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THE COST OF DISEASES CAUSED BY TOBACCO IN HONG KONG

Report researched, written and published by
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Contents

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THE COST OF TOBACCO-RELATED DISEASE

SUMMARY

This study has been carried out using local data and gives a conservative estimate of the health care costs of tobacco-related disease in smokers and non-smokers as well as associated productivity losses.

Methods

The costing was carried out according to the international guidelines for costing alcohol, tobacco and illicit drugs.

Data used

The principal sources of data were three large local studies

a) the University of Hong Kong (HKU) Lifestyle and Mortality study (LIMOR) which gave the relative risks of mortality from various causes for smokers and some information on the risk for non-smokers exposed to secondhand smoke (SHS) and covers 79% of the deaths from all causes in 1998.
b) the HKU Harvard Household Survey (HHS) which provided population estimates for exposure to SHS and utilization of health care
c) the HKU Police Health survey (PHS) which provided data on associations between SHS exposure and use of health care or time off work

and the clinical database of the Hospital Authority as well as routine data sources such as census, Department of Health and other government statistical reports. Further data was obtained directly from these organizations.

Costs of active smoking: Data on the relative risk of mortality due to active or passive smoking were used to calculate the attributable fractions of cause-specific mortality for those over 35 years. Premature lives lost (under 75 years) could be valued at HK$10 million each and years lost under 65 years could be valued as lost production. Life years lost were discounted at 3% to reflect present day values. The attributable fractions were applied to hospital admissions for those over 35 years for the same diagnostic groups and, for active smoking, to all visits to specialist and general outpatient clinics and accident and emergency units by those over 35 years

old. Unit costs for a visit were obtained from each organization. Attributable visits by active smokers over 15 years old to private general practitioners (GPs) for respiratory illness were estimated and valued using results of local surveys. The extra visits made to GPs by workers exposed to secondhand smoke were estimated from the PHS. For passive smoking, we did not include visits to specialist and outpatient clinics or accident and emergency units nor admissions to private hospitals because of lack of data to estimate the proportions of exposed non-smokers attending such units. The amount of extra time taken off work by smokers and passive smokers was estimated using data from the PHS and census data and was valued at the median wage. The attributable days spent as an inpatient by the working population were also valued at the median wage but this cost was not included to avoid double counting with the cost of time taken off work. The cost of nursing homes and of hiring domestic helpers to look after an elderly person with special needs was estimated for active smoking but nursing home costs could not be estimated for passive smoking. All estimates made were conservative, with the lowest value being used when there was a choice. For passive smoking, estimates are shown for exposure only at home and exposure at home and at work with the latter being taken as the main estimate. A range of final estimates is presented based on the 95% confidence interval of the risk estimates used.

Limitations

One of the main limitations of the costing is the lack of comprehensive longitudinal studies to estimate the extra hospital utilization by adult active and passive smokers. However, we have this data for GP utilization and time off work and for children who are passive smokers. For the hospital utilization, we have assumed that the mortality risk estimates can be used to approximate to morbidity risk. This assumption has been made in previous studies in many countries and is likely to under-estimate the costs. Since our attributable fractions and cost data are disease specific, this assumption would only be invalid if the proportion of smokers among inpatients with a particular condition differed greatly from the proportion of smokers among deaths which were due to that condition and this is unlikely. The mortality risk ratios that we used were controlled for age, sex and education as a proxy for social class. Other confounders which might impact on mortality, such as lifestyle factors (exercise, diet) were found not to affect these risk ratios very much. The alternative approach, that of comparing utilization of smokers and non-smokers directly requires comprehensive databases which we had and used for infants and children and, for adults, for consultations with a general practitioner and for time off work.

For some of the public outpatient data, we could not obtain a breakdown of visits by disease category which makes the validity of the use of mortality risks weaker but we have no information to determine in which direction any difference would lie. The same applies to nursing home costs. The cost estimates for these services may therefore be over- or under-estimated but are likely to have been under-estimated.

The value of pain and suffering could not be included. For passive smoking, we could not estimate the cost of home exposure on GP visits or time off work nor the impact of any exposure on private hospital admissions, specialist and general outpatient visits and attendances at accident and emergency units.

Results

We calculated that 3,398 lives would be lost prematurely each year due to active smoking and 529 due to passive smoking. These lives can be valued at HK$39,270 million. The value of the 8,669 productive years lost due to active smoking and the 815 due to passive smoking would be $1,353 million. For hospital admissions, we are spending around $1,439 million due to active smoking and $498 million due to passive smoking each year, a total of $1.9 billion of which 94% falls on the public hospital sector. For outpatient and accident and emergency unit visits for active smoking, we spend around $455 million of which 81% is from the public sector. For passive smoking, we spend around $248 million per year on primary care visits due to passive smoking at work but we do not know the impact on GP visits of passive smoking at home. We could not estimate the costs for other ambulatory care services such as public specialist clinics.

The costs of long term care come to $918 million for active smoking and $2 million for passive smoking. Productivity losses due to extra time taken from work are around $66 million for active smoking and $353 million due to passive smoking, a total of $419 million of which 10.3% falls on the public sector.

Conclusion

A conservative estimate of the total cost of tobacco-related disease costs is therefore around HK$2.7 billion for health care costs, $1.8 billion for productivity losses and $0.9 billion for long term care, a total of $5.3 billion. In this estimate, 82% of the health care costs fall on the public sector and 28% of all costs are due to passive smoking.

1. INTRODUCTION

1.1 The cost of tobacco-related disease in Hong Kong

Smoking tobacco results in many costs which fall on a variety of groups in society. In this report, while we focus only on health-related costs, there are other legitimate costs including fire related costs, decreased productivity due to smoking breaks, litter created by smokers' detritus, smoke damage of furniture, rooms, clothing and other possessions (1). In this report, we group the health-related costs under two main headings:

a) the costs of *active* smoking, that is, costs to the smoker, the health care system and society as a result of the health damage caused to the smoker
b) the costs of *passive* smoking, that is, those costs which result from non-smokers inhaling tobacco smoke.

This report focuses on those costs which are being incurred annually in Hong Kong, taking 1998 as the example year. As far as possible, local data have been used in these estimations, particularly those obtained from three large studies which are described more in page 5 of this report.

1.2 Epidemiological background

The costs related to the use of tobacco can only be estimated by using accurate and reliable epidemiological data on the impact of tobacco use. To determine this impact, we use the concept of the *attributable risk*. According to Last's Dictionary of Epidemiology (2), attributable risk is 'the proportion of a disease or other outcome in exposed individuals that can be attributed to the exposure'. The exposure in this case is active or passive smoking. To calculate the attributable risk, we need data on the relative risk (RR) relationship between exposure and the health outcome. We can then use the *attributable risk* together with the prevalence of the exposure to estimate what proportion of the total costs of a disease or other outcome are associated with exposure – the *attributable fraction*.

1.3 Published studies

1.3.1 Deaths and life years

There are many overseas studies which have estimated the cost of tobacco use, particularly for active smoking. In the US, it was estimated that 419,000 deaths were due to smoking in 1990, that is, nearly one in 5 deaths and more than a quarter of deaths in the 35 to 64 age group (3); this was updated to 440,000 premature deaths annually in 1995-99 (4). Warner estimated that each smoker who died from a smoking-related disease lost 15 years of life (5); a later study from Denmark estimated only 7 years were lost but with an extra 12-13 years in poor health (6). Single et al (7) estimated that, in 1992, tobacco use accounted for 17% of deaths from all causes in Canada and 16 years of potential life lost. Yuan et al (8) in Shanghai estimated that 21% of all male deaths and 36% of all male cancer deaths in those aged 45 to 64 years were attributable to smoking in 1986-93. At that time, the prevalence of smoking in China was 50% among males with 7% ex-smokers.

1.3.2 Health care costs

There have been a number of attempts to estimate the health care costs associated with morbidity due to smoking. When Warner, in 1999, reviewed all the previous costing studies in the US, he concluded that the costs associated with smoking equaled or exceeded 6-8% of personal health expenditure (9). The cost of production losses due to premature mortality plus the excess morbidity costs were estimated to be US$3,391 per smoker per year in the US (4). Using utilization data and controlling for a variety of sociodemographic, economic and behavioural factors, Miller et al estimated that US state expenditures on medical care attributable to tobacco smoking in 1993 were 11.8% of total medical expenditure or US$72.7 billion (10). The Medicare expenditure attributable to smoking in 1993 amounted to 9.4% of Medicare expenditure or US$14.2 billion (11). A Chinese study that estimated the impact of mortality and morbidity cost the Chinese economy around 27 billion Yuan in 1989, with a heavier burden in urban than in rural areas (12) while another costing found a cost of 2 billion RMB for medical costs alone (13). A Japanese study estimated that, in the population aged 45 years and above, around 4% of medical costs were due to smoking (14) while an Australian study showed that smokers used 40% more bed days than never smokers (15).

1.3.3 Work related costs

A Scottish study showed absenteeism to be higher among smokers than non-smokers and estimated that smoking-related productivity losses were £450 million per annum (16). A study of refinery workers also showed that smokers had a twofold increased risk and duration of absence from work compared with non-smokers (17), and that smokers also have increased risk after surgical procedures (18).

1.3.4 Conditions related to tobacco use

Data on mortality due to smoking has been collected for many years and *smoking attributable fractions* (SAFs) based on mortality, although they do differ between studies, give a fairly uniform picture of cost in terms of deaths. For example, some of the US studies differed in the actual SAFs for specific categories of disease but, when aggregated across disease groups, the differences tended to cancel out (9). Many of the mortality categories are quite well established as being smoking-related, for example, cancers, respiratory and vascular diseases. A proportion of other causes of mortality, for example, digestive diseases and injuries and poisoning, may also be smoking related. Collins and Lapsley, in Australia, obtained a comprehensive list of conditions associated with smoking by using the most up-to-date epidemiological information (19). They produced the following categorisation:

Active smoking

Cancers	oropharyngeal, oesophageal, stomach, anal, pancreatic, laryngeal, lung, endometrial*, cervical, vulvar, penile, bladder, renal parenchymal, renal pelvic, respiratory carcinoma in situ
Cardiac and cardiovascular	atherosclerosis, ischaemic heart disease, pulmonary circulation disease, cardiac dysrhythmias, heart failure, stroke
Respiratory	chronic obstructive pulmonary disease, pneumonia
Digestive	peptic ulcer, crohn’s disease, ulcerative colitis
Pregnancy-related	ectopic pregnancy, spontaneous abortion, antepartum haemorrhage, hypertension in pregnancy*, low birthweight, premature membrane rupture
Other conditions	tobacco abuse, parkinson’s disease*, fire injuries, sudden infant death syndrome (in utero smoke exposure)

**Note: The attributable fractions for these conditions were negative implying a possible protective effect; Collins and Lapsley estimate that the lives saved due to this effect are around 1.3% of those lost due to the other conditions and hospital bed-days saved are 1.9% of those used for the other conditions, a saving which they call ‘trivial’ compared with the costs imposed.*

Passive smoking

Sudden infant death syndrome (post natal smoke exposure)

Asthma (under 15 years)
Lower respiratory illness (under 18 months)
Lung cancer
Ischaemic heart disease

Most other costing exercises to date have used a less comprehensive list of conditions due to lack of epidemiological data. The difference between studies becomes greater when we consider costing of morbidity. There are two main ways that this has been done in the past. The first way is to use the SAFs for mortality and apply the same attributable fractions to the total cost of hospital and ambulatory care for the smoking-related conditions. The rationale is that the proportion who die of a condition due to smoking will be similar to the proportion who use specialist health care services for that condition because of smoking. However, this could under-estimate the use of health care if smokers stay for a longer time in hospital or use more ambulatory care services or vice versa. Another approach is to examine directly the health care utilization of smokers and non-smokers and calculate a utilization or morbidity-based SAF. When this has been done, the proportions of health care used have sometimes been lower than those predicted by the mortality SAFs but the methodology of these studies has been criticized (9). More recent studies however have given estimates of morbidity SAFs that are at least as large or larger than those estimated by mortality SAFs (10, 11). Collins and Lapsley (1), used SAFs based on hospital utilization of smokers and non-smokers for various smoking-related conditions and these SAFs were generally higher than in the published US studies. However, although attributable fractions were quoted in the epidemiological report on which the costing was based (19), insufficient detail was provided for us to make comparisons with our calculations.

