



Research Article

ESTIMATION OF TOBACCO RELATED CANCERS DEATHS AND COSTS OF PRODUCTIVITY LOST IN INDONESIA

Susi Ari Kristina ^{1*}, Chairun Wiedyaningsih ¹, Wa Ode Masrida ², Yuni Andriani ², Pia Rika Puspawati ²

¹ Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, Indonesia

² Pharmacy Management Graduate Program, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, Indonesia

*Corresponding Author Email: susiari_k@ugm.ac.id

Article Received on: 13/06/19 Approved for publication: 02/08/19

DOI: 10.7897/2230-8407.1009259

ABSTRACT

There is a widely known that smoking economic burden has a significant impact on country health expenditure as well as society. This study aimed to estimate the mortality of major cancers associated to tobacco smoking in Indonesia and cost of productivity lost due to mortality in 2018. This study employed prevalence based epidemiological study design. Death rate of major cancers due to tobacco smoking among adults by gender was obtained from Globocan 2018 database. Smoker prevalence was obtained from the Basic Health Research 2018. Life expectancy of Indonesian was taken from the WHO Life Tables, while the average income of Indonesian population was retrieved from National Statistics Bureau. The expected years to life and average wages among active working population were used to estimate cost of productive lost due to smoking. The data analysis was conducted by Excel software. The largest of the smoking attributable fraction (SAF) was lung cancer, as amount as 99.82% and 96.93% in men and women respectively. The highest number of deaths caused by smoking on men was lung cancer (16,541 deaths), while in women was lung cancer (4,572 deaths). The total mortality of cancers associated to tobacco was 43,913 deaths in men, compared to 30,729 deaths in women. Total cost of productivity lost of cancer caused by smoking was 4,287,141 million IDR, with lung cancers costs in the first rank. Cancer burden caused by smoking were significantly impact on health and economy of the Indonesian government and community. These evidences can be useful in drawing up the strategy of intervention on prevention and control of tobacco use.

Keywords: cancers, tobacco, mortality, cost of productivity lost

INTRODUCTION

The cancer incidence is continues to escalate to 18.1 million new cases and 9.6 million deaths in the world¹. Globally, the total number of patients of cancer diseases is estimated to be 43.8 million annually. Mortality pattern depicted that approximately half of the cancer deaths occurs in Asia in 2018¹. The burden of cancers in ASEAN member countries, which is composed of 60% worldwide population is substantially high, with lung cancer as the highest rank of cancer prevalence, accounted for 2.1 million diagnoses in 2018¹, contributing about 11.6% of the total cancer disease burden².

Tobacco is the biggest preventable cause of cancers. The association between smoking and cancer is revealed by various studies, including current meta analysis³. Smoking accounts for more than 7 million deaths per year. It is estimated that more than 8 million people annually will die from diseases related to tobacco use by 2030 if prevalence of tobacco smoking is not change. Consequently, tobacco charges economic burden on health system where about 4-13% of disability-adjusted life years (DALYs)⁴.

Smoking contributes around 90% lung cancer cases in Indonesia⁵, which is also the most common cause of cancer death. Economic burden of cancers is becoming major concerns of Indonesian government due to the high cost of treatment and substantial burden to the national budget since universal coverage implemented in 2014. In fact, Indonesian smokers is highest among ASEAN countries⁵. From the total population 264 million

people, the prevalence of smoking among male and female adults Indonesian (15+ years) was 67% and 2.7%, respectively⁶. In addition, the country recently is not ratify WHO FCTC and there is no legislations to protect public from the negative impact of tobacco use⁷.

The healthcare costs study of tobacco-related diseases in Indonesia have been conducted in 2018, resulted the treatment cost for chronic diseases related to tobacco was US\$2177 million, approximately 2.5% of the 2015 national GDP⁸. In total, Indonesian burden of cancers attributed to smoking was 638,682 DALY⁹. Previous studies may explain the observed effective interventions by countries to reduce the prevalence of smokers and exhibited positive results in decreasing the mortality and morbidity associated with smoking^{10, 11}. However, the new data show that most countries are still faced with an increase in the number of young smokers, new cancer cases and high expenditure of cancers treatment^{12, 13}.

Important tools to evaluate the burden of smoking related cancer is quantifying the economic burden of cancers associated to tobacco. In terms of mortality, measures to estimate the burden of cancers are mortality attributable to risk factor and cost of productivity lost. The basic two measures are more popular in many studies to estimate premature mortality attributable to tobacco¹⁴.

