

Estimation of Infant and Child Mortality, Life Expectancy and Construction of Abridged Life Table

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ABSTRACT

Abridged life tables for both sexes, separate for males and females have been constructed to study the mortality pattern at different ages. The Pakistan Demographic Survey Data for 1999 has been used in this article. From these life tables, the life table functions $0q_1$, $1q_4$ and e_0 are used to estimate the level of infant mortality, child mortality and life expectancy at birth. The analysis demonstrates that the levels of infant and child mortality are still very high in Pakistan. The life expectancy at birth is improving but still low as compared to many developing countries. It has been argued to improve the women status through improving their education for enhancing their abilities to seek better health care and nutrition for their new born children. The effective role of health practitioners to address the issue of infant and child mortality should also be ensured.

Key words: Infant and child mortality, life table, life expectancy at birth, Pakistan

INTRODUCTION

The human infant is a totally dependent and highly valuable birth. It is true that mortality generally is a reflection of lifestyle and position in social structures and what is true of mortality in general is even more the case with infant mortality. Infant and child mortality is a barometer to assess the development of any country. In fact the infant mortality is general considered to be explanative to all the aspects of development (Preston, 1975). Infant mortality rate is still very high in many parts of developing world as compared to the industrialized countries. The high infant high rate is due to the rising poverty, high malnutrition, lack of health care and educational facilities, gender discrimination, poor housing conditions, and environmental pollution. The high death rate among the children in Pakistan is a tragic loss to nation.

The direct estimate of infant mortality based upon the number of deaths under one year for every 1000 live births is 85 (Anonymous, 2000). The data quality particularly on infants birth and death is highly erroneous and error prone. In developing societies where illiteracy level is very high the majority people do not remember the exact day and month of their infants' birth and death. In such situation the direct estimate of infant and child mortality is not reliable; the indirect estimation of these measures has been suggested in many demographic studies for framing and formulating effective strategies to address the issue of infant and child mortality (Shryock and Siegel, 1976).

Abridged life approach has been used to find the indirect estimates of infant and child mortality. The life expectancy is also calculated. A life table is designed essentially to measure mortality, but it has been also employed to examine the effectiveness of different development programs. The life table is generated from age specific mortality rates and the resulting values are used to measure mortality, survivorship and life expectancy.

Life tables are also classified into two types complete and abridged life table. A complete life table contains data for every single year of age from birth to the last applicable age. An abridged life table, on the other hand, contains data by intervals of 5 or 10 years of age. In this study the data by 5 year age interval has been used for constructing abridged life table.

The basic life table functions are nqx , ndx , nLx , Tx and ex , these six columns are generally calculated and published for every life table. In the more common interpretation, the life table is viewed as depicting the life time mortality experience of a single cohort of new babies who are subject to the age specific mortality rates on which the table is based. The cohort of new born babies called the radix is usually assumed to number 100,000. In this case, the interpretation of different life table functions is as follows. The manual of Formal Demography published by the London University (1986) has been consulted for interpretation of life table functions and formulas.

nq_x = It is probability of dying between exact age x and $x+n$ e.g. $1q_0$ is the probability of dying between exact age 0 and one year, is an estimate of infant mortality. nq_x 's are calculated for different age groups with the following formula:

$$nq_x = \frac{n \cdot nM_x}{1 + n(1 - ax) nM_x}$$

where

nM_x is age specific death rates = D_x/P_x

D_x = Deaths during the year of persons age x .

P_x = Population of age x at mid year

ax = This is defined as the average proportion of the time lived in the interval x to $x+n$ by those who die in that intervals. It is common to use $a_0 = 0.3$, $a_1 = 0.4$ and $a_2 = 0.5$ because the mortality pattern is different in first five years especially in the first years while the deaths are evenly distributed in all other age groups.

np_x is probability of surviving between age x and $x+n$ and it is derived from the nq_x :

$$np_x = 1 - nq_x.$$

l_x = The number of persons alive at exact age x . l_0 is an arbitrary number called the RADIX, usually it is a round number such as 1 or 1000 or 1,00,000. The l_x is calculated as

$$l_x = l_{x-n} \cdot np_{x-n}$$

ndx = The number of persons who would die within the indicated age interval (x to $x+n$) out of the total number of births assumed in the table.

nL_x = The number of person-years lived between exact age x and $x+n$. nL_x calculated with the formulas:

$$1L_0 = l_1 + 0.284 \times 1d_0$$

$1L_0$ calculated separately because the mortality pattern in the first year of life is different than the other age group while in other age group the deaths are almost evenly distributed in the different age groups.

