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Life table analysis of a small sample of Santal population living in a rural locality of West Bengal, India

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Abstract: Life table calculation of small populations, especially of marginal populations, is difficult due to a small number of death records and lack of a systematic birth and death registry. The present study aimed to calculate a life table of a small sample of Santal population from Beliatore area of the Bankura district, West Bengal, India, using the recall method. The data on birth and death events were collected using house-to-house interviewing and cross-checking the data with reference to the significant events of the area and the family. The life table was calculated from age specific death rate of a closed population retrospectively estimated for 10 years. The calculated life expectancy at birth of the study population was 63.9 years with a standard error of 3.15 years. The finding agrees with the life expectancy of the other larger populations of the region, although calculated using conventional methods. The method needs to be evaluated to get the optimum number of death events required for calculating the life table with an acceptable error level. The study will be helpful for comparisons of overall health status of small populations with respect to time and space.

Key words: Anthropological demography, Santals of West Bengal, life table analysis, small population, recall method

Introduction

Life expectancy at birth is the most important function of life table, which is also an indicator for health status and human development. Life table analysis is one of the oldest and most popular demographic tools used at the large population level; so far not as widely calculated using small population samples. However, the life table analysis for a small population is equally important for local development, planning, and policy making – especially in demographically and culturally diverse countries, like India.

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The major difficulty for life table analysis for a small population is a small number of death records, making it difficult to calculate age-specific death rate (ASDR) for all ages or even age groups. The difficulty for life table calculation increases for marginal tribal populations of developing countries where little or no birth and death records are available; however, these small scale populations need special attention in developmental perspective.

Attempts were made to calculate life tables of small populations using the model life tables in developing countries, which have always been questionable (Pressat and Wilson 1985). In India, life table calculations for sub-populations have been attempted using Sample Registration System (SRS) based on ASDR (ORGI 1999, 2006). Many scholars have examined the validity and reliability of SRS data for its accuracy, relevance, comparability and timeliness (Mahapatra 2010). However, scholars like Bhat (2000, p-1) stated that the official life tables of the Office of the Registrar General and Census Commissioner of India (ORGI) had never been checked against the independent evidence provided by population censuses.

Life expectancy of tribal population in India was calculated in several studies, among those Basu and Kshatriya (1989, 1993), Dutta (1990), Chettlapalli et al. (1991), and Roy and Rath (1991) are noteworthy. However, all these studies estimated the life expectancy either using the model life tables or by predicting the mortality pattern of the population from the census records of young age groups; whereas the mortality pattern of the advanced age groups may not be correctly predicted from the mortality records of younger age groups. The theoretical assumption of this type of analysis is that the study population was a stable population, that is a population having a pyramid with an unchanged structure for a long period, which may not be true especially in the populations of developing countries.

Howell (1979) developed a viable method for life table calculation in small populations and calculated the life table of !Kung people in Dobe area of Southern Africa in her pioneering work. She did a prospective study of mortality pattern by observing a small population sample for more than 10 years from 1963 to 1973. However, conducting such a study is logistically difficult because of the time constraint.

Recent developments of anthropological demography make it possible to use different data collection and interpretation techniques like ‘own children method’ (Childs 2004), ‘critical interpretive approach’, ‘micro analysis technique’, etc. (Kertzer and Fricke 1997) for construction of life table for small population. Utility of the life table analysis of small populations has been extensively practiced in historical anthropology. The studies of Budnik et al. (2004), Budnik and Liczbińska (2006), Liczbińska (2010), and Rüttimann and Loesch (2012) are noteworthy in this aspect. Advancements in techniques of both data collection and analysis of mortality from historic record made it possible to attempt life table calculation for small and marginalized populations.

Therefore, the purpose of the present study is to calculate the life table of a small population sample using the recall method. The outcome of the present study will not only help in quick calculation of life table for small population samples, but will also be useful for comparisons of demographic data and overall health status of small populations in a larger scale.

Materials and Methods

Participants and data collection

Data were collected as a part of a larger anthropological study among the Santals, living in four villages of Beliatore area of the Bankura district, West Bengal, India, using a demography data collection schedule. Santals are one of the scheduled tribe populations in West Bengal. Many scholars have published a number of ethnographic reports on Santals (Kochar 1970; Culshaw 2004). The Scientific Ethical Committee for Protection of Research Risks to Humans of the parent institute of the second and third authors affirmed the compliance of the study with ethical issues dealing with human participants.

A single investigator (BMD) collected all demographic data and vital records from all 183 households in the four villages to eliminate the inter-investigator error in data collection. The data included date of birth/age, sex, place of birth, marital status, date of marriage, occupation, and educational status of all members of the family. Demographic data were collected from the household head of every household and were crosschecked from other family members as well.

