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**MORTALITY CHANGES AND LIFE  
EXPECTANCY BY CAUSE OF DEATH IN  
SINGAPORE, 1980-1990**

Tan Khye Chong and John Pollard

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[jpollard@efs.mq.edu.au](mailto:jpollard@efs.mq.edu.au)  
School of Economic and Financial Studies  
Macquarie University  
Sydney NSW 2109 Australia

**Mortality changes and life expectancy by  
cause of death in Singapore, 1980 - 1990**

**TAN Khye Chong**

Division of Actuarial Science and Insurance  
Nanyang Business School  
Nanyang Technological University  
Singapore 2263

**John Pollard**

Division of Actuarial Science and Insurance  
Nanyang Business School  
Nanyang Technological University  
Singapore 2263  
and  
School of Economic and Financial Studies  
Macquarie University  
Sydney, N.S.W. 2109  
Australia

1. Introduction

Over the decade from 1980, the population in Singapore has experienced substantial improvements in life expectancy at birth. For females the increase has been from 74.22 years in 1980 to 77.27 years in 1990 (Table 1). The corresponding figures for males are 69.02 in 1980 and 72.21 in 1990.

In this paper we investigate the changes which have occurred to Singaporean life expectancy by sex and cause of death from 1980 to 1990. Projected life tables for Singaporean males and females in the year 2000 are obtained by extrapolating the mortality trends observed for the various cause-specific rates.

## 2. Data and Lifetime

Analysing mortality differentials to account for sex and cause of death is indeed a demanding and cumbersome manual task. Recently with the World Health Organisation (WHO) personal computer package LIFETIME, useful results can be produced very quickly. LIFETIME provides a wide variety of methods for mortality analysis.

The data used in this study were kindly provided by WHO, although the original source was of course the Department of Statistics, Singapore. As five-year age groupings were used in the data provided, the life table functions produced by LIFETIME may differ slightly from those calculated using single-year age groups. The differences are of no consequence. In fact, LIFETIME has a slight graduation effect.

The cause of death codings used in the investigations have been the B codings under the Ninth Revision of the International Classification of Diseases. LIFETIME allows analysis up to 40 cause groups at a time. We decided to use 16 cause groups in our present study. These cause groups are mutually exclusive and exhaustive and are listed in the Appendix.

### 3. Crude mortality rates

Table 2 provides the crude mortality rates per 100,000 for Singaporean males and females in 1980 and 1990 for the 16 selected causes of death.

Significant changes have taken place over the decade. Whilst ischaemic heart disease (IHD) remains the dominant killer for the males, it has now become the dominant killer for the females. Its relative importance has increased rapidly especially for the females. Deterioration in the crude mortality rate for both sexes is also evident for the following causes: "Smoking neoplasms", "All other neoplasms", "Cerebrovascular disease", "Non-motor accidents" and "Suicide".

"Respiratory disease" remains a major killer for both genders though its relative importance is diminishing. Motor vehicle and other violence mortality have also declined.

A direct comparison of the male and female crude mortality rates from all causes over the period can be misleading as the effect of the age structure changes can be significant. Using the method of Kitagawa (1955), the figures in Table 3 shows that female mortality from all causes fell by 1.182/4.505 (around 26 per cent) rather than a rise of 0.103/4.505 (around 2 per cent). The corresponding figures for male mortality are a proportionate fall of 1.553/5.807 (around 27 per cent) rather than 0.176/5.807 (around 3 per cent).

The slightly larger proportionate fall in overall male mortality suggests that the gap between male and female life expectancy is narrowing.

#### 4. Standardised mortality rates

Another approach to avoid the problems inherent in analysing crude mortality rates caused by changing age structures is to calculate standardised mortality rates (SMR) with a common population as standard. Standardised mortality rates for the same 16 cause groups are shown in Table 4. The standard population used was the Singaporean population 1990 (males and females combined).

Mortality from non-motor accidents and suicide increased for both genders. Breast cancer and IHD mortality for females worsened over the decade whereas males enjoyed a reduction in mortality from IHD. Substantial reductions in mortality from respiratory diseases and to a lesser extent from smoking cancers have occurred for both genders. IHD is still a major killer in 1990.

