

Mortality trends of elderly people in Taiwan from 1974 to 1994

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Abstract

Background: the hypothesis that disability and death will eventually be compressed to a period late in life needs empirical confirmation.

Objectives: we have examined the secular trends of life expectancy and common causes of death in the aged population of Taiwan.

Method: we compared the life expectancy, causes of death and probability of death for people at birth, at age 65 and at age 85 for both sexes from 1974 to 1994 using data from Taiwan government statistics.

Results: there has been a substantial gain in life expectancy, especially for men age 85 and over, in the past 20 years. Mortality due to stroke, ischaemic heart disease, hypertension and chronic pulmonary disease has declined. There has been a steep increase in cancer deaths and deaths associated with diabetes mellitus. Tuberculosis and injury-related deaths have declined but pneumonia deaths have increased. For elderly people, the probability of dying from cancer and ischaemic heart disease increased with time. However, the probability of dying from stroke decreased. Although there was a decrease in probability of deaths associated with falls, there was an increase of deaths due to 'frailty' (as judged by falls, pneumonia and septicemia).

Conclusions: cancer is a major cause of death in the elderly population of Taiwan. This rapidly expanding elderly population seemed to suffer from poorer health in the later period of their life.

Keywords: cancer, cause mortality, elderly, frailty, life expectancy, mortality trends, stroke

Introduction

Taiwan has become an ageing society in recent years. The proportion of people over 65 was 4.1% in 1979 and reached 7% in 1993. A conservative projection estimates that by the year 2010 older people will account for more than 10% of the total population [1]. The health of elderly people is a major concern. In the 1987 Taipei Study of Gerontology, 28% of the respondents reported that they were unhealthy. The older the respondents, the higher was the proportion with poor health [2]. Fries has suggested that with the elimination of premature death, the mortality curve will eventually be rectangularized. He predicted that disability and death will be compressed to a later period of life [3]. Schneider and Brody argue that an increase in the numbers of the oldest-old will be associated with increases in the period of diminished vigour and in the numbers of people with chronic diseases [4]. However, empirical data are needed to support these hypotheses.

Mortality trends in the elderly population have several important uses. They may provide information on projections of mortality patterns. A change in causes of death can help us identify important health issues in old age. Beneficial effects of past interventions can be evaluated by observing a decline in mortality. We can also understand how mortality reductions affect the health status of survivors to advanced age.

To understand mortality trends, especially the commonest causes of death in elderly people, and to verify Fries's theory from empirical experience, we examined changes in life expectancy, mortality rates from specific causes and proportions of deaths in Taiwanese people aged 65 and over from 1974 to 1994.

Methods

Data of cause-specific deaths were derived from Health and Vital Statistics compiled by the Department of Health annually from 1974 to 1994. In Taiwan,

physicians must report each death to the national death certification system immediately after the event. Causes of death were classified with the International Classification of Diseases (ICD) 8th edition (ICD-8) from 1974 to 1980, and with the ICD-9 from 1981 to 1994. Data for the calculation of decrement life table were obtained from the Taiwan-Fukien Demographic Fact Book and the Abridged Life Tables of Taiwan Area, The Republic of China, published by the Ministry of Interior from 1974 to 1994.

Life expectancies at birth, at age 65 and at age 85 from 1974 to 1994 were compared separately for men and women. This explains whether a prolonged life expectancy was achieved by a reduction in premature deaths or from a decline of mortality in old age.

Changes of cause mortality rates for cancer (ICD codes 149-208), stroke (430-8), ischaemic heart disease (IHD; 410-14), hypertensive disease (401-5), diabetes mellitus (250), chronic pulmonary diseases (490-93), accidents (E800-949), pneumonia (480-6) and tuberculosis (010-8) from 1974 to 1994 were analysed. Manton used pneumonia, septicaemia and hip fracture deaths to represent causes of death prevalent in debilitated elderly persons [5]. In our study, falls were used instead of hip fracture because the number of deaths attributed to hip fracture was too small. There is evidence which relates fall injuries to frailty in advanced age: this justifies the use of fall deaths as an indicator of frailty in our study [6, 7].

The probability of death (l_{xA}/l_x) due to a given condition was calculated from the multiple decrement life table method [8]. The proportion of expected deaths for cause *A* after age *x* is

$$l_{xA} = \sum_{t=x}^{\infty} (l_t)(q_{tA})$$

The probability of surviving to age *x* is $l_x = l_{x-1} (1 - q_{x-1})$.

l_{xA}/l_x estimates the proportion of deaths due to cause *A* for people who survived to age *x*. It also implied the probability that a person surviving to age *x*

will eventually die of cause *A* (${}_{\infty}q_{tA} = l_{xA}/l_x$). The l_{xA}/l_x for a person at birth, surviving to age 65 and 85 for cancer, stroke, IHD, pneumonia, septicaemia and falls were compared between 1974 and 1984, and between 1984 and 1994. If the l_{xA}/l_x of a certain disease at 65 is larger than the value before 65, this disease is more important in the elderly population than at younger ages.

