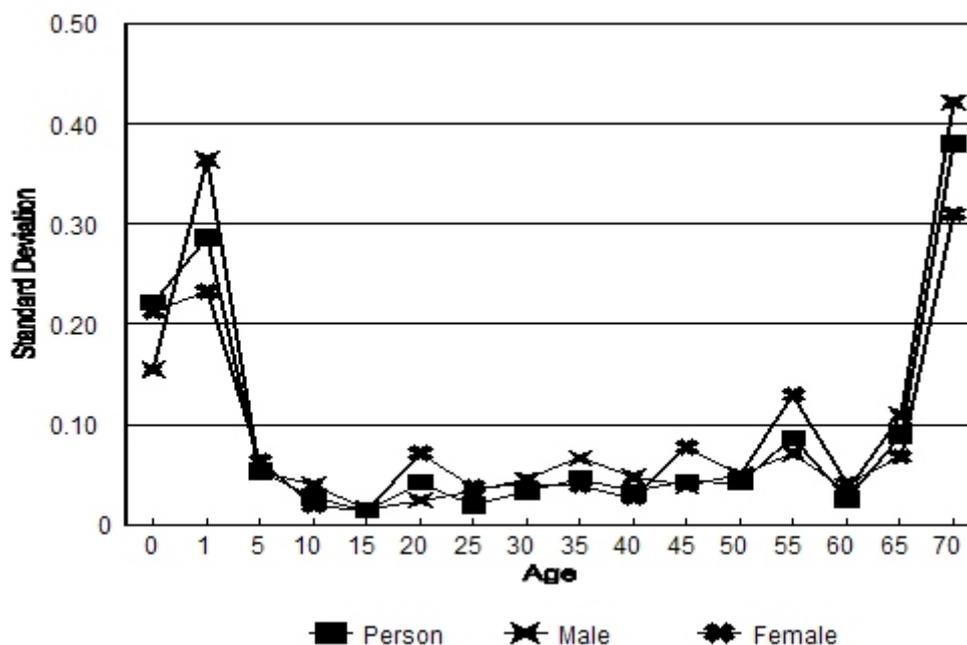
actually increased in the age group 25-29 years which resulted in marginal decrease in the expectation of life at birth. Mortality improvement in males has also been very slow in the age group 35-44 years. Even in the age group 70 years and above, improvements in mortality during the period under reference contributed only about 0.7 years to the total increase in the expectation of life at birth.

As compared to males, mortality transition in females has been faster in all age groups during the period under reference. Although, more than 58 per cent of the total increase in the expectation of life at birth in females of urban India was confined to just three age groups: 0-1 years, 1-4 years and 70 years and above, yet improvement in mortality in females was substantial in other age groups also. For example, transition in mortality in the reproductive age group (15-49 years) accounted for more than 17 per cent of the total increase in the female expectation of life at birth. By comparison, mortality improvement in males in this age group accounted for only about 11 per cent of the increase in the male expectation of life at birth.

The age pattern of transition in mortality, however, remains more or less same in both males and females. Mortality transition in urban India has been most rapid in the first year of life. From second year onwards, mortality transition has slowed down rapidly and during the age group 25-29 years, the transition in

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Figure 6
Contribution of different age groups to the increase in
the expectation of life at birth in Indian states
1970-75 through 1998-2002

mortality has been the slowest - almost stagnant; in fact, mortality has increased in this age group in males. Beyond the age group 25-29 years, mortality transition has gained the pace with the increasing age in both males and females. However, among all age groups, improvement in mortality in the first year of life remains the greatest contribution to the increase in the expectation of life at birth in both males and females.

