An Overview of the Sample Registration System based life table in Assam

ABSTRACT:

Life table is a statistical tool that summarizes the mortality experience of a population and yields information about longevity and life expectation. The present study aims to calculate the components of life table for the state of Assam which is located in the north-eastern part of India. The result indicates that the life expectancy at birth in Assam has been 63.5 and 66.2 years for males and females respectively. The life expectancy of female is higher than their male counterpart in all the age groups. The finding also reveals that the life expectancy for urban areas is higher than that of rural areas. The study may have some policy implication that would help the planners and policy makers of the government to take necessary steps in achieving life expectancy as high as possible.

Key words: Life table, life expectancy, Age specific death rate, infant mortality, Sample registration system

1. INTRODUCTION

The study of mortality which is the oldest subject in demography was first brought under systematic and rigorous analysis through the concept of life table. A life table is a mathematical tool that portrays the mortality conditions at a particular period of time among the population. Life table is a life history of a hypothetical group, or cohort of people, as it is diminished gradually by deaths [1]. According to [2], life table is a Scheme for expressing the forms of mortality in terms of probabilities. Long before the development of modern probability theory and statistics, men were concerned with the length of life and they constructed tables to measure longevity. The concept of life table as we know it today, first originated from [3] when he published a rudimentary life table in 1662 based on the analysis of his famous “Bills of Mortality”. In this life table, [3] introduced the proportions of people surviving to various ages. There were subsequent contributions by [4], [5]. [6] studied the length of life from a purely statistical point of view, making the life table a valuable analytical tool for demographer, epidemiologist, physician, zoologists, manufacturers , and investigator in other fields. Using the interpolation formula, [7] presented a method of getting the values of life table functions at pivotal points. [8] and [9] gave a short method of abridged

life table. [10] combined the death rates in the life table with other demographic data into a complex model to measure the joined impact of mortality and changes in one or more socioeconomic characteristics. [11] constructed a complete life table from an abridged one using "smoothing" formulae and three interpolation schemes. Office of the Registrar General of India (ORGI) over the years produced life table for India and its major states, referring to urban, rural and total areas, of males, females and both sexes combined, using conventional life table method and the age-specific death rates (ASDRs) of the Sample Registration System, which is a duel record system for collecting fertility and mortality indicators. The purpose of present manuscript is to review and study the components of the Sample Registration System based life table in Assam. The present study may be useful to the health planners and researchers for making policies and programmes relating to public health.

2. MATERIALS AND METHODS

In the present paper, an attempt has been made to study the SRS based abridged life tables 2011-15 [12]. The life table has been constructed for all India and bigger States/UTs (having population 10 million and more) along with Himachal Pradesh. But in the present study, the life table for the state of Assam only is considered. Life table can be classified into complete life table and abridged life table according to the length of the age interval in which basic data are presented. SRS based life table is an abridge life table where life table information is given for age intervals such as x to x+5. There are several methods for construction of life tables. In this study, the life tables have been generated using mortality package for life table estimation (MORTPAK 4), which is a United Nation's software package for mortality measurements. A typical abridge life table generally has the following columns.

$(x, x+n)$: Age interval or period of life between two exact ages stated in years

${}_nq_x$: Probability that a person at aged *x* will die before reaching *x*+*n*

${}_np_x$: Probability that a person at aged *x* will survive up to age *x*+*n*

l_X : Number of person alive at age *x* (or surviving at the beginning of the age interval) out of an assumed number of birth, say l_0 usually called the cohort or radix of the life table

${}_nd_x$: The number of persons in the cohort who die in the age interval *(x, x+ n)*

62 $_nL_x$: Number of years of life lived by the cohort within the age interval *(x, x+ n)* (or
63 Number of person-years lived by the cohort in the age interval)
64 T_X : Total person-years of life contributed by the cohort after attaining age x (total number
65 of person-years lived by the cohort beyond age *x*
66 e_x^0 : Life expectancy at age *x (*or Average number of years of lived after age *x*)
67 **Relationship between various columns of life table**

