CHAPTER 13

LEVELS AND PATTERNS OF MORTALITY

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13.1 Mortality

Like fertility mortality is also one of the factors, which affects the structure and size and growth of a population. Mortality rates are based on death statistics. Note that the population studies follows the definition of death put forward by UN and WHO which defines death as "the permanent disappearance of evidence of life at any time after birth has taken place". Here one should note that birth refers to a live birth.

In Nepal earlier decline of mortality and later decline in fertility has resulted in relatively high rate of natural growth of population. The mortality decline is relatively faster due to increased access and improved health services. There has been consequential decline in mortality during recent past, but the pace of decline in fertility is slower than that of mortality. Consequently Nepal's population is increasing over the years.

Like fertility there are different indices for the description of trend and level of mortality. Here we discuss some of these indicators. These indicators are:

a) Crude death Rate

b) Infant Mortality Rate

c) Child and under 5 mortality rate

d) Maternal Mortality Ratio and

e) Life expectancy

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[*] Late Dr. Regmi was an eminent Demographer of the country who passed away on 4th Oct, 2003 before he was able to complete this chapter.

[**] Mr. Dongol who is currently a freelance Demographer has kindly volunteered to complete this chapter.

13.2 Source of Data

Main source of death data generally is the vital registration system. In Nepal though the system was implemented firstly in 1977 in 10 districts and had made universal by 1990, the recording system is still immature. Despite the continuous effort of government for exhaustive coverage of death statistics, it remained highly under reported. As of the system-report the death rate is about 3.0 deaths per thousand. The country has not yet developed its social and economical status so as to meeting the crude death rate as low as 3 per thousand in 2000. So the data from the system could not reflect actual mortality level of Nepalese people. Under such situation, mortality indices have to be continually derived either from frequently conducted surveys or decennial censuses. Note that the sample surveys have proved to be better sources than in censuses in terms of coverage and quality. In the survey, collection of mortality related data had generally given less attention compared to fertility related data collection as it is closely linked with family planning, which is more often interested. However the mortality indicators discussed below are either based on stable or quasi-stable population analysis or data based on survey, where both the direct and indirect measures of estimation are employed.

13.3 Crude Death Rate (CDR)

Crude death rate (CDR) is defined as ratio of annual number of deaths to the person years of exposure to death during that period multiplied by a constant (usually 1000). Note that for simplicity, person-years of exposure is usually approximated by the mid-year population. Like crude birth rate this is usually widely understood and is very frequently used summary measure of mortality. However, like CBR, CDR is also heavily affected by the age and other compositional structure of the population. For example, note that age specific death rate at age 15-19 is very low compared age specific death rate at 0-4 or 60-64 years of age. Therefore, combining all the deaths into one and calculating the rate for all population ignores the age composition of the population. In two populations even if the age specific death rates are exactly the same, if age-sex structure is different then they will have different crude death rate (CDR).

13.3.1 Crude Death Rate for Different Years

Different estimates of CDR for Nepal available since 1954 are provided in Table 13.1. Because most of these estimates are based on stable population techniques, these estimates do not present a very consistent trend. Moreover, this could be also due to the use of different data that come either from censuses or surveys. It should be borne in mind that both of these sources of data suffer from inherent errors.

Table 13.1 : Crude death rate, Nepal, 1954 - 1999

S.N.	Source	Estimated Duration	Crude Death Rate		
			Total	Male	Female
1.	Vaidhyanathan & Gaige, 1973	1954	36.7	-	-
2.	CBS, 1977	1953-61	27.0	28.0	24.8
3.	Guvaju, 1975	1961	22.0	-	-
4.	CBS, 1977	1961-71	21.4	21.3	22.6
5.	CBS, Demographic Sample Survey, 1976	1974-75	19.5	18.6	20.4
6.	CBS, Demographic Sample Survey, 1977	1976	22.2	21.5	22.8
7.	CBS, Demographic Sample Survey, 1978	1977-78	17.1	17.9	16.2
8.	CBS, 1977	1971-81	13.5	12.2	14.9
9.	New Era, 1986	1984	10.9	10.8	11.0
10.	CBS, Demographic Sample Survey, 1986	1986-87	16.1	-	-
11.	CBS	1991	13.3	12.9	13.6
12.	CBS	1996	11.6	-	-
13.	MOPE	1999	10.3	-	-

Source: CBS, 1995; CBS, 1998; MOPE, 1998

The table indicates that CDR was a little over 35 in 1950s, which decreased to less than 20 in 1970s, and further reduced to 10.3 by 1999. Despite fluctuations in the estimate of CDR, it can easily be concluded from the table that mortality in Nepal has been declining over the years.

Another thing that emerges from the table is that these estimates consistently indicate higher female mortality than males. Nepal is one of the few countries in the world where female mortality is higher than males.

There is no reliable information on Age Specific Death Rates (ASDR) in Nepal, which could provide mortality information for different age groups. The lack of reliable estimates of adult mortality by age has led us to use CDR.

13.3.2 Crude Death Rate 2001

Direct estimation of crude death rate is not possible because of data dearth. Despite of poor reporting in the vital registration system, the census of 2001 also showed under reporting of deaths. For example the rate was found to be 4.7 per thousand populations in 2001. Health services available, prevailing living standard of population (more than 90 percent population are in the area which is of rural characteristics) and high poverty level (about 42 %) should led high

death rate. The rate does not reflect crude death rate of Nepalese population in 2001. Therefore this asks for indirect estimates of death rates in the country.

As of the computation made in the forth-coming population projection of the Central Bureau of Statistics, the crude birth rate is about 33.3 per thousand populations (TFR is 4.0) in 2001. Population growth rate is 2.25 percent during the period 1991 to 2001. These statistics, the population growth rate and crude birth rate put Nepalese crude death rate at 10.8 per thousand populations (assuming net international migration is nil). Note that beside this type of crude and general rate, no information is available on mortality separately for adults.

13.4 Infant Mortality Rate (IMR)

The IMR is the number of deaths under one year of age per 1000 live births during a period of time, usually one year. Although it is called a rate, in fact, it is the probability of survival to age one since birth. Several factors affect the IMR of a country and these are:

a) Nutrition of mothers and children
b) Birth intervals
c) Parity
d) Age of the mother at child's birth
e) Basic health services including
    i. Immunization
    ii. ARI
    iii. Diarrhea
    iv. Safer motherhood programmes etc;

In other words IMR usually declines with a certain level of socio-economic development as reflected by the above-mentioned services. Therefore IMR has been considered as an indicator of socio-economic development and general health condition of a society. Since the adult mortality is relatively lower even in developing countries and smaller proportion of population is in older group, a substantial number of deaths occur during the first five years of life. In developing countries where medical health systems are not fully developed infant death is a substantial part of under five-age deaths. Therefore, reduction of IMR is needed to achieve a significant reduction in the overall morality. Moreover the interdependent relationship between fertility and infant mortality suggests that a reduction in infant child mortality will trigger a subsequent decline in fertility (Regmi, 1994), it has also found that lower IMR motivates couples to produce less number of children.

