RESEARCH PAPER

# Disease burden of adult lung cancer and ischaemic heart disease from passive tobacco smoking in China

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**Objective:** To address the health hazards tobacco smoking imposes upon non-smokers in China, this paper estimates the burden of diseases in adults from passive tobacco smoking for two major diseases—lung cancer and ischaemic heart disease (IHD).

**Methods:** The disease burden was estimated in terms of both premature mortality and disability adjusted life years (DALYs), a measure that accounts for both the age at death and the severity of the morbidity.

**Results:** Passive smoking caused more than 22 000 lung cancer deaths in 2002 according to these estimates. When the toll of disability is added to that of mortality, passive smoking was responsible for the loss of nearly 230 000 years of healthy life from lung cancer. Using the evidence from other countries that links IHD to passive smoking, we estimated that approximately 33 800 IHD deaths could be attributable to passive smoking in China in 2002. Passive smoking is also responsible for the loss of more than one quarter of a million years of healthy life from IHD. Although most of the disease burden caused by active smoking occurs among men, women bear nearly 80% of the total burden from passive smoking. The number of deaths among women caused by passive smoking is about two-thirds of that caused by smoking for the two diseases we examined.

**Conclusion:** Even without considering the passive smoking risks for other diseases and among children that have been documented in other countries, passive smoking poses serious health hazards for non-smokers, especially for adult female non-smokers in China, adding more urgency to the need for measures to be taken immediately to protect the health of non-smokers and curb the nation's tobacco epidemic.

China is the largest producer and consumer of cigarettes among all countries. According to the 1984 and the 1996 national smoking surveys, more than 70% of men above age 30 were smokers,[1–3] and the total smoking population exceeds 350 million. Because of the high smoking rate, the health burden from tobacco smoking is the greatest of all countries. A recent report jointly issued by the World Health Organization and the Ministry of Health of China[4] pointed out that nearly one million Chinese smokers died from smoking-related diseases in 2000 and two million will die of smoking-related illnesses annually by 2020, double the figure for 2000, if the number of smokers continues to grow at present rates. The number of passive tobacco smokers in China is even greater than numbers of active smokers. According to the 1996 national smoking survey, 53.5% of all non-smokers above age 30 in China reported exposure to secondhand tobacco smoke (SHS) for more than 15 minutes a day for at least one day per week,[1 3] including 49% of teenage non-smokers between age 15 and 19. The total number of passive smokers is as many as 400 million.

In this paper, we estimate the disease burden from two major diseases (lung cancer and ischaemic heart disease, IHD) in adults caused by passive smoking in China. These estimates begin the process of placing SHS health effects into context with other health risks in the country. This paper does not report the total SHS burden, however, which would include other diseases and other age groups. We estimate the SHS disease burden in terms of both premature mortality and disability adjusted life years (DALYs), a measure that accounts for both the age at death and the severity of the morbidity.[5] DALYs is a health gap measure (health adjusted life year, HALY) that extends the idea of potential years of life lost due to premature death, to include equivalent years of ''healthy'' life lost to illness or injury (together termed ''disability'').[6 7] It is the sum of two measures: the years of life lost from mortality (YLLs), and the years of life lost from living with disability (YLDs):

$$\text{DALYs} = \text{YLLs} + \text{YLDs} \quad (1)$$

YLLs is the number of years of life lost from death due to a specific disease and YLDs is the number of years living with a disease, adjusted by a factor that accounts for the severity of the disease.

## METHODS

In our calculations, we use epidemiological and exposure information from China itself wherever possible. To maintain consistency with the World Health Organization Global Burden of Disease and the Comparative Risk Assessment Projects,[8] however, we use data on population and background disease rates from these databases. These are derived in a consistent and coherent manner across all countries, which requires some adjustment in each of the 14 regions covered. By population, China makes up ~85% of WPRO-B (Western Pacific Regional Office—countries with low child and adult mortality rates),[9] and thus this factor is applied to data from that WHO subregion. As a result, in some cases there are some minor differences from official Chinese national statistics, but the overall impact on the burden of disease comparisons is small.