68 1. $_nd_x = l_x - l_{x+n}$ 2. $_nq_x = \frac{_nd_x}{l_x}$

69 3. $_np_x = 1 - _nq_x = 1 - \frac{_nd_x}{l_x} = \frac{l_x - _nd_x}{l_x} = \frac{l_{x+n}}{l_x}$

70 4. $_nL_x = \frac{(l_x + l_{x+n})}{2}$ except the young age and age group 1-4

71 $L_0 = 0.3l_0 + 0.7l_1$

72 $_4L_1 = 1.9l_1 + 2.1l_5$

73 5. $T_X = {}_nL_{X+n} + {}_nL_{X+n} + \ldots\ldots\ldots + {}_\infty L_{85}$

74 6. $e_x^0 = \frac{T_X}{l_X}$

75 $e_0^0 = \frac{T_0}{l_0}$ = Life expectancy at birth

76 7. $_np_x = \frac{2n \times {}_nM_x}{2 + n \times {}_nM_x}$ where

77 $_nM_x = \frac{_nD_x}{_nP_x}$

78 $_nD_x$ =number of deaths in the age group between *x* and *x+n*

79 $_nP_x$ =number of individuals of the age group between *x* and *x+n*

80 $_nM_x$ =ASDR of individuals of the age group between *x* and *x+n* or life table death
81 rate

82

3. RESULTS

Table 1 and table 2 show the life table for the state of Assam by sex and residence respectively. In these table, ${}_nq_x$ represents the Probability of dying a person of between ages x and x+n given that he survives up to age x The probability of dying in the age interval 0-1 for female (0.05040) is higher than that of their male counterpart (0.04968). Male has the lowest probability value of 0.00434 in the age group 5-10 years where as female has the lowest probability of 0.00349 in the age interval 10-15 years. With the exception of age groups 0-1 to 5-10 and 15-20, the value of ${}_nq_x$ is higher in male than in female. In all the age groups, the probability value for rural areas is higher than urban areas.

l_x indicates the number of person who survived to age x of a 'hypothetical cohort' of 100,000 individuals. In the age groups 0-1 years to 30-35 years, the number of female survived at the beginning of the age interval is lower than that of male and in the higher age group the value is higher in female. The urban areas have the higher value of l_x than those of rural areas.

${}_nd_x$ presents the number of persons in the hypothetical cohort who die in the age interval (x, x+ n). The number of male dying from the hypothetical cohort of 100,000 individuals (male) in the age group 0-1 years is 4968 where as the number of female in the same age group is 5040. Among the male population, the maximum and minimum value of ${}_nd_x$ is found in the age group 75-80 (13389) and 5-10 (406) respectively. In contrary, the maximum and minimum value for female population is shown in the age group of above 85 years (15783) and 10-15 (322) respectively. In all the age group except 80 years and above the value is lower in urban areas that of rural areas. In both the rural and urban areas the lowest value is found in the age 10-15 whereas the highest value in rural and urban area is found in age interval 75-80 years (14273) and above 85 years (24240) respectively.

${}_nL_x$ indicates the number of years of life lived by the cohort within the indicated age interval (x, x+ n) (or person years of life in the age interval). In the age groups 1-5 to 30-35, the value of ${}_nL_x$ for females is lower than those of males. The difference is very low in the age interval 0-1 (22).The value for urban area is higher than that of rural area in all the age groups.

T_x shows the total person-years of life contributed by the cohort after attaining age x. The value of T_x for female is greater than the male counterpart in all the age groups with the

maximum gap occurs in the age interval 35-40 with the value of 290871. The value is higher in urban areas than rural areas.

e_x represents the life expectancy at the given age. It is a very important measure derived from life tables. It can be interpreted as the average number of years a person expected to live subject to the prevalence of mortality conditions of a specified period throughout the lifespan. Hence, the life expectancy at birth is the average length of life of a person. Similarly, the life expectancy at age x is the average number of remaining years a persons who survive to age x has to live. The life expectancy of female is higher than their male counterpart in all the age groups. The life expectancy at birth in Assam has been 63.5 and 66.2 years for males and females respectively with a gap of 2.7 years. The life expectancy after surviving through the first year of life has been 65.8 and 68.7 years for males and females respectively. The Life expectancy at birth is 63.3 years for rural and 71.5 years for urban. The life expectancy for urban area is higher than that of rural area in all the age group and that gap between urban and rural life expectancy is the highest in the age group of 0-1 years and the lowest in the age group of above 85 years. The expectancy of life at age one is higher than that at birth for both rural and urban areas.

