Demography India
Vol. 18 (1989), pp. 147-153

MahmoudA.Bustan, MustafaM.Mustafa, B.R. KohliandAHM. El-Sayed

Potential Gains in Life Expectancy of Kuwaiti Nationals through Partial and Complete Elimination of Neoplasm Mortality, 1984

ESTIMATES of gains in life expectancy have been used by health planners in support of public health programmes as well as in measuring health progress. As early as 1760, D. Bernoulli and D. Alembert published papers in support of smallpox vaccination as a public health measure and their argument was based on an analysis of prospective increase in complete life through elimination of smallpox as a cause of death. In recent times Hickman and Richard (1969) have demonstrated the use of partial life expectancies towards defining goals for health programmes. Estimates of gains in life expectancy through partial/complete elimination of a particular cause of death can therefore prove helpful in setting health targets.

Kuwait is a developing country which is on the threshold of joining the club of the developed countries as far as the health status of the people is concerned. This is the result of the concerted emphasis placed by the Kuwait government on health care in its development plans during the last three decades. Life expectancy at birth for the Kuwaiti population is currently estimated at about 72 years which compares very favourably with the level prevailing in developed societies.

Cancer has become a public health problem both in the developed and developing countries (WHO 1980). In absolute numbers there are now more cases and deaths from cancer in the Third World than in the industrial countries (Parkin et al. 1984). It is expected that the incidence of cancer would rise further in most developing countries as a result of ageing of these populations and reduction in mortality from infectious diseases among them (Stjernsward et al. 1985). As in the developed countries, the top three killers in Kuwait are cancer, cardiovascular diseases and automobile traffic accidents. Currently cancer alone is causing a little more than 10 per cent of total deaths among the Kuwaiti population (Ministry of Public Health, Kuwait 1984).

This study attempts to estimate potential gains in life expectancy of Kuwaiti males and females which would accrue when the neoplasm mortality in 1983-85 declines by specific extents in future.

Materials and Methods

Mortality data by age, sex, nationality (Kuwaitis and non- Kuwaitis) and cause of death for the years 1983, 1984 and 1985 were obtained from Vital and Health Statistics Division, Ministry of Public Health, Kuwait. Regarding mid-year 1984 population and its distributions by age, sex and nationality, the estimates prepared by the Central Statistical Office, Ministry of Planning, Kuwait have been used. The average of three years deaths during 1983-85 together with mid-year population distributions for 1984 have been used to calculate age-specific death rates for 1983-85 and this method was followed to overcome errors due to random fluctuations in annual deaths.

Using the standard procedure, life tables were constructed for 1983-85 separately for Kuwaiti males and Kuwaiti females which indicate the mortality level in 1983-85.

The basic function to be derived, when cause *i* is eliminated as a cause of death, is $nqx^{(-1)}$ which is the probability of dying in the age interval x to $x + n$ after cause i has been eliminated as a cause of death. The method used to derive this function was proposed by Chiang (1968 and 1978) as an approximate formula for expressing the value of $nqx^{(-1)}$ and is based on competing risk theory. Accordingly

$$ {}_nq_x^{(-i)} = 1 - {}_np_x \ ({}_nD_x - {}_nD_x^i)/{}_nD_x $$

where ${}_nD_x$ = observed deaths in the population in the age interval $(x, x + n)$

${}_nD_x^i$ = observed deaths in the population due to cause i in the age interval $(x, +n)$

and ${}_np_x = 1 - {}_nq_x$

After having calculated the values of ${}_nq_x^{(-i)}$, the values of all other life table functions we derived in the same manner as those in the basic life table.

In case of partial elimination of the cause of death, the probabilities of dying are deriv from the following equations:

$$ {}_nq_x^{(-i)}\left(\begin{matrix}\pi \\ k\end{matrix}\right) = 1 - \underset{n_x^p}{(}{}_nD_x - \pi_k \, {}_nD_x^i)/{}_nD_x $$

where $\underset{k}{\pi}$ = improvement factor ($0 \le \pi_k \le 1$)

Results and Discussion

Life Expectancy in 1983-85

Life tables were constructed for Kuwaiti males and females for 1983-85 which were based upon the three-years' average of deaths during 1983-85 together with the mid-year 1984 population distributions by age and sex. The results are shown in Table 1. As may be seen, life expectancy at birth for Kuwaiti males was 68.46 years and for Kuwaiti females 73.15 years. Also Kuwaiti females have higher life expectancy at all ages compared to Kuwaiti males.

