

RESEARCH ARTICLE

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Incidence and Mortality of Cancers Related to Secondhand Smoking in Southeast Asia Countries

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Abstract

Background: Secondhand smoke has been a big problem for human being worldwide as it is well-established risk factors for cancers. ASEAN (Association of Southeast Asian Nations) bear high burden of cancers since the high prevalence of secondhand smoke. The objective of this study is to estimate the burden of cancer attributable to secondhand smoking in ASEAN. **Methods:** This research was using descriptive epidemiological incidence and prevalence-based research design, with cancers incidence and mortality data gained from GLOBOCAN 2012. Secondhand smoke attributable fractions (SAFs) of six cancers (lung, bladder, colorectal, stomach, pancreas and larynx) were estimated and burden of cancers caused by secondhand smoking in ASEAN were calculated in term of incidence and mortality. **Results:** Secondhand smoking estimated for 453,562 cancer cases and 323,284 of total cancer mortality in 2012. The number of incidence and death of lung cancer attributable to secondhand smoking show the highest number compared with other type of cancers. Furthermore, we found that the number of cancer cases and cancer deaths attributable to secondhand smoking varied by each countries due to differences in size of population, various background risk of the cancer, and prevalence of secondhand smoking in each country. **Conclusion:** Secondhand smoking has been a risk factor for about two-fifth of cancer incidence and mortality in ASEAN. Therefore, ASEAN member countries are strongly encouraged to put in place stronger tobacco control policies and to strengthen the existing tobacco control measure in order to decrease the number of secondhand smokers and more effectively control cancers.

Keywords: Burden of disease- secondhand smoke- cancer- attributable fraction- ASEAN

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Introduction

Secondhand smoke is a heterogeneous aerosol generated by burning tobacco. According to the study, there are 4000 harmful chemical compounds contained in cigarette smoke, including nicotine, tar, cyanide, benzene, cadmium, methanol, ammonia, and arsenic (World Health Organization, 2015). The amount of harmful substances in the body of secondhand smokers is greater than active smokers, because the toxins inhaled through the breath are not filtered; make them more susceptible to health problems compared to active smokers. On the other hand, although the prevalence rate of smoking among women is relatively low, women and children still have health risks as secondhand smokers due to men smoke at home or public space (Centers for Disease Control and Prevention, 2006).

Many studies have reported that exposure to secondhand smoke can cause a number of health problems (Centers for Disease Control and Prevention, 2006; Chen et al., 2017). Exposure to secondhand smoke is still a global

health problem, because it can causes various diseases such as coronary heart disease, stroke, and respiratory disorders in adults, and infant death syndrome in infants and children (Chen et al., 2017). Several studies have also reported a link between cancers and secondhand smoking. From the International Agency for Research on Cancers' (IARC) monograph data, which is a summary of various meta-analysis of cancer due to secondhand smoking, shows the result that there is an association between secondhand smokers with some types of cancer indicated by relative risk value of more than one (World Health Organization, 2015).

In the other hand, secondhand smoke is a major problem in countries of the South-East Asia region as a large portion of the population smokes tobacco and the level of general awareness about the actual harmful effects of secondhand smoke is not sufficient (Sein et al., 2012; Kristina et al., 2015). The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967 in South East Asia region and consists of 10 countries namely Brunei Darussalam, Cambodia,

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Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The member countries have a combined population of approximately 625 million people, accounted for 9% of the world's population (Lian and Dorotheo, 2013).

Like other places in the world, cancer is an increasing problem in ASEAN due to ageing and a transition to western lifestyle. It was recently estimated that there were over 700,000 new cases of cancer and 500,000 cancer deaths in ASEAN in the year 2012 (Kristina et al., 2016). Furthermore, these numbers were expected to increase, leading to substantial need for effective cancer control intervention and cancer service provision (Kimman et al., 2012; Kimman et al., 2015). Nevertheless, several ASEAN governments have been slow to react to this problem, leading to cancer epidemic in the region. Recent study indicated that over 75% of cancer patients in ASEAN experiencing death or financial catastrophic within one year. Based on the facts, ASEAN will bear burden of cancer due to secondhand smoking (Kimman et al., 2015).