## 5. Changes in life expectancy at birth

We saw in Table 1 that life expectancy at birth for males increased by 3.20 years over the decade 1980 to 1990, compared with 3.05 years for females. Consequently the sex differential in life expectancy at birth has narrowed from 5.21 to 5.05 years, a result which we anticipated in our earlier analysis of the Kitagawa-adjusted CMR.

Details of the contributions of the selected causes within selected age groups to these improvements in life expectancy are readily obtained using the decomposition method of Pollard (1982, 1988). The LIFETIME package allows such calculations to be performed, and Tables 5 and 6 show the results for males and females respectively.

In the case of males (table 5), improvement in respiratory diseases contributed almost 20 percent of the increase in life expectancy at birth (0.63 years out of 3.20), this contribution coming almost entirely from the mortality improvement in the age group 50 years and above. The same gain of 0.63 years is shown by the females (table 6).

Improved IHD mortality had the effect of increasing male life expectancy by 0.39 years. However for females, increased IHD mortality reduced life expectancy by 0.03 years, mainly due to deaths from age 50 onwards.

Decreased mortality from cerebrovascular disease added 0.26 years and 0.46 years of life for males and females respectively. Females also show a larger gain in life expectancy at birth than males from improvements in circulatory disease mortality (0.42 years compared to 0.22). However this pattern is reversed for infectious diseases mortality, male life expectancy having increased by 0.26 years and female expectancy by 0.16 years.

Both genders show an improvement in life expectancy from reduced smoking cancer mortality. This is also the case with mortality from all other cancers. The combined contribution from these two causes is 0.36 and 0.25 years for males and females respectively.

Over the decade, females have not enjoyed improvement in breast cancer mortality. The effect is a reduction in life expectancy by 0.02 years, chiefly in the age range 15 - 49.

The net contribution from non-motor and motor accidents mortality is almost nil for both genders. The two separate contributions are also quite small.

## 6. Sex differentials in life expectancy at birth

The method used to study the change in life expectancy at birth of a population can also be used to analyse sex differentials in life expectancy at birth (tables 7 and 8). From Table 7, we can see that in 1980 the major causes producing the sex differential

in life expectancy at birth were, in descending order of magnitude: IHD contributing 1.44 years, respiratory diseases (0.97 years), smoking cancers (0.79 years), all other cancers excluding breast cancer (0.61 years), and motor vehicle accidents (0.29 years).

These five major causes retain their rankings ten years later, as can be seen from Table 8. Although the contribution from IHD mortality fell to 1.23 years, it is of some concern to note that the contribution from smoking cancers increased to 0.91 years, indicating that male deaths from this cause is getting heavier than the females. Further, more than 50 percent of this differential of 0.91 years comes from the age range 50-69. The contributions from the other three major cause groups are essentially the same as in 1980.

Breast cancer reduced the sex differential in life expectancy at birth by a quarter of a year in 1980 and a third in 1990.

## 7. Singapore life tables 2000

We extrapolated to estimate the Singaporean life table in 2000 by assuming that the trends in cause of death observed over the decade to 1990 were to continue for another ten years. Pollard (1987) has demonstrated that such an approach to mortality projection is as successful as any and better than most other methods.



The ratio of the 1990 SMR to the 1980 SMR was calculated for each of the 16 causes of death. Then the 1990 mortality rates by age and cause were adjusted with these ratios to project the 2000 mortality rates by age and cause. Life tables under the adjusted mortality scenerio are readily computed using LIFETIME. The projected abridged life tables for 2000 are shown in Table 9.

The projected life expectancies at birth in 2000 are 74.72 and 79.48 years for males and females respectively resulting in a gap of 4.76 years.

Table 10 provides the probabilities of ultimately dying from a particular cause for the 1980, 1990 and projected 2000 tables. We observe that for the year 2000, IHD accounts for almost 25 per cent of female deaths. The corresponding figure for males is slightly lower at 22 per cent. Further, IHD together with respiratory diseases account for more than 42 per cent of deaths for both genders. Fewer females are expected to die from smoking cancers, motor and non-motor accidents compared with the males but rather more from cerebrovascular disease. For both genders, there is an increase in the probability of death from suicide.

## 8 Conclusion

The cause of death which alone made the largest contribution to the increase in the life expectancy was respiratory disease, with 20 per cent of the improvement in male life expectancy and 21 per

cent for the female improvement. In contrast, the other major killer, ischaemic heart disease, made a negative contribution of 1 per cent in the gain in female life expectancy and contributed 12 per cent improvement in the case of males.

