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Editorial

Dr Abdul Abyad
Chief Editor

In this issue of the journal the papers discuss the demographic trends in India which are of great interest in addition to dealing with geriatric care through life.

In the paper on Generation Life Table for India, 1901-1951. The authors stressed that the study of mortality in India during the first part of twentieth century forms a very important and interesting study. It is very significant to note that India's population growth in those years (1901-1951) was governed not by the fluctuations in the birth rate but by the wide variations in the death rate. The aim of the present study is to construct sex wise generation life table of India and to assert the advantage of generation life expectancy over period life expectancy. Further, the effects of different birth cohorts on distribution of age at death for male and female population of India are also examined. The data used in this study are secondary in nature and put with fitted arguments. The construction of different generation life table of India shows the higher value of generation life expectancy over period life expectancy and help to recognize that different birth cohorts of India have different distribution of age at death. This can be important for policy makers to tackle the health problems of different cohorts. It is further expected that the construction of generation life table would open up newer areas of studying mortality pattern of a country.

In the second paper A Comparative Study of Life Tables in an Urban Set-up of North –East of India, since 1986 to 2011. The authors stressed that life table gives life expectancies, death probabilities, the most preferred indicators in demographic and health analysis that used to measure status of good health, education and other valued achievements. The authors aims is to study the trend and differential of mortality of Guwahati city, Assam for male and female by means of life table for the period 1986 to 2011. Materials and Methods: Data in this study has been extracted from the Office of Birth and Death Registration, Guwahati Municipal Corporation (GMC) for the years 1986 to 2011 at an interval of five year. Total 24,145 death records were collected from Office of Birth and Death Registration, GMC during 1986 to 2011. The results showed significant changes of life expectancies at different age has found for both sexes of Guwahati city during 1986-2011. A declining trend of probabilities of death has been found since 1986- 2011 irrespective of sex. The authors concluded that though healthcare policies in Assam are adequate in addressing the issues of infants, children and mothers, it is required to address the issues regarding survival gain in Guwahati.

The last paper discussed the association of lifelong learning process with geriatric care i.e. the physical and mental well-being of the elderly people of India. The study utilized data from Census of India, National Sample Survey Organization and Sample registration system for reviewing the relevant issues like who are the old, what are their problems and why do they need care or why society should at all bother for their care? The authors proposes the introduction of folk games or traditional games for identifying psychological / psychiatric disorder of the elderly people. Another fruitful learning experience may be the learning a new language in a later age. The post retirement period may be the fertile ground for hobby and experience sharing. All these proposed schemes of learning for the aged people demands an infrastructure. Here comes the responsibility of the government and society as a whole. The authors concluded that the study does not demand credit for any innovative schemes of learning. The present study only proposes a few new contexts for these processes. It is sincerely expected that the use of Lifelong Learning as a medium for the physical and mental upliftment of this esteemed section of the society would give the 'concept of learning' it's much needed humanistic approach.

Original Contribution/Clinical Investigation

Generation Life Table for India, 1901-1951

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ABSTRACT

Introduction: The study of mortality in India during the first part of the twentieth century forms a very important and interesting study. It is very significant to note that India's population growth in those years (1901-1951) was governed not by the fluctuations in the birth rate but by the wide variations in the death rate. This kind of study is therefore increasingly being necessary to examine the past and future population trends of India.

Objective: The aim of the present study is to construct a sex wise generation life table of India and to assert the advantage of generation life expectancy over period life expectancy. Further, the effects of different birth cohorts on distribution of age at death for male and female populations of India are also examined.

Data and Methodology: The data used in this study are secondary in nature and put with fitted arguments.

Results and Conclusion: The construction of a different generation life table of India shows the higher value of generation life expectancy over period life expectancy and helps to recognize that different birth cohorts of India have different distributions of age at death. This can be important for policy makers to tackle the health problems of different cohorts. It is further expected that the construction of generation life table would open up newer areas of studying the mortality pattern of a country.

Key words: Generation Life Table, India, Generation Life Expectancy, Period Life Expectancy, Trend of Mortality.

Introduction

The study of mortality in India during the first part of the twentieth century forms a very important and interesting study. It is very significant to note that India's population growth in those years i. e. from 1901 to 1951 was governed not by the fluctuations in the birth rate but by the wide variations in the death rate. Thus death rate, not birth rate determines the population trend in India. In those earliest years of the twentieth century, the population was constant or declined as a result of great catastrophe like famine, epidemic, war or at times, a combination of all these. Even though at some point of time the Indian populace was exempted from the aforementioned calamities, it was however constantly being the prey of poor diet which very significantly determined the mortality patterns of the country. The change in population is also negligibly influenced by impact of emigration. The study of mortality is increasingly being necessary to examine the past and future population trends of India. (Davis, K., 1961). This kind of work requires a long time series of data which subsequently enables one to trace the demographic history of a birth cohort, that is, the group of persons born in a given year. (Bourbeau, et.al. ,2004). Here comes the importance of construction of generation life tables.

Life tables are one of such vital statistical models through which transition pattern of mortality can be explained. A life table has been universally regarded as a concise way of showing the ability of a member of a particular populace existing or disappearing at a particular age. Life tables do not require standard population for comparing mortality like other measures of mortality. The levels and trends in mortality depict the change in the quality of life of a population. The community health employees, researchers, planners and many more from other allied disciplines utilize life table notion and method in their study. (Kintner, 2004). Stating the importance of life tables Coale and Demeny (1966) opine "Life tables provide a succinct description of what is the most prominent aspect of the state of human mortality; they show the varying chances of dying as a function of age."

Life table can be categorized into two types according to the reference year - period or current life table and generation or cohort life table. The period life table demonstrates the collective mortality experience by age of the people living in an area. It describes the mortality pattern prevailing in a particular short period such as one or three years. The second type of life table i.e. the generation life table consists of mortality rates experienced by a particular birth cohort, in which the age specific death rates of that cohort from their birth through each consecutive age in successive calendar years are used. This kind of life table requires data for a long period, at least for 100 years. This requirement of data for a longer period put hurdles in constructing generation life tables. Hence one generally prefers construction of period life table instead of generation life tables. However, generation life tables have their own share of significance in projecting actual mortality transition. Generation life table is useful for projections of mortality, for study of mortality trends, and for the measurement of fertility and re-productivity (Kintner, 2004). Hence, more precisely, the generation life tables can be used to compute generation reproduction rates, to study life expectancy historically, to project mortality, and to make estimates of orphanhood (Gregory, 1965). In this way, generation life tables help to study the mortality trends in a population more specifically since they are based on the different combinations of age specific death rates.

Dublin and Spiegelman (1941), Dublin, Lotka and Spiegelman (1949), Spiegelman (1957) and others study generation life tables with great results. A number of countries viz. Germany (Bomsdorf, 1993), England and Wales (Case, 1962), Australia (Lancaster,1959; Young,1969), Belgium (Veys,1981), France (Delaporte, 1941; Vallin, 1973), the Netherlands (Tas, 1991; Van Poppel, 1996), Sweden (Schoen and Urton 1979; Bolander,1970), the United States (Jacobson, 1964), Thailand (Prasartkul and Rakchanyaban, 2002), Canada and Quebec (Bourbeau.et.al, 2004) construct generation life tables. However in India due to a dearth of reliable data on mortality, period life tables are usually preferred instead of generation life tables. However, the period life table has certain problems in reflecting proper mortality pattern. This method understates the mortality status as it believes in a unitary set of health conditions. The generation life table, on the other hand, could represent the development of life expectancy of real cohorts since it believes in changing mortality status over the years. Willets (1999), (2004), Richards and Jones (2004), Richards et al. (2006) and many others also discuss the importance of birth cohorts for studying the pace of mortality.

The aforesaid discussion prompts one to construct sex-wise generation life table for India. This will further help one to examine the influence of different birth cohorts on distribution of age at death.

Objectives

The objectives of this paper are:

1. to construct sex wise generation life table of India for 1901 to 1951, for birth cohorts 10 years apart.
2. to assert the advantage of generation life expectancy over period life expectancy by computing the magnitude of the gap between the two life expectancies.
3. to examine the effects of different birth cohorts on distribution of age at death for male and female population of India.

Data and Methodology

It has already been mentioned that the key focus of this work is to trace the mortality trend of India for the period 1901 to 1951 by constructing a generation life table. Justifications for use of generation life table has partly been offered in the introduction and widely been discussed throughout this paper. Though it is possible to construct generation life table for any birth cohort, this study earmarked the period from 1901 to 1951 with specific reasons. It is considered that the pre twentieth century data for India are seemingly hazy and unreliable and beyond 1951, data become too dependent on projections.

The data used in this study are secondary and the unavailability of reliable data for such a long period of time justifies the use of different sources of secondary data for constructing the generation life tables. Murray et.al (2003) has supported the use of

different sources of data to estimate mortality in countries like India, China and Brazil where different sources including surveillance systems, vital registration and surveys are used. Here we do not go for smoothing of the data since in this study of generation life table; the emphasis is to establish its closeness to the actual data than to remove the fluctuations if any. (Kintner, 2004). The different steps required for constructing generation life tables are discussed in the following:

Computing and estimating life expectancies at birth:
The first step in constructing generation life table is to obtain and estimate the trends of sex wise period life expectancies at birth eo. In this work eo are obtained for population of India during the 20th and first half of the 21st century (1901 to 2051) from the available data. For instance, the construction of a generation life table of 1901 requires life expectancy at birth for 100 years i.e. for 1901,1902, 1906 and then for every 5 year intervals, 1911,1916 so on up to 2001. This will provide information for ages 0, 1, 5, 10 ,.... and so on as in the case of abridged life table. The generation life tables of 1911, 1921, 1931, 1941 and 1951 will follow the similar pattern.
In this work the data on life expectancy at birth for the male and female population of India is taken from life tables constructed by Malaker and Roy (1990), reports published by the office of the Registrar General of India (Sample Registration System reports: 1989-93, 1994-98 and 1999-2003), CBHI (Central Bureau of Health Intelligence, 2005) and life expectancy at birth projections made by Mahmood and Kundu (2006). The generation life tables of this study are based on a set of life expectancy at birth available for the periods covered as shown below:

Period 1901-1971:
The life expectancy at birth from 1901, 1911 to 1971, i.e. for every 10 year intervals were obtained from CBHI (Central Bureau of Health Intelligence, 2005).

Period 1902-1952 and for the year 1980:
The life expectancy at birth for the years 1902, 1912, 1922, 1932, 1942, 1952 and 1980 were estimated from the available period life tables by assuming a uniform annual increment or decrement of expectation of life at birth. The Registrar General of India used to estimate life expectancy at birth using Sample Registration System (SRS) data for some states of India. These estimates are derived from the clubbed data for a period of five years of Age Specific Mortality Rate and published in SRS abridged life tables. The estimates for the period 1998-02 may be referred to the mid period 2000. This is illustrated as follows: If life expectancy at birth increases by 3.8 years during 1991-2000, then it gains at about 0.38 years annually. (SRS based on abridged life table 2002-06). This incites us to assume that life expectancy at birth increases/decreases uniformly annually.

Period 1906-1986:
The mid period life expectancy i.e. for 1906, 1916 to 1986, i.e. for every 10 year interval, was not available in CBHI and hence taken from life tables constructed by Malaker and Roy (1990). Malaker and Roy reconstructed life tables for India from 1901-11 to 1971-81 and projected for 1981-91 and 1991-2001. Further the mortality pattern observed in the life tables of Malaker and Roy (1990) is similar to the sample registration system and thereby validates the use of the life tables of Malaker and Roy in this study.

Period 1991-2001:
The life expectancy at birth for the years 1991, 1996 and 2001 were obtained directly from period life tables of 1989-93, 1994-98 and 1999-2003 constructed by Register General of India, using Sample Registration System. (SRS Analytical Studies, Report No. 1 of 1996, report No.3 of 2003 and report No.1 of 2006).

