Direct and indirect costs of smoking in Vietnam

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ABSTRACT

Objective To estimate the direct and indirect costs of active smoking in Vietnam.

Method A prevalence-based disease-specific cost of illness approach was utilised to calculate the costs related to five smoking-related diseases: lung cancer, cancers of the upper aerodigestive tract, chronic obstructive pulmonary disease, ischaemic heart disease and stroke. Data on healthcare came from an original survey, hospital records and official government statistics. Morbidity and mortality due to smoking combined with the average per capita income were used to calculate the indirect costs of smoking by applying the human capital approach. The smoking-attributable fraction was calculated using the adjusted relative risk values from phase II of the American Cancer Society Cancer Prevention Study (CPS-II). Costs were classified as personal, governmental and health insurance costs.

Results The total economic cost of smoking in 2011 was estimated at 24 679.9 billion Vietnamese dong (VND), equivalent to US$1173.2 million or approximately 0.97% of the 2011 gross domestic product. The direct costs of inpatient and outpatient care reached 9896.2 billion VND (US$470.4 million) and 2567.2 billion VND (US$122.0 million), respectively. The government's contribution to these costs was 4534.3 billion VND (US $215.5 million), which was equivalent to 5.76% of its 2011 healthcare budget. The indirect costs (productivity loss) due to morbidity and mortality were 2652.9 billion VND (US$126.1 million) and 9563.5 billion VND (US $454.6 million), respectively. These indirect costs represent about 49.5% of the total costs of smoking.

Conclusions Tobacco consumption has large negative consequences on the Vietnamese economy.

BACKGROUND

In addition to damaging health, tobacco use imposes costs on individuals, their families and society as a whole. The estimates of these costs highlight the economic burden associated with tobacco use and help justify government intervention in the tobacco market.

There are only a few estimates of these costs in Asia, where the majority of the world's smokers live. Our literature review examined the estimates for the cost of smoking in Singapore,[1] Korea,[2] Myanmar,[3] Taiwan,[4] Bangladesh,[5] China,[6] Hong Kong,[7] India,[8] and Vietnam.[9 10] All of these studies used a prevalence-based approach, and eight out of nine employed a societal perspective. However, not all studies included indirect costs (IC), and only four estimated direct non-medical costs, such as transportation to and from medical facilities.

The two studies in Vietnam suffered from many limitations. Ross *et al*[10] measured the social cost of hospitalisation related to three major tobacco-related diseases: lung cancer, chronic obstructive pulmonary disease (COPD) and ischaemic heart diseases. It was the first study to measure the economic burden of smoking in Vietnam and estimated that the cost was at least 1602 billion Vietnamese dong (VND; equivalent to US$76 million in 2005. However, this study covered a limited number of diagnoses, only considered costs due to hospitalisation and did not include costs associated with premature death. In addition, they only assessed 390 patients. The second study conducted in Vietnam updated the 2007 findings of Ross *et al*[10] using 2010 data[9] and addressed some limitations of the previous effort by adding outpatient healthcare and self-treatment costs. The total tobacco-related costs were estimated at 2300 billion VND (US$109 million), not including IC.

This study was designed to overcome the limitations of the two previous investigations by calculating both the direct and indirect health costs of five smoking-related diseases that are responsible for almost 75% of all smoking-related deaths in Vietnam. IC in our study include lost productivity and revenue due to premature smoking-related deaths. In addition, we used original survey data based on a large sample of patients treated in 13 hospitals representing all levels of the health service system to estimate the unit cost of inpatient and outpatient treatment of a smoking-related disease episode. We did not include self-treatment costs due to the uncertainty of the patients' self-diagnoses and the significant number of non-responses regarding self-treatment on our questionnaire. There are no statistics on self-treatment expenses by disease category in Vietnam.

The goal of this study was to inform researchers, policymakers and the public of the negative economic impact of tobacco use in Vietnam. It is intended to motivate policymakers to adopt appropriate policy reforms to reduce costs associated with tobacco use in Vietnam. In addition, our research contributes to the understanding of the economic burden of tobacco use in developing countries. The methodology used in this investigation can be applied to other studies in developing countries in which both resources and valid data are scarce. The large range of costs estimated using different relative risks (RRs) also demonstrates how the estimate can vary with different assumptions and highlights the need for country-specific estimates of RR.

DATA AND METHODS

Understanding the healthcare system is crucial for calculating the actual cost of smoking in Vietnam. Healthcare is delivered at four levels: central, provincial, district and community. The district and

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community levels only provide primary healthcare, whereas specialised healthcare is available at the central and provincial levels. The cost of healthcare is covered either by private parties or by the government.