Care was taken to estimate the age of each individual as correctly as possible. In the study population there was no tradition of keeping birth registration or any written records of birth dates. Therefore, age was estimated by reference to some important local events of recent history, and cross-checked with the age of the individuals with authentic birth records. The fertility and mortality records for each family were collected from the adult ever-married females of the household using a fertility-mortality schedule. The reproductive performance of each ever-married woman was recorded along with the year of occurrence of death cases that happened in last 15 years within the family.

Age and sex of the deceased individuals was also recorded. If exact ages of the deceased persons were not available, then they were estimated with probing. If the deceased individual was a child, the mothers were asked about the development markers (such as if the child could sit up/walk/whether weaned or not/eruption of teeth/started attending school or not/in which standard the child was in school/was there any year loss in school, etc.) that the child attained before death. Mothers were also asked about other events, such as whether any of the younger children was already born or not. Also they were asked to identify the persons in the current population who are contemporary with the deceased child and who are about the same age as the deceased child. Genealogies of each family were also collected in order to crosscheck the fertility and mortality data.

Theoretical consideration

The following life table functions were used in the analysis:

${}_nD_x$=number of deaths in the age group between x and $x+n$

${}_nP_x$=number of individuals of the age group between x and $x+n$

${}_nM_x$=ASDR of individuals of the age group between x and $x+n$

Note: Alternatively, ${}_nM_x$ can be referred to as "life table death rate". The difference between these two is that the denominator of life table death rate is "person-years lived in the interval" as opposed to "number of individuals alive at the middle of the interval" for ASDR. The difference of result by using either concept may be negligible in many cases. Therefore, following the convention, the term ASDR is used throughout the article.

${}_nq_x$=probability that someone aged exactly x will die before reaching $x+n$

l_x=number of people who survived to age x of a 'hypothetical cohort' of 100,000 individuals

${}_nd_x$=fraction of people who die between x to $x+n$ from the 'hypothetical cohort'

${}_nL_x$=person-years lived between x to $x+n$

T_x=total number of person-years lived above age x

e^0_x=life expectancy at age x

The following formulae were used to calculate the life table functions.

$$ {}_nM_x = {}_nD_x / {}_nP_x \quad (1) $$

$$ {}_nq_x = (n.{}_nM_x)/\{1+(1-a_x)\ n.{}_nM_x\} \quad (2) $$

Where, n=length of the age interval, and a_x=fraction of last age interval of life.

$$ {}_nd_x = l_x.{}_nq_x \quad (3) $$

$$ l_{x+n} = l_x - {}_nd_x \quad (4) $$

$$ {}_nL_x = n_x(l_x - {}_nd_x) + a_x.n.{}_nd_x \quad (5) $$

$$ T_x = {}_w\sum^x{}_nLx \text{ where } x=0,\ x+n_1, $$

$$ x+n_2.....w-1 \quad (6) $$

$$ \text{and } T_w = l_w/M_w \quad (7) $$

$$ e^0_x = T_x/l_x \quad (8) $$

The life table analysis based on the small sample size is subject to a sampling error and can be a poor representation of the actual mortality pattern of the population. Therefore, standard errors (SE) of the life table functions were also calculated using the formulae given by (Chiang, 1984).

$$ SE_nq_x = {}_nq_x.\sqrt{1/{}_nD_x(1-{}_nq_x)} \quad (9) $$

$$ SEl_x = $$

$$ = l_0.\sqrt{(l_x/l_0)._{x=0}\sum^{w-1} SE_nq_x^2/(1-{}_nq_x)^2} \quad (10) $$

$$ SEe^0_x = $$

$$ = SE_np_x.\sqrt{_{x=0}\sum^{w-1}{}_np_x^2(n_x-a_x)n_x+e^0_{x+n}} \quad (11) $$

where p_x is the survival probability and can be calculated by l_x/l_0, and

$$ SE\,{}_np_x = {}_nq_x.\sqrt{(1-{}_nq_x){}_nD_x} \quad (12) $$

Data consideration

In the present study, a modified version of the method, which was used by Howell (1979), was followed; the ASDR of Santals were estimated from a baseline demographic data of the year 2000. The survivorship of that population for over next ten years was used for their life table calculation. As the demographic data of the present study were collected during the year 2010, it was necessary to estimate the population counts of the year 2000 retrospectively. Also the baseline population was kept as a closed population that implies that all the people in the baseline remained within the study area except for the events of deaths; so no one joined or went out within the study period. To estimate a baseline closed population retrospectively, certain precautions were taken: (1) careful calculation of baseline study population from current age, birth and death records within the study population, and (2) exclusion of those individuals from the study population who had come in and went out during the study period.