However, there is currently no research on measuring the burden of cancer due to secondhand smoking in ASEAN. Given this background, the present study was performed to estimate the burden of cancers attributable to secondhand smoking in ASEAN member of countries. By assessing the estimated burden of cancer due to secondhand smoking, the data obtained can be used as a basis for further research and contribute in policy making in the context of prevention and control of tobacco and cigarettes through health promotion to raise public awareness about the negative impact of tobacco smoke, both in terms of the quality of life and the economic burden of the countries.

Materials and Methods

This research was using descriptive epidemiological incidence and prevalence-based research design to estimate the burden of cancers due to secondhand smoking in most member of ASEAN. There were 4 steps to gain the data; first we selected secondhand smoke-related cancers by systematic review. Second, we estimated population-related secondhand smoke attributable fraction (SAF) using relative risks and prevalence of secondhand smokers in each member of countries in ASEAN. Third, we calculated the number of incidence and cancer mortality of each country. Then lastly, we estimated smoking attributable incidence and mortality from the number of incidence and mortality multiplied by SAF.

Secondhand smoking prevalence

The prevalence of smoking was obtained from Global Adult Tobacco Survey (GATS) of each countries which reported by World Health Organization Regional Office for South East Asia. The data obtained mostly in 2011, for Cambodia, Indonesia, Malaysia and Thailand (Ministry of Health Malaysia, 2011; Ministry of Health Thailand, 2011; WHO Western Pasific Region, 2011; Ministry of Health Republic of Indonesia, 2012). Prevalence data from GATS for Myanmar was available in 2009 (Sein et al., 2012); Philippines and Viet Nam in 2015 (Ministry

of Health Philippines, 2015; Ministry of Health Viet Nam, 2015). It should be noted that due to the data limitation, the prevalence data for Brunei Darussalam, Lao PDR and Singapore was unpublished. As shown in Table 1, the highest prevalence of secondhand smoking both among male and female was in Indonesia (81.4% and 75.4%), followed by Viet Nam for male (65.2%), and Cambodia (53.5%). Meanwhile, the second highest prevalence among female in ASEAN was Myanmar (57.8%), followed by Viet Nam (55.0%). On average, the prevalence of secondhand smoking was lowest among female than in male.

Selection of secondhand smoke-related cancers

The selection of secondhand smoke-related cancers included in this study was based on a systematic review. The relative risks for the cancers were obtained from monograph of meta-analysis by International Agency for Research on Cancers (IARC) of WHO (2015). According to the levels of evidence, we decided to include 6 secondhand smoke related cancer diseases which have RR value more than 1 and specifically got exposure in home. Those cancers are lung cancer (C33 – 34), colorectal (C18 – 21), stomach (C16), bladder (C23 – 24), pancreas (C25), and larynx (C32). Most relative risks (RRs) of secondhand smoking-related cancers were derived from recent many meta-analyses (World Health Organization, 2015), which consisted of research reported from many regions of the world. This global meta-analysis was selected because it is the most updated and that there is no meta-analysis conducted in Asia exists.

Incidence and cancer mortality

The number of cancer incidence cases and cancer mortality in ASEAN member countries in 2012 were derived from GLOBOCAN 2012 (IARC, 2012; Ferlay et al., 2013; Ferlay et al., 2015). GLOBOCAN estimated cancer incidence, mortality, and prevalence worldwide in 2012. The methods of estimation are country specific and the quality of the estimation depends upon the quality and on the amount of the information available for each country. Incidence data are derived from national cancer registries. If country data is not available, estimation by modeling, using incidence mortality ratios derived from recorded data in country or local cancer registries is used. Mortality statistics are based on national data that are collated and made available by the WHO for countries with vital registration. The cancer incidence and mortality of ASEAN member countries were shown in Table 2 and Table 3.

Estimation of secondhand smoke attributable fraction (SAF) of cancers

To calculate SAF values due to cancers, two parameters were considered: 1) the relative risks of secondhand smokers for the different related cancers, and 2) prevalence of secondhand smokers for male and female. The formula of SAF is shown below,

$$\text{SAFs} = \frac{p (RRi - 1)}{1 + p (RRi - 1)}$$

where “p” is the prevalence of secondhand smokers in the national population, “RR” is the relative risk of illness due to secondhand smoking, sub-script-i is a category of disease (World Health Organization, 2011). Exception for Singapore, due to there has been no any prevalence data of secondhand smoking, the SAF value gained and used directly from prevalence-based study of Cher et al., (2016) .