There are two health insurance schemes: public and private. Public health insurance is compulsory for all employees, and the costs are shared by the employer (two-thirds) and employee (one-third). Private health insurance supplements public health insurance; it is profit driven and primarily used by wealthier individuals.

The patients and insurance companies share the operational costs for inpatient and outpatient care (eg, medical exams, drugs, lab tests), with the insurance covering 80% and the remaining 20% being covered by patients 'out of pocket'. The overhead costs including labour costs and asset depreciation are covered by the government. We utilised a prevalence-based, disease-specific approach to estimate the economic costs of the five most common diagnoses related to smoking: lung cancer, cancers of the upper aerodigestive tract, COPD, ischaemic heart disease and stroke. According to the WHO, these diseases are responsible for more than 75% of all smoking-attributable deaths in Vietnam.[11]

The costs of smoking include both direct costs (DC) and IC. DC consist of medical costs (service fees, overhead costs, drugs not included in the service fees) and non-medical costs (transportation, supplemental foods). IC include patients' income losses due to sick leave and premature death, as well as income losses for family members providing patient care.

DC were estimated by employing methodology recommended by the WHO.[12] The smoking-attributable DC of a given disease (SDC_{ijk}) are the product of a smoking-attributable fraction (SAF_{ij}) and the total medical and non-medical DC of this disease (DC_{ik}):

$$SDC_{ijk} = SAF_{ij} \times DC_{ik}$$

where (i) represents the five diseases, (j) is sex, and (k) indicates the type of healthcare service (inpatient or outpatient).

The annual DC were estimated as:

$$DC_{ijk} = n_{ijk} \times Q_{ik}$$

where n_{ijk} is the annual number of episodes and Q_{ik} is the average direct cost for treating a typical episode (one hospitalisation or one outpatient visit).

We conducted a hospital-based cost study to estimate Q_{ik}. A convenience sample of 13 public hospitals was selected based on the level of healthcare service provided and the geographical areas so that they represent both north and south Vietnam. Six were national hospitals, five were provincial hospitals and two represented district-level hospitals. All patients aged 18+ years discharged from these hospitals between March and October 2011 who were diagnosed with any of the five diseases of interest were invited to participate. The goal was to collect information from at least 600 patients with each diagnosis. In the end, the study enrolled 3128 inpatients (74.4% male, 25.6% female) with an average age of 63; 727 had lung cancer, 679 had cancer of the upper aerodigestive tract, 627 had COPD, 675 had ischaemic heart disease and 420 had stroke. The average number of hospital days was 38.1. About 86% of these patients had health insurance. The majority (64%) were treated in national hospitals, 23% were treated in provincial hospitals and 3% of the patients' data came from district hospitals. In addition to data from hospital discharge records, trained hospital staff interviewed the patients on the day of discharge using a Patient Exit Questionnaire that collected information on patients' socio-demographic characteristics, smoking status, number of days off due to illness (both due to hospitalisation and outpatient visits), number of days spent by relatives providing care, transportation expenditures, meals, drug/medical supplies purchased outside the hospital, informal service fees, number of outpatient visits during the previous 3 months related to the discharge diagnoses and expenditures for each of these visits.

Q_{ik} was calculated by summing the average direct user's cost (covered by patients and insurance companies), the average direct provider's cost (covered by the government) and the average direct non-medical user's cost per unit of treatment. The direct user's costs included service fees paid to healthcare facilities, informal fees and the cost of drugs purchased outside the hospital. The sum of these expenditures for all survey participants was divided by the total number of disease-specific hospitalisations or the number of outpatient visits to estimate the average user's direct cost for one episode of hospitalisation or one outpatient visit.

The average provider's costs were estimated using data from annual hospital reports. These costs included overhead costs, labour costs not covered by service fees, and asset depreciation. Hospital departments were classified as those directly (eg, labs) and indirectly (eg, finance) involved in patient treatment. The total costs incurred by each department not covered by service fees were extracted from annual hospital reports.[13] The labour and depreciation costs of directly involved departments plus a share of the overhead costs from the indirectly involved departments were divided by the total units of treatment (inpatient days and outpatient visits) to generate an average provider cost. The allocation of overhead costs was based on the number of annual inpatient days and outpatient visits, and the relative costs of these two types of healthcare services. The cost for one inpatient day was multiplied by the average number of days spent in the hospital for each diagnosis to obtain the average provider's cost per hospitalisation. The average direct non-medical cost included transportation to and from the hospital for the patient and their family members and the cost of food while being hospitalised. These data came from the patient's questionnaire.