Figure 1: Trend of e_o from 1901-2051, India, males and females

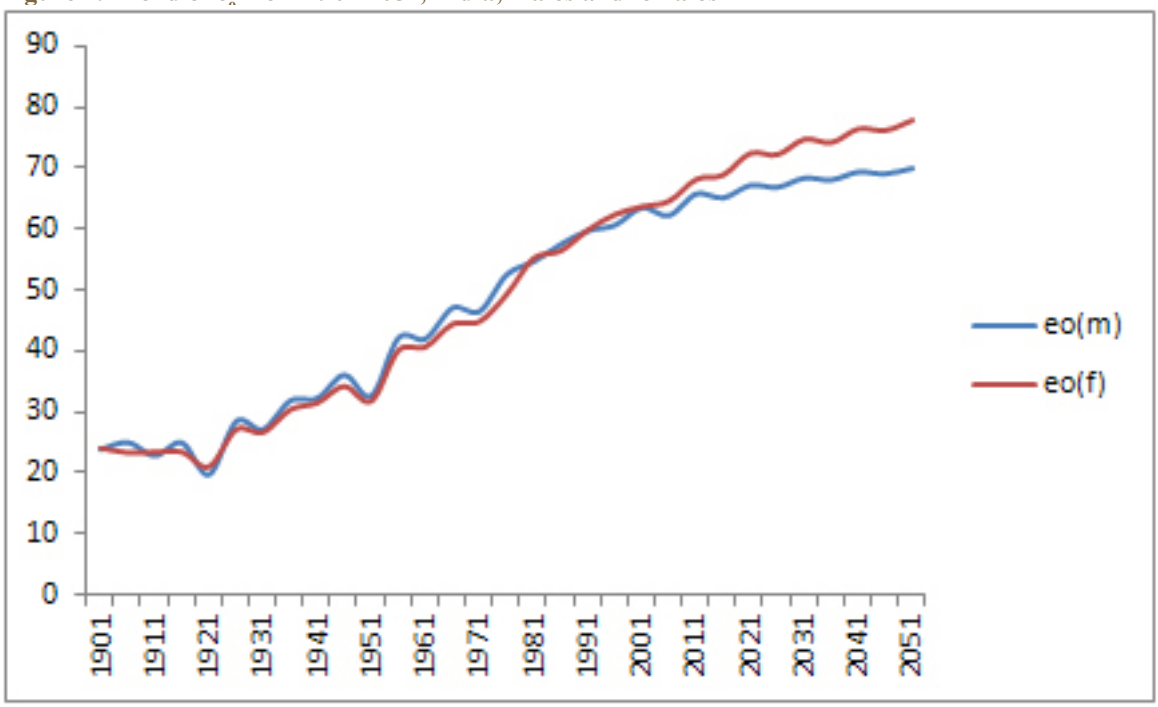


Table 1: Estimated Sex wise Life expectancies at birth, India, 1901-2051

Year	e_o(m)	e_o(f)
1901	23.63	23.96
1906	24.76	23.23
1911	22.59	23.31
1916	24.74	23.34
1921	19.42	20.91
1926	28.26	26.97
1931	26.91	26.56
1936	31.63	30.25
1941	32.09	31.37
1946	35.91	34.09
1951	32.45	31.66
1956	42.04	39.95
1961	41.89	40.55
1966	46.98	44.27
1971	46.4	44.7
1976	52.45	49.13
1981	54.63	55.03
1986	57.48	56.27
1991	59.7	59.7
1996	60.6	62.2
2001	63.5	63.5
2006	62.22	64.4
2011	65.77	67.95
2016	65.14	68.7
2021	67.2	72.25
2026	66.9	72
2031	68.4	74.55
2036	68.1	74
2041	69.4	76.25
2046	69.1	76
2051	70	77.65

Period 2006-2051:

The life expectancy at birth from 2006 to 2051 was taken from the projections made by Mahmood and Kundu (2006). The rationale behind the use of this projection is that it projects population of India by using component method of projection, similar to Mari Bhat (2001) who projects population of India around the year 2025 by using the same method. The base year in the former case is provided by the census of India 2001 whereas Mari Bhat considers it to be 2000, on the basis of the provisional results of the 2001 census. The life expectancy at birth of the male and female population of India for the year 2011 is 65.77 and 67.95 years respectively according to the 2011 census. (Office of the Registrar General and Census Commissioner, 2011), and the corresponding eo in 2011 estimated by Mahmood and Kundu (2006) are 65.48 and 68.95 respectively. This may provide necessary justification in support of using this projection for constructing generation life table. With the help of the aforementioned sources we have obtained and estimated the different life expectancies at birth for the male and female population of India.

The life expectancies as shown in Figure 1 represent the pattern of mortality evolution of population of India during the 20th and the first half of the 21st century.

Table 1 and Figure 1 track the general trend of mortality by computing expectation of life at birth for the males and females of India from 1901 to 2051. It is observed that eo ranges between 19 and 78 years during the 20th and first half of the 21st century. In the beginning of the twentieth century males and females of India were subjected to excess mortality due to prevalence of epidemics, floods, famines and war or a blending of all these. The first half of the twentieth century witnessed the influenza endemic of 1918 which increased the annual death rate to 63 per thousand. But after this calamity, death rate was never too high and it started declining gradually. The infant mortality rate was also high in 1918. It was 267 per thousand life births and a gradual decline thereafter. Though such decline in infant mortality rate is not parallel to the general mortality rate; the fall in the infant mortality contributed a major share to the reduction in general mortality. (Davis,K. 1951). Further, data from Sample Registration System indicates that Crude Death Rate of India declined from 14.9 in 1971 to 7.6 in 2005. The infant mortality rate of India also declined from 115 per thousand live births in 1961 to 53 in 2008. (Sample Registration System, 2001). This transformation of mortality over the years influenced the expectation of life at birth. The present study also observes that between 1901 and 2051, female birth cohorts' life expectancy at birth is more than three times in India rising from 24 years to 78 years. However the gains for males were smaller than the females, with life expectancy at birth of males rising only from 24 years to 70 years between the same cohorts. The present and future females of India thus would have higher life expectancy at birth than the males. Bourbeau et al (2004) too observe higher life expectancies at birth among females of Canada and Quebec than the males. From figure 1 it is seen that the gap between life expectancy at birth for the two sexes remained almost negligible in the twentieth century. However the 21st century female cohorts have considerably improved their probability of survival compared to those of the male cohorts. The gap between life expectancy at birth for the two sexes of India rose to 1 year for the 1911 cohort to 8 years for the 2051 cohort. An Indian female in the 2051 cohort would, therefore, expect to live 8 years longer than her male counterpart. Bourbeau et al (2004) also find that the gap between life expectancy at birth for the two sexes rose from 5 years for the 1901 cohort to 8 years for the 1941 cohort for Canada.

Derivation of $_nq_x$ from the above estimated e_o:

These computed eo are now used to obtain the probability of death by age ($_nq_x$). In India period life tables are not available for every year of this study. Hence model life tables are used. The model life tables are also used by the United Nations population Division and the World Bank from their estimated and

extrapolated life expectancies. Out of the four Coale and Demeny regional model life able, we use here West model life table. The table covers countries of Western Europe and the non-European population. This model is the representative of the general mortality pattern since it is derived from the largest and broadest variety of cases. In general, the West families of the Coale- Demeny model produce better overall fit to the data especially at the younger ages, 0-15 years. (Coale and Demeny,1966). And in our country, the age group is most unpredictable. In 1982 the United Nations published a set of model life tables for developing countries. But in this study the life expectancy at birth does not match with any of the five regions prepared by the United Nations. Hence it catalyses this work to use West model life table in studying mortality trends. The following formula as suggested by Keyfitz for which period life table is unavailable is used for obtaining a comparable set of model life tables for each sex with the same level of life expectancy at birth as that of the individual states. This formula is also discussed by Kohli (1977). Also this notion is partially used by Andreev, E et al (1985) in obtaining distribution of mean life expectancy of 100,000 randomly chosen pairs on the 81 points with a maximum difference in e_o of 3 years. Mahmood and Kundu (2006) also observed that the figure of e_o is very helpful for selecting suitable model life table for a country for which a reliable life table is not available.

The formula to obtain the probability of death is discussed as follows:

The weight W is obtained as

$$W= \{i-e_o'\}/ \{e_o-e_o'\}$$

Where i stands for expectation of life at birth of an individual state and e_o and e_o' are the upper and lower limits of the expectation of life at birth of the West model life table.

The new set of q_x'' values is obtained by

$$Wq_x+ (1-w)q_x'=q_x''.$$

qx and qx' are the observed values for the above expectation of life at birth of the model life table.

The last age used in these mortality data is 100. Hence we apply mortality law $l(x) = C^* a^b$ to extrapolate survivors in a life table beyond the last age as discussed by Preston et al (2001). Parameters C, a and b can be estimated from the last three values of the life table survival function, l(y), l(y+n) and l(y+2n).(Horiuchi and Coale,1982). We have

$$B=[\ln\{ l(y+2n)/ l(y+n)\}/ \ln\{ l(y+n)/ l(y)\}]^{1/n}.$$

$$a=\exp [\ln\{ l(y+n)/ l(y)\}/\{b^y(b^n-1)\}]$$

$$C=l(y)*\exp (-b^y*\ln a).$$

Now ${}_nq_x$ is obtained from the above extrapolated l_x values by using ${}_nq_x = {}_nd_x/l_x$

The ${}_nq_x$ for the years 1921 and 1941 are obtained directly from the life tables constructed by Davis (1951). In his study life tables are constructed for males and females of India for 1911-21 and 1931-41. The ${}_nq_x$ for the years 1991, 1996 and 2001 were obtained directly from the period life tables of 1989-93, 1994-98 and 1999-2003 as published by the office of the Registrar General of India. (SRS Analytical Studies, Report No. 1 of 1996, report No.3 of 2003 and report No.1 of 2006).

Arrangement of ${}_nq_x$ by age and calendar years:

These ${}_nq_x$ are to be arranged by age and calendar years to represent the mortality schedule at corresponding ages of each birth cohort. Figure 2 explains the procedure of transformation of ${}_nq_x$ presenting the ${}_nq_x$ of 1901 generation life table. The examples are as follows:

${}_1q_0$ of the cohort born in 1901 is the ${}_1q_0$ in the 1901 period life table,

${}_4q_1$ of the cohort born in 1901 is the ${}_4q_1$ in the 1902 period life table,

${}_5q_5$ of the cohort born in 1901 is the ${}_5q_5$ in the 1906 period life table,

${}_5q_{90}$ of the cohort born in 1901 is the ${}_5q_{90}$ in the 1991 period life table,

and ${}_5q_{100}$ of the cohort born in1901 is equal 1.

Figures 3 and 4 (pages 8-9) represent the generation probabilities of death by age, sex and birth cohort. In general, the probability of dying for all ages has fallen for both males and females since the 1901 cohort. However, a generalized excess mortality among males and females are observed for the 1911 cohort. This decade 1911-21 recorded the highest decade mortality rate due to the ravages of the 1918-19 influenza epidemic (Davis, K. ,1951). In 1918 influenza alone claimed 12 million lives in India. Further plague, smallpox, cholera, etc. also catalyzed the high mortality during this period. The severe droughts in 1911, 1913, 1915, 1918 and 1920 also increased the death toll. The First World War (1914-18) also claimed the lives of thousands of Indian soldiers. However after 1921, improvement in health and sanitation conditions controlled occurrences of epidemics to some extent. These resulted in declining death rate. The diminishing trends of death rate were also achieved as a result of improvement in transportation which subsequently facilitates distribution of food during drought and flood across the country (Census of India 1911 and 1921). The shape of the curve (in figures 3 and 4) representing the probability of dying at different ages has changed little over the generations for both males and females. The probability curve for the 1911 male cohort shows up a bump at age 70 whereas there was no such bump for female cohort, probably death was not sufficiently significant among female cohorts to change the shape of the curve.

Calculation of other columns of the life table:

Other columns of the life table can be described as follows:

Year: 1901-2001.

Age: 0-100.

${}_nd_x$: Number of deaths in the cohort between ages x and x+n.

${}_nd_x = {}_nq_x * l_x$

l_x : Number of survivors to age x in the cohort.

l0=100000.

${}_nL_x$: is the number of person years lived in the cohort between ages x and x+n.

Figure 2: Transformation of nqx from period to cohort life tables

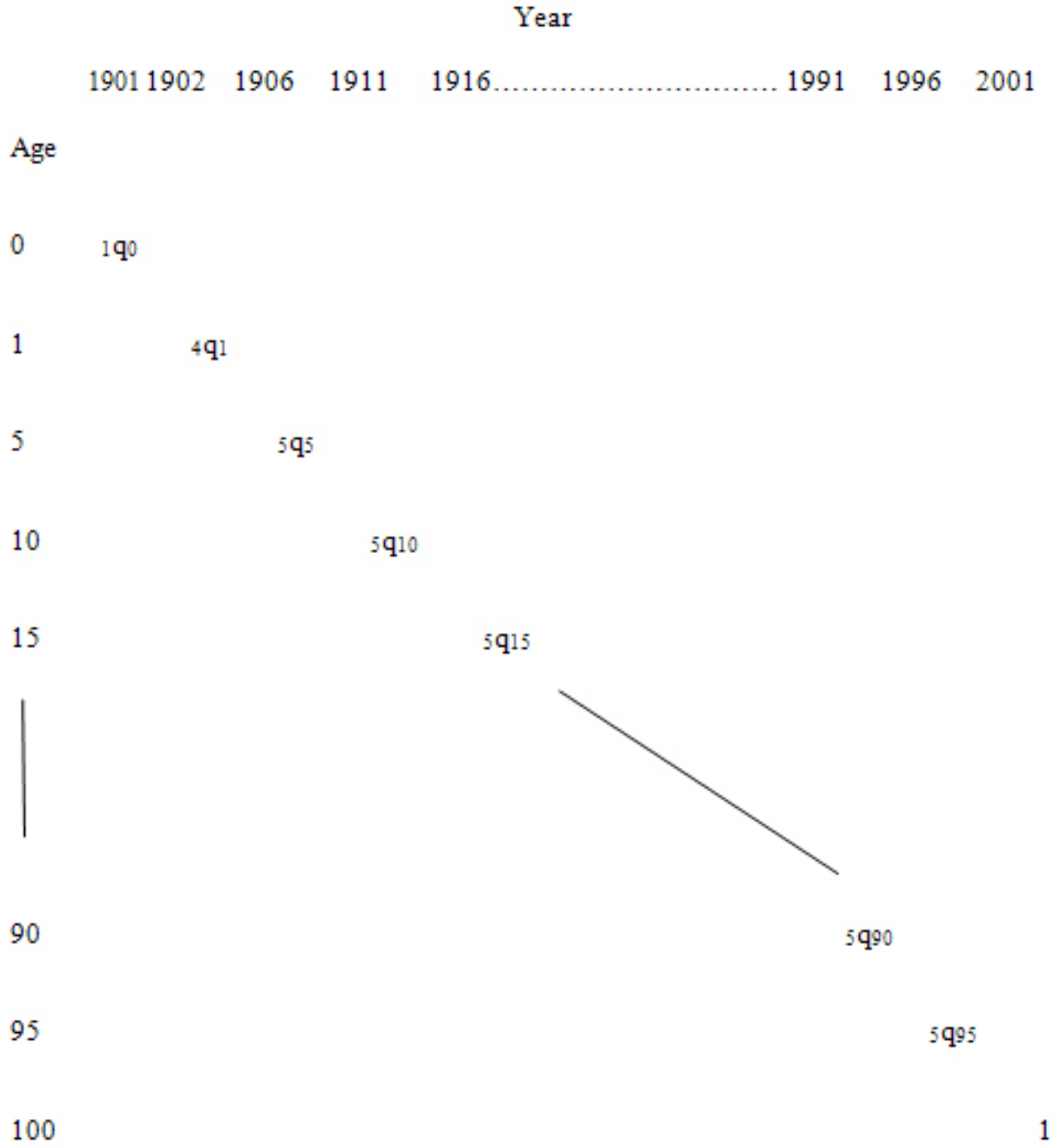


Figure 3: Generation probabilities of death ($_nq_x$) across different birth cohorts of males of India