Calculation of baseline study population: All the surviving individuals from the population counts of the year 2000 were ten years older at the beginning of 2010. Therefore, all the individuals aged ten years or above in the population of the year 2010, that is at the time of data collection, were at least ten years younger in the year 2000. For example, in the year 2010 there were 9 people at 65 years of age. So, they all were 55 years old at the end of 2000. But just by subtracting ten years from the current age of the ten year or older persons of 2010 population counts will not give the entire population counts of the year 2000 because all those people who did not survive this ten years span were also present in 2000. For instance, in the case of above mentioned age group who were 65 years old at the beginning of 2010, one of them died in 2007 and one more died in 2008. Therefore, in the year 2000 the number of people at 55 years of age was 9+2=11. Following this procedure, all the individuals were tabulated by their age during each year in between 2010 and 2000 or up to the year of their death. A portion of the tabulation of the population counts and death counts is presented in Table 1. Both death counts and population counts of the year 2010 were dropped from the analysis as the year 2010 was not completed during the data collection and it is problematic to interpret the first year of retrospective observation.

After completing the tabulation of the population counts, death counts, and the number of people at risk of death for each year from 2000 to 2009 were calculated for each age. For example, 53 people were exposed to risk of death in between the year 2000 and 2009 at the age of 65 years. Out of those 53, only six people died between the year 2000 and 2009. Similarly, one out of 78 people died at an age of 60 years, two out of 71 died at 61 years, three out of 64 died at 62 years, but none died at age 63 or 64 years in between the years 2000 and 2009. Summing up the population counts from 2000 to 2009, a total of 78+71+64+60+56=329 people were exposed to risk of death aged between 60 to 64 years, out of them only 1+2+3+0+0=6 died. Therefore, the ASDR for age group 60-64 years is 6/329=0.018 between the year 2000 and 2009.

Getting a closed population: For life table analysis, a closed population was estimated to avoid chances of distortion of the result in the events of in-or-out migration. Most common forms of migration in the study population were marriages (both in and out migration) and mobility due to occupation and study (only out-migration). The study population practices a patri-local form of marriage, where a wife lives with her husband and in-laws after her marriage. However, there are some instances where the husband, instead of the wife, came into the in-laws family to live after their marriages. Therefore, all the married couples who got married in the last ten years were scrutinized for their place of birth. If their place of birth were one of the four villages of the study area they were kept in the calculation, otherwise removed from the calculation of the baseline population of 2000. Those women who out-migrated due to their marriages and those individuals who out-migrated permanently in the last ten years were not considered either because they were not present at the 2010 population. Although the out-migrated persons were present in the study area

Table 1. The brief tabulation process of the population counts (number of people at risk of death or P_x) and death counts (M_x) from 2000 to 2009 (all age groups not presented here)

	Number of people at risk of death in each year												Death count in the year											
Age(y)	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	P_x	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	M_x
<1	13	16	17	9	24	11	21	18	12	17	30	175		1	1			1	5	1	1	3	3	16
…	…	…	…	…	…	…	…	…	…	…	…	…		…	…	…	…	…	…	…	…	…	…	…
55	14	10	6	16	2	11	7	12	4	6	11	85			1									1
56	10	6	15	2	11	7	12	4	6	11	8	82												0
57	6	15	2	11	7	12	4	6	11	8	8	84												0
58	15	2	11	7	12	4	6	11	8	8	13	82		1				1			2			4
59	2	10	7	12	4	5	11	8	6	13	2	78												0
60	10	7	12	4	5	11	8	6	13	2	10	78						1						1
61	7	12	4	5	11	7	6	13	2	10	1	71				1				1				2
62	12	4	5	10	7	6	13	1	10	1	7	64			1							1	1	3
63	4	5	9	7	6	13	1	10	1	6	2	60												0
64	5	9	7	6	13	1	10	1	6	2	1	56												0
65	9	7	6	13	1	10	1	6	2	1	6	53	1		2				1	1		1	1	6
66	6	6	11	1	10	1	5	1	1	5	7	48												0
…	…	…	…	…	…	…	…	…	…	…	…	…		…	…	…	…	…	…	…	…	…	…	…
90						1						1												0
91					1						1	2												0
92				1						1		2												0
93			1						1			2												0
94		1						1				2												0
95	1						1					1												0
96						1						1												0
97					1							1				1								1
Total	821	810	800	792	786	765	760	754	741	734	725		2	6	9	3	3	6	15	5	5	8	8	68

in the year 2000, were removed from the analyses, because it was difficult to track the history of those people.

Now looking only at the survivorship of individuals born in or after 2000; there were two problems if the census population between 1 and 9 years age group were to be considered for the life table analyses. The first problem was that the sample will be very small especially in the early years of the 1–9 year age group and the second one was that it would violate the criteria for a closed population for the analysis. The issue was resolved by calculating the survivorship of the children born since 2000; data for this calculation obtained from the fertility records which were collected from every mother. There were 188 live births since the beginning of 2000 in the study population (see Table 1). Thirteen of them yet to reach the first year of their life were excluded because of the uncertainty of their survival in the first year of their life. This left the survival of 175 children (who had the chance to complete the first year of their life) to calculate the infant mortality of the population. Sixteen of those 175 died before completing first year, therefore, the Infant Mortality Rate (IMR) would be 91.43 per 1,000 live births. Again 159 children had the chance to complete their second year of their life, 142 children for the third year, and so on. Using this procedure the ASDR of 1–4 year and 5–9 year age groups was calculated.