TABLE 1 : LIFE EXPECTANCY AT DIFFERENT AGES, KUWAITI POPULATION, 1983-85

Age (in Years)	*Kuwaiti Males Life Expectancy (in Years)*	*Kuwaiti Females Life Expectancy (in Years)*
0	68.46	73.15
1	69.25	73.84
5	65.54	70.11
10	60.76	65.23
15	55.96	60.32
20	51.29	55.40
25	46.63	50.50
30	41.95	45.62
35	37.24	40.75
40	32.66	35.99
45	28.12	31.24
50	23,81	26.69
55	19.93	22.38
60	15.98	18.26
65	12.87	14.75
70	9.70	11.17
75	7.61	8.88
80	5.27	6.19

Neoplasm Mortality in 1983-85

Age-specific neoplasm death rates for 1983-85 for Kuwaiti nationals are shown in Table 2. These were calculated using the average neoplasm deaths by age for three years among Kuwaiti nationals and the mid-year 1984 population distributions. These rates clearly show that

1. Neoplasm mortality increases with age.
2. Neoplasm mortality is low till the age of 35 years.
3. Neoplasm mortality is quite high among Kuwaiti males compared to Kuwaiti females after the age of 55 years.

TABLE 2 : NEOPLASM DEATH RATES (PER 100,000 POP.) BY AGE AND SEX, KUWAITI POP. 1983-85

Age Group	*Kuwaiti Nationals*		
	Male	Female	Total
o*	2.6	5.3	3.9
1-4	8.4	4.0	6.2
5-14	8.8	5.3	7.1
15-24	8.7	5.4	7.0
25-34	12.3	13.8	13.1
35-44	41.4	40.4	40.9
45-54	112.5	131.3	121.6
55-64	355.3	249.2	305.2
65-74	829.0	418.0	630.9
75 +	1713.4	788.0	1262.0
All Ages	52.6	33.4	43.0

* For infants, death rates are per 100,000 live births.

Potential Gains in Life Expectancy through Complete Elimination

One way to measure the importance of a cause of death is to examine the gains in life expectancy when the cause of death is completely eliminated. Following the methodology already described, life tables were constructed for Kuwaiti males and females when neoplasm mortality is completely eliminated.

The results show that potential gains in life expectancy at birth would be 1.81 years for males and 1.58 for females (Tables 3 and 4). After infancy at age 1, the gains would be even more: 1.86 years for males and 1.61 years for females. It is also observed that the gains in life expectancy would be more than one year up to age 65 years for males and up to age 55 years for females. Even at age 70 years, males would gain 0.95 years and females 0.50 years in their life expectancy.

Potential Gains in Life Expectancy through Partial Elimination

Complete elimination of deaths due to neoplasm is however, unlikely to happen. A more realistic approach is to examine the potential gains in life expectancy through partial elimination. The results from partial elimination by 10 per cent, 20 per cent, 30 per cent, 50 per cent, 70 per cent and 90 per cent of the level of mortality prevalent in 1983-85 are also presented in Tables 3 and 4.

Gains in life expectancy are slightly more in the case of Kuwaiti males than females. For instance, at 50 per cent elimination of neoplasm mortality, males would add 0.87 years to life expectancy at birth and 0.52 years at age 65 years whereas the corresponding gains for females would be 0.78 years and 0.33 years respectively. Further, as partial reduction is increased from 10 to 90 per cent the gains in life expectancy at birth go up accordingly from 0.17 years to 1.62 years in the case of males and 0.15 years to 1.42 years for females. Even at age 60 years, the gains in life expectancy for males range from 0.12 years to 1.22 years as partial elimination increases from 10 to 90 percent and for females the gains are from 0.08 years to 0.74 years.

