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The Social Cost of Smoking in Singapore

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ABSTRACT

This study provides estimates for the cost of smoking in Singapore in 1997. A first attempt for Singapore, the paper reports on two different methods used, namely, the human capital approach and the demographic approach. These two measures are similar in that they compare the economic cost of smoking in the actual situation with the hypothetical alternative where there had been no smoking. The direct cost of smoking includes the amount spent on hospital care for five main diseases related to smoking whilst the indirect cost includes the value of lost income. The mortality cost of smoking is derived from the aetiological fractions of these diseases. The results from the human capital approach show that the social cost of smoking in 1997 ranged from S$673 million to S$839 million. Assuming there has been no smoking since 1990, calculations from the demographic approach indicate that national output would have increased by S$614 million in 1998. Nonetheless, the results from both approaches show that most of the cost of smoking is incurred by males.

Keywords: smoking, social cost, mortality, demography, human capital

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INTRODUCTION

In April 1999, the Sub-committee on Information and Evaluation was formed as part of the main civic Committee on Smoking Control to support its role in advising the Ministry of Health on smoking control policies and measures. The immediate task of the Sub-committee was to look into the social cost of smoking in Singapore. This paper reports on two different methods used by the Sub-committee to measure the social cost of smoking in Singapore, namely, the human capital approach and the demographic approach. These two measures are similar in that they compare the production and abuse cost of smoking in the actual situation with those in a hypothetical alternative situation that would have existed had there been no past or present smoking. The difference relates to the way in which the production costs of premature mortality are treated.

THE HUMAN CAPITAL APPROACH

Although smoking prevalence has been reduced in recent years[10], smoking still exerts a high cost in Singapore. Using data provided by the Ministry of Health, the cost of smoking in Singapore in 1997, the year in which data were readily available, was estimated. Drawing on the current knowledge of the effects of smoking, this method provides estimates on the monetary value of direct and indirect costs of smoking. Examples of similar studies done in other countries using this approach can be found in Rice and Hodgson[8], and Rice and Max[9].

METHODOLOGY

Smoking exerts heavy costs on society, not only through higher medical costs but also the losses in production due to illnesses. The social cost of smoking in Singapore consists of three components: direct, morbidity and mortality costs. The direct cost component consists of the payments for hospitalisation and health care due to smoking, the morbidity costs refers to the lost production due to illnesses associated with smoking and the mortality cost is the lost production from people who died early due to smoking-related causes of death.

The prevalence-based approach is used to estimate the cost of smoking. This method estimates the direct and indirect cost of smoking incurred in 1997 as a result of illnesses and deaths. The calculation of present day monetary values requires the suitable choice of a discount rate[7]. The rate used here must be a long term rate because of the long time period involved for smoking-related problems. As there are no long term discount rates in Singapore, this study used the coupon rate (i.e. the annual value of a bond's interest payments expressed as a percentage of the bond's par value) of 10-year Singapore government

securities which was 4.375 percent as of March 1999. Further calculations show that a small percentage change in the coupon rate (e.g. to 4.5 percent) does not result in any material change in the estimated loss figures.

It is also essential to take into account the future loss of income. Noting that wages have been rising consistently in the past decades[6], a five percent per annum growth rate for wages is used in the calculation. This is in line with the long term government growth rates forecast of four percent to six percent.

The direct costs of smoking include the amount spent on hospital care, physician and nursing home care for current and former smokers. Data on physician visits and nursing home care are not available. Admittedly, this is a serious omission and together with other costs (e.g. palliative, prophylactic and rehabilitative) for which data are also not available, implies that the results obtained in this analysis most likely under-estimate the social cost of smoking. Information on hospital stay for five main diseases associated with smoking is provided by the Ministry of Health. They are: malignant neoplasm of oesophagus (ICD9: 150), larynx (ICD9: 161), trachea, bronchus and lung (ICD9: 162), ischaemic heart disease (ICD9: 410-414) and cerebrovascular disease (ICD9: 430-438). The cost of treatment was not available but as a proxy, the average inpatient bill size for "Class A" patients in public sector hospitals was used. This is because the average public sector hospital's bill is reflective of the basic cost of medical provision.