1.4 The cost of tobacco-related ill health in Hong Kong

1.4.1 Previous work

One previous study attempted to estimate the cost of tobacco-related disease in Hong Kong (20). However, the author was obliged to use RR from overseas populations which were criticized as being not relevant to Hong Kong. Two recent studies have derived Hong Kong based estimates for RR of mortality due to active (21) and passive smoking (22). In the active smoking study, Lam et al estimated that 5,720 out of 31,349 deaths in Hong Kong in 1998 were related to smoking; 2,703 deaths in those aged 35 to 69 years and 3,017 in those aged 70 years and over (23). In the passive smoking study, the risk estimates for lung cancer, all cancers, chronic obstructive pulmonary disease (COPD), all respiratory disease, ischaemic heart disease (IHD), stroke and all circulatory disease and all cause mortality were positive and significant while those for injury and poisoning were around unity and not significant (22).

1.4.2 Data used in this study

In this costing study, we have made use of the dataset of Lam et al, known as the University of Hong Kong (HKU) Lifestyle and Mortality Study (LIMOR) (23), as well as other local datasets: the HKU Harvard Household Survey (HHS) (24, 25) and the HKU Police Health Survey (PHS) (26,27). We have also used data from the Hong Kong Hospital Authority clinical database, the Annual Digest of Statistics (28), population census (29), statistics (30-32) and special topic reports (33-34) from the Hong Kong Census and Statistics Department (CSSD), annual reports from the Hong Kong Hospital Authority (HA) (35) and Department of Health (DH) (36) and unpublished data supplied by the above organizations, referenced as written communications.

1.4.3 Population groups covered by the analysis

The age range included in the analysis of mortality and serious morbidity due to active smoking is 35 years and over, unless otherwise specified. This allows for the time lag between starting to smoke and the presentation to health services with serious chronic disease and is consistent with other published studies. However, the age range of 15 years and over is used for the costing of milder illness and symptoms associated with smoking, since these more immediate effects will affect smokers of all ages. For passive smoking, the same approach is used for mortality and hospitalization in adults and including those ages 15 years and over for general practice visits. Infants of 12 months and under and children of 1 to 15 years have been included in the analysis of the impact of parental smoking. When calculating impacts on work-related costs, only the population who work at least part-time was used in the analysis and the labour force participation rate (30) was used to adjust life years lost to give potentially productive life years lost. Where the RR of association of an outcome with active smoking was statistically significant only for a certain age range, the population used in the extrapolation was, in some cases, limited; these cases are noted in the text.

1.4.4 The costing

The methodology used for the costing follows the international guidelines developed in 1996 and revised in 2001 (37). A conservative approach to estimation of costs was taken with lower cost alternatives being chosen when we had a choice. For active smoking, we included only those conditions which have been accepted in the literature as being associated with smoking, that is, the categories of *cancers, respiratory disease, cardiovascular disease and peptic ulcer*. This approach may produce an underestimate of tobacco-related disease costs but is useful for comparison with the costing of mortality and inpatient care in other countries where such an approach has been taken. For passive smoking, we have used an estimate which is extrapolated to passive smoking at work as the main estimate but include one based only on passive smoking at home for comparison.

1.4.5 Overview of the report

Our analysis of tobacco-related costs in Hong Kong is presented in four sections covering:

- the mortality cost attributable to active smoking
- the morbidity cost attributable to active smoking.
- the mortality cost attributable to passive smoking
- the morbidity cost attributable to passive smoking.

These sections are then further broken down into relevant subsections. The estimations in each section follow the same steps. First, the attributable risk for exposure to either active or passive smoking is estimated and the findings are extrapolated to the relevant population groups to determine the attributable fraction of a specific cost. Finally, the results are valued in Hong Kong dollars.

2. COSTS OF MORTALITY ATTRIBUTABLE TO ACTIVE SMOKING

2.1 Introduction

In this section we estimate the fraction of total mortality that is attributable to active smoking and produce a value for these deaths.

2.2 Methods

2.2.1 Smoking-attributable fractions

The attributable fractions for mortality due to active smoking (smoking attributable fraction (SAF)) were derived from the data set of the 1998 Hong Kong Lifestyle and Mortality (LIMOR) Study (23). In this study, the person reporting a death at one of Hong Kong's four death registries was asked to provide information on the decedents' lifestyle ten years previously while information on the cause of death was obtained from the death register. The resulting data set included almost all deaths (79 %) from mid-December 1997 to mid-January 1999. We have used the complete data set for analysis of the association between smoking and mortality but, when estimating absolute numbers of deaths, we have used only those deaths reported as occurring in 1998, the base year for the costing.

The calculations of relative risks of mortality from this data set have been published (21). For this study we re-calculated all associations using the published methods but with more disease categories in order to include more detailed categories of causes of death and different age ranges to those previously published.

The causes of death were divided into categories by their ICD-9 codes and the association between cause of death and ever-smoking was examined as in Lam et al (21). Since it is a case-control study, the odds ratio (OR) was used to approximate to the RR. Those categories found to have a significant positive relationship with ever-smoking were designated as "smoking-related-diseases" (SRD) and used in subsequent calculations. Those with a non-significant result were regarded as non-smoking-related and excluded from the costing. There were no significant negative associations. We identified twelve SRD categories; the disease groupings used, in

ICD9 codes, are shown in the appendix. The cost data were obtained using the same ICD-9 categories except where noted.

For each SRD category, the OR and SAF were calculated separately for males, females and the three age groups 35 to 64 years, 65 years and over and 65 to 74 years. The resulting ORs which were greater than 1 were used to calculate the relevant SAF regardless of their individual level of significance except when the OR for a subgroup was much higher than the overall OR for that disease group and likely to be unreliable due to a small sample size. In this case, the gender and age group specific OR was replaced by the overall OR for that disease group, as a conservative approach. When the sub-group OR was less than 1 the relevant SAF was taken to be zero. None of the sub-groups ORs were less than 1 and statistically significant.

2.2.2 Total smoking-attributable deaths

In our re-analysis, the following 12 disease groupings were significantly and positively related to ever- smoking:

- Lung cancer
- Oesophageal cancer
- Stomach cancer
- Liver cancer
- Oral, pharyngeal, laryngeal, pancreas and bladder cancers.
- Other malignancies
- COPD/pulmonary heart disease
- Combined respiratory TB and other respiratory
- Ischaemic heart disease
- Cerebrovascular disease
- Other vascular disease
- Disease of the digestive system

We included only the first 11 of the above disease groupings and only those digestive conditions which have been shown to be associated with active smoking in other studies i.e. peptic ulcer and associated conditions. This gives a conservative estimate.

The number of smoking attributable deaths in each disease group were obtained for the LIMOR group by the following equation:

> Smoking-attributable deaths for i^{th} disease = SAF(i^{th} disease) x number of ever-smoker deaths in the LIMOR study group in 1998 for i^{th} disease.

Separate calculations were performed for males, females and the three age groups; total smoking-attributable deaths were obtained by summation over all the disease groups. These results were extrapolated to all deaths in each sex and age sub-group in Hong Kong using a multiplier (F) to compensate for the fact that the LIMOR deaths only represented 79% of the total deaths in 1998; F was separately calculated for each of the age and sex sub-groups and is shown in Table 2.1. A comparison between the LIMOR sample of deaths and all deaths in 1998 showed that the sample was reasonably representative.

Table 2.1: Multiplier (F) to extrapolate LIMOR data to the HK population

	Age 35-64	Age 65 and over	Age 65 to 74
Male	1.451	1.244	1.292
Female	1.284	1.227	1.240

The multiplier F was used as follows:

Smoking-attributable number of deaths in population (age/sex) =

Smoking- attributable number of deaths in LIMOR group (age/sex) x F (age/sex)

2.2.3 Premature deaths and years of potential life lost

We defined premature death as those deaths occurring before age 75. This definition is consistent with the literature (38) and is below the life expectancy at birth in Hong Kong in 1998 of 77.4 years for males and 83.0 years for females (31). The calculation of the number of premature deaths due to active smoking is identical to that for the total number of attributable deaths except that only those who died before 75 years are included. The ORs were calculated separately for those between 35 and 64 years and those between 65 and 74 years because costs for length of stay in hospital are likely to differ between these age groups. Smaller age groups were not feasible due to the resulting small numbers in sub-groups. The OR was used to calculate the SAF for each age group in the same way as for total deaths. This SAF was applied to the appropriate population using the multiplier F (Table 2.1) to give the population value. In the same manner, we calculated the OR and SAF for death before the end of productive life assuming a normal retirement age of 65 years (39). Some people work after age 65 years but we did not have detailed data on their earnings and so, conservatively, we have included only those life years lost up to the normal retirement age.

We calculated the potential number of life years lost (YPLL) in two ways – compared with life expectancy up to age 75 (premature YPLL) and years of productive life lost (YPPLL). Where a decedent died before attaining the age of 75 years, the difference between 75 and their age at death was calculated. This potential number of life years lost was summed for the ever-smokers in the LIMOR dataset who died of a particular disease and the total multiplied by the SAF for death due to that disease, to obtain a proportion of the total life years lost due to that disease which were attributable to smoking i.e. the premature YPLL.

In a similar fashion, years lost before age 65 were also calculated and combined with the relevant SAF. The result was then multiplied by an estimate of the proportion of the age group who were working (labour force participation rate (30)) to give the YPPLL. The multiplier F was used to give the population values. Because these extra years of life would have occurred in the future, after 1998, they were discounted at a rate of 3% per year for the main estimate but results undiscounted and discounted at 5% are also shown.

The premature YPLL for the SRD groups were combined to give the total smoking-attributable premature YPLL for the LIMOR study group. The following formula shows how the YPLL for deaths prior to age 75 years were calculated:

> YPLL (sex/age) for LIMOR study group = sum of (YPLL i^{th} disease x SAF (mortality i^{th} disease))

Where YPLL i^{th} disease = sum of (74.5 – age at death of ever-smoking LIMOR decedent dying from i^{th} disease) with 3% discount rate.

The years lost under 65 years (YL65) were calculated using the following formula:

> YL65 (sex/age) for LIMOR study group = sum of (YL65 i^{th} disease x SAF (mortality i^{th} disease))

Where YL65 i^{th} disease = sum of (64.5 – age at death of ever-smoking LIMOR decedent dying from i^{th} disease) with 3% discount rate.

2.2.4 The valuation of lives lost

There are several ways to value lives lost. The *human capital* approach assigns a value of lost potential production to a life that is lost prematurely. The product of the number of years lost and the income that would be earned in those lost years provides a value for the lost life. This approach assigns a low or zero value to lives lost after the end of productive life. Other aspects of productivity could be included but we had no data on this in Hong Kong.

An alternative approach is to use studies of *willingness-to-pay* which use real data on amounts actually paid to avoid premature mortality, for example the cost of road safety improvements. We can also use stated amounts that people would be willing to pay to avoid losing life years. This approach tends to produce larger estimates of the value of a life or life years.

A value of 1.4 million euros was proposed as the value of one life lost (40) in a WHO multi-country study of the value of lives lost due to air pollution. This estimate was made after an extensive review of the value of life literature and was a middle estimate of all those available. The estimate was recently validated in Hong Kong in a study which verified that HK$10 million (approximately 1.4 million euros) was a reasonable value to pay for the avoidance of the loss of one life (41).

2.2.5 Valuing lost production

The usual retirement age in Hong Kong is 65 years (39). For all those premature deaths occurring before age 65 there is a loss of production due to the loss of a worker. This is expressed as the years of productive life lost (YPPLL). If we assume that the production value of a non-employed person (e.g. a housewife) is the same as an employed person then we can take the full amount of the YL65 as the YPPLL. We could, on the other hand, make the assumption that the productivity of a person not in the work force is zero; in this case, we would exclude from the calculation of lost life years those who were not working in the year we are costing. To estimate this, we used the labour force participation rate age and sex-matched to our data and used this, more conservative, method as the main estimate. After discounting the resulting YPPLL we applied the median annual wage (30) separately for males ($HK12,000) and females (HK$9,000).

2.3 Results

2.3.1 Total and premature deaths and deaths during working life

The total number of attributable deaths in the LIMOR sample was extrapolated by age-group and sex to the population and the result is shown in Table 2.2.

Table 2.2: Total smoking-attributable deaths, premature deaths and deaths during working life in the Hong Kong population

	Deaths during working life (35-64 years)	Premature deaths (35-74 years)	Total deaths for those 35 years and over
Male	1,467	3,052	4,533
Female	62	346	1,063
Total	1,529	3,398	5,596

We estimate that 5,596 deaths (aged 35years and over) in Hong Kong in 1998 were attributable to active smoking and 3,398 (61%) of these are premature deaths (<75 years). The number of deaths occurring while smokers or ex-smokers were in their productive years (<65 years) was 1,529 (27% of all attributable deaths).