The annual number of hospital admissions and the number of outpatient visits came from the Health Statistics Yearbook 2011.[14]

SAF_{ij} was estimated using the following formula:

$$SAF_{ij} = \frac{P \times (RR_{ij} - 1)}{P \times (RR_{ij} - 1) + 1} \times 100\%$$

where RR is the RR for cause-specific mortality related to tobacco use, P is the prevalence of ever smokers, and i and j are defined as above. P is based on the 2010 Global Adult Tobacco Survey in Vietnam that estimates that 66.5% of males and 2.5% of females are ever smokers.

Since Vietnam does not have an estimate of cause-specific morbidity RR, we used the cause-specific mortality RRs based on phase II of the American Cancer Society Cancer Prevention Study (CPS-II) adjusted for important covariates such as age; race; education; marital status; 'blue collar' occupation; weekly vegetable and citrus fruit consumption; vitamin, alcohol, and aspirin use; body mass index; exercise; dietary fat consumption; and family history of cancer, hypertension and diabetes.[15–17]

This adjusted RR from CPS-II has been employed by the majority of studies in Vietnam.[18] The estimates of alternative RRs from China[19] and Taiwan,[4] which are substantially lower compared to CPS-II, have been recently opened to doubt due to new research results demonstrating much larger risks associated with smoking.[20]

Smoking-attributable IC (productivity losses) include costs related to morbidity and mortality. The IC of morbidity (ICMB) were estimated using the following formula:

$$ICMB_{ij} = SAF_{ij} \times DL_{ijk} \times S$$

where DL_{ijk} is the annual number of working days lost due to hospitalisations and outpatient visits by patients and their caregivers, S is the average daily income obtained from VLSS 2010,[21] and SAF_{ij} is defined as above. We assume that the number of working days lost due to hospitalisations equals the number of inpatient days adjusted for a 6-day work week. The number of working days lost due to one episode of outpatient care was obtained from patients' questionnaires.

The IC of mortality (ICMT) for each disease category by sex and 5-year age group starting at the age of 35 were estimated as:

$$ICMT_{ija} = SAF_{ij} \times N_{ija} \times PVLE_{ja}$$

where $PVLE_{ja}$ is the present value of lifetime earnings for sex (j) and age group (a), N_{ija} is the number of deaths by disease (i) by sex (j) and age group (a), and SAF_{ij} is defined as above except for males for whom we replace P with the smoking impact ratio (SIR) because the prevalence of smoking is a poor proxy for the cumulative hazards of smoking among males.[22] SIR was calculated using the lung cancer mortality rates among the whole Vietnamese population, (non-smokers and smokers) and the reference population (CPS-II).[23] For females, SIR was approximated by P due to their traditionally low smoking prevalence. N_{ija} was taken from a 2008 study on the burden of disease and injury for Vietnam.[24] These mortality estimates were based on a national representative cause of death survey in 192 communities located in 16 provinces using verbal autopsy methods.

$PLVE_{ja}$ was estimated separately for males and females using a human capital approach as described by Max *et al*.[25 26] We assumed that the 2011 labour force (defined as the population over 15 years of age) was the same as that for 2010, which means that 80% of males and 71% of females were potentially active in the labour force,[27] and that the annual productivity growth rate was 6%, which approximates the average real growth rate of gross domestic product (GDP) in Vietnam between 2008 and 2010. A discount rate of 3% was employed to convert a stream of earnings into its current worth.

RESULTS

Table 1 shows the average direct medical and non-medical costs per one episode of hospitalisation and one outpatient visit by diagnosis. The costs are lowest for COPD and are highest for cancers.

Table 2 presents the estimated number of hospitalisations (hospital admissions) and the number of outpatient visits in 2011 for the entire country, as well as the SAFs for males and females.

Table 3 shows that the total smoking-attributable DC of inpatient and outpatient care are 9896.2 billion VND (US $470.4 million) and 2567.2 billion VND (US$122.0 million), respectively. The total DC reached 12 463.5 billion VND (US $592.5 million), with COPD being the most expensive. About 36.4% of these costs (4534.3 billion VND or US$215.5 million) were covered by the government while the rest were covered by private expenditures (by patients and insurance companies).