The value of lost income due to smoking-related diseases is the morbidity cost. Using data supplied by the Ministry of Health[4], the work loss days are calculated from the length of stay in hospitals of the patients. As the age groups of the patients were given but not their occupations, the number of days of hospitalisation of a patient was multiplied by the average income of a worker for his age group to find the lost compensation due to hospitalisation, assuming the patient is an employee. The calculation takes into account the labour force participation rates of the various age groups so as to gauge the value of lost production as a result of hospitalisation. The age when people are admitted to hospitals for diseases caused by smoking has been set at 30 as younger patients may be admitted because of other factors. This forms the lower bound estimate for the morbidity cost of smoking. The upper bound estimate does not make this distinction.

To estimate the mortality cost of smoking, the number of deaths attributable to smoking-related diseases must be accounted for. This list of diseases used by the Ministry of Health, Singapore, to estimate the number of persons who died from smoking in 1997 is shown in Table I together with the aetiological fraction for both males and females. These fractions, based on United States, United Kingdom and Australian estimates, are compiled and supplied by the Ministry of Health in 1999[5].

The number of attributable deaths at each age group is multiplied by the lost income per capita till the age of 79. The age 79 was taken as the last cut off age because the labour force participation rates were classified into quinquennial age groups with the last category being 75 and above[6]. The estimated loss to society is appropriately discounted, taking into account the age and gender of the deceased. The labour force participation rate at each age group is also

Table I. Diseases and aetiological fractions.

Cause of death	Aetiological Fractions Men	Women
1. Malignant Neoplasm		
Mouth (ICD9: 140-145)	0.73	0.50
Pharynx (ICD9: 146-149)	0.72	0.50
Oesophagus (ICD9: 150)	0.72	0.50
Stomach (ICD9: 151)	0.16	0.08
Pancreas (ICD9: 157)	0.46	0.16
Larynx (ICD9: 161)	0.80	0.50
Trachea, Bronchus and Lung (ICD9: 162)	0.85	0.53
Uterine Cervix (ICD9: 180)	–	0.24
Bladder (ICD9: 188)	0.52	0.41
Kidney (ICD9: 189)	0.24	0.12
2. Ischaemic Heart Disease (ICD9: 410-414)	0.31	0.22
3. Diseases of the pulmonary (ICD9: 415.1, 415.0, 416)	0.77	0.55
4. Heart failure and ill-defined descriptions and complications of heart (ICD9: 428, 429)	0.31	0.22
5. Cerebral ischaemic, infarction and haemorrhage (ICD9: 431-438)	0.14	0.21
6. Peripheral vascular disease (ICD9: 440-443, 445-459)	0.70	0.62
7. Chronic bronchitis and emphysema (ICD9: 490-492, 495-496)	0.77	0.55
8. Accidents caused by fires and flames (E890-E899)	0.17	0.17
Total causes of death	0.23	0.12

Source: Ministry of Health, Singapore 1999.

Table II. Cost of smoking in Singapore.

Estimates	Low (S$)	High (S$)
Direct cost for males	46,838,220	47,307,260
Direct cost for females	27,009,840	27,227,200
Morbidity cost for males	3,011,595	3,045,287
Morbidity cost for females	305,267	305,461
Mortality cost for males	539,739,592	689,931,119
Mortality cost for females	56,739,540	71,417,391
Total	673,644,054	839,233,718

taken into consideration so that the lost income for a person as the person ages (if still alive) would be more accurately measured.

As an example, consider males who died of malignant neoplasm of the nasopharynx in 1997. From the Report on Registration of Births and Deaths 1997, there were 28 males in the 40-49 age group who died of this disease. The aetiological fraction is 0.72 for this cause of death. Thus, there were 20.16 males who died from this cause due to smoking. Taking the median age as 45 for this age group, a male has 34 years left before he reaches 79 when his productive contribution ends. From the Labour Force Survey 1997, the average compensation for a worker aged 45 was determined. This income is multiplied by 1.05 and discounted at a rate of 4.375% per annum for nine years to derive the lost income until age 54. The income figures for the age group 45 to 49 are multiplied by the average labour force participation rate of 96% while that for the age group 50 to 54 is multiplied by the average labour force participation rate of 90% to obtain the lost market-based income. The corresponding lost income figure for 55 years and above is derived in a similar manner. For the 20.16 males who died from malignant neoplasm of the nasopharynx in 1997 the lost income was S$9,501,194.

Table III. Medical cost of smoking.