$$nL_x = n/2 (l_x + l_{x+n})$$

T_x = The total number of person-years after exact age x , it is calculated by cumulating the nL_x from the bottom.

$$T_x = T_{x+n} + nL_x$$

e_x = This is the expectation of life at age x or the average number of years a person aged x has to live. e_0 refers to life expectancy at birth. The expectation of life is calculated as :

$$e_x = T_x/l_x$$

RESULTS AND DISCUSSIONS

The life tables for both sexes, and separate for males, and females have been constructed by using Pakistan Demographic Survey data 1999. The value of $1q_0$ indicates probability of dying under the age of 1 year is an estimate of the level of infant mortality which is 102 deaths in the first year of life for every 1000 live births, 110.5 for males and 85 for females, The findings indicate that male infant mortality is higher than female infant mortality. According to the United States Census Bureau (2002) the level of infant mortality for Pakistan is 78.5 for the year 2001. The findings indicate that the level of infant mortality is declining in Pakistan but the pace is very slow. In almost in all the neighboring countries like China, India, Iran, and Sri-Lanka, the level of infant rate as compared to Pakistan is low. The China which is a biggest country in the region has infant mortality rate 27.3 for the year 2001. In the developed countries the rate is almost negligible. For example, for Japan it is 3.8, for Canada 5 and for France 4.4. The reason for the quoting the infant mortality rate for developed countries here in this article is to stress upon the alarming situation of mortality in Pakistan, urging the need for comprehensive health policy to address the issue.

The $1q_4$ is probability of dying between exact age 1 and 4, is an estimate of child mortality. The child mortality for Pakistan for the year is 37 deaths between one year and less than five years for every 1000 children of age 1 and under 5 years (Table 1). The estimates of child mortality for Pakistan's male and female children were 35.2 (Table 2) and 39.0 (Table 3) respectively.

Table 1: Life table for Pakistan (both sexes) 1999

Age	Px(pop)	Death Dx	C.I	$nMx = Dx \backslash px$	qx	lx	dx-lx-qx	nLx	Tx	ex = Tx \backslash lx
0-1	2872867	315923	1	0.1020	0.1020	100,000	10200	179522	5894877	58.95
1-4	15082550	143269	4	0.0094	0.0368	89800	3296	351860	5715355	63.64
5-9	20202650	57444	5	0.0028	0.0139	86130	1197	727550	5363495	62.27
10-14	17991993	45765	5	0.0025	0.0124	84890	1053	422225	4935954	58.14
15-19	14278843	26597	5	0.0018	0.0089	84000	748	415775	4513720	53.73
20-24	11158454	37946	5	0.0034	0.0169	82310	1391	407950	4097945	49.79
25-29	8710729	26048	5	0.0029	0.0144	80870	1165	399925	3689995	45.63
30-34	7267391	26692	5	0.0036	0.1077	79100	1400	391075	3290070	41.59
35-39	6943126	25587	5	0.0036	0.0177	77330	1369	1380300	2898995	37.49
40-44	5426021	28351	5	0.0052	0.0254	74790	1900	367300	2518695	33.67
45-49	4976542	18696	5	0.0037	0.0182	72250	1315	356700	2151095	29.77
50-54	3861591	33970	5	0.0087	0.0419	70430	2951	341675	1794395	25.48
55-59	2878057	27173	5	0.0094	0.0451	66240	2987	319925	1452720	21.93
60-64	2563983	45286	5	0.0176	0.0819	61730	5056	288175	1132795	18.35
65-69	1664691	38720	5	0.0232	0.1058	53540	5664	241250	844620	15.77
70over	2350724	167408		0.0712	1.000	42960	42960	603370	603370	14.04

