Life Expectancy of Police Personnel of the 6th Assam Police Battalion, Kathal, Cachar District, Assam: A Report

Data Source: Service particulars of Expired and Retired Personnel of the 6th Assam Police Battalion, Kathal, Silchar as supplied by the concerned office.

Prepared by:

Dibyojyoti Bhattacharjee,
Professor and Head,
Department of Statistics,
Assam University, Silchar
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Introduction

Life expectancy is an estimate of the average number of additional years that a person of a given age shall live. The most common measure of life expectancy is **life expectancy at birth**. Life expectancy at birth is the average number of years that a person is expected to survive. As per the World Bank data of 2016 Japan has the highest Life expectancy at birth i.e. 83.98 years. This means that a child born in Japan (in 2016) is expected to survive to an age of almost 84 years on an average. The same value is 82.3 in Canada and 80.9 in the United Kingdom. Life expectancy at birth in the same report is 78.7 in the United States, 76.3 in China and in India it is as low as 68.6. Life expectancy at birth is a crude measure of the prevailing health condition of a country. The above statistics indicated that roughly speaking India requires improvement in her health infrastructure as it is way behind other leading countries of the world in terms of life expectancy at birth.

However, life expectancy differs considerably by sex, age, race, profession and geographical location. Therefore, life expectancy is commonly given for specific categories, rather than for the population in general. For example, the life expectancy for females born in India in 2003 or life expectancy of army personnel etc.

Life expectancy reflects local living conditions and risk involved in life. In less-developed countries, life expectancy at birth is relatively low, compared with more-developed countries.

Life expectancy at age *x* or simply speaking life expectancy, as defined earlier, is an estimate of the average number of additional years that a person of age x shall live. Simple speaking, if we tell that the life expectancy of a person of age 35 if 42.5 years it means that a person of age 35 years on an average shall survive to 42.5 more years i.e. 35 + 42.5 = 77.5 years. In case of life expectancy at birth we take $x = 0$.

It may be noted that even within a country the value differs from region to region, gender to gender, profession to profession and so on. In simple terms various socio-economic and demographic factors influence the life expectancy at age x.

Thus, need is always felt to analyse and construct life expectancy for people having different demographic, socio-economic and professional backgrounds. In the backdrop of this discussion the attempt of the administration of 6th Assam Police Battalion to compute the life expectancy of their employees seems to be a very pertinent and a scientific endeavor.

Utility of Computing Life Expectancy

The life expectancy at any age x (say) is utilized by the life insurance companies to determine the premium of different insurance policies. Though the life expectancy values are a type of averages even then over the years the values have proved to be successful in estimating the additional number of years that a person of age x is expected to live.

When life expectancy is computed for individuals belonging to different professions it indicates the competitive advantage that a profession has over the other. Putting in simple terms if the life expectancy of personnel belonging to a particular profession (Profession A, say) is less than that of the other (Profession B, say) at different ages then we can conclude that Profession A is more risky than Profession B.

As mentioned earlier, life expectancy can be used as a crude indicator of health condition of a country. A country with high life expectancy indicates that the health scenario of the country is such that it can deliver better basic medical facilities to its citizens and also make them aware about healthy practices. Thus, citizens of that country enjoy a longer life. A country with lower life expectancy indicates poor health infrastructure and lack of awareness of its citizens about health issues.

Life Table

The statistical tool that helps us to compute the life expectancy at different ages is called as the life table. According to Bogue, "The life table is a mathematical model that portrays mortality condition at a particular time among a population and provides a basis for measuring longevity. lt is based on age specific mortality rates observed for a population for a particular year." Barklay defines life table as - "…a life history of a hypothetical group or cohort of people, as it is diminished

gradually by death. The record begins at the birth of each member and continues until all died."

So, life table is a statistical tool which shows the life span of persons up to a particular age or their probable date of death relates to a cohort of people born at the same time until they die. A life table can be constructed for a country or an area on the basis of sex, occupation, race, etc.

A life table can tell us about the following facts:

- the probability of surviving to any particular year of age
- the remaining life expectancy for people at different ages
- the proportion of the original birth cohort who are still alive.