	Low Estimate (S$)		High Estimate (S$)	
	Males	Females	Males	Females
Below 65	28,145,260	10,476,180	28,614,300	10,693,540
65 and above	18,692,960	16,533,660	18,692,960	16,533,660
Total	46,838,220	27,009,840	47,307,260	27,227,200

Table IV. Morbidity cost of smoking.

	Low Estimate (S$)		High Estimate (S$)	
	Males	Females	Males	Females
Below 65	2,571,223	97,770	2,604,915	97,964
65 and above	440,372	207,497	440,372	207,497
Total	3,011,595	305,267	3,045,287	305,461

Table V. Morbidity cost of smoking.

	Low Estimate (S$)		High Estimate (S$)	
	Males	Females	Males	Females
Below 65	484,638,567	45,183,299	634,830,094	59,861,150
65 and above	55,101,025	11,556,241	55,101,025	11,556,241
Total	539,739,592	56,739,540	689,931,119	71,417,391

RESULTS

The total cost of the health effects of smoking in Singapore in 1997 amounted to S$674 million (lower bound) and S$839 million (upper bound), excluding the lost household production, as shown in Table II.

The direct costs of smoking are the hospital expenses incurred. The direct costs are S$46.8 million to S$47.3 million for males and S$27 million to S$27.2 million for females. The total direct costs thus range from S$73.8 million to S$74.5 million for the five diseases considered. Thus, there is reason to believe that these figures are on the low side because of the limited range of diseases covered as well as the omission of the costs of outpatient care and other incidentals. Table III shows the direct costs of smoking for the five diseases, broken down by gender and age.

Males below age 65 incurred larger medical expenses, regardless of whether it is the lower or upper bound estimate. Females above age 65 incurred larger medical expenses because of the larger number of older female patients.

The morbidity cost measures the lost output from hospitalisation. A total of 26,065 patients were

Table VI. Demographic estimates of the cost of smoking in Singapore.

	Population projection			Population adjusted for smoking			Loss in population				
Year	Males	Females	Persons	Males	Females	Persons	Males	Females	Persons	Per capita GNP, $	Loss in GNP
1990	1,370,059	1,335,356	2,705,415								
1991	1,388,157	1,354,276	2,742,433	1,389,775	1,354,962	2,744,737	1,618	686	2,304	24,360	56,125,440
1992	1,405,474	1,373,053	2,778,527	1,408,533	1,374,267	2,782,800	3,059	1,214	4,273	25,867	110,529,691
1993	1,422,190	1,391,350	2,813,540	1,426,706	1,393,095	2,819,801	4,516	1,745	6,261	28,600	179,064,600
1994	1,439,037	1,409,417	2,848,454	1,444,940	1,411,706	2,856,646	5,903	2,289	8,192	32,369	265,166,848
1995	1,454,770	1,426,656	2,881,426	1,462,100	1,429,486	2,891,586	7,330	2,830	10,160	35,107	356,687,120
1996	1,469,003	1,442,661	2,911,664	1,477,819	1,446,045	2,923,864	8,816	3,384	12,200	36,918	450,399,600
1997	1,482,771	1,458,052	2,940,823	1,493,026	1,461,989	2,955,015	10,255	3,937	14,192	39,396	559,108,032
1998	1,495,681	1,472,403	2,968,084	1,507,296	1,476,880	2,984,176	11,615	4,477	16,092	38,170	614,231,640

admitted to the hospitals for the five diseases. The aetiological fractions as provided in Table I were used to calculate the number admitted because of smoking. The costs for males and females are shown in Table IV.

The morbidity cost for younger males is much higher than that for females. This is due to the larger number of young male patients admitted. The difference between the morbidity costs for high and low estimates is larger for males than for females, reflecting the larger number of male patients below the age of 30.

The mortality cost is the value of lost production from smoking related death. The figures estimated were S$540 million to S$690 million for males and S$56.7 million to S$71.4 million for females as shown in Table V.

The mortality cost of young males is more than ten times that of females'. This shows the huge market-based production cost that is lost due to smoking. The gap between the high and low estimates for both sexes is quite constant. The mortality cost for deceased females over age 65 ranges from 18 percent to 24 percent of the younger females. The corresponding figures for males range from eight percent to 11 percent.

THE DEMOGRAPHIC APPROACH

The demographic approach compares the actual population with the size and structure of the hypothetical alternative of no-substance abuse population in estimating the cost of smoking in Singapore for the years 1991 to 1998 using 1990 as the base year. The population used is the Singapore resident population (i.e. citizens and permanent residents of Singapore only). Two sets of population projections were done; one with smoking and the other without smoking (i.e. adjusted for smoking). In both cases, the projected population figures for 1991 to 1998 do not take into account net migration as these figures are not available.