4. DISCUSSION

Life expectancy at birth is not only a summary measure of mortality at all ages, but also an indicator of the quality of life of a country. The above result shows that the life expectancy at birth in the state of Assam for male and female are 63.5 and 66.2 respectively. These values are lacking behind the India's national figure of 66.9 years (male) and 70.0 years (female). This may be due to fact that age specific of death rate for the children of age less than one year in Assam is lower than that of national value. It may be noted that expectancy of life at age one is higher than that at birth. The reason may be that age specific death rate for the children of age less than one year is more than all other quinquenial age groups [12]. The life expectancy of female is higher than their male counterpart in all the age group and the sex gap in life expectancy is the highest in the age group 20-25 year. The female life expectancy at birth is higher than that of male by 2.7 years. This view is supported by the finding of [13], [14], [15], [16], [17]. Biological, Environmental, social and behavioral factors play a role in creating the gender gap between men and women in life expectancy. The infant mortality rate in male is higher than that of male as boys are biologically weaker and more susceptible to diseases and premature death. Men get employed in more dangerous, harmful, stressful and difficult occupation than women as a result of which the mortality rate

in the working age group is higher in men. Smoking and alcohol consumption rate in men is higher than the female counterpart. The deaths mostly associated with motor accidents, homicide, suicide, cancer and drowning is higher for men in the age of 20 to 25 years as compare to female. The life expectancy for urban areas is higher than that of rural areas in all the age group and that gap between urban and rural life expectancy is the highest in the age group of 0-1 years and the lowest in the age group of above 85 years. This finding is in agreement with the findings of [18], [19]. The higher value of life expectancy in urban areas is thought to be caused by the fact that owing to greater concentration of medical facilities and public health services in urban areas and certain other characteristics such as higher education, higher income and greater awareness regarding health, mortality level in urban areas is lower than rural areas.

As life expectancy is a key indicator for quality of life in both developing as well as developed countries, the population scientists and health planners should take necessary steps to promote an opportunities for increasing life expectancy by developing the strategies to improve the literacy rate, access of doctors in rural areas, income. Certain other factors like smoker study, certain type of diseases that inhibit life expectancy should be studied in detail as they may influence life expectancy in a higher way. The finding of above study may be interesting and revealing to the health planner and executors to design proper future policies and plans for improving the life expectancy.

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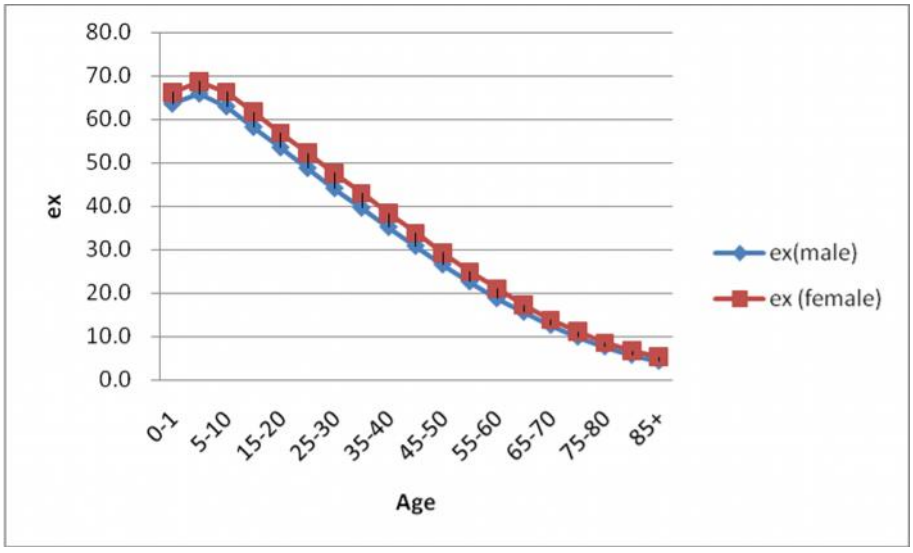
Table1. Life table for the state of Assam by sex