Most of updated studies about estimating the economic burden of cancers related to tobacco have been conducted in developed countries^{10, 15} and the research on this field in developing world

less conducted^{13,16}. Estimating the burden of selected cancers due to tobacco smoking is very pivotal in order to plan and create of effective efforts aimed at decreasing the prevalence of active smoking. Current estimates of smoking-attributable mortality by disease condition for Indonesian are generally unavailable. Therefore, the current study aimed to estimate the economic burden of smoking-attributable cancer deaths in Indonesia 2018.

MATERIALS AND METHODS

To carry out the mortality and the costs productivity lost of cancers attributable to tobacco in Indonesia, we conduct three analytical steps. Firstly, Smoking Attributable Fractions (SAFs) was calculated by input parameters of relative risks of cancers and prevalence of active smokers in Indonesia. The second step was calculating smoking attributable mortality (SAM) by multiplying the SAFs with a mortality rate of selected cancers. Costs of productivity lost were calculated by multiplying SAM with life expectancy and the average income of patients.

Data Sources

Smoker prevalence: the prevalence of smoker was obtained by the Basic Health Research 2018 Database, from the Agency for Health Research and Development of the Ministry of The Republic of Indonesia⁶. Relative risks: RR of selected cancers associated with smoker were drawn from comprehensive meta analysis, as listed in Table 1³. Cancer mortality: Mortality data was obtained from Globocan 2018 database¹. Confidentiality, data storage, and handling ethical practice was followed. Data were collected from Globocan records to which patients gave consent.

Estimated Smoking Attributable Mortality (SAM) and Smoking Attributable Fractions (SAFs) cancer due to smoker

Smoking Attributable Mortality (SAM): SAM was obtained by multiplying the total number of cancer deaths (age group 20-24 years, 25-29 years, 30-34 years, 35-39 years, 40-44 years, 45-49 years, 50-54 years, 55-59 years, 60-64 years, 65-69 years and 70-74 years) with the SAFs of each cancer disease.

Smoking Attributable Fractions (SAFs): the attributable fractions provides estimates of the public health burden of each risk factor and relative importance of risk factor for multi factorial diseases

¹⁴. The disease specific SAF were derived using sex-specific relative risk (RR) estimated from meta-analysis³. SAF formula is as follow:

$$SAF = p(RR_i - 1) / (1 + p(RR_i - 1)) * 100 \%$$

Where “p” denotes the smoking prevalence rate and “RR” denotes the relative risk of the disease of interest.

Costs of productivity lost

Estimation of cost of productivity lost due to premature mortality was conducted by multiplying smoking attributable cancer mortality with life expectancy and the average income of active working days. Life expectancy of Indonesian was taken from the WHO data Life Tables 2018¹⁷, while the average income of Indonesian population aged 20-60 was retrieved from National Statistics Bureau¹⁸. The average income per month was IDR 3, 06 million for male and IDR 2, 3 million for female based on current available data. Sensitivity analysis assuming a 5%, 10%, increased prevalence in current smoking and reduction of 1% prevalence rates were also undertaken.

RESULTS

The value of RR and SAF of cancers can be seen in Table 1. Estimation of SAF obtained different results between men and women. The largest value of the SAF was lung cancer, as amount as 99.82% and 96.93% in men and women respectively.

Table 2 showed the mortality of cancer in single year of 2018. The largest mortality of cancers caused by smoking on men was lung cancer (16,541 deaths), followed by liver cancer (11,739), and leukemia (5,657 deaths). In women, the largest mortality of cancer related to smoking was cervix uteri cancer (16,078 deaths), followed by lung cancer (4,572 deaths), and leukemia (3,406 deaths). The death rate of cancer associated to tobacco was higher in men (43,913 deaths) compared to women (30,729 deaths).

Table 3 shows costs of productivity lost in Indonesia 2018 among working aged population. The largest costs of productivity lost of cancer caused by smoking on men was lung cancer (IDR 898,504 million) followed by liver cancer (IDR 676,076 million) and leukemia (IDR 456,160 million). While in women, the largest premature mortality cost was cervix uteri cancer (IDR 890,933 million) followed by leukemia cancer (IDR 248,268 million) and lung cancer (IDR 222,018 million).