Statistical Analysis

As life expectancy of any community is strongly influenced by many socio-economic factors, a population pyramid and some selected socioeconomic characteristics of the study population were presented. The life table of the study population was calculated up to the age group of 90 years and above. Since the full death records are not available and ax for all age groups of the study population were not previously estimated, the WHO guidelines for a_0 were used (Chiang 1984). Following the guideline, a_0 was considered as 0.3 since the IMR of the population was > 60, a_x for 1–4 years was considered as 0.4, and as 0.5 for other older age groups. The curves for l_x, and e^0_x for 0–70 years of age were plotted along with the UN South Asia model life table (2010) curves for visual comparisons.

To test the reliability of the present life table calculation and to explore the effect of random fluctuation in the distribution of the events of mortality, the Monte Carlo simulation process was used. The random numbers between 0 and 1 were generated through a computer program. The generated random numbers were then compared with the proportion of hypothetical population of 100,000 individuals in the l_x column of life table considering the l_x as a discrete random variable. For example, in the present study it was found that 85,202 individuals out of 100,000 survived the first 10 years of their life. Therefore, if the random number was between 1 and 0.85202, the number was grouped with 0–10 year age group. Following these procedures, three samples of random numbers were generated with the frequencies of 1000, 250 and 50. Assuming each generated number as one death event, the relative frequency of random numbers in their assigned age group will give the probability of death occurring in those age groups. It is also expected that the increase of the sample size of random numbers will give a better estimate of the probability distribution of death events in different age groups and the standard error of estimation will be minimal. The standard errors of the probability distribution of death events in different age groups were estimated using the following formula:

$$SE = \sqrt{p_x(1-p_x)/n} \quad (13)$$

Where p_x is the probability of death generated in the Monte Carlo simulation, and n is the sample size (1000, 250 and 50) of the simulated random numbers.

The 95% confidence intervals of the l_x using the standard errors generated from simulated random numbers were calculated and presented graphically to get a visual idea of error levels due to random fluctuation, which can occur in the mortality data due to different sample sizes. Confidence interval (95%) of all estimates was calculated by multiplying standard errors by 1.96. All calculations and graphical presentations of the data were done using MS Excel 97 software.

Results

Figure 1 shows the population pyramid of the study population. The population in 0–4 years and 5–9 years age groups showed a constriction compared to the age groups of 10–14 years and the 15–19 years age group, which was similar to the national trend for census population. Almost half of the population (47.4%) belonged to the age group below 25 years. The sex ratios of different age groups were similar to each other. The sex ratio of the study population was 1032 female per 1000 males.

Table 2 shows the socioeconomic characteristics of the study participants. A high percentage of males (47.5%) had education up to secondary level, followed by primary level (19.8%) and illiterate (23.8%). Females, mostly had no education (54.5%), followed by females with secondary level (26.5%) and primary

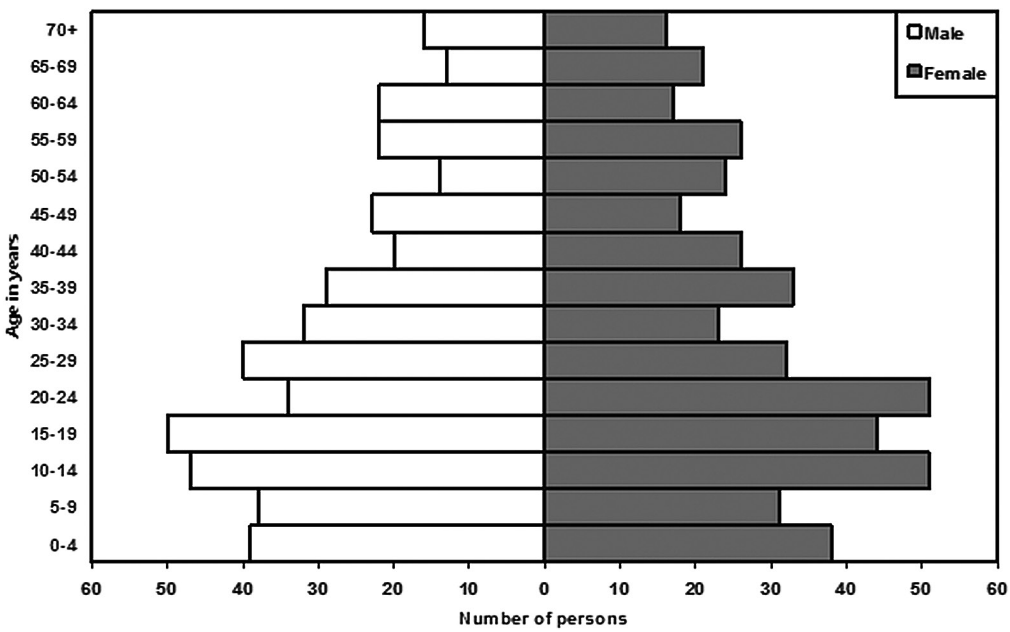

Fig. 1. Population pyramid of the study population (in 2010)