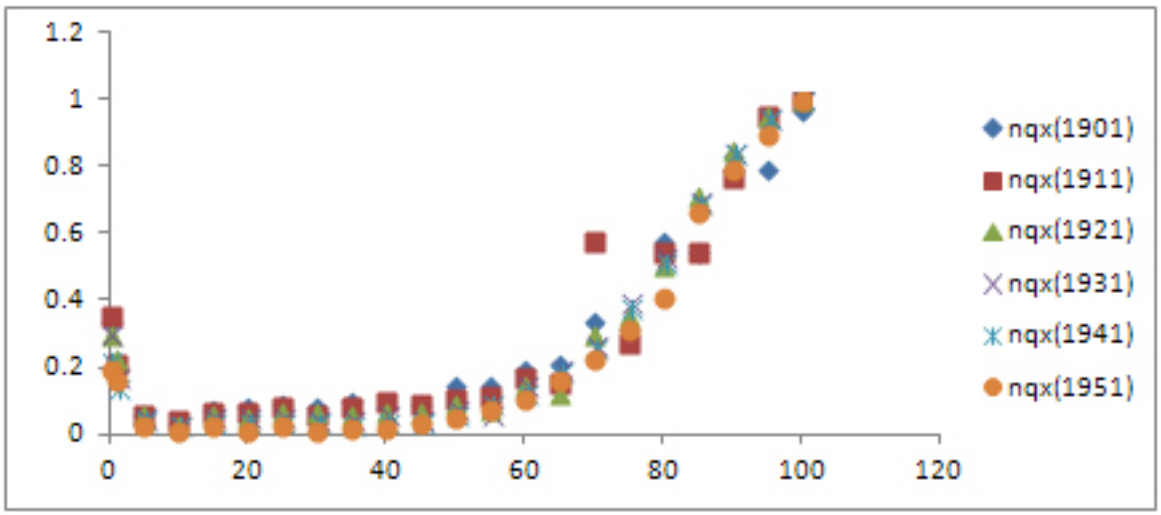
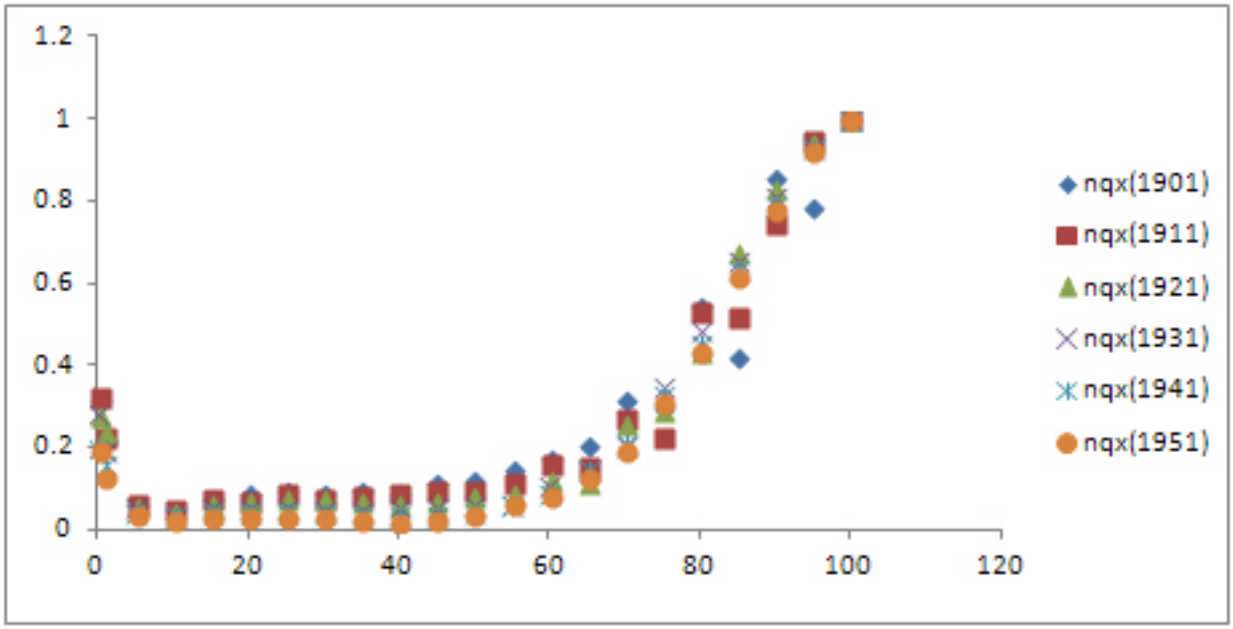


Figure 4: Generation probabilities of death ($_nq_x$) across different birth cohorts of females of India



According to Reed and Merrell Lx may be obtained from the following equations for ages under 10.

$L_0=0.276l_o+0.724l_1$
$_4L_1=0.034l_0+1.184l_1+2.782l_5$
$_5L_5=-0.003l_0+2.242l_5+2.761l_{10}$

Greville (1943) observed that method given by Reed and Merrell is a particular case and suggested the following formula when n is equal

$_nL_x=n/2(l_x+l_{x+n})+n/24(_nd_{x+n}-{}_nd_{x-n})$
For last age 100, L100=l100 (log10l100).
T_x : Person years lived above age x.

$T_x=\sum {}_nL_x$
e_x : Expectation of life at age x.
$e_x = T_x / l_x$.
This lead to construction of sex wise generation life tables of India for the years 1901, 1911 to 1951, every 10 years apart as depicted in tables 2 to 4.

Calculation of gap:
Gap is computed by
Gap=Cohort life expectancy at birth - period life expectancy at birth (Goldstein and Wachter, 2006). This gap will reflect the change in mortality pattern over time by studying the differences between period and cohort life expectancy at birth across cohorts as shown in Table 5.

Distribution of age at death for 60^+ or aged to study the effects of different cohorts:
Distribution of age at death=$d_{b,x}/d_{b,mode}$ (Richards, 2008)
$d_{b,x}$ and $d_{b,mode}$ are the number of deaths at age x and number of deaths at the modal age at death for birth cohort b respectively. This ratio will take the peak value one at the modal age at death i.e. at age having maximum number of deaths as portrayed in Tables 6 and 7.

Results and Conclusions

The construction of generation life table informs about the general mortality trends prevailing among male and female populations of India. Tables 2 to 4 represent the generation life table for birth cohort 1901 to 1951 i. e. cohorts born every 10 years of intervals for male and female population of India. These tables help in studying the mortality transition of people residing in this part of the world.

The generation life expectancies are calculated by allowing changes in mortality rates in coming years and are hence considered as the more appropriate measure to know about a person's expectation of life. (Kintner, 2004). Table 5 depicts the variation between period and cohort life expectancy at birth by computing gaps. In India gaps rise from about 1 year in 1901 to 12 years in 1951 among its male members. Its female counterpart's gap is slightly less than one year in 1901 to about 14 years in 1951. Thus we may observe that the variation between period and cohort life expectancies has lengthened over time and it may increase further for both of its male and female populations of India. Prasartkul and Rakchanyaban (2002) also observed such a kind of gap among the male and female population of Thailand. The generation life table for the cohort of U.S females born in 1900 also added nearly 10 years to its life expectation at birth of 58.3 years in contrast to the expectation of life at birth of period life table of 49 years (Bell et al., 1992). The cohort life expectancy at birth is greater than its corresponding period life table since mortality decreases across the years. The gaps as computed in columns 4 and 7 of table 5 are the bonus years received by the cohort from taking advantage of future mortality improvement. From the same table we may observe that the period life expectancy at birth in 1941 and 1951 is 32 and 31 years for males and females respectively. This is the same as generation life expectancy at birth in 1931. Hence there is a past cohort with the same summary measure of mortality as given by the period life table. The plausible reason of this variation may be that the generation life tables are used to study the development of mortality and life expectancy of real cohorts over time. This type of table

studies the mortality improvement for the actual cohort for a long period of time whereas period life table understate this improvement. The generation life table considers the changing intra cohort influence on health whereas period table considers only the single mortality improvement pattern and unitary set of health condition (Kintner, 2004). The amount of gap portrays the pace of mortality improvement across time. In other words the pace of decline in mortality plays an important role in determining the magnitude of gap (Goldstein and Wachter 2006). Thus the generation life table paves new avenues to study the mortality status of people residing in India.

Tables 6 and 7 show that the birth cohorts of 1901 to 1921 have the modal age at death at age 70 and for birth cohorts of 1931 onwards the modal age is at age 75 both for male and female populations of India. Here we observed a contrast peak value of 1 at age 80 for female birth cohort of 1911. The peak value 1 at higher ages depicts that most deaths fall at older ages. This ratio of db,x/db,mode also indicates the tendency of increasing longevity by year of birth i.e. fewer premature deaths among the elderly population of India, with rising birth cohorts. Richards (2008) also observed that for modern populations of England and Wales, most deaths fall at older ages, the peak value will be after age 70 years.

Tables

Different tables have been provided in this section.

Table 2: Sex Wise Generation Life table of India for 1901 and 1911

	1901				1911			
	Males		Females		Males		Females	
Age	$_nq_x$	e_x	$_nq_x$	e_x	$_nq_x$	e_x	$_nq_x$	e_x
0	0.34232	24.46	0.31739	24.52	0.35523	24.74	0.32478	25.43
1	0.20656	36.05	0.22361	34.79	0.21336	37.22	0.23049	36.53
5	0.06556	41.1	0.0692	40.44	0.06434	42.96	0.06741	43.08
10	0.04085	38.83	0.05054	38.29	0.04605	40.76	0.05534	41.03
15	0.07952	35.37	0.08213	35.19	0.07374	37.61	0.07649	38.29
20	0.08786	33.21	0.08897	33.11	0.06727	35.4	0.07253	36.25
25	0.09865	31.16	0.10006	31.1	0.08666	32.77	0.0892	33.89
30	0.08646	29.31	0.09142	29.28	0.06367	30.65	0.07705	31.97
35	0.10008	26.84	0.10175	26.98	0.08308	27.56	0.08793	29.43
40	0.08646	24.56	0.0907	24.76	0.09981	24.83	0.09232	27.03
45	0.09625	21.64	0.12017	21.97	0.09258	22.31	0.09703	24.52
50	0.14791	18.67	0.12517	19.63	0.11127	19.33	0.0961	21.89
55	0.15388	16.48	0.15288	17.08	0.1161	16.44	0.12043	18.95
60	0.19644	14.02	0.17959	14.71	0.1778	13.26	0.16123	16.2
65	0.21641	11.85	0.20935	12.39	0.15829	10.6	0.16025	13.84
70	0.33944	9.42	0.3207	10	0.58142	7.05	0.27194	10.98
75	0.32166	8.01	0.30065	8.57	0.27663	8.59	0.22723	9.18
80	0.58186	5.6	0.54844	6.16	0.55058	5.89	0.53654	6.1
85	0.54764	5.09	0.42692	5.77	0.54743	5.18	0.52164	5.4
90	0.83399	3.29	0.8583	3.18	0.77302	3.51	0.75207	3.63
95	0.80063	3.17	0.78863	3.39	0.95709	2.46	0.95051	2.5
100	0.96927	1.49	1	2.28	1	0.91	1	1.32