Table 13.2 : Infant mortality rate, Nepal, 1954 – 1999.

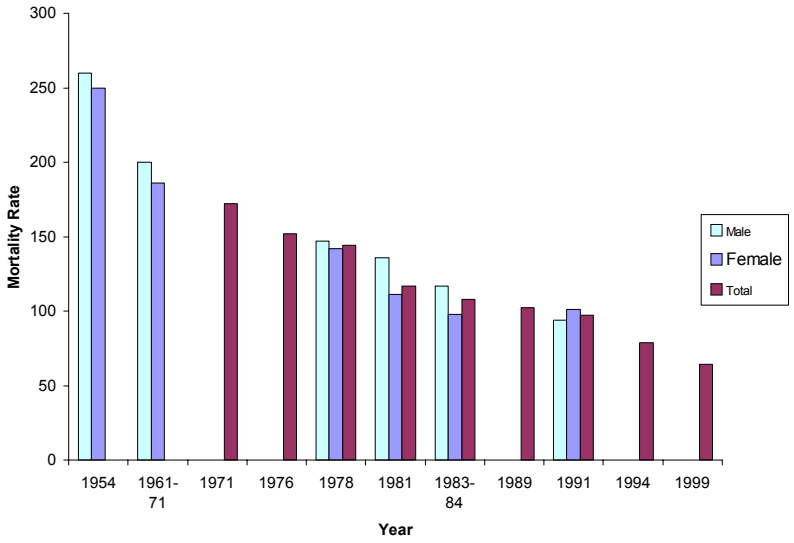
S.N.	Source	Estimated Duration	Infant Mortality Rate		
			Total	Male	Female
1.	Vaidhyanathan & Gaige, 1973	1954	-	260	250
2.	Guvaju, 1974	1961-71	-	200	186
3.	CBS, 1974	1971	172	-	-
4.	Nepal Fertility Survey, 1977	1976	152	-	-
5.	CBS, 1985	1978	144	147	142
6.	New Era, 1986	1981	117	136	111
7.	Fertility and Family Planning Survey	1983-84	108	117	98
8.	Fertility and Family Planning Survey, 1991	1989	102	-	-
9.	Census, 1991	1991	97	94	101
10.	Family Health Survey,1996	1993-96	79	-	-
11.	Nepal demographic Health Survey	1998-2001	64	-	-

Source : CBS, 1995; MOH, 1997; NDHS2001

In Table 13.2 provides estimates of infant mortality based on different sources have been provided. Note that except for the census estimate for 1991 all the estimates before 1989 have either been based on indirect techniques of estimation. Since the 1991 survey it has been argued that the quality of pregnancy history data has improved and there is very little omission of births and deaths especially during the recent past. As the effect of these omissions on the calculation of demographic rates is minimal, direct method of estimation has been used since then.

The Table 13.2 indicates that a high IMR of around 250 per thousand live births prevailed in the country during the fifties. In the sixties it decreased to around 150 to 200 per thousand live births. Since the mid seventies decline in IMR is secular and by 1998-2001 it has reached 64 per 1000 live births. Figure 13.1 shows the success in lowering IMR more clearly.

Figure 13.1 : Infant mortality rate, 1954-1999



Infant mortality is affected by various socio-economic and demographic factors. These factors are particular interest, since these provide clues for the identification of priority groups in policy formulation and programme implementation. Differentials in IMR in Nepal has been presented in Table 13.3

Table 13.3 : Infant mortality rates by socio-economic & demographic characteristics, Nepal, NFHS 1996 and NDHS 2001.

(for ten years period preceding the survey)

Characteristics	NFHS 1996	NDHS 2001
Residence		
Urban	61.1	50.1
Rural	95.3	79.3
Ecological Region		
Mountain	136.5	112.0
Hill	87.4	66.2
Terai	90.9	80.8
Development Region		
Eastern	79.4	77.5
Central	86.3	77.4
Western	84.3	60.1
Mid-Western	114.8	72.9
Far Western	124.3	112.2
Education		
No Education	97.5	84.6
Primary	80.0	61.0
Secondary	53.4	49.9*
Age of Mother at Birth		
< 20	120.1	108.2
20-29	79.5	67.6
30-39	103.9	72.9
Previous Birth Interval		
< 2 yrs	141.4	124.4
2-3 yrs	78.8	67.8*
3 yrs	-	45.2
4+ yrs	44.7	38.9
Sex of Child		
Male	101.9	79.2
Female	83.7	75.2

Source : MOH, 1997, NDHS2001

Note : *Refers to two year birth interval

Before the data in Table 13.3 is discussed we would like to remind the readers that the estimate of IMR from NFHS 1996 and NDHS 2001 presented in Table 13.2 were based on births that

occurred during the preceding 5 years. The estimate of infant mortality differentials presented in Table 13.3 is based on births that occurred during the preceding 10-year period. Both of these surveys indicate that mother's education, place of residence; birth interval and age of mother have great impact on IMR. IMR for mothers whose age is less than 20 or the duration of birth interval is less than two years, is much higher than those aged 20+ and have longer birth interval. In general the differentials observed during the 1996 survey seem to have decreased in the 2001 survey. This indicates that decrease in IMR is somewhat faster in groups where IMR used to be higher.

13.5 Child and Under 5 Mortality

Before we present the data from the two recent surveys i.e. NFHS1996 and NDHS2001 definition of these mortality indicators would be in order. Child mortality rate is defined as the probability of surviving from age 1 to age 5. This assumes that the child has already survived to age 1 to begin with. Under-five mortality rate is defined as follows. Of the 1000 children born today how many will die before their 5^{th} birthday. In other words, it is probability of dying between birth and their fifth birthday. Note, once again that the estimate of these indicators are based on the births that occurred during the last 5 years. Data on child and under age-5 mortality obtained from NDHS 2001 have been summarized in Table 13.4.

Table 13.4: Child and under age-5 mortality rates for five year periods preceding the survey, Nepal 2001.

Years Preceding the Survey	Child Mortality	Under 5 Mortality
0-4	28.6	91.2
5-9	39.7	126.2
10-14	57.0	158.0

The table indicates that the child mortality 0-4 years preceding the survey is 50 percent of what it was 10-14 years preceding the survey. In other words there has been an impressive decline in child mortality during the last 15 years. A very similar picture in decline in under 5 mortality has also been seen.

Note that current (i.e. for 1998) estimate of child mortality in Nepal is 28.6 indicating that of the 1000 babies surviving to age 1, 28.6 die before they reach the age of 5. In a likewise manner under 5 mortality is 91.2 indicating that of the 1000 children born today 91.2 will die before they reach the age of 5.

Table 13.5 : Child and under 5 mortality rates by socio-economic & demographic characteristics, Nepal, NFHS 1996 and NDHS 2001.