Results

Relative risks and SAF of countries members of ASEAN reported in Table 4. As shown in Table 4, secondhand smoke is attributable to about 33% - 87% of lung cancer in ASEAN male meanwhile accounted to approximately 9% - 71% in female.

Secondhand smoking attributable cancer incidence in ASEAN member countries has shown in Table 5. According to the estimation, secondhand smoking accounted for 453,562 new cancer cases in 2012 (303,525 male and 150,037 female cases). In male, the total number of secondhand smoking attributable cancer incidence was the highest in Viet Nam (76,173 cases), followed by Singapore (48,020), and Thailand (45,037cases). On the other hand, the highest number of secondhand smoking attributable cancer incidence in female was found in Philippines (44,767), followed by Viet Nam (35,498) and Thailand (17,241). In male, the number of patients with lung cancer attributable to secondhand smoking was the highest followed by colorectal cancer and stomach cancer. Meanwhile, in female, the number of patients with stomach cancer attributable to secondhand smoking was the highest followed by colorectal cancer and lung cancer.

In sum, total cancer mortality in ASEAN due to secondhand smoking accounted for 323,284 which consisted of 234,287 and 88,997 cancer mortality for male and female respectively as shown in Table 6. When the

Table 1. Prevalence of Secondhand Smoking Among ASEAN Countries

Country/year	Number of population (million)	Prevalence of secondhand smoking	
		Male (%)	Female (%)
Cambodia/2011	14.5	53.5	33.3
Indonesia/2011	241.9	81.4	75.4
Malaysia/2011	29.0	43.3	33.3
Myanmar/2009	50.1	52.0	57.8
Philippines/2015	101.6	39.0	30.3
Singapore/2010	5.0	NA	NA
Thailand/2011	67.6	39.9	32.3
Viet Nam/2015	91.7	65.2	55.0

mortality is ranked by country, the total number of cancer death attributed by secondhand smoking was the highest in Viet Nam (61,163), followed by Singapore (39,850), and Thailand (35,554). Among female population, the highest number of secondhand smoking attributable cancer mortality was found in Viet Nam (22,884), followed by Singapore (14,219) and Thailand (13,278). In male, the number of patients with lung cancer mortality attributable to secondhand smoking was the highest (128,049) followed by stomach cancer (38,993), and colorectal cancer (31,357). Similar pattern with male counterpart, the number of patients with lung cancer mortality attributable to secondhand smoking among female was the highest (31,357) followed by stomach (21,644) and colorectal cancer (20,107).

Discussion

This study found that secondhand smoking was responsible for 453,562 cancer incidence in 2012 (303,525 male and 153,334 female cases), accounted for about

Table 2. Cancer Incidence in ASEAN Countries, 2012

Gender	Cancers	Cancer incidence in ASEAN countries, 2012								Total
		Cam	Ind	Mal	Mya	Phi	Sing	Thai	Viet	
Male	Bladder	128	5832	6,609	7,212	7,886	8,148	10,063	10,749	56,627
	Colorectal	487	16,452	19,208	21,288	35,960	27,454	33,886	38,435	193,170
	Larynx	82	2337	2,739	3,478	4,586	4,706	5,767	6,862	30,557
	Lung	829	26,151	29,774	34,580	43,394	44,718	57,810	73,881	311,137
	Pancreas	62	13,881	3,439	3,838	4,672	4,905	5,887	6,388	43,072
	Stomach	324	4,135	5,369	8,478	9,884	10,286	11,896	21,292	71,664
	Total	1,912	68,788	67,138	78,874	106,382	100,217	125,309	157,607	706,227
Female	Bladder	78	1,350	1,541	1,808	2,118	2,194	2,810	3,025	14,924
	Colorectal	420	12,207	14,354	16,133	20,008	21,176	26,231	50,509	161,038
	Larynx	30	432	483	680	968	979	1,146	1,368	6,086
	Lung	441	9,814	11,135	14,826	18,073	18,723	25,132	30,905	129,049
	Pancreas	81	2,899	3,168	3,558	4,402	4,573	5,509	5,852	30,042
	Stomach	206	2,405	3,169	4,973	59,799	6,224	7,455	12,249	96,480
	Total	1,256	29,107	33,850	41,978	105,368	53,869	68,283	103,908	437,619
Total	3,168	97,895	100,988	120,852	211,750	154,086	193,592	261,515	1,143,846	

Cam, Cambodia; Ind, Indonesia; Mal, Malaysia; Mya, Myanmar; Phi, Philippines; Sing, Singapore; Thai, Thailand; Viet, Vietnam.