Table3:SexWiseGenerationLifetableofIndiafor1921and1931

	1921				1931			
	Males		Females		Males		Females	
Age	$_nq_x$	e_x	$_nq_x$	e_x	$_nq_x$	e_x	$_nq_x$	e_x
0	0.3015	28.52	0.2793	28.44	0.30428	32.17	0.28944	31.76
1	0.22989	39.72	0.24126	38.35	0.17614	45.12	0.19764	43.58
5	0.05952	47.19	0.06277	46.14	0.05186	50.49	0.05584	50
10	0.0348	45.04	0.04473	44.08	0.02862	48.14	0.03731	47.83
15	0.06446	41.6	0.06808	41.03	0.05302	44.48	0.05866	44.58
20	0.0557	39.3	0.07492	38.84	0.05496	41.83	0.06031	42.2
25	0.07169	36.46	0.07699	36.79	0.05574	39.11	0.06173	39.75
30	0.07048	34.07	0.07625	34.65	0.04878	36.28	0.05494	37.2
35	0.06482	31.49	0.07061	32.3	0.04744	33.01	0.05473	34.22
40	0.07064	28.5	0.06624	29.57	0.05936	29.53	0.05705	31.06
45	0.06843	25.47	0.07557	26.49	0.04731	26.24	0.05595	27.79
50	0.0968	22.16	0.08476	23.45	0.07532	22.41	0.06206	24.29
55	0.0818	19.27	0.09009	20.39	0.0638	19.04	0.06388	20.73
60	0.15059	15.76	0.12486	17.16	0.14672	15.15	0.11229	16.96
65	0.12821	13.11	0.11589	14.25	0.19785	12.31	0.15296	13.79
70	0.29969	9.66	0.26115	10.77	0.26574	9.73	0.20894	10.82
75	0.36077	7.75	0.29523	8.7	0.39695	7.34	0.35318	8
80	0.51036	5.67	0.43544	6.29	0.52942	5.56	0.48698	6.01
85	0.7147	4.07	0.68051	4.24	0.70196	4.08	0.66004	4.4
90	0.85242	3.09	0.83144	3.21	0.84628	3.12	0.81129	3.32
95	0.95341	2.31	0.94422	2.52	0.95045	2.49	0.9369	2.56
100	1	0.9	1	1.22	1	1.01	1	1.38

Tables continue pages 12- 13

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Table 4: Sex Wise Generation Life table of India for 1941 and 1951

	1941				1951			
	Males		Females		Males		Females	
Age	$_nq_x$	e_x	$_nq_x$	e_x	$_nq_x$	e_x	$_nq_x$	e_x
0	0.2175	39.88	0.2039	39.52	0.20209	43.85	0.19921	44.49
1	0.14367	49.89	0.1652	48.57	0.16384	53.88	0.13104	54.48
5	0.0425	54.04	0.04807	53.93	0.03272	60.19	0.0384	58.51
10	0.02821	51.34	0.0369	51.54	0.01203	57.15	0.02423	55.76
15	0.04097	47.76	0.04691	48.42	0.0297	52.82	0.03623	52.08
20	0.03848	44.69	0.04322	45.68	0.0121	49.36	0.03655	48.94
25	0.04066	41.38	0.04778	42.63	0.02777	44.93	0.03519	45.71
30	0.04042	38.03	0.04663	39.65	0.01496	41.145	0.0308	42.28
35	0.03251	34.53	0.04036	36.47	0.02471	36.73	0.02829	38.54
40	0.04141	30.6	0.03833	32.9	0.01981	32.6	0.02064	34.59
45	0.03643	26.82	0.03935	29.11	0.04013	28.2	0.02686	30.27
50	0.06406	22.73	0.04475	25.2	0.05788	24.27	0.03758	26.03
55	0.08969	19.11	0.06351	21.26	0.07693	20.61	0.06309	21.95
60	0.12508	15.75	0.09161	17.52	0.10816	17.11	0.08536	18.25
65	0.18555	12.63	0.14804	14.03	0.16506	13.88	0.13254	14.72
70	0.25869	9.93	0.217	11.02	0.22822	11.12	0.19327	11.57
75	0.38293	7.52	0.33283	8.37	0.31881	8.66	0.31184	8.73
80	0.51966	5.66	0.45772	6.31	0.41096	6.56	0.43554	6.56
85	0.69217	4.15	0.63781	4.57	0.6684	4.39	0.61939	4.72
90	0.84081	3.15	0.79499	3.42	0.79365	3.46	0.77977	3.52
95	0.94801	2.51	0.93041	2.61	0.89869	2.78	0.92218	2.67
100	1	1.21	1	1.66	1	1.87	1	1.89

Table 5: Gap between generation and period life expectancy at birth

Years	Generation e_0	Period e_0	Gap	Generation e_0	Period e_0	Gap
(1)	(M)(2)	(M)(3)	(4)	(F)(5)	(F)(6)	(6)
1901	24.46	23.63	0.83	24.52	23.96	0.56
1911	24.74	22.59	2.15	25.43	23.31	2.12
1921	28.52	19.42	9.1	28.44	20.91	7.53
1931	32.17	26.91	5.26	31.76	26.56	5.2
1941	39.88	32.09	7.79	39.52	31.37	8.15
1951	43.85	32.45	11.4	44.49	31.66	12.83

Table 7: Distribution of deaths by age at different birth cohorts for female population of India

Birth cohorts	1901	1911	1921	1931	1941	1951
age	dx/dmode	dx/dmode	dx/dmode	dx/dmode	dx/dmode	dx/dmode
60	0.86333	0.75828	0.61794	0.53451	0.45422	0.42764
65	0.82564	0.63217	0.50194	0.64635	0.66675	0.60738
70	1	0.90086	1	0.74784	0.83268	0.76826
75	0.63683	0.54804	0.83526	1	1	1
80	0.81244	1	0.86826	0.89186	0.9175	0.96114
85	0.28558	0.4506	0.76605	0.62014	0.69329	0.77155
90	0.32902	0.31076	0.29903	0.25914	0.31299	0.3697
95	0.04284	0.09738	0.05724	0.05647	0.0751	0.09629
100	0.01148	0.00507	0.00338	0.0038	0.00562	0.00813

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Original Contribution/Clinical Investigation

A Comparative Study of Life Tables in an Urban Set-up of North-East of India, since 1986 to 2011

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ABSTRACT

Background: Life tables give life expectancies, death probabilities, the most preferred indicators in demographic and health analysis that used to measure status of good health, education and other valued achievements. Keeping this in mind, this study was conducted in Guwahati city, a major place of North East of India.

Objective: To study the trend and differential of mortality of Guwahati city, Assam for male and female by means of life table for the period 1986 to 2011.

Materials and Methods: Data in this study has been extracted from the Office of Birth and Death Registration, Guwahati Municipal Corporation (GMC) for the years 1986 to 2011 at an interval of five year. Total 24,145 death records were collected from Office of Birth and Death Registration, GMC during 1986 to 2011.

Results: Significant changes of life expectancies at different age was found for both sexes of Guwahati city during 1986-2011. A declining trend of probabilities of death has been found since 1986- 2011 irrespective of sex.

Conclusion: Though healthcare policies in Assam are adequate in addressing the issues of infants, children and mothers, it is required to address the issues regarding survival gain in Guwahati.

Key words : Guwahati, SRS, Life expectancy, death probabilities, temporary life expectancy.

Introduction

One of most important devices used in demography is life table (15). From various literature on mortality investigation and other allied topics it is being found that probably the first rudimentary life table was prepared by a Roman author, Ulpian sometime during the third century (9).

The life table provides a convenient, comprehensive and self-contained summary of mortality conditions prevailing in an actual or hypothetical population(2). A life table combines the mortality experience of a population at different ages into a single statistical model, and describes the life history of that hypothetical population. The relations among its columns and parameters have formed one of the most fruitful traditions of mathematical population research. The actuaries, demographers, public health workers and many others use this statistical device in studies of longevity, fertility, migration, and population growth (21). The method of life table is applicable to the analysis of not only mortality but of many measurable processes involving attrition or accession to aggregate size(12).

Of all the summary measures that can be derived from a life table, the expectation of life (or life expectancy) is perhaps the most well-known, widely-used, widely-cited and widely-studied statistic.

For any age x (most frequently, at age zero or birth) ex reports the mean number of person-years of each person at age x can expect to live, given the mortality rates observed throughout the entire life Table[2]. It gives the cumulative effect of mortality over the remaining life span.

Life expectancy at birth e_0^0 is the most preferred indicator in demographic and health analysis.

As mortality rates decline, life expectancy increases, thus a relationship exists with the change in mortality schedule. There is a complex relationship between actual mortality changes at various age groups and resulting change in life expectancy. This idea was first brought under consideration by Arriaga (1982). He introduced the notion of temporary life expectancy, an index to measure by each age group, the annual relative change in the years to be lived. The gain in expectation of life at birth e_x^0 is attributable to the effects of mortality improvements. Arriaga (1984) Vaupel (1986), Pollard (1988), has given rise to analysis of the e_x^0, that shows how the progress in the mortality schedule would translate into progress in expectation of life at birth(28). While analysing changes in life expectancy at birth or studying differences in life expectancy between two populations, decomposition of a difference

may identify ages at which the difference originates in mortality or ages at which the differences occur.

Different phases of life, namely- infancy, childhood, working life, reproductive life, and elder age are normally adopted in life table concept. This division of life phases help in understanding variations in the age patterns and also facilitates comparison of different reasons for mortality. The level of mortality in these phases of life is measured by temporary life expectancy(10). But temporary life expectancy (TLE) gives only increase or decrease of years of life between particular ages in different time periods without considering the maximum possible reduction in those ages. Therefore, the pace of mortality change during a period of time is treated in relative measures by referring it with the maximum possible change (Arriaga,1984). In this case, the index of Annual Relative Change (ARC) in TLE can be used as a better indicator. Annual Relative Change (ARC), an index of TLE represents the difference in percentage change between two mortality measures in their observed reduction in deaths in relation to the total possible reduction (Arriaga, 1984). In other words, it shows the change in TLE between two periods.

It is seen that, life expectancy at birth for the world population has undergone a significant change from 48 years in '1950- 1955' to 68 years in '2010' according to estimates presented in United Nations (UN Population Prospects, 2010 revision). According to Sample Registration System (SRS) based abridged life table, there has been a significant improvement in life expectancy in India resulting in greater longevity. The life expectancy at birth in India has increased from 50.5 years in 1970-75 to 64.6 years in 2006-10 for males and from 49.0 years in 1970-75 to 67.7 years for females during 2006-10. Whereas in Assam, life expectancy at birth has increased from 52.9 years in 1986-90 to 61 years for males and from life expectancy of 53.6 years in 1986-90 to 63.2 years for females in 2006-10. There is evidence of convergence in mortality decline across the states in India.

Guwahati, the head quarter of Kamrup Metropolitan District and the capital of state Assam of India is a fast growing metropolis with a population of 9.69 Lakhs (Census report, 2011). The city is far the largest and fastest growing commercial, industrial, educational settlement in the North-Eastern region of India. Geographically, it is located in the southern bank of the River Brahmaputra between 26º 05' to 26º 15' N Latitude and 91º 35' to 91 º 55' E Longitude. The decadal population growth rate in Guwahati Metropolitan Area between 1981-91, 1991-2001 and 2001-2011 are 117.27, 38.6 and 26.3 respectively(Census, India). The recent decadal growth rate (2001-2011) of Guwahati city of 26.3 % is higher than the national population growth rate of 17.64%. The municipal limit of the city is 651.12 sq. Km in 2011. The population density of the city has been 2558, 2705, 3741 and 4445 persons per sq.km in 1981, 1991, 2001 and 2011 respectively. Among all other cities in the state, Guwahati is the largest urban centre in Assam with 23.89% of the total urban population of the state and it alone contributes 55% of the combined population of the significant towns within the state (Various issues of the Census, India). This city is now become one of the prime places for Business, Government as well as non Government offices, Educational Institutions, and Health care services in North- East of India.

With increase of number of government, semi government establishments, big to small private business establishments, household units, vehicles during the last 25 years (1986-2011) Guwahati is growing fast and thus making a deficiency of housing. Rural and other migrants have been crowded together in different areas. A rapidly urbanizing city Guwahati leads a well comfortable life for a large section of the people and in contrast, critical lives in slum areas clouded by polluted and unhygienic

conditions. City's drainage system is poor in many areas. These polluted conditions may affect the mortality situation of the city dwellers. All these have tempted us to study the mortality situation of the city in the last 25 years. In this paper, it is attempted to study the changes in the trend and differential of mortality of Guwahati city by means of life table for males and females for the period 1986 to 2011.

Objectives

(i) To study the trend and differential of probability of death and expectation of life at birth and at some selected ages by means of life table for the years 1986, 1991, 1996, 2001, 2006 and 2011 for males and females in Guwahati.
(ii) To study the trend and differential of temporary expectation of life (TLE) and annual relative change (ARC) in TLE at different age group (0,5), (5,15), (15, 50), (15,60) and 60 and above for both sexes for the above mentioned years in Guwahati city.
(iii) To study the age decomposition analysis in life expectancies at birth for the above mentioned years in Guwahati city for males and females.

Data
Data for this study has been extracted from the Birth and Death Registration, Office of the Guwahati Municipal Corporation (GMC) for the years 1986, 1991, 1996, 2001, 2006 and 2011. From large registered data on death in Guwahati since 1986 to 2011, we limit our analysis to a specific year considering every 5 year interval starting from 1986 to 2011. We believe that selection of the years at 5 year intervals will give us possible information about trend and differentials prevailing in death statistics over 25 years.

In this city, deaths are usually registered with specified cause of death certified by medical practitioner. Deaths occurring at health institutions are certified by physicians as many of them are preceded by an illness and attended by medical practitioner and deaths that occur at home or at any other place are reported by their relative to the authority. Further when a person dies his or her body is brought to the cremation ground and the person employed by Guwahati Municipal Corporation (GMC) registers the name, age, sex, address, cause of death and sends that to the higher concerned authority (4). Even when a particular case, cause of death is not known, the medical registrars are able to give the best information on the cause leading to the death after probing from the Post mortem reports.