To be consistent with the databases used in the Comparative Risk Assessment Project for 2000[10] and the 2002 Global Burden of Disease database,[8] we use DALYs discounted at 3% for future

**Abbreviations:** DALYs, disability adjusted life years; HALY, health adjusted life year; IHD, ischaemic heart disease; LRI, lower respiratory infection; RR, relative risk; SHS, secondhand tobacco smoke; WPRO, Western Pacific Regional Office; YLDs, years of life lost from living with disability; YLLs, years of life lost from mortality

**Table 1** Summaries of relative risks used to make the estimates in this paper

| | Males (95% CI) | Females (95% CI) |
|---|---|---|
| **Smoking** | | |
| Lung cancer | 2.72 (2.62 to 2.82) | 2.64(2.48 to 2.80) |
| IHD | 1.72 (1.61 to 1.83) | 2.69 (1.82 to 3.98) |
| **Passive smoking** | | |
| Lung cancer | 1.63 (1.12 to 2.37) | 1.63 (1.12 to 2.37) |
| IHD | 1.22 (1.10 to 1.35) | 1.24 (1.15 to 1.34) |

IHD, ischaemic heart disease.
The 95% confidence intervals (CI) shown were derived from the meta-analyses and do not reflect all sources of uncertainty.

life years to capture uncertainty that increases with time, and non-uniform age weighting, which gives more weight to years of life lost during middle-age for its higher productivity.

## Attributable lung cancer burden from active smoking in 2002

As is common in such calculations,[11 12] the burden of disease is determined here by multiplying the population attributable fraction of disease due to the risk factor, SHS, by the background disease rate. As active smoking is such an important cause of lung cancer in all parts of the world, however, the average lung cancer rate is greatly affected by smoking rates. As the impact of SHS on smokers (smokers breathing secondhand tobacco smoke from other people's smoking) is not known, it is more conservative—that is, resulting in the lower but more certain estimates, to conduct the analysis with the lung cancer rate in non-smokers. Since there are no available mortality statistics specifically for non-smokers in China, however, the number of lung cancer deaths among Chinese non-smokers was estimated by first calculating the active smoking attributable lung cancer mortality among smokers and essentially removing it from the total. This analysis was restricted to adults above age 30 because the few deaths from lung cancer under 30 were mostly among young children and few were attributable to active or passive smoking.[13] It was also assumed that the relative risk was constant for both sexes above this age. Age-specific and sex-specific mortalities for lung cancer in the entire Chinese population in 2002 were extrapolated from the WHO subregion WPRO-B estimates.[8]

The health effects of active smoking have been documented in Chinese epidemiological studies. In a meta-analysis by Yu and Zhao,[14] 15 case-control studies on lung cancer and smoking in China were summarised. The overall estimate by Yu and Zhao[14] was an odds ratio (OR) of 3.01 (95% CI: 2.64 to 3.46) for smoking men and 2.32 (95% CI: 2.02 to 2.66) for smoking women compared to non-smokers. Liu *et al*[13] assessed the death records of one million people and found that smokers were more likely to die from lung cancer than non-smokers (relative risk (RR) of men = 2.72 (2.62 to 2.82); RR of women = 2.64 (2.48 to 2.80)) (table 1). Although these estimates are smaller than similar estimates in other countries, we use these results since they are derived from exclusively Chinese studies. Table 1 presents the relative risks and 95% confidence intervals used in our calculations in this paper.

The 1984 smoking rates of the 2002 population were used to estimate the burden of disease of lung cancer attributable to smoking in 2002 to account for the latency period of lung cancer (for example, to estimate the disease burden of age group 50–60 in 2002, the smoking rate in age group 30–40 in 1984 was used). Combining the RRs from Liu *et al*[13] and the smoking rates in 1984, the active smoking attributable risks for lung cancer was calculated as follows:

$$AR_s = 1 - \frac{1}{1 + P_s \times (RR_s - 1)} \quad (2)$$

where $AR_s$ is attributable risk from smoking within a specific age/sex group; $P_s$ is smoking prevalence within a specific age/sex group; $RR_s$ is RR from smoking.

The mortality caused by lung cancer among non-smokers in 2002 was estimated from the active smoking attributable mortality and the smoking rates:

$$D_{nons} = (D_{total} - D_{smka}) \times (1 - P_s) \quad (3)$$

where, within a specific age/sex group $D_{nons}$ is mortality among all non-smokers from lung cancer; $D_{total}$ is mortality from lung cancer among both smokers and non-smokers; $D_{smka}$ is smoking attributable mortality from lung cancer; and $P_s$ is smoking prevalence.

## Attributable lung cancer burden from passive smoking in 2002

In a meta-analysis, Gan *et al*[15] pooled 19 published Chinese case-control studies on passive smoking and lung cancer to find that non-smoking women exposed to SHS regularly in a lifetime face 63% increased risk of lung cancer (OR = 1.63, 95% CI: 1.12 to 2.37) compared to non-exposed women (table 1) and living with a smoking husband is associated with an OR of 1.28 (95% CI: 1.03 to 1.59). Only one study with lifetime risk from SHS exposure among males was identified by Gan *et al*[15] and the study found no increased risk from such exposure. Given the limited evidence of studies on males, and the fact that little sex difference has been found in other countries,[16–18] we applied the same relative risks among females as non-smoking males.