2.3.2 Years of potential life lost

Taking the 3,398 premature deaths, we calculated the YPLL. The results are in Table 2.3 with discount rates of 0% (undiscounted), 3% and 5%.

Table 2.3: Smoking-attributable years of potential life lost for the Hong Kong population

	No discount	3% discount rate	5% discount rate
Male	34,459	26,935	23,368
Female	2,043	1,733	1,575
Total	36,502	28,668	24,943

The estimated total smoking-attributable years of potential life lost for all deaths between ages 35 to 74 years in Hong Kong 1998 was thus 28,668 years with a 3% discount rate. This equates to 8.4 years for each smoking-attributable premature death. The results for the calculation of YPPLL are in Tables 2.4.

Table 2.4: Smoking attributable YPPLL in the Hong Kong population

	No discount	3% discount rate	5% discount rate

Male	10,638	8,558	7,519
Female	136	110	97
Total	10,774	8,669	7,616

The estimated total smoking-attributable YPPLL for those workers dying aged 35 to 64 years in Hong Kong 1998 was 8,669 person years with a 3% discount rate. This equates to an average loss of 5.7 years of potential earning for each smoking attributable death between the ages of 35 and 64 years.

2.3.3 Valuation of the lives and life years lost

If we apply the value of HK$10 million to each life lost, this comes to a total cost of $55,960 million HKD in 1998, assuming that the value of a life lost is the same for all ages at death. If we only apply this value to those deaths which are considered premature, we obtain a figure of HK$33,980 million as the value of the premature lives lost. This assumes any attributable life lost after the age of 75 has no value.

The monetary value of the lost productive years is $1,244 million, valued at the median wage in 1998 (30).

2.4 Summary of findings on cost of mortality due to active smoking

Active tobacco smoking is responsible for the following costs, each year in Hong, Kong through attributable mortality

	Best estimate	Upper estimate[1]	Lower estimate[2]
Deaths	5,596	6,978	4,096
Premature deaths (< 75 years)	3,398	4,357	2,311
Deaths in working life (< 65)	1,529	1,942	1,054
Lost life years	28,668	36,566	19,906
Lost productive years	8,669	11,111	7,042
Value of lost lives	$33,980 million	43,570 million	23,110 million
Value of lost production	$1,244 million	$1,592 million	$1,009 million

1. Based on upper 95% confidence limit of the risk estimate
2. Based on lower 95% confidence limit of the risk estimate

2.5 Comparison with other studies

Single et al (7) estimated that tobacco attributable deaths in Canada were 17.1% of deaths from all causes. From the Hong Kong Annual Digest of Statistics (28), the total number of deaths in 1998 for all ages was 32,847, so the estimate of 5,596 smoking attributable deaths in Hong Kong 1998 is 17.0% of all deaths, a similar value to that obtained from the Canadian study.

Yuan et al (8) found that 21% of all male deaths in Shanghai from 1986 through to 1993 were attributable to smoking. In our data, 4,533 smoking attributable deaths were in men; this was 24.3% of all male deaths in 1998.

Doll et al (42) in their 40 year prospective study of British doctors estimated that smokers died on average 7.5 years earlier than non-smokers and the age by which half of the smokers have died is 8 years less than that for non-smokers. This corresponds with our finding of 8.4 and 5.7 years of life lost per smoking death among those under 75 years and under 65 years respectively.

3. COSTS OF MORBIDITY ATTRIBUTABLE TO ACTIVE SMOKING

3.1 Introduction

In this section, we use local data to estimate the costs of morbidity due to active smoking. As for mortality, the base year for all calculations was 1998. As there are many different calculation methods included under this section, the report is laid out first as methods and then results for each subsection. The main subsections are inpatient costs, public outpatient costs, private outpatient costs, time off work and long term care.

3.2 Inpatient costs

3.2.1 Methods

Inpatient costs arise from public acute and long stay hospitals and private hospitals. Both acute hospital and long-stay hospital costs were included in this analysis. Private hospital costs were estimated using available data. Calculations of inpatient costs included only those aged 35 years and over because most serious medical conditions which are initiated or complicated by smoking and which are likely to require hospitalization, usually occur after a relatively long latent period from the start of smoking. The estimates include the same disease groups as for the mortality cost estimates.

The smoking attributable fractions (SAFs) derived for mortality were used, thus making the assumption that the attributable fraction for severe disease requiring hospitalization is the same as the attributable fraction for mortality. In these calculations, we principally used the population attributable fraction (PAF) version because we did not have the breakdown of most cost data by smoking status and so the SAF could not be used.

Public inpatient care: All episodes recorded in the Hospital Authority clinical database in 1998 were included. The dataset used included dates of admission and discharge, principal and secondary diagnoses, type of hospital and demographic data. The mean number of bed days per episode were calculated for each of the smoking-related disease (SRD) categories. Separate calculations were done for acute and long-stay hospitals, males and females and two age groups, 35 to 64 years and over 65 years. The cost used for a bed-day was the average cost as provided by the Hospital Authority (HA) for the specific bed type (43). This average cost includes staff, drugs, equipment, procedures and hotel costs. It may also include the costs for intensive care and coronary care units and so we have not included these costs separately. For an acute hospital the bed-day cost was $3,744 and $1,985 for a long-stay hospital. It was assumed that the mean cost of a bed day was the same for each disease, age and gender group.

Four sets of PAFs (i.e. males and females and the two age groups of 35 to 64 and 65 and over) were applied to the total number of bed days in acute and long-stay hospitals in 1998 for each SRD and sex-age group to obtain the smoking-attributable bed-days. This was multiplied by the average cost of the corresponding bed days to derive the smoking-attributable cost of the bed-days which was then summed over all SRD and sex-age groups using the formula below:

> (Number of episodes in acute hospitals in 1998 x mean bed days in acute hospital x PAF x $3,744)
> + (Number of episodes in long-stay hospitals in 1998 x mean bed days in long-stay hospitals x PAF x $1,985)

One exception was in the main estimate for digestive disease i.e. peptic ulcer where, due to insufficient cases in the LIMOR data set for this disease category if age groups were broken down, only two sets of PAFs (i.e. males and females and the age group 35 and over) were applied to the total number of bed days for ages 35 to 64 years and 65 and over.

Private inpatient care: From the Department of Health Annual Report 1998/99 (36) we obtained the numbers of discharges and deaths from private hospitals in 1998 for the ICD codes best corresponding to our smoking-related disease categories. Due to slight differences in ICD9 code groupings, the categories of included diseases differed a little in this part of the costing; details are in the appendix. We were unable to obtain information relating to age, sex, length of stay or cost associated with these admissions. We thus made the following assumptions: that the mean length of stay for males and females 35 years and over for each disease category was the same for both sexes and for private and public acute hospitals; that the mean cost of a bed day in a private hospital in 1998 was the same as that in an HA acute hospital ($3,744) and that this was the same for all ages, genders, and disease categories; that the proportions of total episodes which were used for each disease category were the same for private and public hospitals.

We then carried out the following calculation for each SRD category:

> Smoking-attributable cost in private hospital for i^{th} disease = total number of admissions to private hospital for i^{th} disease x P (i^{th} disease) x mean length of stay for i^{th} disease in a public acute hospital for those 35 years and over x PAF (i^{th} disease) x $3,744
>
> where P = is the proportion of episodes for the i^{th} disease in public hospitals for those aged 35 years and over
> and PAF (ith disease) = PAF from the LIMOR study for the i^{th} disease for those aged 35 years and over

Results were then summed over all SRD categories.

3.2.2 Results

The results shown here are the aggregate results.

Public inpatient care: Table 3.1 shows the main estimate of costs of public inpatient care.

Table 3.1: Attributable costs of acute and long-stay hospitals in Hong Kong in 1998 due to active smoking (HK$)

Hospital	Male		Female		Total
	35-64 yrs	65 and over	35-64 yrs	65 and over	
Acute	332,765,656	502,449,322	14,622,399	161,185,610	1,011,022,987
Long-Stay	77,989,165	167,195,115	3,441,667	54,856,553	303,482,500
Total	410,754,821	669,644,437	18,064,066	216,042,164	1,314,505,488

Thus the estimated total smoking-attributable cost of public acute and long-stay hospital care for smokers in Hong Kong in 1998 is HK$1,315 million. The total public hospital operating costs in 1998 were calculated as the sum of the following: staff costs $20,100,498,000; medical supplies and equipment $1,985,336,000; and other operating expenses $3,044,509,000 (excludes operating leases and building projects) (44). The total was $25,130,343,000. Therefore the cost of $1,315 million is about 5% of the Hospital Authority's total expenditure in 1998. This is a very conservative estimate.

Private hospitals: The aggregate results are shown here. Table 3.2 shows the cost of private inpatient care.

Table 3. 2: Attributable cost of private inpatient care due to active smoking in 1998

No. of days in hospital for SRD categories, 35 years and over	Smoking attributable days	Smoking attributable cost (HK$)
209,083	45,107	168,880,981

Thus the estimated cost of private hospital utilization in Hong Kong in 1998 attributable to active smoking, using HA charges as a proxy, is HK$169 million. As a comparison, we substituted, for the public hospital estimates, the average cost per admission for each SRD group as provided by a local insurance company, BUPA (Asia) Limited. We had contacted the two largest authorised insurers in Hong Kong according to numbers of claims paid for accidents and health problems in the financial year ended 31st December 2001 (46). The largest insurer was HSBC Medical, with 344,841,000 claims paid out but they could not provide us with the required data. The second largest insurer was BUPA, with 304,214,000 claims paid out. The costs obtained from BUPA included all costs during the admissions, namely, bed and board charge, medicine, physician fee, surgeon and operating theatre fee, and all other ancillary charges for beds in wards, semi-private and private rooms. The resulting smoking-attributable cost of admissions was $124,082,566 compared with $169 million already calculated. Hence the new estimate has been substituted as it is more conservative.

3.2.3 Validation and comparison with other studies

Public inpatient care: We have made the assumption that mortality SAFs are applicable to morbidity as estimated by health care utilization. This has been done in previous studies (45) and the method has been applied in many countries. Since our SAFs are disease specific, this assumption would only be invalid if the proportion of smokers among inpatients with a particular condition differed greatly from the proportion of smokers among deaths which were due to that condition and this is unlikely. The mortality risk ratios that we used were controlled for age, sex and education as a proxy for social class. Other confounders which might impact on mortality, such as lifestyle factors (exercise, diet) were found not to affect these risk ratios very much, perhaps because their effect is mainly contained within that of social class. The same confounding factors would apply to utilization and we have no evidence that their effect would be different. The alternative econometric approach involves comparing utilization of smokers and non-smokers directly (45) and requires comprehensive databases. We have used this approach as far as possible in estimating health care utilization of infants and children and, for adults, consultations with a general practitioner and time off work. We did not have such data for hospital admissions but are in the process of making such a comparison for decedents using the LIMOR dataset.

The results presented here do not distinguish between the costs with and without Intensive Care Units (ICU) and Coronary Care Units (CCU) because these costs were included in the bed-day cost we obtained. These facilities would be used by those suffering from smoking-related disease and we have had to assume that their utilization for smoking and non-smoking related disease is proportional to the use of other bed-days.

As a comparison with the costs estimated here, we calculated the cost of public inpatient care for the hospital days actually used by the decedents in the LIMOR study, in public hospitals, in the year prior to their deaths. The total smoking-attributable costs for acute and long-stay hospitals for this group were $739 million. The LIMOR group includes 79% of all deaths among the Hong Kong population aged over 35 years in 1998. Therefore, these costs would become HK$934 million when extrapolated to the whole population. These costs are for those smokers who died in 1998 while the $1,315 already calculated is for all smokers. Most individuals have their highest health care utilization in the year before death. The two findings are therefore consistent, with the estimate for the year before death being 71% of the estimated total hospital use of $1,315 million for both decedents and survivors.

Private inpatient care: In the data used for our calculations, 15% of the total inpatient episodes of care for the 13 SRD in those over 35 years are in private hospitals and 85% in public hospitals while 76.4% of the total number of admissions for the 13 SRD categories were for people aged 35 years and over. From the HHS

16% of all admissions for those over 35 years in the preceding 6 months were to a private hospital and 84% to a public hospital (24). The CSSD has reported that 22.4% of the population had attended a private hospital and 77.6% a public hospital for their last admission (34). However these percentages were for all age groups and this report also noted that the use of private hospitals was greater for those aged less than 4 years, and those aged 20 to 45 years. Therefore, our estimate is likely to be reasonably accurate for those aged over 35 years.