Table 1 Average direct medical and non-medical costs by healthcare service type

Diagnosis	Mean total healthcare cost per hospitalisation (SD) in thousand VND and in US$	Mean of total healthcare cost per outpatient visit (SD) in thousand VND and in US$
Lung cancer	67 374 (54 157) US$3203 (2574)	7128 (21 574) US$339 (1026)
Upper aerodigestive tract cancers	84 505 (28 499) US$4017 (1355)	4203 (2643) US$200 (126)
COPD	12 470 (6997) US$593 (333)	1223 (2201) US$58 (105)
Ischaemic heart disease	36 690 (50 097) US$1744 (2381)	1846 (4895) US$88 (233)
Stroke	14 528 (9795) US$691 (466)	1385 (4057) US$66 (193)

COPD, chronic obstructive pulmonary disease; VND, Vietnamese dong.

The smoking-attributable IC (productivity loss) due to morbidity and mortality based on the RR from CPS-II are presented in table 4. The total morbidity costs were primarily driven by inpatient care, which resulted in 2429.5 billion VND (US$115.5 million) productivity loss, while the outpatient care caused 223.4 billion VND (US$10.6 million) of productivity loss. Tobacco use caused about 37 614 male and 12 269 female deaths in Vietnam in 2010, which represents 13% and 5% of all male and female deaths, respectively. Assuming that the number of deaths in 2011 was similar to the number of deaths in 2010, the total smoking-attributable mortality costs reached 9563.5 billion VND (US$454.6 million), accounting for approximately 78.3% of the total IC of smoking.

The total economic cost of smoking for five smoking-related diseases was 24 679.9 billion VND (US$1173.2 million), with lung cancer being the most expensive (table 5). This represents approximately 0.97% of Vietnam's 2011 GDP.[14]

DISCUSSION

We found that the total costs of smoking in Vietnam amounted to 24 679.9 billion VND (US$1173.2million) or 0.97% of Vietnam's 2011 GDP. The share of GDP lost due to smoking is

Table 2 Numbers of hospitalisations and outpatient visits in 2011

Diagnosis	SAFs (%)		Number of hospitalisations		Number of outpatient visits	
	Male	Female	Male	Female	Male	Female
Lung cancer	93.1	22.3	34 875	12 253	101 136	35 534
Upper aerodigestive tract cancers	82.5	11.1	27 752	9751	80 482	28 277
COPD	86.7	22.0	424 880	149 282	1 232 151	432 918
Ischaemic heart disease	37.4	2.7	6578	2311	19 076	6702
Stroke	31.8	2.9	84 218	29 590	244 232	85 811

COPD, chronic obstructive pulmonary disease; SAF, smoking-attributable fraction.

Table 3 Smoking-attributable direct costs*

Studied smoking-related disease	Inpatient care		Outpatient care		Total healthcare costs
	Government	Insurance and personal costs	Government	Insurance and personal costs	
Lung cancer	978.3 (US$46.5)	1.394.1 (US$66.3)	162.6 (US$7.7)	565.1 (US$26.9)	3101.1 (US$147.4)
Upper aerodigestive tract cancers	1122.6 (US$53.4)	904.1 (US$43.0)	163.3 (US$7.8)	128.8 (US$6.1)	2318.8 (US$110.2)
COPD	1736.7 (US$82.6)	3266.7 (US$155.3)	259.8 (US$12.3)	1163.3 (US$55.3)	6426.4 (US$305.5)
Ischaemic heart disease	6.2 (US$0.3)	86.4 (US$4.1)	1.5 (US$0.1)	11.9 (US$0.6)	105.9 (US$5.0)
Stroke	96.1 (US$4.6)	305.2 (US$14.5)	7.2 (US$0.3)	103.6 (US$4.9)	512.1 (US$24.3)
Total costs	3939.8 (US$187.3)	5956.4 (US$283.2)	594.5 (US$28.3)	1972.8 (US$93.8)	12 463.5 (US$592.5)

*Values are in VND billions and US$ millions.COPD, chronic obstructive pulmonary disease; VND, Vietnamese dong.