Table 3 also provides estimates of the contribution of mortality transition in different age groups to the increase in the expectatio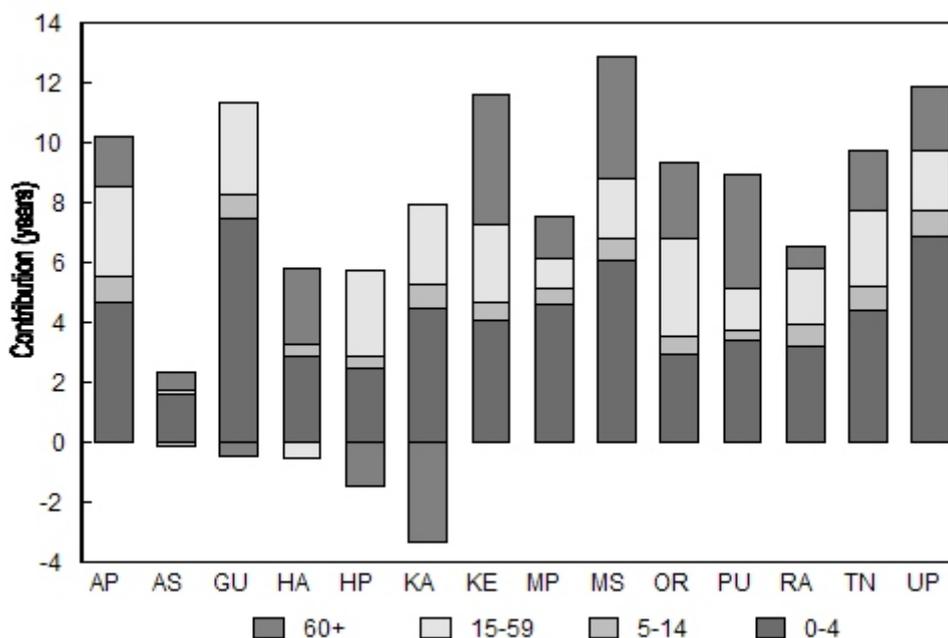n of life at birth in different five-year periods of the period under reference. The contribution of mortality transition in different age groups to the increase in the expectation of life at birth in different five-year periods has been found to fluctuate widely. In the combined population as well as in males and females, mortality has been found to have increased in different age groups in different five-year time periods resulting in a decrease rather than increase in the expectation of life at birth. These fluctuations in the contribution of different age groups to the increase in the expectation of life at birth over time are measured in terms of the standard deviation and is presented in figure 5 - the higher is the value of the standard deviation in a given age group, the greater is the variability in the contribution of that age group to the increase in the expectation of life at birth over different five-year time periods. The figure indicates that for the age group 5-69 years, the

standard deviation is in general less than 0.10 for the combined population as well as in males and females with the exception of females in the age group 55-59 years and males in the age group 65-69 years but the variability in the contribution to the increase in the expectation of life at birth as the result of mortality transition has been found to be substantially higher in the age groups 0-1 years, 1-4 years and 70 years and above.

Mortality transition in urban India has also been found to vary widely across different states of the country. The increase in the expectation of life at birth during the period under reference has been most rapid in Maharashtra where life expectancy at birth increased by more than 12 years. Increase in the expectation of life has been more than 10 years in the states of Andhra Pradesh, Gujarat, Kerala and Uttar Pradesh also. Among these states, Kerala was having the second highest expectation of life at birth during the period 1970-75 whereas the expectation of life at birth in Uttar Pradesh was the lowest. On the other hand, mortality transition has been the lowest in Assam where the urban expectation of life at birth increased just by about 2 years during the period under reference. Other states where mortality transition in the urban areas has been slow are Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh and Rajasthan. In Haryana, Himachal Pradesh and Karnataka, the increase in the expectation of life at birth ranged between 4-5 years. In all these states, the expectation of life at birth during the period 1970-75 was amongst the highest in the country - more than 63 years - with Karnataka having the highest expectation of life at birth of 64.302 years amongst the major states of the country at that time. In Madhya Pradesh and Rajasthan, on the other hand, the increase in the expectation of life at birth as the result of the transition in mortality has been in the range of 6-8 years.

Contribution of different age groups to the increase in the expectation of life at birth in major states of the country is shown in figure 6. In five states of the country - Assam, Gujarat, Haryana, Himachal Pradesh and Karnataka - mortality, instead of decreasing, increased in at least one age group during the period 1970-75 through 1998-02. In Assam, mortality increased in the age group 5-14 years while Haryana recorded an increase in mortality in the age group 15-59 years. In the remaining three states, increase in mortality was confined to the old population - population with age group 60 years and above. In Karnataka, increase in mortality in the age group 60 years and above was responsible for a decrease of more than 3.3 years in the expectation of life at birth. In Himachal Pradesh, increase in mortality in the age group 60 years and above was responsible for a decrease of almost 1.5 years in the expectation of lie at birth. Barring Gujarat, the net transition in mortality during the period 1970-75 through 1998-2002 has been the slowest in the remaining four states. In both Himachal Pradesh and Karnataka, increase in mortality in the age group 60 years and above has largely been responsible for the slow down in mortality transition.