(for ten years period preceding the survey)

Characteristics	NFHS 1996		NDHS 2001	
	Child Mortality	Under 5 Mortality	Child Mortality	Under 5 Mortality
Residence				
Urban	22.5	82.2	16.7	65.9
Rural	53.2	143.4	35.4	111.9
Ecological Regions				
Mountains	82.2	207.5	51.2	157.4
Hill	43.3	126.9	29.7	93.9
Terai	53.0	139.1	34.8	112.8
Development Regions				
Eastern	36.3	112.8	29.6	104.8
Central	56.1	137.5	36.4	110.9
Western	37.6	118.8	25.1	83.7
Mid Western	71.2	177.8	41.2	111.0
Far Western	62.3	178.9	41.7	149.2
Education				
No Education	56.8	148.8	39.5	120.7
Primary	21.0	99.3	13.4	73.5
Secondary	7.7**	60.7**	14.3	63.5
S.L.C.+	-	-	3.7	14.9
Age of the Mother at Birth of the Child				
<20	44.1	158.9	28.5	133.6
20-29	52.4	127.7	32.6	98.0
30-39	54.5	152.8	42.5	112.3
Previous Birth Interval				
< 2 Years	74.7	205.5	54.8	172.4
2-3 Years	52.4	127.1	40.0*	105.1*
3 Years	-	-	22.4	66.6
4 or More Years	32.1	75.4	20.1	58.2
Sex of the Child				
Male	45.5	142.8	27.8	104.8
Female	56.5	135.5	40.2	112.4

Table 13.5 provides the differentials in child and under5 mortality for Nepal obtained from NFHS 1996 and NDHS 2001 surveys. Note once again that for the differentials births that occurred during the last ten year period has been taken into account.

The same factors, which were important in the differentials of infant mortality, are also important for child and under age-5 mortality. These are mother's education, mother's age, previous birth interval and ecological regions.

Like the infant mortality the differentials in child and under5 mortality has decreased over the last five years again suggesting that the programmes aimed at reducing child mortality is also reaching those groups where child and under 5 mortality used to be higher, however the differentials still persist in child and under-age 5 mortality.

13.6 Maternal Mortality

Maternal deaths are defined as any death that occurred during pregnancy, childbirth or within six weeks after the birth or termination of pregnancy. Maternal mortality is defined as the ratio of maternal deaths and number of live births during the same period multiplies by 100,000. The hospital record on maternal mortality shows that maternal mortality was 189 per 100,000 live births (Malla, 1986 as cited in MOH, 1993, pp.142) in 1979 to 1985. Taking time reference into consideration, the hospital record is inappropriate for estimation of maternal mortality rate. Because such low rate in the time prior to 1985 is no way to endorse it. The fertility, mortality and morbidity survey carried out some time in 1997-78 in the three rural areas of Katmandu, Rupendehi and Kavre revealed maternal mortality ratio of 850 per 100,000 live births (FP/MCH as cited in CBS, 1987, pp250).

Table 13.6: Maternal mortality ratio 1987 - 1998

Reference Year	Ratio per 100,000	Sources
1991	515	NFHS, 1991, MOH
1990-1996	539	NFHS, 1996, MOH
1998	596-683	MMMS, 1998, MOH

NFHS, 1991 and 1996 had collected data on maternal mortality through sisterhood method in 1991 and direct method in 1996. Estimation of maternal mortality ratio utilizing the methods mentioned above yielded a ratio of 519 and 539 deaths per 100,000 live births respectively. The slight increased in ratio in the latter year may be due to differences in methods adopted and inherent errors. However the difference is very small. The survey from MMMS, 1998 estimated maternal mortality ratio at 596-683 per 100,000 live births. Note that this study was on the basis of Hospital Death Audits of two districts hospitals. Result of the later survey has problems, basically of reporting from the area outside the concerned district, which seriously effect on

deciding the denominator. Nevertheless, maternal mortality ratio is still continuing to be as high as 500 to 550 per 100,000 live births in the country. This ratio is one of the highest in the world indicting that a sizable number of mothers die during childbirth.

In order to combat this high ratio of maternal mortality His majesty's government has embarked on a number of programmes under Family Health division's safer motherhood programmes. In this effort the government is also being supported by different donor agencies such as UNICEF, DFID, USAID, GTZ and other INGOs.

13.7 Life Expectancy at Birth in the Past

Life expectancy at birth is defined as the average number years a newborn baby will survive if s/he is subjected to current mortality pattern. Note that like the TFR this is also a synthetic cohort measure. This measure of mortality like the IMR is free from distortions of age composition and thus international comparisons can readily be made.

To calculate life expectancy we need the age specific mortality rates, which are difficult to obtain, as it requires a survey of large sample size. Because the birth registration data is not available, life expectancy in Nepal is usually estimated based on the census data, employing indirect techniques. Table 13.6 provides estimated life expectancy at birth from 1954 to 1999.

Table 13.6 : Expectation of life at birth, Nepal, 1954 - 1996

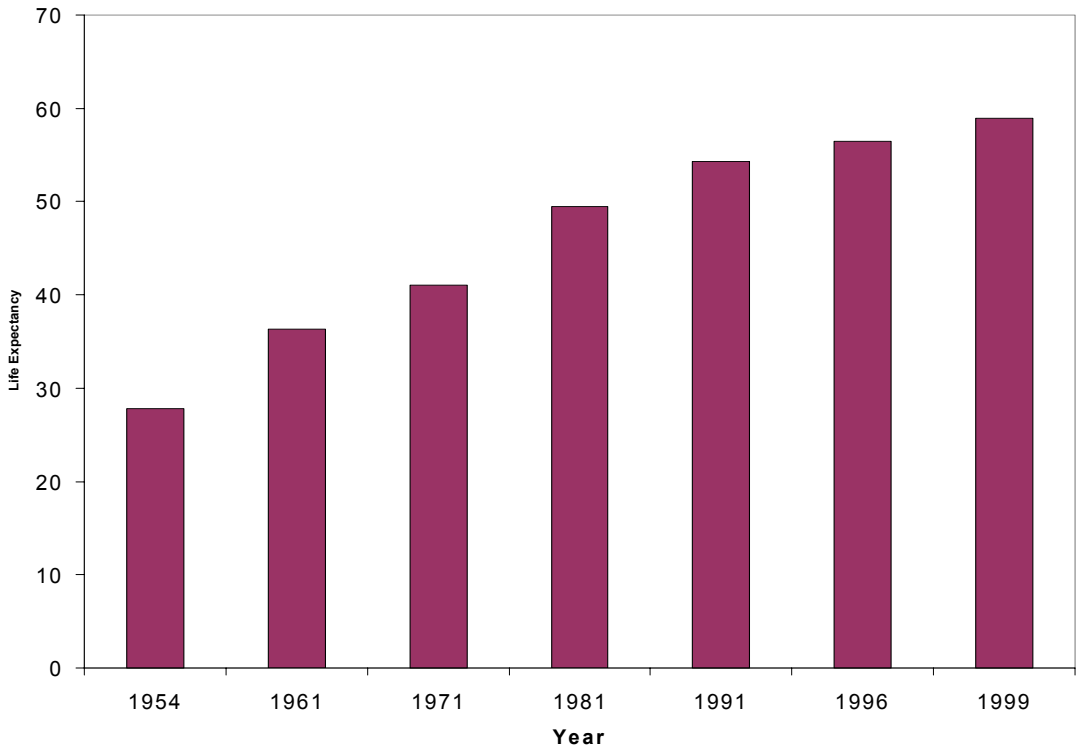
S.N.	Source	Estimated Duration	Life Expectancy		
			Male	Female	Total
1.	Vaidhyanathan & Gaige, 1973	1954	27.1	28.5	-
2.	CBS, 1974	1953-61	35.2	37.4	-
3.	CBS, 1977	1961-71	37.0	39.9	-
4.	Gubhaju, 1982	1971	42.1	40.0	-
5.	Demographic Sample Survey, 1977	1976	43.4	41.1	-
6.	CBS, 1986	1981	50.9	48.1	-
7.	CBS, 1987	1983	51.8	50.3	-
8.	CBS, 1993	1991	55.0	53.5	-
9.	CBS, 1996*	1996	-	-	56.5
10.	MOPE, 1999	2000			58.9