Table 2. Background characteristics of the study population

	Male (n=439)		Female (n=453)	
	n	%	n	%
Educational status*				
Illiterate	95	23.7	226	54.5
Primary	79	19.7	60	14.5
Secondary	190	47.5	110	26.5
Higher secondary	23	5.7	9	2.2
Graduation and higher education	13	3.2	10	2.4
Occupational category				
Agricultural activity	204	46.5	172	38,0
Salaried (Public/Privet) and pension holders	18	4.1	10	2.2
Skilled work/ Business	10	2.2	2	0.4
Student	129	29.4	108	23.8
Household work	19	4.3	106	23.4
Others (dependent or unemployed)	59	13.4	55	12.1
Per capita monthly expenditure group				
Below Rs.500/-	52	11.8	71	15.7
Rs.500/- to less than Rs.1000/-	366	83.4	365	80.6
Rs.1000/- and above	21	4.9	17	3.7
House type				
Temporary (made of bamboo, wood, mud, straw, etc.)	353	80.4	360	79.5
Semi-permanent (partially brick built)	50	11.4	63	13.9
Permanent (brick built with concrete roof)	36	8.2	30	6.6

*39 male and 38 female children could not attend the standard age for schooling.

level (14.5%) of education. Around 3% of study participants of both sexes got higher education up to the graduation level.

Large proportions of individuals of both sexes were engaged in agricultural activities especially as daily labourers (46.5% males and 38.0% females) and students (29.4% males and 23.9% females). Much lower proportion of males and females had jobs in public or private sector (4.1% males and 2.2% females) or conducted small businesses (2.3% males and 0.4% females). Most of the females took the making of 'dining plates' using 'Saal leaves' (*Shorea robusta*) collected from the nearby forests as their secondary occupation along with household work (23.4%). Per capita monthly expenditure (PCME) of most of the individuals (83.4%

Table 3. Abridged Life table of the study population based on the survivorship of 725 individual and the survivorship of 175 children from 2000 to 2009

x (in years)	D_x	P_x	M_x	q_x	l_x	d_x	L_x	T_x	e^0_x	SEq_x	SEl_x	SEe^0_x
<1	16	175	0.091	0.086	100,000	8593	93,9850	6,387,167	63.872	0.021	0	3.247
1–4	3	543	0.006	0.022	91,407	1994	360,844	6,293,182	68.848	0.012	2,054	3.190
5–9	3	311	0.010	0.047	89,413	4211	436,540	5,932,338	66.347	0.027	2,009	3.141
10–19	2	1355	0.001	0.015	85,202	1248	845,783	5,495,798	64.503	0.010	2,200	2.717
20–29	6	1166	0.005	0.050	83,954	4212	818,482	4,650,015	55.388	0.020	3,189	2.685
30–39	2	985	0.002	0.020	79,742	1603	789,409	3,831,533	48.049	0.014	3,141	2.597
40–49	4	862	0.005	0.045	78,139	3544	763,676	3,042,124	38.932	0.022	3,489	2.574
50–59	7	861	0.008	0.078	74,596	5828	716,819	2,278,448	30.544	0.028	3,498	2.567
60–69	17	540	0.031	0.272	68,768	18705	594,155	1,561,629	22.709	0.056	3,598	2.651
70–89	7	173	0.040	0.576	50,063	28843	712,832	967,474	19.325	0.142	4,921	3.119
90+	1	12	0.083	1.000	21,220	21220	254,642	254,642	12.000	0.000	7,398	0.000

males, 80.6% females) was between Rs.500 and less than Rs.1000 ($1 ~ Rs. 50). Very small percentage (around 4%) of the individuals belonged to the families with PCME of Rs.1000 and above. Around 80% of the individuals of both sexes were living in 'Kaccha' (building material of the house is mud, bamboo, wood, straw, etc.) houses.

The life table of the study population is presented in Table 3. The first age group is below one year; and is separated from the age group of 1–4 years. The second and third columns are D_x and P_x, which were calculated from the procedure described in Table 1. Readers should be cautious that the distribution of the numbers of person-year at risk of death between 2009 to 2000 or P_x is different from the numbers in the population pyramid (Fig. 1), which are the population in 2010. Ten-year age categories were distinguished between the age of 10 to 69 years. For the advanced age groups, two age categories were made; 70 to 89 years and 90 years and above. The calculated value of life expectancy at birth for the study population was 63.9 ± 3.2 years.

The Figure 2 shows the survivorship curve or l_x curve of the study population against the l_x curve of UN South Asia model life table (2010). Up to 20 years, the l_x curve of the study population followed the l_x curve of e^0_0=60 years. Major parts of the early and middle adulthood the l_x curve of the study population lied between the l_x curve of e^0_0=50 years and 60 years. Later the l_x curve again raised, and at the age of 60 years the l_x curve of the study population were just above the l_x the curve of e^0_0=60 years.