There were a total of 24,145 deaths in Guwahati Metropolitan city under consideration of every five year interval since 1986 to 2011. The population age and sex structure of Guwahati city is derived from census of India (1991, 2001 and 2011) and the next consecutive years' population are estimated by taking the census population figures.

Method of constructing life table
For construction of life table Greville's method was used. Certain relationships among the functions of life table have been made based on observed relationship between the probability of death ($_nq_x$) and the age specific death rates ($_nM_x$), between age x to x+n.

The function ($_nq_x$) is calculated by,

$$_nq_x = \frac{nMx}{\left(\frac{1}{n}\right)+nMx\left[\left(\frac{1}{2}\right)+\left(\frac{n}{12}\right)(nMx-k)\right]}$$

$_nM_x$ is the observed age specific death rate. k is constant, obtained on the assumption that $_nM_x$ values follow an exponential curve. Here, K = 0.09.

q_0 value for age group 0-1 is calculated by,

$$q_x = \frac{2Mx}{2+Mx}$$

The values of $_nd_x$ are calculated on multiplying $_nq_x$ by l_x. We start with taking l_0 as 100,000. To obtain I_{x+n} we subtract from I_x the corresponding value of $_nd_x$ and the process is repeated.

The values of $_nL_0$ are obtained by -

$$L_0 = 0.276\ l_0 + 0.724\ l_1$$

$$_nL_x = \frac{n^{d_x}}{n^{M_x}}$$

The values of T_0 and e_x^0 are obtained as

$$Tx = {}_nL_x + {}_nL_{x+1} + \ldots\ldots\ldots\ldots + {}_nL_{x+80}$$

and $$e_x^0 = \frac{Tx}{lx}$$

Temporary Expectation of Life (TLE)
The Temporary Life Expectancy (TLE) is the average number of years lived between the ages of x and x + n by a group of lx members, all aged x. It is a good indicator to understand the mortality reduction. TLE can be calculated for various age spans of life defined by

$$_nE_x = \frac{Tx-Tx+n}{lx}$$

where l_x is the radix of the life table,
T_x and T_{x+n} are the numbers of person-years lived after ages x and x+n,

Index of Annual Relative Changes (ARC) in TLE
Change in TLE between two periods or the pace of mortality change during the period of time can be treated in relative measure by referring it with the possible maximum change (Arriaga, 1984). The index of Annual Relative Change (ARC) serves as a good indicator to observe the maximum mortality changes,

$$_nARC_x^i = [1-(1-nRC_x^i)^{\frac{1}{i}}] * 100,$$

i is the width of the study years and nRC_x^i is the observed change in TLE in relation to the maximum possible changes in age intervals x to x+n.

Where, $nRC_x^i = \frac{(n^{E_{x+n}}) - (n^{E_x})}{n - (n^{E_x})}$ (Arriaga,1984)

Decomposing a Difference in Life Expectancies

Mathematically, decomposing a difference in life expectancies is defined as

$$_n\Delta_x = \frac{l_x^1}{l_0^1}\left(\frac{{}^nL_x^2}{l_x^2} - \frac{{}^nL_x^1}{l_x^2}\right) + \frac{T_{x+n}^2}{l_0^1}\left(\frac{l_x^1}{l_x^2} - \frac{l_{x+n}^1}{l_{x+n}^2}\right) =$$

Contribution of mortality difference in age group x to x+n to difference in life expectancy at birth.

$$_\infty\Delta_x = \frac{l_x^1}{l_0^1}\left(\frac{T_x^2}{l_x^2} - \frac{T_x^1}{l_x^1}\right)$$

= Contribution of mortality difference in open ended age group to difference in life expectancy at birth.

Total life expectancy difference

$$e_0^0(2) - e_0^0(1) = \Sigma\ {}_n\Delta_x$$

Results and Discussion

Comparison of calculated values of expectation of life at birth (for Guwahati with urban, Assam estimates by SRS based Abridged Life table(India), 1986-2011.

In Table 1 a comparison is made between the values of expectation of life at birth for Guwahati city obtained by us and estimated by SRS (India) for urban, Assam for different periods viz 1986-90, 1989-93, 1994-98, 1999-2003, 2004-2008 and 2006-2010. Life tables are available for its major states of India and the country by rural and urban areas, by sex for period of every five years prepared by Census of India based on SRS data. There is a good concordance between the two sources.

It is seen from the table that values of e_0^0 for Guwahati are higher than the values obtained by SRS. This may be due to the fact that people of Guwahati are more aware about their health problems where literacy rate may contribute to this factor. An average male population of Guwahati lives 7.95 years longer in 2011and females live 8.16 years longer in 2011 compared to 25 years earlier.

In 2006-2010, the expectation of life at birth among urban males was lowest in Assam (66.9) in comparison to other states of India i.e, the expectation of life at birth among males were longest in Himachal Pradesh (72.6), Kerala (72.3), Jammu & Kashmir (72.2), Maharashtra (69.6), West Bengal (69.6), Punjab (69.1) and Tamil Nadu (69.0)(15).

When it came to urban females, Kerala (76.4) took the top expectation of life at birth in 2006- 2010, followed by Himachal Pradesh (75.7) , J&K (75.0), Punjab (73.5), Maharashtra (73.2) and urban Assam was at the bottom of the ladder with an average woman expected to live till just 71.1 years. Higher expectation of life at birth has been observed for females for all the study years since 1986-2011. The coverage of mortality conditions by Office of the Birth and Death registration observed higher e_0^0 for average population in the city than overall e_0^0 for urban population of Assam by SRS for both males and females. Though expectation of life at birth in Guwahati city improving over the years it is still behind in development of some aspects of mortality conditions compared to other urban areas of India.

Table 1: Life Expectancy at Birth for male and female, Guwahati, since 1986 to 2011 calculated by us and estimated by SRS of India for urban, Assam

	Proposed values of e_0^0 for Guwahati			Estimated e_0^0 for urban, Assam by SRS(India)	
Period	Male	Female	Period	Male	Female
1986	63.56	64.55	1986-1990	60.6	61.3
1991	64.90	67.58	1989-1993	63.0	64.1
1996	67.13	69.52	1994-1998	65.0	66.1
2001	68.80	70.47	1999-2003	66.3	67.4
2006	70.95	72.40	2004-2008	66.8	70.8
2011	71.51	72.71	2006-2010	66.9	71.1

While observing growth of life expectancy at birth it is seen that life expectancy has increased from 63.56 years to 71.51 years in 1986-2011 for males and from 64.55 to 72.71 years for females. Expectation of life at birth has increased by 1.34 years and 3.03 years for males and females respectively in the period 1986-1991 which became 0.56 years and 0.31 years for males and females respectively in the recent period 2006-2011 in Guwahati. In the three years 2001, 2006 and 2011 respectively, the city witnessed increasing life expectancies at birth from 68.8, 70.9 to 71.5 years respectively for males and 70.5, 72.4, 72.7 years respectively for females. Overall, for the population of Guwahati, expectation of life e_0^0 has shown an increasing trend (Figure 1) with an increase of almost 8 years for males and 8.2 years for females over the last quarter century i.e, 1986-2011. The maximum increase of e_0^0 (male) was observed as 2.22 years during 1991-1996 and the corresponding value for females was observed as 3.03 years. Also as the values of e_0^0 increases with time from 1986-2011 for both males and females, it is observed that e_0^0 for females is greater than those of males in all the years (1986-2011). This may be because deaths are more prevalent in males in the age group 15-50 due to their hard work and consumption of alcohol, cigarettes etc.

Figure 1: Expectation of life at birth for both male and female, Guwahati, 1986 to 2011

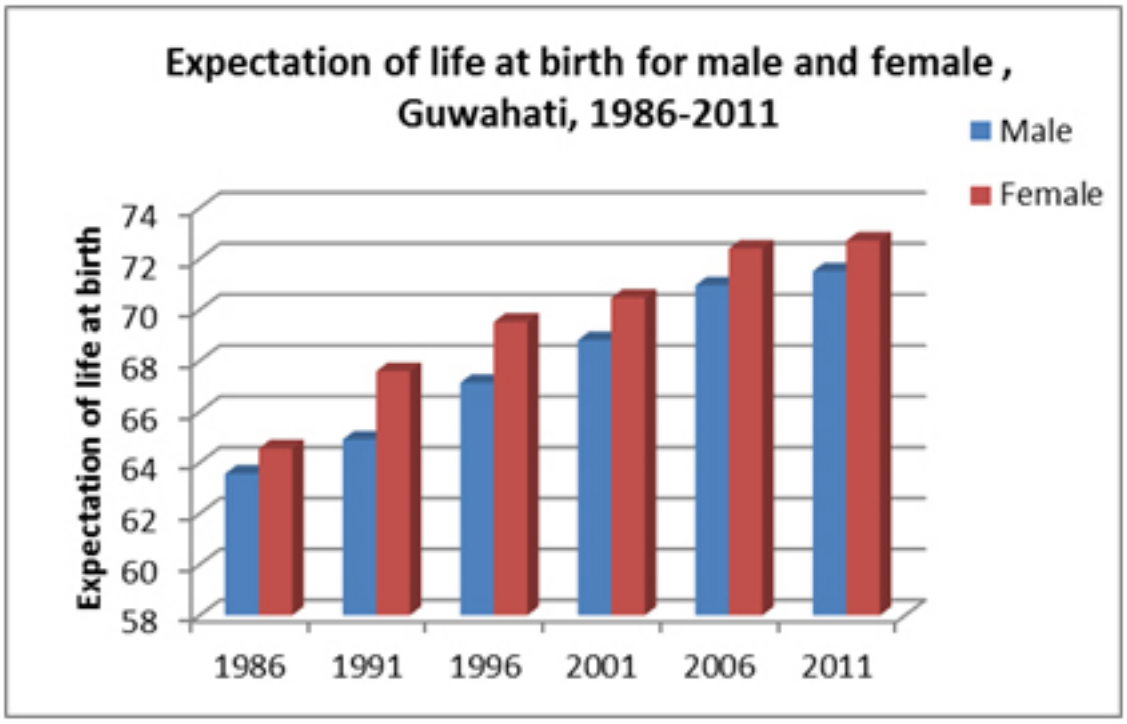


Table 2 : Life expectancy at selected ages for male and female, Guwahati since 1986 to 2011

	e_1^0		e_5^0		e_{15}^0		e_{30}^0		e_{45}^0		e_{60}^0	
	M	F	M	F	M	F	M	F	M	F	M	F
1986	66.9	67.5	63.6	64.8	53.9	55.3	40.0	41.7	27.2	28.4	16.2	17.9
1991	67.4	69.5	64.0	66.6	54.3	56.9	40.3	43.2	27.1	30.0	16.6	18.5
1996	68.9	71.3	65.5	67.9	55.7	58.3	41.6	44.4	28.4	31.1	17.5	19.3
2001	70.3	72.2	66.8	68.8	57.0	59.1	42.7	45.0	29.3	31.5	18.1	19.6
2006	72.5	74.0	69.0	70.5	59.2	60.7	44.8	46.7	31.0	33.1	18.8	20.5
2011	73.1	74.3	69.5	70.8	59.7	61.0	45.4	47.0	31.5	33.4	18.9	20.2

Table 2 (previous page) recorded the expectation of life at selected ages for male and female, Guwahati since 1986 to 2011. It is observed that , in this period there had been remarkable changes of expectation of life at all age groups. Twenty five years back in 1986, the city had expectation of life at age 30 as 40 (41.7) years for male (female), at age 60 it was 16.2 (17.9) years for male (female) which has now in 2011 become 45 (47) years at age 30 to almost 19 (20) years at age 60 for male (female) respectively.

A joint look at the table 1 and 2 reveals that e_x^0 is highest at age 1. This may be possibly due to higher Infant Mortality Rate (IMR).

That is the city is yet to achieve a better IMR like Kerala (Sarma and Choudhury, Canadian studies of population 2014). From 1986 to 2011 it has been observed that life expectancy, e_x^0 was higher for females than their male counterparts. Highest value of e_x^0 occurs at the age 1 and age 5 than all other age groups for both male and female in most of the study years. With the increase of ages, values of e_x^0 decreased over the years under consideration. In the year 1986, the minimum expectancy of life at age 60 was 16.2 years for males whereas for females it was 17.9 years. That is old age longevity is not satisfactory.