Age-Interval **x to x_{x+n}**	**Male**							**Female**						
	$_nM_x$	$_nq_x$	l_x	$_nd_x$	$_nL_x$	T_x	e_x	$_nM_x$	$_nq_x$	l_x	$_nd_x$	$_nL_x$	T_x	e_x
0-1	0.05178	0.04968	100000	4968	95952	6351139	63.5	0.05251	0.05040	100000	5040	95974	6621656	66.2
1-5	0.00411	0.01627	95032	1546	376265	6255187	65.8	0.00585	0.02305	94960	2189	374241	6525682	68.7
5-10	0.00087	0.00434	93485	406	466411	5878919	62.9	0.00107	0.00534	92771	495	462618	6151441	66.3
10-15	0.00102	0.00509	93079	474	464213	5412504	58.1	0.00070	0.00349	92276	322	460574	5688824	61.7
15-20	0.00101	0.00504	92606	467	461908	4948288	53.4	0.00137	0.00683	91954	628	458285	5228250	56.9
20-25	0.00164	0.00817	92139	753	458943	4486378	48.7	0.00137	0.00683	91326	624	455099	4769965	52.2
25-30	0.00233	0.01159	91387	1059	454424	4027434	44.1	0.00173	0.00861	90702	781	451599	4314868	47.6
30-35	0.00313	0.01553	90328	1403	448272	3573010	39.6	0.00179	0.00891	89921	801	447661	3863270	43.0
35-40	0.00389	0.01927	88925	1714	440504	3124738	35.1	0.00250	0.01243	89120	1108	442932	3415609	38.3
40-45	0.00516	0.02549	87211	2223	430854	2684234	30.8	0.00285	0.01415	88012	1245	437125	2972678	33.8
45-50	0.00884	0.04330	84988	3680	416261	2253378	26.5	0.00510	0.02521	86767	2187	428905	2535554	29.2
50-55	0.01112	0.05419	81308	4406	396260	1837116	22.6	0.00981	0.04796	84579	4056	413456	2106649	24.9
55-60	0.02201	0.10463	76902	8046	365572	1440855	18.7	0.01288	0.06249	80523	5032	390654	1693193	21.0
60-65	0.02799	0.13105	68856	9024	322390	1075281	15.6	0.02010	0.09601	75492	7248	360598	1302542	17.3
65-70	0.04162	0.18905	59832	11311	271774	752889	12.6	0.03628	0.16696	68244	11394	314063	941947	13.8
70-75	0.06197	0.26885	48521	13045	210500	481114	9.9	0.05060	0.22529	56849	12808	253110	627886	11.0
75-80	0.09324	0.37742	35476	13389	143600	270613	7.6	0.08372	0.34619	44042	15247	182116	374777	8.5
80-85	0.14101	0.51471	22087	11368	80621	127013	5.8	0.11771	0.45188	28795	13012	110544	192664	6.7
85+	0.23104	...	10718	10718	46392	46393	4.3	0.19219	...	15783	15783	82120	82121	5.2