Figure 7

Distribution of deaths prevented in the age group 0-69 years by age
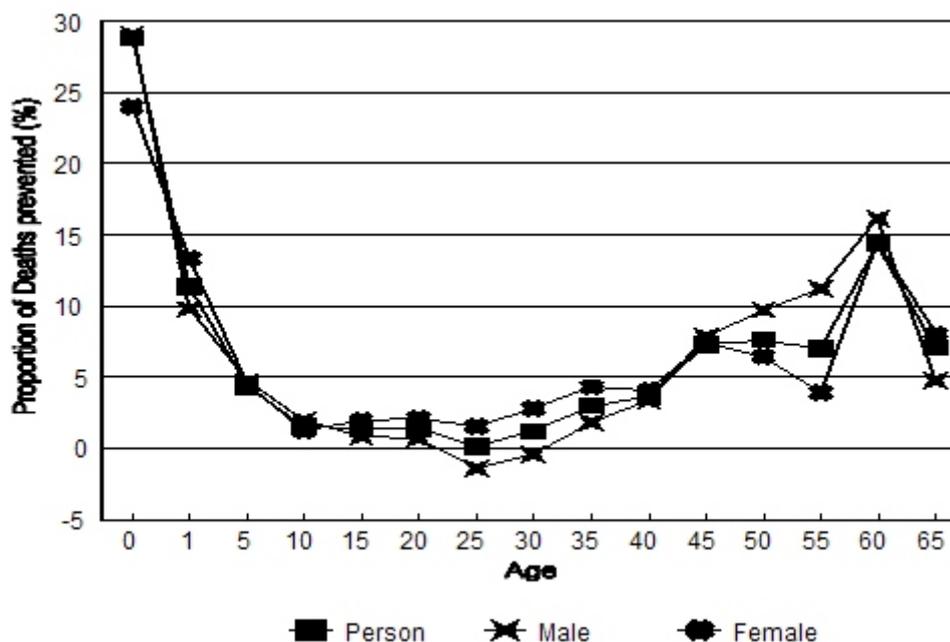
Mortality transition in Uttar Pradesh has been remarkable during the period under reference. During 1970-75, this state was having the lowest expectation of life at birth in the country. By the period 1998-2002, the expectation of life at birth in the state increased largely because of a very rapid decline in mortality in the age group 0-4 years. The transition in mortality in the age group 0-4 years in Uttar Pradesh alone was responsible for an increase of almost 7 years to the total increase of almost 12 years in the expectation of life at birth in the state. In Gujarat also, an increase in mortality in the age group 60 years and above was compensated by some very rapid decline in mortality in the age group 0-4 years which alone was responsible for an increase of nearly 8 years to the total increase of almost 11 years in the expectation of life at birth in the state. On the other hand, there has been very slow transition in adult mortality in Madhya Pradesh and Punjab and virtually no transition in Assam. In Madhya Pradesh, transition in mortality in the age group 15-59 years was responsible for the increase of less than one year only to the total increase of around 7.5 years in the expectation of life at birth. In Punjab, this contribution was slightly more than 1.4 years.

Mortality transition in the old age has also been found to vary widely across the states of the country. Improvement in mortality in the age group 60 years and above has been most rapid in Kerala and Maharashtra where mortality transition in the age group 60 years and above has been responsible for an increase of at least 4 years in the expectation of life at birth. By comparison,

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Figure 8
Contribution of change in q(x) and l(x) to
total deaths prevented
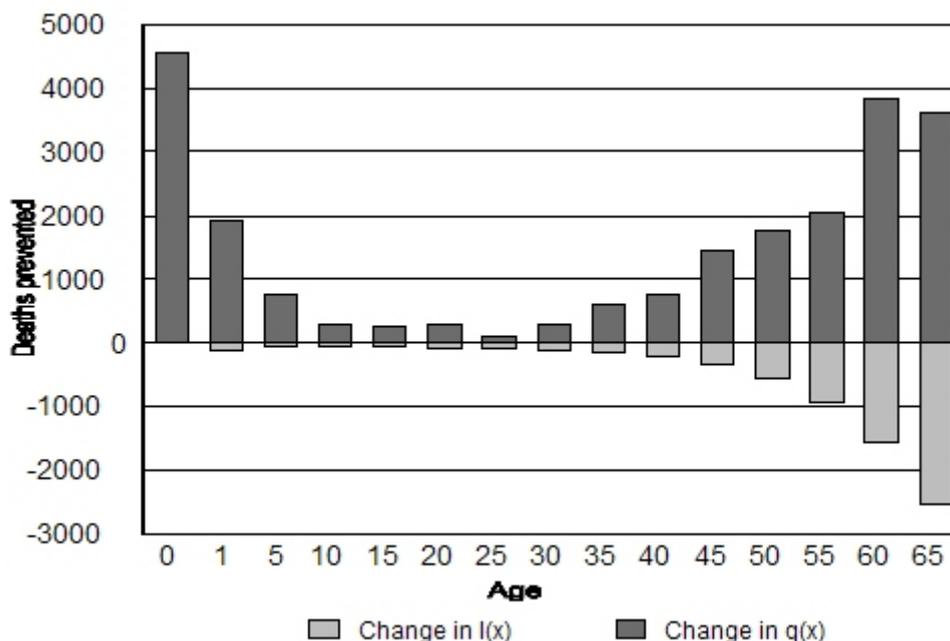
mortality transition in the age group 60 years and above in Assam and Rajasthan has been responsible for an increase of less than one year only to the total increase in the expectation of life at birth during the period under reference while in Karnataka, Himachal Pradesh and Gujarat, mortality actually increased in the age group 60 years and above.