The 1984 smoking survey did not cover exposure to passive smoking, but since the smoking rates are similar between the two national surveys in 1984 and 1996,[2 3] we assumed that the passive smoking rates in 1984 were the same as in 1996. The attributable risks of lung cancer from passive smoking were estimated based on the passive smoking prevalence from the second national smoking survey in 1996[3] and the RRs of lung cancer from passive smoking[15]:

$$AR_{ps} = 1 - \frac{1}{1 + P_{ps} \times (RR_{ps} - 1)} \quad (4)$$

where $AR_{ps}$ is attributable risk from passive smoking within a specific age/sex group; $P_{ps}$ is passive smoking rate within a specific age/sex group; $RR_{ps}$ is RR from passive smoking.

For each death attributable to smoking or passive smoking, the number of YLLs was calculated based on the standard life expectancy at the same age and of the same sex (see Table 1.1 in Murray and Lopez[5]). The total YLLs caused by smoking or passive smoking are the sums of the YLLs from all deaths attributable to smoking or passive smoking, respectively.

To estimate the YLDs caused by active smoking and passive smoking, we first calculated the total YLDs from all lung cancer cases in China.[8] Then we estimated the YLDs caused by active smoking by applying the attributable risks of smoking to the total lung cancer YLDs—that is, the same attribution for YLDs as for YLLs. It was assumed that a lung cancer death from smoking or passive smoking had the same amount and severity of disability (lung cancer illness) associated with it as an average lung cancer death in China—that is, on average two years of illness at a disability weight of 0.15.[19]

**Table 2** Premature deaths (in thousands) and DALYs attributable to active smoking in China in 2002

| | Male | | | | | Female | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30–44 | 45–59 | 60–69 | 70+ | Total | 30–44 | 45–59 | 60–69 | 70+ | Total | Total |
| **Lung cancer** | | | | | | | | | | | |
| Deaths | 3.2 | 26.4 | 41.4 | 43.7 | 114.7 | 0 | 1.1 | 4.3 | 10.0 | 15.3 | 130.0 |
| DALYs | 80.3 | 418.5 | 376.2 | 179.4 | 1,054.3 | 0.8 | 17.4 | 42.2 | 46.5 | 106.9 | 1,161.2 |
| **IHD** | | | | | | | | | | | |
| Deaths | 5.6 | 20.4 | 29.4 | 63.3 | 118.7 | 0.4 | 4.0 | 10.4 | 36.0 | 50.9 | 169.6 |
| DALYs | 155.9 | 344.2 | 276.7 | 260.1 | 1,036.8 | 12.3 | 70.9 | 107.1 | 167.3 | 357.7 | 1,394.6 |

IHD, ischaemic heart disease.
Central estimates based on RRs in table 1.

The YLDs from all lung cancer cases among non-smokers were estimated using formula 3 except that YLDs in the formula replaced mortality. The lung cancer YLDs caused by passive smoking were estimated by applying the attributable risks from passive smoking to the lung cancer YLDs among all non-smokers. For each age/sex group, the DALYs attributable to active smoking and passive smoking were estimated, respectively.

### Smoking and passive smoking attributable disease burden from IHD in 2002

We also estimated the IHD burden caused by passive smoking, as evidence from other countries suggests that SHS causes more deaths from IHD than from lung cancer among non-smokers. We first calculated the smoking attributable IHD burden using evidence from Chinese epidemiological studies, and then we calculated the passive smoking attributable IHD burden using evidence from studies mainly from other countries. He and Lam[20] conducted a meta-analysis of 25 Chinese epidemiological studies on IHD and active smoking; they estimated that smoking men and women were 1.72 (95% CI: 1.61 to 1.83) and 2.69 (95% CI: 1.82 to 3.98) times more likely to die from IHD, respectively (table 1). Compared to the evidence of the effects of smoking on heart disease, the evidence of passive smoking in China is limited and the findings are mixed. In a study based in Xi'an, He[21] found that exposure to husband's smoking was associated with an increased risk of IHD (OR = 3.52, 95% CI: 1.33 to 9.80) among non-smoking women. In a later study He *et al*[22] found elevated but insignificant risks of passive smoking from husband's smoking (OR = 1.24, 95% CI: 0.56 to 2.72) and from SHS exposure at work (OR = 1.85, 95% CI: 0.86 to 4.00). A recent study by Wen *et al*[23] followed 65 000 non-smoking women for seven years and found that smoking by their husbands increased the risk of cardiovascular disease (consists mainly of IHD and stroke) by 52% (OR = 1.52, 95% CI: 0.92 to 2.50), and exposure to SHS in childhood increased the risk by 82% (OR = 1.82, 95% CI: 0.96 to 3.43). The authors found no elevated risk from workplace SHS exposure.