In Table 3 results of probabilities of death, ${}_nq_x$ for selected ages viz 0,1,15,30,45,60 since 1986 to 2011 for male and female in Guwahati city are depicted. It is seen from the result that, probability of death at infancy i.e. 0-1 age group is higher than all the age groups except 60 years for both sexes in all the study years. This says the gravity of the situation. Even the death of children in 1-5 years of age is also high. High death in infancy to children under 5 years occurs due to malnutrition, prevalence of infectious diseases, acute respiratory diseases, sanitation, acute diarrhoeal diseases etc(13). While comparing the probabilities of mortality for male and female we found that probabilities of dying ${}_1q_0$ for male in Guwahati had higher values than their female counterparts in almost all study years since 1986 to 2011 except in 200. During 1986-2001 probabilities of dying of female children at age under 5 years were found higher than male but, in recent years 2006-2011 under 5 years male children showed lower survival. Apart from this from the analysis it is observed that values of ${}_5q_{30}$ for females were higher than their male counterparts in all of the study years , but the reverse was observed in ${}_5q_{45}$ and ${}_5q_{60}$ that is, male probability of death was higher in these age groups of (45-60). Females below 40 years of age may have higher death probability due to complications of pregnancy and any other maternal causes during this period of their life. The age group (15-30) belongs to a vulnerable special risk period for females. The risk is due to pregnancy and child bearing or deaths due to complications of pregnancy and child birth during these ages. Thus, reduction of mortality of females in this age group has been an area of concern. High mortality of females may be a reflection of low social, cultural as well as low health status of women in India. Negligence of health care, less care during their reproductive age period, malnutrition, and stress in all aspect of life may be some causes(17). This states the gravity of the situation. Even if a steep decrease of infant mortality resumes in future, importance of female adult-age mortality and health for the

Variations of probabilities of death (nqx) at selected ages, Guwahati, 1986-2011

Table 3 : Values of nqx, at selected ages for male and female of Guwahati, since 1986 to 2011

	${}_1q_0$		${}_4q_1$		${}_5q_{15}$		${}_5q_{30}$		${}_5q_{45}$		${}_5q_{60}$	
	M	F	M	F	M	F	M	F	M	F	M	F
1986	0.0639	0.0574	0.0111	0.0192	0.0076	0.0082	0.0118	0.0136	0.0462	0.0297	0.1633	0.1341
1991	0.0517	0.0422	0.0094	0.0152	0.0064	0.0073	0.0114	0.0135	0.0456	0.0251	0.1329	0.1114
1996	0.0403	0.0394	0.0083	0.0085	0.0051	0.0058	0.0090	0.0130	0.0436	0.0224	0.1257	0.1030
2001	0.0355	0.0385	0.0079	0.0083	0.0035	0.0055	0.0068	0.0092	0.0434	0.0218	0.1225	0.0992
2006	0.0355	0.0354	0.0066	0.0065	0.0030	0.0052	0.0065	0.0077	0.0193	0.0189	0.1060	0.0758
2011	0.0355	0.0354	0.0065	0.0064	0.0029	0.0051	0.0064	0.0102	0.0187	0.0147	0.0863	0.0748

female population of Guwahati city with other parts of the country will have to be improved. Higher probability of death in the age group 15-30 for females may also occur due to the deaths of illiterate females during their pregnancy and child bearing period, specifically in slum areas. Thus female education needs to be improved, also concern needed for nutrition, increase of health services during pregnancy, at the time of delivery, successful implementation of the expanded programmes on immunization, diarrhoeal disease, acute respiratory disease control programmes as well as the control of the other infectious diseases may also contribute to lower the infant mortality(13).

Decreasing trend for values of ${}_1q_0$ has been observed (see Figure 2). It shows that the values of ${}_1q_0$ give a declining trend since 1986 to 1996 for both males and females in Guwahati city. After that the values of ${}_1q_0$ have been stagnant. This may be because mortality has not changed since 1996.

The Temporary Expectation of Life (TLE)

The Temporary Expectation of Life (TLE), under mortality conditions of Guwahati city for male and female along with Annual Relative Change during 1986-2011 is depicted in Table 4. It is observed that high variations in pace of improvements in TLE and ARC existed across the study years, for the age groups, irrespective of sex. Maximum annual relative change (ARC) has been observed during 1986 to 1991 for male in TLE ${}_5E_0$, whereas for female ARC was maximum during 1991 to 1996 in TLE ${}_{10}E_5$. Children below 10 years of age have higher values of ARC compared to Adults and elderly age group irrespective of sex. The relative changes in mortality were considerably low even negative in some of the age group during 1986- 1991, 1996-2001 for male and during 1996-2001, 2001-2006 and 2006-2011 for female. Mostly, smaller changes of ARC have been lower from elderly age group 60+ years to adult age group for both male and female in almost all the study years. This may be due to the fact that adults as well as the elderly persons belong to high risk exposure age group. Therefore low pace of change of fatality reduction has been observed since adulthood for both male and female.

It is observed from Table 4 (next page) that, the values of ${}_5E_0$ for male and female are almost the same in recent years like 2011, though it showed slight higher values for female in previous study years viz 1986, 1991 ,1996 and 2006 respectively, then in 2001 male showed higher ${}_5E_0$ value. This has been depicted in Figure 3. It is seen that, the trend of temporary expectations over the last 25 years is having a wide variation in the age group (5-15) and (15-60) years (see figure 3). The TLE ${}_{10}E_5$ for male, trend is smoothly increasing over the study years. It is interesting to notice that, for the total population female is in a more advantageous position than males with the only exception in age group (5-15) years.

For female ${}_{10}E_5$, the trend shows increasing trend with higher values than their male counterpart, came down slightly from 2006 onwards. For the age group (15-60) i.e. for working age group male and female has wide variation since last 25 years. The TLE ${}_{45}E_{15}$ for males in 2001 had less value than females, but it became higher in 2011. For elderly persons female has been having increasingly higher values of E_{60+} than male counterparts though in recent 2011 both male and female has almost the same TLE values. Kerala's outstanding performance in terms of TLE was observed as this state experienced lower level of child mortality, adult mortality(25).

Higher values of TLE for female are also common in other major places of India like Kerala(24). The study shows higher values of the index of Annual Relative Change (ARC) in early age for both male and female, gives low values in (15-60) and 60+ ages over the years. We observed smaller changes in ARC during (1996-2001) to (2006 to 2011) for age group (5-15) & (15-60). High exposure of ill health may lead to low ARC of mortality by adults and elderly in Guwahat.

Figure 2: The probability of death ${}_1q_0$, for male and female Guwahati during 1986-2011

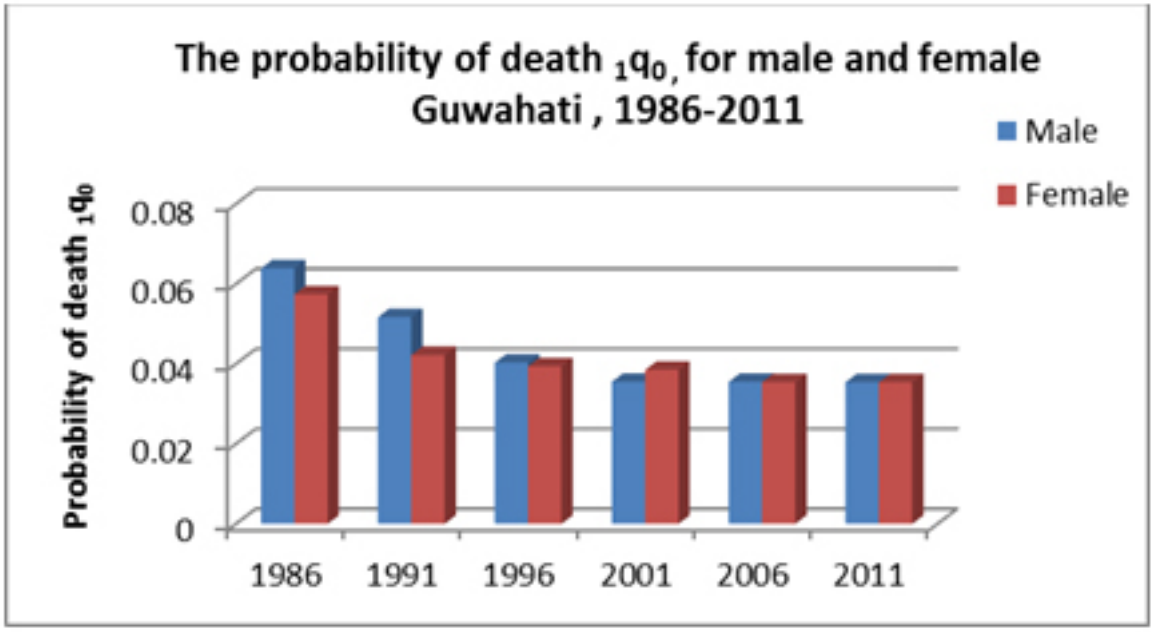


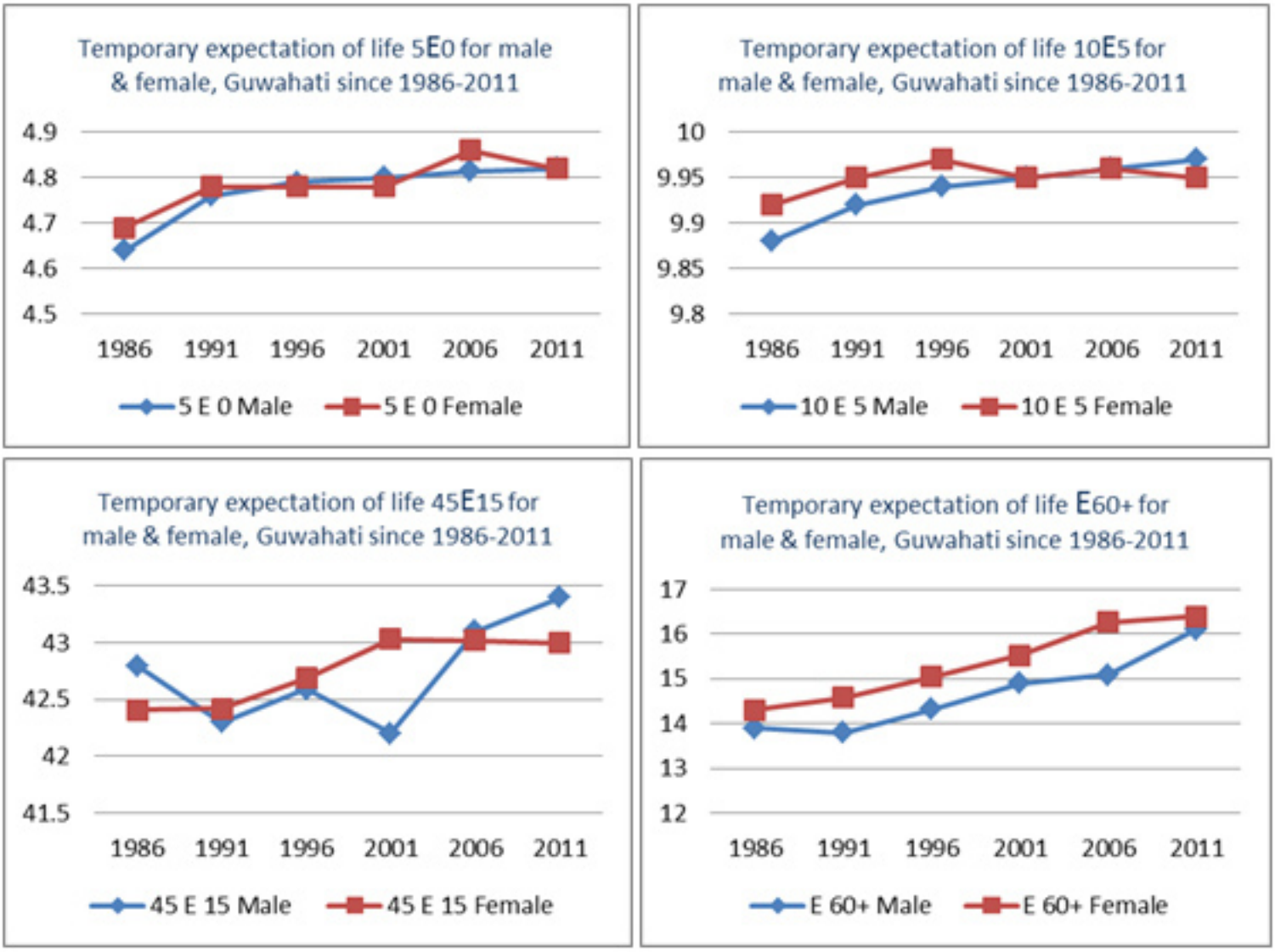
Table 4: Temporary Expectation of life and Annual Relative Changes since 1986-2011, Guwahati city

	Temporary Life Expectancy (TLE)						Annual Relative Change (ARC) in TLE				
Male	1986	1991	1996	2001	2006	2011	1986-1991	1991-1996	1996-2001	2001-2006	2006-2011
${}_5E_0$	4.68	4.74	4.79	4.82	4.819	4.82	7.79	2.64	0.97	2.09	0.55
${}_{10}E_5$	9.98	9.97	9.98	9.99	9.987	9.99	7.79	5.59	3.58	4.36	5.59
${}_{45}E_{15}$	41.9	41.6	42.26	42.6	43.2	43.4	5.03	2.25	-3.05	7.46	3.38
E_{60+}	13.1	13.8	14.06	14.5	14.86	14.9	-0.03	1.74	2.13	0.76	4.50
	Temporary Life Expectancy (TLE)						Annual Relative Change (ARC) in TLE				
Female	1986	1991	1996	2001	2006	2011	1986-1991	1991-1996	1996-2001	2001-2006	2006-2011
${}_5E_0$	4.69	4.77	4.80	4.80	4.82	4.82	6.63	0.00	0.00	8.64	-5.15
${}_{10}E_5$	9.95	9.97	9.98	9.98	9.99	9.98	8.97	9.71	-1.76	4.36	-4.56
${}_{45}E_{15}$	41.84	42.29	42.56	42.88	43.09	43.2	0.07	2.18	3.13	-0.50	-0.20
E_{60+}	14.20	14.45	14.85	15.12	15.87	16.1	1.00	1.76	2.02	3.55	0.76

Table 5: Percentage of ratios of TLE to max possible years in each phase of life of Guwahati, 1986-2011

	Percentage of ratios of TLE to maximum possible years					
Male	1986	1991	1996	2001	2006	2011
0-5	92.8	95.2	95.8	96	96.3	96.4
5-15	98	99.2	99.4	99.5	99.6	99.7
15-50	94.1	94.3	95.6	96.8	97.7	98.5
15-60	95.1	94	94.6	93.8	95.8	96.4
60+	34.5	34.5	35.8	37.3	37.7	40.3
Female	1986	1991	1996	2001	2006	2011
0-5	93.8	95.6	95.6	95.6	97.2	96.4
5-15	99.2	99.5	99.7	99.5	99.6	99.5
15-50	94.40	96.49	95.28	96.22	95.28	96.14
15-60	94.2	94.3	94.9	95.6	95.6	95.6
60+	35.5	36.5	37.6	38.8	40.7	41

Figure 3: Temporary Expectations of life for male and female, Guwahati for different span of life since 1986-2011



The values of percentage of the ratio of TLE at various age groups (Table 5) e.g. children of (0-5) years, children and adolescent of (5-15) years , male and female of (15-50) years and (15-60) years age group oscillate mostly around 95% and 96% over the years under consideration in a city like Guwahati. After 1986 the ratio of TLE of (0-5) has been showing an increasing trend for both male and female (see figure 4.i). The same picture of increasing trend is being observed for (5-15), (15-50) and even for age of 60 years above.