The mean length of stay (LOS) in a public hospital for those aged 35 and over, both genders, for all SRD groups was 7.2 days. This was the LOS that was used in the main estimate of private hospital costs. For comparison, the mean LOS in the HHS was 6.9 days in a public hospital and in the HA report for 1998-9 was 7.3 days (45). The HHS reports the mean LOS in a private hospital as 4.3 days but this is based on only 91 cases (24). Unless otherwise stated, these lengths of stay were for all ages and all causes, including day surgery, and thus may underestimate the LOS for those aged over 35 years with chronic diseases.

3.3 Public outpatient costs

3.3.1 Methods

Public outpatient costs: There are 3 types of outpatient clinics or services provided by the public sector. These are specialist outpatient clinics (SOPC) which are provided by medical, surgical and other hospital specialists, general outpatient clinics (GOPC) which are first contact clinics and accident and emergency services (A&E).

Specialist outpatient clinics (SOPC): The number of attendances at adult SOPC clinics provided by the HA in 1998 was assumed to be the number of total SOPC attendances minus those at pediatric clinics that is, 4,924,978 visits. From the HHS (24) we know the proportion of SOPC attendees aged 35 and over (77.7%). We estimated the proportion of visits for the SRD groups by applying a ‘disease-specific ratio’ (DSR) for each group based on the proportion of all admissions to an acute public hospital which applied to that SRD. The calculation of the DSRs was as follows:

DSR (i^{th} disease) = total no. discharges and deaths from HA acute and long-stay hospitals in 1998 for those 35 years and over for i^{th} disease / total no. discharges and deaths from HA acute and long-stay hospitals in 1998 for those 35 years and over for all disease categories.

where 'i^{th} disease' refers to the smoking-related disease categories from the LIMOR study.

The smoking-attributable attendances were calculated using the appropriate PAF for mortality. The results for each of the SRD categories were summed and multiplied by $578, the average cost of an SOPC visit, to estimate the smoking-attributable cost of SOPC visits. The formula for calculating the smoking-attributable SOPC visits was:

Smoking-attributable attendances i^{th} disease = DSR (ith disease) x total attendances to HA adult SOPCs in 1998 x P (35 years and over) x PAF (i^{th} disease)

where P (35 years and over) = proportion of visits to adult SOPCs by those aged over 35 years (77.7%) (24).

General outpatient clinics (GOPC): There were 5,349,619 doctor consultations to DH and 758,164 to HA GOPCs in 1998. The average cost per attendance was $218 for the DH and $265 for the HA clinics. From the HHS we estimated the proportion of visits to GOPC that were for those 35 years and over. This proportion (65.4%) was applied to the total number of attendances to estimate the number of visits by those 35 years and over. We applied the overall PAF (17.9%) for mortality for all diagnoses, both sexes and all age groups as derived from the LIMOR data to determine the smoking-attributable number of GOPC attendances for each clinic type. The smoking attributable number of visits was multiplied by the appropriate mean visit cost to derive the smoking-attributable cost for GOPD DH and HA clinics. The formula was:

Estimated smoking-attributable GOPC cost = total no. attendances GOPC in 1998 x P(35 years and over) x PAF(all disease) x mean cost per visit.

Accident and emergency services (A&E): The total number of HA A&E attendances in 1998 was 2,303,614 (43). From the HHS, 25.6% of visits to A&E were for those aged 35 years and over. This proportion was applied to the total number of visits to estimate the number of visits by those aged 35 years and over (590,670). The overall PAF from the LIMOR study was applied to estimate the number of smoking-attributable attendances which was then multiplied by the mean cost per attendance ($572) to estimate the smoking-attributable cost of A&E visits. The formula was:

Cost of A&E attendance = no. A&E attendances 1998 x P(35 years and over) x PAF (all diseases) x mean cost per visit.

where PAF (all diseases) was 17.9% and P (35 years and over) was 25.6%.

3.3.2 Results

SOPC clinics: Smoking-attributable visits to an HA SOPC numbered 256,823, with a cost of HK$148,443,928. These 256,823 visits represent 5.2% of all visits to HA adult SOPC and 6.7% of visits estimated to be by those 35 years and over.

General outpatient clinics: The results are shown in Table 3.3.

Table 3. 3: Attributable cost of GOPC attendances in 1998

	GOPC (HA)	GOPC (DH)	Total
Total attendances (>34 years)	495,846	3,498,696	3,994,542
Smoking-attributable attendances	88,702	625,883	714,585
Smoking-attributable cost	$23,506,048	$136,442,581	$159,948,629

The cost of attendances at GOPCs due to active smoking by those 35 years and over in 1998 is estimated to be HK$160 million; this is 11.7% of the total cost for all visits to HA and DH GOPC in 1998 and 17.9% of visits for those 35 years and over. If we assume that the average HA/DH doctor sees 60 patients a day, 5 days a week for 48 weeks of the year, then the 716,213 smoking-attributable visits represents the workload of 50 full-time doctors in GOPC.

Accident and emergency service visits: The total number of visits to A&E clinics in1998 was 2,303,614 of which 590,670 were for those 35 years and over. Smoking attributable visits amounted to 105,661 with a cost of $60,440,543. This amounts to 4.6% of total A&E visits and cost in 1998 and 17.9% of visits by those 35 years and over.

3.3.3 Validation and comparison with other studies

SOPC: The methods used make two main assumptions: that inpatient DSRs and mortality PAFs are applicable to outpatient services. The justification is that those conditions which have more inpatient admissions are likely also to have more SOPC visits since SOPC visits are often used prior to admission or after discharge from hospital. Also, those conditions which cause greater mortality are likely to cause more of the type of serious disease which results in admissions and SOPC visits.

The cost estimate for HA SOPC smoking-attributable attendances is likely to be a conservative estimate of the total SOPC cost for the following reasons. Firstly, the DH provides a large number of SOPCs which have not been included in our costing because of difficulties disaggregating and attempting to estimate those visits that were for smoking-related diseases, lack of a suitable means to estimate the smoking-attributable fraction and the absence of cost data. In 1998, 982,818 attendances were made to the DH Tuberculosis and Chest Service, while there were 51,796 visits to Elderly Health Services. A proportion of these visits are expected to be for smoking-related disease. Secondly, we have used the mean HA SOPC consultation cost of $578 in our calculation. This is considerably lower than the cost of an HA Medical SOPC visit of $987 and the cost of an HA Surgical SOPC visit of $695. As many people with smoking-related diseases would attend these two clinics, using the lower value of $578 per visit will underestimate the true cost.

A&E: A US Emergency Department study by Bernstein (47) looked at the risk attributable to active smoking in adults and A&E attendance, subsequent admission and hospital cost. He estimated that the SAF was 4.9% for A&E attendances, 6.8% for subsequent admissions from A&E and 10% of hospital charges.

Lee et al (48) found that 34.0% of A&E attendances were in those aged less than 20 years while 35.6% were in those 20-44 years. If we assume homogeneity in distribution of attendance across this latter age range we could estimate that 21.3 % of attendances were for those aged 20 to 34 years. Thus 55.3% of visits to accident and emergency are estimated to be in those under 35 years. The estimate that we used (72.5% under 35 years), therefore gives a conservative estimate of accident and emergency costs for those 35 years and over.

We were unable to determine number of visits by sex thus all calculations for A&E are for males and females combined. Law and Yip (49) found “no significant difference between males and females in the utilization pattern of A&E attendances”.

3.4 Private general practitioner costs

3.4.1 Methods

Included in this section is the cost of general practitioner (GP) services only. Private specialists, Chinese Medicine Practitioner services and private A&E services are not included due to lack of data. The calculations are for ages 16 years and over since GP visits can be for mild conditions in young smokers, not just chronic conditions in older smokers.

In a local study, Wun et al (50) found that being a current smoker was significantly related to GP attendance for a new episode of respiratory disease with an adjusted OR of 1.25 (95% confidence interval (CI) 1.20 - 1.30). From the HHS, the adjusted OR for GP attendance for cold, flu or fever was 1.18 (95% CI 0.896 - 1.560) for current smokers and, from the PHS, the adjusted OR for any doctor attendance for a respiratory problem was 1.15 (95% CI 0.86 - 1.54) for males and 1.32 (95% CI 0.45 - 3.89) for females but none of these was significant. From the HHS (24) we obtained the mean cost for a visit for a respiratory problem ($181) which includes dispensed medications.

The conservative OR of 1.20 (lower limit of Wun et al’s estimate) was used to derive a population attributable fraction (PAF) for GP visits, separately for males and females. The proportion of consultations for respiratory disease (57%) was also taken from Wun et al's study (50). The number of visits was then annualized and extrapolated to the Hong Kong mid-year population in 1998 by the following formulae:

Estimated number of doctor consultations for respiratory disease in 1998 = total number visits to Dr in last 14 days for all diseases from HHS X 26 X Hong Kong mid-year population / number respondents HHS X 57%

Attributable cost of doctor consultation for respiratory disease 1998 = estimated number of doctor consultations x PAF x $181

where PAF (doctor visit for new episode of respiratory disease) for males = 6.35%, females = 0.75%

3.4.2 Results

Table 3.4 shows the summary of the cost of GP visits attributable to smoking in 1998.

Table 3.4: Cost of GP visits for respiratory disease due to active smoking in Hong Kong in 1998

	Total GP visits for respiratory disease	Smoking-attributable GP visits for respiratory disease	Smoking-attributable cost
Male	6,872,708	436,383	$78,985,291
Female	11,080,926	83,580	$15,127,950
Total	17,953,634	519,963	$94,113,240

The estimated attributable cost of GP consultations for respiratory disease, including associated medications in 1998 which is attributable to active smoking is HK$86 million. The attributable visits are 2.9% of total doctor consultations for respiratory disease in 1998 and amount to 519,967 extra doctor consultations. If we assume each GP sees 60 patients per day (4 consultations per hour, 7.5 hours per day) and works a 5 day week for 48 weeks of the year, these 519,967 attributable consultations are equivalent to the workload of 36 full-time doctors.

3.4.3 Validation and comparison with other studies

From the HHS sample 58.2% of responders had visited a private GP at least once in the last 14 days (24) while 6.8% had visited a private specialist (combined total 65%). This is comparable to the 66.3% reporting having visited either in the preceding two weeks obtained from the CSSD Thematic Survey in 1996 (51). CSSD also estimated that, for all age groups, 56% of doctor consultations in the previous 14 day period were for diseases of the respiratory system. A joint HKU/Chinese University of Hong Kong study (52) estimated that 57.0% of visits to private GPs were for respiratory disease and 80% due to URTI. Their study was carried out over a full year so there was no seasonal influence.

3.5 Time off work

Smoking is associated with excess morbidity and utilization of healthcare services. In employed smokers this extra morbidity can lead to extra absenteeism by smokers and a cost to employers. Thus we looked at absence from work due to illness and injury. These costs are estimated below. We also estimated the time off work due to inpatient admission.

3.5.1 Methods

The PHS data set was used to determine the PAF for absence from work due to illness by smokers. The number of absences of the whole population was known for the private sector from the CSSD survey in 1998 (53); this provided a conservative estimate when extrapolated to the whole working population to obtain the estimated number of absence days attributable to active smoking.

For the calculation of absences due to inpatient admission, the proportion of workers aged 35 to 64 in the Hong Kong population in 1998 was estimated by using the information from the Hong Kong Annual Digest of Statistics (28). This showed that 88.9% of males and 47.9% of females aged 35 to 64 were in employment in 1998. These figures were applied to the smoking-attributable days spent by this age group as an inpatient in a public hospital.

3.5.2 Results

The estimated total days of absence for illness due to active smoking number 151,160 in the private sector at a value of $58,027,410 and 21,610 at a value of $8,376,804 in the public sector, a total of $66,404,214. A total of 116,590 days of work are estimated to have been lost by workers admitted to hospital with a smoking-related illness; these days are valued at $45,730,655. We assume that these days lost are already included in the total of 172,770 days lost from work estimated above. This estimate includes sick-days only and does not include the cost of time off for doctor consultations or a period of sub-optimal productivity on return to work.

3.6 Long term care

Those who suffer from tobacco-related diseases may use other services such as long term care i.e. residential homes, nursing homes or may be looked after at home by a domestic helper or family members. We estimated these costs based on the number of smoking attributable cases of disease identified.