METHODOLOGY AND RESULTS

The population projected for 1991 and adjusted for smoking was calculated from the 1990 resident population taking into account the reduction in the rate of mortality and increase in the rate of fertility based on smoking related aetiological fractions as shown in Table I. The fractions for the total causes of death were used (0.23 for males and 0.12 for females). The smoking adjusted projected population for 1992 was calculated based on the 1991 smoking adjusted population. The mortality and fertility rates used were the adjusted rates based on the same aetiological fractions applied to the 1991 published rates of mortality and fertility. Standard multiple-decrement table formulae were used to calculate these modified rates[1]. This process was repeated for the other years. The projected population adjusted for smoking for 1991 to 1998 is the projected resident population without migration and without smoking.

For both sets of projections, the life-tables used were from the Yearbook of Statistics[11] except for the 1990 life-table which was taken from Lun[3]. Nonetheless, as all calculations were performed using single years of age, these abridged life-tables need to be re-estimated to provide single-year numbers. This was done by using the six-point Lagrangian interpolation formula[2]. Further, for ages above 75 smoothing by fitting a Gompertz mortality curve was used.

The difference between the two projected populations is the loss in population due to smoking. It can be seen that if there has been no smoking since 1990, the resident population would have been 2.745 million in 1991. The projected resident population with smoking was 2.742 million, leaving Singapore with a net loss in population of 2,304 persons in the year 1991. This figure is multiplied by the gross national product (GNP) per capita at market price to get the loss in GNP from smoking. The loss was estimated at S$56 million in 1991 and would have reached S$614 million in 1998. The losses from 1991 to 1998 are shown in Table VI.

Sensitivity analysis calculations also show that when the aetiological fraction was increased by five percent to 0.2415 for males and 0.126 for females, the loss in population for 1998 would have increased to 16,914. This is nearly equal to a five percent increase in terms of the loss persons. A decrease of five percent in the aetiological fractions will result in a loss of 15,272 persons in the 1998 population. This decrease in loss persons is also very nearly equal to five percent. Thus for small perturbations in the parameters used in the calculations, the estimated loss figures can be readily determined on a proportionate basis.

Nevertheless, these loss figures are to be considered as averaging values. A more desirable and accurate determination will need the availability of the contribution to national output by ages. This information is not available. The loss figures estimated may be viewed to be an overestimation as the method assumes that every person has contributed to national output.

It can be seen that smoking exerts a high cost on society, even if only 1990 is used as the base year when there is cessation of smoking. If an earlier year is used, the cumulative loss would have been greater

and costs would have been much higher. The loss for males is much higher than for females because the prevalence of smoking is greater among males. The loss in output would increase over the years as the mortality and fertility rates will be affected by the loss in lives due to smoking.

CONCLUSION AND LIMITATIONS

The human capital approach estimates the value of a worker's future production stream, discounted to present-day values by the use of an appropriate discount rate. It was estimated that the total costs of the health effects of smoking in Singapore in 1997 ranged from S$673 million (lower bound) to S$839 million (upper bound). Also, males incur ninety percent of the costs of smoking.

The demographic approach compares the actual population size and structure with the size and structure of the hypothetical alternative of no-substance abuse population. From the comparison, actual and hypothetical outputs are compared to yield the production costs in that year of past and present substance abuse. The cost of smoking was estimated for the years 1991 to 1998 using 1990 as the base year. The estimated loss in GNP due to smoking was at S$56 million in 1991 and would have reached S$614 million in 1998.

Although Singapore has been successful in reducing smoking prevalence over the years, the cost from smoking is still very high. While this study is the first attempt to measure the social cost of smoking, it has nonetheless managed to highlight the potential damage from smoking. The cost of smoking incurred by males is very much greater then that for females. As cigarette smoking is one of the leading preventable causes of illnesses and premature deaths, policy makers must implement effective policies to encourage people especially the males to quit or never take up smoking at all. Smoking exerts a high cost on any society.

Undoubtedly, the availability and quality of data will determine the accuracy of the estimated costs of smoking. Nonetheless, the values presented here which clearly represent an "in the neighbourhood" estimation of the social cost of smoking do suggest that the loss to society from smoking is substantial.

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