Table 6 presents the number of deaths prevented as the result of transition in mortality in different age groups for the life table radix of 100000. Between 1970-75 and 1998-2002, total number of deaths prevented in the age group 0-69 years as the result of mortality transition in urban India were 15780 for the life table radix of 100000 resulting in an increase in l_{70} by 15780. This number of was 16874 for females as compared to 13953 for males. The distribution of the total number of deaths prevented as the result of mortality transition in different age groups is shown in figure 7. More than 45 per cent of the total deaths prevented in urban India during the period under reference were confined to the first 15 years of life whereas more than one fifth of the deaths prevented were confined to the age group 60 years and above. On the other hand, less than one third of the total deaths prevented were confined to the period 15-59 years.

The age structure of the deaths prevented in males and females as the result of mortality transition is more or less same, although there are marginal deviations. However, in males, the number of deaths increased rather than decreased in the age group 30-39 years during the period 1970-75 through 1998-

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Figure 9
Contribution of change in q(x) and change in l(x) to
total deaths prevented in Indian states
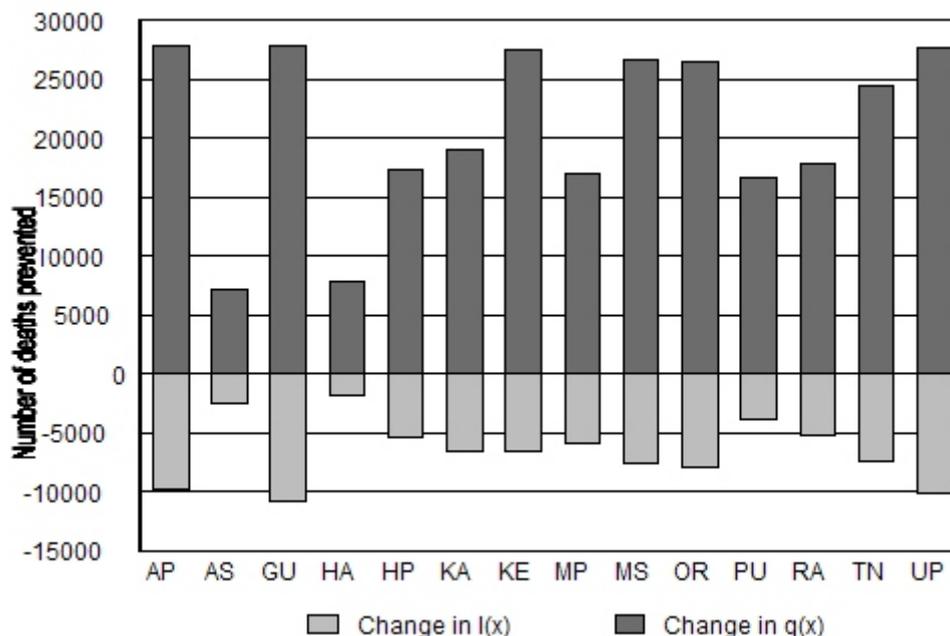
2002. On the other hand, more than 45 per cent of the total deaths prevented were confined to the first 15 years of life in males whereas this proportion was only about 43 per cent in females. By contrast, in females, the proportion of deaths prevented confined to the age group 60 years and above has been marginal higher as compared to males. The proportion of deaths prevented in the age group 15-59 years has been more or less same in the two sexes.

Total number of deaths prevented in different age groups as the result of mortality transition are determined by the change in the probability of death, q_x in a given age group and the change in the value of l_x in that age group. A decrease in q_x in any age group results in an increase in l_x in the next age group. Total number of deaths prevented in a given age group can therefore be decomposed into the total number of deaths prevented as the result of the decrease in the probability of death in that age group and the number of deaths prevented as the result of the change in l_x. In the urban India as a whole, the decrease in the probability of death in different five-year age groups of the age span 0-69 years resulted in the prevention of 22550 deaths for the life table radix of 100000 between 1970-75 and 1998-2002. However, increase in l_x in different age groups as the result of a decrease in the probability of death in the immediately previous age group resulted in an increase of 6769 deaths during the period under reference. In the male population, decline in the probability of death during the period under reference resulted in the prevention of 20517 deaths