The projected Singaporean life table in 2000 was obtained by assuming that trends in the various causes of death observed over the period 1980-1990 will continue for another ten years. The calculations show that the expectations of life at birth in 2000 to be 74.72 and 79.48 years for males and females respectively.

#### **Acknowledgements**

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Appendix

Group number	General description	ICD ninth revision - B coding
1	Infections	1-7
2	Neoplasms - "smoking"	8,10
3	Neoplasms - breast	11.3
4	Neoplasms - all other	9,11-17 excl. 11.3
5	Ischaemic heart disease	27
6	Cerebrovascular	29
7	Circulatory	25,26,28,30
8	Respiratory	31,32
9	Cirrhosis	34.7
10	Childbirth and related	38-41
11	Congenital/perinatal	44,45
12	Non-motor accidents	47-53 excl. 47.1
13	Motor accidents	47.1
14	Suicide	54
15	Other violence	55,56
16	All other causes	18-24, 33-37 excl. 34.7, 42-43, 46

Table 1

Expectation of life at birth. Singaporean males and females, 1980 and 1990.

	1980 (1)	1990 (2)	Improvement (2) - (1)
Males	69.02	72.21	3.19
Females	74.22	77.27	3.05
Differential (female - male)	5.20	5.06	

Table 2

Crude mortality rates per 100,000 by cause. Singaporean males and females, 1980 and 1990.

Cause group	Males 1980	Males 1990	Females 1980	Females 1990
1 Infections	22.2	15.0	12.8	10.5
2 "Smoking" neopl.	50.1	55.6	19.4	20.9
3 Breast cancer	0.0	0.0	10.7	14.2
4 All other neopl.	77.2	84.0	58.8	69.4
5 Isch. heart dis.	103.2	112.5	59.0	82.4
6 Cerebrovascular	55.4	57.8	64.4	65.3
7 Circulatory	34.9	31.4	38.4	30.6
8 Respiratory	92.1	87.2	70.0	68.5
9 Cirrhosis	7.1	7.1	3.0	2.2
10 Obstetrics	0.0	0.0	0.2	0.1
11 Congen./perinatal	16.5	12.8	17.6	10.3
12 Non-motor accid.	8.5	11.7	1.4	3.0
13 Motor accidents	16.3	14.4	4.1	3.6
14 Suicide	12.4	14.7	10.0	11.4
15 Other violence	15.9	10.9	4.9	4.4
16 All other causes	69.1	48.1	76.0	63.9
All causes	580.9	563.2	450.7	460.7

Table 3

Singaporean males and females. Changes in the crude mortality rates per 1,000 over the decade 1980 to 1990. .

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Males:

CMR in 1980	5.807
Effect of changed mortality	-1.553
Effect of changed age structure	+1.377
CMR in 1990	5.631

Females:

CMR in 1980	4.505
Effect of changed mortality	-1.182
Effect of changed age structure	+1.285
CMR in 1990	4.608

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Table 4

Standardised<sup>a</sup> mortality rates per 100,000 by cause. Singaporean males and females, 1980 and 1990.

Cause group	Males 1980	Males 1990	Females 1980	Females 1990
1 Infections	31.6	17.0	14.4	9.0
2 "Smoking" neopl.	68.1	60.9	23.1	19.1
3 Breast cancer	0.0	0.0	12.9	13.6
4 All other neopl.	105.2	92.2	69.6	64.0
5 Isch. heart dis.	144.9	125.7	69.8	71.5
6 Cerebrovascular	82.1	66.2	76.4	56.0
7 Circulatory	48.7	35.2	44.7	26.5
8 Respiratory	147.3	105.2	81.1	55.2
9 Cirrhosis	9.1	7.6	3.3	2.1
10 Obstetrics	0.0	0.0	0.2	0.1
11 Congen./perinatal	17.5	12.6	19.1	10.5
12 Non-motor accid.	9.1	12.0	1.1	2.8
13 Motor accidents	17.1	14.8	4.7	3.4
14 Suicide	14.7	15.2	10.5	11.0
15 Other violence	17.9	11.5	5.3	4.2
16 All other causes	103.0	54.7	87.0	55.9
All causes	816.3	630.8	523.2	404.9

a

The Singaporean population 1990 (males and females combined) was used as standard.