Results

Change in life expectancy from 1974 to 1994

The life expectancy of those aged 0, 65 and 85 years was 66.92, 12.20 and 3.10 years respectively for men and 72.29, 14.63 and 4.16 years for women in 1974. The life expectancy of those aged 0, 65 and 85 was 71.81, 14.76 and 5.23 years for men and 77.76, 17.21 and 5.72 years for women in 1994. These figures showed substantial gains in the past 20 years, with a more rapid change between 1974 and 1984 than between 1984 and 1994. The relative gain was more obvious for those age 85 and older. There was a gradual decrease in sex differences and an increase in the male to female ratio at age 85 (Tables 1 and 2); although women still live longer than men, the differences have become smaller in recent years.

Table 2. Absolute and relative differences in life expectancy between sexes at different ages in 1974, 1984 and 1994

	Sex difference					
	At age 0		At age 65		At age 85	
	Years	M/F (%)	Years	M/F (%)	Years	M/F (%)
1974	5.37	92.6	2.43	83.4	1.06	74.5
1984	5.18	93.1	2.14	86.4	0.73	86.0
1994	5.95	92.3	2.45	85.8	0.49	91.4

Table 1. Absolute and relative change of life expectancy between 1974 and 1984 and between 1984 and 1994

	Change in life expectancy					
	At age 0		At age 65		At age 85	
	Years	%	Years	%	Years	%
Men						
1974-84	2.84	4.2	1.45	11.9	1.37	44.2
1984-94	2.05	2.9	1.11	8.1	0.76	17.0
Women						
1974-84	2.65	3.7	1.16	7.9	1.04	25.0
1984-94	2.82	3.8	1.42	9.0	0.52	10.0

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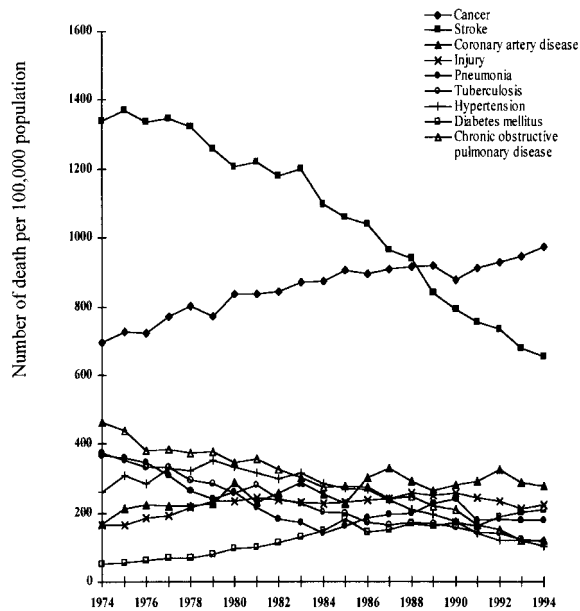


Figure 1. Changes in mortality of men aged 65 and older between 1974 and 1994.

Change in cause mortality rates from 1974 to 1994

Figure 1 shows a sharp decline in stroke mortality and a sustained increase in cancer mortality in aged men. These two curves crossed in 1988, when cancer became the major cause of death for men. IHD mortality gradually increased but in a fluctuating course. Fatal hypertensive disease and chronic pulmonary disease declined almost at the same pace. Deaths related to diabetes mellitus showed a fourfold increase from 1974 to 1994. Tuberculosis deaths rapidly declined from 1974 to 1984 and then flattened out. Pneumonia deaths increased from 1984

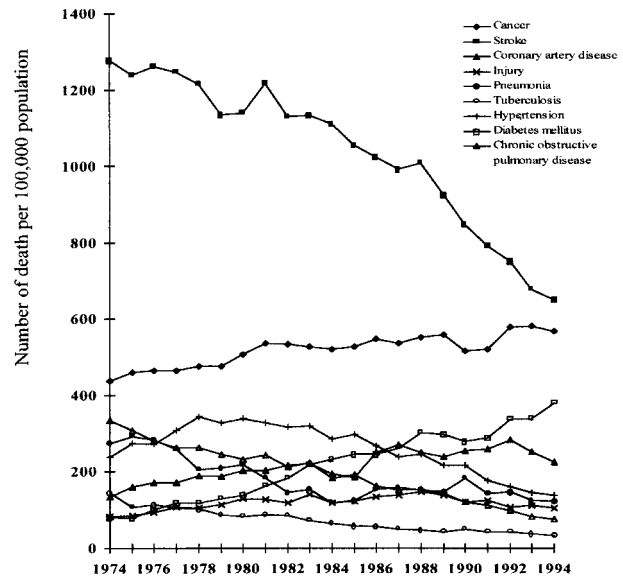


Figure 2. Changes in mortality of women aged 65 and older between 1974 and 1994.

until 1990 and then fell to the 1986 level. The rate of deaths caused by accidents gradually rose from 1974 to 1981, then levelled off at 2.2–2.6 per thousand per year.