Considering the mixed findings of the risk of passive smoking on IHD, we estimated the disease burden from IHD that could be caused by passive smoking in China based on epidemiological findings mainly from other countries. In a recent meta-analysis on passive smoking and IHD, He *et al*[24] summarised 18 studies from eight countries (10 cohorts and eight case-controls, the two Chinese studies He[20] and He *et al*[21] were also included in this meta-analysis). Their pooled RR estimates were 1.22 (95% CI: 1.10 to 1.35) for SHS exposed men and 1.24 (95% CI: 1.15 to 1.34) for SHS exposed women (table 1). In a review of epidemiological studies the California Environmental Protection Agency[25] found similar findings that passive smoking increased the lifetime odds of IHD by 30%.

The estimation of the IHD burden caused by passive smoking followed the same methodology as in the lung cancer estimation. The only difference is that when calculating the active smoking attributable IHD burden the average smoking rate across the three surveys (1984, 1996 and 2002) was applied as both long-term and short-term exposures to tobacco smoke are important risk factors for IHD. Since the 2002 survey did not report detailed passive smoking rates, the passive smoking rate in 1996 was used in estimating the passive smoking attributable disease burden assuming the same passive smoking rates in 1984 and 2002 as in 1996. The potential bias introduced by such an assumption would probably be extremely small as the smoking rates among males were very similar across the three surveys.

## RESULTS

Our burden estimates are summarised in tables 2 and 3 and all results presented in this paper with 95% CI estimates are based on the 95% CIs of the RR estimates from the meta-analyses. Given the extremely high male smoking rate and the quite low female smoking rate, it may not be surprising to find that more than half of all male lung cancer deaths in 2002 were attributable to active smoking compared to only 9% among females. On the other hand, a significant proportion of lung cancer deaths among non-smokers was caused by passive

**Table 3** Premature deaths (in thousands) and DALYs attributable to passive smoking in China in 2002

| | Male | | | | | Female | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30–44 | 45–59 | 60–69 | 70+ | Total | 30–44 | 45–59 | 60–69 | 70+ | Total | Total |
| **Lung cancer** | | | | | | | | | | | |
| Deaths | 0.2 | 1.2 | 1.7 | 2.5 | 5.7 | 1.1 | 4.5 | 4.1 | 6.9 | 16.5 | 22.2 |
| DALYs | 8.6 | 18.4 | 15.9 | 10.1 | 53.0 | 28.9 | 73.6 | 40.0 | 32.1 | 174.6 | 227.6 |
| **IHD** | | | | | | | | | | | |
| Deaths | 0.3 | 0.9 | 1.3 | 3.9 | 6.3 | 0.9 | 2.6 | 3.9 | 20.0 | 27.5 | 33.8 |
| DALYs | 7.1 | 14.6 | 12.0 | 16.1 | 49.9 | 25.3 | 46.6 | 40.4 | 92.9 | 205.2 | 255.1 |

IHD, ischaemic heart disease.
Central estimates based on RRs in table 1.

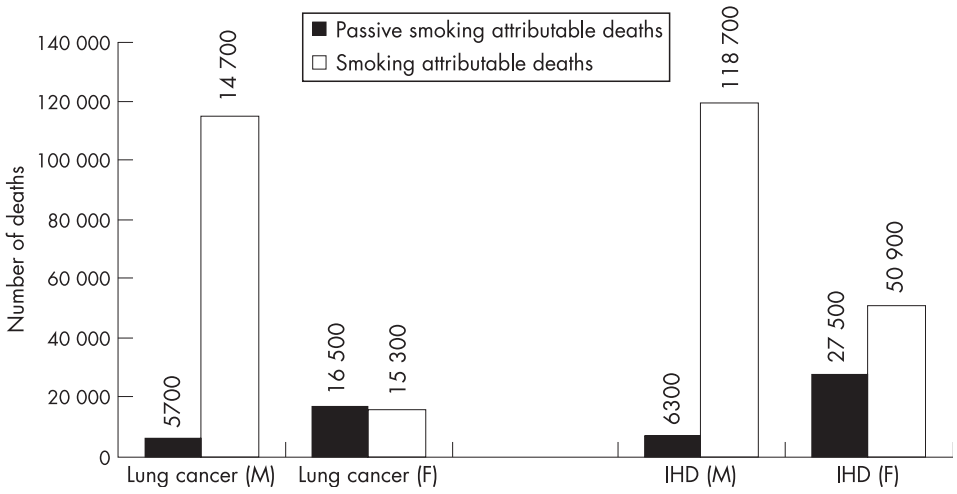


**Figure 1** Number of premature deaths caused by passive smoking vs number of deaths caused by smoking by disease and sex.

smoking (about 21% among non-smoking males and 26% among non-smoking females). Specifically, in 2002, 130 000 people died from lung cancer because of active smoking, of which 88% were men. An additional 22 200 non-smokers died from lung cancer because of exposure to SHS, with 5700 among men and 16 500 among women. The number of DALYs lost was also significant; overall active smoking caused the loss of over 1.1 million years of life from lung cancer and passive smoking was responsible for the loss of 228 000 years of life from the same disease.