TABLES : POTENTIAL GAINS (IN YEARS) IN LIFE EXPECTANCY BY PARTIAL/COMPLETE ELIMINATION OF NEOPLASMS 1983-85, KUWAITI MALES

Age	*Partial Elimination By*						*Complete Elimination*
	10%	20%	*30%*	*50%*	70%	90%	
0	0.17	0.34	0.52	0.87	1.24	1.62	1.81
1	0.17	0.35	0.53	0.89	1.27	1.66	1.86
5	0.17	0.35	0.52	0.89	1.26	1.64	1.84
10	0.17	0.34	0.52	0.88	1.25	1.63	1.83
15	0.17	0.34	0.52	0.87	1.24	1.61	1.81
20	0.17	0.34	0.51	0.86	1.23	1.60	1.79
25	0.17	0.34	0.51	0.86	1.22	1.59	1.78
30	0.16	0.33	0.50	0.85	1.21	1.58	1.77
35	0.16	0.33	0.50	0.84	1.20	1.56	1.75
40	0.16	0.33	0.49	0.83	1.18	1.54	1.73
45	0.15	0.31	0.47	0.79	1.13	1.47	1.65
50	0.15	0.30	0.45	0.76	1.08	1.42	1.59
55	0.14	0.28	0.42	0.71	1.01	1.33	1.49
60	0.12	0.25	0.38	0.65	0.93	1.22	1.37
65	0.10	0.20	0.31	0.52	0.77	0.97	1.09
70	0.09	0.18	0.27	0.45	0.65	0.85	0.95
75	0.06	0.11	0.17	0.29	0.40	0.53	0.59
80	0.03	0.07	0.10	0.17	0.24	0.32	0.35

TABLE 4 : POTENTIAL GAINS (IN YEARS) IN LIFE EXPECTANCY BY PARTIAL/COMPLETE ELIMINATION OF NEOPLASM 1983-85, KUWAITI FEMALES

Age	*Partial Elimination By*						*Complete*
	10%	20%	*30%*	50%	70%	90%	*Elimination*
0	0.15	0.31	0.46	0.78	1.09	1.42	1.58
1	0.15	0.31	0.47	0.79	1.11	1.44	1.61
5	0.15	0.31	0.47	0.78	1.11	1.44	1.60
10	0.15	0.31	0.46	0.78	1.10	1.43	1.60
15	0.16	0.31	0.46	0.78	1.09	1.42	1.58
20	0.15	0.31	0.46	0.77	1.09	1.41	1.57
25	0.15	0.30	0.45	0.76	1.07	1.39	1.55
30	0.15	0.30	0.44	0.75	1.05	1.36	1.52
35	0.14	0.29	0.43	0.73	1.03	1.33	1.49
40	0.13	0.27	0.41	0.69	0.97	1.26	1.41
45	0.13	0.27	0.40	0.67	0.94	1.22	1.36
50	0.11	0.23	0.35	0.59	0.83	1.08	1.21
55	0.11	0.21	0.31	0.51	0.72	0.94	1.05
60	0.08	0.16	0.24	0.40	0.57	0.74	0.83
65	0.07	0.13	0.20	0.33	0.47	0.60	0.67
70	0.05	0.10	0.15	0.25	0.35	0.45	0.50
75	0.04	0.07	0.11	0.18	0.25	0.32	0.35
80	0.02	0.03	0.05	0.08	0.12	0.15	0.17

Conclusion

The paper estimates the potential gains resulting from partial and complete elimination of mortality due to neoplasm. Even though the complete elimination of a cause of death may not be biomedically feasible, the results point out the optimum gains that could be achieved. More realistic are the findings based on partial elimination which have implications for practical decision-making in setting health goals, allocation of resources and evaluation of health programmes.

References

Chiang C.L., 1968. *Introduction to Stochastic Process in Biostatistics,* New York, John Willey & Sons.

Chiang C.L., 1978. *WHO Life Table and Mortality Analysis,* WHO, Geneva; 96-7.

Hickman J.C., and Jf. E. Richard, 1969. On the use of Partial Life Expectancies in setting Health Goals, *American. Journal Public Health, 59* (12): 2243-50.

Ministry of Public Health, 1982. *Kuwait Health Plan 1982-2000, Vol. I,* Office for National Health Planning, Kuwait: 11-12.

_____, 1984, *Cancer Mortality among Kuwaiti Population, 1974-83,* Vital and Health Statistics Division, Kuwait

Parkin D.M. et al., 1984. Estimates of the worldwide frequency of twelve major cancers, *Bulletin of the WHO,* 62: 163-82.

Stjemsward J. et al., 1985. Cancer control: strategies and priorities. *World Health Forum,* 6:160-4.

WHO, 1980. *Sixth Report on the World Health Situation 1973-1977, Part I, Global Analysis.* Geneva.