The change of mortality rates in the above conditions in women is shown in Figure 2. The decline in stroke mortality and rise in cancer mortality were similar to men except that these two curves have not yet crossed. Stroke was still the main cause of death in aged women before 1994. The change in mortality for the other diseases and injuries were similar to that of men except that the values of the rates and the amplitude of change were smaller and the increase of mortality associated with diabetes mellitus was steeper for women.

Table 3. Proportion of deaths ($100 \times I_{xA}/I_x$) for cancer, stroke, ischaemic heart disease (IHD), pneumonia, septicaemia and falls in 1974, 1984 and 1994

	At birth			At age 65			At age 85		
	1974	1984	1994	1974	1984	1994	1974	1984	1994
Men									
Cancer	11.81	15.49	19.85	9.82	13.50	18.00	3.94	7.01	9.79
Stroke	17.71	16.85	12.50	19.89	18.66	13.63	13.84	12.84	11.12
IHD	2.28	3.96	5.24	2.49	4.54	5.69	1.40	4.50	4.61
Pneumonia	5.74	2.69	3.71	5.97	3.01	4.53	7.44	4.35	6.39
Septicaemia	0.44	0.47	1.42	0.25	0.39	1.56	0.18	0.15	1.40
Fall	0.45	0.85	0.93	0.32	0.62	0.55	0.53	0.87	0.40
Women									
Cancer	9.63	11.72	14.17	7.04	9.07	11.51	2.71	4.28	5.88
Stroke	20.46	20.33	14.65	21.79	21.37	15.41	12.75	15.17	12.52
IHD	2.14	3.59	5.15	2.30	3.94	5.50	1.77	3.78	5.20
Pneumonia	5.36	2.63	3.12	5.17	2.74	3.45	6.51	3.75	4.37
Septicaemia	0.37	0.54	1.73	0.24	0.48	1.78	0.17	0.33	1.89
Fall	0.31	0.66	0.53	0.29	0.63	0.44	0.47	0.86	0.49

Table 4. Absolute and relative change of proportion of deaths for cancer, stroke, ischaemic heart disease (IHD), pneumonia, septicaemia, and falls between 1974 and 1984, 1984 and 1994 in elderly people in Taiwan

Sex/ cause of death	At birth				At age 65				At age 85			
	1974-84		1984-94		1974-84		1984-94		1974-1984		1984-1994	
	Years	%	Years	%	Years	%	Years	%	Years	%	Years	%
Men												
Cancer	3.68	31.16	4.36	28.15	3.68	37.47	4.50	33.33	3.07	77.92	2.78	39.66
Stroke	1.68	73.68	1.28	32.32	2.05	82.33	1.15	25.33	3.10	221.43	0.11	2.44
IHD	-0.86	-4.86	-4.35	-25.82	-1.23	-6.18	-5.03	-26.96	-1.00	-7.23	-1.72	-13.40
Pneumonia	-3.05	-53.14	1.02	37.92	-2.96	-49.58	1.52	50.50	-3.09	-41.53	2.04	46.90
Septicaemia	0.03	6.82	0.95	202.13	0.14	56.00	1.17	300.00	-0.03	-16.67	1.25	833.33
Falls	0.40	88.89	0.08	9.41	0.30	93.75	-0.07	-11.29	0.34	64.15	-0.47	-54.02
Women												
Cancer	2.09	21.70	2.45	20.90	2.03	28.84	2.44	26.90	1.57	57.93	1.60	37.38
Stroke	1.45	67.76	1.56	43.45	1.64	71.30	1.56	39.59	2.01	113.56	1.42	37.57
IHD	-0.13	-0.64	-5.68	-27.94	-0.42	-1.93	-5.96	-27.89	2.42	18.98	-2.65	-17.47
Pneumonia	-2.73	-50.93	0.49	18.63	-2.43	-47.00	0.71	25.91	-2.76	-42.40	0.62	16.53
Septicaemia	0.17	45.95	1.19	220.37	0.24	100.00	1.30	270.83	0.16	94.12	1.56	472.73
Falls	0.35	112.90	-0.13	-19.70	0.34	117.24	-0.19	-30.16	0.39	82.98	-0.37	-43.02