Table 3. Cancer Mortality in ASEAN Countries, 2012

Gender	Cancers	Cancer mortality in ASEAN countries, 2012								Total
		Cam	Ind	Mal	Mya	Phi	Sing	Thai	Viet	
Male	Bladder	76	3,016	3,276	3,652	3,944	3,999	4,975	5,342	28,280
	Colorectal	349	10,908	12,323	13,876	16,579	17,128	20,968	24,080	116,211
	Larynx	45	1,098	1,237	1,687	2,166	2,206	2,766	3,311	14,516
	Lung	738	23,263	26,379	30,647	38,314	39,397	51,251	65,652	275,641
	Pancreas	60	2,983	3,457	3,846	4,580	4,823	5,702	6,191	31,642
	Stomach	296	3,726	4,302	7,220	8,415	8,677	9,972	18,563	61,171
	Total	1,564	44,994	50,974	60,928	73,998	76,230	95,634	123,139	527,461
Female	Bladder	47	706	761	927	1,065	1,085	1,397	1,516	7,504
	Colorectal	289	8,142	9,295	10,627	12,825	13,220	16,228	19,092	89,718
	Larynx	16	203	213	335	1,372	475	563	671	3,848
	Lung	370	8,772	10,262	13,538	16,240	16,747	22,562	27,720	116,211
	Pancreas	73	2,795	3,136	3,518	4,260	4,468	5,311	5,643	29,204
	Stomach	183	2,165	2,555	4,248	5,096	5,265	6,256	10,596	36,364
	Total	183	22,783	26,222	33,193	40,858	41,260	52,317	65,238	282,054
Total		1,747	67,777	77,196	94,121	114,856	117,490	147,951	188,377	809,515

Cam, Cambodia; Ind, Indonesia; Mal, Malaysia; Mya, Myanmar; Phi, Philippines; Sing, Singapore; Thai, Thailand; Viet, Vietnam.

39.65% of the new cases of cancer in ASEAN in 2012. In term of mortality, secondhand smoking was accounted for 44.42% of cancer deaths in male (234,287) and 31.55% deaths in female (96,265). Based on the types of cancer, the strongest association with secondhand smoking was found for lung cancer and it is also responsible for the highest number of death both in men and women compared with other type of cancer significantly.

Exposure to secondhand smoke has been identified as a risk factor for various cancers associated with the respiratory system, especially lung cancer (Hori et al., 2016), since the last three decades. In Asomaning et al., (2008) research, it was reported that people exposed to secondhand smoke have a higher risk of lung cancer than active smokers, especially in subjects exposed to tobacco smoke before the age of 25 years. Tobacco smoke particles

that accumulate in the lungs through the respiratory system can lead to sister chromosome exchange, DNA oxidative damage, and increase the number of P53 mutations in lung cancer.

Previous meta-analysis revealed a statistically significant association between secondhand smoke exposure and lung cancer in Japanese non-smokers. According to the National Health and Nutrition Survey in Japan 2013, 20.6% people were exposed to secondhand smoke at least once a month at home with the overall relative risk of lung cancer from secondhand smoke exposure is about 1.3. That meta-analysis confirmed a significant association between secondhand smoking and lung cancer has a critical implication for promoting legislation to prevent secondhand smoke exposure and enact comprehensive tobacco control policies in Japan,

Table 4. Relative Risks and Secondhand Smoking Attributable Fractions (SAFs) of Selected Cancers in ASEAN Countries, 2012