Lung cancer was the first disease to be linked to smoking and passive smoking, but later research revealed that IHD caused far more deaths. The results from this study support this finding as well. As shown in tables 2 and 3, active smoking caused about 40 000 more deaths from IHD than from lung cancer (169 600 vs 130 000), and the number of passive smoking-related IHD deaths also exceeded lung cancer (33 800 vs 22 200). Compared to lung cancer, the gender disparity in the IHD burden caused by active smoking is smaller; 30% of all the IHD deaths caused by active smoking were among women compared to only 12% of lung cancer deaths. Women shouldered most of the deaths caused by passive smoking—81% and 74% of all IHD and lung cancer deaths from passive smoking occurring among women. Overall, 169 600 IHD deaths were caused by active smoking and 33 800 IHD deaths were caused by passive smoking in 2002. In terms of DALYs, 1.4 millions years of healthy life were lost from IHD because of active smoking and about a quarter of a million years were lost because of passive smoking.

For lung cancer and IHD combined, the mortality caused by passive smoking was about 19% of the mortality caused by active smoking. Similarly, the total DALYs lost from these two diseases as a result of passive smoking combined was 19% of the total DALYs lost as a result of active smoking. Among males, the mortality caused by active smoking far exceeded that caused by passive smoking (fig 1). Among females, however, SHS exposure attributable IHD deaths were about two-thirds of the active smoking attributable IHD deaths; and SHS exposure attributable lung cancer deaths even exceeded the active smoking attributable lung cancer deaths (tables 2 and 3; fig 1). Overall, the number of deaths caused by passive smoking among females was about two-thirds of that caused by active smoking, and the DALYs lost from passive smoking (379 800) were more than 80% of the DALYs lost from active smoking (464 600) for females.

It is assumed in this study that the attribution is the same for YLLs and YLDs. YLDs make up a small proportion of the total DALYs (<4% for both smoking DALYs and passive smoking DALYs). The proportion is even smaller for lung cancer (~1%), as few people survive lung cancer for long. Thus, the final DALYs estimates are not very sensitive to the assumption related to determining YLDs.

## DISCUSSION

The mortality caused by passive smoking has been examined in many countries,[12 26–29] but our study seems to be the first to systematically estimate part of the disease burden in China. We find that passive smoking causes around 56 000 deaths from lung cancer and IHD each year in China. The added risk passive smoking puts upon exposed non-smokers is ~20/100 000. For comparison, the risk of dying from traffic accidents in China is ~8/100 000, less than half the risk from passive smoking. To further compare the risk of passive smoking with other risk factors, passive smoking causes more deaths than unsafe sex and twice as many deaths as illicit drug use in China in 2000. Active smoking is one of the leading causes of disease burden in China. According to the World Health Report 2002,[9] active smoking is the second leading cause of premature mortality only after high blood pressure. Likewise, the number of years of life lost from active smoking is the third after high blood pressure and alcohol use. Recent estimates of the economic costs of active smoking in 2000 amounted to $US5.0 billion in total or about $25 per smoker, which is 3.1% of China's national healthcare expenditure.[30] This includes the direct costs of morbidity and mortality attributable to smoking, but does not include that due to SHS, which would add significantly more. In sum, the adverse health effects of smoking and passive smoking constitute a major health and economic burden to China.

We estimated the burden of disease for only two major outcomes—lung cancer and IHD, as our effort has been limited by lack of local epidemiological evidence and the uncertainty in the quality of mortality statistics.[31] Many of the diseases related to SHS exposure in studies around the world that are not estimated in this study may have significant health consequences, especially among women and children. Recently the California Environmental Protection Agency[25] summarised the scientific evidence regarding diseases related to SHS and found that the evidence was sufficient to conclude that SHS exposure is a risk factor for low birth weight, sudden infant death syndrome, a host of respiratory diseases including asthma, otitis media and lower respiratory infection (LRI), as well as breast cancer and nasal sinus cancer. Of these, breast cancer and LRI are of particular importance in China. The California Environmental Protection Agency[25] found that SHS exposed premenopausal women experienced about twice the risk for