From Table 5, it is observed that as time passes the value of a particular ${}_nE_x$ increases. For example the percentage values for the age group 0-5 for male(female) in 2011 was 96.4(96.4). In 1986 this value for male(female) was 92.8(93.8). The highest value of ${}_5E_0$ is not satisfactory because in the city like Guwahati one expects this value to be 100. Percentage values in the age group 5-15 are almost satisfactory because for this age group values are approximately equal to 100, indicating that in the adolescent period mortality is negligible in the city.

For the age range 15-50, the percentage values are not satisfactory for males and female. From 1996 to 2011 these values are slightly higher for females. This may be due to the death of females during reproductive and child bearing period for malnutrition. Literature from many countries has shown that women in younger age less than 20 and older than 35 years have higher mortality rates(30). Female mortality in age group (15-50) also increases with number of children they carry and birth order (NFHS-3,2005-2006). 6% of teenage mothers aged less 20 years contribute to high mortality of women. The percentage values for males and females for the age group 15-60 are also not satisfactory where for female deaths in the early part of this age range have already been stated and for males this may occur due to hard work, consumption of alcohol, smoking, cigarette etc. For the old age (60+) the percentage values are far from being satisfactory. The highest value among males and females is 41, not even half of maximum possible value i.e, 100. However, in all study years for age above 60 year higher values of ratio of TLE have been seen for females than their male Counterparts (Figure 4.iii).

These values of ratios are expected to lie around 100 and state authorities should take necessary measures to improve this situation in Guwahati to bring the percentage of ratio of TLE for different spans of life to 100.

The decomposition analysis (Table 6) shows, the contribution of different age groups in the increase of life expectancy at birth for male and female. Early childhood mortality i.e. infant mortality is a major contributor to the total change of life expectancy as compared to the higher age group in Guwahati for almost all the age group between 1986-2011. It shows from decomposition analysis that for the total e_0^0 difference (male) as 7.94 early childhood mortality has contribution of 26.43% in contrast to -0.17% at age 80+ and for the total e_0^0 difference (female) as 7.78, early childhood mortality has

Table 6 : Age decomposition of differences in life expectancies (LE) at birth between 1986 and 2011 for male and female separately, Guwahati

Total difference of life expectancy, $e_0^0(2011) - e_0^0(1986) = \sum n\Delta x = 7.9433$ for male

Age Group	MALE $n\Delta x$	% Contribution of age specific death (ASD) to total e_0^0 increase	FEMALE $n\Delta x$	% Contribution of age specific death (ASD) to total e_0^0 increase
0-1	2.09968	26.43%	1.65617	21.28%
1-5	0.29995	3.78%	0.8820	11.33%
5-10	0.0647	0.81%	0.24702	3.17%
10-15	0.09728	1.22%	0.06783	0.87%
15-20	0.24132	3.04%	0.16354	2.10%
20-25	0.20498	2.58%	0.20486	2.63%
25-30	0.09673	1.22%	0.16729	2.15%
30-35	0.20899	2.63%	0.13701	1.76%
35-40	0.14826	1.87%	0.13493	1.73%
40-45	0.79092	9.96%	0.25839	3.32%
45-50	0.68134	8.58%	0.39608	5.09%
50-55	0.32856	4.14%	1.37768	17.70%
55-60	0.77076	9.70%	0.90625	11.64%
60-65	0.83894	10.56%	0.77577	9.97%
65-70	0.85955	10.82%	0.72842	9.36%
70-75	0.06371	0.80%	0.03962	0.51
75-80	0.08439	1.06%	0.08088	1.04%
80+	-0.0136	-0.17%	-0.4410	-5.67%
Total	**7.9433**	**100**	**7.78276**	**100**

Total difference of life expectancy, $e_0^0(2011) - e_0^0(1986) = \sum n\Delta x = 7.7828$ for female

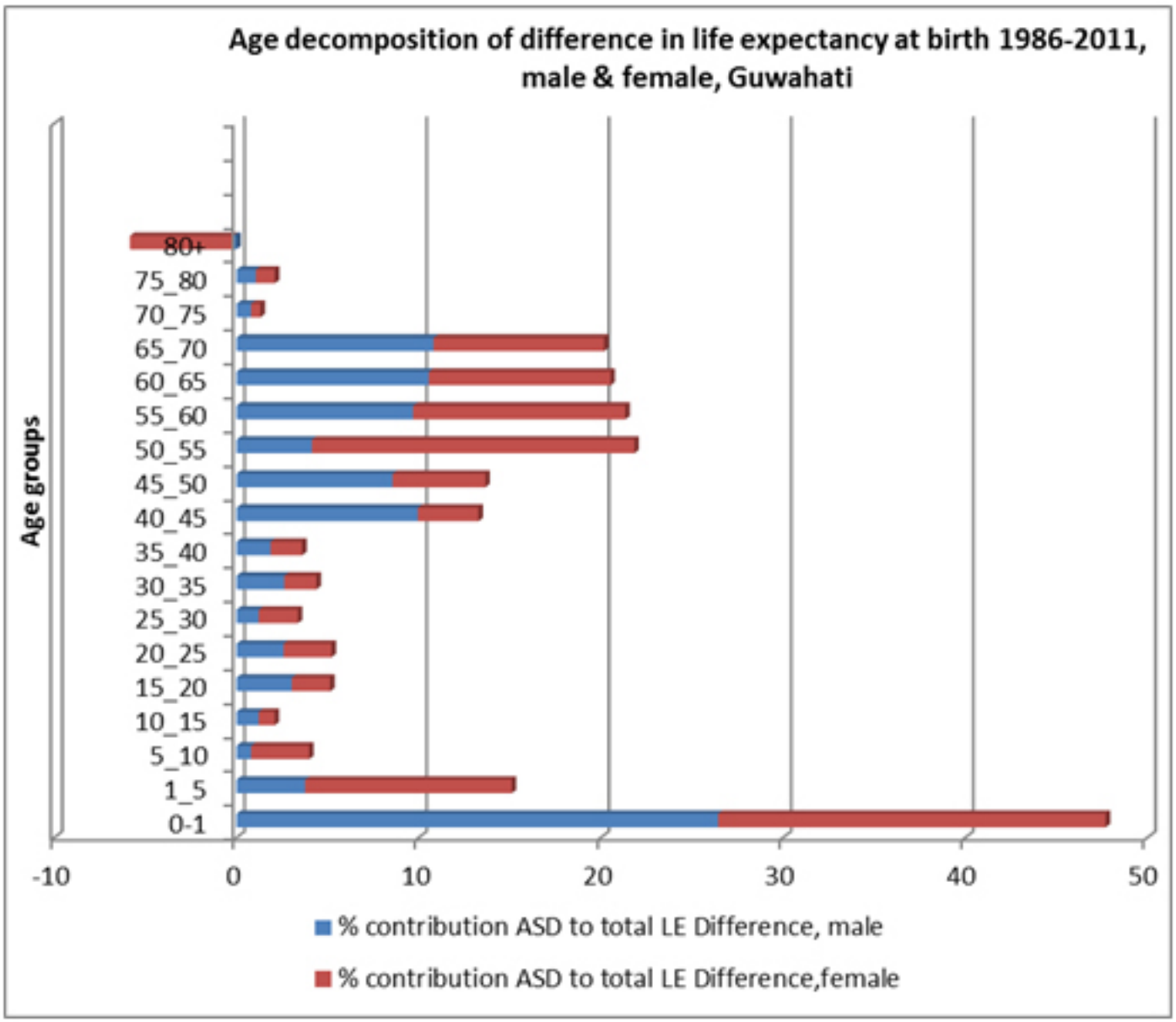
contribution of 21.28% in contrast to -0.44% at age of 80+. Overall the decomposition analysis here produces positive and subsequently negative contribution to the total changes or total differences in expectation of life at birth in the city between 1986-2011. It is the improvement in the process of survival of population in Guwahati that contributes improvement in life expectancy.

It is seen from the above table that there is gain in life expectancy in almost all the age groups for both males and females (expect for males in the age group 80-85 and 85+). At birth, the life expectancy for males is 71.51 years according to the life table, and for females it is 72.71 years. The gain in life expectancy at birth may be due to the improvement in mortality rates for the middle age group.

The objective of this study is to see the trend and differential of mortality of Guwahati city by means of life table. The strength of the study is 25 years of prospectively collected data. Overall, expectation of life at birth has undergone a significant change from 1986 to 2011. Females have recorded accelerated improvements in their life as compared to their male counterparts over the last 25 years. The findings in Guwahati have slight higher values than SRS, Assam urban life table values in most of the study years.

The demonstration of comparative study of life tables of Guwahati, an urban set up of North-East of India since 1986-2011 may be of help to planners and implementers of the State's health development programmes. With its rich natural resources and high business and economic activities, Guwahati is a major place of North-East of India and it has to achieve the desired outcomes of longevity of life. The issues of infants, children and mothers as well as adults need more attention to address the issues regarding overall gain in survival of people in Guwahati city. Future progress should be judged not only in terms of overall gain in life expectancy but also in terms of healthy life of people. The national programmes that are followed for prevention of communicable and non communicable diseases should be sincerely carried out to bring a change in overall longevity of life in this area and it should be the goal which is within our reach.

Figure 5



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Original Contribution/Clinical Investigation

Geriatric Care Through Life Long Learning: A Humanistic Approach

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ABSTRACT

Objectives: This working paper is a modest attempt to associate Lifelong Learning process with geriatric care i.e. the physical and mental well-being of the elderly people of India.

Methods and Materials: The present study utilised data from Census of India, National Sample Survey Organisation and Sample registration system for reviewing the relevant issues like who are the old, what are their problems and why do they need care or why society should at all bother for their care?

Results: The present study humbly proposes the introduction of folk games or traditional games for identifying psychological / psychiatric disorders of elderly people. Another fruitful learning experience may be the learning of a new language in a later age. The post retirement period may be the fertile ground for hobby and experience sharing. All these proposed schemes of learning for aged people demand an infrastructure. This is the responsibility of the government and society as a whole.

Conclusion: This study does not demand credit for any innovative schemes of learning. The present study only proposes a few new contexts for these processes. It is sincerely expected that the use of Lifelong Learning as a medium for the physical and mental upliftment of this esteemed section of the society would give the 'concept of learning' it's much needed humanistic approach.

Key words: lifelong learning, geriatric care, humanistic approach.

Introduction

Lifelong Learning is a process where one can participate in the learning process throughout ones' whole life which implies that it is never too soon or too late to learn. One should always be open to new ideas and learning. So it can be summarised that Lifelong Learning is a practice which starts even before schooling and never ever stops (even after the accomplishment of formal education).

The notion of Lifelong Learning evolved in the early twentieth century, particularly after the First World War and gained worldwide popularity in the mid 90's just after international bodies like UNESCO began to popularise the idea. Actually, the idea of Lifelong Learning germinated in a government report of Britain published in 1919 which expressed that adult education...is a permanent national necessity...and therefore should be both universal and lifelong. (1) The urge for an all embracing education system can be understood in the context of the post World War scenario when the whole of Europe was handicapped by the atrocities of the War. The situation became graver after the Second World War. There was an increasing demand for skilled labour force for the purpose of post war reconstruction and as the conventional education system proved inadequate to produce as much skilful workers, hence there surfaced the demand of an alternative education to cope with the situation. The concept of lifelong learning became an international agenda with the active participation of world bodies like UNESCO, European Union (EU), Organization for Economic Cooperation and Development (OECD) and many others. While, as an intellectual body UNESCO's primary concern was to achieve all around development through learning and to pay as much heed to human development as to purely material progress (2), the focus of organizations like EU and OECD remained static with the notion of growth, competitiveness and employment.(3) It is seen that in a changing world UNESCO's slogan of learning to be has been overrode by the more alluring 'economistic' paradigm of knowledge economy.

The foregoing discussion leads us to the conclusion that the concept of Lifelong Learning emerged as an aide of the contemporary perception of 'knowledge economy' and thus facilitating learning as a tool to create a highly skilled and a adaptable workforce for the global market economy. Thus Lifelong Learning, from its very inception was imbibed with an economic undertone. Recently attempts are being made to free this idea from the stigma of being a hand maid of the global economy. In this attempt some scholars try to give Lifelong Learning process a pedagogic sugar-coat.