* Not a census year. Estimates are based on a projection.

Source : CBS, 1995; MOPE, 1999.

As indicated by the table expectation of life at birth for both the males and females has been increasing gradually over the years. The expectation of life at birth for males was 27.1 in 1954. Corresponding figure for females was 28.5 years. This figure increased to 55 and 53.5 years in 1991, respectively for male and females. Mortality estimates used in the population projection (MOPE 1999) life expectation of life at birth for the Nepalese has reached 58.9 years. Such a significant change in life expectancy is due to the improvement of health facilities that has reduced death rates, especially infant and child death rate during recent decade.

Figure 13.2 : Life expectancy, 1954-1999



13.8 Mortality Pattern

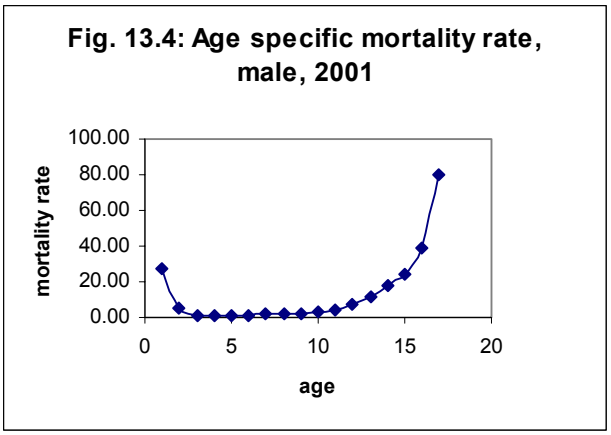
As explained earlier vital registration system though exists in operation, its coverage is very low. Therefore one has to depend upon either the censuses or sample surveys conducted in the country. Sample surveys so far conducted in the country, focus only on childhood mortality rather than adolescent and adult mortality. Therefore the censuses were the only sources that would provide mortality pattern by age. The censuses included questions on mortality like deaths in the year just prior to the census. So if some one is interested to see mortality pattern on the basis of census data of 2001, he or she can refer the Table 13.7. Though the death statistics are very poor in term of its completeness, we can analyze death statistics in term of death rate and mortality pattern. We will

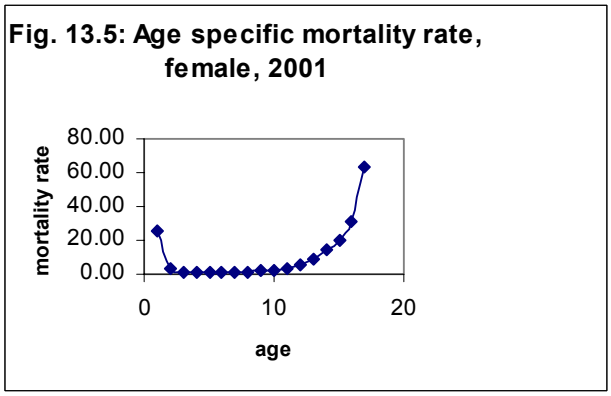
see then what it looks like. Age specific death rates and mortality curve drawn by sex are shown in Table 13.7 and figures 4 and 5. Shapes of the curves, though tend to represent mortality pattern of Nepalese people, high in the child hood and much more high at the old ages, might not exhibit exact Nepalese mortality pattern. If we assume deaths were being under reported by the same factor, the inflated structure will also be of the same pattern. Only difference will be in magnitude. But the assumption is unlikely as there are several evidences that show under reporting mostly in the childhood. Besides, we cannot avoid overall inherent under reporting through out all ages.

No other method can be employed to estimate age specific death rate and other mortality indices with the exception of indirect techniques. Therefore different indirect techniques as given by United Nations will be used to compute mortality indices in Nepal.

Table 13.7: Age specific mortality rates, 2001

Age	Age Specific Death Rate	
	Male	Female
< 0	27.55	25.10
1-4	4.89	3.76
5-9	1.06	1.01
10-14	0.87	0.67
15-19	1.09	1.02
20-24	1.53	1.21
25-29	1.74	1.39
30-34	1.79	1.54
35-39	2.45	1.89
40-44	3.39	2.08
45-49	4.32	3.36
50-54	7.06	5.06
55-59	11.34	8.83
60-64	17.96	14.02
65-69	24.30	20.42
70-74	38.91	30.98
75+	80.41	63.13
CDR	5.24	4.15





When we talk of the use of indirect estimates for estimating mortality indices, we have to borrow life table model that fits good to our country from other sources.

If we look at the past history of indirect techniques used, we will see up to 1991 demographers and researchers have used West Model of Coal and Demeny Model life table. But it was found

that Nepal fits very close to General pattern of United Nations model rather than West model of Coal and Demeny model[1]. The study was done using data of the Nepal Fertility Survey, 1976. Question is now "how about in 2001". Is this model still fit in 2001? So our first task is to investigate "which model fits well to the country?" For this investigation we will use information from the latest survey data of Demographic Health Survey 2001.

For this purpose we will use the cross sectional data of IMR and corresponding CMR as described by the same manual.

Following attempts were being made to investigate this issue:

Table 13.8: IMR and corresponding CMR from west model and observed data from DHS, 2001

From West Model			From Observed Report		
IMR is 67.35	For	CMR is 26.79			
IMR is 56.57	For	CMR is 20.02			
IMR is 64.4	For	CMR is 24.94[2]	IMR is 64.4	For	CMR is 28.6

Note that the survey report shows that CMR is 28.6 for the IMR of 64.4. But from the West model, it is found that CMR is 24.94 corresponding to the same IMR of 64.4 (Table 13.8). This reveals that CMR obtained from the survey deviate from that of the West model by 3.66 (28.6 – 24.94) per thousand.