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Figure 10
Age distribution of deaths prevented in Andhra Pradesh and Kerala
(For life table radix of 100000)
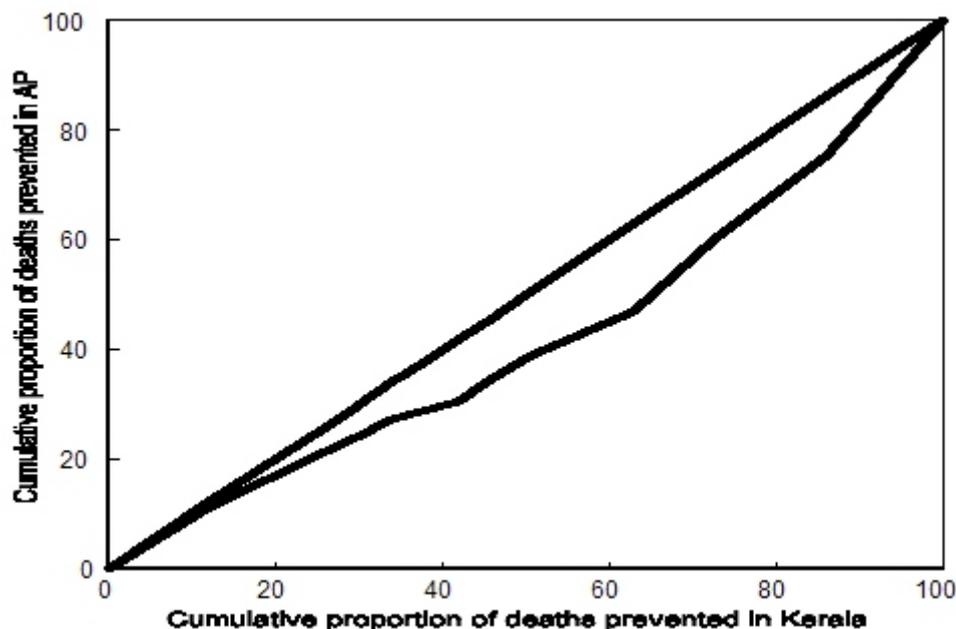
whereas increase in l_x in different age groups resulted in an increase of 6564 deaths for the life table radix of 100000. In females, on the other hand, decline in the probability of death resulted in a prevention of 23220 deaths for the life table radix of 100000 whereas the increase in l_x as the result of the resulted in an increase in the total number of deaths by 6346 deaths for the life table radix of 100000 during the period under reference.

Among different states of the country, the number of deaths prevented as the result of mortality transition during the period under reference varied widely. Total number of deaths prevented for the life table radix of 100000 have been found to be the highest in Kerala followed by Maharashtra, Orissa and Andhra Pradesh. By contrast, total number of deaths prevented have been found to be the lowest in Assam followed by Haryana, Madhya Pradesh and Himachal Pradesh. In Kerala, total number of deaths prevented for the life table radix of 100000 during the period 1970-75 through 1998-2002 were almost four times the total number of deaths prevented in Assam during the same period. The inter-state variations in the number of deaths prevented for the life table radix of 100000 is the result of both change in the levels of mortality and the change in the age structure of mortality which, in turn, is also influenced by the levels of mortality.

Although the total number of deaths prevented as the result of mortality transition in different age groups during the period under reference as been highest in Kerala, yet the number of deaths prevented as the result of the decrease

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in the probability of death has been the highest in Andhra Pradesh. In fact, in Andhra Pradesh, Gujarat, and Uttar Pradesh, the number of deaths prevented as the result of the decrease in the probability of death only have been higher than the total number of deaths prevented in Kerala. The age distribution of the deaths prevented as the result of the decrease in the probability of death has been different in the two states. in Andhra Pradesh the deaths prevented as the result of the decrease in the probability of death were concentrated more in the younger age group. On the other hand, almost one fourth of the total deaths prevented as the result of the decrease in the probability of death were confined to the age group 65-69 years alone. A similar situation exists in case of Gujarat and Uttar Pradesh.

Conclusions

It may be concluded from the foregoing analysis that mortality transition in urban India during the 27 years between 1970-75 and 1998-02 has, at best, been slow. Transition in male mortality during the period under reference has been slower than slow rise trajectory in the expectation of life at birth suggested by the United Nations. On the other hand, transition in female mortality has been able to follow the slow rise trajectory in the expectation of life at birth suggested by the United Nations. There has also been a considerable slow down in mortality transition during the period 1981-85 through 1986-90 largely because of near stalling of mortality transition in the male population. In the recent years also, mortality transition in urban India has remained slower than expected, especially among females.

Mortality transition has also not been uniform in all age groups. It has largely been confined to the early years of life and to the old age. Mortality transition has been relatively slow in the working age population, especially among males. Among males, instead of decreasing, mortality has actually increased in some of the working age groups resulting in a decrease in the expectation of life at birth. Moreover, mortality transition in different age groups has not been consistent over time.

Mortality transition has been more rapid in urban females as compared to urban males in all age groups during the period under reference. As the result the female male gap in the expectation of life at birth in urban India has widened over time. Compared to the past, today females live longer than the males in urban India.

Reasons for the observed transition in mortality in urban India, especially, very slow transition in male mortality, are not known at present. A useful clue for the reasons behind the observed transition in mortality in urban India and sex differentials in the transition may be obtained through the analysis of the causes of death and changes in the cause of death pattern over time. However, information about the causes of death in urban India is currently not available because of the problems in medical certification of the cause of death. Some very

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limited information about the cause of death pattern in the country is available through the 'Medical Certification of Cause of Death Scheme' of the Government of India. This scheme, however, provides information for the country as a whole and not for the rural and urban areas separately.