Change in proportion of deaths (I_{xA}/I_x) from 1974 to 1994

A person at 65 had a higher probability of dying from stroke and IHD than a person at 85. The probability of dying with pneumonia increased with advanced age, whereas that of septicaemia declined with age. The probability of deaths related to falls did not change very much with age (Table 3). The changes in proportion of deaths are shown in Table 4. The probability of dying from cancer increases with time. IHD shows a similar pattern, but the increase is more rapid at age 85 only from 1974 to 1984. The probabilities of stroke death declined continuously from 1974 to 1994, the change being more rapid at age 65 in the 1984 to 1994 period in both sexes. The probability of dying with pneumonia decreased from 1974 to 1984, but increased from 1984 to 1994. For septicaemia, there was a huge increase in mortality from 1984 to 1994 in both sexes. At age 85, men have twice the rate of death from septicaemia as women. From 1974 to 1984, there was an increase in fall-related deaths in all ages for both sexes. From 1984 to 1994, fall-related deaths mostly declined, especially at age 85.

Discussion

An increase in the proportion of aged people in a population has three main causes: a decreased birth rate, a decline in premature deaths and a decrease in mortality in the aged. After implementation of the birth control programme in 1964, the crude birth rate in Taiwan declined from 50 per thousand in 1951 to 16 per thousand in 1986 [9]. The crude death rate declined from 18 per thousand in 1947 to 5 per thousand in 1965. After 1965, the crude death rate

levelled off and even increased slightly to 5.6 in 1995 [9]. This infers that the decline in birth and death rates contributed to the increase in the aged population before the mid-1980s. Afterwards, the increase in life expectancy was mainly caused by prolongation of life in aged people. Another important finding is the diminishing of sex differences in life expectancy, especially in people age 85 and older. In this they differ from elderly Americans, in whom the sex difference in life expectancy has progressively widened since 1950 [10].

The mortality rate of elderly people continued to decline from 1974 to 1994. Mortality from strokes in elderly people has halved in the past 20 years. Hypertensive disease mortality has also declined, but to a lesser degree. There have been nationwide hypertension, stroke prevention and anti-smoking programmes since the late 1980s, but the decline in cerebrovascular mortality cannot be solely due to these programmes. Improvements in lifestyles and increased accessibility to health care may play a role in the reduction of stroke mortality. Cancer mortality continues to increase. The decline in IHD mortality is probably due to the effects of the above programmes as well as diet education. However, a longer period of observation is needed to see whether this is a real trend or just a year-to-year fluctuation. Diabetes mellitus has emerged as another important chronic disease especially in elderly women. Since many diabetic patients die of other diseases (such as end-stage renal disease or infection), the impact of diabetes mellitus is often underestimated. Injury-related mortality in elderly men and women had a twofold increase between 1974 and 1994, similar to the 1.6 increase between 1974 and 1990 [11].

Taiwan's decline in stroke mortality is similar to that of most western industrialized countries though we

had a time-lag of 10 years; the decline of IHD mortality is less marked, and cancer mortality increased more quickly [12, 13].

We found an increase in the probability of pneumonia deaths in aged people. Since the increase in pneumonia and septicaemic deaths outweighed the decline in fall-related deaths, there was a net increase in mortality from these three conditions. This evidence does not support Fries' hypothesis and suggests that the average health status declines in advanced age.

There are several limitations and possible biases in this study. First, an autopsy diagnosis is the most important confirmation of the reliability of death certificates. Unfortunately, the autopsy rate in Taiwan is extremely low. Secondly, physicians frequently list 'cardiac' and 'respiratory' as causes of deaths on death certificates in Taiwan [14]. This overestimates common causes of death and underestimates underlying or occult causes [15]. Thirdly, only a single cause of death is coded and analysed in the mortality statistics in Taiwan. This obscures deaths due to multiple causes, especially in those with chronic diseases [16]. Fourthly, our study period covered the 8th and 9th editions of the ICD. Changes in coding may cause a sudden jump between two consecutive years before and after a new edition, although long-term trends can be interpreted without major distortion.

Mortality statistics are easily available sources of data. The results of this study are useful for public health planning, though careful interpretation is necessary.

Key points

- The progressive increase in life expectancy in Taiwan for the past decade is mainly due to prolongation of life in aged people.
 - There is a trend of a decrease in sex differences in life expectancy, especially in people aged 85 and older.
 - Cancer is a major cause of death in aged people in Taiwan and the commonest cause of death in old men.
 - Diabetes mellitus is now an important cause of chronic disease-related death, especially in elderly women.
 - There was an increase in deaths due to 'frailty', which implies that the expanding elderly population in Taiwan seemed to suffer from poorer health in the later stages of life.
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John Crabtree, aged 91, in his back garden, Oldham. © Ian Beesley.