Table 13.9: IMR and corresponding CMR from general model and observed data from DHS, 2001

From General Model			From Observed Report		
IMR is 65.03	For	CMR is 26.90			
IMR is 61.41	For	CMR is 24.47			
IMR is 64.4	For	CMR is26.48[2]	IMR is 64.4	For	CMR is 28.6

Similarly referring to the Table 13.9, the General model shows that CMR is 26.48 (Table 13.9) corresponding to the same value of IMR of 64.4. This reveals that CMR obtained from the survey deviate from that of the General model by 2.12 per thousand. This tells that General model has the least deviation compared to west Model. Therefore the General model fits best than West Model. Therefore general model is widely used to derive mortality related indices.

[1] United Nations, 1990: "Indicators of Mortality in Childhood" Step by Step Guide to the Estimation of Child Mortality, New York.

[2] Interpolated value from the model

In fact it is not enough to establish the suitability of the model life table on the basis of infant and child mortality only. The basis of establishing a suitable model should include adult mortality and elderly mortality also. But there is no such study ever taken to provide adult and elderly mortality rate.

13.9 Determination of Mortality Level

When we say certain particular mortality Level of a country, it will be very technical term. So we will translate it into "life expectancy at birth" so that every body could understand what does it mean?

There are various indirect techniques to determine life expectancy at birth. We will use those techniques only that are permissible by the available statistics in the country. Among the different methods stable population technique is also one. But in the context of Nepal where fertility as well as mortality level is declining since the last several years, the population is no longer stable.

13.9.1 Survivorship Ratio Method

Theoretically this method can be applied to sexes, male and female separately. But due to substantial size of out migration, particularly of males this method would not hold good for estimating level or life expectancy at birth of male during inter census period (in 2001 male absentees were 679468). Similarly age distribution of females also could have been affected by out migration (in 2001 female absentees were 82712). However the statistics shows that females out migration are comparatively less (ratio of out migration to total present population is about 0.7 percent females against 6.0 percent males). Therefore here an attempt is being made to study mortality level or life expectancy at birth by using female's ten years survivorship ratio method from 1991 to 2001.

The Table 13.10 reveals that life expectancy at birth for females varies from the lowest value of 42 years to highest value of 67 years during 1991 to 2001. The ranges can be divided into two set of life expectancy at birth. One set is below 54 years and another is more than 60 years with a large gap.

If we assume the reference year as 1996, the values of life expectancy at birth below 54 years cannot be accepted as the study done already based on population census of 1991 showed Nepalese life expectancy at birth had reached 54 years in 1991. Of course it could be less than 54 years if health services had worsened dramatically during 1991 to 1996, which is unexceptional

case as well as beyond the reality. Another set of figures showed life expectancy at birth lies between 61 years and 67 years in 1996. Even if we accept the lowest value of 61 as life expectancy at birth in 1996, the statistics showed that the life expectancy at birth increased by 7 years (54 years in 1991 to 61 years in 1996) in 5 years period, which ruled out universal annual increment rate in life expectancy at birth.

Table 13.10: Ten-year female life table survival ratio (1991-2001)

Age	Female Population[3]		Survival Ratio (General Pattern)			
	1991	2001	From	To	SR	eo
0-'4	1,435,313	1,539,450	0-4'	10-14'	0.9950	GT
5-'9	1,266,523	1,492,620	5-'9	15-19	0.9988	GT
10-'14	1,116,166	1,428,130	10-'14	20-24	0.9897	67.0
15-19	970,968	1,264,950	15-19	25-29	0.9743	60.7
20-24	851,512	1,104,720	20-24	30-34	0.9323	49.6
25-29	741,834	946,027	25-29	35-39	0.8908	42.6
30-34	618,453	793,883	30-34	40-44	0.8869	43.6
35-39	508,384	660,789	35-39	45-49	0.8864	46.0
40-44	421,205	548,518	40-44	50-54	0.8712	47.6
45-49	347,913	450,638	45-49	55-59	0.8629	53.9
50-54	284,128	366,953	50-54	60-64	0.8546	61.9
55-59	231,759	300,197	55-59	65-69	0.7953	62.9
60-64	183,005	242,828	60-64		0.6714	
65-69	128,602	184,311	65-69		0.6187	
70 +	……	……				

There would be several constraints in using survivorship ratio for determining mortality indices. Most common problem is that both set of population were suffering from net migration. Population who were out in 1991 could already be back in 2001. Similarly some of the population who were present in the cohort in 1991 might had gone out during 10 years period, 1991 to 2001. Therefore though they were counted in 1991, they would be among the absentees in 2001.

13.9.2 Translation of Under-Age 5 Mortality into Life Expectancy at Birth

As explained earlier Nepal Life Table is not available due to paucity of data. It was also already described that General Model Life Table suits the Nepalese population. Therefore indirect technique is used to estimate life expectancy at birth using the General Model.

[3] Population data has been smoothed

It is possible to estimate life expectancy at birth in any country using probability of surviving to age 5. The advantage of this method is that results hold good even when the population in question is far from stable (United Nations: 1983).

Table 13.11: Translations of under-five mortality rate into life expectancy at birth.

Sex	Under Five[4] Mortality (Per 1000 Live Birth)	Probability of Surviving to Under 5 (λ_5) (Per 1000 Live Births)	Translation of (λ_5) into eo	Reference Year
Male	104.8	895.2	58.8 years	1996
Female	112.4	887.6	59.3 years	1996

According to Griffith Feeney increment of life expectancy at birth in developing countries is about 2.3 years (refer Annex 1) during five-year period when the life expectancy at birth approaches 59 years. This would place life expectancy at birth for the country in 2001 as followings:

a) 61.1 years for males and

b) 61.6 years for females

13.9.3 Translation of Proportion of Population Under Age-15 into Life Expectancy at Birth

As we did translation of probability of surviving to under-age five among the live births into life expectancy at birth, similarly proportion of population under-age 15 can be translated into life expectancy at birth by sex. The advantage of this method also is that results hold good even when the population in question is far from stable (United Nations: 1983). The main problem in computation of life expectancy at birth is that detail works has not yet been done to make the Model Life Tables for developing countries user friendly as were done in Coale and Demeny model life tables. In this case, therefore West Model life table of Coale and Demeny has been used. Note that the statistics has to be adjusted to fit the figures in the General model.

[4] Under-five mortality rates for 10-years period preceding the survey

Table 13.12: Translations of proportion of population under age-15 into life expectancy at birth.