The Figure 3 shows the life expectancy curve or ex curve of the study population against the e^0_x curve of UN South Asia model life table (2010). At 10 year of

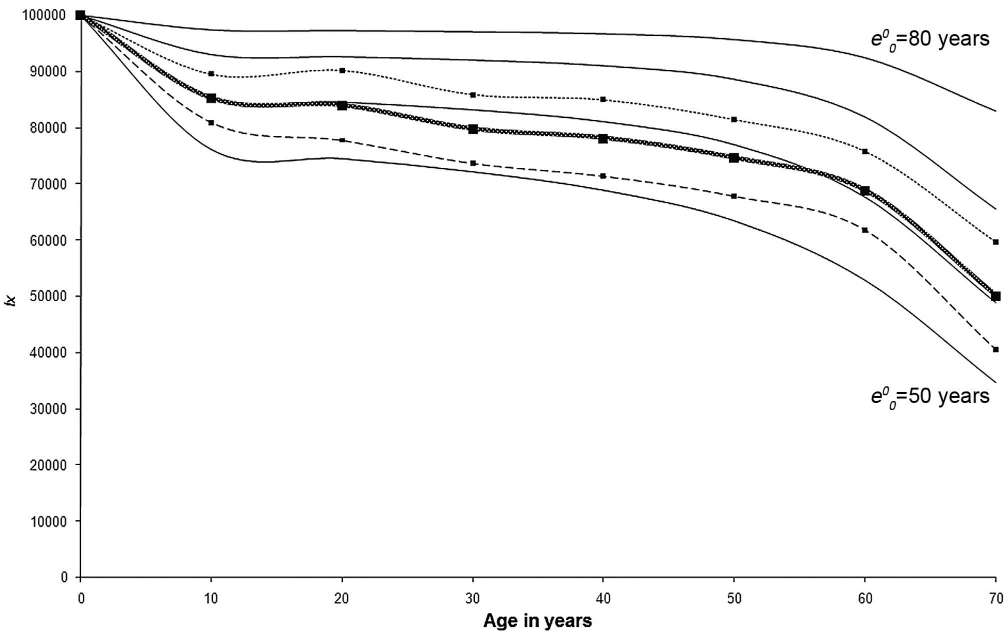

Fig. 2. Probability of survivorship curve (95% CI) of the study population and the UN South Asia model probability of survivorship curves

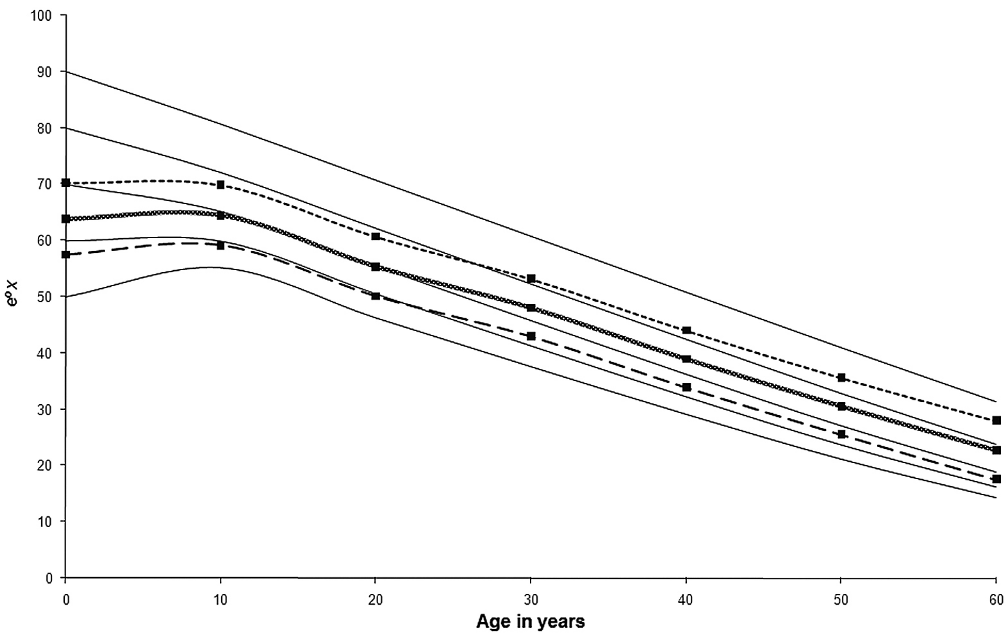

Fig. 3. Life expectancy curve (95% CI) of the study population and the UN South Asia model life expectancy at birth curves