Types of Life Table

The best approach for collecting raw data for a life table is quite straightforward: follow a group of individuals in the same population from birth to last death in the group. The group of individuals thus followed is called as cohort. A cohort usually consists of individuals born in the same calendar year. A life table compiled in this manner is called a cohort (or age-specific) life table. Compiling data for a cohort life table is difficult for long-live organisms such as humans, simply because the study would take a whole life time. Alternatively, researchers tally the deaths within each age group in the population over a prescribed time interval (e.g., all the deaths in each age class in a town in one year). Life tables tabulated in this manner are called static (or time specific) life tables because we must assume that (1) age specific mortality rates did not change over time (i.e., between generations) and (2) the population size did not change so there is a stable age distribution. That is, the population is static. Neither assumption may be justified. For instance, in this procedure individuals share only a common time in which they died; they were born at different times and thus may have experienced different environments at a certain age. It is up to the investigator to determine whether these assumptions are reasonable and thus whether

a static life table design will produce reasonably better estimates of survival.

Columns of Life Table

A life table has the following columns:

x : represents the age in years. It is an integer.

l_x : number of persons who attained the exact age x out of the total number of persons with whom the study started i.e. the cohort. The cohort is the initial value of the l_x column which is represented by l_0

d_x : the number of persons amongst the l_x persons who reached age x and died before reaching age $x+1$. Thus, $d_x = l_x - l_{x+1}$

q_x : the probability that a person of exact age x will die before reaching age $x + 1$. Thus, $q_x = d_x/l_x$. Sometimes, the probability is multiplied by 100 to express it in terms of percentage.

L_x : the number of years lived in aggregate by the cohort between the ages x to $x+1$ years. Under the assumption that the deaths occurring in the interval [x, x+1] are uniformly distributed we can deduce the following relation $L_x = l_x - \frac{1}{2} d_x$.

Roughly speaking this is the average size of the number of people surviving in the age interval x to $x + 1$ years.

T_x : this is the number of years lived by the cohort after attaining age x or the total future lifetime of the l_x persons who attained x years of life. Mathematically, $T_x = L_x + L_{x+1} + L_{x+2} + \ldots$

e_x^0 : This is the expectation of life or life expectancy of a person of age x. It indicates the additional number of years lived (on an average) by a person after attaining age x. The value of

e_x^0 is obtained by the relation $e_x^0 = \frac{T_x}{l_x}$. This is the most sought column of the life table. However, as values from the other columns acts as inputs for the computation of e_x^0 so those too shall also be computed. The other columns too have their own significance.

Assumptions of Life Table

A life table is constructed based on the following assumptions:

- The deaths are equally distributed throughout the year.
- The cohort of people diminish gradually by death only.
- The cohort is closed to the in-migration and out-migration.
- The death rate is related to a pre-determined age specific death rate.
- The cohort of persons die at a fixed age which does not change.

Computation of the Life Table of Police Personnel of the 6th Assam Police Battalion

Based on the information obtained from the concerned section of the office, the life table is constructed. Information related to date of birth, date of joining service, designation, date of retirement/expiry etc. of 703 police personals were available. Obviously, neither the date of birth nor the year of joining to service of all the personnel were in the same calendar year. So precisely speaking they do not form a cohort. But they were assumed to be a cohort and there are accordingly used to form the life table. Thus, it is obvious that some of the assumptions of the life table might get violated. The risk with which the police personnel work might vary over the years because of change in facilities available to them, instruments used, advances in technology etc. over the years.

Since, none of the police personnel is recognized to become a police personnel at birth so the life table starts at 18 (minimum year of joining the service) instead of 0. The table below gives the corresponding life table:

Age in years (x)	Persons attaining age x (l_x)	No. of deaths in the age x to x+1 years (d_x)	Probability of death in the age x to x+1 years (q_x)	Aggregate number of years lived in the age x to x+1 years (L_x)	Total future lifetime of all the persons who attained age x (T_x)	Additional no. of years lived after attaining age x (e_x^0)
18	703	2	0.002845	702	31392	44.65434
19	701	0	0	701	30690	43.78031
20	701	0	0	701	29989	42.78031
21	701	1	0.001427	700.5	29288	41.78031
22	700	2	0.002857	699	28587.5	40.83929
23	698	4	0.005731	696	27888.5	39.95487
24	694	3	0.004323	692.5	27192.5	39.18228
25	691	3	0.004342	689.5	26500	38.35022
26	688	2	0.002907	687	25810.5	37.51526
27	686	0	0	686	25123.5	36.62318
28	686	2	0.002915	685	24437.5	35.62318
29	684	4	0.005848	682	23752.5	34.72588
30	680	2	0.002941	679	23070.5	33.92721
31	678	5	0.007375	675.5	22391.5	33.02581
32	673	4	0.005944	671	21716	32.26746
33	669	4	0.005979	667	21045	31.4574
34	665	9	0.013534	660.5	20378	30.64361
35	656	3	0.004573	654.5	19717.5	30.05716
36	653	6	0.009188	650	19063	29.19296
37	647	4	0.006182	645	18413	28.45904
38	643	2	0.00311	642	17768	27.63297
39	641	2	0.00312	640	17126	26.71763
40	639	7	0.010955	635.5	16486	25.79969
41	632	10	0.015823	627	15850.5	25.07991
42	622	11	0.017685	616.5	15223.5	24.47508
43	611	9	0.01473	606.5	14607	23.90671
44	602	11	0.018272	596.5	14000.5	23.25664
45	591	8	0.013536	587	13404	22.6802
46	583	4	0.006861	581	12817	21.98456
47	579	10	0.017271	574	12236	21.13299
48	569	6	0.010545	566	11662	20.49561
49	563	7	0.012433	559.5	11096	19.7087
50	556	8	0.014388	552	10536.5	18.95054
51	548	8	0.014599	544	9984.5	18.21989
52	540	9	0.016667	535.5	9440.5	17.48241

Age in years (x)	Persons attaining age x (l_x)	No. of deaths in the age x to x+1 years (d_x)	Probability of death in the age x to x+1 years (q_x)	Aggregate number of years lived in the age x to x+1 years (L_x)	Total future lifetime of all the persons who attained age x (T_x)	Additional no. of years lived after attaining age x (e_x^0)
53	531	8	0.015066	527	8905	16.77024
54	523	7	0.013384	519.5	8378	16.01912
55	516	8	0.015504	512	7858.5	15.22965
56	508	11	0.021654	502.5	7346.5	14.46161
57	497	3	0.006036	495.5	6844	13.77062
58	494	4	0.008097	492	6348.5	12.85121
59	490	2	0.004082	489	5856.5	11.95204
60	488	0	0	488	5367.5	10.99898
61	488	0	0	488	4879.5	9.998975
62	488	0	0	488	4391.5	8.998975
63	488	0	0	488	3903.5	7.998975
64	488	0	0	488	3415.5	6.998975
65	488	0	0	488	2927.5	5.998975
66	488	0	0	488	2439.5	4.998975
67	488	0	0	488	1951.5	3.998975
68	488	0	0	488	1463.5	2.998975
69	488	0	0	488	975.5	1.998975
70	488	1	0.002049	487.5	487.5	0.998975
71	487					

Interpretation of the Life Table

The life table thus computed takes us to some interesting findings. It is important to interpret different columns of the life table so that better insight into the mortality situation of the police personnel can be achieved. The last column is the most important column of the table so far as measuring of life expectancy is concerned.

- At the age of 18 if a person joins the said police force then he is expected to survive another 44.65 years[1] i.e. a total of 18 + 44.65 = **62.65 years** on an average i.e. he is expected to reach his age of

[1] Refer to value of column e_x^0 of the life table corresponding to the row with age 18 years.

retirement. It may be noted that the average is less than the Indian average of life expectancy at birth which is 68.6 years.

- Similarly, at the age of 20 if a person joins the said Police force then he is expected to survive another 42.78 years[2] i.e. a total of 20 + 42.78 = 62.65 years on an average i.e. he is expected to reach his age of retirement.
- Likewise, at the age of 30 a person in the police force is expected to survive another 33.92 years[3] i.e. a total of 30 + 33.92 = 63.92 years on an average.
- Proceeding in this way, at the age of 40 a police personnel is expected to survive another 25.71 years[4] i.e. a total of 40 + 25.71 = 65.71 years on an average. Thus, even after surviving for 40 years, given the life risk involved in the job the life expectancy of the police personnel is below the Indian average life expectancy at birth i.e. 68.6 years.
- It is only at the age of 49 years that police personnel with an expected longevity of 19.71 more years[5] touches (49 + 19.71 = 68.71 years) the Indian average life expectancy at birth i.e. 68.6 years, which clearly indicates the extent of life risk involved in the job of Police Personnel of the 6th Assam police Battalion.

Since data beyond 60 years of life is scanty so the interpretation of the life table shall not be much meaningful for ages beyond the age of 60 years. This is characterized by several zeros in the life table in the columns d_x and q_x from 60 years of age onwards. However, for maintaining the continuity in the life table mortality situation till 70 years of age are shown.