Table 5

Contributions of the various causes of death by age to the change in Singapore male life expectancies at birth between 1980 and 1990. (The entries are hundredths of a year of life.)

Cause group	Age group							All Ages
	0	1-4	5-14	15-29	30-49	50-69	70+	
1 Infections	2	2	0	-0	5	10	7	26
2 "Smoking" neopl.	0	0	-0	1	2	10	1	14
3 Breast cancer	0	0	0	0	0	0	0	0
4 All other neopl.	-0	-1	-2	0	7	14	3	22
5 Isch. heart dis.	0	0	0	1	13	27	-1	39
6 Cerebrovascular	1	0	-0	1	1	17	5	26
7 Circulatory	0	0	0	1	2	12	7	22
8 Respiratory	7	2	0	-2	-1	28	28	63
9 Cirrhosis	0	0	-0	-0	1	2	-0	3
10 Obstetrics	0	0	0	0	0	0	0	0
11 Congen./perinatal	18	-1	0	1	0	0	-0	19
12 Non-motor accid.	1	1	1	0	-5	-1	-1	-4
13 Motor accidents	0	1	-1	1	1	2	1	5
14 Suicide	0	0	0	-2	-2	0	1	-2
15 Other violence	0	1	0	5	2	4	1	14
16 All other causes	4	5	0	6	11	20	28	75
All causes	33	9	0	-14	38	146	80	320

Table 6

Contributions of the various causes of death by age to the change in Singapore female life expectancies at birth between 1980 and 1990. (The entries are hundredths of a year of life.)

Cause group	Age group							All Ages
	0	1-4	5-14	15-29	30-49	50-69	70+	
1 Infections	4	2	1	0	3	2	4	16
2 "Smoking" neopl.	0	0	0	2	4	6	-1	11
3 Breast cancer	0	0	0	-1	-2	-0	1	-2
4 All other neopl.	0	-0	-1	-0	-3	16	2	14
5 Isch. heart dis.	0	0	0	-0	5	-3	-4	-3
6 Cerebrovascular	1	0	0	1	3	18	23	46
7 Circulatory	1	0	0	1	1	20	20	42
8 Respiratory	7	3	2	2	-1	20	29	63
9 Cirrhosis	-0	0	0	0	1	1	1	3
10 Obstetrics	0	0	0	0	0	0	0	0
11 Cogen./perinatal	29	3	1	1	1	1	0	36
12 Non-motor accid.	-1	1	0	-1	-1	-0	-1	-3
13 Motor accidents	0	1	2	-1	0	-1	2	3
14 Suicide	0	0	-0	1	-2	1	0	-0
15 Other violence	0	-0	1	0	1	2	-0	3
16 All other causes	1	3	3	5	9	16	38	74
All causes	41	12	10	10	19	99	114	305

Table 7

Contributions of mortality differentials by age and cause to the sex differential in life expectancy at birth in Singapore in 1980. (The entries are hundredths of a year of life.)

Cause group	Age group							All Ages
	0	1-4	5-14	15-29	30-49	50-69	70+	
1 Infections	-0	1	-1	0	4	14	11	29
2 "Smoking" neopl.	0	0	-0	-0	7	49	23	79
3 Breast cancer	0	0	0	-0	-7	-14	-3	-25
4 All other neopl.	-0	1	-0	4	7	30	20	61
5 Isch. heart dis.	0	0	0	1	27	91	24	144
6 Cerebrovascular	-0	0	0	1	3	16	-6	13
7 Circulatory	-1	1	1	3	6	5	-4	11
8 Respiratory	3	-1	-3	0	7	37	53	97
9 Cirrhosis	0	0	0	0	4	7	1	12
10 Obstetrics	0	0	0	-0	-0	0	0	-0
11 Congen./perinatal	-2	-3	-0	0	-1	-1	-0	-6
12 Non-motor accid.	1	1	3	6	3	4	1	19
13 Motor accidents	0	0	-0	14	8	6	1	29
14 Suicide	0	0	0	1	3	2	2	8
15 Other violence	-0	1	0	10	8	4	4	27
16 All other causes	1	2	-2	3	3	9	7	24
All causes	2	3	-3	44	82	262	131	521

Table 8

Contributions of mortality differentials by age and cause to the sex differential in life expectancy at birth in Singapore in 1990. (The entries are hundredths of a year of life.)