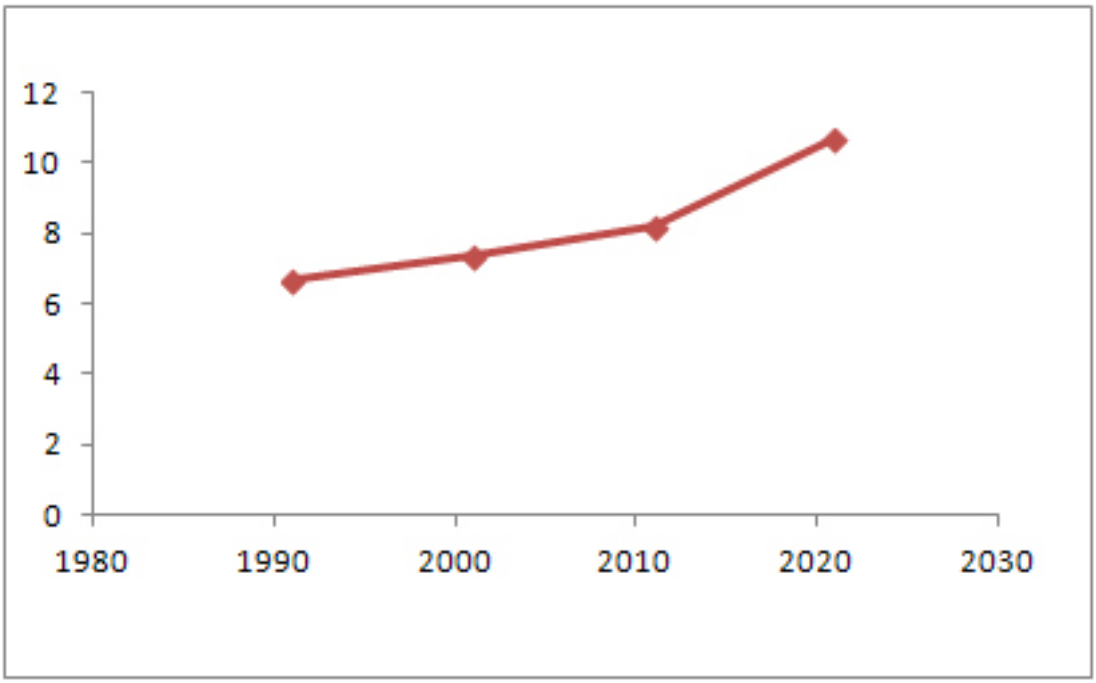
The present study, however, will not try to justify or to explain either of these explanations. On the other hand, it attempts to suggest another approach for lifelong learning process, which is more humanistic in its essence. The proposed approach would link Lifelong Learning with geriatric care which means the wellbeing of the aged people, a very significant section of Indian society.

Methods and Materials

Before moving towards the main context of this study i.e. linking up lifelong learning with geriatric care, let us have a brief look into the relevant issues like, who are the old, what are their problems and why do they need care or why society should at all bother for their care?

Old age or ageing is an inevitable component of all living beings. It is a reflection of physical, psychological and social change. The definition of old age is not rigid since the meaning of old age varies among the different people of the world. In some societies people are considered old due to alteration in their social position and restricted regenerative capability as

Figure: 1 Percentage of 60+ aged population of India, 1991-2021



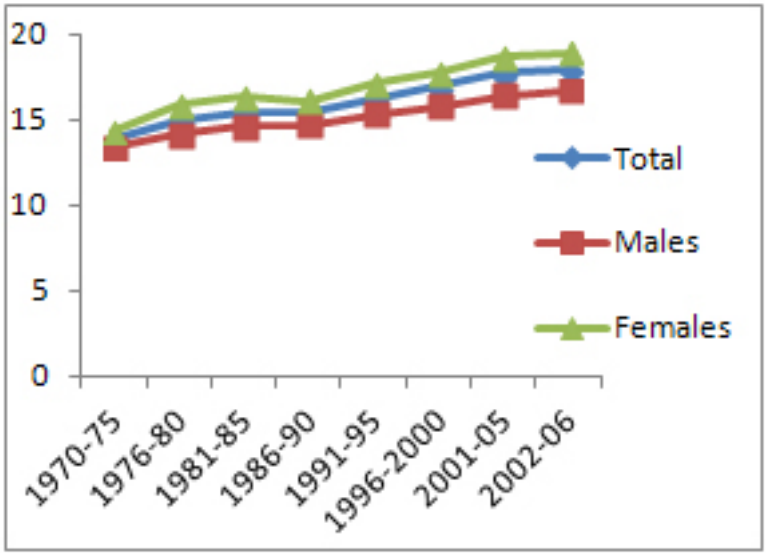
Source: Census of India, 1991,2001,2011,2021*(*projection)

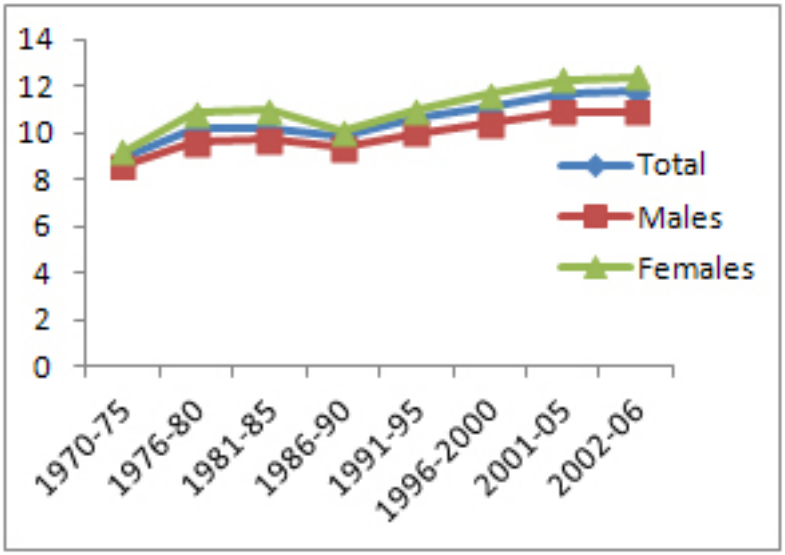
Figure: 2 Percentage of population aged 60 and above to general population by sex, India, 1901-2001

Year	Persons	Males	Females
1901	5.06	4.55	5.59
1911	5.22	4.81	5.65
1921	5.37	5.04	5. 70
1931	5.09	4.86	5.35
1941	5.66	5.43	5.91
1951	5.43	5.21	5.66
1961	5.63	5.46	5.80
1971	5.97	5.94	5.99
1981	6.42	6.35	6.50
1991	6.55	6.45	6.66
2001	7.70	7.55	7.86

Source: Sharma, S.P. & Peter Xenos. 'Ageing in India: Demographic background and analysis based on census materials' Occasional paper No. 2 of 1992, Office of the Registrar General and Census Commissioner, India, New Delhi, 1992

Figure: 3 Expectation of life at age 60 and 70+ by sex over time of India





Source: Sample Registration System (SRS) Office of the Registrar General, India.

Figure 4: Old age dependency ratio by sex for India, 1961-2001

Year	All	Male	Female
1961	10.9	10.9	10.9
1971	11.5	11.4	11.6
1981	12	11.8	12.2
1991	12.2	12.2	12.2
2001	13.1	12.5	13.8

Source: Office of the Registrar General, India

Figure 5: Per 1000 Distribution of aged persons living alone for each sex and residence, India

Living Alone	Rural male	Rural female	Rural Persons	Urban male	Urban female	Urban Persons
1995-96	25	61	43	30	60	45
2004-05	28	76	58	21	65	43

Source: NSS 52nd round (1995-96), NSS 60th round (2004-05).

compared to other adults. According to the Government of India's definition on old age, adopted in 'National Policy on Older Persons' (1999), an 'elderly' or a 'senior citizen' is a person who is 60 years of age or above. (4) Although 60 years is a too young age to be old, here in this study, we shall take the Government of India's yardstick to gauge the age of the old people of this country.

Major increase in life expectancy and a host of other reasons brings a rapid demographic transition in India since the last quarter of the preceding century. This demographic change specifically highlights the massive increase in older population and ageing people, which in turn, poses to be a grave concern for the health planners of India. The following figures will show the increasing scenario of the senior citizens of India across the years.

The above figures clearly indicate the steady growth of the elderly people in recent years. If demographic projections are to be believed, the proportion of elderly people would increase into an insurmountable amount amount up to 360 per cent by 2050.(5) Therefore, it is high time to sensitively chalk out adequate and effective strategies to address the physical and mental wellbeing of this sizeable section of the society.

Normally in our country, people retire from active working life between the age group of 60-65. At this age a man usually finds himself in a sufficiently healthy and active position. However, as a result of rise of expectancy of life over the years, a person generally lives for another 20 to 25 years even after his retirement from formal and informal working life. At this age group, a man suddenly discovers that the periphery of his activity has been rapidly shrinking with his growing age. This discovery brings a negative sense of emptiness and void to the mind of the concerned person which consequently paves the way for numerous mental and physical ailments. At this critical juncture persons need care and support from the immediate family, society and government.

Unfortunately care for the aged is not yet been in the priority list of the health policies of this country. Further, the enormity of the situation confirms that it is not only the responsibility of the government and other stakeholders, but society as a whole should come forward to tackle this issue with care and consideration. In this regard, this study attempts to explore the various avenues of using Lifelong Learning as a tool for geriatric care.

Results and Discussion

Because of its much needed flexible format, the process of lifelong learning is the best alternative for geriatric care. Learning is a lifelong exercise and new learning experiences in a later phase of life may provide newer meaning of life to the senior members of our society. In this context, the present study humbly proposes the following avenues of learning which may positively affect the mental and physical wellbeing of the elderly people.

It is a fact that games, particularly folk games, carry with them a psychological significance of practical application. (6) Thus these games are evidently therapeutic in stress-management and can also be utilized as a diagnostic tool in identifying psychological / psychiatric disorders. Some of these games can be used as remedial tools for senior citizens of our society.

As a result of invention of modern medicines and for many other reasons there has been a considerable increase in the life expectancy of the people, but unfortunately this longevity does not tally with health expectancy. In other words, people now-a-days are living a longer life than their predecessors but are prone to various ailments - both mental and physical.

Subsequently, the society is experiencing an increase in the population of senior citizens. These people, now in their old age, are sometimes confronted with the feeling of isolation and neglect from their own family members.

It is seen that traditional games, particularly, board games, are likely to be useful for the elderly people. Traditional games are associated with the roots of one's culture and learning these games will give the elderly people the pleasure of rediscovering their childhood and will preoccupy them in some leisurely activities. The involvement in these games would also increase their physical dynamism.

Board games can be beneficial to these people as they assist the participants with regular mental exercise which will effectively help them to prevent or minimize mental diseases like insomnia, depression, Alzheimer's disease etc. Medical reports say that the risk of dreaded Alzheimer's disease can be minimized by involving in regular mental exercise like playing board games.(7) The senior members of the family can play these games with their grand-children and such involvement in traditional activities may resurrect the family ties which are otherwise on the wane.

Another fruitful learning experience may be the learning a new language in a later age. Language learning at any age can unlock new avenues. It is proved to be very beneficial to the elderly learners too. Research shows that mature learners have more advantage in mastering new language as they can cast aside the hassles of everyday life and devote more time in study than their younger counterparts. Further, the informal approach of this new learning process gives the mature students respite from the stress and anxiety usually associated with formal education's examination and evaluation process.

Learning a second language has immense cognitive benefits. Frequent learning and review of a new language s invigorates the brain to react faster. A 2012 article in the UK's "Telegraph" suggests that studying a second language "rewires" the brain, and could help delay the onset of dementia for years.(8) To be precise, it is purely a refreshing learning experience which may provide the senior learners with much needed self-confidence and help them to come out of negativity.

In the prime time of life people have had many dreams and desires most of which have remained unfulfilled. One might have been a promising poet, artist, actor or a violin player in his/her youth. But the busy schedule of his/her professional life hardly spared any time for participation in these hobbies. The post retirement period may be the fertile ground for satisfying such long cherished desires. Similarly hobby and experience sharing may be a very constructive way of passing time. The senior members of the society are the live treasure house of varied experiences. By sharing their firsthand experiences with the listeners (or learners) of heterogeneous age they can impart their contemporary knowledge to the generation next and make society enriched.

All these proposed schemes of learning for the aged people demands an infrastructure. These people at least need a premise where they can sit and learn and play one or two new games, practise newly learned language and share hobbies and experiences with others. Here comes the responsibility of the government and society as a whole. Government should construct halls in the model of community centres where all necessary amenities for elderly people should be readily available. There should be provision for staff like caretakers instructors etc. Another plausible alternative may be the educational institutions like schools and colleges which may easily arrange such community hall for the elders as they have the necessary infrastructure. Funding should not be a very big issue as the University Grants Commission and other funding agencies would not object in funding such extension activities. The urgent need at this moment is a responsible, compassionate and humanistic approach towards the elderly members of our society.

Conclusion

This study does not demand credit for any innovative schemes of learning. All the aforementioned schemes already exist. The present study only proposes a few new contexts for these processes. It is sincerely expected that the use of Lifelong Learning as a medium for the physical and mental uplifting of this esteemed section of the society would give the 'concept of learning' it's much needed humanistic approach.

Footnotes

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