Gender	Cancers	RR	Secondhand smoking attributable fractions (SAF)							
			Cam	Ind	Mal	Mya	Phi	Sing	Thai	Viet
Male	Bladder	1.75	0.29	0.38	0.25	0.28	0.23	0.36	0.23	0.33
	Colorectal	1.9	0.33	0.42	0.28	0.32	0.26	NA	0.26	0.37
	Larynx	2.9	0.5	0.61	0.45	0.5	0.43	0.69	0.43	0.55
	Lung	2.28	0.41	0.51	0.36	0.4	0.33	0.87	0.34	0.45
	Pancreas	6.0	0.73	0.8	0.68	0.72	0.66	0.2	0.67	0.77
	Stomach	5.8	0.72	0.8	0.68	0.71	0.65	0.19	0.66	0.76
Female	Bladder	3.3	0.43	0.63	0.43	0.57	0.41	0.41	0.43	0.56
	Colorectal	1.8	0.21	0.38	0.21	0.32	0.2	NA	0.21	0.31
	Larynx	2.9	0.39	0.59	0.39	0.52	0.37	0.66	0.38	0.51
	Lung	1.31	0.09	0.19	0.09	0.15	0.09	0.71	0.09	0.15
	Pancreas	6.0	0.62	0.79	0.62	0.74	0.6	0.21	0.62	0.73
	Stomach	5.8	0.62	0.78	0.62	0.74	0.59	0.12	0.61	0.73

Cam, Cambodia; Ind, Indonesia; Mal, Malaysia; Mya, Myanmar; Phi, Philippines; Sing, Singapore; Thai, Thailand; Viet, Vietnam.

Table 5. Secondhand Smoking Attributable Cancer Incidence in ASEAN Countries, 2012

Gender	Cancers	Secondhand smoking incidence (2012)								Total
		Cam	Ind	Mal	Mya	Phi	Sing	Thai	Viet	
Male	Bladder	37	2,211	1,620	2,024	1,785	2,933	2,318	3,530	16,458
	Colorectal	158	6,956	5,386	6,787	9,343	NA	8,953	14,213	51,796
	Larynx	41	1,419	1,236	1,729	1,952	3,247	2,487	3,797	15,908
	Lung	337	13,344	10,617	13,819	14,449	38,905	19,543	33,609	144,623
	Pancreas	45	11,143	2,352	2,772	3,088	981	3,921	4,888	29,190
	Stomach	233	3,292	3,625	6,053	6,442	1,954	7,815	16,136	45,550
	Total	851	38,365	24,836	33,184	37,059	48,020	45,037	76,173	303,525
Female	Bladder	34	856	668	1,032	870	900	1,198	1,689	7,247
	Colorectal	88	4,593	3,020	5,101	3,904	NA	5,386	15,433	37,525
	Larynx	12	254	187	356	354	656	436	699	2,954
	Lung	41	1,859	1,042	2,253	1,552	13,293	2,287	4,502	26,829
	Pancreas	51	2,291	1,979	2,643	2,652	960	3,402	4,291	18,269
	Stomach	127	1,884	1,949	3,655	35,435	747	4,532	8,884	57,213
	Total	353	11,737	8,845	15,040	44,767	16,565	17,241	35,498	150,037
Total		1,204	50,102	33,681	48,224	81,826	64,576	62,278	111,671	453,562

Cam, Cambodia; Ind, Indonesia; Mal, Malaysia; Mya, Myanmar; Phi, Philippines; Sing, Singapore; Thai, Thailand; Viet, Vietnam.

as one of states in Asia Pacific Region (Hori et al., 2016).

Furthermore, although the exposure to tobacco smoke is very high from public places, the duration of the exposure is not proportional to the time at home or workplace where people often spend most of their time. Therefore, appropriate policies to reduce both home and workplace smokers are also indispensable. Not only the ban or punishment, appreciation may also need to be given to the agency or workplace that is firmly in the smoking ban. To effectively reduce the incidence of secondhand smokers at home, it is necessary to counsel, educate, and advise on the dangers of tobacco smoke and make plans to eliminate the habits, especially in men (Asomaning et al., 2008; Hori et al., 2016; Zahra et al., 2016).