In any case, the very fact that the observed transition in mortality in urban India during the 27 years between 1970-75 through 1998-2002 has been slow has important implications for the evolution of the urban health policy and for the urban health planning. The observation that mortality transition has not been consistent either over time or between the two sexes or across different states of the country also suggests that the factors that determine the probability of death vary widely across urban India. Although, the empirical evidence is not available, yet it is logical to assume that factors that determine the probability of death in different age groups vary with the size class of town. Similarly, it may also be argued that the disease profiles or morbidity conditions which are important proximate determinants of mortality also vary with the size class of towns. Unfortunately, very little information is currently available to understand the dynamics of mortality in urban India.

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Table 1:   Expectation of life at birth in urban India, 1970-2002.

Period	Person	Male	Female	Absolute increase			Female-Male
				Person	Male	Female	
1970-75	58.437	58.675	58.820				0.145
1976-80	59.953	59.347	60.668	1.516	0.672	1.848	1.321
1981-85	62.533	61.612	63.480	2.580	2.265	2.812	1.868
1986-90	63.444	62.018	64.940	0.911	0.406	1.460	2.922
1991-95	65.858	64.485	67.284	2.414	2.467	2.344	2.799
1996-2000	67.336	65.734	68.764	1.478	1.249	1.480	3.030
1998-02	67.920	66.283	69.153	0.584	0.549	0.389	2.870
Increase	9.483	7.608	10.333				

Table 2: Expectation of life at birth in urban areas in Indian states: 1970-75 and 1998-2002.

States	1970-75		1998-2002		Increase	
	Level	Rank	Level	Rank	Absolute	Rank
Andhra Pradesh	56.808	9	66.971	8	10.163	5
Assam	55.700	12	57.857	13	2.157	14
Gujarat	54.836	13	65.645	10	10.809	4
Haryana	63.346	3	68.553	6	5.207	11
Himachal Pradesh	64.040	2	68.260	7	4.220	13
Karnataka	64.302	1	68.886	5	4.584	12
Kerala	62.473	4	74.090	1	11.617	3
Madhya Pradesh	56.762	10	64.254	11	7.492	9
Maharashtra	57.464	8	70.285	3	12.821	1
Orissa	56.319	11	65.645	10	9.326	7
Punjab	62.027	5	70.957	2	8.930	8
Rajasthan	59.600	6	66.148	9	6.548	10
Tamil Nadu	59.175	7	68.911	4	9.736	6
Uttar Pradesh	51.274	14	63.138	12	11.864	2

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Table 3:   Actual and expected change in the expectation of life at birth in urban India.

Period	Actual levels of expectation of life at birth	Expected levels of expectation of life at birth assuming United Nations trajectory of		
		Fast rise	Middle rise	Slow rise
Males				
1971-75	58.68	58.68	58.68	58.68
1976-80	59.35	61.18	61.18	60.68
1981-85	61.61	63.68	63.48	62.68
1986-90	62.02	65.98	65.78	64.68
1991-95	64.48	67.98	67.28	66.68
1996-00	65.73	69.98	68.78	68.18
Females				
1971-75	58.82	58.82	58.82	58.82
1976-80	60.67	61.32	61.32	60.82
1981-85	63.48	63.82	63.82	62.82
1986-90	64.94	66.32	66.32	64.82
1991-95	67.28	68.82	68.62	66.82
1996-00	68.76	71.12	70.62	68.82

Table 4: Contribution of different age groups to the total change in the expectation of life at birth in urban India.

Age	1970-75/ 1976-80	1976-80/ 1981-85	1981-85/ 1986-90	1986-90/ 1991-95	1991-95/ 1996-2000	1996-2000/ 1998-02	1970-75/ 1998-2002
	Person						
0	0.933	0.697	0.387	0.315	0.558	0.122	3.012
1	-0.216	0.606	0.418	0.362	0.092	0.039	1.300
5	0.181	0.090	0.045	0.089	0.024	0.030	0.459
10	0.060	-0.003	0.047	0.000	0.058	-0.000	0.162
15	0.007	0.027	0.029	0.046	0.008	0.028	0.144
20	-0.006	0.101	0.004	-0.011	0.050	0.000	0.139
25	0.002	0.052	0.002	0.008	-0.004	-0.017	0.042
30	0.044	0.068	0.039	-0.019	-0.009	-0.016	0.107
35	0.121	0.049	0.042	0.023	-0.021	-0.015	0.200
40	0.013	0.079	0.094	0.030	0.021	-0.007	0.230
45	0.074	0.127	0.031	0.108	0.016	0.027	0.383
50	0.027	0.117	0.068	0.131	0.034	0.025	0.403
55	0.038	0.123	-0.001	0.215	-0.017	0.033	0.392
60	0.120	0.065	0.123	0.142	0.098	0.090	0.638
65	0.054	0.106	-0.035	0.240	0.088	0.066	0.519
70	0.064	0.275	-0.382	0.735	0.483	0.180	1.354
All ages	1.517	2.580	0.911	2.414	1.479	0.584	9.483