breast cancer compared to non-exposed premenopausal women. Statistics show that the incidence rate of breast cancer in China has been increasing at around 3% per year from 17/100 000 in 1972 to 52/100 000 in 2004. How much passive smoking contributes to this increased burden and how passive smoking interacts with other risk factors are still to be investigated. As in most of the world, LRI is a major killer for children under age 5 in China, accounting for about 500 000 deaths annually.[32] Both the California Environmental Protection Agency report[25] and the Surgeon General's report[16] concluded that young children exposed to SHS were found to be at 1.5–2-fold risk of acute LRI compared to non-exposed children, although no mortality studies seem to have been conducted. As reports that link childhood diseases to a specific risk factor always draw substantial public attention, any evidence linking passive smoking with LRI among young children in China will help raise the awareness of smoking among the public.

Evidence has accumulated over the past decade that passive smoking might also be a risk factor for stroke. Three studies[33–35] so far have investigated this issue, including one study from Shanghai, China by Zhang *et al*.[35] This is a cross-sectional study based on the baseline data of the Shanghai Women's Health Study.[23] They found that the OR for stroke was elevated by SHS exposure, significantly so with higher or longer exposures. There were also significant exposure-response trends for both degree and duration of exposure. The findings were supported by two other studies in New Zealand and Australia,[33 34] which also found elevated risks of stroke from SHS exposure. Overall, the evidence is suggestive of a causal relation between SHS exposure and the risk of stroke, as been concluded by the California Environmental Protection Agency.[25] Because of the limited evidence, we do not include estimates for stroke in this paper, but such an association would be important in China because it is one of the leading causes of death and disability and statistics show that many more people die from stroke than from IHD.[35]

In the second National Smoking Prevalence Survey,[1] 53.5% of non-smokers answered ''yes'' to the question ''Are you exposed to SHS at least 15 min/day for at least one day per week,'' which was formulated based on WHO's definition of passive smoking. Since most epidemiological studies[36–39] and major surveys in other countries[40 41] use a less clearly defined but much more straightforward definition, which is simply based on the presence of a smoker in the household, we believe that directly using the complex WHO definition in a survey question may have led to a significant number of missing answers and consequently a considerably underestimated prevalence rate. Moreover, urinary cotinine measurements show that survey questionnaire tends to underestimate the actual exposure rate.[41] For the reasons above, we believe the attributable estimate from passive smoking in this paper should be considered as a conservative estimate of the actual burden from passive smoking.

A 3% discount rate is normally used by WHO in calculating the DALYs to capture the uncertainty that increases with time and the need to use resources efficiently.[5 8] For consistency in comparing with DALY estimates from other countries, a 3% discount rate has also been applied in this paper. The WHO cost-effectiveness handbook,[42] however, recommends presenting data with a zero discount rate as well, which would increase the DALY estimates in this paper by approximately 30%. The 95% confidence intervals of the RRs in table 1 reflect that part of the uncertainty in the overall calculations because of variation in the results of individual studies, but do not capture other types of uncertainty, such as publication bias, poor study design, residual confounding, or use of non-representative populations.

## What this paper adds

- To our knowledge, no previous study has examined the disease burden from passive smoking in China. The current study focuses the burden from two major diseases caused by passive smoking—lung cancer and ischaemic heart disease.
- The results of this study serve as strong evidence that more stringent legislation needs to be put into place in China to protect non-smokers from the harm caused by tobacco smoke.

## CONCLUSION

Exposure to SHS imposes significant risks upon non-smokers in China. Based on our analysis of only two of the diseases known to be associated with SHS exposure, a total of 56 000 people died in China in 2002 from lung cancer (22 200) and IHD (33 800) because of exposure to SHS. The disability adjusted life years (DALYs) lost in 2002 caused by passive smoking from lung cancer and IHD combined was 482 700 years, which was 19% of the burden of the same diseases caused by active smoking. As relatively few (5.4%) women smoke, but most live with a smoker, passive smoking causes a surprisingly high toll of tobacco-related deaths in women—about two-thirds of that caused by active smoking.

More epidemiological research should be conducted on the other diseases associated with passive smoking—for example, breast cancer among premenopausal women and a number of childhood diseases, such as pneumonia, asthma, and sudden infant death syndrome. Understanding the impact of SHS on their health burden is important both because of their importance in China and the potential influence such understanding might have on the public's perception of smoking as a cause of ill health.