3.6.1. Methods

To estimate the amount of time over which a person requires long term care, we used the LIMOR dataset. One of the data items was the response to a question about how long the decedent had been unable to go outdoors alone in the previous year. This was averaged for smokers and non-smokers to give the average time (days) spent requiring some kind of assistance and the average number of days spent in hospital was subtracted. From survey data (30,54,55), we know that 20.1% of those 65 and over who are not in hospital or an elderly care home are in some type of residential care. Using these data, the breakdown of type of home and the monthly cost and the number of attributable deaths, we calculated the attributable cost of formal long term care for decedents in the last year of life. However, since some of these costs are already included in the cost of nursing home care below, we have not added this cost to the final total.

We also know that 20.1% of these elderly people are looked after in their own home by a domestic helper (30,54,55) and, using the breakdown and cost of local and foreign domestic helpers (55, 56), we calculated the attributable cost for decedents in their last year. Finally, 53.5% of elderly people who require special care are looked after by family members (30,54,55) but, due to lack of suitable cost data we have not attributed any cost to this care.

Residential care: The number of persons enrolled in the four types of residential care home: hostel for the elderly, home for the aged, care and attention home and nursing home was obtained from routine data (57). The overall PAF for those aged 65 and over was used to obtain the smoking attributable figures. It was not possible to break down these numbers for males and females. The unit monthly cost for each kind of residential care home per month (57) was multiplied by the attributable number of cases to get the annual smoking attributable nursing home cost.

3.6.2 Results

The attributable cost of residential care in the last year of life was $918,595,829 of which $5,253,636 was the cost of hiring a domestic helper. The cost of care given by family members was not valued.

3.7 Summary of findings on cost of morbidity due to active smoking

The costs of morbidity due to active smoking are summarized below. Note that the categories of cost fall on different sectors with public sector costs, usually paid by the Government, private sector costs paid by employers, through insurance or out of pocket by individuals and production losses which fall on employers or, ultimately, on society.

Table 3.5:Smoking-attributable cost (HK$) of health care and time off work in 1998

	Best estimate	Upper estimate[1]	Lower estimate[2]
Public acute hospital	1,011,022,987	1,294,356,729	695,462,919
Public long-stay hospital	303,482,500	377,537,271	222,664,320
Total for public hospital	1,314,505,487	1,671,894,000	918,127,239
GOPC (HA&DH)	159,948,629	174,011,796	145,107,750
SOPC (HA)	148,443,928	172,206,417	120,665,965
A&E (HA)	60,440,543	65,754,658	54,832,550
Total for public clinics	368,833,100	411,972,871	320,606,265
Total for public services	1,683,338,587	2,083,866,871	1,238,733,504
Private inpatient	124,082,566[3]	147,227,888[3]	97,119,821[3]
Private GP	94,113,240	137,438,963	94,113,240
Total for private services	218,195,806	284,666,851	191,233,061
Working days lost as inpatient	(45,730,655)[4]	(59,103,861)[4]	(29,570,775)[4]
Time off work (private sector)	58,027,410	115,562,157	3,792,533
Time off work (public sector)	8,376,804	16,647,949	548,449
Total for working days lost	66,404,214	132,210,106	4,340,982
Nursing homes (public)	328,260,591	358,424,275	296,148,286
Nursing homes (private)	584,546,168	638,259,793	527,362,561
Total for nursing homes	912,806,759	996,684,068	823,510,847
Home-based helper	5,253,636	6,577,483	3,879,825
Total for long term care	918,060,395	1,003,261,551	827,390,672
Total of all costs	2,885,999,002	3,504,005,379	2,261,698,219
Private costs	866,023,020 (30%)	1,045,066,284 (30%)	726,267,980 (32%)
Public costs	2,019,975,982 (70%)	2,458,939,095 (70%)	1,535,430,239 (68%)

1. This estimate uses the upper 95% confidence limit for the risk estimate
2. This estimate uses the lower 95% confidence limit for the risk estimate
3. This estimate uses BUPA charges for the bed-day cost
4. This cost is not included as it is part of the two costs below

4. COSTS OF MORTALITY ATTRIBUTABLE TO PASSIVE SMOKING

4.1 Introduction

In this section we describe the estimation of the fraction of total mortality that is attributable to passive smoking or exposure to secondhand smoke (SHS) for men and women who are non-smokers. We have used local data on the association of passive smoking with mortality to estimate the attributable deaths in adults. The grouping of causes of death according to ICD codes are the same in this analysis as in the active smoking part of the report.

In children, sudden infant death syndrome (SIDS) has been linked with passive smoking. However, we have no local evidence of the impact of passive smoking on infant mortality and the incidences of SIDS in Hong Kong is low. Therefore we have not included any estimate in this study.

For adults, exposure to passive smoking or secondhand smoke (SHS) can occur in social, domestic, and work-related situations. It is difficult to measure social exposure and we have limited this report to an analysis of the impact of SHS exposure at home and at work only. The base year used for the costing is 1998.

4.2 Mortality costs of SHS exposure at home and work for adults

4.2.1 Methods

Most of the epidemiological data on the impact of SHS, including that from Hong Kong, is derived from studies examining exposure at home. We have summarized the information on mortality due to SHS at home from Hong Kong, other areas in China and overseas. From a conservative estimate of the relative risk we have calculated the population attributable risk (PAR) of mortality due to conditions for which there is adequate evidence. Using local data on prevalence of SHS exposure at home we have then calculated the population attributable fraction of mortality. Since the data is derived from studies of exposure at home, we have initially calculated the attributable fraction using only the prevalence of SHS exposure at home. However, more recent studies indicate that exposure at work carries a similar, or even greater, risk to that at home (58). Therefore we include a further calculation using the prevalence of exposure at work and at home and take this one as the main estimate. Using the same approach to valuation as in the section on active smoking, we have calculated the monetary value of this exposure.

4.2.2 Results

Overseas studies

Lung cancer: Hackshaw et al (59), in a meta-analysis of 39 studies of spousal exposure to SHS (37 included women, 9 included men) found relative risks of lung cancer of 1.24 (1.13-1.36) for women and 1.23 (1.13-1.34) for both sexes together. This was the estimate used in the New Zealand assessment of cost of passive smoking (60). There have been a few more recent papers which are summarized here. Miller et al (61) showed an association in never and ever smokers, with a higher, though non-significant OR of 1.38 (0.78-2.43) for the never-smokers to 1.56 (1.00-2.41) for current smokers and 1.66 (1.22-2.25) for ex-smokers. A Russian study (62) found a risk of 1.53 (1.06-2.21) for spousal exposure. Jockel et al (63) report a non-significant effect of SHS from a spouse with ORs of 1.58 (0.39-5.85) and 1.87 (0.45-7.74) for exposures in non-smokers and never-smokers respectively. Boffetta et al (64) found weak evidence of a dose-response relationship between risk of lung cancer and SHS exposure from spouse with ORs of 1.65 (0.85-3.18), 1.20 (0.92-1.55) and 1.27 (1.00-1.62) in non-smoking men, women and both respectively with ORs up to 1.8 (1.12-2.90) in the most heavily exposed. Although one recent paper purported to show no significant association of SHS exposure (65), the data reported did actually show an increased risk of mortality from chronic obstructive pulmonary disease for men and women combined and its analysis and reporting have been criticized (66). A meta-analysis of 43 primary studies conducted in Australia (67) found a pooled RR of 1.29 (1.17-1.43) for never-smoking women exposed through their spouses.

Coronary heart disease: He et al (68) estimated risks of SHS as 1.25 (1.17-1.32) with exposure at home having an OR of 1.17 (1.11-1.24) and another meta-analysis (69) gave an OR of 1.23 with similar risks for exposed males and females. In a large cohort study, Steenland et al (70) estimated risks of 1.23 (1.03–1.47) for never smoking men and 1.19 (0.97–1.45) for never smoking women exposed to spouse’s smoking. An Australian study (71) found an OR of 1.99 (1.40-2.81) for the association between any SHS exposure and a coronary event in women but no clear association in men with an OR of 1.02 (0.81-1.28).

Pitsavos et al (72) found an association between exposure to SHS and acute coronary syndrome with an OR of 1.51 (1.21-2.99). Law et al (73) carried out a meta-analysis of all studies looking at IHD and concluded that the effect of SHS was to increase the risk by 23% if adjusted for diet effects and 30% if not adjusted.

Stroke: Bonita et al (74) reported the risk of acute stroke for non-smokers exposed to SHS as 2.10 (1.33-3.32) in men and 1.66 (1.07-2.57) in women and 1.82 (1.34-2.49) overall.

Chronic obstructive pulmonary disease (COPD): The US Environmental Protection Agency concluded in 1992 (75) that passive smoking had subtle but statistically significant effects on the respiratory health of nonsmoking adults.

Hong Kong studies

Lung cancer: There are 4 published case-control studies on lung cancer in spouses of smokers in Hong Kong. The estimated relative risks, adjusted for smoker misclassification are, 0.74 (0.47-1.17), 1.54 (0.98-2.43), 1.64 (1.21-2.21) and 2.51 (1.49-4.23) with an overall estimate of 1.48 (1.21-1.81) (75). We have published a recent analysis of the association between passive smoking at home and mortality using the LIMOR dataset (22). We obtained an OR of 1.38 (0.94-2.04) for mortality from lung cancer in females and 1.34 (0.82-2.17) for males with 1.39 (1.03-1.88) for both sexes together.

Coronary heart disease: The baseline risk of coronary heart disease is lower in the local population compared with most Western populations where studies of the association with SHS exposure have been carried out; the current Hong Kong heart disease mortality rates are about 2.6 times lower than in the US. That does not mean, however, that the risk of passive smoking is less than elsewhere.

Using the LIMOR dataset (22), we found an association between exposure to SHS and death due to IHD. The OR for females was 1.39 (0.95-2.04) and for males 1.30 (0.88-1.93). Taking both sexes together gives an OR of 1.35 (1.03-1.76).

Stroke: Using the LIMOR dataset (22), the association with SHS exposure gives an OR of 1.57 (1.11-2.34) for females and 1.31 (0.87-1.99) for males with 1.49 (1.15-1.94) overall.

COPD: Again, from the LIMOR dataset (22), we have an OR for females of 2.90 (1.34-6.29), for males of 1.67 (0.95-2.94) and both sexes together of 1.99 (1.28-3.10).

Other conditions in adults: We have not estimated the impact of SHS on mortality due to other causes because of the small numbers in other categories of conditions in the LIMOR dataset and therefore the unreliability of risk estimates.

4.2.3 Calculation of the passive smoking-attributable fraction (PSAF) of mortality

The ORs for the association between passive smoking at home and death from lung cancer or IHD obtained from the local data are quite similar to those published overseas. We have therefore used the local ORs for males and females together for this costing, since there is no evidence that the effect of passive smoking on males and females is different.

For fatal stroke and COPD, the overseas data is lacking. We have again used the local data; what overseas data there is on acute stroke is consistent with our estimates.

The passive PAF was calculated using the OR from the LIMOR data. The prevalence of exposure used was that from the LIMOR study (exposure at home) or that from HHS (exposure at work and/or at home), giving two estimates of impact.

4.2.4 Calculation of cost

Total and premature passive smoking-attributable deaths and deaths during working life: The number of deaths in the LIMOR group which can be attributed to passive smoking at home were extrapolated to the population, using the sex and age-related multiplier (see Table 2.1). All risks were applied to non-smokers, making the assumption that ex-smokers have the same risks as never-smokers when exposed to SHS.

Table 4.1: Passive smoking-attributable deaths, premature deaths and deaths during working life in the Hong Kong population in 1998 using exposure at home only

	Deaths during working life (35-64 years)	Premature deaths (35-74 years)	Total deaths for those 35 years and over
Male	37	115	260
Female	74	210	508
Total	111	325	768

Table 4.2: Passive smoking-attributable deaths, premature deaths and deaths during working life in the Hong Kong population in 1998 using exposure at work or home

	Deaths during working life (35-64 years)	Premature deaths (35-74 years)	Total deaths for those 35 years and over
Male	104	305	643
Female	74	225	681
Total	178	529	1,324

There were around 768 deaths of non smokers aged 35 years and over in Hong Kong in 1998 which could be attributed to passive smoking at home. Of these, 325 (42 %) were premature deaths (< 75 years) and 111 (14%) were during the productive years (< 65 years).

If we include exposure to SHS at work, we obtain around 1,324 deaths of non-smokers aged 35 years and over in Hong Kong in 1998 which could be attributed to passive smoking. Of these, 529 (40%) were premature deaths (< 75 years) and 178 (13%) were during the productive years (< 65 years).