Sex	Proportion of Population Under Age-15 C (15)	Translation of C (15) into Life Expectancy at Birth (eo)	Reference Year
Male	0.401660	58.8 years	2001
Female	0.385494	59.5 years	2001

Annex 2 shows that when life expectancy at birth is at the range of 58 to 59 the life expectancy at birth is higher by 0.3 years in the case of General model than in the West model. This figure can be used to adjust life expectancy at birth when West model is translated to General model. Consequently life expectancy at birth as of General model will be as given below:

a) 59.1 years for males

b) 59.8 years for females

The computations mentioned above provides two sets of data for life expectancy at birth, one set derived from survival from birth to under age-5 and another from proportion of the population below the age-15 separately for males and females. These were derived fitting Nepalese people's mortality pattern in the United Nations general model. Note that the difference in figure obtained from first indirect technique and second indirect technique is about 1 year. Average of the two statistics worked out separately for males and females, therefore gives best fit of life expectancy at birth for Nepalese people. Finally life expectancy at birth for 2001 is accounted as given below:

a) Life expectancy at birth for males is 60.1 years

b) Life expectancy at birth for females is 60.7 years

13.9.4 Indirect Estimate of Mortality Indices Based on Children Ever Born and Children Still Surviving.

Statistics on children ever born and children still alive can be used for indirect estimate of mortality indices. The exercises were being attempted with input data from the census, 2001 and DHS, 2001. The results from two sources of data, thus obtained are extremely inconsistent though the input data refer to the same year 2001. The census showed typically low mortality indices, where as the DHS showed unexceptionally high mortality indices. For example as of General Model, life expectancy at birth was 68.6 (q2) years from population census, 2001 and 58.2 (q2) from the DHS, 2001 (refer annex 3 and 4). Note that the technique was developed under the assumptions that fertility and mortality were constant in the recent past and also childhood mortality did not depend upon number of births and age of mother. But trends of fertility and

mortality level showed that the fertility level is declining and mortality rate is decreasing over the years significantly (see fertility chapter). Similarly childhood mortality rate depends also on number of births and age of mother (see Table 13.5). These evidences clearly tell that under lying assumptions of the technique do not hold good any more. It is also evident from the results (Appendices 3 and 4) that the census of 2001 is highly affected by under reporting of children deaths to the mothers, whereas survey work of 2001 is less likely affected.

13.10 Model Life Table

On the basis of general model life table, which is found to be most appropriate for Nepalese people in 2001 Abridge Life Table has been computed separately for male and female (refer Annex 5 and 6). This life tables showed that IMR is slightly more than what has been computed directly from the survey data of 2001. The figure from the table IMR is about 71.4 for males and 70.9 for females in 2001 against 79.2 for males and 75.2 for females in 1996 (see Table 13.3). It is to be noted that the life table provides indirect estimate of IMR rather than direct method.

13.11 Conclusion

In Nepal though vital registration system has been universally implemented since 1990, the recording of events are so poor that we cannot use them to estimate vital rates. Under such situation, mortality indices have to be continually derived either from frequently conducted surveys or decennial censuses. Note that the sample surveys have proved to be better sources than the censuses in terms of coverage and quality. In the survey, collection of mortality related data had generally given less attention compared to fertility related data collection as it is closely linked with family planning, which is more often of interest. However mortality indicators are particularly computed from the survey based data. Both direct and indirect measures of estimation are employed depending upon the quality of data.

Probability of surviving to under-age five among the live births and proportion of population under-age 15 are being translated into life expectancy at birth by sex. This explains mortality level of Nepalese people by sex in 2001. General model for developing countries of United Nations fits best the Nepalese mortality experience. Life expectancy at birth of Nepalese female is found higher than that of males in 2001. The figure was 60.1 years for males and 60.7 years females in 2001.

Limitation of this study is that due to lack of any information on mortality indices of adult and elderly persons, defining mortality level estimation derived at in this present study may not able to take into account, in precision, the mortality pattern of adult and elderly persons.

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Annex 13.1: Rate of change in expectation of life at birth at different levels of life expectancy.

Initial Level	Base Change	Rescaled Change
40	2.10	3.13
41	2.14	3.19
42	2.18	3.24
43	2.21	3.30
44	2.25	3.36
45	2.29	3.42
46	2.31	3.45
47	2.33	3.48
48	2.35	3.51
49	2.38	3.55
50	2.40	3.58
51	2.42	3.61
52	2.44	3.63
53	2.45	3.65
54	2.45	3.65
55	2.44	3.64
56	2.42	3.62
57	2.40	3.58
58	2.37	3.53
59	2.33	3.48
60	2.28	3.39
61	2.20	3.28
62	2.11	3.15
63	2.00	2.98
64	1.88	2.81
65	1.78	2.65
66	1.66	2.48
67	1.54	2.30
68	1.44	2.14
69	1.32	1.98
70	1.18	1.78

Notes: *Estimated form United Nations Population Division estimates of life expectancy for 181 countries for five year periods from 1950-55 through 1985-90. See text for further explanation. The two columns show the relationship between level of expectation of life at birth in a given five year period and the change in expectation of life at birth between this and the following period. To illustrate using the first scaling, if expectation of life at birth for 1986-91 is 50 years, expectation of life at birth for 1991-96 would be 50 + 2.40 = 52.40 years. Alternative scaling allow for the very different rates of increase observed in different countries. The second scaling is used for extrapolating expectation of life at birth in Nepal for future periods based on the rate of increase estimated in previous sections.*

Source: Griffith Feeney, 1998: Population Projection for Nepal 1996 – 2016, Volume 1, Ministry of Population and Environment HMG, June 1998.

Annex 13.2: Transformation of IMR into life expectancy at birth from West Model and General Model.

q (0-1)*1000	eo*	eo **
108.20	52.36	51
104.03	53.15	52
99.91	53.94	53
95.84	54.74	54
91.81	55.54	55
87.84	56.34	56
83.92	57.15	57
80.04	57.95	58
76.21	58.76	59
72.43	59.57	60
68.70	60.38	61
65.03	61.20	62
61.41	62.02	63
57.85	62.82	64
54.35	63.64	65
50.90	64.46	66
47.54	65.27	67
44.24	66.05	68
41.01	66.83	69
37.87	67.57	70
34.82	68.34	71
31.85	69.15	72
28.99	69.93	73
26.24	70.70	74
23.60	71.50	75