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Age	1970-75/ 1976-80	1976-80/ 1981-85	1981-85/ 1986-90	1986-90/ 1991-95	1991-95/ 1996-2000	1996-2000/ 1998-02	1970-75/ 1998-2002
				Male			
0	0.678	0.573	0.227	0.458	0.577	0.146	2.660
1	-0.507	0.583	0.320	0.293	0.198	0.084	0.972
5	0.191	0.062	0.050	0.056	0.052	0.009	0.419
10	0.081	-0.017	0.061	-0.005	0.056	-0.003	0.173
15	-0.006	0.024	0.021	0.035	-0.002	0.005	0.077
20	-0.008	0.046	-0.026	0.015	0.018	0.031	0.076
25	-0.011	0.016	-0.018	0.015	-0.075	0.018	-0.054
30	0.010	0.049	0.011	0.011	-0.086	0.007	0.003
35	0.126	0.012	0.042	0.038	-0.082	-0.028	0.109
40	-0.012	0.050	0.125	0.027	0.010	-0.015	0.185
45	0.038	0.144	0.043	0.050	0.061	0.009	0.345
50	-0.001	0.110	0.062	0.141	0.042	0.055	0.410
55	0.105	0.055	0.008	0.214	0.040	0.030	0.452
60	0.116	0.078	0.069	0.161	0.088	0.090	0.602
65	0.025	0.111	-0.085	0.252	0.082	0.054	0.439
70	-0.154	0.368	-0.503	0.706	0.269	0.056	0.741
All ages	0.672	2.265	0.406	2.467	1.249	0.549	7.608

Age	1970-75/ 1976-80	1976-80/ 1981-85	1981-85/ 1986-90	1986-90/ 1991-95	1991-95/ 1996-2000	1996-2000/ 1998-02	1970-75/ 1998-2002
				Female			
0	0.533	0.848	0.541	0.174	0.536	0.096	2.729
1	0.114	0.607	0.524	0.438	0.014	-0.071	1.625
5	0.178	0.113	0.046	0.121	-0.006	0.058	0.511
10	0.039	0.010	0.029	0.008	0.062	0.003	0.152
15	0.020	0.032	0.034	0.060	0.021	0.050	0.216
20	0.006	0.168	0.026	-0.040	0.087	-0.031	0.216
25	0.025	0.081	0.047	-0.020	0.077	-0.058	0.152
30	0.084	0.091	0.025	-0.007	0.078	-0.043	0.227
35	0.110	0.101	0.041	0.001	0.052	-0.003	0.303
40	0.038	0.083	0.090	0.041	0.022	-0.003	0.272
45	0.111	0.111	0.014	0.178	-0.038	0.041	0.416
50	0.064	0.134	0.049	0.128	0.006	-0.012	0.370
55	-0.049	0.213	-0.025	0.206	-0.084	0.040	0.300
60	0.133	0.048	0.171	0.126	0.100	0.087	0.664
65	0.083	0.100	0.015	0.220	0.059	0.062	0.540
70	0.360	0.071	-0.167	0.711	0.495	0.174	1.643
All ages	1.848	2.812	1.460	2.343	1.481	0.389	10.333

Table 5:   Contribution of different age groups to the total change in the expectation of life at birth in Indian states during 1970-75 through 1998-2002 (Urban areas only).

State	Age group				All ages
	0-4	5-14	15-59	60+	
Andhra Pradesh	4.679	0.805	3.036	1.644	10.163
Assam	1.609	-0.151	0.115	0.585	2.157
Gujarat	7.470	0.767	3.060	-0.488	10.809
Haryana	2.881	0.375	-0.571	2.523	5.207
Himachal Pradesh	2.424	0.400	2.862	-1.466	4.220
Karnataka	4.448	0.798	2.689	-3.351	4.584
Kerala	4.053	0.620	2.595	4.349	11.617
Madhya Pradesh	4.601	0.512	0.984	1.396	7.492
Maharashtra	6.076	0.690	1.996	4.058	12.821
Orissa	2.912	0.596	3.256	2.563	9.326
Punjab	3.382	0.327	1.416	3.805	8.930
Rajasthan	3.170	0.723	1.875	0.780	6.548
Tamilnadu	4.358	0.804	2.545	2.028	9.736
Uttar Pradesh	6.818	0.925	1.988	2.134	11.864

Table 6:　　　　Number of deaths prevented as the result of transition in mortality in urban India.