Years of potential life lost: Taking the premature deaths, we can estimate the years of potential life lost (YPLL) which are attributable to passive smoking. These have been discounted because they are years of life which would have occurred in the future. The results extrapolated to the population are shown in Tables 4.3 and 4.4 undiscounted and with discount rates of 3% and 5%. The formula (undiscounted) used is:

Estimated YPLL(age/sex) Hong Kong population = YPLL(age/sex) LIMOR study group x F(age/sex).

Table 4.3 Passive smoking-attributable YPLL for the Hong Kong population in 1998 using exposure at home only

	Premature YPLL		
	No discounting	3% discounting	5% discounting
Male	947	770	684
Female	1875	1490	1307
Total	2822	2260	1991

Table 4.4: Passive smoking-attributable YPLL for the Hong Kong population in 1998 (3% discount rate) using exposure at home or at work

	Premature YPLL		
	No discounting	3% discounting	5% discounting
Male	2681	2134	1874
Female	2009	1585	1386
Total	4690	3719	3260

The passive smoking-attributable YPLL in Hong Kong in 1998 was thus 2,260 years when exposure at home was considered and 3,719 years when home or work exposure is used. This equates to 7.0 years for each passive smoking-attributable premature death whether home exposure or home or work exposure is used.

A similar method was used to estimate the productive YPLL (YPPLL). In this case, to the years lost under the age of 65 years in the LIMOR sample, the labour force participation rate (30) was applied and the result extrapolated to the population. Again, discount rates of 0%, 3% and 5% are applied. Results are in Tables 4.5 and 4.6. Again the estimate made at a 3% discount rate is taken as the main estimate.

Table 4.5: Passive smoking-attributable YPPLL in Hong Kong in 1998 due to SHS exposure at home only

	YPPLL		
	No discounting	3% discounting	5% discounting
Male	207	167	147
Female	255	198	170
Total	462	365	317

Table 4.6: Passive smoking-attributable YPPLL in Hong Kong in 1998 due to exposure at home or at work

	YPPLL		
	No discounting	3% discounting	5% discounting
Male	732	582	509
Female	299	233	201
Total	1031	815	710

The passive smoking-attributable YPPLL in Hong Kong 1998 was 365 person years with 3% discounting for home exposure and 815 years for home or work exposure. This is an average of 3.3 years (home exposure) or 5 years (home or work exposure) of potential earning lost for each passive smoking-attributable death between the ages of 35 and 64 years.

Valuation of the lives and life years lost

If we apply the value of HK$10 million to each premature life lost, this equates to a cost of HK$3,250 million in 1998 for exposure at home only and $5,290 million for exposure at home or at work, assuming that the value of a premature life lost is the same for all ages. This does not include the value of lives lost after the age of 75 years. In Hong Kong, the average life expectancy at birth is currently 77 years for males and 83 years for females (31).

The monetary value for the lost productive years is $45 million for exposure at home and $109 million for exposure at home or at work using the median monthly earnings by those employed in Hong Kong in 1998 (30). The YPPLL on which this estimate is based are already discounted at 3%.

4.3 Costs of SHS exposure of adults in the workplace

4.3.1 Methods

We had local data with which to estimate the impact of SHS at work for one particular population of exposed workers: catering workers (76). This analysis used measures of urinary cotinine and a model developed by Repace et al (77) to estimate the number of deaths due to lung cancer and heart disease in one year due to SHS exposure at work.

4.3.2 Results

With the cotinine levels measured in the catering workers, it was estimated that a working lifetime at these levels of exposure to SHS conferred an annual excess risk of 3% for mortality due to cancer or heart disease. This 3% excess risk translates to up to 150 per year of the 200,000 people working in the catering industry.

4.4 Summary of findings on mortality due to passive smoking

Passive smoking of tobacco smoke is responsible for the following each year in Hong Kong due to attributable mortality

Table 4.7: Passive smoking attributable mortality and costs in Hong Kong in 1998

	Best estimate	Upper estimate[1]	Lower estimate[2]
Deaths	1,324	2,251	334
Premature deaths (< 75 years)	529	909	123
Deaths in working life (< 65)	178	310	38
Lost life years	3,719	6,448	816
Lost productive years	815	1,423	168
Value of lost lives	$5,290 million	$9,090 million	$1,230 million
Value of lost production	$109 million	$190 million	$40 million

1. Based on upper 95% confidence limit of the risk estimate
2. Based on lower 95% confidence limit of the risk estimate

4.5 Discussion

Woodward and Laugesen's paper on mortality due to SHS in New Zealand (61) used prevalence of passive smoking at work which had been estimated in New Zealand workplaces in the past. They could therefore allow for a lag period between the exposure and the manifestation of disease. This is appropriate for those non-acute effects of exposure. However, for the acute effects, the simultaneous level of exposure would be more appropriate. In Hong Kong, we do not have historical data on prevalence of passive smoking at work. We have therefore made the assumption in calculating these health impacts that the previous prevalence is similar to the 1998 estimates.

5. COSTS OF MORBIDITY ATTRIBUTABLE TO PASSIVE SMOKING

5.1 Introduction

In this section, we estimate the costs of morbidity due to passive smoking for men, women and children who are non-smokers.

5.2 Methods

In the previous section, we have calculated the number of deaths from lung cancer, CHD, stroke and COPD due to SHS. However, these conditions will result in a great deal of morbidity too. Apart from this there is also morbidity in children exposed to SHS.

For adults, more serious morbidity often results in hospitalisation and time off work. More minor morbidity may result in outpatient utilization, use of over-the-counter medicines and time off work as well as decreased quality of life

We report here on the a) costs of morbidity in children due to passive smoking at home and b) costs of serious and minor morbidity in adults due to passive smoking home and at work. The serious morbidity costs are estimated for public hospital inpatients only because we have little data on private hospital utilization.

5.2.1 Morbidity in children

We have published data on excess hospitalisations and doctor consultations due to SHS for babies in the first twelve months of life and their dollar cost (78). This data came from a local birth cohort study carried out by the University of Hong Kong (HKU). In another HKU study (79), the extra visits to a doctor by aged 8 to 12 years who lived in a smoking household were calculated. These were valued at US$15 (HK$117) for the consultation plus some costs for time off work and travel. We extrapolated the prevalence of exposure and the costs to the number of children aged between 2 and 15 years in 1998. We have not included in this analysis the value of time spent in hospital by the mother because of birth complications due to smoking or passive smoking, or any effects of low birth weight due to passive smoking by the foetus other than those captured in the birth cohort study.

5.2.2. Serious morbidity in adults: public hospital use

For serious morbidity that results in use of hospital services, we have used an attributable risk calculation based on RRs for mortality in a similar calculation to that used for the impact of active smoking on hospital utilization. We have made two calculations, one using only the prevalence of SHS exposure at home and one using home or work exposure.

We could estimate the proportion of hospital utilization by non-smokers from the HHS; for example, in those over 64 years, 76% of the admissions for males and 93% of those for females were for non-smokers. We estimated, by age-group and sex, the proportion of all hospital admissions of those 35 and over which were for non-smokers.

From the HHS survey (24), 80% of all admissions were to public hospitals and 20% were to private hospitals. However, no data was available regarding private hospital costs so these are not included. The average Hospital Authority cost for an acute public hospital bed day was $3744 and for a long-stay public hospital bed day was $1,985 in 1988.

Total bed days in public hospital (acute/long-stay) in 1998
= Total episodes x PPAF% x admission proportion of non-smoker x mean LOS

Estimated total public hospital cost
= attributable total LOS in acute hospital x $3,744 +
attributable total LOS in long-stay hospital x $1,985

5.2.3 Minor morbidity in adults: outpatient use

For minor morbidity we have used local data on self-reported use of GPs and costs for those exposed to SHS at work. These data are mostly cross-sectional and so odds ratios (OR) have been calculated to estimate relative risks (RR) of exposure to SHS on minor morbidity. These ORs have then been used to calculate population attributable risks (passive smoking population attributable fractions - PPAF) for each outcome measure along with data on prevalence of exposure to SHS. The outcome and unit cost data are then used to estimate the attributable costs. We had no suitable local data on the association of GP visits and SHS exposure at home so we have omitted these costs.

We used published data from the HHS which shows an OR of 1.37 for likelihood of an exposed non-smoking worker making a visit to a doctor for cold, flu or fever compared with a non-exposed, non-smoking worker (25). The prevalence of exposure to SHS at work among non-smoking male and female workers in the HHS was 56.6% and 36.7% respectively while a further 9.3% of males and 22.7% of females are exposed only at home. The published calculation only includes data for those exposed at work.

The population attributable risk was calculated stratified by occupational groups and combined with the average cost of a visit to a doctor for cold, flu or fever in that group. These costs, which were for a 14 day period, were aggregated to a year by multiplying by 26. Finally, the costs were attributed to the public or private sector; private sector costs include those paid by employers and those paid by the individual from their own pocket.

5.2.4 Excess days off work

A published paper using the PHS dataset shows that those never-smokers exposed to SHS had more days off work than those not exposed (27). We re-calculated ORs from this dataset to provide sex-specific ORs and obtained values of 1.80 for men and 1.99 for women for the association between taking time off work and exposure to SHS. We then estimated the PPAF for absence from work due to illness by non-smokers using these ORs. The number of workers in government departments and in the private sector were obtained (28) and the number who were non-smokers were estimated (33). The rate of sick leave not due to work injury and the average duration of leave was known for private sector workers (53). This provided a conservative estimate when extrapolated to the whole non-smoking, working population since public sector workers usually take more time off than those in the private sector. We valued these absences using the median wages for males and females.

Admissions to hospital also result in days off work. We know that 48% of males and 39% of females admitted to hospital in 1998 were non-smoking workers (24). Applying this to the number of bed-days attributable to passive smoking in non-smokers, we can estimate the number of working days lost due to admission and its cost.

5.3 Results

5.3.1. Children

Extra hospitalizations and outpatient consultations due to SHS expose in utero and post-natally at home result in an annual cost of $27.1 million HK (78). This is made up of around $4.3 million and $19.3 million for private and public hospitals respectively and $3.0 million and $0.4 million for private and public outpatient visits. Peters et al (79) estimated that 46.6% of 8 to 12 year old children live with one or more smokers and the lowest estimate of excess cost due to doctor consultations for these children is $2,191,363. Extrapolating to all of the children aged 1 to 15 in Hong Kong in 1998 (1,197,400) gives an estimate of $6,222,011 for extra doctor visits for children.

5.3.2. Serious morbidity: public hospital use

As shown in Tables 6.1 and 6.2, public hospital use for the four conditions of lung cancer, COPD, IHD and stroke, attributable to passive smoking, cost a total of HK$235,860,300 for home exposure only and $471,032,268 for home or work exposure in 1998.

Table 5.1: Passive smoking attributable costs of public inpatient care in 1998 for home exposure only

Hospital	Male		Female		Total
	35-64 yrs	65 and over	35-64 yrs	65 and over	
Acute	16,970,153	51,861,230	18,794,956	77,949,773	165,576,112
Long-Stay	5,690,084	20,842,824	6,447,823	37,303,457	70,284,188
Total	22,660,237	72,704,054	25,242,779	115,253,230	235,860,300

Table 5.2: Passive smoking attributable costs of public inpatient care in 1998 for home or work exposure

Hospital	Male		Female		Total
	35-64 yrs	65 and over	35-64 yrs	65 and over	
Acute	46,807,873	156,627,904	18,661,513	110,802,458	332,899,748
Long-Stay	16,227,473	62,771,941	6,393,003	52,740,103	138,132,520
Total	63,035,346	219,399,845	25,054,516	163,542,561	471,032,268

5.3.3. Minor morbidity: visits to a doctor

When extrapolated to the approximately 3.04 million full-time workers in Hong Kong, we obtain a total of around 1.5 million extra visits to a doctor for cold, flu or fever which are attributable to SHS exposure at work (25). The cost is HK$248 million with 8.4% attributed to the public sector ($21 million), 28.5% paid for by the employer ($71 million) and the employees themselves ($156 million). We do not have data for home exposure effects on GP visits.

5.3.4. Days off work

After applying the PPAF to the total number of days off, we estimate, for work exposure only estimated from the HHS, an attributable loss of 451,951 absence days for men in a year and 592,848 for women, a total of 1,044,799 days. Applying the median salary, we have a cost of sick leave due to exposure to SHS of $353,722,064. We apportioned the costs to the private and public sector by applying the estimate that 9.8% of workers are in the public sector.