Cause group	Age group							All Ages
	0	1-4	5-14	15-29	30-49	50-69	70+	
1 Infections	1	0	0	1	2	6	7	18
2 "Smoking" neopl.	0	0	0	1	10	51	29	91
3 Breast cancer	0	0	0	-1	-10	-17	-4	-32
4 All other neopl.	0	2	1	3	-3	34	25	62
5 Isch. heart dis.	0	0	0	0	20	71	31	123
6 Cerebrovascular	0	0	0	0	5	15	5	25
7 Circulatory	-0	1	1	3	5	10	2	21
8 Respiratory	2	1	-1	4	8	27	57	98
9 Cirrhosis	-0	0	0	0	4	7	2	13
10 Obstetrics	0	0	0	0	-0	0	0	-0
11 Congen./perinatal	8	2	1	-0	-0	-0	0	9
12 Non-motor accid.	-1	1	2	6	8	6	1	24
13 Motor accidents	0	-0	2	14	7	4	2	28
14 Suicide	0	0	0	3	3	4	1	11
15 Other violence	-1	-0	1	6	7	2	2	17
16 All other causes	-2	-0	0	1	0	0	-1	-2
All causes	7	6	6	41	66	219	160	505

Table 9

Projected abridge life tables. Singapore males and females, 2000.

Age x	<u>Males</u>			<u>Females</u>		
	l(x)	q(x)	e(x)	l(x)	q(x)	e(x)
0	100000	0.00516	74.72	100000	0.00401	79.48
1	99484	0.00046	74.10	99599	0.00024	78.80
2	99439	0.00039	73.14	99576	0.00021	77.81
3	99400	0.00034	72.16	99555	0.00019	76.83
4	99366	0.00029	71.19	99536	0.00017	75.84
5	99338	0.00025	70.21	99519	0.00015	74.86
10	99231	0.00023	65.28	99449	0.00015	69.91
15	99092	0.00040	60.37	99365	0.00019	64.97
20	98824	0.00083	55.52	99259	0.00034	60.03
25	98370	0.00097	50.77	99055	0.00048	55.15
30	97888	0.00100	46.01	98798	0.00059	50.29
35	97375	0.00119	41.24	98472	0.00082	45.45
40	96715	0.00174	36.50	98004	0.00115	40.65
45	95674	0.00302	31.87	97344	0.00177	35.91
50	93864	0.00504	27.43	96266	0.00309	31.28
55	91002	0.00839	23.21	94401	0.00528	26.84
60	86299	0.01435	19.33	91412	0.00819	22.63
65	79025	0.02214	15.86	86992	0.01322	18.65
70	69278	0.03268	12.73	80111	0.02145	15.02
75	57172	0.04451	9.88	70376	0.03216	11.74
80	43861	0.06814	7.10	57781	0.05200	8.73
85	27838	0.12312	4.71	41198	0.08916	6.20

Table 10

Probability of ultimately dying from a particular cause. Singaporean males and females, 1980, 1990 and projected 2000.

Cause group	Males			Females		
	1980	1990	2000	1980	1990	2000
1 Infections	.040	.028	.020	.026	.025	.020
2 "Smoking" neopl.	.082	.093	.099	.035	.040	.038
3 Breast cancer	.000	.000	.000	.018	.020	.023
4 All other neopl.	.126	.140	.148	.109	.123	.132
5 Isch. heart dis.	.181	.206	.223	.143	.192	.246
6 Cerebrovascular	.108	.115	.118	.161	.157	.146
7 Circulatory	.060	.055	.051	.092	.070	.053
8 Respiratory	.200	.204	.205	.193	.194	.181
9 Cirrhosis	.010	.010	.010	.006	.004	.003
a				4	4	4
10 Obstetrics	.000	.000	.000	.0 9	.0 5	.0 2
11 Congen./perinatal	.010	.007	.005	.011	.006	.003
12 Non-motor accid.	.007	.011	.016	.002	.005	.014
13 Motor accidents	.014	.013	.012	.007	.005	.004
14 Suicide	.014	.015	.018	.012	.013	.016
15 Other violence	.017	.012	.011	.006	.006	.006
16 All other causes	.131	.091	.064	.179	.141	.115
All causes	1.000	1.000	1.000	1.000	1.000	1.000

a

The female entries are respectively .00009, .00005 and .00002

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