Age	Number of deaths prevented for life table radix of 100000 during							Deaths prevented due to	
	1970-75/ 1976-80	1976-80/ 1981-85	1981-85/ 1986-90	1986-90/ 1991-95	1991-95/ 1996-2000	1996-2000/ 1998-02	1970-75/ 1998-2002	Change in q(x)	Change in l(x)
Combined Population									
0	1460	1068	581	463	800	176	4548	4548	0
1	-395	881	611	525	118	49	1789	1917	-128
5	288	128	63	135	32	45	690	751	-60
10	100	-16	75	-5	93	-1	246	282	-36
15	-0	36	44	78	7	50	214	267	-53
20	-29	191	-3	-33	91	-3	214	286	-72
25	-12	96	-9	6	-20	-40	20	105	-85
30	99	146	84	-61	-36	-43	188	297	-109
35	335	103	102	49	-72	-43	473	620	-148
40	-8	200	278	75	46	-26	565	762	-197
45	216	388	54	370	28	89	1145	1467	-322
50	-9	335	201	497	91	89	1203	1754	-550
55	22	339	-178	947	-165	139	1104	2038	-934
60	472	-136	520	507	458	446	2267	3832	-1564
65	-89	78	-705	1147	385	297	1114	3625	-2511
All ages	2449	3836	1717	4699	1856	1225	15780	22550	-6769

Age	Number of deaths prevented for life table radix of 100000 during							Deaths prevented due to	
	1970-75/ 1976-80	1976-80/ 1981-85	1981-85/ 1986-90	1986-90/ 1991-95	1991-95/ 1996-2000	1996-2000/ 1998-02	1970-75/ 1998-2002	Change in q(x)	Change in l(x)
Male Population									
0	1067	889	346	686	846	213	4047	4047	0
1	-831	874	482	431	281	121	1360	1442	-81
5	319	88	76	84	77	12	656	704	-48
10	146	-41	104	-14	93	-6	281	313	-31
15	-17	35	34	61	-12	7	108	149	-41
20	-24	84	-66	20	26	62	103	156	-53
25	-32	19	-53	23	-186	36	-193	-124	-69
30	21	105	19	14	-233	11	-63	31	-94
35	382	-1	112	91	-248	-88	250	384	-134
40	-81	116	408	59	20	-56	465	646	-181
45	112	490	112	145	208	27	1094	1390	-296
50	-79	328	191	561	135	220	1356	1865	-509
55	501	-0	-131	973	125	104	1572	2486	-914
60	523	57	205	615	392	456	2248	3825	-1577
65	-254	238	-1053	1212	328	198	669	3203	-2534
All ages	1752	3282	786	4961	1853	1319	13953	20517	-6564

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| Age | Number of deaths prevented for life table radix of 100000 during | | | | | | | Deaths prevented due to | |
	1970-75/ 1976-80	1976-80/ 1981-85	1981-85/ 1986-90	1986-90/ 1991-95	1991-95/ 1996-2000	1996-2000/ 1998-02	1970-75/ 1998-2002	Change in q(x)	Change in l(x)
					Female Population				
0	828	1282	799	251	754	135	4049	4049	0
1	132	850	743	626	2	-104	2248	2397	-148
5	278	159	59	181	-14	89	751	814	-64
10	62	4	41	8	98	4	218	254	-36
15	25	40	48	100	31	87	330	389	-58
20	-5	317	37	-91	159	-61	356	441	-85
25	41	151	87	-54	152	-123	254	346	-92
30	195	191	41	-29	170	-99	469	580	-110
35	287	240	92	-8	121	-7	724	860	-136
40	83	199	251	113	44	-8	683	861	-178
45	356	310	-11	609	-162	139	1241	1529	-288
50	160	410	117	466	-22	-51	1080	1585	-506
55	-449	789	-278	883	-467	185	662	1488	-826
60	590	-323	816	431	483	451	2447	3872	-1425
65	185	-62	-340	1036	229	314	1361	3756	-2394
All ages	2765	4555	2501	4522	1578	952	16874	23220	-6346

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Table 7: Deaths prevented as the result of mortality transition in Indian states (For life table radix of 100000).

State	Deaths prevented due to change in q(x)	Deaths prevented due to change in l(x)	Net deaths prevented
Andhra Pradesh	27906	-9796	18111
Assam	7177	-2480	4698
Gujarat	27883	-10761	17122
Haryana	7831	-1810	6020
Himachal Pradesh	17287	-5449	11838
Karnataka	19080	-6595	12484
Kerala	27510	-6559	20950
Madhya pradesh	16967	-5983	10984
Maharashtra	26702	-7667	19036
Orissa	26411	-8035	18376
Punjab	16639	-3828	12811
Rajasthan	17935	-5234	12701
Tamilnadu	24533	-7500	17034
Uttar Pradesh	27648	-10095	17553