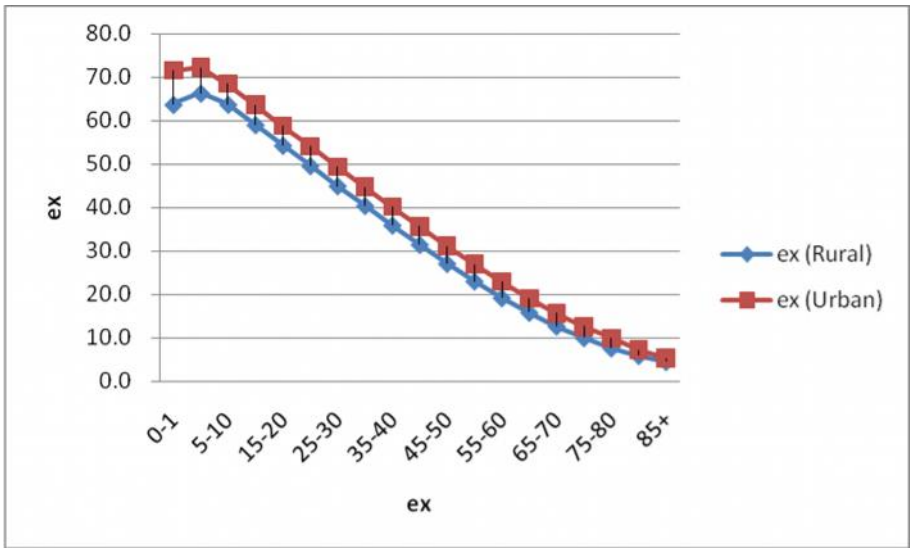
Table2. Life table for the state of Assam by residence

Age-Interval **x to x_{x+n}**	**Rural**							**Urban**						
	$_nM_x$	$_nq_x$	l_x	$_nd_x$	$_nL_x$	T_x	e_x	$_nM_x$	$_nq_x$	l_x	$_nd_x$	$_nL_x$	T_x	e_x
0-1	0.05602	0.05361	100000	5361	95693	6373473	63.7	0.024471	0.02395	100000	2395	97872	7149923	71.5
1-5	0.00544	0.02147	94639	2032	373461	6277779	66.3	0.000729	0.00291	97605	284	389732	7052051	72.3
5-10	0.00102	0.00509	92608	471	461860	5904320	63.8	0.000551	0.00275	97321	268	485935	6662318	68.5
10-15	0.00092	0.00459	92137	423	459626	5442463	59.1	0.000471	0.00235	97053	228	484697	6176382	63.6
15-20	0.00120	0.00598	91714	548	457256	4982842	54.3	0.001051	0.00524	96826	507	482953	5691686	58.8
20-25	0.00156	0.00777	91165	708	454138	4525590	49.6	0.001149	0.00573	96318	552	480244	5208735	54.1
25-30	0.00215	0.01069	90457	967	449960	4071455	45.0	0.001411	0.00703	95766	673	477227	4728492	49.4
30-35	0.00256	0.01272	89489	1138	444701	3621497	40.5	0.002040	0.01015	95093	965	473166	4251267	44.7
35-40	0.00338	0.01676	88351	1481	438199	3176796	36.0	0.002519	0.01252	94128	1178	467802	3778104	40.1
40-45	0.00428	0.02119	86870	1841	430040	2738596	31.5	0.003271	0.01623	92949	1509	461204	3310302	35.6
45-50	0.00759	0.03729	85029	3171	417799	2308554	27.2	0.005401	0.02667	91441	2439	451549	2849099	31.2
50-55	0.01114	0.05429	81858	4444	398905	1890753	23.1	0.008210	0.04027	89003	3584	436553	2397553	26.9
55-60	0.01857	0.08895	77414	6886	370792	1491846	19.3	0.011461	0.05579	85419	4765	415806	1961004	23.0
60-65	0.02575	0.12129	70528	8554	332221	1121053	15.9	0.017310	0.08316	80653	6707	387470	1545202	19.2
65-70	0.04129	0.18776	61974	11636	281809	788832	12.7	0.027290	0.12817	73946	9478	347296	1157738	15.7
70-75	0.05952	0.25972	50338	13074	219653	507022	10.1	0.043030	0.19461	64469	12546	291568	810447	12.6
75-80	0.09498	0.38303	37264	14273	150276	287370	7.7	0.052601	0.23310	51922	12103	230093	518883	10.0
80+85	0.13622	0.50239	22991	11550	84793	137095	6.0	0.097591	0.39125	39819	15579	159640	288794	7.3
85+	0.21873	...	11440	11440	52302	52303	4.6	0.187675	...	24240	24240	129162	129158	5.3

Graph1. Table1. Life table for the state of Assam by sex



Graph2. Table1. Life table for the state of Assam by residence



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