Tobacco smoking causes as many as one million deaths a year in China and the smoking rate is expected to rise in the next decade. Sustained efforts to invest in long-term comprehensive tobacco control programmes at national and local levels are desperately needed. Although smoke-free environment policies at work and in public places have been shown to effectively reduce smoking, such policies cannot be successfully implemented without sufficient awareness of the harm of passive smoking among the public, which is unfortunately lacking. In light of the serious threat tobacco poses for the health of both smokers and non-smokers in China, including children, we urge more resources be allocated to educate both health professionals and the public about the health impact of smoking and passive smoking and more stringent legislation be put into place to curb the nation's tobacco epidemic, one of the largest epidemics of any type in world history in terms of numbers of potential deaths.

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## REFERENCES


1 **Chinese Academy of Preventive Medicine**. *1996 National prevalence survey of smoking patterns*, Chinese Academy of Preventive Medicine, 1997:403.
2 **Weng XZ**, Hong ZG, Chen DY. Smoking prevalence in Chinese aged-15 and above. *Chin Med J* 1987;**100**:886–92.
3 **Yang G**, Fan L, Tan J, *et al*. Smoking in China: findings of the 1996 National Prevalence Survey. *JAMA* 1999;**282**:1247–53.
4 **World Health Organization**. *Preventing chronic diseases: a vital investment*. Geneva: WHO, 2006.
5 **Murray CJ**, Lopez AD. *The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries, and the risk factors in 1990 and projected to 2020*. Geneva: World Health Organization, 1996.
6 **Gold MR**, Stevenson D, Fryback DG. HALYS and QALYS and DALYS, oh my: similarities and differences in summary measures of population health. *Annu Rev Public Health* 2002;**23**:115–34.
7 **Steenland K**, Armstrong B. An overview of methods for calculating the burden of disease due to specific risk factors. *Epidemiology* 2006;**17**:512–9.
8 **Global Burden of Disease Project**. http://www3.who.int/whosis/menu.cfm?path=evidence,burden,burden_estimates,burden_estimates_2002N&language=english, Global Burden of Disease Project, World Health Organization 2005.
9 **World Health Organization**. *The world health report, 2002*. Geneva: WHO, 2002.
10 **Ezzati M**, Lopez AD. Regional, disease specific patterns of smoking-attributable mortality in 2000. *Tob Control* 2004;**13**:388–95.
11 **Neubauer S**, Welte R, Beiche A, *et al*. Mortality, morbidity and costs attributable to smoking in Germany: update and a 10-year comparison. *Tob Control* 2006;**15**:464–71.
12 **McGhee SM**, Ho LM, Lapsley HM, *et al*. Cost of tobacco-related diseases, including passive smoking, in Hong Kong. *Tob Control* 2006;**15**:125–30.
13 **Liu BQ**, Peto R, Chen ZM, *et al*. Emerging tobacco hazards in China: 1. Retrospective proportional mortality study of one million deaths. *BMJ* 1998;**317**:1411–22.
14 **Yu SZ**, Zhao N. Combined analysis of case-control studies of smoking and lung cancer in China. *Lung Cancer* 1996;**14**(Suppl 1):S161–70.
15 **Gan Q**, Hammond S, Colford Jr J, *et al*. Exposure to secondhand smoke and the risk of lung cancer in China: a systematic review and meta-analysis. (submitted), 2007.
16 **US Department of Health and Human Services**. *The health consequences of involuntary exposure to tobacco smoke: a report of the Surgeon General—Executive Summary*, US Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2006.
17 **Hackshaw AK**, Law MR, Wald NJ. The accumulated evidence on lung cancer and environmental tobacco smoke. *BMJ* 1997;**315**:980–8.
18 **Zhong L**, Goldberg MS, Parent ME, *et al*. Exposure to environmental tobacco smoke and the risk of lung cancer: a meta-analysis. *Lung Cancer* 2000;**27**:3–18.
19 **Mathers CD**, Lopez AD, Stein C, *et al*. *Deaths and disease burden by cause: global burden of disease estimates for 2001 by World Bank Country Groups*. Geneva: WHO, 2003.
20 **He Y**, Lam TH. A review on studies of smoking and coronary heart disease in China and Hong Kong. *Chin Med J* 1999;**112**:3–8.
21 **He Y**. Women's passive smoking and coronary heart disease (in Chinese). *Chin J Prev Med* 1989;**23**:19–22.
22 **He Y**, Lam TH, Li LS, *et al*. Passive smoking at work as a risk factor for coronary heart disease in Chinese women who have never smoked. *BMJ* 1994;**308**:380–4.
23 **Wen WQ**, Shu XO, Gao YT, *et al*. Environmental tobacco smoke and mortality in Chinese women who have never smoked: prospective cohort study. *BMJ* 2006;**333**:376–9.