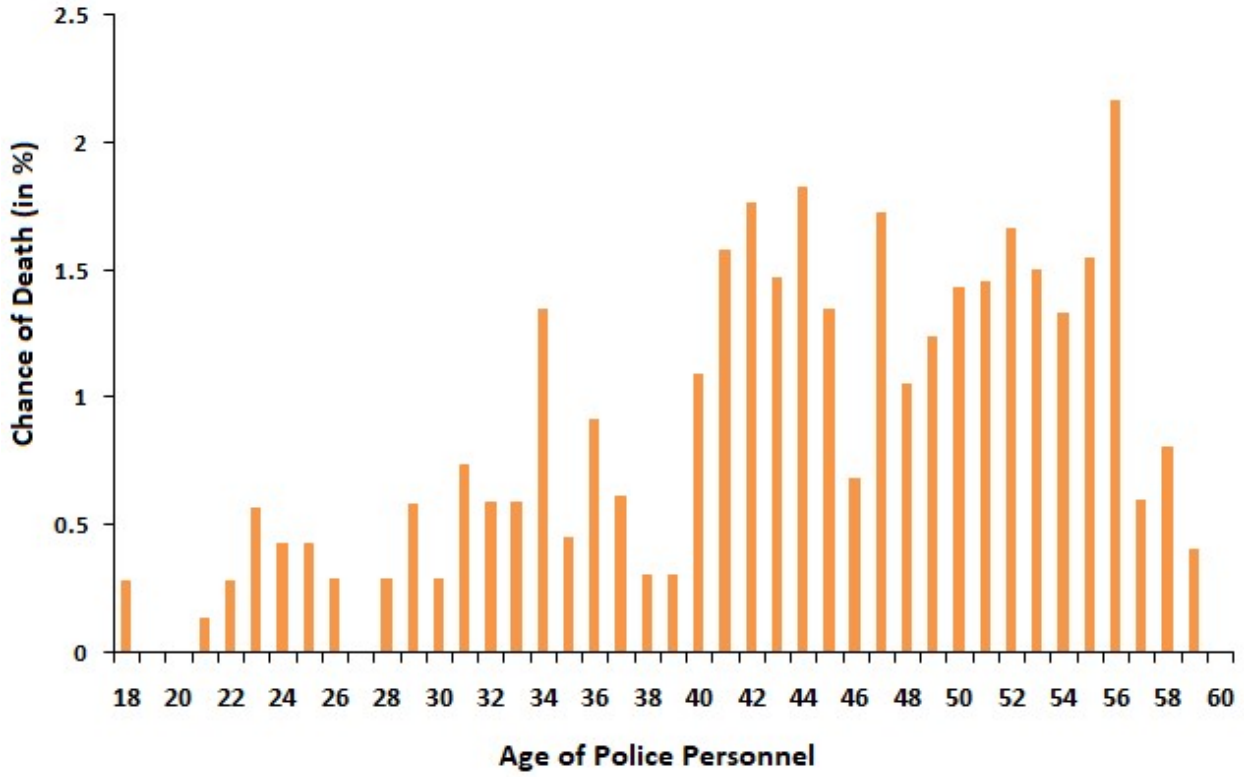
[2] Refer to value of column e_x^0 of the life table corresponding to the row with age 20 years.

[3] Refer to value of column e_x^0 of the life table corresponding to the row with age 30 years.

[4] Refer to value of column e_x^0 of the life table corresponding to the row with age 40 years.

[5] Refer to value of column e_x^0 of the life table corresponding to the row with age 49 years.