Table 4 Smoking-attributable indirect costs

Studied smoking-related disease	Morbidity cost	Mortality cost	Total indirect cost
Lung cancer	2309.2 (US$109.8)	3226.4 (US$153.4)	5535.6 (US$263.1)
Upper aerodigestive tract cancers	220.7 (US$10.5)	979.2 (US$46.5)	1199.9 (US$57.0)
COPD	55.3 (US$2.6)	1636.7 (US$77.8)	1692.0 (US$80.4)
Ischaemic heart disease	3.4 (US$0.2)	918.7 (US$43.7)	922.1 (US$43.8)
Stroke	64.3 (3.1)	2802.4 (US$133.2)	2866.7 (US$136.3)
Total costs	2652.9 (US$126.1)	9563.5 (US$454.6)	12 216.4 (US$580.7)

*Values are in VND billions and US$ millions.
COPD, chronic obstructive pulmonary disease; VND, Vietnamese dong.

comparable to those reported for China[28] (0.7%) and Korea[2] (ranging from 0.59% to 0.78%), but higher compared to that reported for Taiwan[4] (0.4%). None of these studies included the direct non-medical costs associated with smoking. Our estimate of total smoking-associated costs is substantially larger than both the 2005 study[10] (1602 billion VND or US$76 million) and 2010 study (2300 billion VND or US$109 million) conducted in Vietnam. This is because we took a more comprehensive approach that assessed more smoking-related diseases and calculating associated IC.

The IC of smoking represent about 49.5% of the total costs. This is comparable to the ratio of direct and IC in the USA,[23] slightly higher than in Hong Kong[7] (40%), but lower compared to Taiwan (77%). The ratio of DC and IC is highly sensitive to healthcare prices and labour costs.

The government covered approximately 36.4% of smoking-related medical costs (4534.3 billion VND or US $215.5 million), and that amount represented about 5.76% of its 2011 healthcare budget. The government's share of expenditures was larger than the 2005 estimate of 19%. The reason for this discrepancy may be due to methodological differences, but there is also a possibility that the government share of costs is increasing over time. The present study has several limitations. First, owing to data collection complexity and feasibility, we could not assess the costs associated with all tobacco-related diseases. However, the five included diseases are responsible for over 75% of all smoking-attributable mortality in Vietnam (author's estimation based on data from[29]). Second, our study did not estimate the cost of exposure to secondhand smoke or self-treatment costs. Owing to these limitations, we most likely underestimated the total cost of smoking. Third, although convenience sampling was used to select the hospitals, we aimed to include facilities that typically treat all the diseases covered in our study and represent the major geographical areas of Vietnam. Fourth, we used the average income in Vietnam to estimate the IC of smoking. Since smokers are primarily males,

Table 5 Total health costs of smoking*

Smoking-related disease		Total smoking-related health cost
Lung cancer	VND	8635.8
	US$	410.5
Upper aerodigestive tract cancers	VND	3518.7
	US$	167.3
COPD	VND	8118.4
	US$	385.9
Ischaemic heart disease	VND	1028.0
	US$	48.9
Stroke	VND	3378.8
	US$	160.6
Total costs	VND	24 679.9
	US$	1173.2
Total 2011 costs % GDP		0.97%

*Values are in VND billions and US$ millions.
COPD, chronic obstructive pulmonary disease; GDP, gross domestic product; VND, Vietnamese dong.

who have higher incomes compared to females, we most likely underestimated this cost. Fifth, we only accounted for sick days spent in hospitals for current episodes and related outpatient episodes. This most likely underestimated the number of days a patient was not working because many Vietnamese rely on self-treatment and take time off work even before seeking medical care. Finally, we did not capture self-treatment costs. Despite these limitations, our findings demonstrate that the annual cost of smoking in Vietnam (24 679.9 billion VND) is substantially higher than the contribution of the tobacco industry to the annual budget (15 000–17 000 billion VND in taxes). The results of this study provide evidence of the large negative economic consequences of tobacco use on the Vietnamese economy.

What this paper adds

- The existing estimates of the costs associated with smoking in Vietnam indicate that the society suffered an economic loss due to tobacco use.
- The two existing estimates of the costs of smoking in Vietnam suffer from major limitations that result in underestimation of the total costs. Until this study, Vietnam did not have an estimate of the indirect costs of smoking.
- This study provides a more comprehensive and refined estimate of the total costs of smoking in Vietnam including the indirect costs using original survey data. Our research also improves our understanding of the economic burden of tobacco use in developing countries while demonstrating the feasibility of conducting such studies in countries where resources and valid data are scarce.

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Contributors PTHA designed and implemented the research, reviewed and approved the final report, and commented on the manuscript and approved its submission. LTT participated in the research design, coordinated the data collection process, analysed the annual national direct costs and morbidity costs, and helped draft the manuscript. HR provided technical input throughout the course of the study and drafted and finalised the manuscript. NQA developed and implemented the hospital overhead cost data collection tools and analysed this cost component. BNL analysed mortality costs and helped draft the manuscript. NTM helped develop the hospital survey questionnaires, analysed the patients' out-of-pocket expenses, and generated summary statistics for the hospital-based survey.

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Competing interests None.

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