The attributable cost of days off work due to hospital admissions for lung cancer, IHD, stroke and COPD in those aged 35 to 64 years amount to $3,254,934 for exposure at home and $7,246,855 for exposure at home or at work.

5.4 Summary of findings on cost of morbidity due to passive smoking

Because the estimate using only exposure at home will miss out the impact of exposure at work and recent evidence shows that the impact of both could be similar, we have used the estimates relating to exposure at home and at work as the main estimate.

Table 5.3: Passive -smoking-attributable cost (HK$) of health care and time off work in 1998

	Best estimate	Upper estimate[1]	Lower estimate[2]
Admissions and doctor visits for children <12 months	27,074,400		
Doctor visits for children 1 to 15 years	6,222,011		
Total for extra utilization by children	33,296,411		
Public acute hospital	332,899,748	544,812,194	100,608,115
Public long-stay hospital	138,132,520	224,243,305	45,008,613
Total for public hospital	471,032,268	769,055,499	145,616,728
Doctor visits due to SHS at work – employers' cost	71,000,000[3]	133,000,000[3]	7,000,000[3]
Doctor visits due to SHS at work – government cost	21,000,000[3]	40,500,000[3]	2,300,000[3]
Doctor visits due to SHS at work – employees' cost	156,000,000[3]	294,100,000[3]	14,800,000[3]
Doctor visits due to SHS at work	248,000,000[3]	467,600,000[3]	24,100,000[3]
Working days lost as inpatient	(7,246,855) [4]	(11,929,424) [4]	(2,114,073)[4]
Time off work (private sector)	319,057,302[3]	517,307,890[3]	118,202,203[3]
Time off work (public sector)	34,664,762[3]	56,204,183[3]	12,842,368[3]
Total for working days lost	353,722,064[3]	573,512,073[3]	131,044,571[3]
Home based helper	2,398,808	3,995,330	690,036
Total of all costs	1,108,449,551	1,847,459,313	334,747,746
Private costs	554,678,121 (50%)	954,625,231 (52%)	146,914,250 (44%)
Public costs	553,771,430 (50%)	892,834,082 (48%)	187,833,496 (56%)

5. This estimate uses the upper 95% confidence limit for the risk estimate
6. This estimate uses the lower 95% confidence limit for the risk estimate
7. This estimate only covers exposure to SHS at work; we have no data on the effect of home exposure
8. This cost is not included as it is part of the two costs below

5.5 Discussion

The General Household Survey (53) shows that 6.8% of employees in the previous one month took time off work of less than 4 days while 1.7% took 4 or more days off in the last 6 months. In both cases, females and older people took more days off. The PHS had 29.9% reporting days off in the last 6 months for illness and 12.7% taking days off for injury while 3.8% were reported as taking more than 4 days off for illness in the last 6 months. In the above calculations we used only days off for illness. We have estimated the total number of days off for illness by never smokers in the labor force as 4,405,723 days. This gives an average of only 1.67 days absence due to illness per person per annum. The final cost is equivalent to $165.75 per annum for each never-smoker in population or 0.496 days preventable work lost.

6. COST OF TOBACCO USE IN HONG KONG

6.1 Limitations of the study

This study uses the attributable risk approach to calculate an attributable fraction and then apply it to the total costs of care for a condition. This approach has the advantage that it allows the estimation of morbidity costs using mortality attributable risks with the assumption that the proportion of smokers among inpatients with a particular condition is similar to the proportion of smokers among deaths which were due to that condition. For hospital admissions this is a reasonable approach and has been used in many previous studies. If data allowed, it is clearly better to use directly estimated attributable risks for morbidity but we do not have a database which would allow us to take this approach to inpatient costs in Hong Kong at present. We have, however, directly estimated the extra costs of GP visits, time off work and healthcare utilization in children using data from special studies.

It is difficult to estimate the effect on the findings if directly estimated SAFs for hospital utilization had been available. Two studies which took this approach in Australia (82) and US (10) came up with results that were very similar, when grossed down by population size and smoking prevalence, to ours. It is likely that any effect would be to under-estimate, rather than over-estimate the costs of morbidity. The mortality risk ratios that we used were controlled for age, sex and education as a proxy for social class. Other confounders which might impact on mortality, such as lifestyle factors (exercise, diet) were found not to affect these risk ratios very much, perhaps because their effect is mainly contained within that of social class. The same confounding factors would apply to utilization and we have no evidence that their effect would be different. It would be useful for some population-based cohort studies to be set up to answer questions like these.

A designation of ‘ever-smoking’ was used to characterize smokers which does not allow for any difference between current and former smokers. The proportion of ex-smokers was quite small and, since all risk estimates used in the costing were based on ever-smokers, the impact on both ex- and current smokers is included in the costing.

Where possible, risk estimates were age-group and sex specific but, in some cases, due to limitations of data available, an overall (age and sex) estimate was used. In particular, this was the case for outpatient visits where sex-based costs were not available although some age-group breakdowns were available. It is difficult to be certain whether this crude analysis would have over or under-estimated the total costs but it is most likely to have underestimated them.

The attributable cost of intensive care units and coronary care units is likely to have been underestimated in this study since the cost of these units is included in the average bed-day cost. Smoking-related conditions tend to be more acute and so these expensive facilities are more likely to be used by smokers than by other inpatients leading to an underestimate of costs when the average bed-day cost is used.

6.2 Summary of the costs

6.2.1 Costs related to mortality

As described in Chapter 2, the main annual costs related to mortality caused by active smoking are 3,398 premature deaths with a value of $33,980 million and 8,669 working years lost with a value of $1,244 million. As described in Chapter 4, we have 178 premature deaths annually in non-smokers, due to passive smoking, with a value of $1,780 million and 815 working years lost which are worth $109 million.

6.2.2 Costs related to morbidity

According to the findings in Chapter 3, the annual health care costs due to active smoking are $1,900 of which 89% ($1.7 billion) fall on the public sector. A further $94 million are lost as GP visits, $66 million as lost working days and $918 million as long term care for smoking-related diseases. In Chapter 5, from the estimates of health care utilization associated with passive smoking, we have health care costs of $752 million of which 67% ($504 million) are costs to the public health care system. Further, we have $248 million due to GP visits, $354 million in lost working days due to illness and $2 million in home-based domestic helper fees.

6.3 Total costs

Hence the total health care costs are $2.7 billion of which $2.2 billion (82%) fall on the public sector. Productivity losses are $1.8 billion and a further 3,927 people die prematurely before age 75. These costs are summarized in the table below.

6.6 Costs not included

The following relevant costs could not be included because of lack of local data:

- The attributable cost of family care for a sick elderly person.
- The cost of hospital care due to active or passive smoking for young people between ages 16 and 34 and for active smoking for those fifteen and under.
- Pain and suffering

In the calculation of costs due to passive smoking, we have included only the four main conditions of lung cancer, heart disease, stroke and chronic obstructive pulmonary disease. This is likely to be an underestimate because evidence is increasingly becoming available that other conditions are linked to passive smoking but we have no useful epidemiological data on this yet. In the estimate of active smoking effects, we did not include the broad areas of digestive system disease, which includes endocrine disease, but this category showed a significant and positive association with active smoking in our analyses. There is increasing evidence to link diabetes with smoking. Therefore again, we will have produced an underestimate of the true cost of disease conditions linked with tobacco.

For the estimate of private doctor consultations, we could only include an estimate of the effect of passive smoking at work since we had no data on the effect of home exposure.

6.7 Conclusion

Excluding the value of pain and suffering, lost lives and some categories of health care utilization, the estimate of the annual health-related costs of tobacco use in 1998 come to around HK$5.3 billion including $2.7 billion for health care costs, $1.8 billion in productivity losses and $0.9 billion in cost of long term care. due to ill health and premature mortality. It is recommended that further data is collected to allow more complete estimation of the costs of tobacco and other population risk factors.

Summary of the annual costs (1998) for mortality and morbidity due to diseases caused by tobacco

Component of cost	**No. of smoking attributable units**	**Unit cost (HK$)**	**Value (million HK$)**
Mortality			
Active smoking			
Total lives lost	5,596	-	-
Premature deaths (<75 years)	3,398	10 million	33,980
Productive lives lost (<65 years)	1,529	-	-
Life years lost (<75 years)	28,668	-	-
Productive years lost (<65 years)	8,669	males:144,000, females:108,000	1,244
Passive smoking			
Total lives lost	1,324	-	-
Premature deaths (<75 years)	529	10 million	5,290
Productive lives lost (<65 years)	178	-	-
Life years lost (<75 years)	3,719	-	-
Productive years lost (<65 years)	815	males:144,000, females:108,000	109
Morbidity			
Active smoking			
Public hospital days			
Acute	270,038	3,744	1,011
Long stay	152,888	1,985	303
Private hospital episodes	6,370	22,500 on average	124
Specialist outpatient clinics	256,823	578	148
General outpatient clinics	714,585	DH: 218, HA: 265	160
A&E (visits)	105,661	572	60
Private GP (visits)	519,962	181	94
Days off work (private sector)	151,160	males:395, females:296	58
Days off work (public sector)	21,610		8
Nursing home care			913
Home-based care			5
Passive smoking			
Admissions and outpatient use in children			33
Public hospital days			
Acute	88,916	3,744	333
Long stay	69,588	1,985	138
Private hospital episodes	not estimated		-
Specialist outpatient clinics	not estimated		-
General outpatient clinics	not estimated		-
A&E (visits)	not estimated		-
Private GP (visits)	1,500,000	181	248
Days off work (private sector)	942,409	males:395, females:296	319
Days off work (public sector)	102,390		35
Home-based care			2

Sub Total Annual Costs:	
Active smoking **$4.1 Billion plus the value of lives lost**	• **Health care: $1,900,000,000** • **Residential & informal care: $918,000,000** • **Lost working time: $1,310,000,000** • **Deaths (all ages): 5,596** Deaths (<75y): 3,398
Passive smoking **$1.2 Billion plus the value of lives lost**	• **Health care: $752,000,000** • **Residential & informal care: $2,000,000** • **Lost working time: $463,000,000** • **Deaths (all ages): 1,324** Deaths (<75y): 529
Total Annual Costs:	**$5.3 Billion, plus the value of 6,920 (3,927 premature) deaths**

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Appendix: International Classification of Diseases, 9th revision (ICD9) categories of disease groups used in the costing

The causes of death used in our analyses are those recorded on the death certificate as the underlying cause of death and the categories of causes of death are the same as those used in the published papers (21,22). The ICD codes for the categories are shown in Table A1 below and the categories used for private hospitals only are shown in Table A2.

Table A1: ICD9 groupings used in the calculation of mortality and morbidity costs

	ICD9 code groups
Lung cancer	162
Oesophageal cancer	150
Stomach cancer	151
Liver cancer	155
Mouth, pharynx, larynx, pancreas, bladder cancer	140-149, 157, 161, 188
Other malignancies	152-154, 156, 158-159, 160, 163-165, 170-175, 179-187, 189, 190-199, 200-208
COPD/Pulmonary heart disease	416-417, 490-492, 496
Respiratory TB	11, 12, 18
Other respiratory	460-466, 470-478, 480-483, 485-487, 493-495, 500-508, 510-516, 518-519
Stroke	430-438
Ischaemic heart disease	410-414
Other vascular	390-398, 401-405, 415, 420-429, 440-444, 446-448, 451-459
Injury and poisoning	800-999
Diseases of the digestive system	530-535, 537, 540-541, 550-552, 555, 557-558, 560, 562, 564, 566-569, 570-578
Peptic ulcer*	531-534, 555-556
Other disease – probably not smoking related	9-10, 13-15, 17, 31, 37-38, 46-47, 70, 117, 137, 212, 223, 225, 236-238, 242, 244, 250, 252-253, 255, 262-263, 275-277, 279-280, 283-289, 290, 294, 307, 311, 320, 322-324, 331-336, 340, 344-345, 348, 353, 357-359, 384, 580-588, 590-593, 595-596, 599, 600, 603, 682, 686, 694-695, 707, 710, 714, 716, 720, 722, 728-729, 730, 737, 745-747, 753, 768, 780, 785-786, 797-799

Notes

1. There are a number of ICD9 code categories which did not appear in the LIMOR dataset, that is, no-one died of that condition in 1998. These categories have also not been included in the mortality or morbidity costing. Most of these are in the category of injury and poisoning. The missing ICD 9 codes are listed below:

175, 181, 394-395, 398, 413, 490, 435, 809-811, 813-819, 822, 824-826, 829-848, 850, 862, 866-867, 870-873, 876-880, 882-887, 890-897, 900, 903, 905-932, 936-945, 947, 950-957, 960-962, 964, 966, 968, 970-971, 975-976, 978-979, 981, 983-985, 988, 991-993

2. The conditions marked with * include gastric ulcer(531), duodenal ulcer(532), peptic ulcer which was site unspecified(533), gastrojejunal ulcer(534), regional enteritis(555) and Idiopathic proctocolitis(556).