The other study conducted in Korea, as another country in Asia Pacific, reported 68% of nonsmokers were exposed to secondhand smoke during a typical day. The results highlight the need for strong, comprehensive secondhand smoking control measures, such as a complete ban of smoking in all workplaces and public places, as well as public health campaigns to promote home smoking bans and non-smoking norms. That study said, to prevent workplace exposure for all Koreans, the law should be expanded to a complete ban on smoking in all workplaces, and should provide for enforcement measures and smoking cessation programs (Hughes et al., 2008).

When looking at each countries in ASEAN, we found that the number of cancer cases and cancer

Table 6. Secondhand Smoking Attributable Cancer Mortality in ASEAN Countries, 2012

Gender	Cancers	Secondhand smoking mortality (2012)								Total
		Cam	Ind	Mal	Mya	Phi	Sing	Thai	Viet	
Male	Bladder	22	1,143	803	1,025	893	1,440	1,146	1,754	8,226
	Colorectal	113	4,612	3,456	4,424	4,307	NA	5,540	8,905	31,357
	Larynx	23	667	558	838	922	1,522	1,193	1,832	7,555
	Lung	300	11,870	9,407	12,247	12,758	34,275	17,326	29,866	128,049
	Pancreas	44	2,395	2,365	2,778	3,027	965	3,798	4,738	20,110
	Stomach	213	2,967	2,905	5,155	5,485	1,649	6,551	14,068	38,993
	Total	715	23,654	19,493	26,466	27,392	39,850	35,554	61,163	234,287
Female	Bladder	20	448	330	529	437	445	595	847	3,651
	Colorectal	61	3,063	1,955	3,360	2,502	NA	3,332	5,834	20,107
	Larynx	6	120	83	175	501	314	214	343	1,756
	Lung	35	1,662	960	2,057	1,394	11,890	2,054	4,038	31,357
	Pancreas	46	2,209	1,959	2,614	2,566	938	3,280	4,138	17,750
	Stomach	113	1,696	1,572	3,123	3,020	632	3,803	7,685	21,644
	Total	280	9,198	6,859	11,858	10,421	14,219	13,278	22,884	88,997
Total		995	32,852	26,352	38,324	37,813	54,069	48,832	84,047	323,284

Cam, Cambodia; Ind, Indonesia; Mal, Malaysia; Mya, Myanmar; Phi, Philippines; Sing, Singapore; Thai, Thailand; Viet, Vietnam.

deaths attributable to secondhand smoking varied by each countries. The highest secondhand smoking attributable cancer mortality was in Viet Nam (84,047), Singapore (54,069) and Thailand (48,832) respectively. Meanwhile, the deaths attributable to secondhand smoking in Cambodia was the lowest, only 995. These can be explained by difference in size of population, various background risk of the cancer, and prevalence of secondhand smoking in each country.

In many studies, there are risk factors other than tobacco smoke associated with cancers such as diet, body mass index (BMI), and alcohol consumption (Peppone et al., 2009; Peppone et al., 2010) are not included in the research model and thus have the potential to cause bias towards the results of the study, included in this study which is became one of our limitations. Secondly, RRs used in our analysis were not limited to ASEAN population. Further study examining the risk of cancer related to secondhand smoking should be conducted among ASEAN population for more valid estimation. Nevertheless, due to the lack data of secondhand smoking prevalence in some counties of ASEAN, cancer incidence and mortality attributable by secondhand smoking in this study just conducted for 8 countries (without Brunei Darussalam and Lao PDR). The prevalence of secondhand smoke data from each country of ASEAN member came from different year, it might influences the results. Furthermore, due to substantial economic development in ASEAN might be changed dramatically so that the SAF may need to be re-estimated.

Based on our study, secondhand smoking accounted for 453,562 new cancer cases and 323,284 of total cancer mortality in 2012 with varied number by each country due to differences in size of population, various background risk of the cancer, and prevalence of secondhand smoking in each country. As many ASEAN countries are in the early stage of the tobacco epidemic, it is likely that the burden of cancer attributable to secondhand smoking will continue to rise over the next decades. Therefore, ASEAN member countries are strongly encouraged to put in place stronger tobacco control policies and to strengthen the existing tobacco control measure in order to effectively control cancer, as the World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC) (World Health Organization, 2009) recommends comprehensive smoke-free policies to protect people from secondhand smoke.

Conflict of interest

The authors declare there is no any conflict of interest.

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