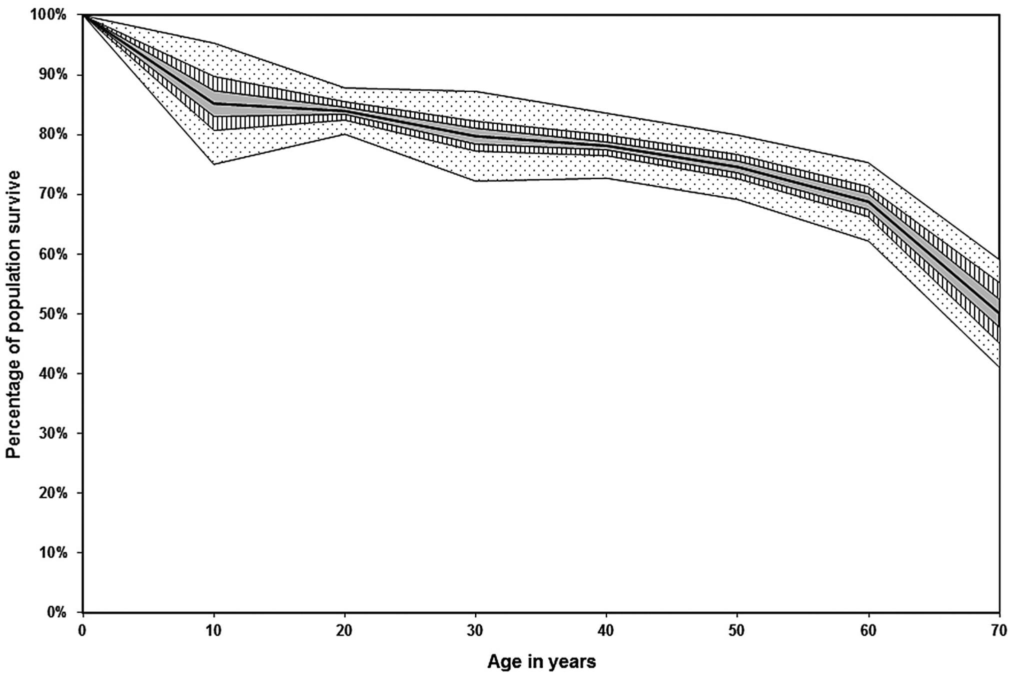

Fig. 4. Confidence interval (95%) of *lx* with sample sizes of 1000 (solid shade), 250 (vertical lines shade) and 50 (dotted shades) deaths

age, the e^0_x curve of the study population followed the e^0_x curve of e^0_0=70 years and remained with the curve up to the age of 20 years. In the following years the e^0_x curve of the study population raises with the advancement of age groups. At age 60 years the e^0_x curve of the study population reaches the e^0_x curve of e^0_0=80 years. This suggests that the individuals of the sample population had lower number of years of expected life at their earlier age groups. Once a person of the study population reaches the advanced age group, she has an increased life expectancy or is expected to live longer than the persons of younger age groups.

In Figure 4, the 95% confidence intervals for l_x were plotted showing the range of errors that might be expected due to a random fluctuation of occurrence of death events in different age groups. The range of l_x with 'dotted' shade calculated from 50 samples of randomly generated numbers using Monte Carlo simulation, denotes the widest standard errors. The range of l_x with shading of 'vertical lines', was simulated from random numbers of a sample size of 250. The narrowest 95% confidence level of l_x (presented in 'solid' shade) was plotted with the sample size of 1000 randomly generated numbers.

Discussion

Calculation of life tables of small populations is difficult due to a small number of death records. An attempt was made to calculate the life expectancy of a small sample of Santal population of rural West Bengal using the recall method;

and the life expectancy of the study population was 63.9 years. A comparison of life expectancies of different populations of India at the national and local level is presented in Figure 5. In this context, the authors want to caution the readers that these life expectancies were calculated using different demographic techniques, which may not be comparable at all. However, these are presented in this figure to give the readers a sense of corroboration or contrast of the findings of the present study in a larger context of the other populations – close or distant to the study population.

In comparison with the life expectancy at birth (e^0_0) of Indian populations estimated by various organizations (range between 64 and 67 years), the estimated e^0_0 for the study population was a little lower, as expected. Tribal populations in India often suffer from malnutrition and ill-health due to their low socio-economic status (SES). However, the estimated e^0_0 among the Santals of the present study was higher than the e^0_0 of the other tribal populations of Eastern India, which were studied earlier. This difference may be due to the following reasons. Firstly, the secular trend of life expectancy – when the earlier studies were conducted, e^0_0 of those populations was much lower than their current e^0_0. Secondly, the study populations of the earlier studies were mostly primitive tribal groups, which had even lower SES than the population of the present study; therefore, they had lower e^0_0 as well. The third reason could be an overestimation of e^0_0 due to a lower number of reported deaths in the advanced age groups of study population. The highest age of death, which was re-