24 **He J**, Vupputuri S, Allen K, *et al*. Passive smoking and the risk of coronary heart disease a meta-analysis of epidemiologic studies. *N Engl J Med* 1999;**340**:920–6.
25 **California Environmental Protection Agency**. *Proposed identification of environmental tobacco smoke as a toxic air contaminant: California Environmental Protection Agency Air Resources Board & Office of Environmental Health Hazard Assessment* 2006.
26 **Jamrozik K**. Estimate of deaths attributable to passive smoking among UK adults: database analysis. *BMJ* 2005;**330**:812.
27 **Nurminen MM**, Jaakkola MS. Mortality from occupational exposure to environmental tobacco smoke in Finland. *J Occup Environ Med* 2001;**43**:687–93.
28 **Center for Disease Control and Prevention**. Annual smoking-attributable mortality, years of potential life lost, and productivity losses—United States, 1997–2001. *MMWR Morb Mortal Wkly Rep* 2005;**54**:625–8.
29 **Woodward A**, Laugesen M. How many deaths are caused by second hand cigarette smoke? *Tob Control* 2001;**10**:383–8.
30 **Sung HY**, Wang L, Jin S, *et al*. Economic burden of smoking in China, 2000. *Tob Control* 2006;**15**:I5–I11.
31 **Rao C**, Lopez AD, Yang G, *et al*. Evaluating national cause-of-death statistics: principles and application to the case of China. *Bull World Health Organ* 2005;**83**:618–25.
32 **Wang YP**, Miao L, Qian YQ, *et al*. Analysis of under 5 years old children mortality and the leading death cause in China from 1996 to 2000. *Zhonghua Yu Fang Yi Xue Za Zhi* 2005;**39**:260–4.
33 **Bonita R**, Duncan J, Truelsen T, *et al*. Passive smoking as well as active smoking increases the risk of acute stroke. *Tob Control* 1999;**8**:156–60.
34 **You RX**, Thrift AG, McNeil JJ, *et al*. Ischemic stroke risk and passive exposure to spouses' cigarette smoking. *Am J Public Health* 1999;**89**:572–5.
35 **Zhang XL**, Shu XO, Yang G, *et al*. Association of passive smoking by husbands with prevalence of stroke among Chinese women nonsmokers. *Am J Epidemiol* 2005;**161**:213–8.
36 **Wang LD**, Lubin JH, Zhang SR, *et al*. Lung cancer and environmental tobacco smoke in a non-industrial area of China. *Int J Cancer* 2000;**88**:139–45.
37 **Stockwell HG**, Lyman GH. Cigarette smoking and the risk of female reproductive cancer. *Am J Obstet Gynecol* 1987;**157**:35–40.
38 **Gao YT**, Blot WJ, Zheng W, *et al*. Lung cancer among Chinese women. *Int J Cancer* 1987;**40**:604–9.
39 **Hirayama T**. Passive smoking and lung-cancer—consistency of association. *Lancet* 1983;**2**:1425–6.
40 **Jarvis MJ**, Goddard E, Higgins V, *et al*. Children's exposure to passive smoking in England since the 1980s: cotinine evidence from population surveys. *BMJ* 2000;**321**:343–5.
41 **Pirkle JL**, Flegal KM, Bernert JT, *et al*. Exposure of the US population to environmental tobacco smoke: the Third National Health and Nutrition Examination Survey, 1988 to 1991. *JAMA* 1996;**275**:1233–40.
42 **Edejer T**, Baltussen R, Tan Torres T, *et al*. *Making choices in health: WHO guide to cost effectiveness analysis*. Geneva: World Health Organization, 2003.


# ELECTRONIC PAGES

## Tobacco Control Online: http://tc.bmj.com

The following electronic only article is published in conjunction with this issue of Tobacco Control.

### Philip Morris's website and television commercials use new language to mislead the public into believing it has changed its stance on smoking and disease

**Lissy C Friedman**

**Objectives:** This paper analyses Philip Morris's evolving website and the legal strategies employed in its creation and dissemination.

**Methods:** Internal tobacco documents were searched and examined and their substance verified and triangulated using media accounts, legal and public health research papers, and visits to Philip Morris's website. Various drafts of website language, as well as informal discussion of the website's creation, were located in internal Philip Morris documents. I compared website statements pertaining to Philip Morris's stance on cigarette smoking and disease with statements made in tobacco trials.

**Results:** Philip Morris created and disseminated its website's message that it agreed that smoking causes disease and is addictive in an effort to sway public opinion, while maintaining in a litigation setting its former position that it cannot be proved that smoking causes disease or is addictive.

**Conclusions:** Philip Morris has not changed its position on smoking and health or addiction in the one arena where it has the most to lose—in the courtroom, under oath.

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