Table A2: Discharges and deaths from private hospitals in Hong Kong in 1998

Diagnoses	ICD 9 codes for morbidity
Lung cancer	162
Oesophageal cancer	150
Stomach cancer	151
Liver cancer	155
Mouth, pharynx, larynx, pancreas, bladder cancer	140-149 157 161 188
Other malignancies	152-154, 156, 158-159 160, 163-165 170-175 179-187, 189 190-199 200-208
COPD/Pulmonary heart disease	415-417 490-491, 492-493, 495-496
Other respiratory	10-12, 16-18 460-466 470-478 480-483, 485-487 494 500-502, 503-508, 510-516, 518, 519
Stroke	430-438
IHD	410-414
Other vascular	390-398 401-405 420-429 440-444, 446-448 451-459
Injury and poisoning	800-999
Diseases of the digestive system	520-529 531, 532, 533, 540-543, 550-553, 560, 571, 574-575, 530, 534-537, 555-558, 562, 564-569, 570, 572, 573, 576-579
Selected digestive system diseases	531-533

吸煙引致疾病帶來的經濟損失

二零零五年二月

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背景
有很多流行病學的證據顯示吸煙危害健康。我們可以利用這些資料計算吸煙對社會帶來的經濟影響。在香港，我們擁有新的主動和被動吸煙引致死亡、吸二手煙的額外醫療使用和有關疾病引致的病假等資料。利用以上的資料和其他數據，包括政府統計數字，我們以 1998 年爲例計算出一年內因吸煙帶來的經濟損失。

目的
本研究是以本地數據來計算出在一年內吸煙所帶來的經濟損失。

研究方法
數據：這項研究利用四大資料庫以及其他常規政府數據（例如人口普查，死亡登記，綜合住戶統計調查和醫療支出）計算因吸煙引致疾病而需入院治療及向醫生求診（包括公共和私家醫療機構）所牽涉的經濟損失。計算包括主動吸煙和被動吸煙的影響。

四大資料庫分別是：香港大學（HKU）生活方式與死亡研究〔The Lifestyle and Mortality Study (LIMOR)[1]〕提供吸煙和二手煙引致各種死亡的相對危險度；香港大學哈佛住戶調查〔The Harvard Household Survey (HHS)[2]〕提供吸煙和吸入二手煙的人數數據及其醫療使用率；香港大學警隊健康調查〔The Police Health Survey (PHS)[3]〕提供二手煙與醫療使用率和請病假的關係；及醫院管理局臨床醫療資料庫提供公共醫院住院資料。

因吸煙及二手煙引致的死亡：LIMOR 資料庫的研究報告已於二零零一和零五年在《英國醫學雜誌》發表，顯示出吸煙者[4]與吸二手煙者[5]因爲煙草而引致的各種死亡風險。在計算主動吸煙時，我們應用這個資料庫但以較精細的疾病類別及年齡組別再計算，獲得非常相似的結果。再利用新計算的相對危險度，推算出因爲吸煙或吸二手煙而引致的死亡百份比，並得出失去生命的數目，提早失去生命的數目（死於七十五歲之前）及在有生產力期間而失去生命的數目（死於六十五歲之前）。根據死亡時的年齡，我們計算出因爲死亡而於七十五歲前失去生命的年數及失去生產力的年數。在計算年數折扣中我們採用了 3%年率。我們把以上資料用金錢來量化：每個提早失去的生命的價值是一千萬港元，但我們並沒有將此計於總經濟損失。我們根據一九九八年香港男或女的入息中位數來計算每一年生產力的經濟損失。

因吸煙及二手煙引致的疾病：
假定因爲不同特定疾病而死亡的比例和因該特定疾病而入院的比例兩者相符，我們將特定疾病吸煙死亡百份比用於吸煙人仕入院次數和診所診症次數的計算。醫院管理局提供的數據包括每天因急症或長期入院的單位價值和每次診所的診症單位價值。有關私家醫院的計算，我們利用入院數目的數據及 BUPA（亞洲）有限公司給我們的平均入院費用。在二手煙的計算中，我們沒有私家醫院和專科診所服務的數據。

政府普通科診所，急症室或私家醫生可以治療一些沒有那麼嚴重而因吸煙引致的疾病。我們利用了 LIMOR 的死亡歸因風險於普通科診所和急症室診症的計算內。私家醫生診症的計算，我們只包括呼吸系統疾病的診症和一個中文大學與香港大學合作的研究[6]中的吸煙人仕相對危險度。私家醫生的診症單位價值則取於

HHS。因爲在辦公室接觸二手煙而引致的額外私家醫生的診症，我們利用 HHS 的數據 [7]。

因吸煙或吸二手煙而請病假的相對危險度是用 PHS 的數據 [8] 作估計。我們將歸因於吸煙百份比用於一個工作人口病假的保守估計，並以入息中位數作評估。

我們利用一個香港大學出生隊列研究的數據 [9] 來計算少於一歲小童因受二手煙影響的醫療支出。我們用另一個本地研究 [10]（八至十二歲小童的數據）來計算一至十五歲小童因二手煙而求診的支出。

我們使用六十五歲吸煙者的死亡百份比來計算因吸煙而需護理中心照顧的開支。最後一年生命所需的家居護理開支，我們利用 LIMOR 的數據（於死亡前一年不能外出的時間）來估計。扣除住院的曰數後，我們把吸煙者或非吸煙者的平均不能外出的時間與因吸煙或吸二手煙的死亡數目相乘，再將這需要家居護理的月份以需要請人照顧的部份來計算。我們假設只靠家人照顧不會增加開支。

以上所有數字均屬港幣和是一年的費用（1998 年）。

研究結果

附表顯示吸煙及二手煙所引致的各項經濟損失的結果。我們估計香港在一九九八年有 5,596 宗死亡（年齡三十五歲及以上）是由吸煙所引致及 1,324 宗死亡是由吸二手煙所引致。而當中有 3,398 宗（61％）吸煙所引致的死亡及 529 宗（40%）吸二手煙所引致的死亡是提早死亡（七十五歲之前）。吸煙者在有生產力期間（六十五歲之前）而死亡的有 1,529 個（即所有吸煙引致死亡數目的 27%），這相等於價值$1,244,000,000 的工作時間損失。而吸二手煙者在有生產力期間而死亡的有 178 個，即$109,000,000 的損失。

每年孕婦及胎兒因在家中接觸二手煙而引致的額外入院及診所求診支出達$27,100,000。至於小童的額外求診支出則達$6,200,000。

在成年人，因吸煙而引致公共醫療急症及長期住院醫院服務開支爲$1,785,000,000。此數佔醫院管理局 1998 年度整體支出約 7%。在私家醫院方面，每年用於與吸煙有關的開支估計爲$124,000,000。

吸煙病患者往專科診所求診醫療開支達$148,000,000，即佔全部診症開支（非兒科）之 5%。

在 1998 年，因吸煙引致在政府普通科診所求診醫療開支估計爲$160,000,000，即佔全部普通科病者總開支之 12%。如假設平均每名醫院管理局或衛生署醫生每天診治 60 名病人，一星期五天，及每年 48 星期，那麼便需要 50 名全職普通科診所醫生之一年工作量來診治因吸煙引起的問題。在 1998 年，因吸煙而需要往急症室求診的醫療開支爲$60,000,000，即佔急症室總求診次數之 5%。

在私家診所診治因吸煙引致的呼吸病患者醫療開支是$94,000,000，相等於 36 名全職醫生之工作量。因二手煙而需要私家診所服務的醫療開支達$248,000,000 或相等於 104 名全職醫生之工作量。

估計因吸煙和二手煙導致請病假的經濟損失分別爲$66,000,000 和$354,000,000。這並末包括員工求診而不能上班的時間及在完全康復前上班時生產力降低的損失。

因吸煙而引致長者（六十五歲以上）需要護理中心的照顧開支達$913,000,000。因吸煙和二手煙而需家居照顧的開支分別達$5,000,000 和$2,000,000。我們未能計算因二手煙而引致的護理中心開支。

結論

我們估計香港每年因煙草而導致在醫療方面的開支達 26 億港元，長期護理的開支達 9 億港元，及生產力的損失達 18 億港元，約有 4,000 人因而在七十五歲前早逝。保守估計，總損失是 53 億港元。

作爲比較，醫院管理局早前估計只因三種疾病而住院的支出是$700,000,000。

在醫療開支上，82%的損失是由公共醫療系統負擔而 10%是生產力的損失。28%的醫療支出

是因爲二手煙所引致。26%生產力的損失是因爲吸二手煙而當中大部份是在工作地點接觸二手煙。

以上的計算是保守的估計，並不包括因疾病帶來的痛楚和痛苦損失，家人照顧的價值，或失去的生命價值。

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主要訊息

- 香港每年因煙草引致健康問題的經濟損失保守估計超過五十億港元。而每年煙草稅收約得二十五億港元。
- 其中約 60%的經濟損失用於醫療服務方面，其餘是因患病或死亡而導致生產力的損失。
- 約 82%的醫療服務開支是由公共醫療系統負擔。
- 約 28%的整體醫療服務開支是吸二手煙導致。
- 政府立法在工作地點和公眾地方全面禁煙，能大幅度減低因二手煙和部份減低因吸煙所導致的健康問題及其帶來的經濟損失。

〔此乃中文譯本，以英文版爲準。〕

附表：每年（**1998**）因吸煙引致死亡和疾病的經濟損失總結表

有關項目	吸煙導致 的損失單位	單位價值 (港元$)	價值 (百萬港元$)
死亡			
吸煙			
失去生命的數目	5,596	-	-
提早失去生命的數目（75 歲前）	3,398	10,000,000	33,980
失去有生產力生命的數目（65 歲前）	1,529	-	-
失去生命的年數（75 歲前）	28,668	-	-
失去有生產力生命的年數（65 歲前）	8,669	男:144,000, 女:108,000	1,244
吸二手煙			
失去生命的數目	1,324	-	-
提早失去生命的數目（75 歲前）	529	10,000,000	5,290
失去有生產力生命的數目（65 歲前）	178	-	-
失去生命的年數（75 歲前）	3,719	-	-
失去有生產力生命的年數（65 歲前）	815	男:144,000, 女:108,000	109
疾病			
吸煙			
入住公立醫院的日數			
急症	270,038	3,744	1,011
長期	152,888	1,985	303
入住私家醫院的次數	6,370	22,500（平均）	124
專科診所 (診症次數)	256,823	578	148
普通科診所 (診症次數)	714,585	衛生署: 218, 醫院管理局: 265	160
急症室 (診症次數)	105,661	572	60
私家醫生(診症次數)	519,962	181	94
病假 (私人機構)	151,160	男:395, 女:296	58
病假 (公共機構)	21,610		8
護理中心			913
家居護理			5
吸二手煙			
兒童入院及診所求診			33
入住公立醫院的日數			
急症	88,916	3,744	333
長期	69,588	1,985	138
入住私家醫院的次數	末計算		-
專科診所 (診症次數)	末計算		-
普通科診所 (診症次數)	末計算		-
急症室 (診症次數)	末計算		-
私家醫生(診症次數)	1,500,000	181	248
病假 (私人機構)	942,409	男:395, 女:296	319
病假 (公共機構)	102,390		35
家居護理			2
每年經濟損失小計：			
吸煙 **$4,100,000,000** 及失去生命的價值	醫療服務： **$1,900,000,000** 院舍及非正式照顧服務： **$918,000,000** 損失工作時間： **$1,310,000,000,** 死亡（所有年齡）： **5,596** 提早死亡（死於 **75** 歲前）： **3,398**		
吸二手煙 **$1,200,000,000** 及失去生命的價值	醫療服務： **$752,000,000** 院舍及非正式照顧服務： **$2,000,000** 損失工作時間： **$463,000,000,** 死亡（所有年齡）： **1,324** 提早死亡（死於 **75** 歲前）： **529**		
每年經濟損失總計：	**$5,300,000,000** 及 **6,920** 死亡（**3,927** 提早死亡）的價值		