* Transformation from West Model compatible to General Model

** General Model.

Computed by B.D.S. Dongol

Annexes 13.3: Indirect estimation of early age mortality for Nepal

Enumeration of Sep. 2000 (DHS 2001) — **Probability of Dying Before Age X**

Age of Woman	Average No. of Children		Proportion Dead	Age X	United Nations Models (Palloni-Heligman Equations)					Coale Demeny Models (Trussell Equations)			
	Born	Surviving			LAT AM	Chilean	So Asian	Far East	General	West	North	East	South
15-20	0.180	0.160	0.111	1	0.118	0.129	0.118	0.117	0.117	0.127	0.125	0.127	0.122
20-25	1.320	1.200	0.091	2	0.096	0.098	0.097	0.095	0.096	0.096	0.092	0.096	0.096
25-30	2.710	2.430	0.103	3	0.104	0.106	0.105	0.103	0.104	0.102	0.097	0.103	0.104
30-35	3.710	3.240	0.127	5	0.128	0.128	0.13	0.126	0.127	0.126	0.123	0.126	0.128
35-40	4.480	3.740	0.165	10	0.171	0.167	0.171	0.167	0.170	0.167	0.170	0.168	0.169
40-45	5.160	4.260	0.174	15	0.173	0.174	0.177	0.173	0.173	0.174	0.177	0.175	0.175
45-50	5.710	4.370	0.235	20	0.235	0.233	0.236	0.233	0.235	0.233	0.235	0.233	0.233

Mean Age at Childbearing = 27.0

Corresponding Mortality Indices

Age of Woman	Reference Date	United Nations Models (Palloni-Heligman Equations)					Reference Date	Coale Demeny Models (Trussell Equations)			
		Lat AM	Chilean	So Asian	Far East	General		West	North	East	South
Infant Mortality Rate											
15-20	AUG 1999	0.118	0.129	0.118	0.117	0.117	OCT 1999	0.127	0.125	0.127	0.122
20-25	JUN 1998	0.078	0.089	0.079	0.080	0.080	JUN 1998	0.081	0.074	0.085	0.081
25-30	OCT 1996	0.077	0.092	0.079	0.080	0.079	JUN 1996	0.079	0.070	0.086	0.081
30-35	MAY 1994	0.085	0.104	0.088	0.088	0.088	DEC 1993	0.089	0.077	0.098	0.091
35-40	SEP 1991	0.099	0.126	0.104	0.102	0.103	MAR 1991	0.106	0.090	0.119	0.107
40-45	AUG 1988	0.097	0.126	0.105	0.099	0.100	APR 1988	0.104	0.088	0.118	0.106
45-50	FEB 1985	0.118	0.153	0.129	0.115	0.121	MAY 1985	0.126	0.106	0.147	0.125

Corresponding Mortality Indices

Age of Woman	Reference Date	United Nations Models (Palloni-Heligman Equations)					Reference Date	Coale Demeny Models (Trussell Equations)			
		Lat AM	Chilean	So Asian	Far East	General		West	North	East	South
Probability of Dying Between Ages 1 and 5											
15-20	AUG 1999	0.086	0.039	0.076	0.071	0.074	OCT 1999	0.069	0.097	0.048	0.079
20-25	JUN 1998	0.042	0.020	0.038	0.036	0.037	JUN 1998	0.036	0.047	0.025	0.031
25-30	OCT 1996	0.041	0.021	0.038	0.036	0.037	JUN 1996	0.035	0.043	0.026	0.032
30-35	MAY 1994	0.048	0.027	0.046	0.043	0.044	DEC 1993	0.041	0.050	0.031	0.041
35-40	SEP 1991	0.063	0.037	0.062	0.055	0.057	MAR 1991	0.053	0.062	0.043	0.058
40-45	AUG 1988	0.060	0.037	0.062	0.052	0.055	APR 1988	0.052	0.060	0.042	0.058
45-50	FEB 1985	0.084	0.053	0.088	0.067	0.075	MAY 1985	0.069	0.077	0.059	0.083
Life Expectancy at Birth											
15-20	AUG 1999	49.8	52.3	54.0	43.1	48.5	OCT 1999	48.9	46.4	53.4	52.5
20-25	JUN 1998	60.3	60.6	62.9	52.9	58.2	JUN 1998	57.9	57.9	60.3	63.2
25-30	OCT 1996	60.6	60.1	62.9	52.9	58.3	JUN 1996	58.1	58.8	60.1	63.0
30-35	MAY 1994	58.5	57.4	60.8	50.8	56.2	DEC 1993	56.2	57.1	58.1	60.6
35-40	SEP 1991	54.7	53.1	57.1	47.1	52.4	MAR 1991	52.9	53.9	54.7	56.5
40-45	AUG 1988	55.4	53.1	57.0	47.9	53.1	APR 1988	53.2	54.5	54.8	56.6
45-50	FEB 1985	50.1	48.0	51.9	43.9	48.1	MAY 1985	49.0	50.4	50.4	51.7

Annexes 13.4: Indirect estimation of early age mortality for

Enumeration of June 2001 (Census)					Probability of Dying Before Age X								
Age of Woman	Average No. of Children		Proportion Dead	Age X	United Nations Models (Palloni-Heligman Equations)					Coale Demeny Models (Trussell Equations)			
	Born	Surviving			LAT AM	Chilean	So Asian	Far East	General	West	North	East	South
15-20	0.154	0.147	0.045	1	0.046	0.051	0.046	0.047	0.047	0.049	0.048	0.049	0.046
20-25	0.969	0.924	0.046	2	0.049	0.050	0.049	0.048	0.049	0.049	0.046	0.049	0.048
25-30	2.059	1.947	0.054	3	0.055	0.056	0.056	0.055	0.055	0.054	0.052	0.055	0.055
30-35	2.870	2.683	0.065	5	0.067	0.067	0.068	0.066	0.066	0.066	0.064	0.066	0.067
35-40	3.442	3.166	0.080	10	0.084	0.082	0.084	0.083	0.084	0.082	0.084	0.083	0.083
40-45	3.821	3.433	0.102	15	0.102	0.103	0.105	0.103	0.103	0.103	0.105	0.103	0.103
45-50	4.037	3.535	0.124	20	0.126	0.126	0.126	0.127	0.127	0.125	0.126	0.125	0.125

Mean Age at Childbearing = 27.0

Corresponding Mortality Indices											
Age of Woman	Reference Date	United Nations Models (Palloni-Heligman Equations)					Reference Date	Coale Demeny Models (Trussell Equations)			
		Lat AM	Chilean	So Asian	Far East	General		West	North	East	South
Infant Mortality Rate											
15-20	MAY 2000	0.046	0.051	0.046	0.047	0.047	MAY 2000	0.049	0.048	0.049	0.046
20-25	FEB 1999	0.042	0.047	0.043	0.043	0.043	FEB 1999	0.043	0.039	0.045	0.044
25-30	JUL 1998	0.044	0.051	0.045	0.045	0.045	MAR 1997	0.045	0.040	0.048	0.048
30-35	MAY 1995	0.049	0.058	0.051	0.050	0.050	DEC 1994	0.050	0.044	0.055	0.055
35-40	DEC 1992	0.056	0.068	0.058	0.057	0.057	JUN 1992	0.056	0.050	0.063	0.063
40-45	FEB 1990	0.063	0.080	0.068	0.065	0.065	SEP 1989	0.065	0.056	0.074	0.073
45-50	SEP 1986	0.072	0.090	0.077	0.070	0.073	OCT 1986	0.071	0.060	0.083	0.081