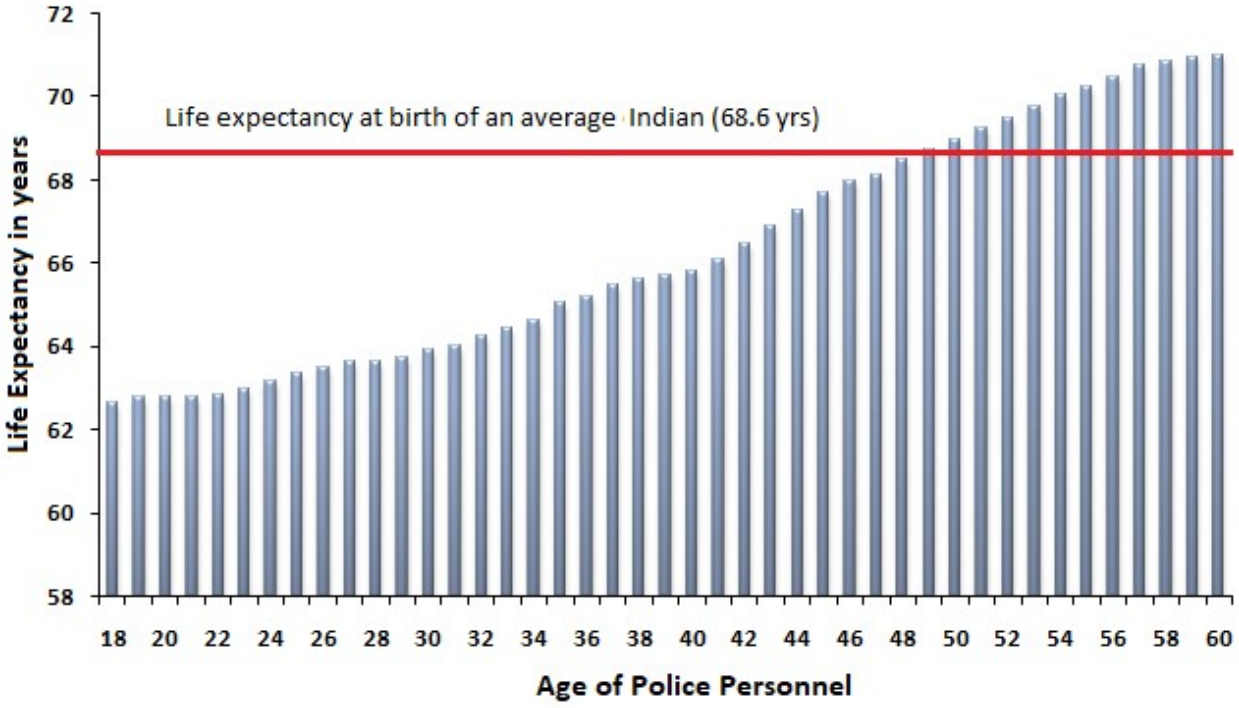
Figure 1: Chance of death of Police Personnel (in percentage) at different ages while in service



The graph above clearly indicates that as the age of the police personnel increases, the chance of death also keeps on increasing. Till the age of 40 years the chance of death during service is generally less than 1 percent but after 40 years of age the chance of death of police personnel is generally more than 1 percent and in some cases even crosses 2 percent.

From Figure 2, it is seen that it is only after surviving 49 years of life that a police personnel of 6th Assam Police Battalion touches the Indian average life expectancy at birth i.e. 68.6 years, which clearly indicates the extent of life risk involved in the job of the police personnel. Life expectancy at birth includes the life risk which babies undergo, being vulnerable to several diseases and unhygienic living conditions. But, a grown up individual is supposed to have a higher life expectancy given that he has already survived the risky childhood days of his life. This is happening to a police personnel only after reaching 49 years of his life.

Figure 2: Life expectancy of police personnel at different ages of service



A comparative study of chance of death at different ages with any other population would have made the extent of risk in the profession of police personal vivid. Unfortunately, age-wise data from any other profession is not available and hence such comparison cannot be materialized. Thus, the life risk of police personnel can only be expressed in absolute terms and not in relative terms.

Conclusion

The study comprises of obtaining the life expectancy of police personnel working for the 6th Assam Police Battalion of Cachar District of Assam. The work is based on information obtained from 703 police personnel who either expired or retired since the inception of the battalion till 2019. The study is based on static life table and tried to evaluate how the 703 police personnel perished at different ages of life. As a person does not remain a police personnel just after his birth so it is not logical to consider age 0 (zero) as the starting age of the life table. Consequently, in the study 18 years is taken as the starting point of the life table given the

fact that it is the minimum age of joining the service in the said police force.

The study finds that a person joining a police force has a life expectancy of 62.65 years which is much less than the life expectancy at birth of an average Indian. This indicates the life risk involved in the life of a police personnel. It is only at the age of 49 years of life that the life expectancy of police personnel touches the Indian average life expectancy at birth i.e. 68.6 years. The study also finds that till the age of 40 years the probability of death during service is generally less than 1 percent but after 40 years of age the chance of death of police personnel is generally more than 1 percent and in some cases even reaches 2 percent.

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