Table 2: Life table for Pakistani males 1999

Age	Px(pop)	Death Dx	C.I	$nMx = Dx \backslash px$	qx	lx	dx-lx-qx	nLx	Tx	ex = Tx \backslash lx
0-1	1454647	187881	1	0.1292	0.1185	100,000	11850	141508	5756278	57.56
1-4	7636896	69000	4	0.0090	0.0353	88150	3112	419730	5214770	63.70
5-9	10595802	28747	5	0.00271	0.01348	84620	1141	419730	5269230	62.27
10-14	9405292	24287	5	0.0026	0.0129	83272	1074	413135	4849500	58.24
15-19	7484156	13896	5	0.0018	0.0089	81982	730	407685	4436365	54.11
20-24	5648621	16611	5	0.0029	0.0144	81092	1168	401860	4028680	49.68
25-29	4335169	14656	5	0.0033	0.0165	79652	1314	394135	3626820	45.53
30-34	3593084	12585	5	0.0035	0.0172	78002	1342	385410	3232685	41.44
35-39	3532786	12835	5	0.0036	0.0177	76282	1350	376985	2846975	37.32
40-44	2820518	16463	5	0.0058	0.0282	74512	2101	365510	2469990	33.15
45-49	2600989	12326	5	0.0047	0.0230	71692	1649	352710	2104480	29.35
50-54	2105053	19081	5	0.0090	0.0433	69392	3005	336135	1751770	25.24
55-59	1537737	15734	5	0.0102	0.0488	65062	3175	313110	1415635	21.76
60-64	1426130	21723	5	0.0152	0.07143	60182	4299	283052	1102525	18.32
65-69	970936	21110	5	0.0217	0.0995	53039	5277	240320	819473	15.45
70 over	1416052	105478		0.0744	1.0000	43089	43089	579153	579153	13.44

Table 3: Life table for Pakistani females 1999

Age	Px(pop)	Death Dx	C.l	nMx=Dx\px	qx	lx	dx-lx-qx	nLx	Tx	ex = Tx\lx
0-1	1418220	128042	1	0.0902	0.085	100,000	8500	127864	6052150	60.52
1-4	7445654	74269	4	0.0099	0.039	91500	3569	358200	5924286	64.75
5-9	9606848	28697	5	0.0029	0.0144	87600	1261	434400	5566086	63.54
10-14	8586701	21478	5	0.0025	0.0124	86160	1068	427700	5131686	59.56
15-19	6794687	12701	5	0.0019	0.0094	84920	798	422250	4703986	55.39
20-24	5509834	21335	5	0.0038	0.0189	83980	1587	415175	4281736	50.98
25-29	4375560	11392	5	0.0026	0.0129	82090	1059	407225	3866561	47.10
30-34	3674307	14106	5	0.0038	0.0186	80800	1503	399350	3459336	42.81
35-39	3410340	12751	5	0.0037	0.0182	78940	1437	390150	3059986	38.76
40-44	2605504	11888	5	0.0046	0.0225	77120	1735	379975	2669836	34.62
45-49	2375553	6370	5	0.0026	0.0128	74870	958	371150	2289861	30.58
50-54	1756538	14889	5	0.0085	0.0410	73590	3017	357700	1918711	26.07
55-59	1340319	11438	5	0.0085	0.0410	69490	2849	337200	1561011	22.46
60-64	1137853	23563	5	0.0207	0.0952	65390	6225	303150	1223811	18.71
65-69	693755	17610	5	0.0253	0.1144	55870	6391	250525	920661	16.48
70 over	934672	61930	-	0.0663	1.0000	44430	44430	670136	670136	15.08

Table 4: infant and child mortality and life expectancy at birth for Pakistan 1999

	Pakistan	Males	Females
Infant Mortality	102.0	110.5	85.0
Child Mortality	36.8	35.2	39.0
Life Expectancy at Birth	58.95	57.56	60.52

The life expectancy is an important indicator of health status of people of any country. The life expectancy at birth is an estimate of longevity of human life (life span) can also be picked from the life tables (Table 1, 2 and 3). The life expectancy at birth for both sexes was 59 years while it was 57.56 years for males and 60.52 females. The life expectancy for females is generally higher in developing societies due to the high female mortality. The similar finding has emerged in this article. It is also generally observed in developing countries particularly in male dominated societies that female mortality is under reported. So this slightly higher life expectancy at birth for females may be due the data unreliability and under reporting of female deaths.

Infant and child mortality levels are still very high and unacceptable. The persistent high level of infant and child mortality should be a great concern for the government and health practitioners. The high level of infant and child mortality in Pakistan is due to lack of improved sanitation conditions, poor level of living, and unattended deliveries by the trained health personnel (Jalil and Zeba, 2001). It is argued to improve the life style through improving women education which will surely enhance the ability of mothers to seek better health care and nutrition for their new born children and ensure their survival. Public education programs should be launched for providing information about the benefits of improved sanitation, good nutrition, antenatal and post-natal care at the household and community level along with strengthening the subject of community medicine.

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