Corresponding Mortality Indices

Age of Woman	Reference Date	United Nations Models (Palloni-Heligman Equations)					Reference Date	Coale Demeny Models (Trussell Equations)			
		Lat AM	Chilean	So Asian	Far East	General		West	North	East	South
Probability of Dying Between Ages 1 and 5											
15-20	MAY 2000	0.017	0.008	0.015	0.014	0.015	MAY 2000	0.017	0.024	0.010	0.007
20-25	FEB 1999	0.015	0.007	0.013	0.013	0.013	FEB 1999	0.013	0.018	0.008	0.007
25-30	JUL 1998	0.016	0.008	0.015	0.014	0.014	MAR 1997	0.014	0.018	0.010	0.009
30-35	MAY 1995	0.019	0.009	0.018	0.017	0.017	DEC 1994	0.017	0.021	0.012	0.013
35-40	DEC 1992	0.024	0.012	0.023	0.020	0.021	JUN 1992	0.020	0.025	0.015	0.018
40-45	FEB 1990	0.029	0.017	0.030	0.025	0.027	SEP 1989	0.025	0.030	0.020	0.025
45-50	SEP 1986	0.036	0.021	0.037	0.029	0.032	OCT 1986	0.029	0.034	0.024	0.031
15-20	MAY 2000	0.017	0.008	0.015	0.014	0.015	MAY 2000	0.017	0.024	0.010	0.007
Life Expectancy at Birth											
15-20	MAY 2000	69.3	69.5	71.0	62.6	67.5	MAY 2000	64.9	64.8	67.0	72.4
20-25	FEB 1999	70.6	70.6	72.0	63.9	68.6	FEB 1999	66.2	67.2	67.8	72.7
25-30	JUL 1998	69.9	69.5	71.3	63.0	67.8	MAR 1997	65.8	67.0	67.2	71.7
30-35	MAY 1995	68.5	67.8	69.8	61.5	66.3	DEC 1994	64.6	65.8	65.9	70.0
35-40	DEC 1992	66.4	65.5	67.9	59.4	64.2	JUN 1992	63.2	64.3	64.3	67.7
40-45	FEB 1990	64.3	62.7	65.4	57.2	62.0	SEP 1989	61.3	62.6	62.4	65.3
45-50	SEP 1986	62.0	60.4	63.2	55.6	59.9	OCT 1986	59.9	61.4	60.8	63.2

Annex 13.5: Abridge life table for male, 2001

AGE	M(X,N)	Q(X,N)	I(X)	D(X,N)	L(X,N)	S(X,N)		T(X)	E(X)	A(X,N)
0	0.07540	0.07135	100000	7135	94632	0.91952	/A/	6014280	60.1	0.248
1	0.00677	0.02662	92865	2472	365127	0.97875	/B/	5919648	63.7	1.438
5	0.00176	0.00874	90393	790	449990	0.99268		5554521	61.4	2.500
10	0.00118	0.00589	89603	528	446695	0.99285		5104532	57.0	2.500
15	0.00181	0.00900	89075	802	443499	0.98905		4657837	52.3	2.660
20	0.00259	0.01286	88273	1135	438642	0.98610		4214337	47.7	2.599
25	0.00298	0.01480	87138	1290	432545	0.98392		3775696	43.3	2.560
30	0.00356	0.01763	85849	1514	425588	0.97994		3343151	38.9	2.585
35	0.00464	0.02297	84335	1937	417049	0.97315		2917563	34.6	2.612
40	0.00637	0.03139	82398	2586	405850	0.96260		2500514	30.3	2.626
45	0.00908	0.04443	79811	3546	390671	0.94622		2094664	26.2	2.635
50	0.01334	0.06464	76265	4930	369659	0.92174		1703993	22.3	2.633
55	0.01965	0.09387	71336	6696	340728	0.88788		1334334	18.7	2.618
60	0.02861	0.13388	64639	8654	302527	0.83508		993606	15.4	2.612
65	0.04469	0.20164	55985	11289	252633	0.75966		691079	12.3	2.582
70	0.06636	0.28491	44697	12734	191914	0.66903		438446	9.8	2.521
75	0.09598	0.38556	31962	12323	128396	0.56211		246532	7.7	2.451
80	0.13686	0.50296	19639	9878	72173	0.38906	/C/	118135	6.0	2.366
85	0.21238	.....	9761	9761	45962	.....		45962	4.7	4.709

/A/ Value given for survivorship of 5 cohorts of birth to age group 0 - 4 = L(0,5)/50

/B/ Value given for S(0,5) = L(5,5)/(0,5)

/C/ Value given for S(80+,5) = T(85)/T(80)

Annex 13.6: Abridge life table for female, 2001

AGE	M(X,N)	Q(X,N)	I(X)	D(X,N)	L(X,N)	S(X,N)		T(X)	E(X)	A(X,N)
0	0.07476	0.07085	100000	7085	94775	0.9157	/A/	6069810	60.7	0.263
1	0.00912	0.03565	92915	3312	363077	0.9733	/B/	5975035	64.3	1.409
5	0.00213	0.01057	89603	947	445645	0.9915		5611958	62.6	2.500
10	0.00128	0.00640	88655	567	441859	0.9923		5166313	58.3	2.500
15	0.00192	0.00958	88088	844	438454	0.9886		4724454	53.6	2.646
20	0.00264	0.01313	87244	1146	433471	0.9855		4286000	49.1	2.599
25	0.00318	0.01580	86099	1360	427190	0.9826		3852529	44.7	2.572
30	0.00385	0.01909	84738	1618	419766	0.9789		3425338	40.4	2.573
35	0.00470	0.02325	83121	1933	410920	0.9742		3005572	36.2	2.577
40	0.00584	0.02880	81188	2338	400309	0.967		2594652	32.0	2.591
45	0.00773	0.03795	78850	2992	387110	0.9551		2194343	27.8	2.614
50	0.01091	0.05317	75858	4033	369725	0.9358		1807233	23.8	2.629
55	0.01602	0.07715	71824	5541	345996	0.9061		1437509	20.0	2.631
60	0.02405	0.11376	66283	7540	313500	0.8606		1091513	16.5	2.624
65	0.03697	0.16981	58743	9975	269803	0.7932		778013	13.2	2.603
70	0.05709	0.25053	48768	12218	214013	0.7012		508209	10.4	2.559
75	0.08680	0.35639	36550	13026	150070	0.5853		294197	8.0	2.491
80	0.13040	0.48694	23524	11455	87842	0.3905	/C/	144127	6.1	2.400
85	0.21443	.....	12069	12069	56285	.....		56285	4.7	4.664

/A/ Value given for survivorship of 5 cohorts of birth to age group 0 - 4 = L(0,5)/50

/B/ Value given for S(0,5) = L(5,5)/(0,5)

/C/ Value given for S(80+,5) = T(85)/T(80)