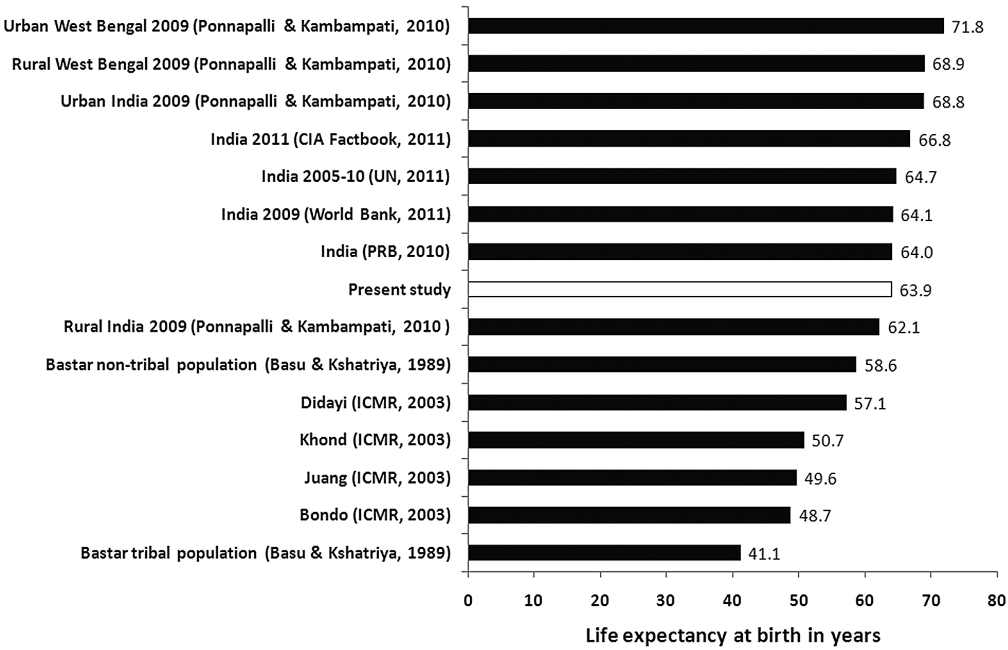

Fig. 5. Life expectancy at birth of different populations of local, and national scale in comparisons with the finding of the present study

ported in the present study, was 97 years. However, the second highest age of death was at 75 years. In between these two deaths there were 14 persons who were living in 2010. Ponnapalli (2010) used SRS data to construct a regression based model life table for the Indian population using their IMR. Using that model, the e^0_0 of the study population was found to be 58.2 years, which is far less than the result of the present study. However, this estimation may be an underestimation of the actual fact because the ASDR of the study population was not uniform throughout the life-span of the individuals of the population and reported higher e^0_0 with the advancement of age.

As this study had a very small number of reported deaths, separate life tables for each sex were not calculated, although the sex differences in life expectancy of tribal populations of Eastern India were earlier reported (Basu and Kshatriya 1989, 1993; Chettapalli et al. 1991). Among the other potential criticisms of estimating mortality rates from recalled data are its non-uniformity of errors, especially for the age of death records. Siegel and Swanson (2004) commented that the errors in reporting the age at death is often associated with personal attributes of the deceased. Along with that, the errors due to duplicate reporting or sometimes underreporting of death events are common.

In the present study, reporting errors of deaths were reduced by cross-checking the reported death records with the age of those persons with verified age and with critical events of the family and locality. Data were collected by single investigator only to omit the inter investigator errors in estimation of the age and death records. Still, a greater number of living individuals in advanced age group (70 years and higher) and a very low death record in that age groups suggest a more careful data collection need to be done especially to reduce the possible overestimation of life expectancy for the elderly people. In order to make the result more conclusive and generalized, the standard errors and confidence limits were also estimated. The values of SE-e^0_xs of different age groups of the study population were very high compared to the SEe^0_xs in the national level data. This is because the present study estimated life table from an extremely small sample. Given a larger sample of mortality data the standard errors of the life table functions should give lower values, and would provide a better confidence limit closer to the estimates from the sample.

Now it is the time to critically evaluate the method described here which will be useful for calculation of life tables in small populations. It is obvious that a larger sample of deaths will give a lower error (as shown in Fig. 4). But how far is it possible to collect correct death records by the recall method depends on several factors. An anthropological field worker can employ different techniques to increase the validity of the collected data but that may bring down the sample size of the study due to logistic reasons. On the other hand, that may increase the standard error of the estimates. Therefore, it is important to conduct further research to find a good balance between sample size and error in order to estimate a more accurate life table without increasing the errors of the estimation.

Concluding remarks

The proposed method will be helpful to calculate the life table of small marginal populations, which are typically studied by anthropologists. However, before accepting it as a standard method of evaluation of the overall health status of small populations, some further research needs to be done to increase its validity and reliability.

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Authors' contributions

All three authors contributed equally to the study design and manuscript writing. BMD collected the data. AM and BMD jointly did the data analysis.

Conflict of interests

The Authors declare that there is no conflict of interests.

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