Table 1: Relative risks and SAF

ICD-10	Cancer type	Relative Risks		SAF (%)	
		Male	Female	Male	Female
C10	Lip and oral cavity	3.53	3.8	99.37	93.07
C14	Pharynx	6.76	6.76	99.72	96.50
C15	Esophagus	2.52	2.28	98.96	86.00
C16	Stomach	1.74	1.45	97.89	68.35
C22	Liver	1.85	1.49	98.16	70.16
C25	Pancreas	1.63	1.73	97.53	77.79
C32	Larynx	6.98	6.98	99.73	96.63
C34	Lung	9.87	7.58	99.82	96.93
C53	Cervix uteri	0	1.83	NA	79.93
C64	Kidney	1.59	1.35	97.37	62.68
C67	Bladder	2.8	2.73	99.12	89.25
C92	Leukemia	1.09	1.09	84.98	30.16

Table 2: Cancers deaths due to smoking in Indonesia 2018

ICD-10	Cancers	Cancer deaths due to smoking in Indonesia 2018	
		Male	Female
C10	Lip, Oral Cavity	1,332	699
C14	Pharynx	499	174
C15	Esophagus	659	178
C16	Stomach	1,384	453
C22	Liver	11,739	3,001
C25	Pancreas	2,271	1,376
C32	Larynx	1,203	110
C34	Lung	16,541	4,572
C53	Cervix Uteri	0	16,078
C64	Kidney	688	242
C67	Bladder	1,940	440
C92	Leukemia	5,657	3,406
	TOTAL	43,913	30,729

Table 3: Costs of productivity lost associated to smoking in Indonesia 2018

ICD-10	Cancers	CPL* (million IDR)		
		Male	Female	Total
C10	Lip, Oral Cavity	83,546	39,586	123,133
C14	Pharynx	29,051	9,596	38,647
C15	Esophagus	37,216	9,187	46,404
C16	Stomach	74,005	26,979	100,984
C22	Liver	676,076	148,286	824,362
C25	Pancreas	125,887	66,646	192,534
C32	Larynx	68,579	6,847	75,426
C34	Lung	898,504	222,018	1,120,523
C53	Cervix Uteri	0	890,933	890,933
C64	Kidney	42,774	13,153	55,927
C67	Bladder	93,544	20,294	113,839
C92	Leukemia	456,160	248,268	704,429
	TOTAL	2,585,342	1,701,793	4,287,141

*CPL: Cost of productivity lost

A Sensitivity Analysis

Based on sensitivity analysis performed, the results showed that every increase 5%, 10% of the smoker prevalence increased the SAF and CPL. In the same way, 1% assumption decrease of the smoker prevalence due to tobacco control intervention, it can decrease SAF and CPL of cancer related to smoker.

Table 4: Sensitivity analysis

Analysis and Variable	SAF		CPL(million IDR)	
	Male	Female	Male	Female
Base case sensitivity analysis	99.82	96.93	222,018	1,120,523
Prevalence increased 5%	99.83	97.07	233,119	1,176,549
Prevalence increased 10%	99.84	97.20	244,219	1,232,575
Prevalence increased 1%	99.81	96.89	219,798	1,109,318

DISCUSSION

Total mortality of cancers caused by smoking in Indonesia on men was 43,913 deaths and women were 30,729 deaths. This figure was lower than another country such as US (443,000 deaths)¹⁰ and China (552,280 deaths in 2009)¹⁹. Differs in mortality figure across countries is might be affected by established tobacco control intervention as well as the prevalence of current smokers in region.

The estimated number of the SAF on various cancer diseases has already been conducted in Indonesia and ASEAN countries including lung cancer in 2016⁵. Previous study revealed that the percentage of lung cancer SAF in Indonesia for men was 85.21, compared with current study was about 99.82⁵. The SAF of lung cancer has a greater value than previous study in our country.

These findings explain that the association of smoking and lung cancers in Indonesia substantially high as a result of increasing prevalence of male young smokers in this country.

Our study found that total cost of productivity loss of cancer attributable smoking was IDR 4,287,141 million. The cost of productivity loss of cancer due to smoking on male was greater than those in female. Estimated number of premature mortality cost on various diseases has already been done in Indonesia 2015. The amount of the lung cancer premature death cost in men in Indonesia earlier was USD 609 million, compared to Indonesia (2018) was about IDR 898, 504 million²⁰. If the premature cost of lung cancer in men in the study compared, the cost of lung cancer in Indonesia earlier has a greater amount than the cost of lung cancer in Indonesia 2018. While in women, the amount of cost in Indonesia earlier on lung cancer disease is USD 11.6 million and

lung cancer in Indonesia 2018 is IDR 222,018 million. The variation of data sources and age group included in the study may explain the difference.

The interpretation of this study may need more caution due to several study limitations. First, the relative risk of smoking for cancers in Indonesia is not available and the relative risks were obtained from the meta-analysis study which may not exactly represent the Indonesian situation. Second, the human capital approach was adopted to estimate the CPL. In this method, the earning of overall population was used to calculate the value of human life and then, the variation of informal sectors were assigned as a lower value. Therefore, the actual CPL may be different from the real cost.

CONCLUSION

Our finding implies on substantial health and economic burden to Indonesian government and community. Moreover, the largest proportion of cancer deaths and cost of productivity lost attributable to smoking was related to lung cancer. It can be recommended to the government to use these evidences as a basic policy in drawing up the strategy of intervention on prevention and control of smoking.

ACKNOWLEDGMENT

This article was part of research grant, contract number 3033/UN1/DITLIT/DIT-LIT/LT/2019 which fully funded and supported by Universitas Gadjah Mada fiscal year 2019.

REFERENCES

1. International Agency for Research on Cancer. Estimated Cancer Incidence, Mortality and Prevalence Worldwide in 2018. Lyon: IARC; 2018.
2. Jha P. Avoidable global cancer deaths and total deaths from smoking. *Nature Rev Cancer* 2009; 9(9): 655.
3. Gandini S, Botteri E, Iodice S, Boniol M, Lowenfels AB, Maisonneuve P. Tobacco smoking and cancer: A meta-analysis. *Int J Cancer* 2008; 122(1): 155-64.
4. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Med* 2006; 3(11): e442.
5. Kristina SA, Endarti D, M T. Burden of cancers attributable to tobacco smoking in member countries of the Association of South East Asian Nations (Asean), 2012. *Cancer Epidemiology* 2016; 44: 84-90.
6. Ministry of Health Republic of Indonesia. Basic Health Survey Report Jakarta: Ministry of Health Republic of Indonesia; 2018.
7. World Health Organization. Framework Convention on Tobacco Control Geneva: World Health Organization; 2018.
8. Kristina SA, Endarti D, Wiedyaningsih C, Fahamsya A, Faizah N. Health care cost of non communicable diseases related to smoking in Indonesia, 2015. *Asia Pac J Pub Health*; 2018. p. 1-7.
9. Kristina SA, Endarti D, Sendjaya N, Pramestuty O. Estimating the burden of cancers attributed to smoking using Disability Adjusted Life Years (DALYs) in Indonesia. *Asian Pac J Cancer Prev* 2016; 17(3): 1557.
10. Rostron BL, Chang CM, Pechacek TF. Estimation of cigarette smoking-attributable morbidity in the United States. *JAMA Intern Med* 2014; 174(12): 1922-8.
11. Sang-Yi L, Sun-Ha J, Il-Soon K, Samet Jonathan M, Ja-Kyung L, Su-Young K, et al. Medical expenditure of National Health Insurance attributable to smoking among the Korean population. *J Prev Med Pub Health* 2007; 40(3): 145-9.
12. Nguyen TX T, Han M, Oh J. The economic burden of cancers attributable to smoking in Korea, 2014. *Tob Induced Diseases* 2019; 17(15): 505-12.
13. Bundhamcharoen K, Aungkulanon S, Makka N, Shibuya K. Economic burden from smoking-related diseases in Thailand. *Tob Control* 2016; 25(5): 532-9.
14. World Health Organization. Economics of Tobacco Toolkit: Assessment of the Economic Costs of Smoking. Geneva: WHO; 2011.
15. Carter HE, Schofield DJ, Shrestha R. The productivity costs of premature mortality due to cancer in Australia: Evidence from a micro simulation model. *PLoS One* 2016; 11(12): e0167521.
16. Mishra GA, Pimple SA, Shastri SS. An overview of the tobacco problem in India. *Indian J Med Paediatr Oncol* 2012; 33(3): 139-45.
17. World Health Organization. WHO Life expectancy by country Geneva: World Health Organization; 2018.
18. National Statistics Bureau. State of the Work Force in Indonesia August 2018. Jakarta: National Statistics Bureau; 2018.
19. Gu D, Kelly TN, Wu X, Chen J, Samet JM, Huang J-f, et al. Mortality Attributable to Smoking in China. *NEJM* 2009; 360(2): 150-9.
20. Kristina SA, Endarti D, Prabandari YS, Ahsan A, Thavorncharoensap M. Burden of cancers related to smoking among the Indonesian population: Premature mortality costs and years of potential life lost. *Asian Pac J Cancer Prev* 2015; 16(16): 6903-8.

Cite this article as:

Susi Ari Kristina et al. Estimation of tobacco related cancers deaths and costs of productivity lost in Indonesia. *Int. Res. J. Pharm.* 2019;10(9):43-46 <http://dx.doi.org/10.7897/2230-8407.1009259>

Source of support: Universitas Gadjah Mada fiscal year 2019, Conflict of interest: None Declared

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